ATTACHMENT AQ1-1

CEQA
air quality handbook

Prepared by:

South
Coast
Air
Quality
Management
District

April, 1993

South Coast
AIR QUALITY MANAGEMENT DISTRICT
21865 E. Copley Drive, Diamond Bar, CA 91765-4182 (909) 396-2000

MESSAGE FROM THE CHAIRMAN

April, 1993

The federal Clean Air Act, the California Clean Air Act, and the 1991 AQMP revision have set forth an attainment program for this region to achieve the federal and state ambient air quality standards. Success in achieving our goal lies in the cooperative efforts of all levels of government as well as public support. Together, we have made the last three years the cleanest on record. But we have a long way to go to regain healthful air in this region. Our efforts will be challenged along the way by increases in population growth, the need to obtain emission reductions from more and smaller sources, and the need for technological breakthroughs.

However, there are actions that local government planners and project proponents can take to be proactive members of the clean air team. One of those actions involves the California Environmental Quality Act (CEQA) process. Only local governments have the ability to assess and mitigate the air quality impacts of land development or redevelopment. This fifth edition of the District's CEQA Air Quality Handbook is intended to assist you in carrying out this objective.

Without this extra effort by local government, new development could account for 43% of reactive organic compounds and oxides of nitrogen generated by mobile sources in the year 2010. It is critical that we reduce these pollutants, as they are precursors to the smoggy haze we see so frequently in our region.

If past experience is any indication of our potential to solve this problem, then I am confident that our continued partnership will succeed and the residents of this region will breathe healthful air by the year 2010.

Henry W. Wedaa

Henry W. Wedaa, Chairman
SCAQMD

PREFACE

The South Coast Air Quality Management District (District) has prepared this CEQA Air Quality Handbook which replaces the District's 1987 Environmental Impact Report Handbook. This Handbook is intended to provide local governments, project proponents, and consultants who prepare environmental documents with guidance for analyzing and mitigating air quality impacts of projects. This Handbook also describes the criteria the District uses when reviewing and commenting on the adequacy of environmental documents. Projects that are categorically or statutorily exempt from CEQA are not subject to these guidelines. This guidance document does not, nor does it intend to, supercede local jurisdictions' CEQA procedures.

This Handbook is an advisory tool and it is hoped that, over time, voluntary use will lead to a standardized format for the preparation of air quality analysis in environmental documents for new development and a proactive procedure for mitigating potential air quality impacts from new projects. This Handbook is intended to address the identification, analysis and mitigation of air quality impacts. Other resources which may be impacted, such as water quality, hazardous materials and light and glare are not addressed in this guidance.

The District staff will initiate a training program aimed at providing technical assistance to those persons responsible for the preparation or review of an air quality analysis. Please contact the District Local Government - CEQA Review Section for information on the training schedule.

The District will update sections of the CEQA Air Quality Handbook as new information and analysis methods become available. Purchasers of the Handbook will automatically be notified about annual subscriptions for these updates. (Subscription rates will cover costs of printing and distribution only.)

The District recognizes that the CEQA Air Quality Handbook may affect environmental documents which are currently being prepared or undergoing revisions prior to release as a final document. It is not our intent that the release of the District's CEQA Air Quality Handbook impede the progress of these documents. The CEQA Air Quality Handbook should, however, be utilized as a guide to preparing any newly initiated environmental documents.

NOTICE TO SUBSCRIBERS

If you purchased this copy of the 1993 CEQA Air Quality Handbook directly from the SCAQMD, you have automatically been recorded as a subscriber for all updates distributed in 1993. Thereafter, subscriptions for Handbook updates will be offered on an annual basis (rates cover costs of printing and distribution only).

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SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT

Office of Planning and Technology Advancement

ALAN C. LLOYD, Ph.D.
Chief Scientist

BARRY R. WALLERSTEIN, D.Env.
Assistant Deputy Executive Officer

CINDY GREENWALD
Planning Manager

AUTHORS

Alene Taber, AICP
Connie Day
Gary Bill
Shalini George
Douglas Kim
Von Loveland
Steve Smith, Ph.D.

ADVISORY/TECHNICAL CONSULTATION

Andy Abele
Barbara Baird
Jack Broadbent
Dave Coel
Mark Coleman
Margaret Hoggan
Henry Hogo
Hasan Ikhrata, Ph.D.
Robert Kwong
Mo Lakhany
Mike Laybourn
Jon Leonard
Pat Leyden, AICP
Danny Luong, P.E.

Chris Marlia
Mohsen Nazami
Robert Pease, P.E.
Ed Pupka
John Reimers
Doug Ronaldson
Mark Saperstein, D.Env.
Tara Sheehy
Cindy Sullivan
Ditas Shikiya
Alex Vardakis
Karen Weir-Brown
Robert Wu
Mel Zeldin

Richard L. Perrine, Ph.D.
Alan Joncich, Ph.D.
Aspen Environmental Group

EDITORIAL AND TECHNICAL ASSISTANCE

Patricia Whiting

F. Miriam Reed, Ph.D.
SAGE Resources

PUBLICATION SERVICES

Royetta Campbell
Lori Inga
Duke Quach
Liz Salazar

Penny Shaw
Donna Vernon
SCAQMD Print Shop
SCAQMD Creative Services

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SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT

Technical Assistance

Special Topic Numbers

Local Government-CEQA Review (909) 396-3109	Information and assistance in the preparation and review of environmental documents for which the District is a responsible/commenting agency, and questions regarding the Handbook and the MAAQI model
Transportation/Indirect Source (909) 396-3269	Local government technical assistance on transportation issues (i.e., model ordinances) and rule development relating to transportation sources
PM10/Global Warming/ Ozone Depletion/Toxics (909) 396-3109	Technical assistance relating to the control of fugitive dust/PM10, and the District's global warming/ozone depletion and toxics policies
Environmental Analysis (909) 396-3109	Information and inquiries regarding Environmental Assessments performed for District rules and regulations
Toxics (909) 396-3108	Information on health risk assessments and toxics permits and compliance
Transportation Program (909) 396-3273	Information on facility-specific Regulation XV trip reduction plans
Intergovernmental Affairs LA/Orange Counties (909) 396-3232 Inland Empire (909) 396-3231	Information for elected local government officials and general local government assistance
Library (909) 396-2600	Information on obtaining publications
Speakers Bureau (909) 396-3202	Requests for public presentations and speakers
Air Quality Evaluation (909) 396-3147	Information on current air quality from monitoring stations
Modeling (909) 396-3179	Information and assistance on air quality modeling

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SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT

General Telephone Numbers

SCAQMD Headquarters
21865 East Copley Drive
Diamond Bar, California 91765
(909) 396-2001

Anaheim Office
2100 E. Katella Avenue, Suite 200
Anaheim, CA 92806
(909) 740-6734

Long Beach Office
145 W. Victoria Avenue
Long Beach, CA 90805
(310) 885-6816

Colton Office
851 S. Mt. Vernon Avenue
Colton, CA 92324
(909) 420-7100
(909) 420-7000

Pasadena Office
(Small Business Asst.)
297 N. Marengo Avenue
Suite 101
Pasadena, CA 91101
(818) 585-6400

Cerritos Office
17215 Studebaker Road
Cerritos, CA 90701
(310) 403-6000

Air Pollution Complaints
(800) 572-6306

Public Information Center
General Inquiries, Referrals, Literature - (909) 396-3600

Daily Air Quality Information Recordings
Los Angeles and Orange Counties - (800) 242-4022
San Bernardino and Riverside Counties - (800) 367-4710

Service Station Nozzle Complaints
(800) 242-4020

CUT SMOG PROGRAM
(To Report Smoking Vehicles)
(800) 288-7664
(800) CUT-SMOG

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INTRODUCTION TO THE CEQA AIR QUALITY HANDBOOK

CHAPTER 1

This California Environmental Quality Act (CEQA) Air Quality Handbook has been prepared by the South Coast Air Quality Management District (SCAQMD, or District) as guidance to assist local government agencies and consultants in developing the environmental documents required by CEQA. With the help of the Handbook, local land use planners will be able to analyze and document how proposed and existing projects affect air quality and should be able to fulfill the requirements of the CEQA review process.

It is within this framework of the CEQA review process that the air quality effects of proposed projects can be identified, analyzed, and mitigated. The CEQA review process is structured to: 1) identify significant adverse environmental impacts of the project, and 2) identify ways that environmental damage can be avoided or significantly reduced, by requiring changes in a project through alternatives or mitigation measures that are found to be reasonable and feasible.

1.1 Categories of Projects Reviewed by CEQA

Any project that has the potential to emit air pollutants should undergo some form of CEQA review. Generally, there are two categories of projects: (1) public, and (2) private. Public projects include those projects initiated by a local agency in support of its responsibilities. For instance, a water district may install water lines to provide customers with a water supply; a city or county may construct new roads, buildings, or other public infrastructure facilities; a local government may prepare a General Plan; or a school district may construct a new school. In each case, the project will have air pollutant emissions during its construction and operation that should be evaluated under CEQA to determine the potential for significant adverse impacts.

Private projects include private sector projects for which the local agency exercises its discretion in issuing a permit before each project can proceed. The most obvious examples of such projects include discretionary land use permits, (i.e., tentative maps, conditional use permits, Specific Plans, and other types of private development).

1.2 Categories of Emissions

In referring to sources of air pollutant emissions, the District categorizes them as:

- o Stationary (area and point) sources
- o Mobile (on-road and off-road) sources

Most sources produce emissions in each of these categories. These categories of emissions, illustrated in Figure 1-1, are defined and discussed below:

Stationary sources can be divided into two major subcategories: **point** and **area sources. Point sources** consist of one or more emission sources at a facility with an identified location and are usually associated with manufacturing and industrial projects. Examples are refinery boilers or combustion equipment that produces electricity or processes heat. **Area sources** are widely distributed and produce many small emissions. Examples of such sources are residential water heaters, painting operations, lawn mowers, agricultural fields, landfills, and consumer products such as barbecue lighter fluid or hair spray.

Mobile sources refer to emissions from motor vehicles, including tailpipe and evaporative emissions, and are classified as either **on-road or off-road.**

- **On-road sources** are considered to be a combination of emissions from automobiles, trucks and **indirect sources**:

  Indirect sources are defined as sources that by themselves may not emit air contaminants; however, they indirectly cause the generation of air pollutants by attracting vehicle trips or by consuming energy. Examples of indirect sources include an office complex or commercial center that generates commuter trips and consumes energy resources through the use of electricity for lighting and space heating. Indirect sources include actions proposed by local government, such as redevelopment districts and private projects involving either large buildings or tract developments. Indirect sources also include those emissions created by the distances vehicles travel.

- **Off-road sources** include aircraft, ships, trains, and self-propelled construction equipment.

Some people are more likely to be affected by air pollution emissions as such, and are considered to be "sensitive." These include children, the elderly, persons with pre-existing respiratory and/or cardiovascular illness, and athletes and others who engage in frequent exercise. Because these groups of people are sensitive to air pollution, their environment is given special consideration. Thus, residences, schools, playgrounds, child-care centers, convalescent centers, retirement homes, and athletic fields are defined as **sensitive receptors,** as shown in Figure 1-2.

1.3 Handbook Organization and CEQA Review Process

The organization of this Handbook follows the steps of the local government project review process. The flow chart in Figure 1-3 sets out the organization of the Handbook and gives a simplified overview of the steps in the CEQA review process. Concurrently, the flow chart summarizes the different air quality impact categories and where each category is discussed in this Handbook. A brief description of each step in the CEQA review process is described below.

BACKGROUND INFORMATION (Chapters 2 and 3)

Chapters 2 and 3 give planners background information on air quality. Chapter 2 introduces the District and explains how the District manages air quality. Chapter 3 discusses why the region has smog and the effects of air pollution on quality of life.

INITIAL CONSULTATION (Chapters 4 and 5)

The first step in the project review process is the initial consultation between local governments and project proponents. The purpose of the initial consultation is to identify projects that may have problems with (1) land use compatibility and (2) site design and planning. The Handbook provides planners with suggestions for creating a local initial consultation process related to air quality. Finally, the Handbook discusses consultation between the District and the lead agency.

INITIAL STUDY AND DETERMINATION OF SIGNIFICANCE (Chapter 6)

The next step in the process is the preparation of the Initial Study and determination by the local government as to the project's significance. Projects with emissions found to be environmentally insignificant are granted a Negative Declaration (ND). Projects with emissions that are determined significant because one or more thresholds are exceeded will require a more in-depth environmental analysis, and the preparation of either a Mitigated Negative Declaration (MND) (when impacts can be made insignificant due to the imposition of mitigation measures) or an Environmental Impact Report (EIR).

DOCUMENT PREPARATION (Chapters 7 through 13)

Pre-Screening Review/Preparation of Environmental Analysis Components. This Handbook provides guidance on preparing the MND and EIR, with sections on establishing baseline, emissions calculations, toxics, mitigation, and consistency. The Handbook also gives instructions for using the Mobile Assessment for Air Quality Impacts (MAAQI) model to analyze air quality (mobile sources and energy) for all types of environmental documents. Prior to completion of the EIR CEQA requires lead agencies to consult with responsible agencies and provides for consultation with any persons or agencies with special expertise (PRC Section 21153).

The District as a Responsible Agency. The Handbook provides guidance in assessing the potential multi-media impacts for those cases when the environmental documentation will address both air quality and other environmental impacts (e.g., water, waste disposal, etc.).

PROJECT REVIEW (Chapter 14)

District Review and Commenting Process. The District reviews and comments on the air quality analysis in environmental documents for projects exceeding the thresholds of significance. The Handbook describes the review process when the District is a responsible and/or commenting agency.

MONITORING AND REPORTING (Chapters 15 and 16)

Implementing and Monitoring Mitigation. State law requires that mitigation be monitored after the EIR or MND is approved by the local government. The Handbook provides planners with suggestions for monitoring and enforcing air quality mitigation measures.

Reporting on Project Disposition. Each year, it is necessary for the District to report to the California Air Resources Board (ARB) and the Federal Environmental Protection Agency (EPA) on the progress made to date in reducing emissions. In order to credit local government actions, local governments are requested to voluntarily report information regarding CEQA documents to the District. Additional monitoring information may be requested by the Southern California Association of Governments (SCAG). The Handbook provides reporting forms.

APPENDICES

The Handbook appendices provide more detailed guidance information, including calculation procedures, quantification formulas, screening tables, and background material, to assist in the preparation of CEQA-required environmental documents.

Figure 1-1. Major Categories of Emissions

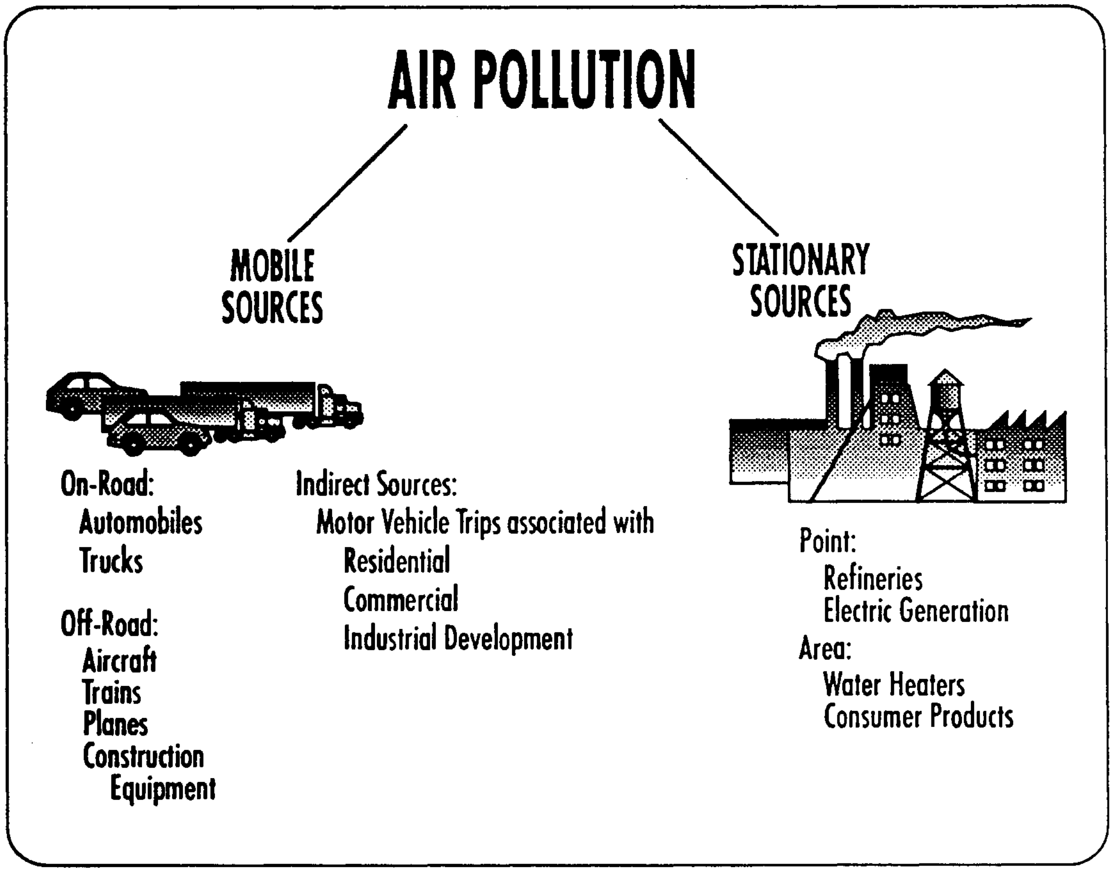


Figure 1-2. Typical Sensitive Receptors

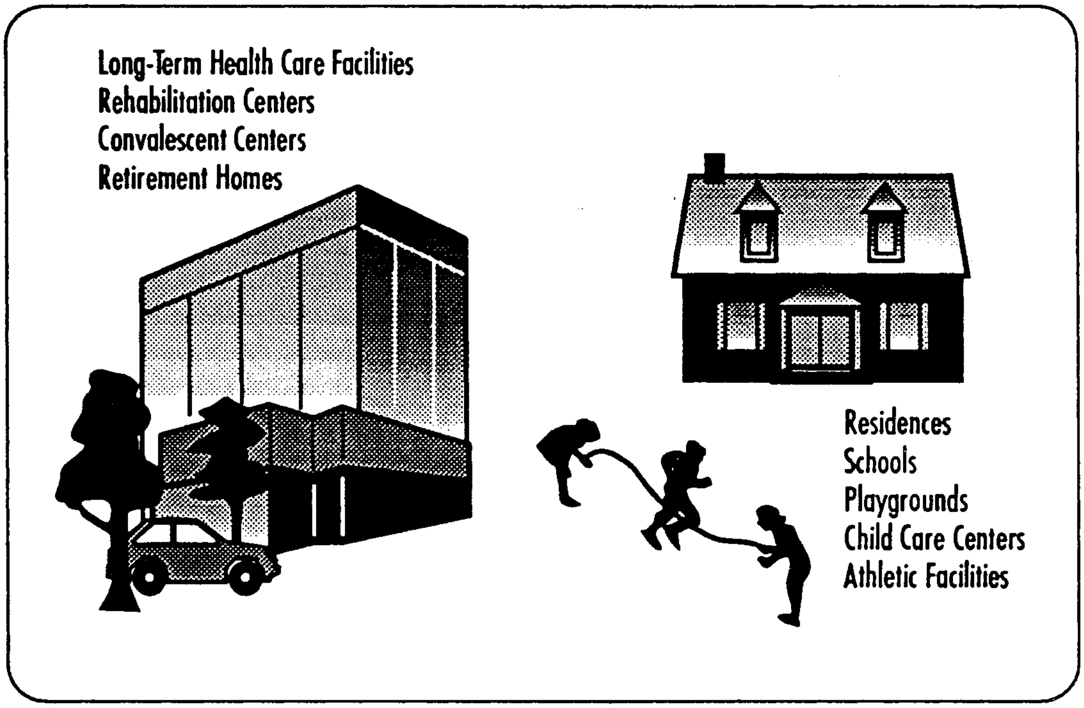
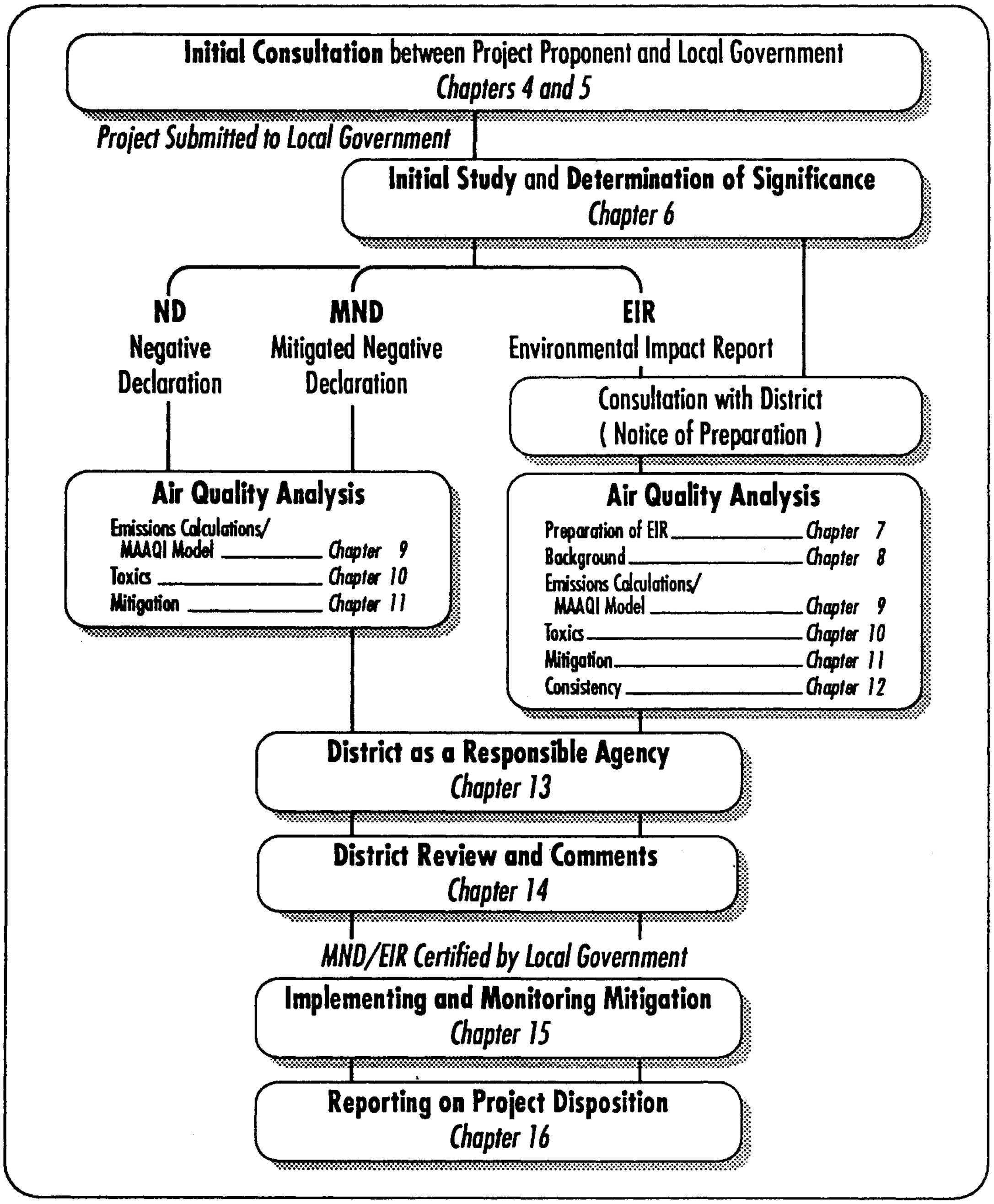


Figure 1-3. Steps in the CEQA Review Process



CHAPTER 2. IMPROVING AIR QUALITY AND THE SCAQMD'S ROLE

GOVERNMENT AGENCIES AND AIR QUALITY MANAGEMENT

Air quality problems in the South Coast Air Quality Management District's (SCAQMD's) jurisdiction are addressed through the efforts of federal, state, regional, and local government agencies (Figure 2-1). The agencies described in the following subsections work jointly and individually, to improve air quality through a variety of programs, including regulations, policy making, and education.

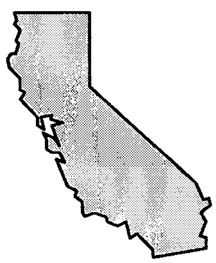
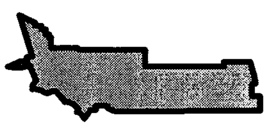
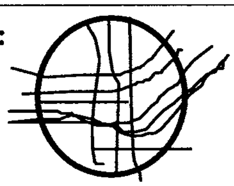
Level	Legislation	Implementing Agencies
Federal: 	Clean Air Act	Environmental Protection Agency
State: 	California Clean Air Act (H&S § 39660 et seq.)	California EPA and Air Resources Board
	AB 1807, Air Toxics Contaminants Act	Office of Environmental and Health Hazard Assessments
Regional: 	Assembly Bill 2588, Air Toxics "Hot Spots" Information and Assessment Act of 1987	South Coast Air Quality Management District
	Lewis-Presley Air Quality Management Act	South Coast Air Quality Management District
Local: 	Local Ordinance Air Quality Element of a General Plan	Public Agencies Including Local Governments and County Transportation Commissions

Figure 2-1

Legislation with Air Quality Components

U.S. ENVIRONMENTAL PROTECTION AGENCY

The U.S. Environmental Protection Agency (USEPA) is responsible for establishing the national ambient air quality standards and enforcing the Clean Air Act. It also regulates emission sources under the exclusive authority of the federal government, such as aircraft, ships, and certain types of locomotives. The USEPA has jurisdiction over emission sources outside state waters (e.g., beyond the outer continental shelf) and establishes various emission standards, including those for vehicles sold in states other than California. Automobiles sold in California must meet the stricter emission standards established by the California Air Resources Board (ARB). For additional information about the USEPA, the reader can contact its general internet address is found at www.epa.gov. Additional information on the activities of USEPA Region IX, which includes California, can be found at www.epa.gov/region9. Finally, additional information on the activities of USEPA's Office of Mobile Sources can be found at www.epa.gov/omswww/omshome.htm.

CALIFORNIA AIR RESOURCES BOARD

The ARB, which became part of the California Environmental Protection Agency (CalEPA) in 1991, is responsible for ensuring implementation of the California Clean Air Act, meeting state requirements of the federal Clean Air Act, and establishing state ambient air quality standards. It is also responsible for setting emission standards for vehicles sold in California and for other emission-sources such as consumer products and certain off-road equipment. The ARB also established passenger vehicle fuel specifications, which became effective in March 1996. The internet address for CalEPA is www.calepa.cahwet.gov; the address for ARB is www.arb.ca.gov.

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT

Because Southern California has one of the worst air quality problems in the nation, the SCAQMD was created by the 1977 Lewis Air Quality Management Act, which merged four county air pollution control agencies into one regional district to better address the issue of improving air quality in Southern California. Under the act, renamed the Lewis-Presley Air Quality Management Act in 1988, the SCAQMD is the agency principally responsible for comprehensive air pollution control in the Basin. Specifically, the SCAQMD is responsible for monitoring air quality and planning, implementing, and enforcing programs designed to attain and maintain state and federal ambient air quality standards in the district. Programs developed include air quality rules and regulations that regulate stationary source emissions, including area and point sources and certain mobile source emissions. The SCAQMD is also responsible for establishing permitting requirements for stationary sources and ensuring that new, modified, or relocated stationary sources do not create net emissions increases and, therefore, are consistent with the region's air quality goals. The SCAQMD enforces air quality rules and regulations through a variety of means, including inspections, educational or training programs, or fines, when necessary.

The SCAQMD has jurisdiction over an area of 10,743 square miles, referred to in this document as the district. This area includes all of Orange County, all of Los Angeles County except for the Antelope Valley, the nondesert portion of western San Bernardino County, and the western and Coachella Valley portions of Riverside County. The South Coast Air Basin (Basin) is a subregion of the district and covers an area of 6,745 square miles. The Basin includes all of Orange County and the nondesert portions of Los Angeles, Riverside, and San Bernardino counties. Figure 2-2 shows the jurisdictional boundaries of the district and the Basin.

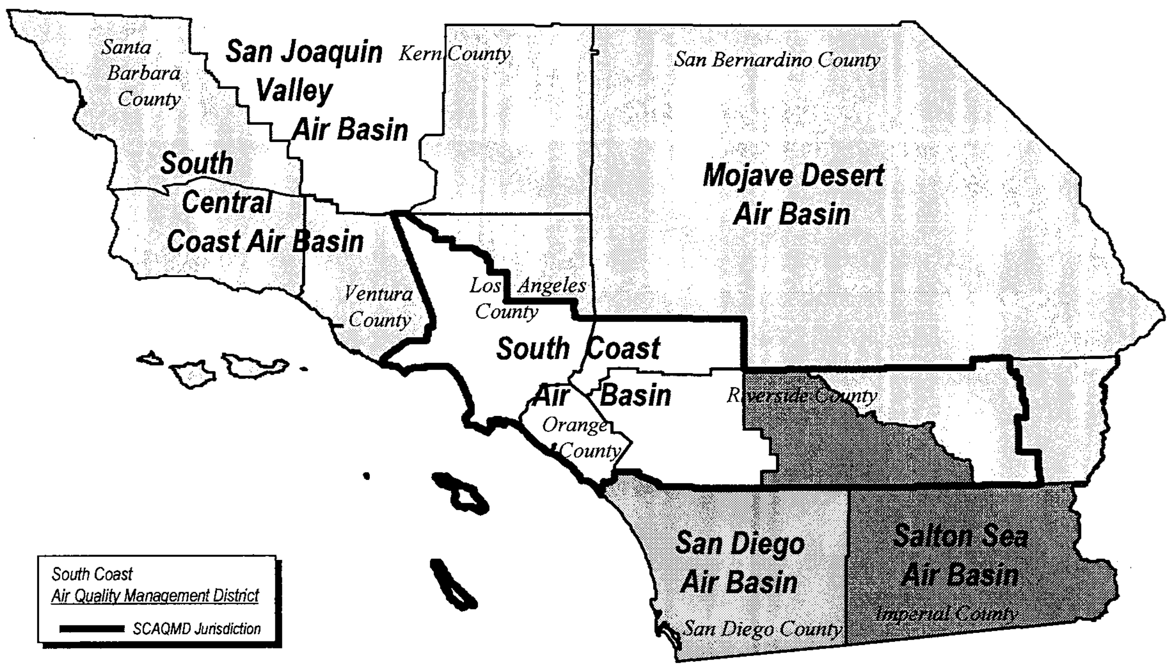


Figure 2-2

South Coast Air Quality Management District

Both the district and the Basin are surrounded by mountains, which tend to restrict air flow and concentrate pollutants in the valleys or "basins" below. The Basin is almost entirely urban, and its pollution is typically related to dense population and associated area sources, heavy vehicular traffic, and industrial sources. In the Coachella Valley, pollution problems are associated primarily with ozone transport from the Basin and with particulate emissions from heavy construction, travel on paved and unpaved roads, and agriculture.

Organization of the SCAQMD

The SCAQMD is organized according to procedures established by the California Legislature and specified in the Lewis-Presley Air Quality Management Act (Figure 2-3). The SCAQMD is organized into three branches. The first branch is the 12-member Governing Board, which is the decision-making body of the SCAQMD that adopts rules, regulations, and plans, such as the air quality management plan (AQMP). The Governing Board is comprised of nine elected officials, one county supervisor from each of the four counties in the district and five members representing the cities of each county. Because of its size, Los Angeles County has both an eastern and western cities representative. The three remaining board members are appointed to the board by state elected officials: one is appointed by the governor, another is appointed by the Speaker of the Assembly, and the third is appointed by the state Senate Rules Committee.

Several special committees review and recommend actions to the Governing Board. For example, the Local Government and Small Business Assistance Advisory Group is made up of local government officials, small business representatives, and members of the general public. This committee, therefore, offers local governmental agencies the opportunity to comment directly on the SCAQMD's rule-making and planning processes.

The second branch of the SCAQMD is the hearing board, which is a quasi-judicial panel authorized to provide relief to regulated facilities from SCAQMD regulations. Relief from regulations can only occur under specific circumstances, such as emergencies, etc. State law requires that the hearing board be appointed by the Governing Board, but the hearing board acts independently of the Governing Board.

The third branch is management/staff, which is the bulk of the agency and reports to the SCAQMD Governing Board. This branch includes the divisions responsible for: developing rules and rule amendments; ensuring compliance with rules and regulations by regulated facilities; planning programs such as the AQMP, the California Environmental Quality Act (CEQA), intergovernmental review; public outreach; small business assistance; prosecuting cases of rule violations, etc. For additional information on the SCAQMD, the reader is referred to the SCAQMD's internet address at www.aqmd.gov.

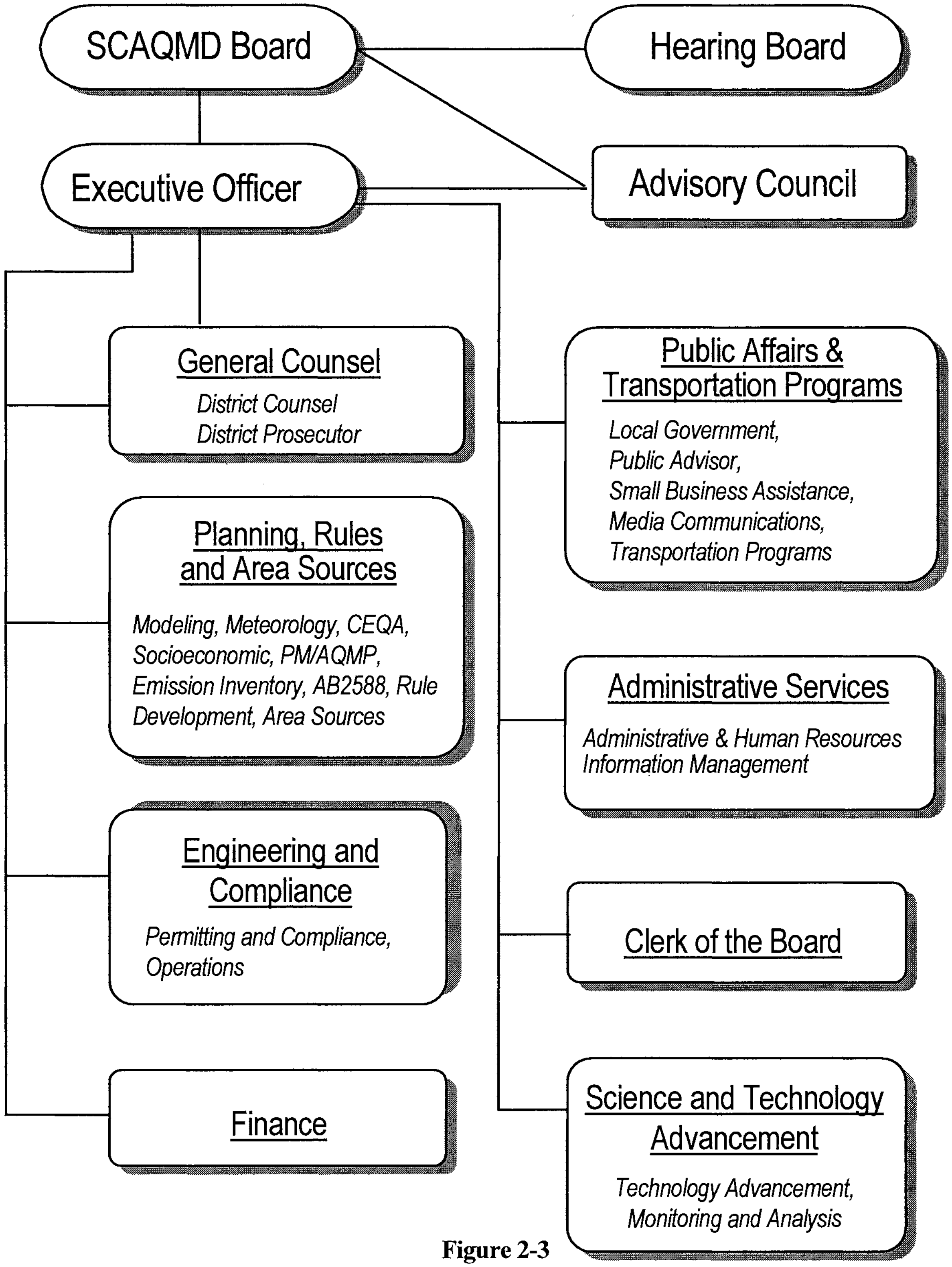


Figure 2-3
SCAQMD Organization

Role of SCAQMD in the CEQA Review Process

As a public agency, the SCAQMD takes an active part in the intergovernmental review process (IGR) under CEQA. Pursuant to CEQA, the SCAQMD may act as a lead agency, a responsible agency, or a commenting agency.

Lead Agency. A lead agency is the public agency with the principal responsibility for carrying out or approving a project subject to CEQA (CEQA Guidelines §15367). In general, a local government agency with jurisdiction over general land uses is the preferred public agency serving as lead agency [CEQA Guidelines §15051(b)(1)]. The lead agency is responsible for determining the appropriate environmental document as well as its preparation.

Both the Public Resources Code and the CEQA Guidelines set forth certain requirements for both lead and responsible agencies designed to ensure that the initial CEQA analysis is sufficient for all other responsible agencies to use in their permitting. CEQA Guidelines §15086 require lead agencies to consult with and solicit comments from responsible agencies for use in preparing their environmental documents.

The SCAQMD typically serves as lead agency for its own projects, such as its own rules and regulations. The SCAQMD's regulatory program (rules and amendments) was certified by the Secretary of the Resources agency pursuant to Public Resources Code §21080.5. Under this certified regulatory program, the SCAQMD prepares substitute EIRs or negative declarations (NDs) pursuant to CEQA Guidelines §15252. All CEQA documents prepared pursuant to the SCAQMD's certified regulatory program are called environmental assessments. In certain circumstances, the SCAQMD may also assume the lead agency role in preparing CEQA documents for projects requiring a permit from the SCAQMD if no CEQA document has been prepared. CEQA documents prepared for permit projects are subject to the standard CEQA requirements so an EIR, ND, or notice of exemption (NOE) is prepared.

Responsible Agency. A responsible agency is a public agency, other than the lead agency, that has responsibility for carrying out or approving a project (State Resources Code §21069 and CEQA Guidelines §15381). As noted above, lead agencies must contact responsible agencies to solicit input or comments on the scope of the environmental analysis or the environmental analysis itself.

The SCAQMD serves as a responsible agency for projects or portions of a project that require a SCAQMD permit, or where the SCAQMD has any other approval authority over the project. As a responsible agency, the SCAQMD is available to the lead agency and project proponent for early consultation on a project to apprise them of applicable rules and regulations, provide guidance on applicable air quality analysis methodologies or other air quality-related issues, etc. As a responsible agency, the SCAQMD may also submit comments to the lead agency through its intergovernmental review process on the adequacy of the air quality analysis prepared by the lead agency and may recommend mitigation measures.

All permits issued by the SCAQMD are considered to be discretionary approvals except for change of ownership permits. A large number of projects requiring permits from the SCAQMD are either exempt from CEQA (statutorily or categorically) or it can be seen with certainty that they will not generate significant adverse air quality impacts and, therefore, are not subject to CEQA analysis [CEQA Guidelines §15061(b)(3)]. Historically, the SCAQMD has found that, in general, the CEQA document prepared by the lead agency in most cases is sufficient to cover the SCAQMD's subsequent permit action.

Commenting Agency. Under CEQA, an agency that is neither a lead agency nor a responsible agency may be an agency with "jurisdiction by law" over a particular natural resource (CEQA Guidelines §15366). Health and Safety Code §40412 names the SCAQMD as the sole and exclusive local agency in the district with the responsibility for comprehensive air pollution control and the duty to represent the citizens of the district in influencing the decisions of other public and private agencies whose actions might have an adverse impact on air quality.

The SCAQMD has a program for reviewing and commenting on the air quality analyses in environmental documents submitted to the SCAQMD under CEQA Guidelines §§15086, 15087, and 15096. As such, the SCAQMD routinely reviews and may comment on the air quality analysis for projects through its intergovernmental review process but for which the agency has no discretionary permit authority and, therefore, is neither a lead or responsible agency. The SCAQMD's comments on the adequacy of the air quality analysis for a project are advisory to the lead agency, similar to those provided by other limited-purpose agencies, such as flood control districts. SCAQMD's comments are focused on identifying a project's impact on air quality and recommending potential mitigation measures for the lead agency's consideration. The SCAQMD can simultaneously serve as both a responsible and a commenting agency for a proposed project.

As a commenting agency, the SCAQMD will review the air quality analysis portions of a CEQA or NEPA document. In addition to the air quality section, other sections of the document that may contribute to air quality impacts include traffic, hazards, etc. At the conclusion of the SCAQMD's review, lead agencies may receive a letter identifying any deficiencies in the air quality analysis, ways of correcting the deficiencies, and may recommend additional feasible mitigation measures.

To determine whether an air quality analysis adequately assesses and mitigates a project's impact, the SCAQMD uses the criteria listed under the following four topics:

- Air Quality Analysis
  - All emissions from construction and operation are quantified according to this Handbook or other reliable guidance sources.
  - The most current emission factors are used in calculations.
  - Assumptions used in calculating emissions are reasonable.
  - The appropriate environmental document was used to evaluate the project.
  - The cumulative impact analysis is performed.
  - The baseline information is included in the EIR.
  - A consistency analysis was performed, consistent with procedures in this Handbook.

- Sensitive Receptors
  - An impact screening assessment was performed when sensitive receptors are to be sited within one quarter-mile of a known source of toxic air pollutants.
  - The potential of an accidental release of an acutely hazardous material into the air has been analyzed.

- Mitigation Measures
  - Assumptions used in quantifying mitigation are reasonable.
  - Mitigation measures are enforceable.

- Mitigation Monitoring
  - The lead agency commits to including standards for measuring whether or not air quality mitigation measures have been implemented.
  - The lead agency commits to remedial action if air quality mitigation is not implemented.

The flowchart shown in Figure 2-4 illustrates SCAQMD's involvement in the CEQA process.

LOCAL GOVERNMENTS

Local governments, which include both city and county agencies, have the ability to control or mitigate air pollution through their police powers and land use decision-making authority. Some cities have adopted air quality elements into their general plans, coordinating these elements with congestion management program requirements of state law. Local ordinances can also provide mechanisms for reducing air pollution. For example, local design standards such as requiring bicycle racks and bicycle paths may result in reducing motor vehicle trips. Further, through capital improvement programs, local governments can fund infrastructure that contributes to improved air quality, such as bus turnouts, energy-efficient street lights, and

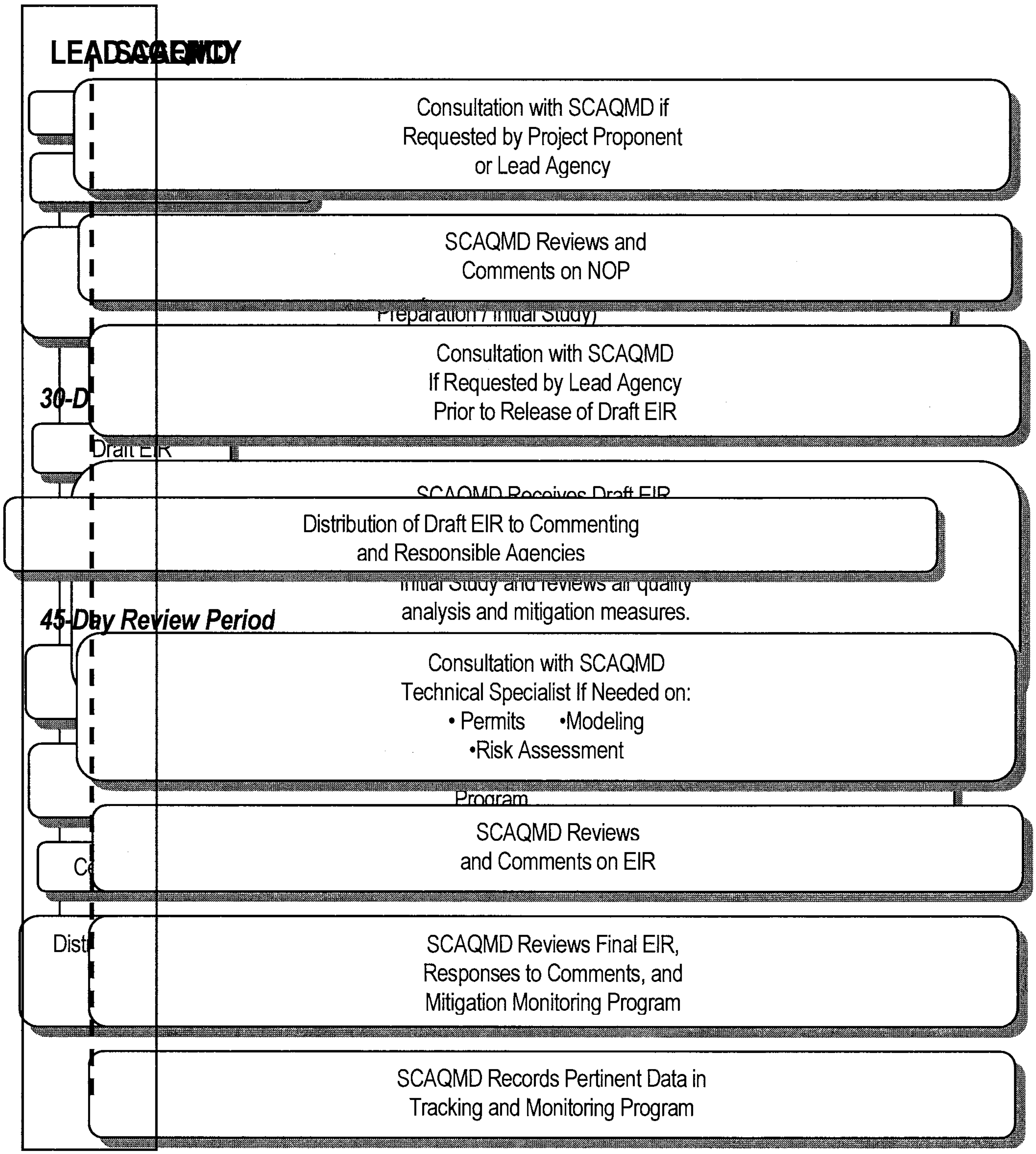


Figure 2-4
SCAQMD Review of Environmental Documents

synchronized traffic signals. Local governments can also take administrative actions that reduce air pollution, such as creating a telecommunication program to enable local government employees to work at home.

Through CEQA review, local governments must assess air quality impacts of projects they undertake or that occur in their areas of jurisdiction and monitor mitigation of potentially significant air quality impacts. In conjunction with analyzing emissions from projects during the CEQA process, local governments can assist the SCAQMD with monitoring region emissions through air quality reports to the SCAQMD on the disposition of all projects with significant adverse air quality impacts. Local governments achieve this by transmitting the final CEQA documents and associated mitigation monitoring programs. In addition, although not required, it is recommended that the lead agency submit a reporting form (Figure 2-5) to the SCAQMD.

The SCAQMD will use the information on the reporting form relating to unmitigated and mitigated emissions to monitor local government efforts in implementing the AQMP or mitigation measures required by the lead agency to reduce air quality impacts. The report submitted to the SCAQMD by the lead agency should be made within 60 days of approval of the project by the lead agency and should include the following:

- final certified EIR or mitigated negative declaration (MND),
- mitigation monitoring program, and
- completed project disposition reporting form.

The project disposition reporting form is divided into three sections. Section I requests information on the lead agency, project location, and State Clearinghouse and SCAQMD project identification numbers (the SCAQMD assigns identification numbers only to those projects that it has reviewed and commented upon). It is imperative that information on the estimated year of construction and buildout be included on the reporting form.

Section II requests specific information regarding the type and size of the project. The SCAQMD needs a definitive description of the project to quantitatively determine the emission reduction benefits of the CEQA program. Planners should provide the number of units or square feet of facilities whenever possible and should use acres as the unit of measure only when estimates of square footage are not available.

In Section III, analysts should identify the emissions produced by the project before mitigation (unmitigated emissions), the emission reductions from mitigation (mitigated emissions), and the emissions that the project will produce with mitigation being applied (net emissions). If the EIR

SCAQMD Reporting Form for EIRs and Mitigated Negative Declarations

This form should be filled out and mailed to SCAQMD for each regionally significant project approved by the lead agency whether or not SCAQMD has formally commented on the draft environmental document. Please attach this form to a copy of the final certified EIR or MND, and the mitigation monitoring program, and send to:

CEQA Contractor
SCAQMD
Office of Planning & Policy
21865 E. Copley Drive
P.O. Box 4939
Diamond Bar, CA 91765

Section I Basic Information

Lead Agency: ____________________ Address: ____________________

Contact ____________________ Phone: ____________________

Name of Project: ____________________ Address: ____________________

State Clearinghouse Number: ____________________ SCAQMD Number: ____________________

Estimated Date of Construction: ____________________ Estimated Date of ____________________

Is SCAQMD the responsible agency for the ____________________

Section II Project Description:

Type of Land Use	Use	Units/Acres/Square Feet
Residential		
Commercial		
Industrial		
Public		
Transportation		
Specific Plan		

General Plan Amendment::____________________
Ordinance:____________________
Other (Please Specify):____________________

Figure 2-5
Reporting Form

SCAQMD Reporting Form, Continued

Section III Project Emissions

	Total Construction Emissions			Total Operational Emissions		
Pollutant	Total Unmitigated Emissions	Mitigated Emissions	Net Emissions	Total Unmitigated Emissions	Mitigated Emissions	Net Emissions
VOC						
NOx						
CO						
SO						
PM10						
Toxics						

Figure 2-5 (continued)
Reporting Form

or MND was prepared in accordance with this Handbook, these emission estimates should be readily available.

The completed reporting form, along with the final certified EIR or MND, mitigation monitoring program, and response to SCAQMD comments should be sent to:

CEQA IGR Coordinator
South Coast Air Quality Management District
21865 East Copley Drive
P.O. Box 4939
Diamond Bar, CA 91765-0939

If you have any questions about reporting or completing the reporting form, contact the CEQA coordinator at 909/396-3232.

CHAPTER 3. BASIC AIR QUALITY INFORMATION

EFFECTS OF POLLUTED AIR ON HEALTH AND WELFARE

The residents of southern California pay for air pollution with:

- increased episodes of respiratory infections and other illnesses;
- increased number of days of discomfort and missed days from work and school;
- increased use of medications to relieve eye and throat irritation, headache, nausea, and aggravated asthma;
- shortened life spans; and
- reduced visibility.

Polluted air also damages agriculture, the natural environment, and human-made materials. Improving air quality enhances public health and produces economic benefits that offset, in whole or in part, the costs of attaining clean air.

The overall strategy for reducing air pollution in the district is contained in the 1997 Air Quality Management Plan (AQMP), which is the most current Board adopted AQMP. The AQMP provides control measures that reduce emissions to attain both state and federal ambient air quality standards by their applicable deadlines. The AQMP is discussed further in Section 3.6.

A socioeconomic impact analysis was conducted for the 1997 AQMP prepared by the South Coast Air Quality Management District (SCAQMD). According to the socioeconomic impact analysis, the 1997 AQMP is projected to yield an average annual benefit of $1.84 to $1.93 billion from 1997 to 2010, which includes $774-860 million for averted illness and higher survival rates, $473 million for visibility improvements, $404 million for congestion relief, $156 million for reduced damage to materials, and $33 million for increased crop yields. Implementing the 1997 AQMP is projected to lower PM10 and ozone concentrations below the federal standards in certain areas of the district, providing even greater air quality benefits in those areas. When those additional improvements are accounted for, the total mortality benefit of the 1997 AQMP rises on average to approximately $4.5 billion annually, (SCAQMD, 1997).

Not all the benefits associated with implementing the AQMP can be quantified. The health benefits do not include benefits resulting from reduced emissions of pollutants other than PM10 and ozone. Reductions of other criteria pollutants; in vehicle hours traveled; and damage to plants, livestock, and forests were not quantified. Further research is needed before the benefits of these effects of the 1997 AQMP can be quantified.

SENSITIVE RECEPTORS

Some people are especially sensitive to air pollution emissions and should be given special consideration when evaluating air quality impacts from projects. These people include children, the elderly, persons with preexisting respiratory or cardiovascular illness, and athletes and others who engage in frequent exercise. Structures that house these persons or places where they gather to exercise are defined as sensitive receptors.

CATEGORIES OF EMISSION SOURCES

Air pollutant emissions sources are typical grouped into two categories: stationary and mobile sources. These emission categories, illustrated in Figure 3-1, are defined and discussed in the following subsections.

STATIONARY SOURCES

Stationary sources are divided into two major subcategories: point and area sources, as described in the following paragraphs.

Point sources consist of a single emission source with an identified location point at a facility. Facilities could have multiple point sources located onsite. Stationary point sources are usually associated with manufacturing and industrial processes. Examples of point sources include boilers or other types of combustion equipment at oil refineries, electric power plants, etc.

Area sources are small emission sources that are widely distributed, but are cumulatively substantial because there may be a large number of sources. Examples include residential water heaters; painting operations; lawn mowers; agricultural fields; landfills; and consumer products, such as barbecue lighter fluid and hair spray.

MOBILE SOURCES

Mobile sources are motorized vehicles, which are classified as either on-road or off-road. On-road mobile sources typically include automobiles and trucks that operate on public roadways. Off-road mobile sources include aircraft, ships, trains, and self-propelled construction equipment that operate off public roadways.

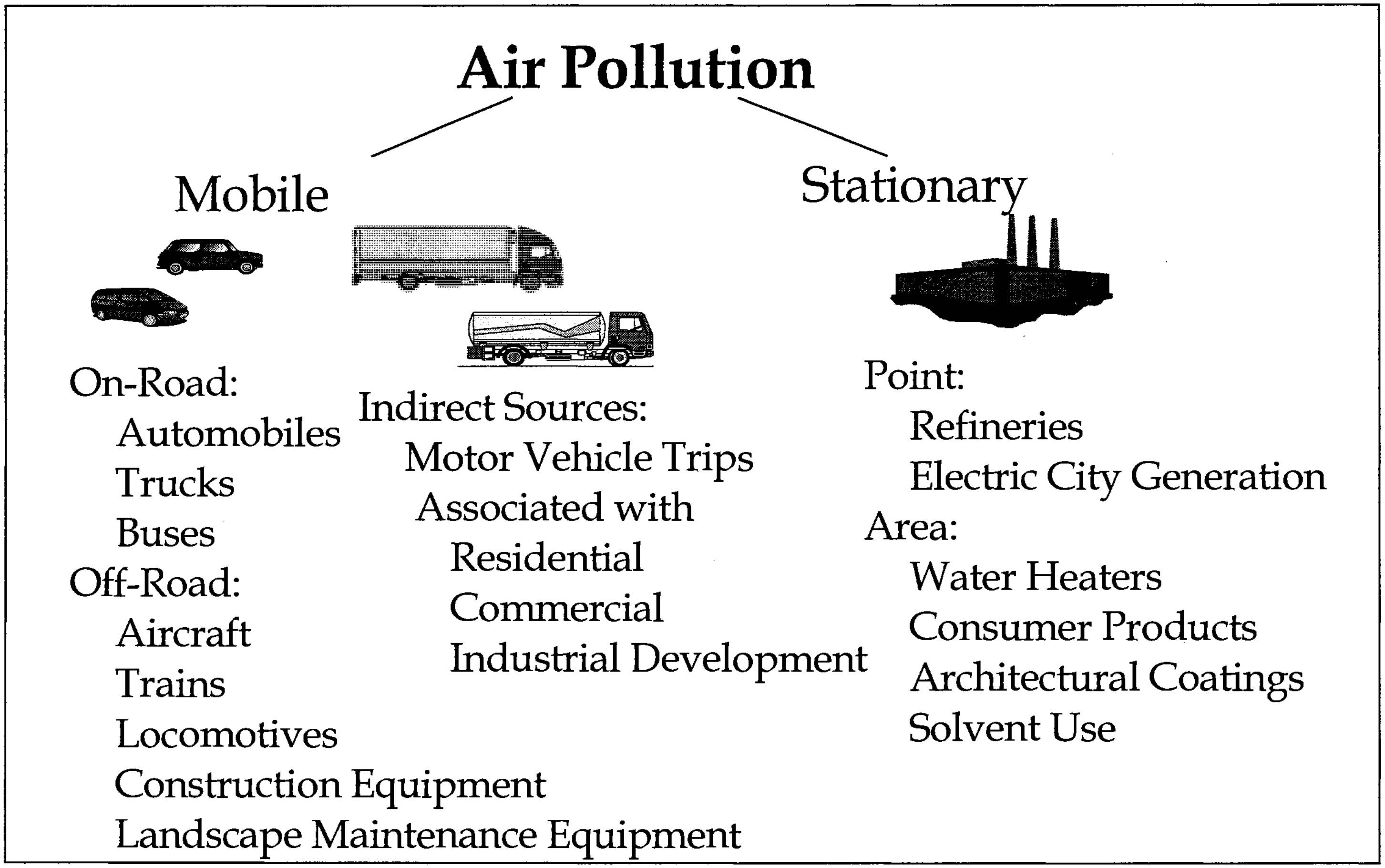


Figure 3-1
Major Categories of Emissions

Mobile source emissions are accounted for as both direct source emissions (those directly emitted by the individual source) and indirect source emissions, which are sources that by themselves do not emit air contaminants but indirectly cause the generation of air pollutants by attracting vehicles. Examples of indirect sources include office complexes, commercial and government centers, sports and recreational complexes, and residential developments.

REGULATED POLLUTANTS

Pollutants regulated by the federal and state Clean Air Acts or other laws fall under three categories:

- criteria air pollutants,
- toxic air contaminants, and
- global warming and ozone-depleting gases.

Pollutants in each of these categories are monitored and regulated differently. Criteria air pollutants are measured by sampling concentrations in the air; toxic air contaminants are measured at the source and in the general atmosphere, and global warming and ozone-depleting gases are not monitored but are subject to federal and regional policies that call for their reduction and eventual phaseout.

CRITERIA AIR POLLUTANTS

Criteria air pollutants are defined as those pollutants for which the federal and state governments have established air quality standards, for outdoor or ambient concentrations to protect public health. The national and state ambient air quality standards have been set at levels to protect human health with an adequate margin of safety. For some pollutants, there are also secondary standards to protect the environment.

National Ambient Air Quality Standards (NAAQS). The U.S. Environmental Protection Agency (USEPA) has established ambient air quality standards for the following air pollutants:

- ozone (O_3),
- nitrogen dioxide (NO_2),
- carbon monoxide (CO),
- sulfur dioxide (SO_2),
- lead (Pb),
- inhalable particulate matter (PM10), and

- fine particulate matter (PM2.5)[1].

California Ambient Air Quality Standards. The California Air Resources Board (ARB) has also established ambient air quality standards for the six pollutants regulated by the USEPA. Some of the California ambient air quality standards are more stringent than the national ambient air quality standards. In addition, California has established ambient air quality standards for the following pollutants or air quality conditions:

- sulfates,
- vinyl chloride, and
- visibility.

Table 3-1 lists the current national and California ambient air quality standards for each criteria pollutant.

Criteria air pollutant concentrations are typically higher in the Basin than in any other area of the country because of the region's climate, geographical setting, and high concentrations of industry and motor vehicles. Although still high, pollutant concentrations have declined sharply throughout the 1990s. Air quality in 1996 was the best recorded since air pollution agencies began monitoring air pollution in this region in the 1940s prior to the creation of the SCAQMD. Table 3-2 lists the primary emission sources of the criteria pollutants and some of the harmful effects of the pollutants. Figure 3-2 identifies criteria and non-criteria pollutants and shows those pollutants for which exposure and resulting adverse health effects have been quantified.

The following paragraphs describe the source and health effects of the criteria pollutants. The SCAQMD publication entitled "Where Does It Hurt?" provides additional health-related information on these pollutants.

Carbon Monoxide. CO is a colorless, odorless gas formed by the incomplete combustion of fuels. Motor vehicles are the main source of this gas. CO competes with oxygen, often replacing it in the blood, thus reducing the blood's ability to transport oxygen to vital organs in the body. The ambient air quality standard for carbon monoxide is intended to protect persons whose medical condition already compromises their circulatory system's ability to deliver oxygen. These medical conditions include certain heart ailments, chronic lung diseases, and anemia. Persons with these conditions have reduced exercise capacity even when exposed to relatively low levels of CO. Fetuses are at risk because their blood has an even greater affinity to bind with CO. Smokers are also at risk from ambient CO levels because smoking increases the background level

[1] In May, 1999, the Federal Court of Appeals in Washington, D.C. overturned the PM2.5 standard. Pending the court decision on the rehearing, the new standard cannot be implemented. It is possible for the USEPA to re-promulgate the standard with a more adequate explanation, if the appeal is denied.

of CO in their blood. The Basin is designated as a serious nonattainment area for carbon monoxide by both USEPA and ARB.

Table 3-1

National and California Ambient Air Quality Standards

Pollutants	National Standards	State Standards
Lead (Pb)	1.5 µg/m³ (calendar quarter)	1.5 µg/m³ (30-day average)
Sulfur Dioxide (S0²)	0.14 ppm (24-hour)	0.25 ppm (1-hour) 0.04 ppm (24-hour)
Carbon Monoxide (CO)	9.0 ppm (8-hour) 35 ppm (1-hour)	9.0 ppm (8-hour) 20 ppm (1-hour)
Nitrogen Dioxide (NO²)	0.053 ppm (annual average)	0.25 ppm (1-hour)
Ozone (O³)	0.12 ppm (1-hour)	0.09 ppm (1-hour)
Fine Particulate Matter (PM10)	150 µg/m³ (24-hour)	50 µg/m³ (24-hour)
Sulfate	None	25 µg/m³ (24-hour)
Visual Range	None	10 miles (8-hour) w/humidity < 70 percent

Nitrogen Dioxide. NO_2 is a byproduct of fuel combustion. The principal form of nitrogen oxide produced by combustion is nitric oxide (NO), but NO reacts quickly to form NO_2, creating the mixture of NO and NO_2 commonly called NO_x. NO_2 acts as an acute irritant and, in equal concentrations, is more injurious than NO. At atmospheric concentrations, however, NO_2 is only potentially irritating. There is some indication of a relationship between NO_2 and chronic pulmonary fibrosis. Some increase in bronchitis in young children has also been observed at concentrations below 0.3 part per million (ppm). NO_2 absorbs blue light; the result is a brownish red cast to the atmosphere and reduced visibility. Although NO_2 concentrations have not exceeded

Table 3-2

Primary Sources and Effects of Criteria Pollutants

Pollutants	Source	Primary Health Effects
Lead (Pb)	Contaminated soil	Impairment of blood function and nerve construction Behavioral and hearing problems in children
Sulfur Dioxide (SO^2)	Combustion of sulfur-containing fossil fuels Smelting of sulfur-bearing metal ores Industrial processes	Plan injury Reduced visibility Deterioration of metals, textiles, leather, finishes, coatings, and so on Irritation of eyes Reduced lung infection Aggravation of respiratory diseases (asthma, emphysema)
Carbon Monoxide (CO)	Incomplete combustion of fuels and other carbon-containing substances, such as motor vehicle exhaust Natural events, such as decomposition of organic matter	Plan injury Reduced visibility Deterioration of metals, textiles, leather, finishes, coatings, and so on Irritation of eyes Reduced lung infection Aggravation of respiratory diseases (asthma, emphysema)
Nitrogen Dioxide (NO^2)	Motor vehicle exhaust High-temperature stationary combustion Atmospheric reactions	Aggravation of respiratory illness Reduced visibility Reduced plant growth Formation of acid rain

Ozone (O^3)	Atmospheric reaction of organic gases with nitrogen oxides in sunlight	Plant leaf injury Irritation of eyes Aggravation of respiratory and cardiovascular diseases Impairment of cardiopulmonary function
Fine Particulate Matter ($PM^{2.5}$)	Stationary combustion of solid fuels Construction activities Industrial processes Atmospheric chemical reactions	Soiling Reduced visibility Aggravation of the effects of gaseous pollutants Increased cough and chest discomfort Reduced lung function Aggravation of respiratory and cardio-respiratory diseases

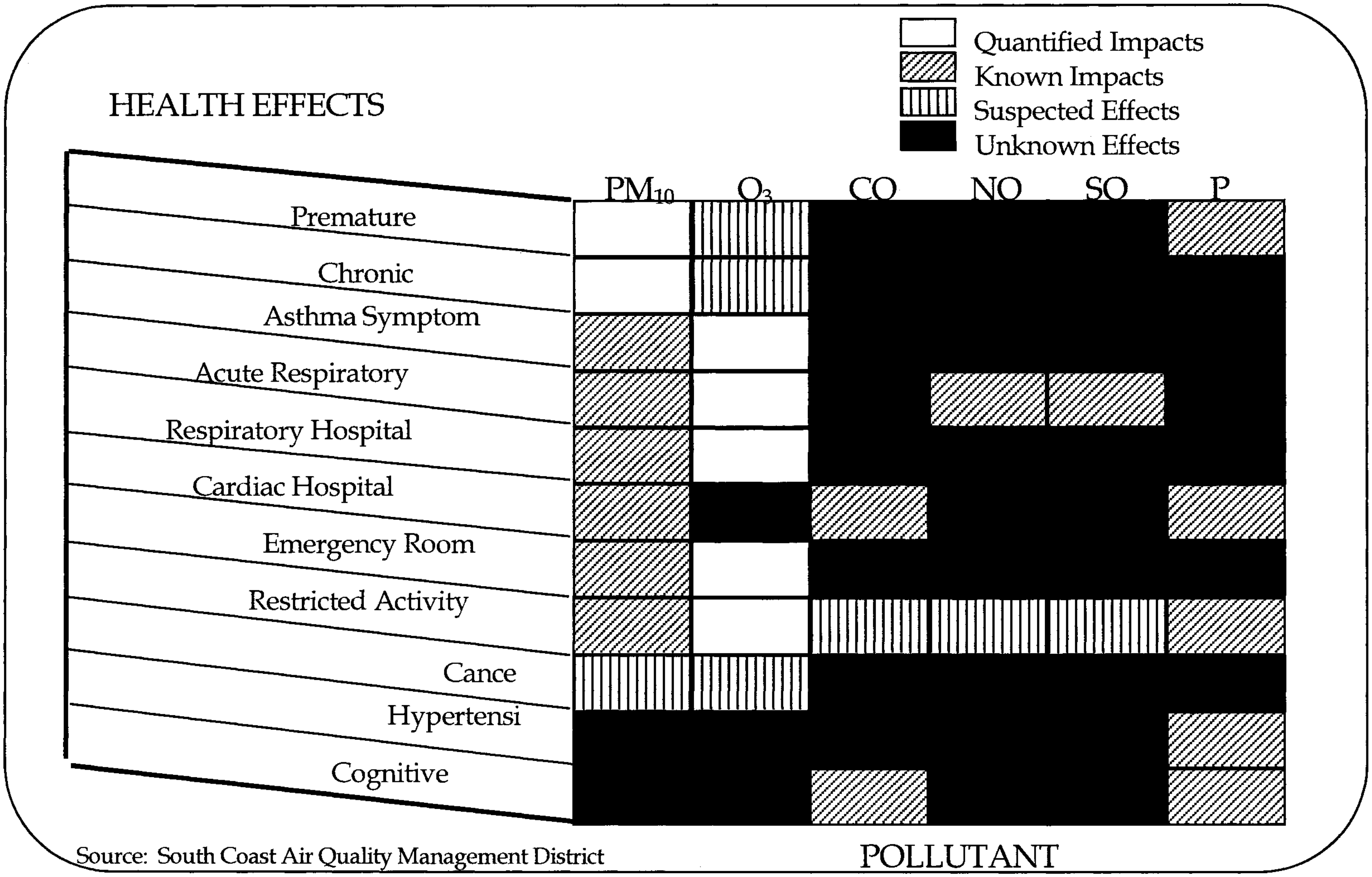


Figure 3-2
Health Responses to Criteria and Non-Criteria Pollutant Exposures

national standards since 1991 and the state hourly standard since 1993, NO_x emissions remain of concern because of their contribution to the formation of O_3 and particulate matter. The Basin is currently designated as nonattainment for NO_2 by both USEPA and ARB. In 1997, the SCAQMD applied for redesignation to attainment for NO_2 since there have been no violations of the federal NO_2 NAAQS. An area must have at least three years with no violations of the NO_2 NAAQS before it can be designated as an attainment area for that criteria pollutant.

Ozone. O_3 is one of a number of substances called photochemical oxidants that is formed when volatile organic compounds (VOC) and NO_x react in the presence of ultraviolet sunlight. O_3 concentrations are higher in the Basin than anywhere else in the nation, and the damaging effects of photochemical smog, which is a popular name for a number of oxidants in combination, are generally related to the concentrations of O_3. Individuals exercising outdoors, children, and people with preexisting lung disease, such as asthma and chronic pulmonary lung disease, are considered to be the subgroups most susceptible to O_3 effects. Short-term exposures (lasting for a few hours) to O_3 at levels typically observed in southern California can result in breathing pattern changes, reduction of breathing capacity, increased susceptibility to infections, inflammation of the lung tissue, and some immunological changes. In recent years, a correlation between elevated ambient O_3 levels and increases in daily hospital admission rates, as well as mortality, has also been reported. Figure 3-3 shows how often the O_3 standard is exceeded in the Basin compared to other areas of the United States. Although O_3 concentrations declined between 1991 and 1996 to the lowest levels since monitoring began, the Basin continues to have peak O_3 levels that are more than two times higher than the national standard and nearly three times higher than the more stringent state standard. The Basin is designated by both the USEPA and the ARB as an extreme ozone nonattainment area.

In July 1997, the USEPA issued a new ozone air quality standard based on an 8-hour average exposure (the current federal ozone air quality standard is based on an 1-hour average period). The new 8-hour average ozone air quality standard provides for greater health protection. Under Presidential Orders, new emission controls to meet the 8-hour ozone standard will not be required until the region attains the current 1-hour ozone standard. Thus, current regulatory control continues to focus on attaining the 1-hour ozone standard with the recognition that these controls will have benefits toward attaining the 8-hour ozone standard.

In May, 1999, the Federal Court of Appeals in Washington, D.C. overturned the 8-hour ozone standard. Pending the court decision on the rehearing, the new standard cannot be implemented. It is possible for the USEPA to re-promulgate the standard with a more adequate explanation, if the appeal is denied.

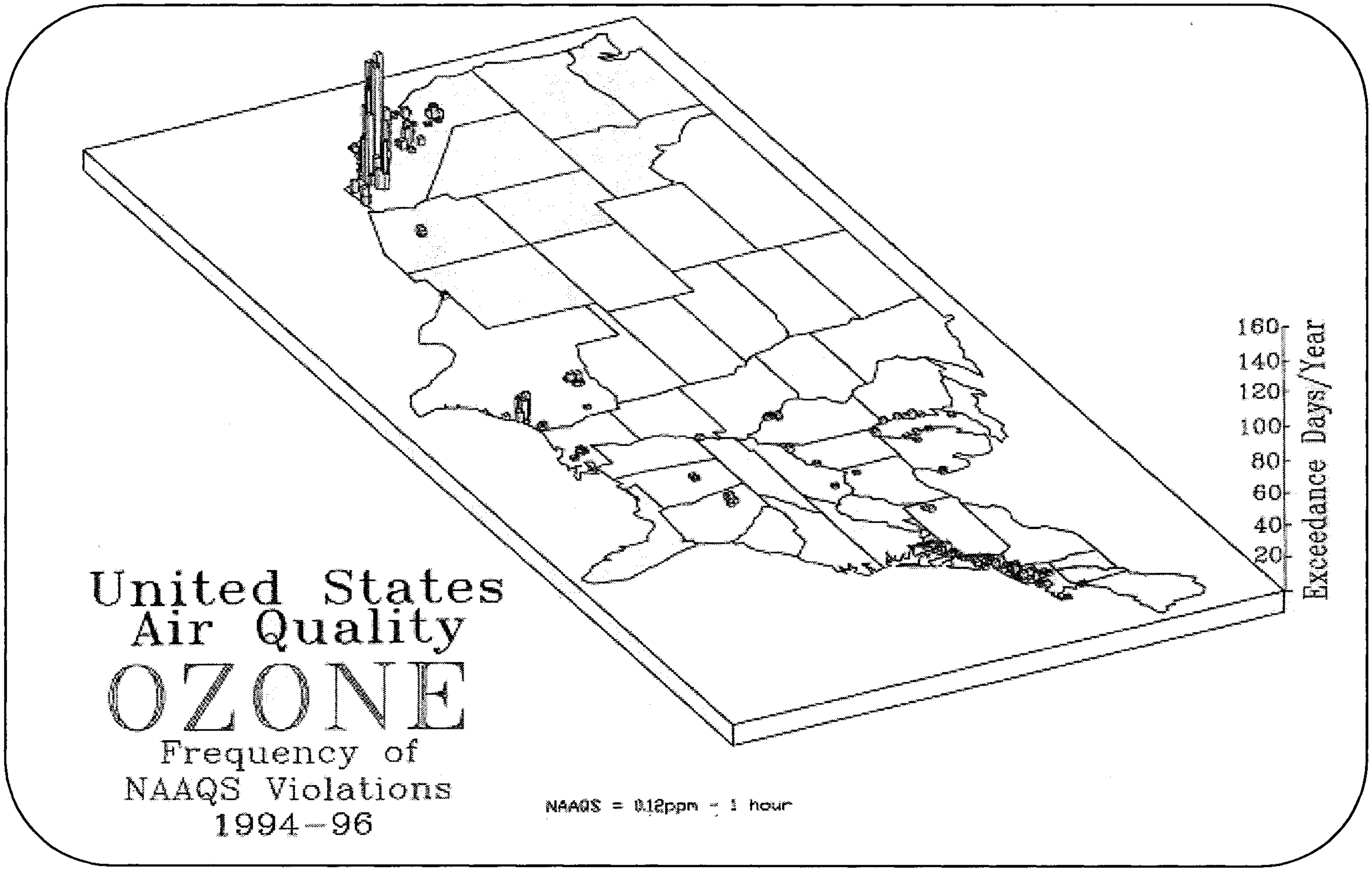


Figure 3-3
Ozone Standard Exceedances in the United States

Particulate Matter Less than 10 Microns in Diameter and Fine Particulate Matter. PM10 consists of extremely small suspended particles or droplets 10 microns or smaller in diameter that can lodge in the lungs, contributing to respiratory problems. PM10 arises from such sources as road dust, diesel soot, combustion products, tire and brake abrasion, construction operations, and fires. It is also formed in the atmosphere from NO and SO_2 reactions with ammonia. PM10 scatters light and significantly reduces visibility.

Inhalable particulates pose a serious health hazard, alone or in combination with other pollutants. More than half of the smallest particles inhaled will be deposited in the lungs and can cause permanent lung damage. Inhalable particulates can also have a damaging effect on health by interfering with the body's mechanism for clearing the respiratory tract or by acting as a carrier of an absorbed toxic substance. For PM10, EPA designates the Basin as serious nonattainment while ARB designates the Basin as simply nonattainment.

In July 1997, the USEPA established a new fine particulate matter (PM2.5) standard, in addition to the PM10 standard. PM2.5 is defined as particulate matter with diameter less than 2.5 microns and is a subset of PM10. PM2.5 consists mostly of products from the reaction of NO_x and SO_2 with ammonia, secondary organics, and finer dust particles. Deadlines for meeting this standard will be ten years after the region is designated as nonattainment by the USEPA.

In May, 1999, the Federal Court of Appeals in Washington, D.C. overturned the PM2.5 standard. Pending the court decision on the rehearing, the new standard cannot be implemented. It is possible for the USEPA to re-promulgate the standard with a more adequate explanation, if the appeal is denied.

Sulfur Dioxide. Sulfur dioxide (SO_2) is a colorless, pungent gas formed primarily by the combustion of sulfur-containing fossil fuels. Health effects include acute respiratory symptoms and difficulty in breathing for children. Though SO_2 concentrations have been reduced to levels well below state and federal standards, further reductions in SO_2 emissions are needed because SO_2 is a precursor to sulfate and PM10. The Basin is considered an SO_2 attainment area by USEPA and ARB.

Lead. Lead (Pb) concentrations once exceeded the state and federal air quality standards by a wide margin, but have not exceeded state or federal air quality standards at any regular monitoring station since 1982. Though special monitoring sites immediately downwind of lead sources recorded very localized violations of the state standard in 1994, no violations were recorded at these stations in 1996. Consequently, the Basin is designated as an attainment area for lead by both the USEPA and ARB.

Volatile Organic Compounds. It should be noted that there are no state or federal ambient air quality standards for VOCs because they are not classified as criteria pollutants. VOCs are regulated, however, because a reduction in VOC emissions reduces certain chemical reactions which contribute to the formation of ozone. VOCs are also transformed into organic aerosols in the atmosphere, contributing to higher PM10 and lower visibility levels.

Although health-based standards have not been established for VOCs, health effects can occur from exposures to high concentrations of VOC because of interference with oxygen uptake. In general, ambient VOC concentrations in the atmosphere are suspected to cause coughing, sneezing, headaches, weakness, laryngitis, and bronchitis, even at low concentrations. Some hydrocarbon components classified as VOC emissions are thought or known to be hazardous. Benzene, for example, is a hydrocarbon component of VOC emissions that is known to be a human carcinogen.

TOXIC AIR CONTAMINANTS

Toxic air contaminants are often referred to as "non-criteria" air contaminants because ambient air quality standards have not been established for them. There are hundreds of air toxics, and exposure to these pollutants can cause or contribute to cancer or noncancer health effects such as birth defects, genetic damage, and other adverse health effects. Effects may be both chronic (i.e., of long duration) or acute (i.e., severe but of short duration) on human health. Acute health effects are attributable to sudden exposure to high quantities of air toxics. These effects include nausea, skin irritation, respiratory illness, and, in some cases, death. Chronic health effects result from low-dose, long-term exposure from routine releases of air toxics. The effect of major concern for this type of exposure is cancer, which requires a period of 10-30 years after exposure to develop.

California regulates toxic air contaminants through its air toxics program, mandated in Chapter 3.5 (Toxic Air Contaminants) of the Health and Safety Code (H&SC §§ 39660 et seq.). and Part 6 (Air Toxics "Hot Spots" Information and Assessment) (H&SC § 44300 et seq.).

The ARB, working in conjunction with the Office of Environmental Health Hazard Assessment (OEHHA), identifies toxic air contaminants. Air toxic control measures may then be adopted to reduce ambient concentrations of the identified toxic air contaminant below a specific threshold based on its effects on health, or to the lowest concentration achievable through use of best available control technology for toxics (T-BACT). The program is administered by the ARB. Air quality control agencies, including the SCAQMD, must incorporate air toxic control measures into their regulatory programs or adopt equally stringent control measures as rules within six months of adoption by ARB.

The regulatory approach used in controlling toxic air contaminant levels relies on a quantitative risk assessment process rather than on ambient air concentrations to determine allowable emissions from the source. In addition, for carcinogenic air pollutants, there is no safe concentration in the atmosphere. Local concentrations can pose a significant health risk and are termed "toxic hot spots."

The Air Toxics "Hot Spots" Information and Assessment Act, codified in the Health and Safety Code, requires operators of specified facilities in the district to submit to the SCAQMD comprehensive emissions inventory plans and reports by specified dates (H&SC §§ 39660 et seq. and §§ 44300 et seq.). The SCAQMD reviews the reports and then places the facilities into high-, intermediate-, and low-priority categories, based on the potency, toxicity, quantity, and volume of hazardous emissions and on the proximity of potential sensitive receptors to the facility. Facilities designated as high priority (category A) must prepare a health risk assessment. Those found to pose a significant risk are required to notify the surrounding population. The emissions inventory data are to be updated every two years.

The Toxic Emissions Near Schools Program (H&SC §§ 42301.6 and 42301.7) requires new or modified sources of air contaminants located within 1,000 feet of the outer boundary of a school to give public notice to the parents of school children before an air pollution permit is granted. The SCAQMD conducts field and database surveys to identify all existing sources of air contaminants located within one-quarter of a mile of a proposed school site.

Air monitoring of disposal sites (H&SC § 41805.5) requires owners of solid waste disposal sites to submit to the SCAQMD a solid waste air quality assessment test report for evaluation. If the SCAQMD determines that levels of specified air contaminants pose a health risk, remedial action must be taken.

GLOBAL WARMING AND OZONE-DEPLETING GASES

"Stratospheric ozone depletion" refers to the slow destruction of naturally occurring ozone, which lies in the upper atmosphere (called the stratosphere) and which protects Earth from the damaging effects of solar ultraviolet radiation. Figure 3-4 illustrates these reactions.

Certain compounds, including chlorofluorocarbons (CFCs,) halons, carbon tetrachloride, methyl chloroform, and other halogenated compounds, accumulate in the lower atmosphere and then gradually migrate into the stratosphere. In the stratosphere, these compounds participate in complex chemical reactions to destroy the upper ozone layer. Destruction of the ozone layer

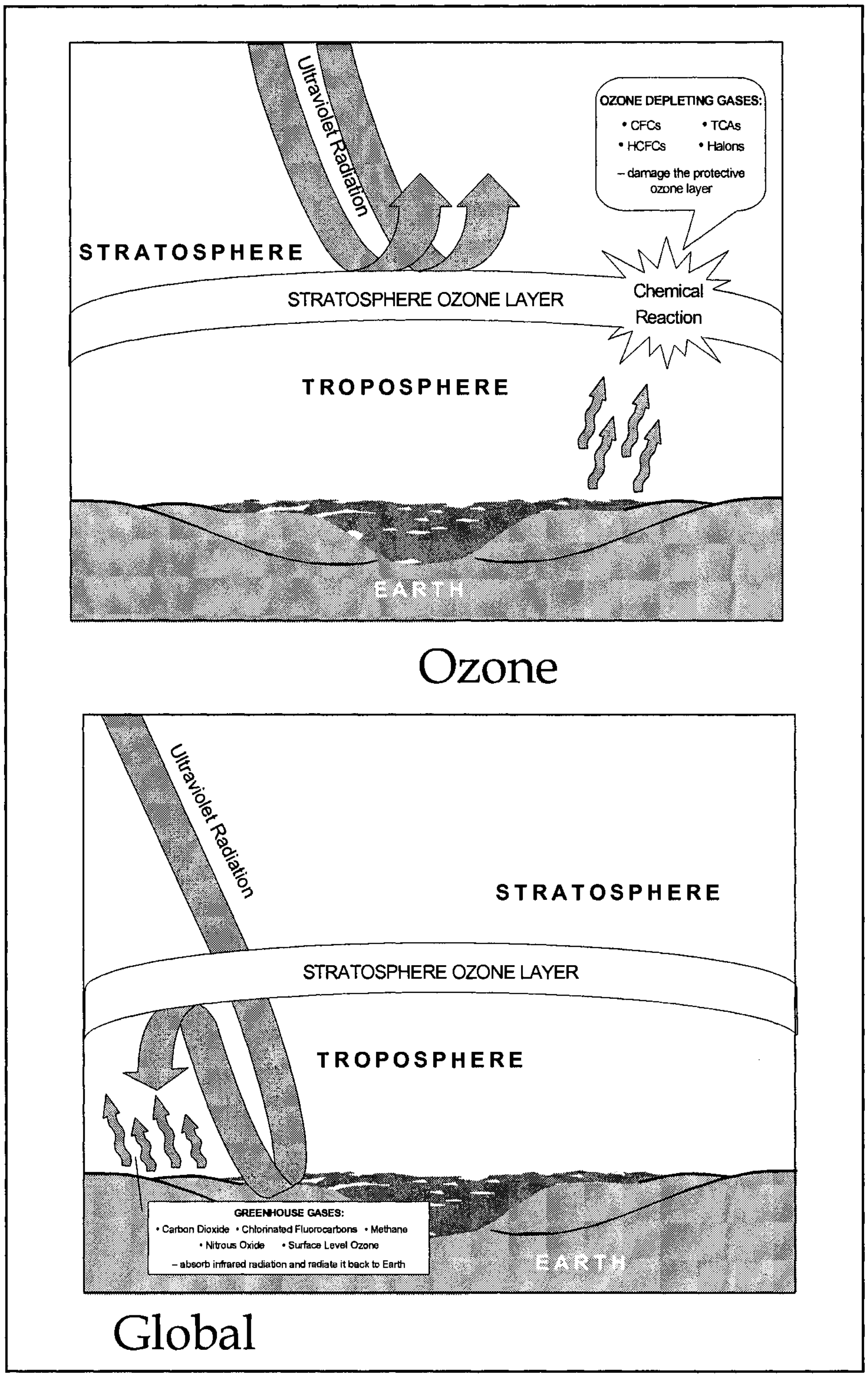


Figure 3-4
Stratospheric Ozone Depletion and Global Warming

increases the penetration of ultraviolet radiation to the Earth's surface, a known risk factor that can increase the incidence of skin cancers and cataracts, contribute to crop and fish damage, and further degrade air quality.

Some gases in the atmosphere affect the Earth's heat balance by absorbing infrared radiation. This layer of gases in the atmosphere functions much the same as glass in a greenhouse (i.e., both prevent the escape of heat). This is why global warming is also known as the "greenhouse effect." Gases responsible for global warming and their relative contribution to the overall warming effect are carbon dioxide (55 percent), CFCs (24 percent), methane (15 percent), and nitrous oxide (6 percent). It is widely accepted that continued increases in greenhouse gases will contribute to global warming although there is uncertainty concerning the magnitude and timing of the warming trend.

Global warming gases and ozone-depleting gases include, but are not limited to, the following:

- Carbon dioxide. Carbon dioxide is caused by fossil fuel combustion in stationary and mobile sources. It contributes to the greenhouse effect, but not to stratospheric ozone depletion. In the Basin, approximately 48 percent of carbon dioxide emissions come from transportation, residential and utility sources contribute approximately 13 percent each, 20 percent come from industry, and the remainder come from a variety of other sources.

- CFCs (chlorofluorocarbons). CFCs are emitted from blowing agents used in producing foam insulation. They are also used in air conditioners and refrigerators and as solvents to clean electronic microcircuits. CFCs are primary contributors to stratospheric ozone depletion and to global warming. Sixty-three percent of CFC emissions in the Basin come from the industrial sector (SCAQMD 1991).

- Halons. Halons are used in fire extinguishers and behave as both ozone-depleting and greenhouse gases.

- HCFCs (Hydro-chlorofluorocarbons). HCFCs are solvents, similar in use and chemical composition to CFCs. The hydrogen component makes HCFCs more chemically reactive than CFCs, allowing them to break down more quickly in the atmosphere.

- Methane. Methane is emitted from biogenic sources, incomplete combustion in forest fires, landfills, and leaks in natural gas pipelines. It is a greenhouse gas and traps heat 40-70 times more effectively than carbon dioxide. In the Basin, more than 50 percent of human-induced methane emissions come from natural gas pipelines, while landfills contribute 24 percent.

- 1,1,1,-trichloroethane. 1,1,1,-trichloroethane or methyl chloroform is a solvent and cleaning agent commonly used by manufacturers. It is less destructive of the environment than CFCs or HCFCs, but its continued use will contribute to global warming and ozone depletion.

CAUSES OF POOR AIR QUALITY

In the Basin, three factors contribute to the region's ozone problem:

- emissions,
- geography, and
- meteorology.

EMISSIONS

Ozone is created from photochemical reactions involving NO_x emissions. The presence of VOC emissions enhances the formation of ozone from NO_x. Emission sources may be as small as individual cans of solvents and household sprays and as large as an electrical power plant. Figure 3-5 illustrates typical emission sources found in the Basin. Figure 3-6 estimates emissions from these sources. In 1993, the baseline year for the 1997 AQMP, total emissions of criteria pollutants into the Basin's atmosphere added up to a daily average of 1,320 tons of VOC, 8,660 tons of CO, 1,290 tons of NO_x, 430 tons of PM10, and 100 tons of sulfur oxides (SO_x).

Vehicular sources accounted for nearly 99 percent of the CO emissions, approximately 77 percent of the SO_x emissions, 88 percent of the NO_x emissions, and 65 percent of VOC emissions.

In 1993, stationary sources contributed approximately 37 percent of total PM10 emissions, mobile sources (both on-road and off-road) contributed approximately 10 percent of total PM10 emissions, and entrained road dust contributed approximately 53 percent of total PM10 emissions.

GEOGRAPHY

The Basin is surrounded by mountains on three sides and the Pacific Ocean on the remaining side. The mountains serve as a barrier, preventing ready dispersion of pollutant concentrations. Prevailing wind patterns off the ocean carry pollutants eastward across the Basin, enabling continual photochemical reactions to occur as new emissions are added to existing pollutant concentrations. Intense sunlight, present at the latitude of the Basin, provides the ultraviolet light necessary to fuel the photochemical reactions that produce ozone.

METEOROLOGY

Compared with other urban areas in the United States, metropolitan Los Angeles has a low average wind speed. Mild sea breezes slowly carry pollutants inland. An inversion layer, which is a layer of warm air that lies over cooler, ocean-modified air, often acts as a lid, preventing air pollutants from escaping upward. In the summer, these temperature inversions are stronger than in winter and prevent ozone and other pollutants from escaping upward and dispersing. In the winter, a ground-level or surface inversion commonly forms during the night and traps CO emitted by vehicles during the morning rush hours. Figure 3-7 illustrates the combination of these criteria pollutant-producing factors.

EPISODE LEVELS OF OZONE POLLUTION

To protect public health, the SCAQMD has initiated a system to warn the public of severe pollution levels in the air (Regulation VII - Emergencies). The ARB has defined episode levels of ozone air pollution as follows.

Health Advisory Levels. Health advisory levels occur when hourly ozone concentrations equal or exceed 0.15 ppm. At this level, residents are advised to avoid prolonged, vigorous outdoor exercise, and persons with respiratory or coronary disease should avoid exercise.

First-Stage Episodes. First-stage episodes occur when hourly ozone concentrations equal or exceed 0.20 ppm. At these times, persons with respiratory or coronary artery disease should be notified to take precautions against exposure and should stay indoors as much as possible. Schools are also notified to advise against strenuous physical activity for their students. The number of first-stage episodes has declined throughout the Basin recently as peak concentrations have decreased.

Second-Stage Episodes. Second-stage episodes occur when hourly ozone concentrations equal or exceed 0.35 ppm. The SCAQMD requires industry to take prompt actions to reduce emissions at those times. First- and second-stage episodes are less frequent in the Basin today than a decade ago. There have been no second-stage episodes in the Basin since 1989.

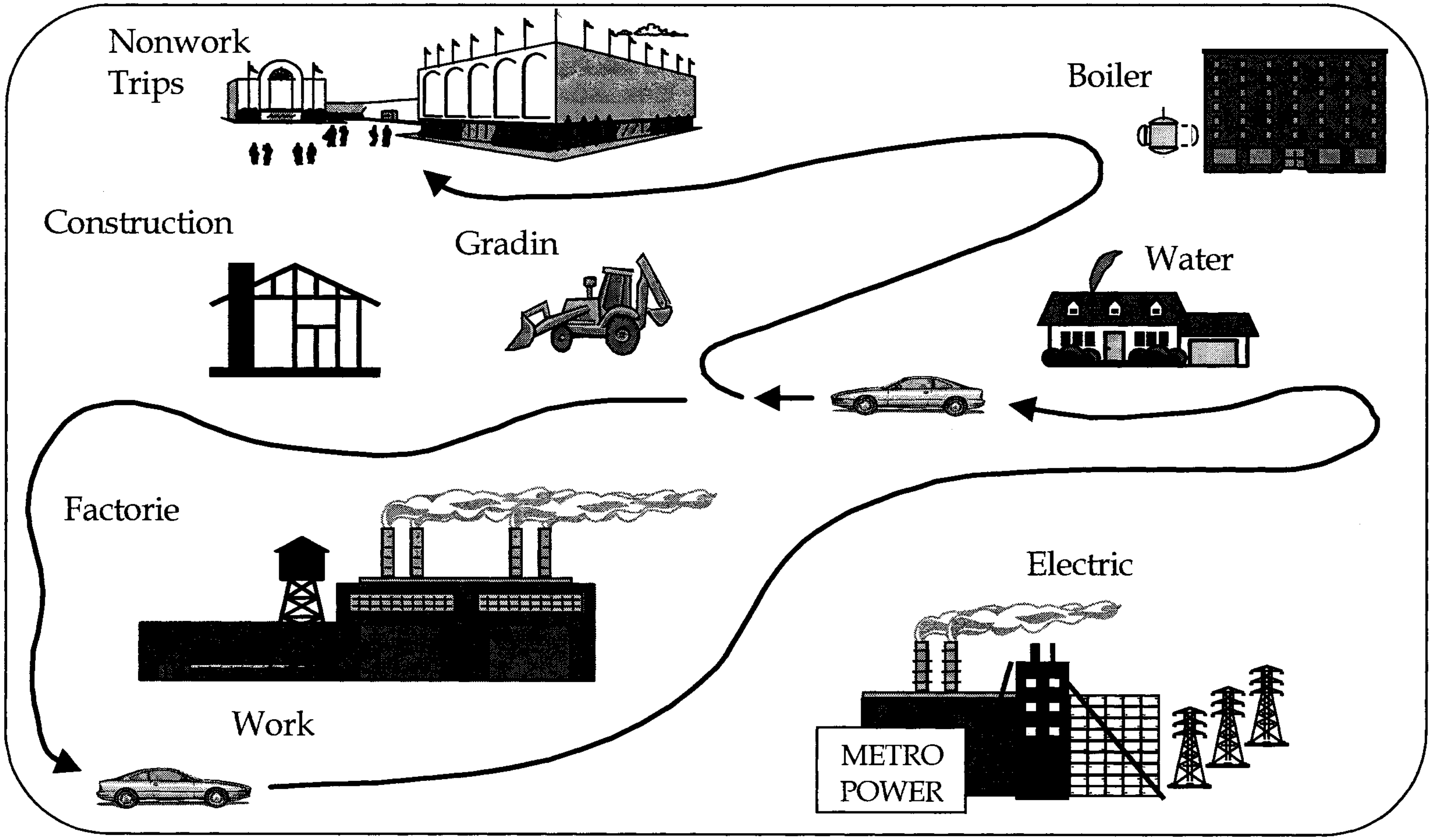


Figure 3-5
Typical Emission Sources

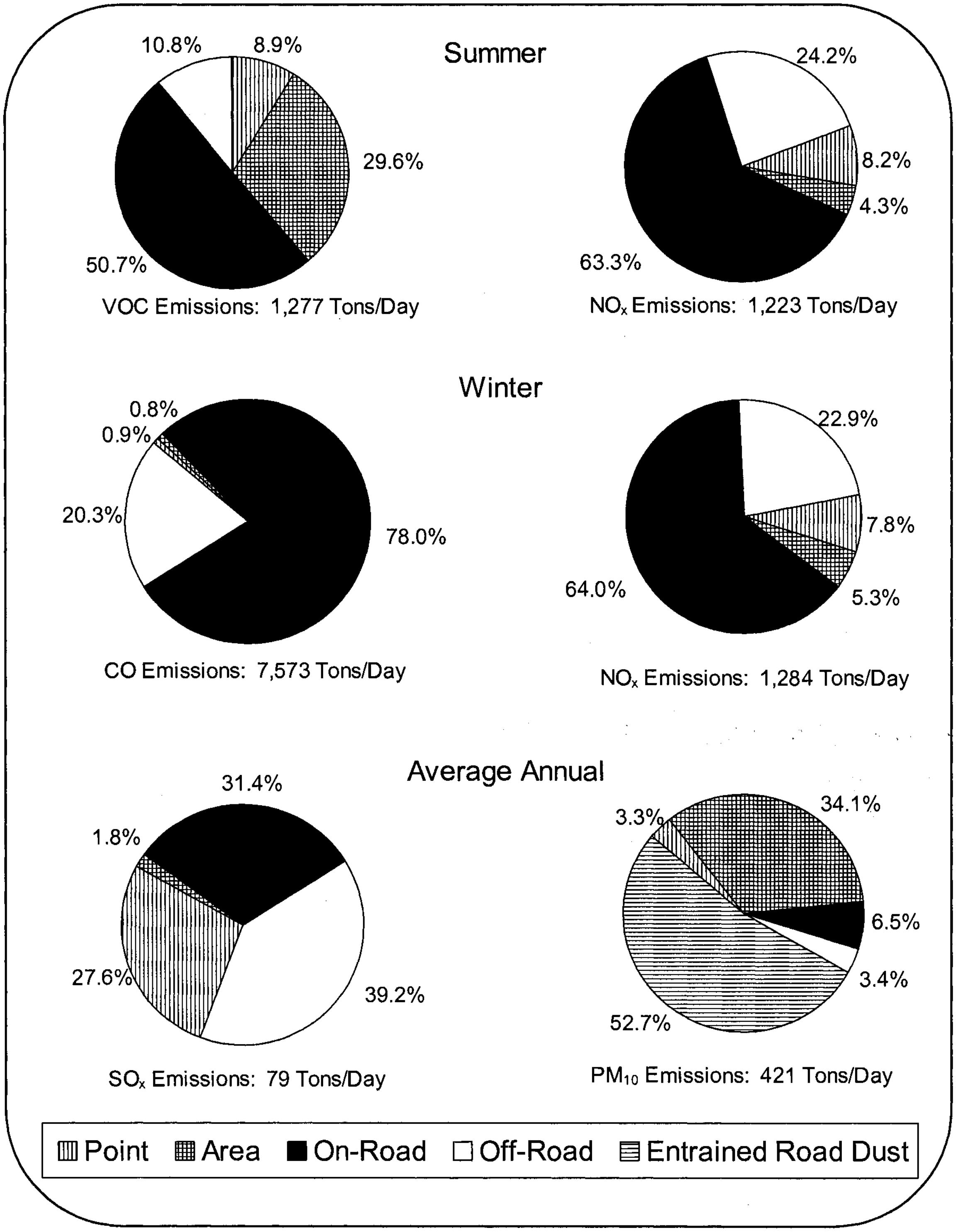


Figure 3-6
Relative Contribution By Source Category of Emissions (1993)

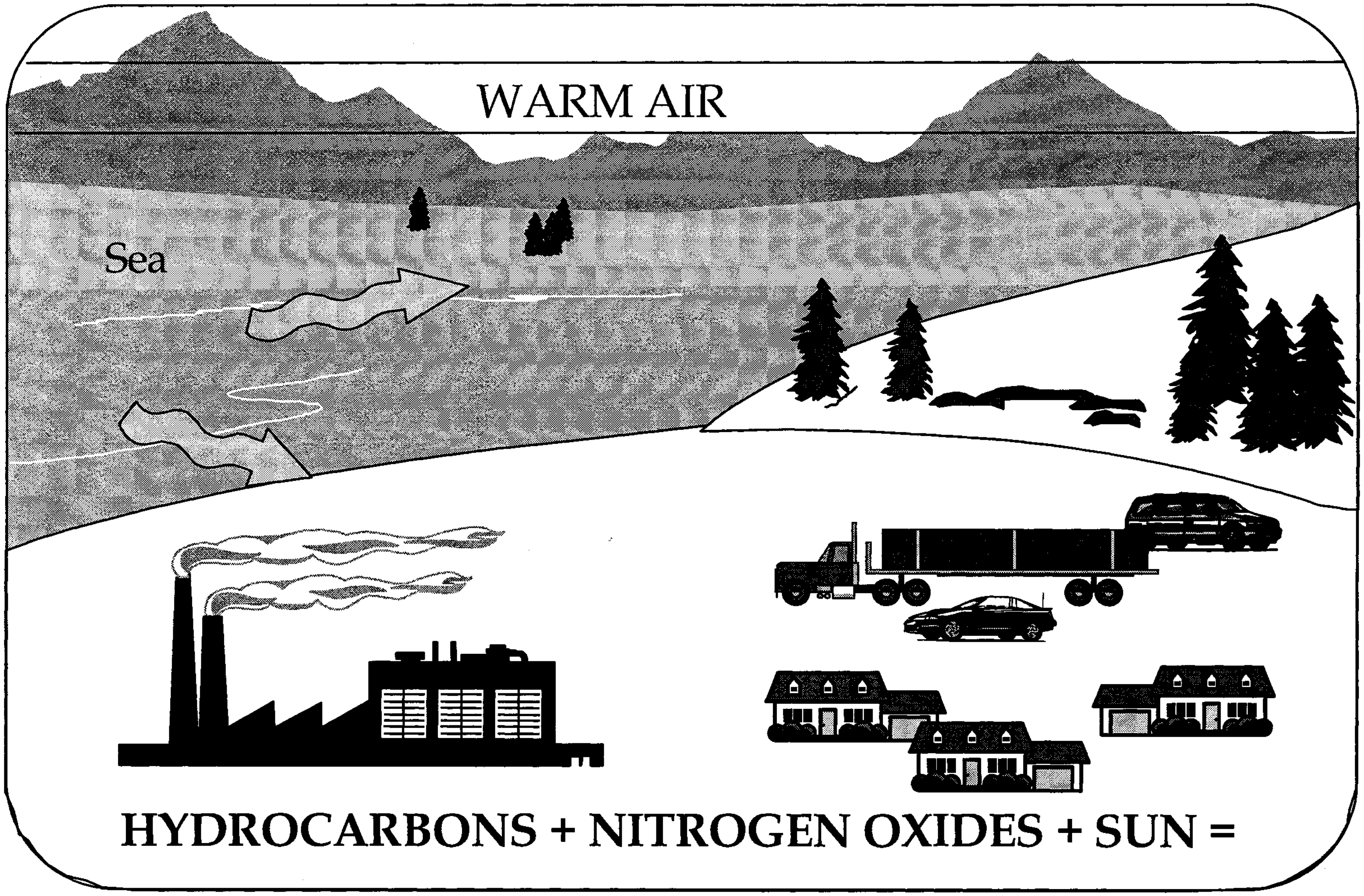


Figure 3-7
Formation of Ozone from Emissions Plus Meteorology

Third-Stage Episodes. Third-stage episodes occur when hourly ozone concentrations equal or exceed 0.50 ppm. The last third-stage episode occurred in the Basin in 1974, and it is not anticipated that the Basin will experience a third-stage episode in the future.

The SCAQMD reports air quality in terms of a Pollutant Standards Index (PSI). The PSI is a simplified method of forecasting and reporting air quality conditions on a numerical scale averaging from 0 to 500. Good air quality is 0 to 50, while 400-500 PSI is a hazardous third-stage episode (Figure 3-8).

SCAQMD CONTROL STRATEGIES

AIR QUALITY MANAGEMENT PLAN

Both federal and state Clean Air Acts require that each nonattainment area prepare a plan to reduce air pollution to healthful levels. The 1988 California Clean Air Act and the 1990 amendments to the federal Clean Air Act (CAA) established new planning requirements and deadlines for attainment of the air quality standards within specified time frames. A revised AQMP that reflected these new requirements from the federal and state government was adopted by the SCAQMD in July 1991. The 1994 revision to this plan was adopted by the SCAQMD's Governing Board in September 1994 and incorporated by ARB in the California State Implementation Plan (SIP), in November 1994. The California SIP was fully approved by the EPA in September 1996.

In November 1996, the SCAQMD Governing Board adopted a revised AQMP that modified the ozone attainment strategy for the Basin and presented an attainment strategy for the national PM10 standard. This revision was submitted by the ARB to the USEPA in February 1997 for approval. The text of the 1997 AQMP and the current status of any revisions to the AQMP can be found on the SCAQMD's web page: www.aqmd.gov.

SCAQMD POLLUTION CONTROL RULES AND REGULATIONS

In accordance with its AQMPs, the SCAQMD has adopted rules and regulations to control emission sources under its authority. The most important rules adopted by the SCAQMD to control emissions are identified in the following paragraphs.

Regulation IV - Prohibitions. Regulation IV rules apply to a wide range of emissions sources. Unlike Regulation XI rules, they do not regulate specific types of equipment or sources of emissions. Further, Regulation IV rules establish emission standards that cannot be exceeded.

Condition	Pollutant Standards Index (PSI)	Episode Level and Recommended Protective Action
Hazardous	500	**3rd STAGE EPISODE** At this hazardous level, everyone should remain indoors and minimize physical activity.
	400 300	**2nd STAGE EPISODE** At this unhealthful level, everyone should try to avoid outdoor activity. Susceptible persons, especially those with heart or lung disease, should stay indoors.
Very Unhealthful	275	**1st STAGE EPISODE** At this unhealthful level, everyone, including healthy adults and children, should avoid vigorous outdoor exercise. Susceptible persons, especially those with heart or lung disease, should stay indoors.
Unhealthful	200	**HEALTHY ADVISORY EPISODE** At this unhealthful level, everyone, including healthy adults and children, should avoid prolonged, vigorous outdoor exercise. Susceptible individuals, especially those with heart or lung disease, should minimize outdoor activity.
	138	**EXCEEDS FEDERAL CLEAN AIR STANDARD** At this unhealthful level, susceptible individuals, such as those with heart or lung disease, should minimize outdoor activity.

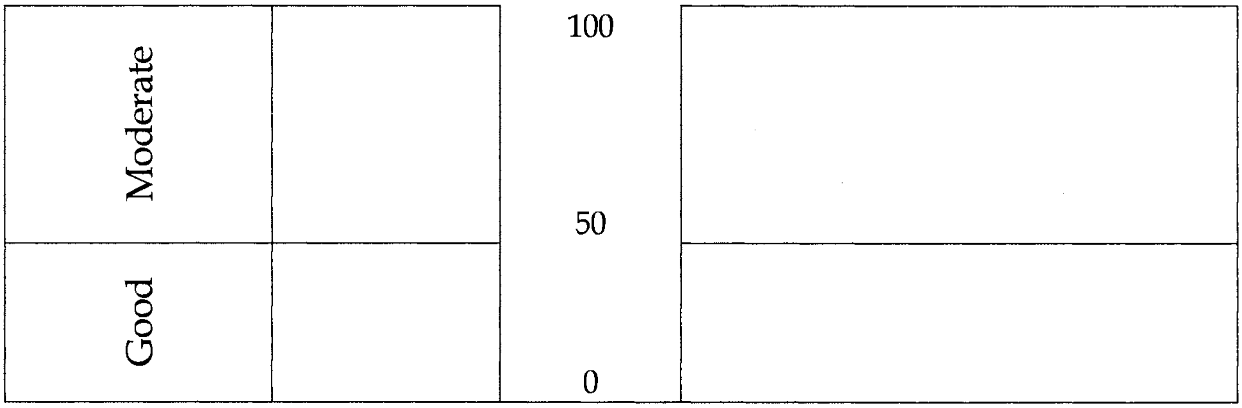


Figure 3-8
Smog Episodes and PSI Grading

This standard is different from Regulation XI rules that typically limit pollutant concentrations, not total emissions.

Regulation XI - Source Specific Standards. Regulation XI rules are air pollution control rules that apply to a wide range of existing stationary sources and generally regulate a single pollutant. Each Regulation XI rule applies to controlling emissions from a specific source category or type of equipment. For example, Rule 1134 - Emissions of Oxides of Nitrogen from Stationary Gas Turbines, controls NO_x emissions from gas turbines; Rule 1136 - Wood Products Coatings, controls VOC emissions from wood product coatings, primarily by establishing VOC content limits, etc.

Regulation XIII - New Source Review. Regulation XIII sets forth pre-construction review requirements for new, modified, or relocated facilities in the Basin. Of the requirements in Regulation XIII, the three described below are the most important. Affected facilities must install best available control technology (BACT) equipment, which must be as stringent as the Lowest Achievable Emission Rate (LAER) as defined in the federal Clean Air Act. For projects with an increase in emissions over one pound, Regulation XIII requires that modeling must be performed and that modeling must show no change in ambient atmospheric concentrations for the pollutant being modeled. The emissions over one pound must be offset by emission reductions generated at the facility or through purchasing emission reduction credits (ERCs), which represent real, surplus, and enforceable emission reductions purchased from other facilities.

Regulation XIV - Toxics and Other Non-criteria Pollutants. The SCAQMD has also adopted rules to control noncriteria pollutants. SCAQMD Rule 1401 (New Source Review of Carcinogenic Air Contaminants) assesses and manages risk from new or modified sources of air toxics through the SCAQMD's permitting program. Rule 1401 also describes the risk assessment procedures to use in evaluating risks from sources that emit cancer-causing substances. Further, it specifies the allowable risks for new and modified stationary sources. Similarly, Rule 1402 - Control of Toxic Air Contaminants from Existing Sources, regulates facilitywide toxic air contaminates from existing facilities, containing risk reduction requirements for facilities that exceed specified risk levels. Regulation XIV also contains a number of source specific rules that regulate toxic air contaminants from specific source categories. Generally, these rules are based on air toxic control measures adopted by ARB.

The SCAQMD adopted a policy on global warming and stratospheric ozone depletion on April 6, 1990, that committed the SCAQMD to consider global impacts in its rule making and in drafting revisions to the AQMP. Adopted goals include phasing out the use of CFCs, methyl chloroform (1,1,1-trichloroethane), carbon tetrachloride, and halons; phasing out large-quantity use of HCFCs by 2000; and developing recycling regulations for HCFCs. Regulation XIV also includes rules controlling emissions of stratospheric ozone depletion or global warming compounds

Regulation XX - Regional Clean Air Incentives Market. Regulation XX - Regional Clean Air Incentives Market (RECLAIM), is a comprehensive market-based regulation aimed at reducing NO_x and SO_x emissions at larger emission sources (annual NO_x or SO_x emissions greater than or equal to four tons) by setting annual declining limits at each facility and allowing the owner to meet these declining targets by either buying surplus emissions reductions from other sources, reducing emissions through installation of air pollution control equipment, or reducing operations onsite. The SCAQMD also maintains monitoring and enforcement programs to ensure compliance with these regulations.

CHAPTER 4. EARLY CONSULTATION AND SENSITIVE RECEPTOR SITING CRITERIA

INTRODUCTION

The purpose of this chapter is to encourage other public agencies that assume the role of lead agency to establish an early informal consultation process with any project proponents who are proposing a project that is required to undergo a formal California Environmental Quality Act (CEQA) or National Environmental Policy Act (NEPA) review process. In addition, public agencies should be aware of land use compatibility issues, particularly with regard to sensitive receptors. The SCAQMD is available to assist the lead agency during this early informal consultation process with the project proponent by identifying potential construction procedures, air quality design standards, sources of toxic air contaminants and air toxics being emitted.

The early consultation process is intended to help both the lead agency and project proponents identify and avoid significant adverse environmental impacts, where possible, before the CEQA or NEPA process begins. In particular, early consultation with the SCAQMD could produce minimal changes in design or project construction procedures that could substantially reduce potential air quality impacts. Project proponents who begin the planning process with an understanding of air quality issues will find it easier to design the project to avoid or mitigate air quality impacts and avoid costly and unnecessary litigation.

In addition to any informal consultation between a public agency and a project proponent, a project proponent may also request that the lead agency set up a pre-application consultation meeting with the lead agency, as well as with responsible and trustee agencies (Public Resources Code §21104). The purpose of such a meeting is to provide the applicant with information about: the type of CEQA document that may be required, potential impacts that could be generated by the project, project alternatives, and mitigation measures.

CONSULTATION WITH PLANNING DEPARTMENTS

The effectiveness of early consultation with respect to air quality is largely dependent on the familiarity of lead agencies with air quality policies and land use compatibility issues. The more familiar a lead agency is with air quality issues, the more likely it will be able to suggest appropriate mitigation measures that can be designed into the project in the early phases of the project. Where a local government with general land use authority is the lead agency, it can provide current information on air quality issues to project proponents through the use of handouts and land use/zoning maps distributed by their planning departments.

HANDOUTS

Handouts on local government land use policies and development standards that are provided to project proponents can be expanded to include air quality issues, including the following:

- identifying compatible land uses (higher densities in transit corridors; support services in commercial districts; etc.) and
- identifying incompatible land uses (location of sensitive receptors adjacent to certain types of land uses).

Handouts could contain suggestions for specific measures to improve air quality, such as:

- landscaping to reduce electrical energy use;
- development standards such as lighter colored buildings and paving materials, providing bicycle racks at commercial developments, designating carpool parking spaces close to building entrances, and placing interior bus turnouts; and
- specifying air quality mitigation measures.

LAND USE/ZONING MAPS

The local public agency can also provide land use/zoning maps to identify the location of facilities that are significant sources of toxic air contaminants (defined as facilities producing emissions that exceed the maximum individual cancer risk of 10 in one million [shown numerically as: 10×10^{-6}] either individually or cumulatively or a project-specific hazard index of 1.0 or a cumulative hazard index of 5.0). Such land use/zoning maps would be useful for identifying potential incompatible land uses (e.g., a hospital located next to a publically owned treatment works). Upon request, the SCAQMD will provide local jurisdictions with a database identifying known permitted stationary sources of air toxics in their jurisdiction. Issues regarding air toxics and land use compatibility must be fully addressed in the CEQA or NEPA document. Bicycle pathways and transit bus stops where land dedications are required can also be identified on maps, along with transit corridors, which are important when considering density and land uses necessary to support high occupancy vehicle ridership.

LAND USES, DENSITIES, SITE PLAN DESIGN, BUILDING DESIGN

Land uses, densities, site plan design, and building design affect the transportation requirements of a project. According to the ARB document *Guidance for the Development of Indirect Source*

Control Programs, design strategies that are sensitive to air quality issues, such as incorporating mixed uses into a land use project, can reduce vehicle trips by as much as 20-50 percent. Another example of a design standard sensitive to air quality that could reduce vehicle trips by 1-10 percent is a site plan that incorporates amenities such as bicycle racks and pedestrian paths. Please refer to Chapter 7 for information on how to quantify these air quality benefits. Other design-related features that are useful for reducing air pollution include: high densities and compatible land uses along transit corridors; lighter building and paving material colors, proper building orientation, and landscaping to maximize passive solar heating and cooling benefits.

During the early design phase of a proposed project or during the early consultation process, the following key questions should be answered relative to the project's propensity to adversely affect air quality. These questions include the following :

- Do the designs of public right-of-way and pedestrian walkways at the site encourage pedestrian traffic?
- Is onsite traffic circulation designed to reduce vehicle queuing?
- Are dedications needed for transit/bike pathways, in compliance with the circulation element of the applicable general plan?
- Are links between the project and bike/pedestrian pathways adequate to facilitate walking and bicycling rather than driving?
- Are supportive land uses, such as restaurants, banks, a post office, etc., included in office and industrial parks?
- Do residential specific plans incorporate mixed uses?
- Is the building or subdivision oriented to take advantage of natural heating and cooling patterns?
- Are landscaped treatments designed to reduce the energy needs of the building?
- Is the project accessible to transit facilities?
- Do developments in transit corridors provide sustainable densities to support transit ridership?
- Could the project affect the levels of service on the congestion management program (CMP) transportation system?

The above questions complement the list of specific site-design mitigation measures, found in the Handbook. At the conclusion of the early consultation process, the project proponent should understand the type of design features that could be incorporated into the project design to reduce potential air quality impacts.

CONSULTATION WITH THE SCAQMD

Lead agencies are encouraged to initiate an early consultation process with the SCAQMD as part of project review so potential air quality issues can be identified in the early design phase of the project. Upon request by the lead agency, the SCAQMD will participate in the early consultation process for any project that has the potential to adversely affect air quality. Contact the SCAQMD's Transportation Unit to request SCAQMD assistance.

It is recommended that other public agencies establish early consultation with the SCAQMD for projects in their areas of jurisdiction with any of the following characteristics:

- potential significant regional or localized air quality impacts during construction or operation;
- potential significant air quality impacts that would require substantial alterations in the project's design or scope to mitigate;
- location of a sensitive receptor within one-quarter mile of a new or existing land use that emits toxic air contaminants, objectionable odors, or is the site of CO hot spots; or,
- potential major stationary source with substantial demands on existing infrastructure or that adversely affects air quality.

In particular, the SCAQMD recommends that the lead agencies along with the project proponents consult with the SCAQMD if proposed projects are extremely large, encompassing several hundred acres or attracting a large number of vehicle trips (e.g., a large stadium, new town, etc.). It may also be useful to consult with the SCAQMD if, regardless of size, the project has the potential to generate substantial amounts of air pollutants or if project proponents would like to explore innovative clean air technologies for the project (such as the use of fuel cells).

An example of a project where early consultation may be beneficial includes construction of a major stationary source, such as a new cogeneration facility (e.g., a gas turbine that produces both electricity and steam that could be used for industrial processes). Such a project could be considered significant by both the local government jurisdiction in which it is located because of land use compatibility issues and the SCAQMD because of emissions generated during the combustion process. Other examples include projects that could increase demand on, or expansion of, existing infrastructure, such as large-scale housing or industrial development. Such projects are likely to affect transportation and wastewater treatment infrastructure and require coordination among county transportation commissions, congestion management planning agencies, and wastewater treatment districts.

MAJOR STATIONARY SOURCES

In addition to obtaining permits from a local government, a project that includes new, modified, or relocated stationary emission sources will need to obtain permits from the SCAQMD to construct and operate. Please refer to Table 4-1 for a list of major sources where it may be helpful for the lead agency to coordinate with the SCAQMD by establishing an early consultation process. Projects on this list were included because they typically emit criteria pollutants in excess of the significance threshold criteria as defined in Chapter 5 of this Handbook. Consequently, projects in Table 4-1 either have the potential to significantly affect air quality or may require substantial technical expertise to adequately assess impacts such as toxic sources.

For projects at an existing facility, such as expansion of or modifications to existing operations, it may be helpful for local governments to coordinate with the SCAQMD to obtain air quality information about the facility's current operations. Information can be obtained from the SCAQMD's Office of Stationary Source Compliance at the numbers indicated in Chapter 1. Table 4-2 provides information on specific types of permits.

TRANSPORTATION INFRASTRUCTURE IMPACTS AND CONGESTION MANAGEMENT PROGRAM

Projects affecting the regional transportation system will also affect air quality. Projects, such as land use development, that affect local transportation/circulation systems through increasing traffic to already congested roadways, thus reducing vehicle speeds and increasing vehicle miles traveled, will result in increased mobile source emissions that could adversely affect regional air quality, especially regional ozone concentrations and localized CO concentrations.

The requirements of CEQA and the Congestion Management Program (CMP) are closely linked. Under CMP legislation, local governments are required to adopt and implement a program to analyze the impacts of land use decisions on their portion of the CMP transportation system. As

Table 4-1

Major Sources Requiring Intergovernmental Coordination with the SCAQMD

Aerospace Projects • Aircraft Manufacturing • Airport Expansions
Aggregate Mining
Base Closings
Bulk Terminal Construction
Cement Plant
Chemical Plant
Chemical Waste Treatment Facilities • For Organic Solvents and Acids
Cogeneration Projects • Usually Greater Than 1 Megawatt
Food Manufacturing Plants
Hazardous Waste Treatment, Storage, Disposal, and Incineration
Infectious Waste Incineration
Landfill
Military Bases
Oil and Gas Production
Power Generating Facilities
Pulp/Paper Mills
Refinery Construction/Modernization Projects • Crude Oil Distillation Units • Catalytic Cracking Units • Gasoline Blending Units
Sewage Treatment Plants
Transportation Facilities (e.g., Rail, Highway)

Waste to Energy
Waterport Projects, Expansions, Shiploading, and Unloading Operations

Table 4-2

Operating Permits Guidance for Local Governments

Type of Facility	SCAQMD Engineering
Chemical Plants, Aerospace, Rubber Products Manufacturing, Electronics	Chemical, Rubber, Electronics, and Aerospace Operations
Small Printing and Coating Businesses	Automotive Services, Small Coating and Printing
Public Facilities, Landfills, Publicly Owned Treatment Works, Medical Waste Disposal, Hospitals, Schools, Military Bases	Public Facilities
Mechanical Processing, Raw Materials	Mechanical Processing, and Raw Materials
Refinery Operations	Refinery and Outer Continental Shelf Operations
Printing Operations, Furniture and Plastics Manufacturing, Other Coatings	Automotive Services, Small Coating, and Printing
Gas and Electric Utilities, Pipelines and Oilfields	Gas and Electric Utilities, and Pipelines and Oil Fields
Dry Cleaners, Charbroilers, and Other Local Commercial Businesses	Neighborhood Commercial Operations
CFC and Vapor Recovery	Neighborhood Commercial Operations
Toxics, Ozone Depletors, and Greenhouse Gases	Air Toxic Program and Global Climate Changes

NOx, SOx Reclaim	RECLAIM and Title V Administration
Title V Permits	RECLAIM and Title V Administration

such, CEQA may be used to facilitate the analysis of impacts on the land use and transportation components of the CMP.

The early consultation process can be useful in assisting public agencies with identifying local areas where a project or series of projects may bring increased congestion to a segment of roadway. It may also be useful for identifying mitigation measures that reduce traffic and improve circulation, thus contributing to improved air quality. If the project would cause traffic service at an intersection to deteriorate below level of service E (considerable congestion) or the level established in the CMP, the resulting congestion should be addressed by improvements, programs, or actions that either mitigate the deficiency or measurably improve the level of service of the system. In fact, the CMP legislation requires that the impact be mitigated through the development of a deficiency plan. Chapter 9 provides further guidance on preparing site-specific mitigation measures that can be used in deficiency plans.

As part of the CMP land use analysis element, most local governments will require project proponents to prepare a traffic impact analysis when, according to the initial study, the project is likely to adversely affect the transportation system. The traffic impact analysis can also become the starting point for the analysis of congestion and air quality impacts in the CEQA document by providing project-specific transportation inputs (assumptions) for calculating pollutant emissions.

WASTEWATER TREATMENT IMPACTS

Developments that significantly increase demand on the wastewater treatment system of an area can create a situation where service demand would be in excess of the system's capacity. Population projections in the regional growth management plan serve as the basis for determining the capacity of a wastewater treatment system. Figure 4-1 lists projects that produce a substantial amount of wastewater or that have the potential to generate toxic air contaminant emissions (treating toxic wastewater could increase toxic air contaminant emissions). Proponents of these types of projects should consult the local wastewater treatment agency to determine whether the project could affect overall wastewater treatment capacity, therefore, increasing air toxic emissions.

SITING CRITERIA FOR SENSITIVE RECEPTORS

When considering land uses and population densities in their jurisdiction, local public agencies should be aware of land use compatibility issues, particularly in reference to sensitive receptors. A sensitive receptor is a person in the population who is particularly susceptible to health effects due to exposure to an air contaminant than is the population at large. Sensitive receptors (and the facilities that house them) in proximity to localized CO sources, toxic air contaminants or odors are of particular concern. (Please refer to Figure 4-2 for a list of land uses where sensitive receptors are typically located and to Table 4-3 for a list of land uses associated with toxic air contaminants.).

Aluminum Farming
Battery Manufacturing
Chemical Manufacturing
Dye Casting
Electronic Firms
Electroplating
Food Manufacturing
Metal Finishing Processing
Metal Molding and Casting
Pharmaceutical
Petroleum Refining
Photography
Pulp and Paper Manufacturing
Reclamation Plants
General Plans
Specific Plans

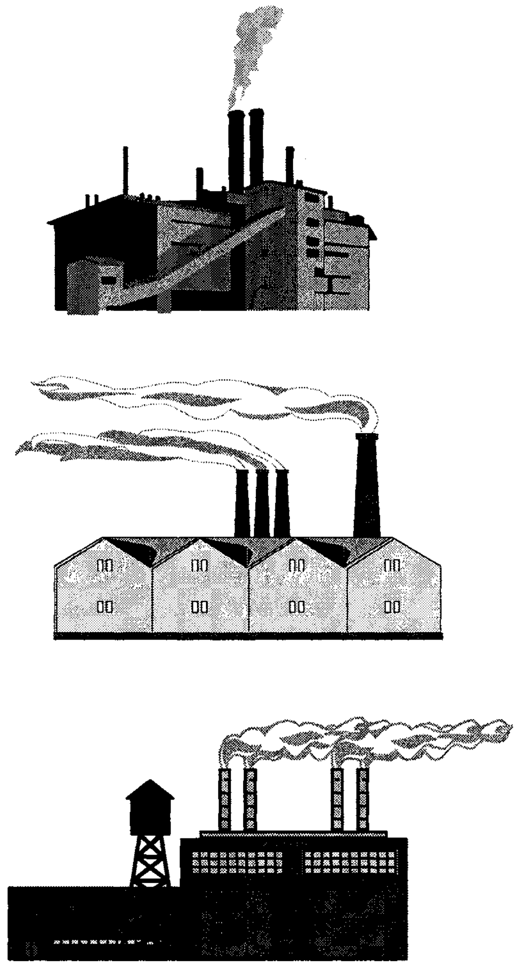


Figure 4-1

Projects Potentially Producing Substantial Amounts of Water or Toxic Wastewater

As suggested earlier in this chapter, land use compatibility issues should have been raised during the early consultation process. Otherwise, any siting issues need to be identified early in the project review process, preferably before projects are formally submitted to the public agencies' planning boards. The following three air quality questions relate to land use compatibility and should be considered for each project with sensitive receptors:

- Will a sensitive receptor be located adjacent to a congested roadway or in an area with high background concentrations of CO?
- Will a sensitive receptor be located within one-quarter-mile of an existing facility that emits toxic air contaminants?
- Will a sensitive receptor be located downwind from an existing source of odors, or will a proposed use associated with odors be located upwind of an existing sensitive receptor?

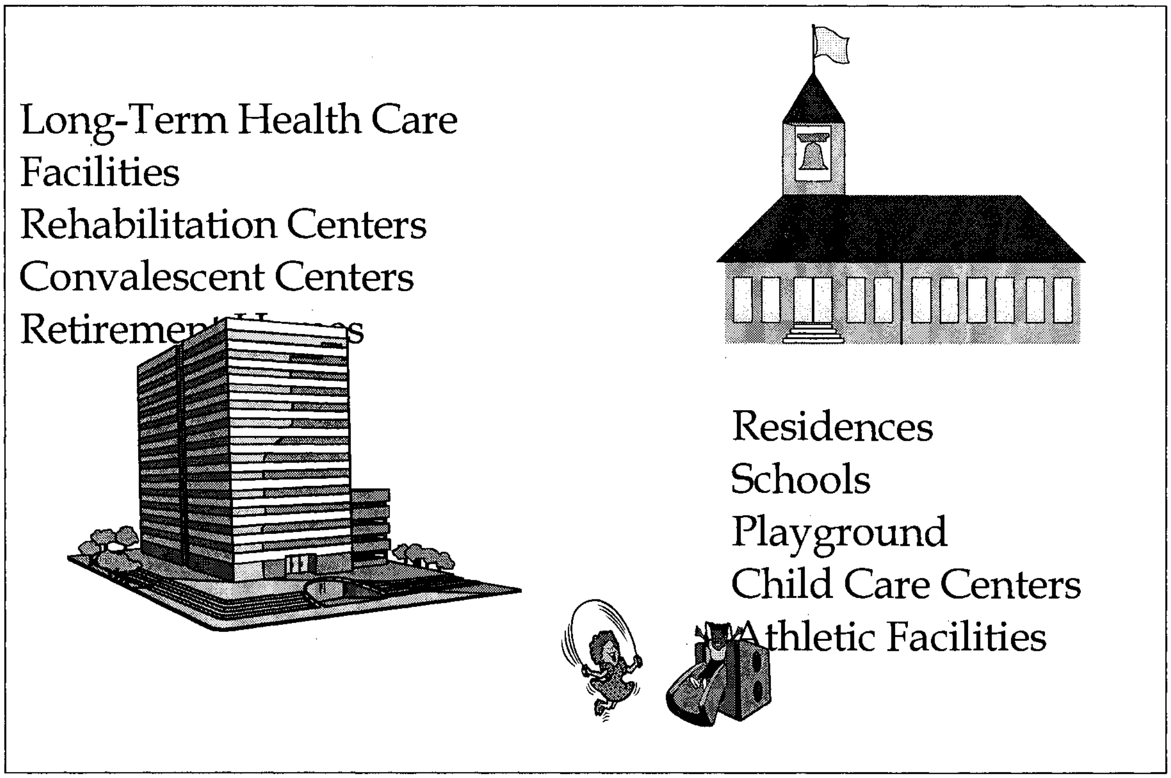


Figure 4-2

Land Uses Considered To Be Sensitive Receptors

Table 4-3

Examples of Toxic Emissions by Land Use

Land Use	Source Type	Air Toxic Emissions
INDUSTRIAL		
Acoustic Ceiling, Asbestos Product, Caulk, and Gasket Manufacturing	Blending Tank with Baghouse	Asbestos
Aerospace Manufacturing	Chrome Plating Shop, Spray Booth, Aircraft Parts	Hexavalent Chromium
Asphalt Batch Plant, Asphalt and Paving Contractors, Asphalt and Asphalt Products Manufacturing	Mixing Tank, Asphalt Manufacturing with Baghouse	Asbestos
Brake Manufacturing Facility	Arc Grinders	Asbestos
Brake Shoe Rebuilders and Recyclers	Brake Debonder with Afterburner	Asbestos
Chemical Manufacturing	Reaction Tank Wastewater Treatment Mixing Tank, High-Temperature Adhesive Manufacturing Feedstock Refrigerants Manufacturing	Ethylene Dichloride, Asbestos
Chemical Plants Hazardous Waste Incinerator	Hazardous Waste Rotary Kiln Incinerator	Berylium, Hexavalent Chromium, Benzene, Carbon Tetrachloride, Dioxins, Dibenzofurans, Ethylene Dicholoride, PAHs, PCBs
Chrome Plating Facility	Chrome Plating Shop, Evaporation System Chrome Acid Solution, Chrome Plating Shop Tank	Hexavalent Chromium, Cadmium

Electrical Manufacturing	Transformer, Plating	PCBs, Cadmium Chromium, Nickel, Trichloroethylene, 1,4-Dioxane

Note: This table does not include all types of and uses with carcinogenic emissions; also, each land use may not emit all listed compounds.

Table 4-3

Examples of Toxic Emissions by Land Use (continued)

Land Use	Source Type	Air Toxic Emissions
Electrical Manufacturing	Plating, Etching	Cadmium, Chromium, 1,4-Dioxane, Nickel, Trichloroethylene
Commercial Medical Equipment Sterilization Facility	Ethylene Oxide Sterilization Chamber	Ethylene Oxide
Fiberglass Manufacturing	Machine Operation with Baghouse	Styrene
Graphite Manufacturing	Polycarbon Graphitization	Dioxins, Dibenzofurans
Industrial with Heating or Steam Needs	Fuel Oil Steam Generator Boiler Unit	Cadmium, Hexavalent Chromium
Petroleum Refinery Modification/Expansion	Petroleum Product Storage Tank Fuel Oil Steam Generator	Benzene, Cadmium
Storage Tank Farm	Storage Tank	Benzene
COMMERCIAL		
Auto Machine Shop	Arc Grinders	Asbestos
Brake Realignment Shop	Arc Grinders	Asbestos
Gas Station	Typical Gas Station	Benzene
Medical Clinic and Laboratory	Ethylene Oxide Medical Sterilizer	Ethylene Oxide
Dry Cleaners		Perchloroethylene
Auto Body Shop		
INSTITUTIONAL/PUBLIC		
College/University	Fuel Oil Boiler Unit Ethylene Oxide Medical Sterilizer	Cadmium, Hexavalent Chromium, Ethylene Oxide
Groundwater Clean up	Aeration Tower	Benzene, Percholoroethylene, Trichloroethylene
Wastewater Treatment		
Hospital	Refuse Incinerator, Medical Sterilization Chamber,	Dioxins, Debenzofurans, Cadmium, Ethylene Oxide

Landfill	Boiler Unit Landfill Gas Flare	Benzene, Vinyl Chloride

Note: This table does not include all types of and uses with carcinogenic emissions; also, each land use may not emit all listed compounds.

Table 4-3

Examples of Toxic Emissions by Land Use (concluded)

Land Use	Source Type	Air Toxic Emissions
Biomedical Laboratory	Fugitive Emissions and Fume Hood Exhaust	Benzene, Carbon Tetrachloride, Chloroform, Formaldehyde, Methylene Chloride
Municipal Solid Waste Incinerator	Mass Burn Incinerator	Dioxins, Dibenzofurans, Cadmium, Hexavalent Chromium, PAHs, PCBs, Mercury
Wastewater Treatment Facility	Digester Gas-Fired Reciprocating Engines	Hexavalent Chromium, Others
Wastewater Treatment Plant	Wastewater Treatment	Benzene, Carbon Tetrachloride, Ethylene Dichloride, Ethylene Dibromide, Chloroform

Note: This table does not include all types of and uses with carcinogenic emissions; also, each land use may not emit all listed compounds.

The following subsections address major land use compatibility issues relative to sensitive receptors.

CO HOT SPOTS

A particularly important consideration during the early design phase of a proposed project or during the early consultation process is consideration of site locations where sensitive receptors would be located. Placement of sensitive receptors near localized concentrations of CO is particularly of concern. High levels of CO are associated with major traffic sources, such as freeways and major intersections. High levels of CO are associated with high traffic concentrations, slow-moving vehicles, and idling vehicles. Depending on existing background concentrations of CO, roadways have the potential to become CO hot spots. Therefore, projects containing sensitive receptors or projects that could adversely affect levels of service on nearby roadways should use the screening procedures described in Chapter 7 of this Handbook and the California Department of Transportation (Caltrans) CO protocol to determine the potential to create CO hot spots (Garza et al. 1996).

A screening procedure should be followed to determine whether a project poses the potential for a CO hot spot. There will be a potential CO hot spot at any location where the background CO concentration already exceeds 9.0 parts per million (ppm), which is the 8-hour California ambient air quality standard. At locations where CO concentrations already exceed 9.0 ppm, the project should be considered significant for CO air quality impacts if a project increases ambient CO concentrations by 0.45 ppm or more. Chapter 7 of this Handbook describes the procedure for conducting a screening level CO analysis. A screening level analysis should be performed for each development phase of the project and project buildout.

If an analysis for a project demonstrates that a sensitive receptor would be exposed to significant CO concentrations, additional mitigation measures (see Chapter 9) should be proposed. The SCAQMD does not recommend siting sensitive receptors on those portions of a project site where the state 8-hour CO standard could be exceeded. Because CO concentrations are declining rapidly through fleet turnover, projects with buildout after 2000 are less likely to cause significant CO impacts than those with early completion dates.

TOXIC SOURCES

Toxic air contaminants are of particular concern with regard to sensitive receptors. For example, state law requires school districts to consider the impact of siting a new school close to existing facilities that emit toxic air contaminants. This same principle should be applied in siting other sensitive receptors close to facilities that emit TAC, such as retirement homes, schools, hospitals, or athletic facilities.

As already noted, the early consultation process is one means of making the project proponent aware of any environmental documentation, including a public health risk assessment, that may be necessary to assess the public health impacts of a project. Both the lead agency and the project proponent should be aware of publicly available information on public health risks posed by nearby sources of toxic air contaminant emissions. For some air toxics, the SCAQMD serves as a clearinghouse for publicly available information on stationary sources that emit toxic air contaminant emissions and associated public health risks. This information is compiled from documentation required of toxic emitters by SCAQMD Rule 1401, Rule 1402, and Assembly Bill (AB) 2588 Air Toxics Hot Spots Program (H&SC §§ 39660 et seq.). The lead agency and the project proponent should make reasonable attempts to obtain information on toxic air contaminants from any known sources that could potentially affect the project site, but may not be covered by the current versions of Rules 1401, 1402 and AB 2588. Pursuant to state CEQA Guidelines Section 15151, if information is unavailable, the adequacy of the analysis (in this case, the air toxics analysis) is determined in light of what data are reasonably available. Additionally, the project proponent should understand that, depending on the risk levels identified through the environmental process, the local government may determine that such a site is not an appropriate location for a particular sensitive receptor.

The steps for evaluating toxic air contaminant impacts on sensitive receptors are listed below and are summarized in Table 4-4:

1. Development plans for sensitive receptor projects submitted to the local public agency should include a radius map. A radius map identifies all buildings surrounding the project, including residences, commercial or industrial property, etc. Compare the uses identified on the map within one-quarter of a mile of the sensitive receptor with the list of land uses associated with toxic air contaminants in Table 4-3.

2. If the map shows an existing industrial source that emits toxic air contaminants within one-quarter of a mile of the proposed sensitive receptor, confirm with the SCAQMD the type of pollutant that this facility emits. The SCAQMD has prepared a database of facilities that emit toxic air contaminant emissions.

   For information, contact the Air Toxics Program section at (909) 396-2703. If SCAQMD's staff identifies that air toxics are being emitted, then the lead agency should include, at a minimum, a public health risk screening assessment as part of the environmental analysis. It is the responsibility of the lead agency to determine whether the risk is significant. As indicated in Chapter 5, the SCAQMD has established a maximum individual cancer risk significance threshold of 10 in one million (10×10^{-6}) or a Hazard Index of 1.0 for noncarcinogens and recommends that other lead agencies use these significance thresholds when approving permits for new or modified stationary sources.

3. If a site for a sensitive receptor is to be pursued as a potential location, then toxic air contaminant emissions from any existing nearby sources should be identified, quantified to the extent that such data are reasonably available, and evaluated in a risk assessment. Chapter 8 includes a discussion on procedures for quantifying toxic air contaminant emissions and preparing health risk assessments. Health risk assessments can be reviewed by the SCAQMD before local governments take action to ensure that the assessment is adequate and that the risk is identified accurately. Depending upon the circumstances of the project (e.g., location of the facility emitting air toxics and the air toxic emitted), mitigation measures may not be available to reduce the maximum individual cancer risk to less than 10 in one million (10×10^{-6}) or the Hazard Index to less than 1.0.

OBTAINING AIR TOXICS INFORMATION FROM THE SCAQMD

As stated above, project proponents and local government staff members can contact the SCAQMD's Air Toxics Program section to determine whether a facility is operating under SCAQMD permits and to find out what types of pollutants are emitted by a specific facility.

Table 4-4

Steps to Evaluate Toxic Impact on Sensitive Receptors*

1. Project proponents for projects considered sensitive receptors (Figure 5-1) are to submit a radius map.
2. Planners compare those uses on the map within a quarter-mile radius of proposed project with uses in Table 5-1.
3. Identify any situations where the sensitive receptor will be within a quarter-mile radius of an existing source of toxic emissions.
4. Confirm with the SCAQMD Air Toxics Unit that the identified land use emits toxics.
5. Require that the CEQA analysis include a health risk assessment if it is determined the sensitive receptor could be within ¼ mile of an existing source of toxic emissions (see Chapter 10).
6. Send the health risk assessment to the SCAQMD as part of the CEQA analysis.
7. Lead Agency determines whether the risk identified in the analysis is acceptable.

*Optional, but recommended approach.

One of the requirements of the Air Toxics "Hot Spots" Information and Assessment Act of 1987 [Assembly Bill (AB) 2588], is that the SCAQMD require risk assessments of facilities that represent significant sources of toxic emissions. AB 2588 also requires facilities to submit updated air toxics emissions inventories every two years.

Based on the quantity and volume of emissions, toxicity and potency of substances, and proximity to receptors, facilities are placed into one of three categories, by the SCAQMD:

- Category A: High-priority facilities that were required to submit health risk assessments within 150 days of being placed in this category.
- Category B: Facilities that were required to submit health risk assessments in a later year.
- Category C: Facilities not required to submit health risk assessments.

The SCAQMD also developed "industrywide" inventories and assessed risks of small business facilities with emissions that are easily characterized. Some of the facilities in the industrywide program are gas stations, small auto body shops, small dry cleaners, plating shops, and fiberglass product manufacturers.

The public can request, through a Public Records Act request, copies of the health risk assessments conducted under AB 2588. Health risk assessments identify impacts on nearby receptors including existing sensitive receptors. This information can then be used as an initial screening tool to determine whether a particular site is advisable for siting a sensitive receptor. In addition, analysts and project proponents may request additional information from the SCAQMD database on cumulative sources of toxic emissions and locations of toxic hot spots.

ODOR ISSUES

Because both the SCAQMD and local governments receive formal complaints about offensive odors, potential sources of odors need to be identified from both the emitter and the downwind receptor. Preferably, this will be done while the project is still in its initial design phase. If potential odor issues can be identified and mitigated before construction, later enforcement problems will be avoided.

While almost any source may emit objectionable odors, some land uses will be more likely to produce odors because of their operation. The early consultation process should identify both new projects that have a probability of emitting objectionable odors and new developments that may be affected by existing downwind odor sources.

Assessing odor impacts depends on such variables as wind speed, wind direction, and the sensitivity of receptors to different odors. By contacting either the SCAQMD's Office of Engineering and Compliance or the jurisdiction's code enforcement department, a planner can determine whether any odor complaints have been filed by property owners/occupants in the general vicinity of the proposed project site and thereby determine whether a sensitive receptor could be affected by odors. Additionally, if the proposed project is close to a use identified in Figure 4-3 or is one of these uses, then potential odor impacts should be addressed.

Agriculture (farming and livestock)

Wastewater Treatment Plant

Food Processing Plants

Chemical Plants

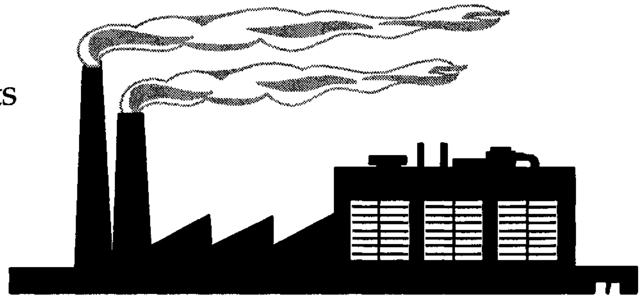
Composting

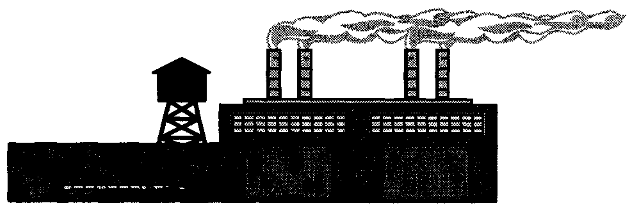
Refineries

Landfills

Dairies

Fiberglass Mo[illegible]ng





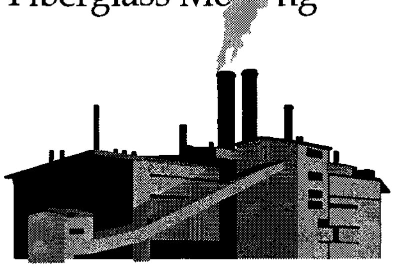


Figure 4-3

Land Uses Associated with Odor Complaints

SENSITIVE RECEPTOR SITING CRITERIA and DESIGN MITIGATION MEASURES

CHAPTER 5

Prior to the formal submittal of the project to the local government, there are two issues that planners need to communicate and which project proponents need to address:

- o Potential air quality impacts on sensitive receptors
- o Integration of site design features that will reduce emissions

Any project evaluation undertaken by local government planners should include these issues.

5.1 Evaluating Impacts on Sensitive Receptors

Sensitive populations are more susceptible to the effects of air pollution than are the population at large. Sensitive populations (sensitive receptors) who are in proximity to localized sources of toxics and carbon monoxide (CO) are of particular concern. (Refer to Figure 5-1 for a list of land uses considered to be sensitive receptors and to Table 5-1 for a list of land uses associated with toxic air emissions.)

Local governments have a responsibility for determining land use compatibility in the case of sensitive receptors. They also determine the type of land uses (sensitive receptors) and densities of use within their jurisdiction. The District has established standards through its rulemaking authority for carcinogenic and toxic air contaminants that are emitted by stationary sources which are designed to protect public health. These standards are identified in Section 5.2. Local governments can use the District standards to assist in making their land use decisions.

State law currently requires school districts to consider the impact of siting a new facility within close proximity to existing facilities that emit toxics. This principle should be applied in siting other sensitive receptors such as rehabilitation centers. Furthermore, local governments should be aware of the potential effects on the health of sensitive populations when a sensitive receptor is proposed to be situated adjacent to a significant source of CO, such as a freeway or a major intersection. High levels of CO are associated with traffic congestion and with idling or slow-moving vehicles. Depending on existing background concentrations of CO, roadways have the potential to be CO hot spots. Therefore, projects with sensitive receptors or projects that could negatively impact levels of service (LOS) should utilize the screening procedures in this chapter to determine the potential to create a CO hot spot. If the project causes the state 1-hour or 8-hour CO standards to be exceeded, then a "CO hot spot" is created. As such, it is considered that the project is likely to cause or contribute to a CO exceedance of a state ambient air quality standard. Therefore, a CO hot spot in and of itself is cause for concern. Once it is determined that a CO hot spot will occur, the project should then be evaluated for its potential impacts on sensitive receptors. (See Section 9.4 to determine the potential for a CO hot spot.) The responsibility for properly siting sensitive receptors rests with local governments.

Another land use compatibility issue involves sources that emit odors. The District's compliance officers may receive a number of odor complaints from residents surrounding a source. Many of these complaints could have been avoided if equipment had not been located upwind of a sensitive receptor, or if the facility employed add-on control equipment to reduce odorous emissions.

Ideally, as suggested in Chapter 4, these types of land use compatibility issues would have been raised at an initial consultation. Otherwise, these siting issues need to be identified early in the project review process, preferably before projects are formally submitted to the jurisdiction. The three key air quality questions that affect land use compatibility and that should be considered for each sensitive receptor project are:

- o Is the proposed sensitive receptor located within a quarter mile of an existing facility that emits toxic pollutants?

- o Is the proposed sensitive receptor adjacent to a congested roadway or in an area with high background concentrations of CO?
- o Is the proposed sensitive receptor downwind of an existing source of odorous emissions, or is a proposed use associated with odorous emissions upwind of an existing sensitive receptor?

In addition, proposed projects that could negatively impact the adjacent roadway's LOS, and as such subject an existing sensitive receptor to high levels of CO, should also undergo the screening procedures in this chapter.

These questions should be used to identify projects where additional review is needed.

5.2 Evaluating Sensitive Receptors for Toxic Impacts

The steps for evaluating toxic impacts on sensitive receptors are summarized in Figure 5-2. First, development plans for sensitive receptor projects should be accompanied by a radius map. An example of the information contained in the radius map is illustrated in Figure 5-3. The planner can compare the uses identified in the map with the list of land uses associated with toxic air emissions in Table 5-1.

If the map shows that there is an existing industrial source that emits toxic or carcinogenic air pollutants which may create a potential human health hazard within a quarter mile of the proposed sensitive receptor, planners should confirm with the District that this facility emits the pollutants indicated. The District is preparing a database of facilities that emit toxic emissions, and planners can contact the Toxics Unit at 909 396-3108. If the District confirms the location and type of emissions, then the local government should include a public health risk screening assessment as part of the environmental analysis. It is the responsibility of the local government to determine if the risk is significant and/or acceptable. The District uses the standard of 1 in 1 million as the maximum individual cancer risk and 10 in 1 million if the source of the toxic emissions uses best available control technology for toxics (T-BACT) when approving permits for new or modified stationary sources.

If the site is to be pursued as a potential location, then the toxic emissions from the existing nearby sources need to be identified (quantified to the extent that such data is reasonably available, Section 4.5) and a risk assessment performed. Chapter 10 discusses procedures for quantifying toxic emissions and making risk assessments. These assessments can be reviewed by the District prior to local government action to ensure that the assessment is adequate and that the risk is identified accurately.

There are no mitigation measures that sensitive receptors can employ to lessen the impact of siting next to a toxic source.

Additional Resources for Toxics Information

Sometimes additional information is needed to understand the extent and type of toxic emissions or to verify that a business does or does not emit toxic compounds. Several additional information sources are available to the planner including:

(1) State of California Health and Safety Code Section 25510(k) and (q) requires businesses that use hazardous materials or that involve a potential threatened release of acutely hazardous materials to submit a business plan for emergency response as set forth in Health and Safety Code Section 25503.5.

In most jurisdictions, the local or county fire department is charged with overseeing compilation of a **Hazardous Material Business Plan** for businesses that store or use hazardous materials in reportable quantities. The fire department will have a documentation package that can be used to provide the necessary information.

(2) Planners can contact the District's Toxic Source Unit to determine if a facility is operating under District permits and to learn the types of pollutants emitted by the facility.

(3) In 1987, the California legislature passed the **Air Toxics "Hot Spots" Information and Assessment Act of 1987** (AB 2588), which requires a statewide emissions inventory of toxic air pollutants. The Act further requires that the District first prioritize facilities and then require risk assessments of facilities that represent significant sources of toxic emissions. Facilities began entering this program on August 1, 1989, according to the schedule set forth in the Act. After entering the program, facilities must submit updated air toxics emissions inventories every two years.

Based on (1) quantity and volume of emissions, (2) toxicity and potency of substances, and (3) proximity to receptors, facilities are placed into one of three categories. The categories are:

Category A: Facilities that are required to submit risk assessments within 150 days of being placed in this category.

Category B: Facilities that may be required to submit risk assessments in a later year.

Category C: Facilities that are not likely to be required to submit health risk assessments.

In addition, the District is developing "industry-wide" inventories and assessing risks of small business facilities with emissions that are easily characterized. Some of the facilities in the industry-wide program include gas stations, small auto body shops, small dry cleaners, plating shops, and fiberglass product manufacturers.

Currently planners and project proponents can request through a public records request to the District health risk assessments performed pursuant to AB 2588. The assessments identify impacts on nearby receptors, including existing sensitive receptors. That information can then be used as an initial screening tool to determine if a particular site is advisable for siting a sensitive receptor.

Ultimately, this program will yield a database that will be made available to local planners in 1993. The database will:

(1) Provide information necessary to assess health impacts from cumulative sources of toxic emissions.

(2) Provide information to planners on the amount and type of toxic emissions from a particular business and/or toxic hot spots that can then be identified on land use/zoning maps for future reference.

Planners can contact the District's Toxics Unit to determine if a business has already submitted a risk assessment that analyzes impacts on sensitive uses. If so, the risk assessment can be used to determine if the siting of a sensitive receptor within the impact area is appropriate. A public health risk assessment, however, may only be available for District 1401 permits (since June 1990) and AB 2855 facilities at this time.

5.3 Evaluating Projects for CO Impacts

In order to evaluate a project and assess the localized CO impacts on sensitive receptors that are sited adjacent to congested roadways, the following screening procedures should be followed, and the roadway level of service (LOS) should be identified during the initial consultation, as described in Chapter 4.

(1) Determine the "no project" ambient background CO concentrations based on information from the air quality monitoring station located in the same source receptor area (SRA) as the project. If CO is not monitored at the station in the same SRA as the project, the nearest or most representative air monitoring station data should be used. Contact the District for assistance in identifying the most representative station. Tables 5-2 (1-hour) and 5-3 (8-hour) may be used to determine project future year CO ambient concentrations.

(2) Estimate the projected 1-hour and 8-hour CO concentration levels at the site. CO concentrations may be determined based on roadway type and LOS. Table 5-4 provides estimates of roadway and intersection emissions. To establish the projected 8-hour concentration, the 1-hour concentration should be multiplied by the persistence factor (see Section 9.4).

(3) Add the "No Project" ambient concentration level to those generated by the project (i.e., total project impact).

(4) Compare the total project impact to the 1-hour and 8-hour state ambient CO standards (Chapter 3).

(5) If a CO hot spot is anticipated, determine the extent of area impacted. This can be accomplished by plotting the queuing distance from the intersection stopline (Q) as the X axis, and the distance from edge of roadway (A) as the Y axis. The area which falls within the XY coordinates is most likely impacted with CO concentration levels which exceed the state standard (refer to Figure 5-4). Identify and determine CO concentration levels for each sensitive receptor.

(6) Compare the concentration levels of CO at the proposed site locations for sensitive receptors to the 1-hour and 8-hour CO standards.

(7) Determine project significance.

This analysis should be performed for each development phase of the project and project build-out.

There may be cases where the background concentration already exceeds the state 1-hour and 8-hour CO standards. In these cases, the analysis should determine if there will be a measurable increase at the project site. A measurable increase is defined as one part per million (ppm) for the 1-hour CO standard and 0.45 ppm for the 8-hour standard (consistent with District Regulation XIII definition of a significant impact).

If it is determined that the project could be significant, there are a number of dispersion models that are available for site specific analysis. The District recommends the use of CALINE or CAL3QHC to estimate the potential for CO hot spots. These models are based on continuous line source emissions and therefore, can estimate roadway impacts. Both models are described in Section 9.7.

Unlike toxic land use compatibility issues, CO excesses can be mitigated to some extent by increasing traffic speeds through methods such as traffic light synchronization, improved intersection channelization, inclusion of left turn lanes, demand management strategies or through site design measures which can considerably reduce the impacts of proximate CO due to dispersion. Expansion of the roadway by adding additional lanes may not be a preferable mitigation measure because increased traffic volume may wipe out any reductions in CO gained from increasing speeds. If the analysis demonstrates that the sensitive receptor will be affected and the state 1-hour or 8-hour CO standards are exceeded, mitigation measures such as those given in Table 5-5 should be employed if the local government intends to approve the proposed project. However, the District does not recommend siting sensitive receptors on those portions of a project site where the state 1-hour or 8-hour CO standard could be violated.

5.4 Evaluating Projects for Odor Impacts

Because both the District and local government are receiving an increasing number of formal complaints about offensive odors, potential sources of odors need to be identified from the standpoints of both the emitter and of the downwind receptor. Preferably, this will be done while the project is still in its initial design phase. If potential odor issues can be identified and mitigated before construction, later problems with enforcement will be avoided.

Assessing odor impacts depends upon such variables as wind speed, wind direction, and the sensitivities of receptors to different odors. By contacting either the District's Office of Stationary Source Rules and Compliance or the jurisdiction's code enforcement department, a planner can learn if any complaints about odors have been filed by property owners/occupants in the general vicinity of the proposed project site and thereby determine if a sensitive receptor could be affected by odors. Additionally, if the proposed project is in close proximity to a use identified in Figure 5-5 or is one of these uses, then potential odor impacts should be addressed.

For sensitive receptors, mitigation measures are limited. In fact, in some instances the only mitigation available to sensitive receptors is to relocate upwind or further downwind from the source. The facility that is, or will be, producing the odor can also relocate equipment so that fumes can be emitted at locations to take the best advantage of wind patterns. Projects that may cause odors can also change stack heights and add additional control technology. In some cases, a project proponent for development of a sensitive receptor may be able to mitigate potential impacts by paying for mitigation at the source.

When odors are an issue, the air quality analysis should include a quantitative assessment of potential odors and meteorological conditions. A method of quantitatively assessing odors has been devised by the American Society of Testing Materials (ASTM, Standard Method D 1391), which considers how many times an air sample must be diluted with "clean" air before the odor is no longer detectable to an average adult with average odor sensitivity. The number of dilutions needed to reach this threshold level is referred to as a "dilution to threshold" (D/T) factor. An odor with a D/T of 2 (2 parts of fresh air to one part of odorous air) becomes faintly detectable to almost all receptors. At 5 D/T, people become consciously aware of the presence of an odor, and at 5 to 10 D/T, the odor is strong enough to evoke registered complaints. The standard to utilize in assessing off-site odor exposure is preferably below 5 D/T and acceptable below 10 D/T.

In addition, ASTM, standard method E679-79 can be used to analyze odors. This method relies on the sensory responses of a selected group of individuals called panelists. The threshold used in this method ranges from only detection that a very small amount of added substance is present but not necessarily recognized to recognition of the nature of the added substance. Other recognized test methods to determine odor impact may be used in addition to ASTMD 1391 and E 679-79.

Determining which properties will be subject to odors requires meteorological data, including a wind rose. A wind rose illustrates the different speeds and directions taken by the wind at different times during the day. With the information from the wind rose, measurements using the ASTM methods are to be taken from surrounding properties to assess the impact. Refer to Chapter 8 for information on developing meteorological information.

5.5 Site Plan Design and Building Design Mitigation Measures

All projects should integrate mitigation measures that facilitate trip reduction, reduce energy use, and reduce PM10 by modifying the following project factors:

- Site plan design
- Building design
- Land use/densities
- Landscape design

This Handbook provides a listing of mitigation measures that planners should make project proponents aware of before projects are designed. Ideally, these mitigation measures are discussed during an initial consultation between planners and the project proponents, as outlined in Chapter 4. Table 5-5 identifies the site plan/building design mitigation measures by type of land use. The District recommends that these mitigation measures be employed by all projects to the extent feasible and consistent with local land use policies.

The mitigation measures relating to site plan design and building design can be divided into four categories:

Suppor: Facilities. Support facilities encourage modes of transportation other than the automobile, such as walking and bicycling. Support facilities include pedestrian pathways, showers and lockers for employees in office buildings, and bicycle racks.

Trip Reduction Through Land Use. Land uses, such as mixed uses, can reduce the number and/or length of vehicle trips by ensuring that supportive land uses are within walking distance of one another. An example would be locating neighborhood retail services, such as food markets and a post office, within walking distance of a residential subdivision. In addition, increased densities in transit corridors (particularly within a quarter of a mile of a transit station, see Table 5-6 for distances) can support transit and carpooling levels.

Reduction in Vehicle Idling Through Design. Idling and slow-moving vehicles produce more emissions, particularly carbon monoxide (CO), than those that are moving more quickly. Enclosed parking facilities can also have high levels of carbon monoxide. Consideration should be given to vehicle speeds and idling when designing parking lots, egress/ingress areas, and drive-through facilities, such as fast-food restaurants.

Reduction in Energy Use. The amount of energy required to maintain a building depends upon such design factors as building orientation, window treatments, and type of indoor lighting. Through careful site planning, wise choice of building materials, and shade-producing landscaping, energy requirements are greatly reduced; this in turn places less demand on power-generating facilities.

Reduction in PM10. PM10 emissions can be reduced by requiring adequately maintained landscaping, inclusion of snow fences or trees as wind breaks in areas prone to dust storms, and ensuring all vehicle parking and maneuvering areas are paved.

In addition, the Local Government Commission (based in Sacramento) recently prepared a handbook, *Land Use Strategies for More Liveable Places*, that identifies site plan and building designs that are effective in mitigating air quality impacts.

References

Land Use Strategies for More Liveable Places, June 1992.
The Local Government Commission, 909-12th Street, Suite 205, Sacramento, CA 95814.

Figure 5-1. Land Uses Considered To Be Sensitive Receptors

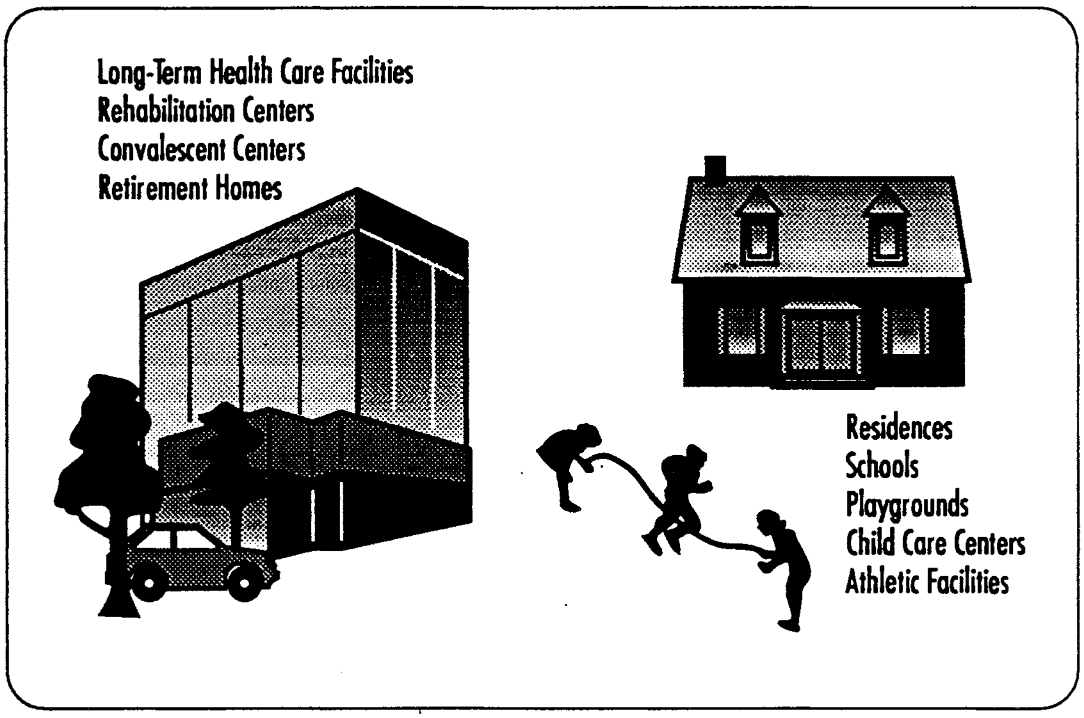


Figure 5-2. Steps to Evaluate Toxic Impact on Sensitive Receptors*

1. Project proponents for projects considered sensitive receptors (Figure 5-1) are to submit a radius map.
2. Planners compare those uses on the map within a quarter-mile radius of proposed project with uses in Table 5-1.
3. Identify any situations where the sensitive receptor will be within a quarter mile of an existing source of toxic emissions
4. Confirm with the District's Air Toxics Unit (see Table 4-2) that the identified and use emits toxics.
5. Require that the CEQA analysis include a health risk assessment if it is determined the sensitive receptor could be within 1/4 mile of an existing source of toxic emissions (see Chapter 10).
6. Send the health risk assessment to the District as part of the CEQA analysis.
7. Local government is to determine if the risk identified in the analysis is acceptable.

*Optional, but recommended approach

Figure 5-3. Radius Map

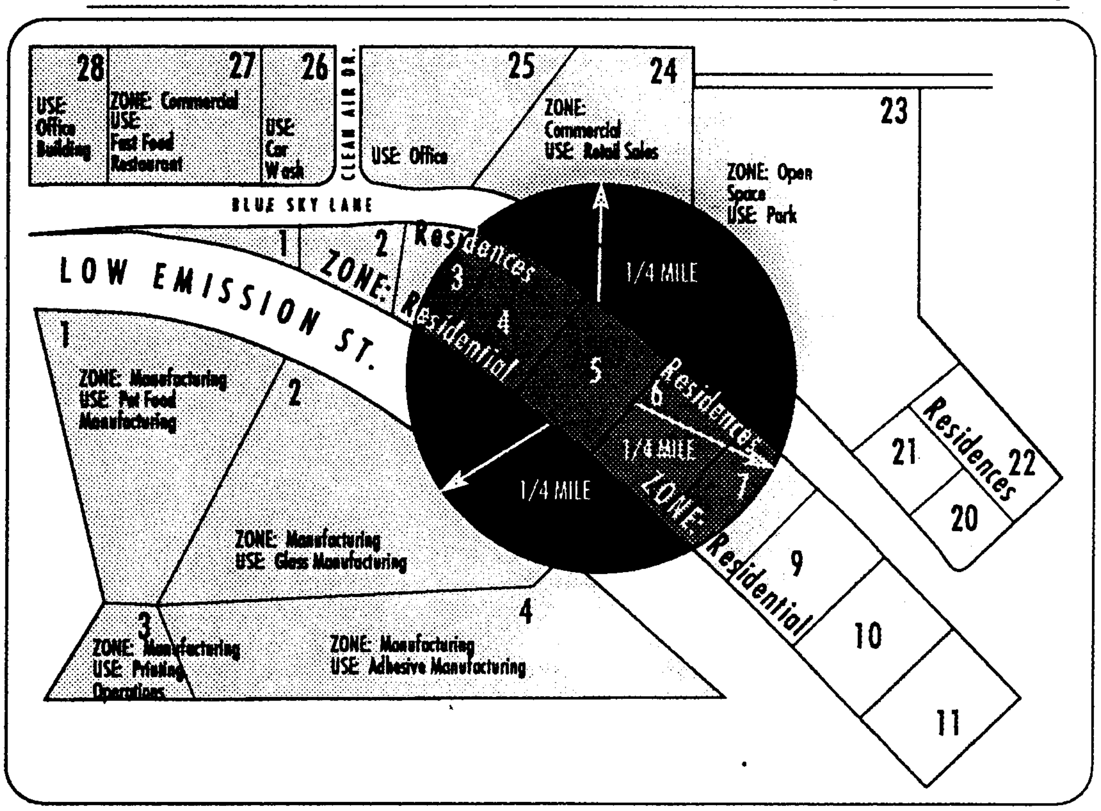
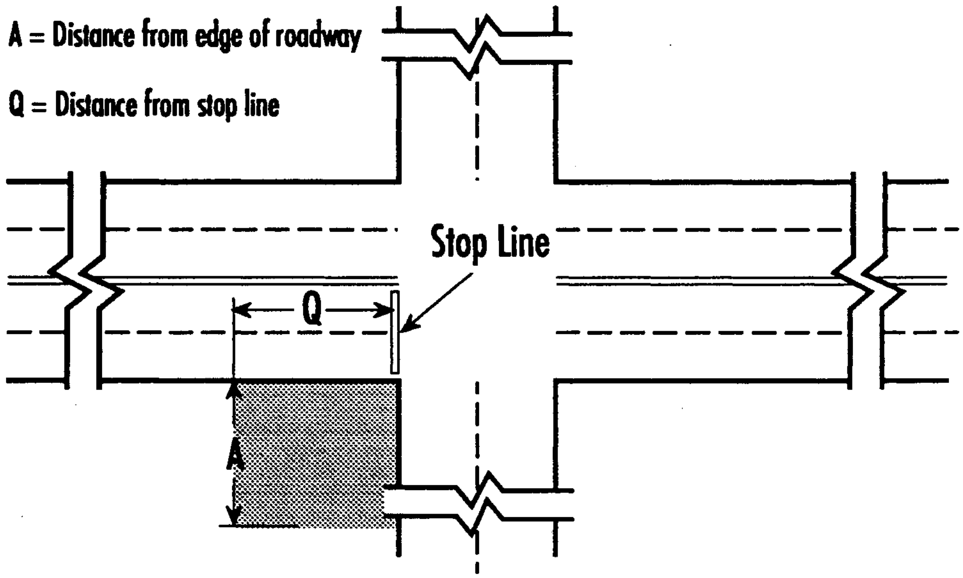


Figure 5-4. Example of Screening Analysis for Sensitive Receptors



Note: Q and A distances are quantified in Table 5-4.

Figure 5-5. Land Uses Associated with Odor Complaints

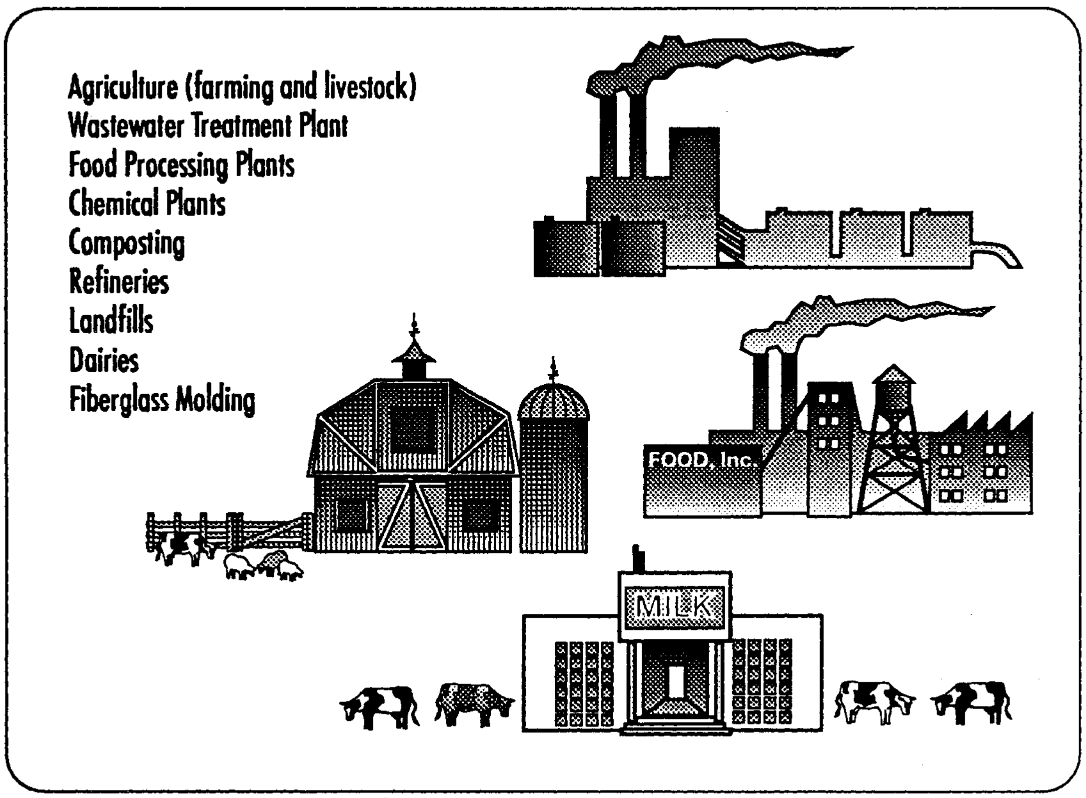


Table 5-1. Examples of Toxic Emissions, By Land Use

Land Use	Source Type	Air Toxic Emissions
INDUSTRIAL		
Acoustic Ceiling, Asbestos Product, Caulk, and Gasket Manufacturing	Blending Tank with Baghouse	Asbestos
Aerospace Manufacturing	Chrome Plating Shop, Spray Booth, Aircraft Parts	Hexavalent Chromium
Asphalt Batch Plant, Asphalt and Paving Contractors, Asphalt and Asphalt Products Mfg.	Mixing Tank, Asphalt Manufacturing with Baghouse	Asbestos
Brake Manufacturing Facility	Arc Grinders	Asbestos
Brake Shoe Rebuilders and Recyclers	Brake Debonder with Afterburner	Asbestos
Chemical Manufacturing	Reaction Tank Wastewater Treatment Mixing Tank, High-Temperature Adhesive Mfg., Chlorinated Wax Manufacturing, Feedstock Refrigerants Mfg.	Ethylene Dichloride, Asbestos Carbon Tetrachloride
Chemical Plants Hazardous Waste Incinerator	Hazardous Waste Rotary Kiln Incinerator	Beryllium, Hexavalent Chromium, Benzene, Carbon Tetrachloride, Dioxins, Dibenzofurans, Ethylene Dicholoride, PAHs, PCBs
Chrome Plating Facility	Chrome Plating Shop, Evaporation System Chrome Acid Solution, Chrome Plating Shop and Tank	Hexavalent Chromium, Cadmium
Electrical Manufacturing	Transformer, Plating	PCBs, Cadmium, Chromium, Nickel, Trichloroethylene, 1,4-Dioxane
Electronic Manufacturing	Plating, Etching	Cadmium, Chromium, 1,4-Dioxane, Nickel, Trichloroethylene

Note: This table does not include all types of land uses with carcinogenic emissions; also, each land use may not emit all listed compounds.

(continued on next page)

Table 5-1. Examples of Toxic Emissions, By Land Use (continued)

Land Use	Source Type	Air Toxic Emissions
Commercial Medical Equipment Sterilization Facility	Ethylene Oxide Sterilization Chamber	Ethylene Oxide
Fiberglass Manufacturing	Machine Operation with Baghouse	Styrene
Glass Container Manufacturing		
Graphite Manufacturing	Polycarbon Graphitization	Dioxins, Dibenzofurans
Industrial with Heating or Steam Needs	Fuel Oil Steam Generator Boiler Unit	Cadmium, Hexavalent Chromium
Petroleum Refinery Modification/Expansion	Petroleum Product Storage Tank Fuel Oil Steam Generator	Benzene Benzene, Cadmium
Storage Tank Farm	Storage Tank	Benzene
COMMERCIAL		
Auto Machine Shop	Arc Grinders	Asbestos
Brake Realignment Shop	Arc Grinders	Asbestos
Gas Station	Typical Gas Station	Benzene
Medical Clinic and Laboratory	Ethylene Oxide Medical Sterilizer	Ethylene Oxide
Dry Cleaners		Perchloroethylene
Auto Body Shop		
INSTITUTIONAL/PUBLIC		
College/University	Fuel Oil Boiler Unit Ethylene Oxide Medical Sterilizer	Cadmium, Hexavalent Chromium, Ethylene Oxide
Groundwater Clean-Up Wastewater Treatment	Aeration Tower	Benzene, Percholoroethylene, Trichloroethylene
Hospital	Refuse Incinerator, Medical Sterilizer Sterilization Chamber, Boiler Unit	Dioxins, Debenzofurans, Cadmium, Ethylene Oxide
Landfill	Landfill Gas Flare	Benzene, Vinyl Chloride
Biomedical Laboratory	Fugitive Emissions and Fume Hood Exhaust	Benzene, Carbon Tetrachloride, Chloroform, Formaldehyde, Methylene Chloride

Note: This table does not include all types of land uses with carcinogenic emissions; also, each land use may not emit all listed compounds.

(continued on next page)

Table 5-1. Examples of Toxic Emissions, By Land Use (continued)

Land Use	Source Type	Air Toxic Emissions
Municipal Solid Waste Incinerator	Mass Burn Incinerator	Dioxins, Dibenzofurans, Cadmium, Hexavalent Chromium, PAHs, PCBs, Mercury
Wastewater Treatment Facility (POTW)	Digester Gas-Fired Reciprocating Engines	Hexavalent Chromium, Others
Wastewater Treatment Plant	Wastewater Treatment	Benzene, Carbon Tetrachloride, Ethylene Dichloride, Ethylene Dibromide, Chloroform

Note: This table does not include all types of land uses with carcinogenic emissions; also, each land use may not emit all listed compounds.

Table 5-2. Projected Future Year 1-Hour CO Concentrations (ppm)

LOCATION	YEAR							
	1993	1994	1995	1996	1997	1998	1999	2000
1 – Los Angeles	11.0	10.2	9.5	8.7	8.0	7.2	6.4	5.7
2 – West L.A.	11.9	11.1	10.3	9.5	8.7	7.9	7.1	6.3
3 – Hawthorne	17.9	16.6	15.3	14.0	12.8	11.5	10.2	8.9
4 – Long Beach	10.9	10.2	9.4	8.6	7.9	7.1	6.3	5.5
5 – Pico Rivera	10.2	9.4	8.7	8.0	7.3	6.6	5.9	5.2
6 – Reseda	14.8	13.8	12.7	11.7	10.6	9.6	8.5	7.5
7 – Burbank	15.6	14.5	13.4	12.3	11.1	10.0	8.9	7.8
8 – Pasadena	12.6	11.7	10.9	10.0	9.2	8.3	7.5	6.6
9 – Azusa	6.4	6.0	5.6	5.3	4.9	4.5	4.1	3.7
10 – Pomona	10.9	10.4	9.9	9.4	8.8	8.3	7.8	7.3
11 – Whittier	10.3	9.6	8.9	8.2	7.6	6.9	6.2	5.5
12 – Lynwood	24.7	23.1	21.5	20.0	18.4	16.8	15.2	13.6
13 – Santa Clarita	10.1	9.7	9.2	8.8	8.3	7.8	7.4	6.9
14 – Lancaster	10.6	10.0	9.5	8.9	8.3	7.7	7.1	6.5
16 – La Habra	20.0	19.0	18.1	17.1	16.1	15.1	14.1	13.1
17 – Anaheim	16.8	15.8	14.7	13.7	12.7	11.6	10.6	9.5
18 – Costa Mesa	12.9	12.1	11.3	10.5	9.7	8.9	8.1	7.3
19 – El Toro	8.5	8.4	8.3	8.2	8.0	7.9	7.8	7.7
23 – Rubidoux	10.2	9.8	9.3	8.9	8.4	8.0	7.6	7.1
– Riverside Mag.	12.8	12.2	11.7	11.1	10.6	10.0	9.5	8.9
33 – Upland	7.8	7.5	7.3	7.0	6.7	6.4	6.1	5.8
34 – Fontana	5.7	5.4	5.0	4.7	4.4	4.0	3.7	3.4
– San Bernardino	8.9	8.4	7.9	7.4	6.9	6.4	5.8	5.3

Table 5-3. Projected Future Year 8-Hour CO Concentrations (ppm)

LOCATION	YEAR							
	1993	1994	1995	1996	1997	1998	1999	2000
1 – Los Angeles	7.8	7.2	6.7	6.2	5.6	5.1	4.6	4.0
2 – West L.A.	6.3	5.9	5.5	5.1	4.6	4.2	3.8	3.4
3 – Hawthorne	12.8	11.8	10.9	10.0	9.1	8.2	7.3	6.4
4 – Long Beach	7.9	7.3	6.8	6.2	5.7	5.1	4.6	4.0
5 – Pico Rivera	8.4	7.8	7.2	6.6	6.0	5.4	4.9	4.3
6 – Reseda	11.6	10.8	10.0	9.1	8.3	7.5	6.7	5.9
7 – Burbank	10.8	10.1	9.3	8.5	7.7	7.0	6.2	5.4
8 – Pasadena	7.9	7.3	6.8	6.3	5.7	5.2	4.7	4.1
9 – Azusa	4.7	4.5	4.2	3.9	3.6	3.3	3.0	2.7
10 – Pomona	6.3	6.0	5.7	5.4	5.1	4.8	4.5	4.2
11 – Whittier	7.1	6.6	6.2	5.7	5.2	4.8	4.3	3.8
12 – Lynwood	17.4	16.3	15.1	14.0	12.9	11.8	10.7	9.6
13 – Santa Clarita	4.6	4.4	4.1	3.9	3.7	3.5	3.3	3.1
14 – Lancaster	6.8	6.4	6.0	5.7	5.3	4.9	4.5	4.2
16 – La Habra	8.9	8.5	8.0	7.6	7.2	6.7	6.3	5.8
17 – Anaheim	9.7	9.1	8.5	7.9	7.3	6.7	6.1	5.5
18 – Costa Mesa	10.2	9.6	9.0	8.3	7.7	7.1	6.5	5.8
19 – El Toro	5.3	5.2	5.1	5.1	5.0	4.9	4.8	4.8
23 – Rubidoux	8.8	8.4	8.0	7.6	7.3	6.9	6.5	6.1
– Riverside Mag.	7.2	6.9	6.6	6.3	6.0	5.7	5.4	5.0
33 – Upland	5.7	5.5	5.3	5.1	4.9	4.7	4.5	4.2
34 – Fontana	4.7	4.4	4.2	3.9	3.6	3.3	3.1	2.8
– San Bernardino	6.6	6.2	5.8	5.4	5.1	4.7	4.3	3.9

Table 5-4. Screening Table to Estimate CO Concentrations from Roadways

ROAD TYPE	1-HOUR CONCENTRATION (ppm)						
	LEVEL OF SERVICE	CAPACITY[3]/ SPEED	LANES	Q	(15m*) A= 49 ft.	(30m*) 98 ft.	(60m*) 197 ft.
Freeway	C	20,400/50	12	0.0	4.0	3.1	2.2
	D	21,600/40	12	0.0	4.3	3.3	2.4
	E	24,000/35	12	0.0	4.8	3.7	2.7
	F0	27,120/30	12	0.0	5.7	4.4	3.2
	F1	31,440/25	12	0.0	7.2	5.6	4.0
	F2	33,840/21	12	0.0	8.5	6.6	4.8
	F3	36,000/18	12	0.0	9.1	7.0	5.1
	C	13,200/50	8	0.0	3.2	2.4	1.8
	D	14,400/40	8	0.0	3.5	2.7	1.9
	E	16,000/35	8	0.0	3.7	2.8	2.0
	F0	18,080/30	8	0.0	4.3	3.3	2.4
	F1	20,960/25	8	0.0	5.4	4.1	2.9
	F2	22,560/21	8	0.0	6.4	4.9	3.5
	F3	24,000/18	8	0.0	6.8	5.2	3.7
Arterial	C	6,375/20		879.25	10.8	7.1	4.4
	D	6,750/15		931.75	12.5	8.3	5.3
	E	7,125/10		980.96	17.5	11.7	7.6
	F0	8,051/10		1108.91	23.2	15.4	10.0
Local	C	255/25		36.09	1.2	0.9	0.7
	D	270/15		36.09	0.8	0.7	0.5
	E	285/10		39.37	0.9	0.7	0.5
	F0	322/10		45.93	1.2	0.9	0.7

Notes:
1. To obtain 8-hr estimate multiply by source receptor persistence factor.
2. These factors do not include background levels.
3. Capacity refers to traffic volume per hour.

* A = Distance from edge of roadway. Q = Distance from stop line.

Table 5-5. Site Plan/Building Design Mitigation Measures

Land Use	Mitigation Measures
Residential	Mixed uses (supportive neighborhood uses) in subdivisions Solar water heaters Centralized water heating systems Energy efficient appliance when built-in units are provided Site design to reduce proximate CO emissions
Residential/Commercial	Increased land use densities in transit corridors (see Table 5-6) Pedestrian facilities and access Building and subdivision orientation to the north for natural cooling Shade trees to reduce building's heat Energy-efficient and automated controls for air conditioners Window treatments (double-paned glass) Increased insulation beyond Title 24 (attic and walls) Snowfences and/or plant trees as wind barriers
Commercial	Bicycle facilities; showers and lockers Bus shelters On-site bus turnaround On-site circulation in parking lots to reduce vehicle queuing* Pedestrian kiosks for pay parking rather than paying from vehicle* Energy-efficient parking lot lights Improve traffic flow at drive-throughs* Light-colored roof materials to reflect heat Park'n ride lots in vacant parking lots Video-conference facility Ventilation system for enclosed parking facilities*
Commercial/Industrial	Reserved and preferentially located carpool/vanpool parking spaces Use of building materials that do not require use of paints/solvents Supportive land uses in office/industrial parks Lighting controls and energy-efficient lighting in buildings Reduction in the number of employee parking spaces consistent with Regulation XV: 23% of employee spaces in San Bernardino 23% of employee spaces in Riverside County 33% of employee spaces in LA/Orange County 43% of employee spaces in Downtown LA

* CO mitigation measures

Table 5-6. Land Use Densities for Supporting Transit Service in Corridors

Type of Transit Service	Residential Densities	Commercial Densities
Minimum level of local bus service (20 daily trips in each direction or 1 bus per hour)	4–5 du/acre (or 3,000–4,000 people/sq. mile)	5–8 million sq. ft. of floor area
Intermediate level of local bus service (40 daily trips in each direction or 30-minute headways)	7 du/acre (or 5,000–6,000 people/sq. mile)	8–20 million sq. ft. of floor area
Frequent level of bus service (120 daily trips in each direction or 10-minute headways)	15 du/acre (or 8,000–12,000 people/sq. mile)	20–50 million sq. ft. of floor area
Light rail transit (medium-capacity of 2,000–20,000 travelers/hour)	9–12 du/acre	35–50 million sq. ft. of floor area
Commuter rail transit (between suburban and Central Business District (CBD) areas)	1–2 du/acre	100 million sq. ft. of floor area

Source: ITE, A Toolbox for Alleviating Traffic Congestion

SCAQMD AIR QUALITY SIGNIFICANCE THRESHOLDS

Mass Daily Thresholds		
Pollutant	**Construction**	**Operation**
NOx	100 lbs/day	55 lbs/day
VOC	75 lbs/day	55 lbs/day
PM10	150 lbs/day	150 lbs/day
SOx	150 lbs/day	150 lbs/day
CO	550 lbs/day	550 lbs/day
Lead	3 lbs/day	3 lbs/day
Toxic Air Contaminants (TACs) and Odor Thresholds		
TACs (including carcinogens and non-carcinogens)	Maximum Incremental Cancer Risk ≥ 10 in 1 million Hazard Index ≥ 1.0 (project increment) Hazard Index ≥ 3.0 (facility-wide)	
Odor	Project creates an odor nuisance pursuant to SCAQMD Rule 402	
Ambient Air Quality for Criteria Pollutants [a]		
NO2 1-hour average annual average	SCAQMD is in attainment; project is significant if it causes or contributes to an exceedance of the following attainment standards: 0.25 ppm (state) 0.053 ppm (federal)	
PM10 24-hour average annual geometric average annual arithmetic mean	10.4 $\mu g/m^3$ (recommended for construction) [b] 2.5 $\mu g/m^3$ (operation) 1.0 $\mu g/m^3$ 20 $\mu g/m^3$	
Sulfate 24-hour average	1 ug/m^3	
CO 1-hour average 8-hour average	SCAQMD is in attainment; project is significant if it causes or contributes to an exceedance of the following attainment standards: 20 ppm (state) 9.0 ppm (state/federal)	

[a] Ambient air quality thresholds for criteria pollutants based on SCAQMD Rule 1303, Table A-2 unless otherwise stated.

[b] Ambient air quality threshold based on SCAQMD Rule 403.

KEY: lbs/day = pounds per day ppm = parts per million ug/m^3 = microgram per cubic meter ≥ greater than or equal to

DETERMINING THE AIR QUALITY SIGNIFICANCE OF A PROJECT

CHAPTER 6

Section 15002(g) of the state CEQA Guidelines defines a significant effect on the environment as "a substantial adverse change in the physical condition which exists in the area affected by the proposed project." Further, the project is considered to be of statewide, regional, or area-wide significance if it, for example, interferes with attaining the federal or state air quality standards (CEQA Guidelines Section 15206(b)(2)). To determine the significance of a project, CEQA requires the preparation of an Initial Study by the project proponent or lead agency. The Initial Study will evaluate the impact of the proposed project upon the environment, including air quality. From an air quality perspective, the impact of the project is determined by examining the types and levels of emissions generated by the project and its impact on factors that affect air quality. As such, projects should be evaluated in terms of air pollution thresholds established by the District. The thresholds of significance differ for the SCAB and the Coachella Valley. The scope of the evaluation and the extent of the required CEQA review will depend upon the estimated extent of the impact as determined by the lead agency in the Initial Study.

6.1 Preparing the Initial Study

To assist local planners and project proponents in answering the questions in the Initial Study, and thereby determining the air quality significance of a project, the key air quality issues to consider in each Initial Study category are summarized in Table 6-1.

Beyond the obvious primary impact of specific emissions arising from the operation and construction of a project, there is the potential for secondary effects. Secondary effects include such things as: impacts on the earth, water, population, transportation/circulation, energy/utilities, human health, and public services, that affect air quality indirectly. Among these secondary effects are, for example, high CO emissions from degradation in roadway level of service and NOx from power plants producing energy. All of those emissions contribute to air pollution, and need to be included in the project's emissions calculations. CEQA requires that in evaluating the significance of the environmental effect of a project, the lead agency shall consider both primary or direct and secondary or indirect consequences (CEQA Guidelines Section 15064 (d)). The impact of a project needs to be evaluated in terms of emisssion thresholds and other indicators of potential air quality impacts.

6.2 SCAB Air Pollution Thresholds for Operations

As seen above, new and modified projects will affect regional air quality both directly and indirectly. To determine the extent of a proposed project's environmental impact and the significance of such impact the project should be compared to established levels of significance. The District has established two types of air pollution thresholds to assist lead agencies in determining whether or not the operation phase of a project is significant. These can be found in the following sections under: 1) emission thresholds; and 2) additional indicators. If the lead agency finds that the operational phase of a project has the potential to exceed either of the air pollution thresholds, the project should be considered significant.

- **Emission Significance Thresholds (Primary Effects)**

The District has established these thresholds, in part, based on Section 182 (e) of the federal Clean Air Act which identifies ten tons a year of volatile organic gases as the significance level for stationary sources of emissions in extreme non-attainment areas for ozone. The South Coast Air Basin is the only extreme non-attainment area in the United States. This emission threshold has been converted to a pounds per day threshold for the operational phase of a project. The District staff also evaluated the thresholds established by other air quality management agencies in California and has taken into account the effect the thresholds would have on local governments' work load.

While Section 15064 (b) of CEQA Guidelines states that an ironclad definition of a significant effect is not possible because the significance of an activity may vary with the setting, the District believes that the setting as referred to in CEQA can be defined in this case. Under California state law (Health and Safety Code Section 40402), the South Coast Air Basin is defined as a distinct geographic area with a critical air pollution problem for which ambient air quality standards have been promulgated to protect public health. As such, the District believes that significance thresholds can be established based on scientific and factual data that is contained in the federal and state Clean Air Acts. Therefore, the District recommends that these thresholds be used by lead agencies in making a determination of significance. However, the final determination of whether or not a project is significant is within the purview of the lead agency pursuant to Section 15064 (b) of the CEQA Guidelines.

Both direct and indirect emissions should be included when determining whether the project exceeds these thresholds. The following significance thresholds for air quality have been established by the District for project operations:

55 pounds per day of ROC

55 pounds per day of NOx

550 pounds per day of CO

150 pounds per day of PM10

150 pounds per day of SOx

Ca. state 1-hour or 8-hour CO standard

Projects in the South Coast Air Basin (SCAB) with daily operation-related emissions that exceed any of the above emission thresholds should be considered to be significant.

Planners and project proponents may determine if a project is likely to be significant by screening the project using Table 6-2. The land uses listed therein are based on the mobile source emissions from projects that have the potential to exceed the emission thresholds. Table 6-2 does not cover all proposed projects or situations. If site-specific information is available, the MAAQI model or emission calculation procedures discussed in Chapter 9 of this Handbook can be used to estimate emissions totals to determine significance. Any emission reductions resulting from existing rules and ordinances should be calculated as the project's non-mitigated emissions and discussed in the project description.

In addition, level of service can be used as a screening method for determining when vehicle trips will impact a roadway, thus violating the state 1-hour or 8-hour standard, and creating a CO hotspot. Refer to Section 9.4.

- **Additional Indicators of Potential Air Quality Impacts (Secondary Effects)**

Additional indicators should be used as screening criteria indicating the need for further analysis with respect to air quality. Whenever possible, the project should be evaluated in a quantitative analysis; otherwise a qualitative analysis is appropriate. The additional indicators are as follows:

- Project could interfere with the attainment of the federal or state ambient air quality standards by either violating or contributing to an existing or projected air quality violation (refer to Chapter 12 and Appendix G, Significant Effects, State CEQA Guidelines);

- Project could result in population increases within the regional statistical area which would be in excess of that projected in the AQMP and in other than planned locations for the project's build-out year (refer to Chapter 12);

- Project could generate vehicle trips that cause a CO hot spot (refer to Section 9.4);

- o Project will have the potential to create or be subjected to an objectionable odor over 10 dilution to thresholds (D/T) (refer to Chapter 5) that could impact sensitive receptors;
- o Project will have hazardous materials on site (Table 10-4 and 10-5) and could result in an accidental release of air toxic emissions or acutely hazardous materials posing a threat to public health and safety (refer to Chapter 10);
- o Project could emit an air toxic contaminant regulated by District rules or that is on a federal or state air toxic list (refer to Appendix 10);
- o Projects could involve burning of hazardous, medical, or municipal waste as waste-to-energy facilities (refer to Chapters 10 and 13);
- o Projects could be occupied by sensitive receptors within a quarter mile of an existing facility that emits air toxics identified in District Rule 1401 (New Source Review of carcinogenic air contaminants) or near CO hot spots (refer to Chapters 5 and 10);
- o Project could emit carcinogenic or toxic air contaminants that individually or cumulatively exceed the maximum individual cancer risk of 10 in 1 million.

If the project has significant air quality impacts, an EIR should be prepared. If the impact of the project can be reduced below significant by the application of mitigation measures, then a Mitigated Negative Declaration (MND) can be prepared. The MND or EIR should quantify the level of emissions using the standards in this Handbook, and identify mitigation measures to lessen the project's impact to the greatest extent possible. The District recommends that all projects apply feasible mitigation measures to reduce individually and cumulatively significant air quality impacts to less than significant. Refer to Chapter 11 for an identification of mitigation measures, and the potential for emission reductions.

6.3 SEDAB (Under District Jurisdiction) Air Pollution Thresholds for Operations

The Coachella Valley and Antelope Valley, which are under the jurisdiction of the District, are in the SEDAB which has a distinctly different air pollution problem than the SCAB. The SEDAB is not classified as an extreme non-attainment area for ozone and therefore, the District has not changed the significance thresholds for the Coachella Valley and Antelope Valley from the 1987 version of this Handbook. In determining whether or not a project exceeds these thresholds, the project emissions should be calculated in the same manner as that for the SCAB (e.g. utilizing the highest daily emissions). These thresholds are as follows:

75 pounds per day of ROC

100 pounds per day of NOx

550 pounds per day of CO

150 pounds per day of PM10

150 pounds per day of SOx

Ca. state 1-hour and 8-hour CO standard

Projects in the Coachella Valley and Antelope Valley portion of the SEDAB with peak operation-related emissions that exceed any of the above emission thresholds should be considered significant.

As with the significance thresholds defined for the SCAB, planners and project proponents may determine if a project is significant by screening the project using Table 6-2 or the alternatives mentioned in Section 6.2. Level of service can also be used for determining a likely violation of the state 1-hour or 8-hour CO standard for the Coachella Valley and Antelope Valley.

The additional indicators of potential air quality impacts identified in Section 6.2 should also be used in determining if a project is significant in the Coachella Valley and Antelope Valley.

6.4 Construction Emission Thresholds for SCAB and Coachella Valley

Both the SCAB and SEDAB (that portion under the jurisdiction of the District) exceed the federal and state PM10 standards. The problem in these areas results from fugitive dust distributed during construction, from transport of disturbed dust on roadways by vehicles and wind. However, since a project's impact is limited to the construction phase, and level of mitigation, the procedure for determining significance is different than that for a project's operational impacts. When estimating a project's construction-related emissions, the emissions can be averaged over a 3-month period to include only actual working days.

The following significance thresholds for air quality have been established by the District on a quarterly basis:

2.5 tons per quarter of ROC

2.5 tons per quarter of NO_X

24.75 tons per quarter of CO

6.75 tons per quarter of PM10

6.75 tons per quarter of SO_X

However, if emissions on an individual day exceed 75 lbs a day for ROC, or 100 lbs a day for NOx, or 550 lbs a day for CO, or 150 lbs a day for PM10 and SO_X, the project should be considered significant.

Projects in the SCAB or SEDAB with construction-related emissions in a quarterly period that exceed any of the emission thresholds should be considered to be significant.

Table 6-3 provides a screening table for determining when a project's construction emissions could exceed the threshold of significance.

6.5 Selecting the Appropriate Document

Upon completion of the Initial Study, the lead agency in consultation with responsible agencies determines the most appropriate type of environmental documentation, (i.e., a Negative Declaration (ND), a Mitigated Negative Declaration (MND), or an Environmental Impact Report (EIR)). Specific criteria for determining the appropriate environmental document with respect to air quality are described below. Table 6-4 provides a quick reference for planners to determine the appropriate environmental documents for particular types of land use projects.

- **Negative Declarations**

A Negative Declaration (ND) is prepared if the Initial Study identifies no significant environmental impacts from the project. Before the release of the ND for the project, the lead agency must determine that there is no substantial evidence that the project without mitigation may have a significant adverse effect on the environment. Article 6 of the State CEQA Guidelines contains the requirements for the ND process and the contents of an ND.

The District recommends that a ND be prepared for any project if it meets all of the below criteria:

(a) The construction or operation of the project will not exceed the emission thresholds of significance as established by the District.

(b) The project will not cause a CO hot spot.

(c) The project will not be occupied primarily by sensitive individuals within a quarter mile of any facility that emits air toxic contaminants which could result in a health risk for pollutants identified in District Rule 1401 or exposure to a CO hot spot.

(d) The project could not result in the accidental release of air toxic emissions or acutely hazardous materials, posing a threat to the public (Table 10-4 and 10-5).

(e) The project will not emit an air contaminant regulated by the District, or found on a federal or state air toxic list, and which causes a significant health risk (see section 6.2).

(f) The project does not involve the burning of municipal, hospital, or hazardous waste.

(g) The project will not violate any ambient air quality standard, contribute substantially to an existing or projected violation or expose sensitive receptors to substantial pollution concentrations (Refer to Appendix G, Significant Effects, State CEQA Guidelines).

(h) The project will not have a significant effect on the environment from a cumulative standpoint (Chapter 9).

- **Mitigated Negative Declarations**

Although the State CEQA Guidelines do not explicitly identify a document called a Mitigated Negative Declaration (MND), this term has come into use to refer to a specific type of environmental document. If an Initial Study is prepared for a project and significant adverse environmental impacts are identified, an MND may be prepared for that project if all potential impacts can be eliminated or mitigated to a level of insignificance. An MND is only appropriate for those projects that have been revised or modified by the application of mitigation measures that reduce the impact below the level of significance. Those mitigation measures then become part of the project description so that the project no longer has a significant impact and, therefore, may be addressed through a ND. The MND is subject to the same requirements as is an ND (see Article 6 of the state CEQA Guidelines).

In order to determine if all impacts are mitigated, all emissions associated with the project as well as the mitigation measures should be quantified through use of either the screening table (Table 6-2), the emission calculation procedures described in Chapter 9, or the MAAQI model. In order to determine the net air quality impact after mitigation is applied, mitigation measures efficiency may be derived by using the data in Tables 11-2, 11-3, 11-4, 11-6, and 11-7; the calculation procedures described in Chapter 11; or the MAAQI model. The District recommends that all projects employ all feasible mitigation measures to reduce individually and cumulatively significant air quality impacts caused by the project to less than significant. Refer to Chapter 11 for an identification of mitigation measures, and the potential for emission reductions.

Agencies certifying MND must take affirmative steps to determine that approved mitigation measures are implemented subsequent to project approval. Specifically, a mitigation monitoring and reporting plan must be prepared pursuant to Public Resources Code 21081.6 for any mitigation measures incorporated into the project or imposed as a condition of approval.

The District recommends that an MND be prepared for any project if it meets all of the following criteria:

(a) The construction or operation of the project may result in the threshold emissions being exceeded; however, quantifiable mitigation measures have been prescribed that reduce the emissions to below the significance thresholds.

(b) The project may cause a CO hot spot; however, quantifiable mitigation measures have been prescribed to prevent it.

(c) The project will not violate any ambient standard, contribute substantially to an existing or projected violation after mitigation or expose sensitive receptors to substantial pollutant concentrations. (Refer to Appendix G, Significant Effects, State CEQA Guidelines).

(d) The project could result in the accidental release of air toxic emissions or acutely hazardous materials, posing a threat to the public (Tables 10-4 and 10-5); however mitigation measures (e.g. safety engineering practices) have been prescribed that reduce the risk of a release to insignificance.

(e) The project could emit an air toxic contaminant that is regulated by the District, or is found on a federal or state air toxic list, and which causes a significant health risk (see Section 6.2); however, mitigation measures are employed which reduce the impact to insignificant.

(f) The project does not involve the burning of municipal, hospital, or hazardous waste.

(g) The project may have a significant effect on the environment from a cumulative standpoint (Chapter 9); however, mitigation measures have been prescribed that make the project's cumulative impacts insignificant.

o **Environmental Impact Reports**

If the Initial Study identifies potential significant adverse impacts from the project that cannot be mitigated below the significance thresholds, then the lead agency should prepare an Environmental Impact Report for the project rather than a Mitigated Negative Declaration. A lead agency may also elect to prepare an EIR if there is serious public controversy over the environmental effects of the project. (Refer to CEQA Guidelines Section 15064(h)(1).)

As with a Mitigated Negative Declaration, all potential impacts should be quantified using the emission calculations procedures described in Chapter 9 for mitigation measures quantified pursuant to Chapter 11.

The District recommends that an Environmental Impact Report be prepared for any project that can be characterized by any of the criteria listed below:

(a) The construction or operation of the project may result in the emission thresholds being exceeded even with application of all possible mitigation measures.

(b) The project will be occupied primarily by sensitive individuals within a quarter mile of a facility that emits an air toxic contaminant(s) which could result in a health risk for pollutants identified in District Rule 1401 or exposure to a CO hot spot.

(c) The project would create a a CO hot spot.

(d) The project could result in the accidental release of air toxic emissions or an acutely hazardous material (Tables 10-4 and 10-5) posing a threat to the public health and safety.

(e) The project will emit an air toxic contaminant that is regulated by the District, or found on a federal or state air toxic list, and which causes a significant health risk (see Section 6.2).

(f) The project involves the burning of municipal, or hospital, or hazardous waste.

(g) The project will violate any ambient air quality standard, contribute substantially to an existing or projected violation or expose sensitive receptors to substantial pollutant concentrations. (Refer to Appendix G, Significant Effects, State CEQA Guidelines.)

(h) The project may have a significant effect on the environment from a cumulative standpoint (Chapter 9).

CEQA requires that immediately after deciding an EIR is required for the project, the lead agency shall send to each responsible agency a Notice of Preparation (NOP). (Refer to CEQA Guidelines Section 15082.) The District will respond to NOPs and provide lead agencies with guidance in preparing the EIR.

6.6 Use of Another EIR for Air Quality Analysis

Prior to adopting the 1991 AQMP, the District prepared a comprehensive program EIR to evaluate any adverse environmental impacts that could be generated by implementing the control measures and strategies contained in the 1991 AQMP. A program EIR was prepared because the AQMP is composed of strategies related to the "issuance of rules, regulations, plans, or general criteria to govern the conduct of a continuing program." (Refer to CEQA Guidelines Section 15168(a)(3).)

The 1991 AQMP is a blueprint outlining the strategies identified for achieving clean air. Therefore, environmental impacts were analyzed in broad, general terms. The level of detailed analysis in the 1991 AQMP EIR is commensurate with the degree of specificity of the strategies contained therein. This degree of specificity is consistent with requirements in the CEQA Guidelines which recognize that the level of detail of an environmental analysis is directly related to the level of detail of the project.

The AQMP provides valuable information for the preparation of the air quality sections of EIRs, as well as information that can be extracted or referenced. The AQMP EIR provides an in-depth analysis of potential control measures. Using the AQMP EIR as a program EIR and tiering other environmental documents after the AQMP EIR is appropriate for programs or projects which implement AQMP control measures; this includes District rules, local government Air Quality Elements, and ordinances that implement control measures.

Although CEQA allows an EIR from a previous project to be used for a later project (refer to CEQA Guidelines Section 15153), this can only occur if "such projects are essentially the same in terms of environmental impact." Consequently, the 1991 AQMP EIR should not be used as the EIR for a specific land use project because the level of detail of the analysis between the AQMP and a land use project is substantially different. Furthermore, the 1991 AQMP EIR did not analyze impacts from specific land use projects, therefore, it is unlikely that impacts resulting from the 1991 AQMP are essentially the same as impacts generated by land use projects. The AQMP EIR is only appropriate for land use projects as a reference on regional air quality issues and source for pollutant baseline emission levels.

The program EIR or MND should identify impacts that are different than those identified at the regional level in the AQMP EIR, as well as any local impacts. The program EIR or MND should also include any appropriate mitigation measures identified in the AQMP EIR, and any additional mitigation measures necessary to mitigate local impacts that were not identified in the AQMP. (Refer to Table 6-4 for a list of mitigation measures identified in the AQMP EIR for local government implementation.) These EIRs or MNDs should also be sent to the District for review and comments.

References

1991 AQMP EIR. Available from the District's Environmental Analysis Unit, (909) 396-3109.

California ARB, Transportation Performance Standards of the CCAA, May 1991. Available from ARB Transportation Strategies Group.

Table 6-1. Preparing the Initial Study

Category	Key Air Quality Issues to Consider
Earth	Fugitive dust emissions from movement of soil Emissions from heavy duty diesel and gasoline-powered construction equipment Changes in topography that could affect wind patterns and cause emissions from the project to impact surrounding residential areas Alterations or expansions of landfills affecting public health as the result of moving toxic materials and contaminated soil Demolition of buildings containing asbestos Movement of contaminated soils
Air Quality	Emissions from construction (equipment and fugitive dust) or operation (vehicle trips and energy consumption) of the project will exceed the thresholds (refer to Table 6-2 for land uses that could exceed the thresholds) Projects that could create or be subjected to objectionable odors
Water	Projects that involve the disposal of toxic or hazardous compounds into wastewater or groundwater that produces air emissions when the compounds are removed
Risk of Upset	Projects that are located on or near an active earthquake fault (Alquist-Priola zone) and which could release acutely hazardous emissions due to an act of God or human error Projects using hazardous materials
Population	Projects resulting in population increases in excess of those projected in the Regional Growth Management Plan or projects locating population in areas other than those projected in the GMP, causing the region to fail to meet the federal and state air quality standards
Transportation/ Circulation	Emissions from vehicle trips (passenger vehicles and trucks) that are attached to or generated by the project (including transportation projects) Projects generating significant trips that could create a CO hot spot Emissions from ships, aircraft and locomotive engines
Energy/ Utilities	Projects demanding significant energy use, that produce emissions through the development of additional sources of energy Emissions from the development of power-generating facilities and waste-to-energy plans

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Table 6-1. Preparing the Initial Study (continued)

Category	Key Air Quality Issues to Consider
Human Health	Projects occupied primarily by sensitive receptors within 1/4 mile of an existing source emitting toxic emissions Projects occupied by sensitive receptors located near an existing landfill or waste-to-energy project or waste disposal facility that could emit toxic/hazardous emissions
Public Services	Projects generating significant waste (solid, wastewater, hazardous) that increases demand for disposal facilities whose disposal methods (landfill/incineration) impact air quality Projects generating a significant amount of hazardous waste that could produce emissions through accidental release
(Not all issues apply to all projects)	

Table 6-2. Screening Table for Operation – Daily Thresholds of Potential Significance for Air Quality

PRIMARY LAND USE		POTENTIALLY SIGNIFICANT AIR QUALITY IMPACT
RESIDENTIAL	Single Family Housing	166 units
	Apartments	261 units
	Condominiums	297 units
	Mobile Homes	340 units
	Retirement Community	612 units
EDUCATION	Elementary School	220,000 sq. ft.
	High School	177,000 sq. ft.
	Community College	150,000 sq. ft.
	* University	813 students
COMMERCIAL	* Airport	15 Daily Commercial Flights
	Business Park	136,000 sq. ft.
	Day Care	26,000 sq. ft.
	* Discount Store	32,000 sq. ft.
	Fast Food w/o Drive-Thru	3,500 sq. ft.
	Fast Food with Drive-Thru	2,800 sq. ft.
	* Hardware Store	28,000 sq. ft.
	Hotel	213 rooms
	Medical Office	61,000 sq. ft.
	Motel	220 rooms
	* Movie Theatre	30,000 sq. ft.
	* Car Sales	43,000 sq. ft.
	Office (small, 10–100)	96,221 sq. ft.
	Office (medium, 100–200)	139,222 sq. ft.
	Office (large, 200–>)	201,000 sq. ft.
	Office Park	171,000 sq. ft.
	Racquet Club	98,000 sq. ft.
	Research Center	245,000 sq. ft.
	Resort Hotel	199 rooms
	Restaurant	23,000 sq. ft.
	* Restaurant (high-turnover)	9,000 sq. ft.
	Shopping Center (small, 10–500)	22,000 sq. ft.
	Shopping Center (medium, 500–1,000)	50,000 sq. ft.
	Shopping Center (large, 1,000-1,600)	64,000 sq. ft.

(continued on next page)

Refer to Appendix 6 for methodologies and assumptions used in preparing this table.

NOTES:

* Trip generation rates from the 5th Edition ITE Manual were based upon small sample sizes.

These size construction projects have the potential to exceed the daily emissions significance thresholds. Local governments should use these thresholds as screening tools when a project proponent first approaches the lead agency for a permit, to determine whether or not the proposed project will be significant. Moreover, using these thresholds, a project proponent should be advised to include feasible mitigation measures at the project design level rather than in the later stages of the project.

DEFINITIONS:

"Manufacturing" means to make goods and articles by hand or by machinery, often on a large scale and with division of labor.

"Industry" means any large-scale business activity or manufacturing productive enterprises collectively, especially as distinguished from agriculture.

Table 6-2. Screening Table for Operation – Daily Thresholds of Potential Significance for Air Quality (continued)

PRIMARY LAND USE		POTENTIALLY SIGNIFICANT AIR QUALITY IMPACT
COMMERCIAL (continued)	*Special Activity Centers (Stadiums and Amusement Parks)	87 Employees
	Supermarket	12,500 sq. ft.
INDUSTRIAL/ MINING	Light Industrial	276,000 sq. ft.
	* Heavy Industrial	1,284,000 sq. ft.
	Industrial Park	276,000 sq. ft.
	Aircraft Manufacturing & Repairs	**
	Bulk Terminals	**
	Cement Plant	**
	Chemical Plant	**
	Hazardous Waste Treatment & Storage	**
	Manufacturing	500,000 sq. ft.
	Mining	**
	Pulp/Paper Mills	**
	Refinery	**
INSTITUTIONAL/ GOVERNMENTAL	* Clinic	94,000 sq. ft.
	* Government Center	83,000 sq. ft.
	* Hospital	176 Beds
	Library	51,000 sq. ft.
	Nursing Home	741 Beds
	U.S. Post Office	26,000 sq. ft.
	Freeway Lane Addition	All
	Designation of a New Transportation Corridor	All
	New Freeway/Highway	All
	Auxiliary Lanes	Beyond One Ramp
	Waterport	**
	Sewage Treatment Plant	**
	Rail	All
	Cogeneration Project	**
	Landfill	**
	Incineration	Hazardous, Medical or Municipal Waste
	Power Generating Facility	**
	Waste-To-Energy Plant	**

Refer to Appendix 6 for methodologies and assumptions used in preparing this table.

NOTES:

* Trip generation rates from the 5th Edition ITE Manual were based upon small sample sizes.

** New facilities, expansions or other change that could result in emissions exceeding the significance thresholds.

These size construction projects have the potential to exceed the daily emissions significance thresholds. Local governments should use these thresholds as screening tools when a project proponent first approaches the lead agency for a permit, to determine whether or not the proposed project will be significant. Moreover, using these thresholds, a project proponent should be advised to include feasible mitigation measures at the project design level rather than in the later stages of the project.

DEFINITIONS:

"Manufacturing" means to make goods and articles by hand or by machinery, often on a large scale and with division of labor.

"Industry" means any large-scale business activity or manufacturing productive enterprises collectively, especially as distinguished from agriculture.

Table 6-3. Screening Table for Construction - Quarterly Thresholds of Potential Significance for Air Quality

PRIMARY LAND USE		POTENTIALLY SIGNIFICANT AIR QUALITY IMPACT
RESIDENTIAL	Single Family Housing Apartments Condominiums Mobile Homes	1,309,000 sq. ft. GFA* 1,410,000 sq. ft. GFA 1,455,000 sq. ft. GFA 1,455,000 sq. ft. GFA
EDUCATION	Schools	660,000 sq. ft. GFA
COMMERCIAL	Business Park Day Care Center Discount Store Fast Food Government Office Complex Hardware Store Hotel Medical Office Motel Movie Theatre Office Resort Hotel Restaurant Shopping Center Supermarket	559,000 sq. ft. GFA 975,000 sq. ft. GFA 975,000 sq. ft. GFA 975,000 sq. ft. GFA 559,000 sq. ft. GFA 975,000 sq. ft. GFA 745,000 sq. ft. GFA 559,000 sq. ft. GFA 745,000 sq. ft. GFA 975,000 sq. ft. GFA 559,000 sq. ft. GFA 745,000 sq. ft. GFA 975,000 sq. ft. GFA 975,000 sq. ft. GFA 975,000 sq. ft. GFA
INDUSTRIAL		1,102,520 sq. ft. GFA
UNPAVED ROADS	Passenger Vehicle Loaded Truck	1,750 Vehicle Miles Traveled (1) 430 Vehicle Miles Traveled (1)
PAVED ROADS	Local Road Construction Road	24,000 Vehicle Miles Traveled (1) 5,000 Vehicle Miles Traveled (1)
DEMOLITION		23,214,000 Cubic Feet of Building
GRADING		177.00 Acres

*GFA = GROSS FLOOR AREA
Refer to Appendix 6 for methodologies and assumptions used in preparing this table.

NOTES:

(1) VMT is a function of linear road length and average daily trips.

These size construction projects have the potential to exceed the quarterly emissions thresholds of significance. Local governments should use these thresholds as screening tools when a project proponent first approaches the lead agency for a permit, to determine whether or not the proposed project will be significant. Moreover, using these thresholds, a project proponent should be advised to include feasible mitigation measures at the project design level rather than in the later stages of the project.

For daily thresholds, divide thresholds by 65, not 91.

Table 6-4. 1991 AQMP EIR Mitigation Measures Identified for Local Government Implementation

Environmental Topic	Impact	Mitigation Measure
Earth	Building/expanding transportation corridors, rail systems transmission lines, could affect topography or soils.	Use discretionary permit authority, place conditions on projects to control erosion, set landscape standards, etc.
Air Quality	Positive air quality impacts.	Implement indirect source control measures; recycling programs; promote energy efficiency for home appliances.
Water (Demand)	Increased demand for water as a fugitive dust suppressant during construction.	Use reclaimed water, non-toxic soil binders, pave dirt roads, etc.
Plant and Animal Life	Reduction in plant habitats and animal populations as a result of changes in land use designation or population relocations. (Primarily the result of factors other than AQMP.)	Establish project setting procedures to preserve sensitive habitat, protect animal populations, and preserve agricultural land.
Noise	Increased noise from construction of transit lines, freeways, etc.	Regulate hours of construction.
Light and Glare	Glare from solar panels for water heaters; increased density of industrial parks.	Establish building stands to screen panels and to minimize glare to adjoining residents.
Land Use	Shift in land uses; population relocation. (Primarily the result of factors other than the AQMP.)	Zoning changes; mixed land uses.
Natural Resources	Increased demand for natural resources, e.g. minerals, timber, etc., that will accompany infrastructure development and changes in land uses.	Establish recycling programs; promote conservation measures.
Population	Growth management and mode shifts resulting in population relocation.	Careful designation of transit routes; incorporate Regional Housing Needs Assessment into General Plan housing elements; use zoning and land use plans.

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Table 6-4. 1991 AQMP EIR Mitigation Measures Identified for Local Government Implementation (continued)

Environmental Topic	Impact	Mitigation Measure
Housing	Growth management policies may affect cost and distribution of housing.	Obtain VMT reduction through ISR measures; provide affordable housing through fee waivers or subsidies.
Transportation/ Circulation	Positive effect. Transportation congestion reduction.	VMT reductions through ISR measures; implement transportation management strategies; increase or expand urban transit systems.
Public Service Impacts	May require new and/or expanded services.	Work with the District to obtain technical and implementation support; secure new sources.
Energy	Shift away from petroleum-based liquid fuels to clean energy such as electricity or natural gas.	Improved standards for thermal integrity of building; high energy efficiency standards for major appliances and equipment; conservation programs; promote recycling.
Utilities-Solid Waste	AQMP has limited affect on solid waste disposal.	Promote recycling and waste minimization; establish conservation programs.
Aesthetics	Windbreaks to minimize fugitive dust could obstruct scenic vista; electrification of transit systems may produce visual impacts from overhead wires.	Establish architectural standards for wind-breaks, e.g. height standards, use vegetation as windbreak; use underground electrical cables where possible.
Recreation	AQMP has limited affect, if any, on recreation resources.	Prepare/update local open space plans; establish development fees for new recreation facilities or maintain existing ones.
Cultural Resources	AQMP has limited affect, if any, on cultural resources.	Establish historical overlay zone status or equivalent for culturally significant sites.

COMPONENTS OF THE AIR QUALITY ANALYSIS FOR EIRs AND MNDs

CHAPTER 7

Any project that contributes emissions during construction or operation affects air quality. Therefore, the extent to which a project impacts air quality should be examined. If, during the preparation of an Initial Study, the impact of the project upon air quality is determined to be significant (see Chapter 6) and the emissions cannot be mitigated below the level of significance, then an EIR with an air quality analysis section should be prepared. The depth of the analysis will be in proportion to the level and significance of the emissions.

This chapter and Figure 1-3 (Chapter 1) are road maps to assist the planner in the preparation of the air quality analysis for an EIR or other CEQA documentation. Table 7-1 summarizes the steps for evaluating air quality impacts. At the end of this chapter is a comprehensive checklist (Table 7-2) that provides the basis for preparing the required components of the air quality analysis.

7.1 Baseline Air Quality Information

CEQA requires an EIR to include "a description of the environment in the vicinity of the project, as it exists before the commencement of the project, from both a local and regional perspective." (Refer to CEQA, Section 15125.) The background, or baseline air quality information, should include a discussion of the following points:

- o Project setting and description
- o Climate and meteorological conditions
- o Existing regional and local air quality
- o Existing sensitive receptors
- o Existing toxics emission sources
- o Extent of air basin affected, and applicable Plan (AQMP or PM10 Plan)
- o Transportation system as it relates to air quality

The air quality analysis of each EIR and MND should provide a description of the existing regional and local environment. Such information is referred to as baseline information (see Appendix 3). Baseline information can consist of a summary of air quality and references to readily available documents which contain detailed information for regional analysis.

Baseline information for the local air quality analysis should include information obtained from the nearest or most appropriate District air quality monitoring station and any site-specific characteristics caused by such factors as congested roadways or existing facilities that emit toxics. Generally, the most appropriate air quality monitoring station is the one located within the same source receptor area as the proposed project (refer to Source Receptor Map, Figure 8-3). Section 8.1 contains specific information regarding selecting appropriate air quality monitoring data.

The baseline air quality data should be tailored to support the evaluation of the air quality impacts. For example, if odors are an issue, the baseline information should include a wind rose, which is necessary for evaluating air quality impacts on surrounding properties. All pertinent data should be included, or at least summarized, if the detailed baseline data necessary to corroborate the analysis are provided only through readily available reference documents.

Data should be concise. Detailed data unnecessary for assessing the impact should be omitted, so that the discussion of impacts can be readily identified by decision makers and the public. Chapter 8 provides more specific information on developing baseline air quality information.

7.2 Emission Sources: Construction and Operational

Emissions that can adversely affect air quality will originate from various activities. A project generates emissions both during the period of its construction and through ongoing daily operations. Emissions from both of these sources should be quantified in the EIR. In addition, the EIR should analyze the impact of emissions during each identified phase of project development and build-out year. As part of the impact analysis, emissions need to be compared to the thresholds of significance. The existing level of background emissions and local air quality need also be taken into account.

In the case of an MND, the analysis need not be as extensive as that prepared for an EIR. If the Initial Study identified emissions from construction and/or operation as a potentially significant effect, then the MND should quantify those sources of emissions and perform an analysis similar to an EIR.

Construction Emissions. The EIR and MND should identify all emissions associated with construction activities, including site preparation, construction of new facilities, or modification of an existing facility or site. Demolition, clearing, grading, excavating, using heavy equipment or trucks on unpaved surfaces and loading/unloading of trucks creates large quantities of fugitive dust, and thus PM10. Heavy equipment required for demolition, grading, and construction generates and emits exhaust emissions. The vehicles of commuting construction workers and trucks hauling equipment or materials (mobile source emissions) are another source of emissions which should be quantified. The emissions from electric power generators, architectural coatings, traffic impacts, and stationary construction equipment must be quantified. In addition, any asbestos removal should also be quantified. Procedures for calculating these various types of emissions are provided in Chapters 9 and Appendix 9. It is appropriate for an MND to utilize the screening tables in Chapter 9 as opposed to the detailed analysis recommended for an EIR.

Operational Emissions. After construction is completed, the project becomes operational. Operational emissions are produced by the occupancy of a facility or residential development and by both mobile and stationary sources connected therewith. Stationary emissions result from natural gas combustion and the use of electricity and equipment for manufacturing processes. Mobile emissions result from motor vehicles, airplanes, trains, ships, and construction equipment. A project may be an "indirect source" of mobile emissions by the nature of its operation; for example, vehicles operating within a project, such as warehouse forklifts or tour trains. However, the most significant indirect source emissions result from vehicles attracted to the project, such as shoppers visiting a mall or employees commuting to the work site. Procedures for calculating all of these emission sources are provided in Chapter 9 and Appendix 9. It is appropriate for a MND to utilize the screening tables in Chapter 9 if applicable as opposed to the detailed analysis recommended for an EIR.

If the District is a responsible agency and the stationary source has the potential to have significant environmental impacts, the calculation procedures in Appendix 13 should be utilized.

7.3 Analysis of Toxic Emissions and Risk of Upset

If a project may emit toxic emissions that could have an impact on sensitive receptors or risk of an on- or off-site upset or spillage, then a quantitative analysis should be performed using the guidelines provided in Chapter 10 and Appendix 10. In these cases, the District may be a responsible agency if a District permit is required. In order for the environmental document to be used for the permitting process, it must be found satisfactory by the District.

The District recommends that if a project is a sensitive receptor within a quarter mile of a source of toxic emissions, then a public health risk screening assessment should be performed as part of the environmental documentation. Refer to Chapters 5 and 10 for information on performing this type of analysis.

7.4 Cumulative Air Quality Impacts

While one insignificant project may not affect air quality, the cumulative effect of numerous smaller projects may. In order to reduce cumulative impacts, the District recommends that all projects should, to the greatest extent possible, employ feasible mitigation measures. CEQA requires that a proposed project be examined within the scope of the existing setting and that the examination take into account new and planned similar and nearby projects.

7.5 Project Alternatives

Analysis of Alternative Emissions. CEQA for EIRs requires that feasible alternatives are to be evaluated for environmental impacts. The analysis for the project alternatives does not need to be as extensive as those for the preferred alternative. Analyses may be developed for each alternative using either the MAAQI model or screening tables and default assumptions. The results should be presented in comparative tables. The comparative analysis more clearly defines the environmental implications and benefits of each proposal. In order to perform such an analysis, the air quality impacts of each alternative should be quantified, to the extent possible. (See section 9.6.)

Beneficial Air Quality Alternatives. The selection of feasible project alternatives should take air quality into account when it is identified as a key environmental issue by either the lead agency or the District. Varying degrees or densities of site development, and the corresponding emission differences, are often considered as project alternatives. Significant mitigation measures can at times be offered as project alternatives. An example is the inclusion of commercial or residential land uses within office complexes to reduce vehicular trips and emissions. Energy cogeneration is in some instances an alternative where introduction of an on-site emission source can result in an overall reduction of emissions (waste heat produced during electrical generation is used for heating and cooling near the power plant). Industrial projects should consider all feasible alternative processes and their resulting emissions. The analysis of beneficial air quality alternatives should be in addition to the "No Project" alternative. The procedures for calculating emissions are in Chapter 9 and Appendix 9.

7.6 Determining Significance with Emission Thresholds

The EIR and MND should compare total project emissions both before and after the application of mitigation measures to the existing regional and local air quality setting and the emission thresholds in Chapter 6. If the project is to be built out over a series of years, then the project emissions should be compared to the projected future baseline (without mitigation) for the years corresponding to project phasing and/or build-out year. In addition, Chapter 6 identifies other indicators of potential air quality impacts based on a project's secondary impacts. An analysis of the project should be performed for those indicators that relate to the project. These comparisons will provide the basis for a determination of significance. If it is determined that the project will have significant impacts on air quality, it is up to the lead agency to determine if the merits of the project outweigh the adverse environmental effects such that it chooses to approve the project. If such a project is approved by the lead agency, then the project should be mitigated to the greatest extent possible and a Statement of Overriding Considerations should be prepared.

7.7 Mitigation Measures

Mitigation is crucial to reducing a project's environmental impact. The question addressed in the analysis is not whether mitigation is necessary, but rather how much mitigation is required. Mitigation must be sufficient to reduce adverse impacts below the level of significance to the greatest extent possible.

A lead agency has the authority to require changes in any or all activities involved in the project to lessen or avoid significant impacts. A responsible agency, such as the District, can also require changes in that part of the project the responsible agency will be called on to carry out or approve. (Refer to CEQA Guidelines Section 15041.) Further, it is the policy of the State of California that agencies should not approve projects as proposed if there are feasible alternatives or feasible mitigation measures available which would substantially lessen the significant environmental effects of such projects (PRC Section 21002). This Handbook identifies feasible mitigation measures that should be employed to reduce a project's impact on air quality.

Quantifying Effectiveness. The EIR and MND should quantify the extent to which mitigation measures can be effective and can reduce a given impact. Chapter 11 provides a menu of mitigation measures and their effectiveness in reducing emissions. Chapter 11 also includes calculation procedures for those cases in which site-specific quantification is desirable. It is appropriate for an MND to utilize the mitigation efficiency tables in Chapter 11 if applicable as opposed to the more detailed analysis recommended for EIRs. Projects should employ enough measures to reduce the impact to a level of insignificance.

In some cases, not all air quality impacts can be mitigated below a level of significance. In such cases, the District recommends that all feasible mitigation measures be applied to the project to reduce the impact to the greatest extent possible.

7.8 Consistency with Regional Plans

It is essential that the EIR analyze a project's consistency with regional plans that deal with large-scale environmental problems such as air quality as required by CEQA Guidelines Section 15125. The EIR should consider consistency of the project with all applicable plans, including:

- Air Quality Management Plan or Coachella Valley PM10 Plan
- Regional Growth Management Plan (population projections)
- Regional Mobility Plan (transportation projects)
- Locally adopted Congestion Management Plan (impacts on established levels of service and CO hot spots)
- Air Quality Element of the local General Plan (if adopted) or Air Quality Policies integrated into several General Plan Elements
- Any other plans that are applicable to the project

Refer to Chapter 12 for additional information on determining consistency/conformity of a project with the appropriate regional plans.

7.9 The District as a Responsible Agency

During the preparation of the Initial Study and throughout the preparation and approval of the EIR, CEQA requires that the lead agency consult with responsible agencies regarding the scope and content of the analysis in the EIR. The responsible agency should in turn review and comment on the notice of preparation of the EIR and the draft EIR, MND, or Negative Declaration (ND). If the responsible agency believes that the final EIR, MND, or ND is adequate for subsequent permit actions, the responsible agency may use that environmental documentation for its purposes. If the responsible agency does not believe the final document is adequate, CEQA requires a responsible agency to take one of four actions (CEQA Guidelines Section 15096(e)):

- Waive its objections.
- Prepare a subsequent EIR if permissible under CEQA Guidelines Section 15162.

- o Assume the lead agency role if authorized pursuant to CEQA Guidelines Section 15052.
- o Take the issue to court to seek a remedy.

Under CEQA, the District is a responsible agency for those portions of a project subject to a District permit. Chapters 13 and 14, and Appendix 13 provide a summary of the steps for coordinating with the responsible agency. Those same sections contain information on the additional emissions analysis the EIR should contain.

The thresholds of significance for District permits are identified in Chapter 13. Where District rules reduce project impacts below the level of significance, the analysis should concentrate on secondary impacts and their mitigation. Secondary impacts are those which result from the application of control technology. (Refer to Section 6.1.)

7.10 Findings

CEQA requires the decision-maker to balance the benefits of a proposed project against its unavoidable environmental impacts in determining whether to approve the project. If the lead agency determines that the benefits of the project outweigh the potential unavoidable adverse environmental impacts, the project may be approved (CEQA Guidelines Section 15093(a)). In these types of cases where the environmental impacts of the project identified in the EIR are not mitigated to a level of insignificance, the agency must state in writing specific reasons that support its action (Statement of Overriding Considerations). In approving such a project, the lead agency must make written findings, supported by substantial evidence in the record. Additionally, the lead agency may not make findings, if the agency making the findings has concurrent jurisdiction with another agency to deal with identified feasible mitigation measures or alternatives (CEQA Guidelines Section 15091).

One example of a case where a local government might consider approving a project with overriding considerations is the siting of high-density housing in a transit corridor which is likely to adversely impact the adjacent roadway system's level of service. In this case, the local government should consider orientation of the project to the roadway and other applicable mitigation to minimize impacts of CO on a sensitive receptor. If the project is still considered significant after application of the mitigation, then the local government should consider the benefit the project would have in supporting transit services in determining whether the benefits outweigh the environmental impact.

7.11 Mitigation Monitoring

As of January 1, 1989, lead agencies are required to prepare a mitigation monitoring plan to ensure implementation of mitigation measures in an EIR or Mitigated Negative Declaration. The Plan is to contain a list of all mitigation measures and to identify the agency responsible to ensure that the mitigation is carried out. In this way, proper follow-up is made, and all conditions applying to the project are fulfilled. Typically, a mitigation monitoring plan is completed after the draft EIR has been circulated for review and before the project is approved.

Mitigation Monitoring and the Need for District Review. The District requests that the draft portions of the mitigation monitoring plan pertaining to air quality be submitted for review. A copy of the response to comments, and a list of conditions of approval or other documentation indicating the mitigation measures included in the final approved EIR should also be forwarded to the District. It is recommended that these documents be submitted to the District within 60 days of approval of the project by the lead agency. All mitigation measures should identify the party responsible for implementation and monitoring. Refer to Chapter 15 for a detailed discussion on monitoring of air quality mitigation measures.

7.12 Program EIRs and EIRs for General Plans

Section 15168 of the CEQA Guidelines states that a program EIR can be prepared on a series of actions that can be characterized as one large project and are related either:

- o geographically;
- o as individual parts of contemplated actions;
- o in connection with the issuance of rules, regulations, plans, or other general criteria; or,
- o as individual activities carried out under the same authorizing statutory or regulatory authority and having generally similar environmental effects which can be mitigated in similar ways.

At a programmatic level, the air quality assessment should be as comprehensive as possible. There are some cases, such as construction impacts of a General Plan, where specific information may not be available. A best-effort approach to disclose all reasonably available information should be used. If the program EIR was not sufficiently detailed so that all significant effects were evaluated, then such evaluation should be performed when subsequent activities involving site-specific operations are contemplated. Additional analysis is also necessary whenever the project could result in significant impacts not analyzed in or changed from the program EIR.

The environmental analysis for a General Plan EIR provides an opportunity for a more exhaustive consideration of effects and alternatives than would be practical for an EIR on a more specific action. Additionally, the program EIR for a General Plan can ensure consideration of cumulative impacts that might be slighted when development projects are considered on a case-by-case basis. A program EIR also allows the lead agency to consider broad policy alternatives and program-wide mitigation measures at an early time when the agency has greatest flexibility to deal with basic problems or cumulative impacts.

Inclusion of air-quality-related goals, policies, and programs may act as mitigation for the overall General Plan build-out scenario, provided that specific objectives and actions are included and implemented within the time frame specified in the General Plan.

7.13 EIR Format Issues

During the preparation of an EIR, many questions regarding the preparation of the air quality analysis arise. Among the most prevalent are:

- o What level of detail is necessary in the analysis?
- o How must assumptions be documented?
- o What format should be used for reporting emissions information?

The air quality analysis should contain sufficient detail to support the conclusions reached in the analysis. If background information pertaining to the analysis is readily available in separate documents, reference to those documents is adequate. The EIR should document all assumptions for quantifying emissions (or other impacts) and mitigation measures. To document assumptions and as a format for reporting emissions, the calculation tables in Appendix 9 may be used. At the option of the preparer those tables may be inserted into the air quality section or placed in a technical appendix to the EIR. All impacts and mitigation measures related to the project should also be summarized as part of the conclusion to the air quality sections.

A practical format for documenting the project's impact is a tabular listing of estimated project emissions, effectiveness of mitigation measures, and net total project impact for the proposed project and each alternative analyzed in the EIR. Concisely summarizing the conclusions of the air quality analysis will permit decision makers to base their decisions on the final results of all calculations and analysis.

Table 7-1. Steps for Evaluating Air Quality Impacts

STEPS	EIR	MND
1. **Baseline information:** Describe existing regional climate and air quality and cite specific ambient air quality from the District monitoring station located in project source receptor area.	■	■
2. Identify and quantify all project **emission sources** (construction and operational).	■	■
3. Identify and assess **toxic source emissions** and risk of upset if applicable.	■	■
4. Assess **cumulative air quality impacts** from potentially related projects.	■	■
5. Identify and quantify **project alternatives** that may attain the goals of the project with substantially fewer or less significant impacts.	■	
6. Compare anticipated project emissions with **thresholds of significance** and existing regional and site-specific air quality.	■	■
7. Identify **mitigation measures** necessary to substantially reduce air quality impacts.	■	■
8. Assess **consistency of project** with the AQMP.	■	
9. Integrate air quality analysis requirements for those projects where the **District is a responsible agency.**	■	■
10. Make **findings.**	■	■
11. Develop a **mitigation monitoring** plan.	■	■

An MND can use screening tables to quantify emissions and mitigation measures, and may not need the same level of detail as an EIR.

Table 7-2. Checklist for an Air Quality Analysis Section

Components	Key Questions	Ref.*	Part of EIR/ Yes	No
1. Baseline Air Quality Information (Chapter 8 and Appendix 8)				
Project Setting and Description	Has the local setting surrounding the project been identified, including any unique geographic elements? Has the total project area, square footage, and use of building been identified?	8.1		
Regional Climate and Meteorological Conditions	Has either a description or reference to regional climate and meteorological data been included? In cases where odors or toxics are an issue, have wind direction and speed been identified?	8.1 5.4 5.2 10.4		
Existing Climate and Local Air Quality	Have the most current data (i.e., background concentrations and numbers of days that exceed federal and state standards) from the nearest District monitoring station in the same source receptor areas as the project been identified?	8.1 A3		
Sensitive Receptors	Are there toxic emitters within 1/4 mile of a sensitive receptor?	5.2		
Air Basin & AQMP	Is the project located in the SCAB or Coachella Valley?	2.2 F2-1		
Transportation System	Have the segments and existing LOS of the transportation system on which the project will generate trips been identified? Will the project generate trips on CMP system? How does the project relate to existing and planned transit network? How does the project relate to regional HOV network?	9.1 4.6		
2. Project-Related Emissions (Chapter 9 and Appendix 9)				
A. Determine Construction-Related Emissions	Have all construction-related emissions been identified and quantified?	9.1		
Grading	Have the amount of soil and number of acres to be disturbed and number of days required for grading been identified? Will grading take place during the windy season for that area?	A9-9		
Demolition	Will any buildings containing asbestos be demolished?	A9-10		
Excavation	Has the amount of soil (cubic feet) to be excavated been identified?	A9-9		

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*The reference column of this table refers to the following portions of this Handbook:
Reference Column Key: A = Appendix F = Figure T = Table 8.1, etc. = Chapter location

Table 7-2. Checklist for an Air Quality Analysis Section (continued)

Components	Key Questions	Ref:*	Part of EIR/ Yes	No
Determine Construction-Related Emissions (continued)				
Heavy Duty Equipment	Have the number and type (weight and wheels) of heavy-duty equipment and trucks on unpaved roads that are expected to operate on site been identified and PM10 emissions quantified?	9.1 A9		
Off-Road Mobile Source Emissions (construction equipment)	Have the number and type (i.e., fuel) of construction equipment been identified and tailpipe emissions quantified?	9.1		
On-Road Mobile Source Emissions (including work trips by construction employees, non-work trips to lunch, etc., and truck trips)	Are all construction-related trips (i.e., hauling, deliveries of materials, trips, and non-work trips) quantified?	9.1		
Power Usage	Has total power usage (i.e., electrical generation, natural gas consumption) been estimated?	9.2		
B. Determine Operation-Related Emissions	Have all operation-related emissions been quantified?	9.2		
Stationary Area Sources (incl. water heaters, energy generators)	Have emissions from area sources (pool heaters, water heaters, boilers) been identified and quantified?	9.2		
Stationary Point Sources (incl. those subject to District permits)	Have emissions from point sources (smoke stacks, paint booths, etc.) been identified and quantified?	9.2		

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Table 7-2. Checklist for an Air Quality Analysis Section (continued)

Components	Key Questions	Ref.*	Part of EIR/ Yes	No
Determine Operation-Related Emissions (continued)				
On-Road Mobile Source Emissions (including work, non-work, truck trips, etc.)	Have the number and length for all trip types (i.e., work, non-work, truck) been identified for each land use?	9.2		
Off-Road Mobile Source Emissions (including ships, trains, etc.)	Will the project generate any emissions from sources such as ships, trains, airplanes, or auxiliary operations? If so, have the emissions been quantified?	9.2		
Fugitive Dust (including mining operations, unpaved roads, etc.)	Will the project generate any fugitive dust emissions from mining or unpaved roads? If so, have the emissions been quantified?	9.2		
3. Toxic Emissions and Risk of Upset (Chapter 10 and Appendix 10)				
Sensitive Receptors	Has analysis been prepared to determine the risk of siting a sensitive receptor within 1/4 mile of a toxic source?	5.2		
Effects on Future Land Use	Has an analysis been included describing the implications of siting a sensitive receptor on land near future businesses handling toxic sources or vice versa?	5.2		
Risk of Facilities Emitting Toxics to Population of Jurisdiction	If the project is a toxic source, has the general risk to the population been identified? If risk of upset is an issue, either due to the nature of the toxic or due to proximity to an earthquake fault (Alquist-Priola zones), has an analysis been included?	10.2 10.4 10.5		
4. Cumulative Air Quality Impacts (Chapter 9)				
Related Projects (under construction, or proposed future projects)	Have emissions from related projects (i.e., recently permitted, similar type, size, or next phase) either under construction or proposed, been identified?	9.5		

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Table 7-2. Checklist for an Air Quality Analysis Section (continued)

Components	Key Questions	Ref:*	Part of EIR/ Yes	No
Cumulative Air Quality Impacts (Chapter 9) (continued)				
Analysis Consistent with CEQA Section 15130	Has the following information been provided? • A list of all past, present and reasonably anticipated future projects; • A summary of expected environmental effects; • A reasonable analysis of relevant projects including mitigation.	9.5		
Optional Cumulative Impact Analysis	Does the documentation provide: • An analysis comparing the project with mitigation to determine if emissions will be reduced by 1% per year or 18% to the year 2010? • An analysis comparing the project with mitigation to determine if it will achieve a 1.5 AVR (or AVO for transportation projects)? • An analysis comparing the project with mitigation to determine if it will reduce the rate of growth in VMT and trips?	9.5		
5. Project Alternatives (Chapter 9)				
Quantify Air Quality Impacts of Alternatives	Have the air quality impacts of the alternatives been determined utilizing the Handbook's emission calculation procedures?	9.6		
Select Alternatives to Reduce Air Quality Impacts When Such Is a Key Issue	If air quality is a key environmental issue, have alternatives been selected that reduce air quality impacts?	9.6		
6. Analyzing Other Indicators of Potential Air Quality Impacts				
Compare Project to Secondary Effects	Has the project been compared to the secondary effects to determine whether the project will need further analysis?	6.2		

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Table 7-2. Checklist for an Air Quality Analysis Section (continued)

Components	Key Questions	Ref.*	Part of EIR/ Yes	No
7. Determining Significance (Chapter 6)				
Compare Total Project Emissions to Significance Thresholds	Have the total project emissions been compared to the significance thresholds to determine whether the project will have a significant impact on air quality?	6.2		
Compare Changes from the Project Baseline Air Quality Information	Does the project have the potential to cause a CO hot spot? Will the project impact sensitive receptors? Will the project result in a measurable change in number or severity of ambient air quality standards ?	9.4		
Analysis of Other Appropriate Impacts (i.e., odor, etc.)	Will the project generate odors? Will the project impact the level of service on the CMP system?	5.4 4.6		
8. Mitigation Measures (Chapter 11 and Appendix 11)				
Identify Mitigation Measures to Reduce Impact from Construction and Operation	Have all applicable mitigation measures been identified to reduce air quality impacts resulting from construction and operation of the project?	11.3 11.4		
Quantify Reductions from Application of Mitigation Measures	Have the emission reduction benefits from the application of the mitigation measures been quantified?	11.8		
Determine Level of Impact after Mitigation	Will the project still result in a significant impact after mitigation?	T11-5		

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Table 7-2. Checklist for an Air Quality Analysis Section (continued)

Components	Key Questions	Ref.*	Part of EIR/ Yes	No
9. Consistency with Regional Plans (Chapter 12)				
Determine the Project's Consistency with AQMP and/or PM10 Plan	Is the project consistent with AQMP and/or Coachella Valley PM10 Plan?	12.2		
Determine the Project's Consistency with GMP	If the project will result in increased jobs, housing, or population, are these increases consistent with the targets in the GMP?	12.2		
Determine the Project's Consistency with RMP	If the project is a transportation project, is it consistent (use location and lane miles) with the RMP?	12.2		
Determine the Project's Consistency with CMP	If the project will generate trips that affect the CMP system, has a Traffic Impact Assessment been completed and mitigation described?	12.2 4.6		
Determine the Project's Consistency with Air Quality Element of a General Plan	If the local government has an Air Quality Element, is the project consistent with its goals and objectives?	12.2		
10. Requirements with the District as a Responsible Agency (Chapter 13)				
Determine If the District Is a Responsible Agency	Is this project subject to District permitting requirements?	13		

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Table 7-2. Checklist for an Air Quality Analysis Section (continued)

Components	Key Questions	Ref.*	Part of EIR/ Yes	No
Requirements with the District as a Responsible Agency (Chapter 13) (continued)				
Determining Significance	Does an assessment indicate if the project exceeds significance standards for District permits?	13.1		
Assessing Cross-Media Impacts	If it is a significant project, is an assessment of the cross-media impacts included?	13.2 A13		
11. Mitigation Monitoring Plan (Chapter 15)				
Develop a Mitigation Monitoring Program	Has the mitigation monitoring program for air quality measures that responds to each of the components been identified?	15.1		
Initiate Monitoring and Reporting	Have the entities responsible for implementation of the mitigation measures and monitoring been notified?	15.2		

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DEVELOPING EIR BASELINE INFORMATION

CHAPTER 8

When an environmental document is required, the preparer should begin to develop the baseline, or background information necessary for the environmental setting and the air quality assessment. Baseline information for the environmental setting should identify and describe the following:

- o Project description
- o Project setting
- o Regional and local climate and meteorological conditions
- o Existing air quality at the site-specific location of the project, including anticipated toxic emissions
- o Sensitive receptors
- o Identification of the appropriate air basin and air quality management plan (AQMP or PM10 Plan)
- o Regional and local transportation system supporting the project

8.1 Background Air Quality Information

Prior to determining the air quality impacts of a proposed project, it is necessary to prepare a detailed description of the existing regional climate and site-specific air quality conditions. This will establish a basis for comparing the project's subsequent air quality impacts with the existing air quality setting.

Project Description. To the extent that the information is available, the description of the project should be specific as to total project area, square footage, and use of buildings and structures. The amount of development projected for each phase, approximate completion date for each phase, and build-out should also be defined. In addition, the project description should include a listing and expected emission reductions from District-required permits, as well as any existing local government ordinances that will result in quantifiable emission reductions.

Project Setting. The EIR should contain a description of the local setting surrounding the project, including identification of any unique geographic elements. The project setting description should identify any elements that may cause or generate air pollutant emissions (such as working construction equipment or the number of acres disturbed). The transportation system which will support the project and existing levels of service (LOS) should also be identified in the EIR. Figure 8-1 explains the LOS categories for freeways. In addition, any earthquake faults (i.e., Alquist/Priola zones) that could result in a threatened release of air toxics should be identified.

Regional Climate. Detailed descriptions of the regional climate are contained in Appendix 8. To streamline the environmental document, a summary of the information contained in Appendix 8 may be used to satisfy the regional climate description. The EIR may also incorporate Appendix 8 in full by reference. A wind rose, illustrated in Figure 8-2, should be provided if toxic emissions or odors are issues. The District maintains a historical archive of wind roses. This information is available upon written request to the District's Meteorological Section at the District's Diamond Bar Headquarters. Identify in the correspondence that this information is for an environmental analysis and it will be given priority.

Existing Air Quality. To characterize the site-specific air quality setting, the environmental document should contain a summary of the most current air quality data. The data must be derived from the nearest District monitoring station located in the same source receptor area(s) (SRA) as the project (see map in Figure 8-3). Some stations do not monitor all pollutants. In that instance, information on the remaining pollutants should be drawn from the nearest upwind station which monitors the pollutants. Air quality data are prepared for each District air monitoring station in table format (see

Appendix 3). These tables are updated annually, generally in March of each year. Monitoring station data should be used to provide background concentration levels of criteria pollutants and the number of days in which the criteria pollutants exceeded state and federal standards. For trend information, refer to Appendix II-B of the 1991 AQMP dated July 1991.

For projects located in more than one SRA, use the SRA most representative of the on-site conditions; or for transportation projects, analyze the project links in each SRA. In some unique cases, the air quality monitoring station within the SRA may not be representative of project site characteristics. Project proponents may contact the District for a recommendation which monitoring stations would be most characteristic of the project site.

As an alternative, a project proponent may perform on-site monitoring based on approved methodologies and monitoring procedures. Contact the District's Air Quality Monitoring Section for assistance in developing an adequate background concentration.

Information on existing air quality is also needed to perform air quality modeling analyses required for environmental documents or for District permit applications. If the project is expected to generate toxic air contaminants, the lead agency should contact the District to obtain information on the specific toxic air contaminant of concern for use in future land use decision-making.

Sensitive Receptors. Special attention should be given to the effect of CO, toxic, and odor emissions on sensitive receptors including:

- o Residences
- o Schools (children)
- o Playgrounds
- o Child care centers
- o Convalescent homes (senior citizens)
- o Retirement homes
- o Rehabilitation centers
- o Athletic facilities (athletes)

When evaluating air quality impacts on sensitive receptors, planners should use the background data described in this chapter to:

(1) Map the source of elevated CO, toxic, or odor emissions in relation to existing sensitive receptor areas.

(2) Identify wind patterns, direction, and speed using nearby wind rose information.

Air Quality Management Plan. The federal and state Clean Air Acts require that non-attainment basins that do not meet federal or state clean air standards must prepare a plan for bringing the area into compliance. The 1991 AQMP is the appropriate plan for that portion of the SEDAB under District jurisdiction. Refer to Figure 2-1 in Chapter 2 to determine in which air basin the project is located.

Transportation System. The regional and local transportation system that will serve the project should be identified. In particular, the EIR should identify existing and proposed transportation infrastructure (i.e., freeways, major arteries, rail and bus transit, etc.), that could in any way be used by vehicle traffic generated by or attracted to the project. SCAG's Regional Mobility Plan should be consulted to determine location and mode of future transportation systems. Any significant roadways that serve the project should be identified, along with their levels of service (LOS). The general information on determining LOS for freeways is provided in Figure 8-1. The county transportation commission, Caltrans, and local governments should also be consulted when determining LOS for freeways and other roadways. The Congestion Management Plan (CMP) identifies LOS for roads on the regional network. Local public works or traffic engineering offices should have information available on the LOS for local streets. See screening Tables 5-2 and 5-4 to determine if the state one-hour CO standard may be exceeded locally. In addition, some CMPs include methods for determining LOS. The CMP of each county should be consulted to determine which roadways are part of the CMP transportation system.

Figure 8-1. LOS Categories for Freeways

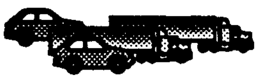
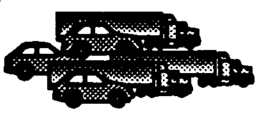
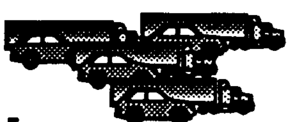
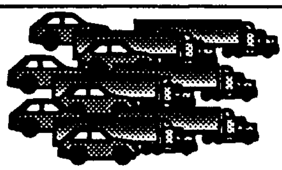
Level of Service	Flow Directions	Operating Speed	Delay	Service Rating
A 	Highest quality of service. Free traffic flow, low volumes and densities. Little or no restriction on maneuverability or speed.	55+	None	Good
B 	Stable traffic flow, speed becoming slightly restricted. Low restriction on maneuverability.	50	None	Good
C 	Stable traffic flow, but less freedom to select speed, change lanes, or pass. Density increasing.	45	Minimal	Adequate
D 	Approaching unstable flow. Speeds tolerable but subject to sudden and considerable variation. Less maneuverability and driver comfort.	40	Minimal	Adequate
 E	Unstable traffic flow with rapidly fluctuating speeds and flow rates. Short headways, low maneuverability and low driver comfort.	35	Significant	Poor
 F	Forced traffic flow. Speed and flow may drop to zero with high densities.	<25	Considerable	Poor

Figure 8-2. Wind Rose

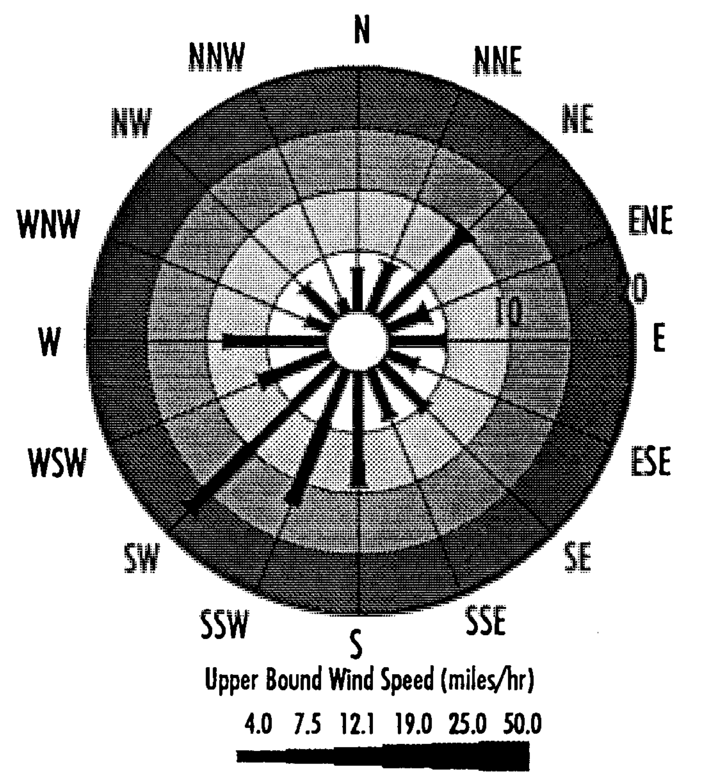
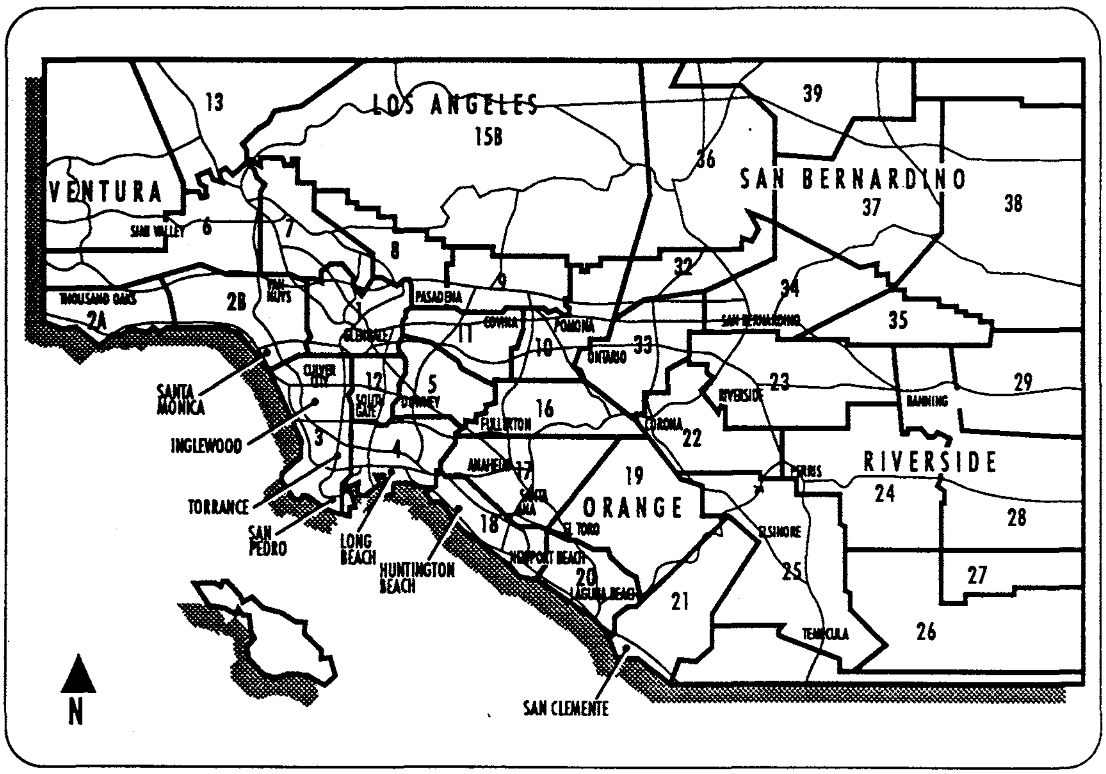


Figure 8-3. Source Receptor Areas



EMISSION CALCULATION PROCEDURES

CHAPTER 9

This chapter outlines District-recommended procedures for calculating emissions that may be generated during project construction and operation. Drafting an EIR or preparing a Negative Declaration necessarily involves some degree of forecasting. While foreseeing the unforeseeable is not possible, an agency must use its best efforts to find out and disclose all that it reasonably can (CEQA Guidelines Section 15144). The District recognizes that in all cases the information necessary for estimating emissions may not be available. However, in preparing the emission calculations, the lead agency should take a best-effort approach. If quantification is not possible, then a qualitative evaluation of project emissions may be acceptable to identify probable or likely emissions from construction and operational sources.

The air quality impact of the project is determined by estimating the total emissions from the construction and operation of the project. Emissions estimates are also necessary for assessing cumulative impacts and for evaluating the air quality impact of the project alternatives.

This chapter identifies the data needed to calculate the emissions estimates, describes the various methods of calculating estimates, and advises on the calculation method appropriate for each type of environmental document. If other methodologies and/or data are used, the source should be documented so that all parties can reasonably evaluate and determine the adequacy of the procedures and data used in assessing air quality impacts.

9.1 Construction Emissions

Emissions are a cause for concern beginning with the very first phase of project development. The first phase may include site preparation, construction of new facilities, modification of an existing facility or site, as well as demolition, renovation, and asbestos removal. These construction activities are responsible for the emissions of ROC and NOx produced by vehicular traffic, asbestos emissions associated with demolition work, and PM10 in the form of fugitive dust raised by earth-moving equipment.

Emissions from construction, renovation, and demolition may be estimated by one of two methods: (1) screening tables, or (2) using the methodology and emission factors shown in Appendix 9. The screening table is appropriate for estimating emissions for a Negative Declaration (ND) and Mitigated Negative Declaration (MND), but should not be used for preparing an EIR. The emissions estimates in screening Tables 9-1 (total construction emissions) and 9-2 (PM10) are based on regional averages. To further break down construction emission sources, Tables 9-3 and 9-4 call out emission factors for construction workers' travel and materials handling, which are a subset of total construction emissions. This information will be useful when quantifying the effectiveness of mitigation measures, as discussed in Chapter 11. To estimate emissions with these tables:

(1) Estimate daily emissions for each source category (i.e., on-road, off-road, and PM10) separately. (Mitigation efficiencies are subtracted from the applicable source categories.)

(2) For each source category, determine the total area for each activity (in units specified in the screening tables).

(3) Multiply those totals by the emissions estimates provided in the screening tables.

(4) Add the emissions from each category to determine total construction impacts.

Other sources of emissions should be identified as appropriate for the project using the information in Appendix 9 and added to the final total of unmitigated project emissions. An example of how to account for emissions by pollutant and source category is provided in Table 9-5.

Figure 9-1 illustrates the process used to identify a project's unmitigated emissions using the screening tables. As is shown in the shaded portion of the figure, once a project's unmitigated emissions have been calculated, quantified mitigation measures can be applied to reduce the potential air quality impact. This process is described in Chapter 11. Step-by-step instructions for using the screening tables to determine unmitigated emissions are described in Table 9-6. These instructions correspond with the unshaded portion of Figure 9-1.

Emissions estimates for an EIR should be made following the methods and emission factors provided in Appendix 9 of this Handbook. All sources of emissions should be identified (refer to Figure 9-2) and reasonably foreseeable significant environmental consequences considered for all emissions forecasting. Emissions estimates should be developed for each phase of development where construction, renovation, and/or demolition will occur. The emissions estimates can be averaged over a 3-month period (for actual working days) when determining tons per quarter. Those estimates should then be reported for each applicable pollutant in pounds per quarter for each year of construction. Where construction is scheduled to occur over several years, emissions estimates should be provided for the base year (initial year of construction), each development phase, and build-out. Any emission reductions resulting from existing rules or ordinances should be calculated as part of the project's non-mitigated emissions and included as part of the project description.

Sources of construction-related emissions, data needs, and emissions factors are discussed below. The emission calculation methodology, emission factors, and assumptions are provided in Appendix 9. The Appendix also provides worksheets for estimating emissions and emissions summary sheets.

In order to estimate emissions, specific information about construction activity is needed. When specific information is not available such as in long range planning documents, reasonable estimates based on past experience may be used. All of the basic assumptions for some of the other factors have also been formulated for this purpose and are provided in Appendix 9. All of the basic assumptions used to estimate construction emissions should be documented in the EIR. Prior to the issuance of a building permit or grading permit, the assumptions used in the EIR should be compared to the construction plan. If the comparison shows that emissions will be greater, additional environmental analysis may be necessary.

Emissions From Construction Equipment. Fugitive dust is generated not only by moving the earth, but by the heavy equipment that does the moving. The exhaust fumes of this equipment are a direct source of PM10, NOx, and ROC. To estimate emissions from heavy-duty construction equipment, the following should be considered:

- o Emission factors for each piece of equipment
- o Types and number of pieces of each kind of equipment
- o Volume of material to be moved
- o Number of hours of operation per average day
- o Number of days of operation in a 3-month period
- o Duration of each activity for each phase of the project

This information can be calculated using the tables provided in Appendix 9.

PM10 and Asbestos. When fugitive dust enters the atmosphere, the larger particles of dust quickly fall to the ground. The smaller particles, however, may remain suspended for long periods and are referred to as total suspended particulates (TSP). Within TSP are those dust particles that are less than ten microns in diameter and which are referred to as PM10. Because PM10 is respirable and can seriously damage the lungs, fugitive dust is a matter of concern. Therefore, sources of fugitive dust which can generate PM10 need to be quantified by identifying the amount of soil that will be disturbed by the following activities:

- o Grading
- o Excavation
- o Demolition
- o Heavy-duty equipment on unpaved roads
- o Loading and unloading trucks of sand, dirt, etc.

The EPA has developed various emission factors which are provided in Appendix 9 for estimating PM10 emissions. When using these factors to estimate emissions, the following data are needed:

- o **Grading and Excavation**
  - Amount of soil to be disturbed
  - Emissions factors for disturbed soil (26.4 pounds of PM10 per day per acre)
  - Duration of grading or excavation
  - Number of days of grading in a 3-month period
- o **Demolition**
  - Cubic feet of buildings
  - Emission factors for demolition (.00042 per cubic foot)
  - Duration of demolition in a 3-month period
- o **Heavy-Duty Equipment on Unpaved Roads**
  - Length of the road
  - Type of soil
  - Type and number of pieces of equipment
  - Average weight and number of wheels on the trucks
  - Duration of activity in a 3-month period
- o **Loading/Unloading Trucks**
  - Volume of material
  - Approximate number of truck loads during a 3-month period
  - Type of material
  - Vehicle speed

In addition, any demolition or renovation work involving asbestos-containing material must be identified. An estimate of potential asbestos emissions should be determined using the procedures in Appendix 9. District Rule 1403 (Asbestos Emissions From Demolition/Renovation Activities) should be identified as a required permit in the EIR. (Compliance with Rule 1403 is considered to mitigate the emissions to a level of insignificance).

Energy Use. Temporary power is often utilized at the construction site to operate equipment. Power usage from temporary generators, natural gas hookups, existing power sources, and other sources should all be identified for the EIR. Such calculations should be based on the following factors:

- Type of power source
- Fuel used if power is provided by a generator
- Duration of power usage
- Estimated power demand over a 3-month period

Architectural Coatings. Architectural coatings applied to a building either during or just after construction are a source of emissions that need to be quantified. In some cases specific information on architectural coatings may not be available, and a good faith effort based on generalized factors would be appropriate. Examples of architectural coatings include painting the exterior walls, or coatings applied to windows and window casings at the construction site. To estimate these emissions, the following should be considered:

- Total area to be covered by the architectural coating
- Estimated amount of material (architectural coating) needed to cover the area
- ROC (reactive organic compounds) emitted by the coating material

Vehicle Trips. Construction and development activities also contribute to mobile emissions generated by commute trips to and from the site, non-work trips associated with lunch or other errands, and trucks hauling soil or construction materials. To quantify these emissions, the following should be considered:

- Number of employee-related work trips and non-work trips and average vehicle miles traveled (VMT), for each type of trip
- Estimated total employee-related passenger vehicle emissions based on number of trips, average speed (lowest speeds should be used for assessing CO and higher speeds for NOx and ROC), and VMT (use worksheets in Table A9 - 17 and Tables A9 - 5/A9 - 9)
- Number of construction trucks in fleet, number of trips, and VMT averaged over a 3-month period
- Estimated total construction truck emissions based on number of trips, average speed (lowest speeds should be used for assessing CO and higher speeds for NOx and ROC), and VMT (use worksheets in Table A9 - 17 and Tables A9 - 5/A9 - 9)
- Estimated total mobile heavy-duty (gasoline- or diesel-powered) equipment emissions based on number of equipment, hours of operation, and VMT (use worksheet in Table A9 - 8 and Table A9 - 9)
- Calculated emissions from the above sources using the most recent ARB and EPA emission factors.

In some cases, construction vehicle trips are difficult to accurately quantify at the time environmental documents are prepared. In all cases, a good faith effort should be made to quantify emissions from these sources to the degree practicable .

Traffic Impacts. Other construction impacts include potential construction-related traffic impacts. Such impacts are caused by congestion and the resulting reduction in level of service (LOS) on nearby streets due to such construction activities as lane closures and parking for construction personnel and/or equipment. These impacts should be identified in the Initial Study. The subsequent environmental document should estimate the impacts by considering the following:

- o Existing local street level of service (LOS) based on existing volume
- o Implications of lane closures and detours on local street LOS
- o Average length of delays at strategic points on local streets within the construction areas
- o Determination of level of pollutant concentrations within construction areas

9.2 Operational Emissions

During the life of the project, a variety of emissions are produced by its day-to-day operations. On-site equipment may emit reactive organic compounds (ROC) and nitrogen oxides (NOx). In addition, vehicle trips to and from the project produce ROC, CO and NOx.

There are three methods available for estimating emissions from the operation of a facility:

- o Screening data through Tables 9-7 and 9-8
- o Employing the Mobile Assessment for Air Quality Impacts (MAAQI) model for mobile emissions
- o Using the methodology and emission factors given in Appendix 9

Tables 9-4 and 9-5 are adequate for estimating emissions when preparing a ND or a MND, but it should not be depended upon for estimates for an EIR. The emissions estimates shown in screening Tables 9-4 and 9-5 are based on regional averages, and focus on emissions from vehicle trips and energy consumption. To estimate emissions with these screening tables:

1) Estimate emissions for each source category (i.e., on-road and area) separately. (Mitigation efficiencies are subtracted from the applicable source categories);

(2) Determine total square footage (or other appropriate unit and land use);

(3) Multiply those totals by the emissions estimates provided in the tables;

(4) Add the emissions from each category to determine total operation impacts;

The District has developed a version of the Urban Air Shed model specific to the South Coast Air Basin (SCAB) called MAAQI. The MAAQI model will estimate emissions associated with vehicle trips, and energy use for residential areas. Planners can estimate emissions with relatively little site-specific information by using the county-wide defaults in the MAAQI model or by entering site-specific information if available.

The MAAQI Model can be used to estimate emissions for the ND or MND; however, site-specific information should be developed to the fullest extent possible for the EIR. Also, emissions from other sources need to be identified in the EIR. (Appendix 9 provides calculation procedures for estimating emissions from these other sources.) The MAAQI model can only be used as a substitute for analyzing the motor vehicle emissions.

If through the Initial Study it is determined that a significant amount of emissions will come from stationary sources, emissions estimates should be developed using the references provided in Appendix 9. These should be added to the total emissions from the project.

Emissions estimates for the EIR should follow the methodology and emissions factors provided in this Handbook. All sources of emissions should be identified (refer to Figure 9-3), with reasonably foreseeable significant environmental consequences addressed. Emissions estimates should be developed for each phase of development and reported in pounds per day for each applicable pollutant. The daily emissions estimate should be based on the highest day (including weekdays and weekends).

This is because travel characteristics are different for weekdays and weekends. In addition, emissions estimates should be provided for the base year (initial year of operation), each development phase, and build-out, based on information available in the traffic impact study. Any emissions reductions resulting from existing ordinances and rules should be calculated as part of the project's non-mitigated emissions.

Sources of operation-related emissions, data needs, and emission factors are discussed below. The emission calculation methodology, emission factors, and assumptions are provided in Appendix 9. The Appendix also provides emissions summary sheets. In order to estimate emissions, specific information about the operation of the facility is needed. When specific information is not available, reasonable estimates based on past experience may be used. Assumptions for some of the factors have also been formulated for this purpose and are provided in the Appendix. All of the basic assumptions used to estimate operation emissions should be documented in the EIR.

Stationary Sources. There are two types of stationary sources: point and area. Point sources refer to a site that has one or more emission sources at a facility with an identified location (e.g., power plants, refinery boilers). Area sources comprise many small emissions sources for which locations are not specifically identified, but for which emissions over a given area may be calculated using socioeconomic data (e.g., water heaters, painting and coatings, and fuel use and consumption).

Emissions from new, modified, or relocated stationary source equipment are regulated extensively through the following:

- o District's Regulation XIII: New Source Review Program
- o District's Permitting Program
- o Compliance with the District's source-specific regulations

Stationary source emissions can be calculated by determining the following:

- o Types and number of pieces of equipment
- o Rate and quantity of fuel consumption
- o Number of hours of operation per day
- o Phases and duration of operation
- o Estimated emissions assuming implementation of SCAQMD-adopted Rules and Regulations (which should be identified in the environmental documentation)

If the number and types of equipment, or other necessary data, are not available when the environmental document is prepared, stationary source emissions may be estimated by using other indicators, such as emission rates per square foot of development. Refer to Appendix 9 for calculation tables. In addition, ARB source classification codes and EPA emission factors should be consulted.

Energy Use. The generation of electric energy and use of natural gas by facilities to power lights, appliances, equipment, etc. should be calculated. Usage factors for natural gas and electric generation are included in Appendix 9, and should be based on the highest daily usage.

Vehicle Trips. Motor vehicles are the primary source of emissions associated with residential, commercial, professional, institutional, and some industrial land uses. Typically, these land uses do not directly emit significant amounts of air pollutants from on-site activities. Motor vehicle trips to and from these facilities do however, emit pollutants adversely affecting air quality.

Development projects and public infrastructure projects are classified as "indirect sources" of vehicle emissions because of trips made to and from them. Quantifying and mitigating emissions from indirect sources poses difficult theoretical and methodological issues.

When quantifying the emissions from indirect sources the issue of assignment and generation of vehicle trips should be considered. When assigning trips to a development there may be some circumstances where a proposed project might divert trips, decrease vehicle trips and/or vehicle miles, or not result in an increase to the extent assumed when using standardized trip generation figures.

For example, the issue of diverted trips arises when a city rejects a proposal to develop a new grocery store. The trips to and from the grocery store do not simply disappear from the region. Customers are likely to travel to another grocery store. Depending on the location of the grocery store's distance from the customer or possible location on a more congested road, VMT and emissions could increase or decrease. Schools are another example of a situation where the construction of a neighborhood school designed to accommodate existing student demand could reduce the number of vehicle miles that students generate by commuting to school outside the neighborhood.

Developers, occupants, and local governments have different abilities to reduce indirect source emissions. Each of these parties can influence trip making, but not fully control trip making through their own actions. The District recommends that project proponents and approving jurisdictions adopt mitigation measures to discourage mobile source emissions which, in the circumstances of the specific project as identified in the CEQA process, are feasible and effective.

Finally, land uses naturally evolve and shift with economic and demographic trends in ways that are difficult to predict and model. These dynamics can completely change commute patterns and related emissions. For example, in the last twenty years, Orange County evolved from a residential county to one with a substantial employment base. Employment centers that once had primarily industrial or manufacturing firms now have mainly commercial and service firms, which have different residential needs and trip-making patterns.

The major technical issue is the difficulty in correlating indirect source emissions from an individual development or infrastructure project with the projections of regional emissions used to develop the AQMP. The Building Industry believes that development and infrastructure projects typically accommodate economic and demographic trends assumed in the AQMP, although they acknowledge that the projects also add to the cumulative impact that greater economic activity has by "inducing" additional trip-making and higher emissions. District staff believes that projects may stimulate as well as respond to growth.

This Handbook recommends the use of the 5th edition of the ITE Trip Generation Manual. The ITE Manual recognizes that the issues of multi-use developments and quantifying capture rates for developments are limited by the specificity of the information provided. Additionally, the ITE Manual discusses primary trips, pass-by trips and diverted linked trips and provides guidance, in the form of technical methodologies, on estimating percentages of each type of trip by land use type. The methodologies contained in the ITE Manual are based on actual data. Just as the CEQA Handbook provides default values for emissions calculations based on county averages, the ITE Manual provides traffic averages based on actual data. Additionally, both the CEQA Handbook and the ITE Manual recommend the utilization of the best available data to calculate impacts. Therefore, if project specific data is available it should be used to adjust the factors for calculating both the traffic reports as recommended by the ITE Manual, and the project emissions. The District is committed to working cooperatively with other public agencies and private groups to improve both the theory and methodologies for quantifying indirect source emissions.

Mobile source emissions include vehicle emissions from work trips, non-work trips, and truck trips to and from the project site. Therefore, when estimating indirect source emissions the following should be considered:

- o Types of land uses (i.e., commercial, industrial, residential, and/or institutional)
- o Size of land use project (i.e., square footage, number of units, and capacity)
- o Modes of transportation and fleet mix of trips associated with each land use category
- o Number of employees per land use category
- o Average number of daily trips associated with each type of trip (work, non-work, truck trips)
- o Vehicle speed (linked to roadway volume) and ambient temperature
- o Average vehicle miles traveled for each trip type

Calculation of project-related trips should be based on the Trip Generation Manual (Fifth edition, 1991) published by the Institute of Transportation Engineers (ITE). Trip generation should be based on the highest day (either weekday or weekend) trips for each land use category. Trip generation data from other sources (i.e., traffic impact analysis) may be used if determined to be more appropriate for a given project. In performing a traffic impact analysis, the procedures specified in the county CMP within which the project is located should be followed. It is presumed that all trips attributed to project development are new trips unless it can be reasonably demonstrated that such trips are derived from elsewhere. There may be some circumstances where a proposed project might decrease vehicle trips and/or vehicle miles, or not result in an increase to the extent assumed when using standardized trip generation figures. Schools are one example of a situation where the addition of an on-site dormitory design to accommodate existing student capacity could reduce the number of vehicle miles that students would generate by commuting to school. Any such analysis in an environmental document should not be based on speculative information. Substantive data based on information from sources such as site-specific and market studies needs to be available to agencies reviewing the environmental documentation to substantiate that trips attributed to the project are either not new trips or that the number or length of trips are less than that expected when using standardized trip information. The air quality analysis should utilize ARB emission factors. Contact the District regarding the current version of the EMFAC program.

In addition, to identify mobile source emissions from trip generation, the impact of additional trips to and from the project site on the transportation system must be assessed. In order to do this, the trips on the transportation network and the impact on level of service must be identified. In particular, the analysis should calculate change in vehicle speed and resulting emissions. Hot spots at intersections should also be assessed and the ARB CALINE model or EPA CAL3QHC model should be employed.

PM10. Although fugitive dust is associated primarily with initial construction activity, many operational aspects of a facility can contribute to PM10 emissions. These include vehicles traveling on unpaved roads, tire wear based on vehicle miles traveled, as well as land use specific impacts from mining operations, outdoor storage of building materials such as sand and dirt, and landfills. In order to estimate emissions, the following factors will need to be determined:

- o Amount of material or soil
- o Type of material or soil
- o Emission factors for materials or disturbed soil
- o Duration of disturbance of material or soil averaged over 3 months
- o Length of road (for unpaved roads)
- o Average vehicle weight and number of wheels per vehicle (unpaved road)

9.3 Assessing Other Indicators of Potential Air Quality Impacts (Secondary Impacts)

In addition to primary emission thresholds of significance, Chapter 6 also identifies other indicators of potential air-quality impacts. The analysis of a proje..'s impact should include an evaluation of these indicators as appropriate for the project. For exampie, only projects that involve sensitive receptors need to evaluate surrounding land uses within a quarter mile to determine if there are any sources of toxic emissions.

The type of analysis to perform for each indicator is discussed in the Handbook as follows:

Chapter 5:	Potential to create or be subjected to an objectionable odor over 10 dilution to threshold that could impact sensitive receptors;
Chapter 5, 9:	Generation of vehicle trips causing a roadway to be reclassified and create a CO hot spot;
Chapter 5, 10:	Emitting air toxic contaminants that are regulated by District rules or on a federal or state air toxic list;
Chapter 5, 10:	Sensitive receptors within a quarter mile of an existing facility that emits air toxics identified in District Rule 1401;
Chapter 10:	Emitting carcinogenic or toxic air contaminants that individually or cumulatively exceed the maximum individual cancer risk of 10 in 1 million;
Chapter 10, 13:	Burning of hazardous, medical, or municipal waste in waste to energy facilities;
Chapter 12:	Interference with the attainment of the federal or state ambient air quality standards by violating or contributing to an existing or projected air quality violation;
Chapter 12:	Population increases in excess of that projected in the AQMP and in other than planned locations for the project's build-out year.

9.4 Guidance for Assessing Carbon Monoxide Emissions

Carbon monoxide (CO) is a localized problem requiring additional analysis when a project is likely to impact a roadway's level of service (LOS), subject sensitive receptors to CO hot spots, or the project itself is the development of transportation infrastructure. For CEQA purposes, a CO analysis should be performed when air quality has been identified as having a significant impact.

Whenever a land use project could have a significant impact on air quality as a result of vehicle trips, even after mitigation is included, a CO analysis should be performed. Transportation projects that should be analyzed for localized CO problems include: park-and-ride lots, high-occupancy vehicle (HOV) lanes, mixed-flow lanes, designation of new transportation corridor, transportation plan or program, rail and bus transit projects, etc. The methodologies contained in SCAG's Carbon Monoxide Transportation Project Protocol, Technical Addendum Sections 1 through 14 (see Appendix 9) would be appropriate for use in a CEQA CO analysis. CEQA, however, requires additional information beyond the discussion contained in the CO Protocol. The methodology discussed below is intended to assist in preparing a complete and adequate CEQA analysis for air quality. To assist planners in preparing a CO analysis and adequately evaluating the potential impacts, the following guidelines were developed.

Methodology. To assess CO emissions and evaluate the impacts, the following steps should be employed:

1. Determine "No Project" ambient concentration of CO emissions. Utilize Tables 5-2 and 5-3 for future year ambient concentrations, or use Table 9-9 to adjust on-site monitoring data to reflect future year emissions.

2. Estimate the CO emissions from the project by modeling.

3. Add the "No Project" ambient concentration level of CO emissions to those generated by the project (i.e., total project impact).

4. Compare the total project impact to the state 1-hour and 8-hour CO standards.

5. If modeling indicates a CO hot spot could occur, determine the area impacted and determine if sensitive receptors are located in that area. Identify and determine the level of CO emissions at sensitive receptors. (Refer to Section 5.3(5) for methodology.)

6. Compare the levels of CO emissions at sensitive receptors to the state 1-hour and 8-hour CO standards.

7. Determine project significance.

The analysis should be performed for the following years: each development phase and project build-out.

If the project causes the state 1-hour or 8-hour CO standards to be exceeded, then a "CO hot spot" is created. As such, it is considered that the project is likely to cause or contribute to a CO exceedance of a state air quality standard. There may be cases where the background concentration already exceeds the state 1-hour and 8-hour CO standards. In these cases, the analysis should determine whether there will be a measurable increase at the project site. A measurable increase is defined as one part per million (ppm) for the 1-hour CO standard and 0.45 ppm for the 8-hour standard (consistent with District Regulation XIII definition of a significant impact). A measurable increase is considered likely to increase the frequency or severity of an existing CO violation.

There are a number of dispersion models that are available to estimate potential CO hot spots. Two such models, CAL3QHC and CALINE, have been developed to estimate potential CO hot spots. The models are based on continuous line source emissions and therefore, can estimate roadway impacts. The CAL3QHC model has been enhanced to analyze idling and queuing from congestion and impacts on sensitive receptors. CALINE is the model used by ARB and CalTrans. The District recommends CALINE. Both models are described in Section 9.7 of this Chapter.

Establishing the "No Project" Ambient Concentration. Two options are available for establishing CO 1-hour ambient background concentrations. Table 5-2 provides projected future year 1-hour CO concentrations based on adopted rules or regulations. These projections may be utilized as the future year ambient concentrations. These numbers will be revised as better modeling techniques are developed and as necessary due to the results of the District's ongoing monitoring.

Planners or the project proponent may wish to utilize the second option and perform more site specific monitoring to determine the CO "No Project" ambient concentrations. On-site monitoring requires a minimum of 4 months of continuous sampling during the winter CO season, November through February. Sampling and receptor siting for this option should be in accordance with 40 CFR 58 microscale criteria and achieve a minimum of 90% data completeness. The monitored data may be adjusted for future years utilizing the factors in Table 9-9. These adjustment factors are also based on implemented rules and regulations.

The 8-hour CO concentration levels may be established in two ways. Table 5-3 provides projected future year 8-hour ambient CO concentrations, adjusted to take into account adopted rules and regulations. For the second option the 8-hour CO concentrations are calculated from the 1-hour levels directly by a factor termed the Persistence Factor. This factor is the ratio over the most recent three years between the highest annual maximum 1-hour and 8-hour CO concentrations as measured at the nearest representative permanent monitoring station. If no nearby monitoring station data is available, the following factors are suggested:

Factor	Setting
0.6	Attainment
0.7	Non-attainment
0.8	Urban areas with persistent stagnation and/or congestion

If a project is located in more than one source receptor area, the background concentration from the air monitoring station which is most representative of the conditions at the project site should be used, or each source receptor area should be modeled separately. It is necessary to evaluate CO impacts based on the highest concentrations, or actual concentrations if they can be determined, because the state law mandates that violation of the CO standards at any location during the year results in the area being classified as non-attainment for that pollutant.

Relocation of CO Hot Spots. Occasionally, project development will cause emission patterns to shift or move, possibly resulting in the reduction or elimination of a hot spot at one location, and the initiation of a new hot spot at another location. For example, if an extra lane for traffic flow is added to a roadway link which has a hot spot, the hot spot may shift to the portion of the roadway link where the extra lane ends. The hot spot is then caused by congestion from vehicles merging into a fewer number of lanes. It is acceptable in some instances to move a hot spot without it being considered as creating a new hot spot when the following criteria are met:

- The relocated hot spot will not be within a quarter mile of sensitive receptors or it is demonstrated that a hot spot will not be created that will impact sensitive receptors;
- The CO emissions will be equal to or less than the emissions at the original hot spot within the project impact area; and
- The relocated hot spot will not result in a new CO violation.

9.5 Cumulative Impact Evaluation

CEQA defines cumulative impact as follows:

- Two or more individual effects which, when considered together, are considerable or which compound or increase other environmental impacts (refer to CEQA Guidelines Section 15355), and
- The change in the environment which results from the incremental impact of the project when added to other closely related past, present, or reasonably foreseeable future projects, and can result from individually minor, but collectively significant, projects taking place over a period of time (refer to CEQA Guidelines Section 15355(b)

Section 15130 of the CEQA Guidelines specifies that cumulative impacts shall be discussed when significant. The discussion of cumulative impacts should reflect the severity of the impacts and the likelihood of occurrence, but need not provide as great detail as needed to assess the effects of the project itself. CEQA requires that the following elements be discussed when assessing cumulative impacts:

- A list of past, present and reasonably anticipated future projects producing related or cumulative impacts, including those outside the control of the Agency or a summary of projections contained in an adopted General Plan or related planning document which is designated to evaluate regional or areawide conditions. The discussion should be guided by the standards of practicality and reasonableness; and

- A summary of the expected environmental effects to be produced by those projects; and

- A reasonable analysis of the cumulative impacts of relevant projects including the examination of reasonable options for mitigating or avoiding any significant cumulative effect of the proposed project.

The following approach has been developed by District staff as a possible means to determine the cumulative significance of a land use project. This approach is consistent with the AQMP which contains performance standards and emission reduction targets necessary to attain the federal and state air quality standards. This approach is not mandatory under CEQA, and District staff is available to consult on the preparation of a cumulative impact analysis:

The environmental documentation could analyze the project according to the following assumptions (as applicable to the project):

- *Reduce the rate of growth in vehicle miles traveled (VMT) and trips*

  According to ARB's transportation performance standards, the rate of growth in vehicle miles traveled (VMT) and trips should be held to the rate of population or household growth. Compliance with this performance standard for residential projects, General Plan amendments, and Specific Plans is assessed by determining the population for the projected build-out year of the project. Planners should use population, VT, and VMT projections disaggregated to the local jurisdiction by SCAG that were contained in the AQMP. The population increase from the project should then be divided by the population projection for the build-out year. This gives the acceptable rate of growth in VMT and trips. To determine the number of VMTs a project can generate, determine VMT and trips projection for the build-out year for the local jurisdiction (after consultation with SCAG), and divide by the acceptable rate of VMT and trip growth percentage. (Refer to Table A9 - 14 for methodology.)

- *1% per year (or 18% over 18 years to the year 2010) reduction in project emission (ROC, NOx, CO, PM10, SOx)*

  The analysis can be performed by calculating the total project unmitigated emissions using the procedures in Chapter 9, and then dividing by the reductions from the application of mitigation measures. This will provide the percent reduction in project emissions. (Refer to Table A9 - 15 for methodology.)

- *1.5 average vehicle ridership (AVR), or average vehicle occupancy (AVO) if a transportation project*

  The calculation procedures in the District's Regulation XV should be used for commercial and industrial land use projects in determining AVR. The AVO for transportation projects should be determined based on ARB's guidance document for complying with the CCAA transportation performance standards. (Refer to Table A9 - 16 for methodology.)

If the analysis shows that the project complies with the above assumptions, the project's cumulative impact could be considered insignificant. If the analysis shows that the project does not comply with the above assumptions, then cumulative impacts are considered to be significant, unless there is other pertinent information to the contrary.

9.6 Analyzing Project Alternatives

CEQA requires that the project be compared to feasible alternatives, including a no-project alternative. CEQA Guidelines Section 15126(A)(d)(3) states that the discussion of alternatives shall focus on alternatives capable of eliminating any significant adverse environmental effects (such as air quality) or reducing them to a level of insignificance even if these alternatives would impede to some degree the attainment of the project objectives, or would be more costly.

The EIR should include an air quality impact analysis of all the project alternatives. For this type of assessment, it is appropriate to estimate emissions only for the build-out year and consider emissions associated only with operations. CEQA does not require the same level of analysis for alternatives as it does for the project-specific analysis. This Handbook suggests that project alternatives should be quantified so that decision makers have the ability to determine which alternative is environmentally superior from an air quality perspective. Quantification may be done to a lesser degree, and does not need to be as extensive as that performed for the preferred alternative. For instance, if a project is reduced in size, emissions can be proportionally reduced. If however an alternative site is considered, it may not be feasible to do a quantified air quality analysis. In addition, since there may not be project specific information developed for each of the alternatives, the MAAQI model with the county-wide default assumptions or the screening table may be used to quantify the alternatives.

All of the alternatives, including the proposed project, should use the same basic assumptions, except where a change in assumptions is necessary due to the nature of the alternative. For example, a project alternative might involve electric vehicles rather than gas-fueled vehicles so that the vehicle emission factors would be different. It is important that all appropriate assumptions be held constant so that it is possible to ascertain the difference in emissions as a result of the alternatives. The use of default assumptions from Appendix 9 is acceptable for the alternatives (including the preferred project alternative) in this analysis. This means that the emissions estimates used in the analyses for the alternatives will be different than those used in estimating the impacts of the proposed project (e.g., preferred alternative).

The emissions estimates for the proposed project and alternatives should be reported in the EIR along with the basic underlying assumptions used in assessing all of the alternatives. Also to be reported is an identification of differences in assumptions among the alternatives, for those cases where a change in assumptions is necessary due to the nature of the alternate. An example of a reporting format for the emissions estimates of the project alternatives is provided in Table 9-10.

9.7 Air Quality Modeling Tools

There are a number of air quality modeling tools available to assess air quality impacts of projects. A few of the models that are available to planners and project consultants are described below. Planners and project consultants are not limited to these models and can use other models, as appropriate, to perform the analysis.

The accuracy from any model is directly dependent on the accuracy of the input variables or assumptions. Meteorology, trip generation rates, and emission factors can vary widely, and in many situations there is a degree of uncertainty in their selection. The user should be confident with the input assumptions before they are used in the model. Preferably, the inputs are based on research or case studies. It is recommended that the user contact the District's Modeling staff prior to selecting meteorological parameters and estimating composite running and idling emission factors. For recommendations on other types of input assumptions, contact the District's Local Government-CEQA Section.

Mobile Assessment for Air Quality Impacts (MAAQI). The MAAQI model is used to estimate CO, ROC, NOx, SOx, and PM10 emissions from the motor vehicles associated with new or modified land uses (e.g., shopping centers, residential development, commercial mini-malls, etc). The District has developed MAAQI to include county default assumptions (for trip length, speeds, temperature, etc.), energy use in residential developments, and quantification of mitigation measures.

The District's MAAQI model has been designed for planners wanting to assess the indirect vehicular emissions associated with various projects, such as residential developments, shopping centers, and offices. The program uses the emission factors generated by the EMFAC7E.P model for on-road motor vehicles as input. The data needed to run the MAAQI model for a new or modified land use project can be as simple as the following:

- Type of land use
- Size of the project
- Year of project operation

The MAAQI model contains a number of built-in default values (values automatically inserted by the program when project-specific data are unavailable). Unless project-specific information is available and documented, the default values for each of the four counties under the District's jurisdiction are recommended for the following model inputs:

- Trip rate
- Percent cold starts
- Vehicle fleet mix types
- Trip speed
- Trip lengths

Input values other than those recommended in MAAQI may be used for calculating commercial and industrial emissions. Likewise, modified trip generation rates and percent work trips may also be used. However, if different values are used, full documentation and justification for the different inputs should be provided. If the MAAQI model is used to estimate emissions associated with land uses, the following non-vehicular emissions must be added to the estimate.

- Emissions from stationary sources
- Emissions from other mobile sources (planes, trains, etc.)
- PM10 emissions
- Emissions from traffic impacts

CALINE. The CALINE is a computer model used to predict CO, nitrogen dioxide (NO2), and particulate concentrations near roadway intersections. CALINE is an effective tool for forecasting free-flowing mobile source emissions resulting from a proposed project and can be used to determine if a CO hot spot will be created. The information obtained from CALINE projections can also be used to determine the project's effect on ambient air quality in localized areas. (Contact the CalTrans Technical Support Division for further information about the CALINE model.)

CAL3QHC. The CAL3QHC is another computer model for predicting the level of carbon monoxide or other criteria pollutant concentrations from motor vehicles near a roadway. The model is based on the assumption that vehicles near an intersection are either in motion or idling. Therefore, CAL3QHC is effective at estimating mobile source emissions which are either free-flowing or idling. Details of the modeling application can be found in "User's Guide to CAL3QHC" (EPA, Contract No. 68-02-4394, 1990).

EMFAC7E.P. These emission factors use the most current assumptions for estimating and projecting emissions from motor vehicles. The model can be used to quickly estimate pollutant emission factors given a vehicle fleet size, year, temperature and operating speed. The output can be used as input to ARB's URBEMIS model and then to CALINE. The vehicle types programmed into this model include light-duty auto, light-duty truck, medium-duty truck, heavy-duty truck and motorcycles.

The EMFAC7E.P model takes into account all ARB regulations adopted up to January 1, 1991. The District recommends that this version be used for all emissions estimates. These emissions factors or the most recent factors can be obtained by contacting the ARB Technical Support Division or the District's Local Government/CEQA unit. The emission factors contained in Tables A9 - 5/A9 - 9 and Table A11 - 5 for on-road mobile sources are generated from EMFAC7E.P.

9.8 Analyzing and Reporting Emissions

Once the emissions from construction and operation of the project have been estimated, the effect of District rules and local ordinances should be taken into account. Any reductions should be documented in the EIR and calculated as part of the project's emissions prior to the inclusion of mitigation. This is because mitigation refers to actions beyond those required by rules or ordinances. Then a quantitative assessment should be completed comparing the project emissions to the thresholds in Chapter 6. In addition, qualitative assessments that compare the project with the existing setting described in Chapter 8 and with any potential impacts identified during the Initial Study need to be made.

The environmental documentation should demonstrate clearly that the amount of emissions generated by the project have been compared to the thresholds of significance. (In this step, construction and operation related emissions should be considered separately). While the analysis for the ND and MND may analyze emissions impacts based on the screening tables, the EIR must include a project specific analysis.

The impacts of the project on the existing setting should be analyzed (e.g., changes to current traffic LOS, etc.) and any other changes from current conditions noted. In addition, an analysis of any impacts relating to air quality identified during the Initial Study should also be included (e.g., changes in population projections, etc.).

All of the assumptions used in estimating future emissions must be documented in the EIR. Emissions estimates for each source related to construction and operation activities along with total emissions from each applicable pollutant (e.g., tons or pounds of pollutant a day) should be reported. Emissions estimates should be reported for each phase of build-out and project completion.

Figure 9-1. Flow Chart for Estimating Emissions from Projects

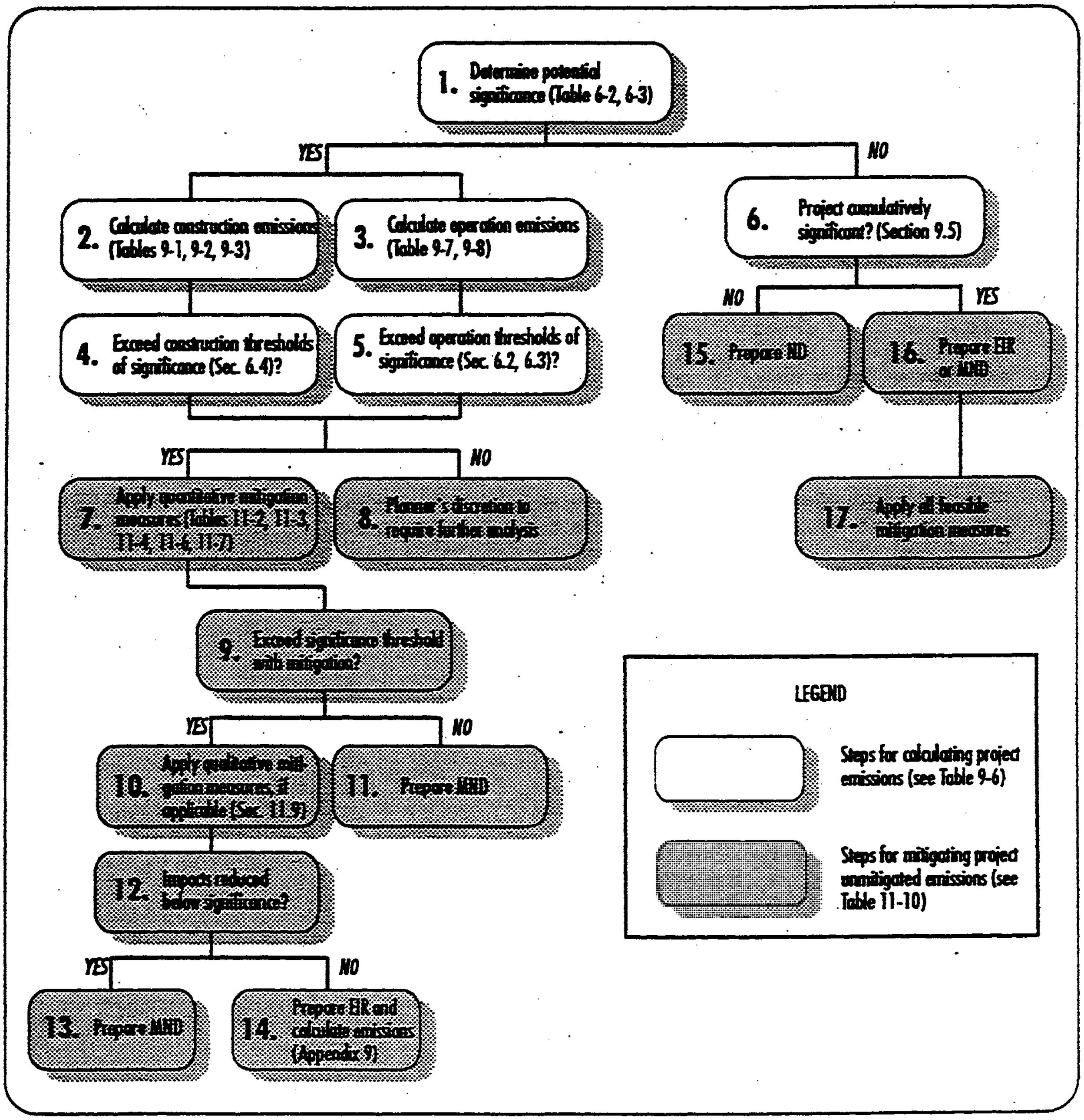


Figure 9-2. Emission Sources Associated with Construction

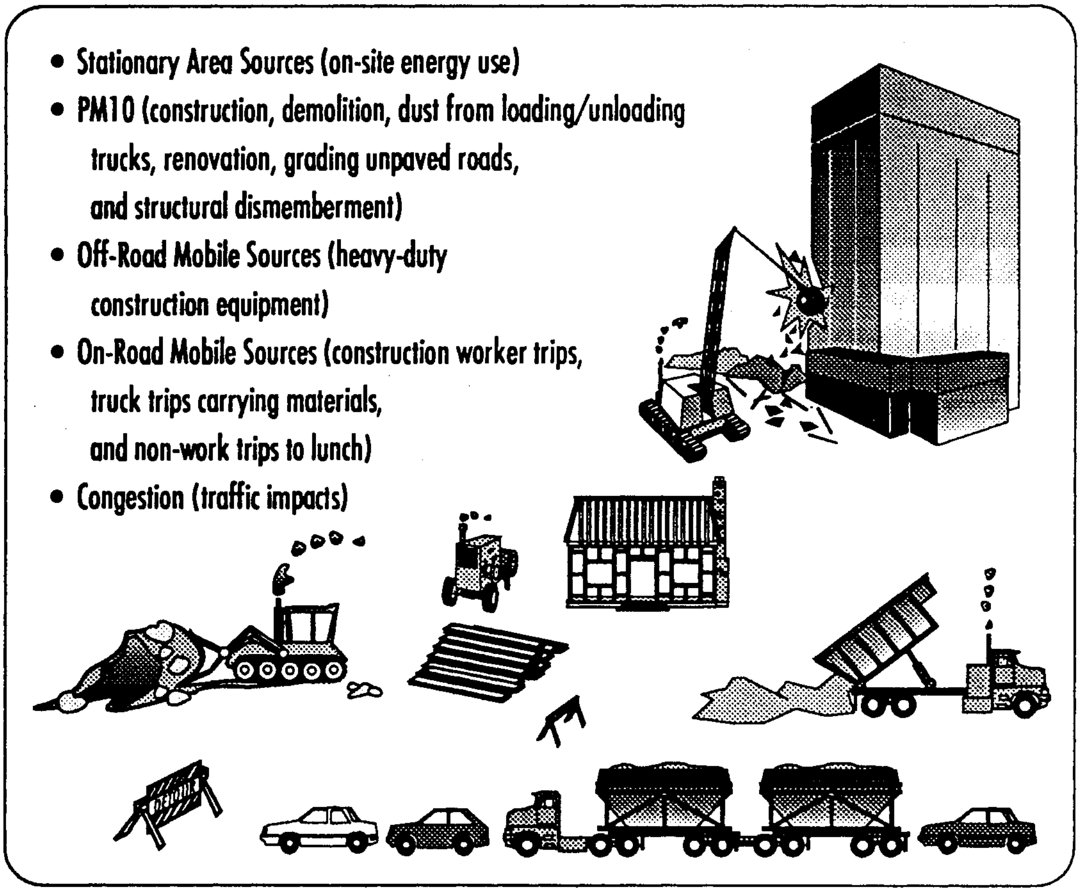


Figure 9-3. Emission Sources Associated with Operation of a Facility

- Stationary Point Sources (large boilers, etc.)
- Stationary Area Sources (on-site energy use)
- PM10 (unpaved roads,
  and structural dismemberment)
- Off-Road Mobile Sources
  (planes, trains, ships, etc.)
- On-Road Mobile Sources
  (work trips, truck trips, non-work trips)
- Congestion (traffic impacts)

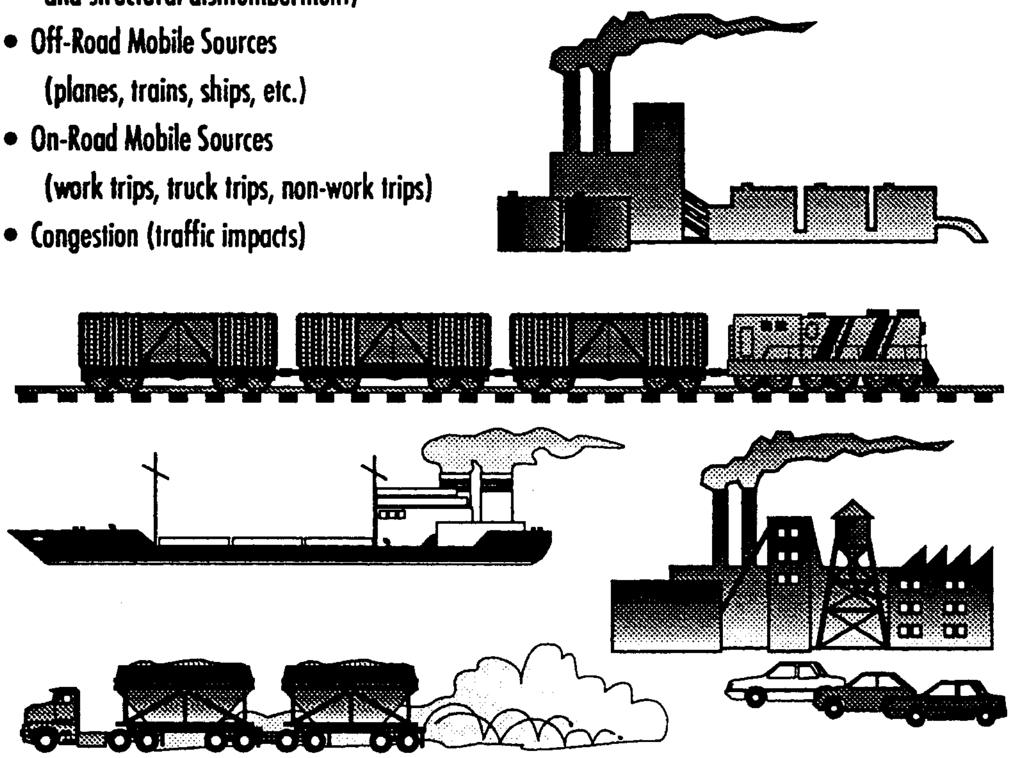


Table 9-1. Screening Table for Estimating Total Construction Emissions**

LAND USE	UNIT OF MEASURE	EMISSION FACTORS LBS/CONSTRUCTION PERIOD			
		ROC	NO_x	CO	PM10
RESIDENTIAL					
Single Family Housing	1,000 sq. ft. GFA*	23.66	347.74	75.62	24.69
Apartments	1,000 sq. ft. GFA	21.97	322.90	70.22	22.93
Condominiums	1,000 sq. ft. GFA	21.30	312.97	68.06	22.22
Mobile Homes	1,000 sq. ft. GFA	21.30	312.97	68.06	22.22
EDUCATION					
Schools	1,000 sq. ft. GFA	46.99	690.52	150.16	49.03
COMMERCIAL					
Business Park	1,000 sq. ft. GFA	55.44	814.72	177.17	57.85
Day Care Center	1,000 sq. ft. GFA	31.87	466.97	101.55	33.16
Discount Store	1,000 sq. ft. GFA	31.78	466.97	101.55	33.16
Fast Food	1,000 sq. ft. GFA	31.78	466.97	101.55	33.16
Government Office Complex	1,000 sq. ft. GFA	55.44	814.72	177.17	57.85
Hardware Store	1,000 sq. ft. GFA	31.78	466.97	101.55	33.16
Hotel	1,000 sq. ft. GFA	41.58	611.04	132.87	43.39
Medical Office	1,000 sq. ft. GFA	55.44	814.72	177.17	57.85
Motel	1,000 sq. ft. GFA	41.58	611.04	132.87	43.39
Movie Theatre	1,000 sq. ft. GFA	31.78	466.97	101.55	33.16
Office	1,000 sq. ft. GFA	55.44	814.72	177.17	57.85
Resort Hotel	1,000 sq. ft. GFA	41.58	611.04	132.87	43.39
Restaurant	1,000 sq. ft. GFA	31.78	466.97	101.55	33.16
Shopping Center	1,000 sq. ft. GFA	31.78	466.97	101.55	33.16
Supermarket	1,000 sq. ft. GFA	31.78	466.97	101.55	33.16
INDUSTRIAL	1,000 sq. ft. GFA	32.79	481.88	104.79	34.22

* GFA = GROSS FLOOR AREA

**Construction emissions include on-site construction equipment and workers' travel.

E = (((Project square footage/1,000) × (Table 9-1 emission factor))/(Number of days to construct))
E = Daily construction emissions

For on-site construction equipment and material handling construction emissions, subtract emissions obtained by using screening Table 9-3.

For on-site construction equipment emissions, subtract emissions obtained by using screening Tables 9-3 and 9-4.

Refer to Appendix 9 for methodologies and assumptions used in preparing this table.

These emissions were estimated using energy consumption values provided in Energy and Labor in the Construction Sector, B. Hannon, R. Stein, and D. Serber, Science, 1978, 202:837–847.

Table 9-2. Screening Table for Estimating Construction PM10 Emissions – Fugitive Dust

LAND USE	UNIT OF MEASURE	EMISSION FACTORS LBS/DAY LBS OF PM10
UNPAVED ROADS		
Passenger Vehicles	Vehicle Miles Traveled (1)	5.56
Trucks	Vehicle Miles Traveled (1)	23.00
PAVED ROADS		
Passenger Vehicles	Vehicle Miles Traveled (1)	0.33
Trucks	Vehicle Miles Traveled (1)	2.00
DEMOLITION	Cubic Foot	0.00042
GRADING	Acres/Day	55.00
ASBESTOS	Cubic Foot	0.00006

Refer to Appendix 9, Table 9-18 for methodologies and assumptions used in preparing this table.

NOTES:

(1) VMT is a function of linear road length and average daily trips. Any combination that equals or exceeds the daily ***and*** quarterly thresholds could be significant.

Table 9-1. Screening Table for Estimating Total Construction Emissions**

LAND USE	UNIT OF MEASURE	EMISSION FACTORS LBS/CONSTRUCTION PERIOD			
		ROC	NO_X	CO	PM10
RESIDENTIAL					
Single Family Housing	1,000 sq. ft. GFA*	23.66	347.74	75.62	24.69
Apartments	1,000 sq. ft. GFA	21.97	322.90	70.22	22.93
Condominiums	1,000 sq. ft. GFA	21.30	312.97	68.06	22.22
Mobile Homes	1,000 sq. ft. GFA	21.30	312.97	68.06	22.22
EDUCATION					
Schools	1,000 sq. ft. GFA	46.99	690.52	150.16	49.03
COMMERCIAL					
Business Park	1,000 sq. ft. GFA	55.44	814.72	177.17	57.85
Day Care Center	1,000 sq. ft. GFA	31.87	466.97	101.55	33.16
Discount Store	1,000 sq. ft. GFA	31.78	466.97	101.55	33.16
Fast Food	1,000 sq. ft. GFA	31.78	466.97	101.55	33.16
Government Office Complex	1,000 sq. ft. GFA	55.44	814.72	177.17	57.85
Hardware Store	1,000 sq. ft. GFA	31.78	466.97	101.55	33.16
Hotel	1,000 sq. ft. GFA	41.58	611.04	132.87	43.39
Medical Office	1,000 sq. ft. GFA	55.44	814.72	177.17	57.85
Motel	1,000 sq. ft. GFA	41.58	611.04	132.87	43.39
Movie Theatre	1,000 sq. ft. GFA	31.78	466.97	101.55	33.16
Office	1,000 sq. ft. GFA	55.44	814.72	177.17	57.85
Resort Hotel	1,000 sq. ft. GFA	41.58	611.04	132.87	43.39
Restaurant	1,000 sq. ft. GFA	31.78	466.97	101.55	33.16
Shopping Center	1,000 sq. ft. GFA	31.78	466.97	101.55	33.16
Supermarket	1,000 sq. ft. GFA	31.78	466.97	101.55	33.16
INDUSTRIAL	1,000 sq. ft. GFA	32.79	481.88	104.79	34.22

* GFA = GROSS FLOOR AREA

**Construction emissions include on-site construction equipment and workers' travel.

E = (((Project square footage/1,000) × (Table 9-1 emission factor))/(Number of days to construct)
E = Daily construction emissions

For on-site construction equipment and material handling construction emissions, subtract emissions obtained by using screening Table 9-3.

For on-site construction equipment emissions, subtract emissions obtained by using screening Tables 9-3 and 9-4.

Refer to Appendix 9 for methodologies and assumptions used in preparing this table.

These emissions were estimated using energy consumption values provided in Energy and Labor in the Construction Sector, B. Hannon, R. Stein, and D. Serber, Science, 1978, 202:837–847.

Table 9-2. Screening Table for Estimating Construction PM10 Emissions – Fugitive Dust

LAND USE	UNIT OF MEASURE	EMISSION FACTORS LBS/DAY LBS OF PM10
UNPAVED ROADS Passenger Vehicle Loaded Truck	 Vehicle Miles Traveled (1) Vehicle Miles Traveled (1)	 5.56 23.00
PAVED ROADS Local Road Construction Road	 Vehicle Miles Traveled (1) Vehicle Miles Traveled (1)	 0.33 2.00
DEMOLITION	Cubic Foot	0.00042
GRADING	Acres/Day	55.00
ASBESTOS	Cubic Foot	0.00006

Refer to Appendix 9, Table 9-18 for methodologies and assumptions used in preparing this table.

NOTES:

(1) VMT is a function of linear road length and average daily trips. Any combination that equals or exceeds the daily *and* quarterly thresholds could be significant.

Table 9-3. Screening Table for Estimating Emissions from Construction Workers' Travel

LAND USE	UNIT OF MEASURE	EMISSION FACTORS LBS/DAY			
		ROC	NO_X	CO	PM10
RESIDENTIAL					
Single Family Housing	1,000 sq. ft. GFA*	0.008	0.007	0.096	0.0007
Apartments	1,000 sq. ft. GFA	0.008	0.007	0.101	0.0007
Condominiums	1,000 sq. ft. GFA	0.008	0.007	0.101	0.0007
Mobile Homes	1,000 sq. ft. GFA	0.008	0.007	0.096	0.0007
EDUCATION					
Schools	1,000 sq. ft. GFA	0.007	0.006	0.086	0.0006
COMMERCIAL					
Business Park	1,000 sq. ft. GFA	0.007	0.005	0.080	0.0006
Day Care Center	1,000 sq. ft. GFA	0.005	0.004	0.060	0.0004
Discount Store	1,000 sq. ft. GFA	0.005	0.004	0.060	0.0004
Fast Food	1,000 sq. ft. GFA	0.007	0.006	0.090	0.0007
Government Office Complex	1,000 sq. ft. GFA	0.009	0.007	0.104	0.0008
Hardware Store	1,000 sq. ft. GFA	0.005	0.004	0.060	0.0004
Hotel	1,000 sq. ft. GFA	0.007	0.006	0.089	0.0006
Medical Office	1,000 sq. ft. GFA	0.008	0.007	0.099	0.0007
Motel	1,000 sq. ft. GFA	0.007	0.006	0.089	0.0006
Movie Theatre	1,000 sq. ft. GFA	0.007	0.006	0.085	0.0006
Office	1,000 sq. ft. GFA	0.007	0.005	0.080	0.0006
Resort Hotel	1,000 sq. ft. GFA	0.007	0.006	0.089	0.0006
Restaurant	1,000 sq. ft. GFA	0.007	0.006	0.090	0.0007
Shopping Center	1,000 sq. ft. GFA	0.005	0.004	0.060	0.0004
Supermarket	1,000 sq. ft. GFA	0.005	0.004	0.060	0.0004
INDUSTRIAL	1,000 sq. ft. GFA	0.003	0.003	0.042	0.0003

* GFA = GROSS FLOOR AREA

(1) Refer to Appendix 9 for methodologies and assumptions used in preparing this table.

(2) Use these emissions to determine post-mitigation emissions after applying percent mitigation efficiencies applicable towards construction workers' travel emissions.

Table 9-4. Screening Table for Estimating Construction Materials Handling Emissions

CONSTRUCTION EQUIPMENT EMISSIONS		EMISSION FACTORS LBS/CONSTRUCTION PERIOD			
LAND USE	UNIT OF MEASURE	ROC	NO_x	CO	PM10
RESIDENTIAL					
Single Family	1000 sq. ft. GFA*	3.38	49.63	10.79	3.52
Apartments	1000 sq. ft. GFA	3.14	46.08	10.02	3.27
Condominiums	1000 sq. ft. GFA	3.04	44.67	9.71	3.17
Mobile Homes	1000 sq. ft. GFA	3.04	44.67	9.71	3.17
EDUCATION					
Schools	1,000 sq. ft. GFA	6.71	98.55	21.43	7.00
COMMERCIAL					
Business Park	1,000 sq. ft. GFA	7.91	116.28	25.28	8.26
Day Care Center	1,000 sq. ft. GFA	4.53	66.64	14.49	4.73
Discount Store	1,000 sq. ft. GFA	4.53	66.64	14.49	4.73
Fast Food	1,000 sq. ft. GFA	4.53	66.64	14.49	4.73
Government Office Complex	1,000 sq. ft. GFA	7.91	116.28	25.28	8.26
Hardware Store	1,000 sq. ft. GFA	4.53	66.64	14.49	4.73
Hotel	1,000 sq. ft. GFA	5.93	87.20	18.96	6.19
Medical Office	1,000 sq. ft. GFA	7.91	116.28	25.28	8.26
Motel	1,000 sq. ft. GFA	5.93	87.20	18.96	6.19
Movie Theatre	1,000 sq. ft. GFA	4.53	66.64	14.49	4.73
Office	1,000 sq. ft. GFA	7.91	116.28	25.28	8.26
Resort Hotel	1,000 sq. ft. GFA	5.93	87.20	18.96	6.19
Restaurant	1,000 sq. ft. GFA	4.53	66.64	14.49	4.73
Shopping Center	1,000 sq. ft. GFA	4.53	66.64	14.49	4.73
Supermarket	1,000 sq. ft. GFA	4.53	66.64	14.49	4.73
INDUSTRIAL	1,000 sq. ft. GFA	4.68	68.77	14.96	4.88

* GFA = GROSS FLOOR AREA
E = Daily Construction Emissions (construction emissions include material handling)

E = (((project square footage/1000)×(Table 9-4 emission factor))/(Number of days to construct))

These emissions were estimated using energy consumption values provided in Energy and Labor in the Construction Sector, B. Hannon, R. Stein, and D. Serber, Science, 1978, 202:837–847

Table 9-5. Examples of Calculating Project Emissions

Project: 210 SINGLE-FAMILY DWELLING UNITS	(Lbs/Day)			
	ROC	NOx	CO	PM10
Unmitigated Daily Construction Emissions				
Exhaust Emissions*	6.66	97.93	21.30	7.01
• Construction Workers' Travel	0.0028	0.0025	0.270	0.0002
• Construction Material Hauling	0.95	13.98	3.04	0.99
• Construction Equipment	5.71	83.95	18.23	6.02
Fugitive Dust Emissions**	37.93	N/A	N/A	N/A
Total Construction Emissions	**6.66**	**97.93**	**21.30**	**44.94**
Construction Significance Thresholds	75.00	100.00	550.00	150.00
Significant?	No	No	No	No
Unmitigated Daily Operation Emissions				
Exhaust Emissions	56.70	48.30	697.20	4.20
Energy	0.04	4.02	0.70	0.14
Total Operation Emissions	**56.74**	**52.32**	**697.90**	**4.34**
Operation Significance Thresholds	55.00	55.00	550.00	150.00
Significant?	Yes	No	Yes	No

* Assumes 1,750 sq. ft. per residential unit and 5 years with 261 days per year to construct.
** Assumes 45 acres of grading in first 65 days of construction.

Project: 190,000 sq. ft. Multi-Tenant Office Building	(Lbs/Day)			
	ROC	NOx	CO	PM10
Unmitigated Daily Construction Emissions				
Exhaust Emissions*	40.36	593.09	128.97	42.11
• Construction Workers' Travel	0.0510	0.0364	0.5824	0.0044
• Construction Material Hauling	5.23	84.65	18.40	6.01
• Construction Equipment	35.07	508.41	109.99	36.10
Fugitive Dust Emissions**	N/A	N/A	N/A	7.74
Total Construction Emissions	**40.36**	**593.09**	**128.97**	**49.85**
Construction Significance Thresholds	75.00	100.00	550.00	150.00
Significant?	No	Yes	No	No
Unmitigated Daily Operation Emissions				
Exhaust Emissions	57.00	32.30	560.50	5.70
Energy	0.05	5.27	0.92	0.18
Total Operation Emissions	**57.05**	**37.57**	**561.42**	**5.88**
Operation Significance Thresholds	55.00	55.00	550.00	150.00
Significant?	Yes	No	Yes	No

* Assumes 1 year with 261 days per year to construct.
** Assumes 4.36 acres of grading in first 31 days of construction.

Table 9-6. Steps for Calculating Project Emissions (Screening Analysis)

(The following steps correspond to the unshaded portion of the flow chart in Figure 9-3.)

1. Determine if the project could be significant by comparing the project to the thresholds in Tables 6-2 and 6-3.

2. Calculate construction emissions using screening Tables 9-1 (Total Construction), 9-2 (Construction PM10), and 9-3 (Construction Workers' Travel) to determine total construction emissions.

3. Calculate operation emissions using screening Tables 9-7 (Mobile Source) and 9-8 (Stationary Source) to determine total operation emissions.

4. Compare project construction emissions to thresholds in Section 6.4 to determine significance.

5. Compare project operation emissions to the thresholds in Section 6.2 or 6.3 to determine significance.

6. Determine if the project could be cumulatively significant (Section 9.5).

Table 9-7. Screening Table for Estimating Mobile Source Operation Emissions

LAND USE	UNIT OF MEASURE	EMISSION FACTORS LBS/DAY			
		ROC	NO_X	CO	PM10
RESIDENTIAL					
Single Family Housing	Dwelling Unit	0.27	0.23	3.32	0.02
Apartments	Dwelling Unit	0.17	0.14	2.11	0.02
Condominiums	Dwelling Unit	0.16	0.13	1.91	0.01
Mobile Homes	Dwelling Unit	0.13	0.11	1.62	0.01
Retirement Community	Dwelling Unit	0.07	0.06	0.90	0.01
EDUCATION					
Elementary School	1,000 sq. ft. GFA*	0.25	0.03	1.84	0.03
High School	1,000 sq. ft. GFA	0.31	0.18	3.08	0.03
Community College	1,000 sq. ft. GFA	0.37	0.22	3.64	0.03
University	Student	0.07	0.04	0.67	0.01
COMMERCIAL					
Airport	Commercial Flight	3.66	1.58	33.06	0.32
Business Park	1,000 sq. ft. GFA	0.40	0.23	3.94	0.03
Day Care Center	1,000 sq. ft. GFA	2.10	0.91	19.03	0.19
Discount Store	1,000 sq. ft. GFA	1.69	0.35	13.24	0.17
Fast Food w/Drive-Thru	1,000 sq. ft. GFA	16.02	1.91	117.77	1.62
Fast Food w/o Drive-Thru	1,000 sq. ft. GFA	19.21	2.29	141.26	1.94
Government Office Complex	1,000 sq. ft. GFA	0.72	0.45	7.29	0.06
Hardware Store	1,000 sq. ft. GFA	1.99	0.41	15.58	0.19
Hotel	Occupied Room	0.26	0.06	2.07	0.02
Medical Office	1,000 sq. ft. GFA	0.91	0.39	8.20	0.08
Motel	Occupied Room	0.25	0.06	2.01	0.02
Movie Theatre	1,000 sq. ft. GFA	1.88	0.39	14.68	0.18
Car Sales	1,000 sq. ft. GFA	1.27	0.55	11.50	0.11
Office (small)	1,000 sq. ft. GFA	0.42	0.24	4.07	0.03
Office (medium)	1,000 sq. ft. GFA	0.30	0.17	2.95	0.03
Office (large)	1,000 sq. ft. GFA	0.25	0.14	2.48	0.02
Office Park	1,000 sq. ft. GFA	0.32	0.18	3.13	0.03
Racquet Club	1,000 sq. ft. GFA	0.56	0.04	4.00	0.06
Research Center	1,000 sq. ft. GFA	0.22	0.14	2.24	0.02
Resort Hotel	Occupied Room	0.28	0.07	2.22	0.03
Restaurant	1,000 sq. ft. GFA	2.56	1.11	23.17	0.23
Restaurant (high-turnover)	1,000 sq. ft. GFA	6.09	2.64	55.06	0.54
Shopping Center (small)	1,000 sq. ft. GFA	1.32	0.27	10.31	0.13
Shopping Center (medium)	1,000 sq. ft. GFA	1.02	0.21	7.97	0.10
Shopping Center (large)	1,000 sq. ft. GFA	0.79	0.16	6.16	0.08
Supermarket	1,000 sq. ft. GFA	4.43	1.27	36.56	0.42

* GFA = GROSS FLOOR AREA

Refer to Appendix 9 for methodologies and assumptions used in preparing this table.

(continued on next page)

Table 9-7. Screening Table for Estimating Mobile Source Operation Emissions (continued)

LAND USE	UNIT OF MEASURE	EMISSION FACTORS LBS/DAY			
		ROC	NO_x	CO	PM10*
INDUSTRIAL					
Light Industrial	1,000 sq. ft. GFA *	0.20	0.12	1.97	0.020
Heavy Industrial	1,000 sq. ft. GFA	0.04	0.03	0.42	0.004
Industrial Park	1,000 sq. ft. GFA	0.20	0.12	1.97	0.020
Manufacturing	1,000 sq. ft. GFA	0.11	0.07	1.09	0.010
INSTITUTIONAL/GOVERNMENTAL					
Clinic	1,000 sq. ft. GFA	0.58	0.14	4.69	0.06
Government Center	1,000 sq. ft. GFA	0.66	0.29	6.00	0.06
Hospital	Beds	0.31	0.14	2.83	0.03
Library	1,000 sq. ft. GFA	1.08	0.18	8.20	0.11
Nursing Home	Beds	0.07	0.04	0.74	0.01
U.S. Post Office	1,000 sq. ft. GFA	2.14	0.53	17.19	0.21

* GFA = GROSS FLOOR AREA

Refer to Appendix 9 for methodologies and assumptions used in preparing this table.

Table 9-8. Screening Table for Estimating Area Source Operation Emissions – Energy Consumption

LAND USE	UNIT OF MEASURE	EMISSION FACTORS LBS/DAY			
		ROC	NO_x	CO	PM10
RESIDENTIAL					
Single Family Housing	Dwelling Unit	0.00017	0.01916	0.00333	0.00067
Apartments	Dwelling Unit	0.00017	0.02203	0.00333	0.00067
Condominiums	Dwelling Unit	0.00017	0.01916	0.00333	0.00067
Mobile Homes	Dwelling Unit	0.00017	0.01916	0.00333	0.00067
Retirement Community	Dwelling Unit	0.00017	0.01916	0.00333	0.00067
EDUCATION					
Elementary School	1,000 sq. ft. GFA *	0.00017	0.01985	0.00345	0.00069
High School	1,000 sq. ft. GFA	0.00024	0.02773	0.00482	0.00096
Community College	1,000 sq. ft. GFA	0.00032	0.03655	0.00636	0.00127
University	Student	N/A	N/A	N/A	N/A
COMMERCIAL					
Airport	Commercial Flight	N/A	N/A	N/A	N/A
Business Park	1,000 sq. ft. GFA	0.00024	0.02773	0.00482	0.00096
Day Care Center	1,000 sq. ft. GFA	0.00024	0.02773	0.00482	0.00096
Discount Store	1,000 sq. ft. GFA	0.00032	0.03718	0.00647	0.00129
Fast Food	1,000 sq. ft. GFA	0.00130	0.14903	0.02592	0.00518
Government Office Complex	1,000 sq. ft. GFA	0.00024	0.02773	0.00482	0.00096
Hardware Store	1,000 sq. ft. GFA	0.00032	0.03718	0.00647	0.00129
Hotel	Occupied Room	0.00019	0.02142	0.00373	0.00075
Medical Office	1,000 sq. ft. GFA	0.00024	0.02773	0.00482	0.00096
Motel	Occupied Room	0.00019	0.02142	0.00373	0.00075
Car Sales	1,000 sq. ft. GFA	0.00032	0.03718	0.00647	0.00129
Office	1,000 sq. ft. GFA	0.00024	0.02773	0.00482	0.00096
Raquet Club	1,000 sq. ft. GFA	0.00024	0.02773	0.00482	0.00096
Research Center	1,000 sq. ft. GFA	0.00024	0.02773	0.00482	0.00096
Resort Hotel	Occupied Room	0.00006	0.00643	0.00112	0.00022
Restaurant	1,000 sq. ft. GFA	0.00130	0.14903	0.02592	0.00518
Shopping Center	1,000 sq. ft. GFA	0.00032	0.03718	0.00647	0.00129
Supermarket	1,000 sq. ft. GFA	0.00141	0.16195	0.02816	0.00563
INDUSTRIAL	1,000 sq. ft. GFA	0.00024	0.02773	0.00482	0.00096

* GFA = GROSS FLOOR AREA

Refer to Appendix 9 for methodologies and assumptions used in preparing this table.

Table 9-9. Future Year CO Adjustment Factors

LOCATION	YEAR							
	1993	1994	1995	1996	1997	1998	1999	2000
1 – Los Angeles	0.78	0.73	0.68	0.62	0.57	0.51	0.46	0.41
2 – West L.A.	0.79	0.74	0.69	0.63	0.58	0.53	0.48	0.42
3 – Hawthorne	0.78	0.72	0.67	0.61	0.56	0.50	0.44	0.39
4 – Long Beach	0.78	0.73	0.67	0.62	0.56	0.51	0.45	0.40
5 – Pico Rivera	0.78	0.73	0.67	0.62	0.56	0.51	0.45	0.40
6 – Reseda	0.78	0.72	0.67	0.61	0.56	0.50	0.45	0.39
7 – Burbank	0.78	0.72	0.67	0.61	0.56	0.50	0.45	0.39
8 – Pasadena	0.79	0.73	0.68	0.63	0.57	0.52	0.47	0.41
9 – Azusa	0.80	0.75	0.71	0.66	0.61	0.56	0.51	0.46
10 – Pomona	0.84	0.80	0.76	0.72	0.68	0.64	0.60	0.56
11 – Whittier	0.79	0.74	0.69	0.63	0.58	0.53	0.48	0.43
12 – Lynwood	0.80	0.75	0.69	0.64	0.59	0.54	0.49	0.44
13 – Santa Clarita	0.85	0.81	0.77	0.73	0.69	0.65	0.61	0.58
14 – Lancaster	0.82	0.77	0.73	0.68	0.64	0.59	0.55	0.50
15 – San Gabriel Mountains	0.80	0.75	0.70	0.65	0.60	0.56	0.51	0.46
16 – La Habra	0.83	0.79	0.75	0.71	0.67	0.63	0.59	0.55
17 – Anaheim	0.80	0.75	0.70	0.65	0.60	0.55	0.50	0.45
18 – Costa Mesa	0.80	0.75	0.71	0.66	0.61	0.56	0.51	0.46
19 – El Toro	0.95	0.93	0.92	0.91	0.89	0.88	0.87	0.85
20 – Central Costal	0.84	0.80	0.76	0.71	0.67	0.63	0.59	0.55
21 – Capistrano Valley	0.87	0.84	0.81	0.78	0.74	0.71	0.68	0.65
22 – Norco	0.88	0.85	0.82	0.79	0.76	0.73	0.70	0.67
23 – Rubidoux	0.85	0.82	0.78	0.74	0.70	0.67	0.63	0.59
– Riverside Mag.	1.86	2.08	2.29	2.51	2.72	2.94	3.16	3.37
24 – Perris	0.96	0.95	0.95	0.94	0.93	0.92	0.91	0.90
25 – Lake Elsinore	1.17	1.21	1.25	1.30	1.34	1.38	1.42	1.47
26 – Temecula	3.87	4.58	5.30	6.02	6.74	7.45	8.17	8.89
27 – Anza	0.64	0.55	0.46	0.37	0.28	0.19	0.10	0.01
28 – Hemet	1.03	1.03	1.04	1.05	1.06	1.06	1.07	1.08
29 – Banning	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
30 – Palm Springs	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
31 – East Riverside County	0.64	0.55	0.45	0.36	0.27	0.18	0.09	0.00
32 – Northwest San Bernardino Valley	0.75	0.69	0.62	0.56	0.50	0.43	0.37	0.31
33 – Upland	0.79	0.74	0.68	0.63	0.58	0.52	0.47	0.42
34 – Fontana	1.32	1.41	1.49	1.57	1.65	1.73	1.81	1.89
– San Bernardino	3.34	3.93	4.51	5.10	5.68	6.27	6.85	7.44
35 – Redlands	0.96	0.95	0.95	0.94	0.93	0.92	0.91	0.90
36 – West San Bernardino Mountains	0.77	0.71	0.66	0.60	0.54	0.48	0.43	0.37
37 – Crestline	0.97	0.96	0.95	0.94	0.94	0.93	0.92	0.91
38 – East San Bernardino Mountains	0.96	0.95	0.94	0.93	0.92	0.91	0.90	0.89

Table 9-10. Air Quality Analysis for Assessing Project Alternatives - Format Example

Pollutants	Energy: Natural Gas lbs/day	Energy: Electricity lbs/day	Vehicle Trips	Stationary	Totals
Proposed Project: CO ROC NO_X SO_X PM10					
Alternative A: CO ROC NO_X SO_X PM10					
Alternative B: CO ROC NO_X SO_X PM10					
Alternative C: CO ROC NO_X SO_X PM10					

Identify any assumptions that are not held constant in the EIR and the basic default assumptions used in the analysis of all the alternatives. Use the screening tables for operation to complete this analysis.

ASSESSING TOXIC AIR POLLUTANTS

CHAPTER 10

During the past decade, concern has grown over certain air pollutants (other than the criteria pollutants) that may cause cancer or otherwise harm human health and the environment. Public interest and hence public policy clearly demand that air toxics and acutely hazardous materials be taken into account. Chapter 3 provides background information on air toxics, defining and explaining their origins. Chapter 5 discusses the siting of sensitive receptors within a close proximity to toxic emission sources. This chapter discusses three primary issues: 1) the analysis necessary for sources of air toxics, 2) the analysis necessary to assess the siting of sensitive receptors within a quarter mile of a toxic source, and 3) the analysis necessary to assess risks from acutely hazardous materials. Figure 10-1 illustrates the sequential flow of these analyses.

Projects emitting significant levels of air toxics must be carefully evaluated, since air toxics may cause harmful effects. Because of their known expected harmful effects, regulations adopted by the federal and state governments and limited purpose districts restrict the levels of air toxics that may be emitted from stationary sources (refer to Chapter 3 for background information.

Concern about toxics introduces a new dimension into the environmental planning process. Planners must now be aware of air toxics and what is required to prevent their release. Historically, environmental planning for air quality has focused on criteria pollutants, about which a great deal is known and on which information can be built into the planning process. "Safe" limits are established for criteria pollutants (ambient air quality standards), and thresholds for significant levels of emissions can be established relative to the air quality standards threshold levels. Release of criteria pollutants at levels exceeding the standards can cause reversible effects, such as eye irritation and coughing, as well as irreversible health effects including deterioration of lung function. When emissions are kept at or below the accepted threshold levels, no adverse health effects are expected to occur.

There are different types of toxics analysis depending on the type of toxic air pollutant and conditions of release (i.e., routine and accidental releases). Table 10-1 provides an overview of the compounds that should be analyzed depending on whether there is a routine or accidental release.

The state is required to compile and maintain a list of substances recognized by the state ARB as presenting a chronic or acute threat to health when present in the ambient air, including, but not limited to, any neurotoxins, or chronic respiratory toxins. Table 10-2 provides a list of current state and federal designated toxic contaminants (AB 1807 and federal NESHAPs) that should be analyzed for chronic health hazards. Table 10-3 lists District-recommended air dispersion models for risk assessment use. Table 10-4 provides a list of acutely hazardous materials that should be analyzed where there is a risk of accidental release. Table 10-5 provides a list of air contaminants that should be analyzed for acute health hazards during routine short-term releases.

As California is part of a belt of earthquakes and volcanic activity that circles the Pacific, there is concern in the Basin regarding the siting of facilities that use acutely hazardous materials and their proximity to active earthquake faults. The San Andreas fault, which extends almost the entire length of the state, is an area of high seismic activity.

The U.S. Geological Survey (USGS) evaluates California earthquake probabilities. Its evaluations are based on a probability model that assumes increased probability with elapsed time since the previous major earthquake on a fault system. A report by FEMA (Federal Emergency Management Agency, 1980) stated that a major earthquake in Southern California comparable to the great earthquake of 1857 (L.A., 7.9 Richter) has a probability of occurrence greater that 50% in the next 30 years. The Working Group of the USGS found that the earthquake hazard on the South San Andreas fault is at least as high as that reported by FEMA. Planners should consult the Alquist/Priola maps to determine if a project proposes to locate near an earthquake zone.

10.1 Roles of the District and Local Governments

Both the District and local governments issue permits to sources that could emit toxic air or acutely hazardous contaminants. The District regulates air toxics and acutely hazardous materials by issuing operating permits which limit the amount of emissions. Local governments control the impact of air toxics on sensitive receptors through land use decisions. The District has adopted Rule 1401 which specifies limits for maximum individual cancer cases from new or modified stationary sources which emit carcinogenic air toxics. Local governments grant discretionary permits for land uses emitting air toxics and issue building permits for the construction of such facilities. In some cases, the local government permit is for equipment that is directly related to a land use, such as a permit for a gas station. Other times the equipment is an accessory to the primary land use, as would be the case with the extensive consumption of gasoline fuels by internal combustion engines at a special activity center.

The local government is the lead agency with respect to the land use decision and any discretionary permits that are required. The District is the lead agency for the District permit to construct and operate. In both cases, the local governments and the District are the respective responsible agencies. The lead agency must consult with responsible agencies. Refer to the front matter of this Handbook to identify the appropriate District number to contact regarding environmental documentation.

10.2 Local Government Land Use Permits (for Stationary Sources Emitting Toxic Emissions)

Most likely, planners will only see those projects that fall into one of two categories: (1) those that involve a use new to the local government, or (2) those for an expanding use that is subject to a discretionary permit. The local government's involvement for most existing uses, is often limited to issuing business licenses, and building permits for minor alterations and equipment. When evaluating permits for new uses, planners have the opportunity to focus on the land use implications of the proposed project. In considering air toxics, planners may use Table 5-1 which identifies land uses and equipment commonly associated with significant toxic emissions, to determine when public health risk assessment should be performed. Refer to Appendix 3 to obtain a full listing of toxic air contaminants under District Rule 1401, ARB (AB 1807), and EPA (NESHAPs).

Planners can use the information in Table 5-1 to identify projects prior to consulting with District staff and prior to the completion of the Initial Study and the preparation of the draft EIR. If the planner determines that the project could have carcinogenic air toxics emissions, based on the District's information, the EIR should thoroughly analyze the air toxics emissions and include a discussion of land use compatibility issues.

In reviewing the EIR, local governments should consider the potential for carcinogenic toxic emissions and threat of release of acutely hazardous materials due to earthquakes from a land use perspective. Local governments should focus the analysis primarily on land use siting issues. As with toxics, the District adopts rules to regulate emissions from these sources. In granting a land use permit that involves carcinogenic toxic emissions or acutely hazardous materials, local government decision makers should ask the following:

- o What is the health risk to the population surrounding the facility?
- o If a discretionary permit is granted to a significant source of toxic emissions, how will this affect land use in the future?
- o What are the health risks associated with siting a sensitive receptor within a quarter mile of a source of toxic emissions?
- o What is the risk of upset from siting a facility using acutely hazardous materials near an earthquake zone? (i.e., Alquist/Priola zone).

The EIR should provide technical information that will assist local governments in addressing these issues. The District staff is available to review any air toxic analysis. The EIR does not need to address District permitting requirements for stationary sources, since the District is responsible for ensuring that emissions from both small and large sources are kept at acceptable levels. The District permitting process does not address land use compatibility or siting issues, which are the responsibility of local governments.

Land use compatibility issues need only be addressed for: (1) projects that emit toxic air contaminants as identified in District Rule 1401, AB 1807, and NESHAPs (2) the siting of sensitive receptors that could be impacted by existing sources of toxic emissions, and (3) projects that have a risk of releasing (either routinely or accidentally) acutely hazardous materials. Refer to Table 5-1 for an example of land uses that could meet this criteria. In addition, if an existing source emitting toxic air contaminants has not obtained a Rule 1401 permit and if a sensitive receptor is to be located within a quarter mile of the existing source, the issue of land use compatibility should be considered.

10.3 District Permits

The District regulates levels of air toxics through a permitting process that covers both construction and operation. Both new and existing industries routinely use materials classified as air toxics. For both new and modified sources, the District has adopted Rule 1401, with which the project proponent must comply before the project can be constructed and put into operation. A permit, when issued, will allow the facility to operate and will specify the conditions, if any, that might limit its operation. The District permit is granted on the basis of an independent environmental analysis conducted according to CEQA Guidelines.

The District's CEQA Guidelines for permit processing consider the following types of projects significant:

- o Any project involving the emission or threatened emission of a carcinogenic or toxic air contaminant identified in District Rule 1401 that exceeds the maximum individual cancer risk of one in one million or 10 in one million if the project is constructed with best available control technology for toxics (T-BACT) using the procedures in District Rule 1401

- o Any project that could accidentally release an acutely hazardous material (Table 10-4) or routinely release a toxic air contaminant posing an acute health hazard (Table 10-5)

- o Any project that could emit an air contaminant that is not currently regulated by District rule, but that is on the federal or state air toxics list (see Appendix 3 and Table 10-2)

Under CEQA, the District is the lead agency for District permits involving projects meeting these criteria. The District will prepare a Negative Declaration when it is determined that the project does not have a significant adverse impact on the environment pursuant to Article 6 of the District CEQA Guidelines. The District will prepare a Mitigated Negative Declaration (MND) when it is determined that the project may have significant adverse impacts on the environment, but that the permit applicant can modify the project so as to eliminate all identified significant impacts or reduce them to a level of insignificance. The District will prepare an EIR when it is determined through substantial evidence that the project might produce significant adverse environmental impacts pursuant to Articles 7 and 9 of the District CEQA Guidelines.

The local government within whose jurisdiction the proposed project is located will be considered the responsible agency. When the District prepares an EIR for its permit, the District will circulate both the Notice of Preparation and draft EIR to the appropriate local government. The District provides the local government, as responsible agency, the opportunity to review and comment on the EIR.

10.4 Assessing Toxics/Acutely Hazardous Materials

Whenever a proposed project will likely entail the use of chemical compounds that: have been identified in District Rule 1401; have been placed on the ARB air toxics list pursuant to AB 1807 or EPA's National Emissions Standards for Hazardous Air Pollutants (NESHAPs) (Table 10-2) and air toxic air contaminants of concern for acute exposure (Table 10-5); or will entail a facility using an acutely hazardous material (Table 10-4), the project proponent should anticipate that some level of risk assessment will be required. In addition, if a facility is using acutely hazardous materials near an earthquake zone or sensitive receptor, a risk assessment should also be performed. The quantities involved for some projects, and the actual release, may result in insignificant levels of risk. In such cases, a very simple "worst case" screening assessment may make that case clear and allow permitting to move ahead. In others, the situation may be uncertain or potentially result in unacceptable risks. At that point, a refined risk assessment may be required. Additional information is available on how to prepare a risk assessment by referring to the SCAQMD document, *"Procedures for Preparing Risk Assessments to Comply with the Air Toxics Rules of the SCAQMD,"* at the Public Information Center.

As required in the EIR, assessing toxics and acutely hazardous materials can be complex and time consuming. It is important at the start to distinguish between those cases where some lesser level of analysis may be sufficient and where nothing less than the most thorough assessment will serve the public interest. Even with limited information, a screening procedure may define a "worst-case" estimate of risk. Simple screening procedures may also give the basis for a more detailed assessment. Contact the District local governments/CEQA unit if the Planner is unsure about the level of analysis necessary.

A useful first step in the screening procedure is to find out whether or not a risk assessment for the facility has been required and performed under AB 2588. A facility will only have an AB 2588 assessment if it is an existing facility. Such an assessment will have brought together most though not necessarily all of the information required for analysis. Information in all cases will include an estimate of the quantities of materials that might be released based on: (1) data from emissions testing, (2) a mass balance calculation, or (3) emission factors for types of processes.

When the District's screening procedure as detailed in the District's procedures for preparing risk assessments is used, some simplified assumptions are made: flat terrain in an urban area, uniform emissions throughout the operation schedule, a source close to the property line. If the project is at substantial variance from these conditions, the simple screening procedure may not be accurate. Exposures to an urban population in a residential area are assumed to extend over the standard reference lifetime of 70 years. Exposures in commercial or industrial areas, presumably limited to working hours, can be adjusted downward.

The District's air toxics compliance guide, listed in the references at the end of this chapter, will help an applicant or consultant work through the required screening procedure, leading to an estimated maximum cancer risk for each carcinogenic air contaminant. Although the District does not currently regulate non-carcinogens, the risks associated with exposure to these air toxics may be assessed following the guidelines established by the California Air Pollution Control Officers Association (CAPCOA) for use in preparing risk assessments for the AB 2588 program.

In those cases where substantial potential risk may be involved, or where the simpler screening approach leads to a determination of significance, a more extensive refined risk assessment will be necessary. At that point, more detailed information will be required, such as:

- Stack Height
- Stack Diameter
- Exhaust Gas Exit Velocity
- Exhaust Gas Exit Temperature
- Exhaust Gas Volume
- Dimensions of Building Structures Near the Source
- Dimensions of Area Sources
- Land Use and Geographical Features Surrounding the Facility

It can be particularly important to have information available on land uses in the surrounding area, and information such as: population distribution in general and population distribution by time of day; locations of potentially sensitive receptors; location and availability of emergency services and their relative sophistication; and similar data.

EIRs for land uses that have the potential to emit toxics must address and identify potential risks associated with siting, including identifying risks to surrounding land uses. The potential for risk and impact on future land uses as well as impact on projects already in place should be considered. The EIR should assist local government in making the land use decision that specifically will:

(1) Identify the risk to the population from the facility

(2) Evaluate future land use implications

(3) Incorporate mitigation measures when appropriate

Sometimes facilities that emit toxics can apply mitigation measures such as: adjusting the location of equipment emitting toxics so that it is not upwind of sensitive receptors, and designating surrounding properties for industrial uses.

The CEQA air toxic analysis is not a substitute for complying with District toxic regulations. The project will still need to undergo an in-depth risk assessment prior to issuance of a District permit. Appendix 10 summarizes the procedures to be followed in complying with Rule 1401 and is a useful guide for preparation of a toxic emission analysis for the EIR.

10.5 Siting of Sensitive Receptors

The local government will need to analyze the land use implications when siting a toxic source within its jurisdiction, particularly when sensitive receptors will be involved (refer to Chapter 5 for discussion on sensitive receptors). Such an analysis is not a substitute for the subsequent District permitting action over the source of the toxic emissions which requires a health risk assessment to be performed pursuant to Rule 1401. Local government analysis of the land use implications should only be based on an accurate health risk assessment, and the District staff is available to review such assessments.

Screening procedures identified in Chapter 5 will determine if further toxic emissions analysis is necessary when siting a sensitive receptor in proximity to a project that releases air toxics. If the initial screening indicates that the toxic emissions could exceed significance thresholds, the planners should require a thorough analysis as part of the CEQA documentation.

Specifically, planners can require that a public health risk assessment be performed and reviewed by the District. This type of assessment would involve summing risks from facilities within a quarter mile radius to the proposed sensitive receptor. Local governments then need to determine if the risk is acceptable in their community. The District uses the following standards for protecting existing receptors from new sources of toxic emissions: exceedance of the maximum individual cancer risk of 1 in 1 million, or 10 in 1 million if the project has best available control technology for toxics (T-BACT).

The health risk assessment for sensitive receptors should be performed using the same methodologies and inputs as those performed for a direct source of toxic emissions on the AB 1807 and NESHAPs lists. Each facility that does not have a Rule 1401 permit should be included in the analysis to the extent feasible. The toxic emissions should be quantified for each source using the District's procedures for Rule 1401 and an individual cancer risk identified for the sensitive receptor in Chapter 5. Risk assessments that have been previously performed pursuant to AB 2588 and Rule 1401 can be used in lieu of a new assessment. The analysis should include AB 2588 data, District Rule 1401 data, AB 1807, EPA NESHAPs toxic compounds and toxic air contaminants of concern for acute exposure. The project proponent should analyze publicly available information on health risks posed by nearby sources of toxic emissions. The District serves as a clearinghouse for publicly available information on toxic emissions and associated public health risks. This information is compiled from documentation required of toxic emitters by Rule 1401 and the AB 2588 Air Toxics Hot Spot Program. The applicant should also make a reasonable attempt to obtain toxic information from any sources that could potentially affect the project site which is not covered by Rule 1401 and AB 2588. Pursuant to CEQA Guidelines Section 15151, if the information is not available, the sufficiency of the air toxics analysis should be reviewed in light of what is reasonably feasible.

The EIR, at a minimum, should:

- o Identify all potential land uses emitting toxics within a quarter mile surrounding the proposed project
- o List types of pollutants most commonly associated with these uses
- o Check the AB 2588 database and identify any risk levels that have been reported
- o Perform a health risk assessment for those pollutants listed on the AB 1807 and EPA NESHAPs lists (Table 10-2), toxic air contaminants of concern for acute exposure (Table 10-5), and data from District Rule 1401 and the AB 2588 program

10.6 Air Quality Modeling Tools

Table 10-3 lists the air dispersion models recommended by the District for use in performing risk assessments. This list is consistent with the CAPCOA-recommended models. The most recent version of these models should be used. The CAPCOA *Air Toxics Hot Spot Program Risk Assessment Guidelines* should be consulted prior to performing any dispersion modeling.

References

Procedures for Preparing Risk Assessments to Comply with Air Toxics Rules of the South Coast Air Quality Management District. Available from the District's Public Information Center.

Air Toxics "Hot Spots" Information and Assessment Act of 1987. California Health and Safety Code Section 44300 *et seq.*

Air Toxics "Hot Spots" Program Risk Assessment Guidelines. California Air Pollution Control Officers Association (CAPCOA); updated yearly. Available from CAPCOA for fee, (916) 676-4323.

Air Toxics Assessment Manual. California Air Pollution Control Officers Association (CAPCOA); 1987.

Toxic Air Contaminants (Chapter 3.5). California Health and Safety Code Section 39650 *et seq.*

Guideline on Air Quality Models (Revised). U.S. Environmental Protection Agency; 1986. EPA-450/2-78-027R.

District Regulation 14. Rules and Regulations. Available from the District's Public Information Center.

California Air Resources Board prepares documents for each specific AB 1807 toxic air contaminant which is identified. These documents are available from ARB. Contact the ARB's Public Information Office at (916) 322-2990.

User guides for each particular air dispersion model are available and should be used with the appropriate model. These manuals are available from U.S. EPA.

Figure 10-1. Toxic Air Quality Analysis Flow Chart

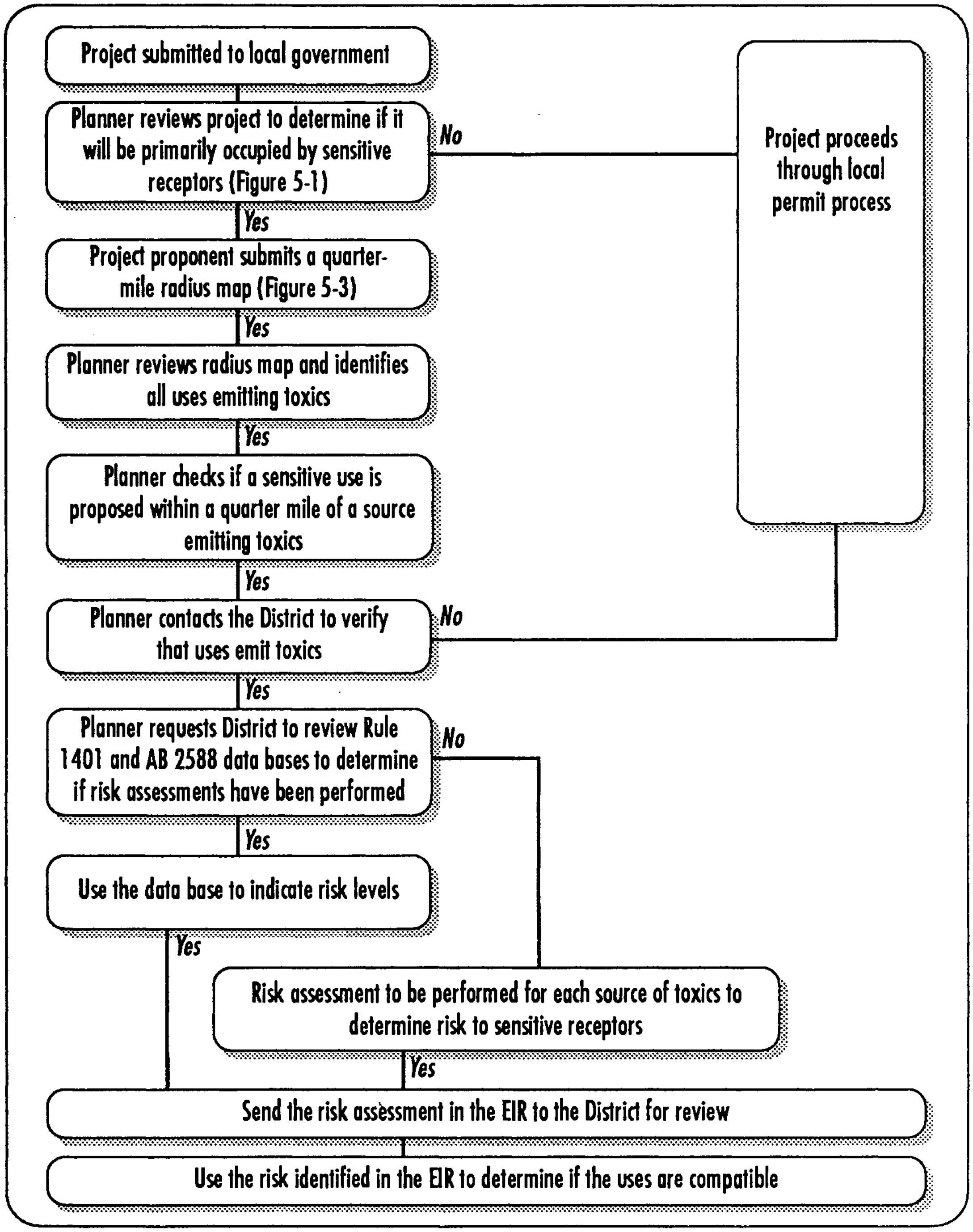


Table 10-1. Toxics Analysis Overview

Routine Releases of Toxic Air Contaminants	Accidental Releases
• Carcinogenic compounds • Compounds of concern for non-cancer health effects from chronic exposure • Compounds of concern for acute exposure	• Compounds of concern for acute exposure from accidental release

Table 10-2. Toxic Air Contaminants Identified Under AB 1807 and Federal NESHAPs

Toxic Emission	Representative Uses and Sources
Acetaldehyde	Combustion of fuel from mobile sources, agricultural burning, wildfires
Asbestos	Manufacturing of brakes, acoustic ceiling tiles, gaskets, brake shoe rebuilders and recyclers
Benzene	Constituent of gasoline; used in organic chemical manufacturing, pharmaceuticals, food processing
1,3-Butadiene	Incomplete combustion of petroleum-derived fuels, petroleum refining, certain fumigant production and styrene-butadiene copolymer production
Cadmium	Secondary smelters; cement manufacturing plants; cadmium electroplating facilities; oil or coal burning; sewage sludge incinerators
Carbon Tetrachloride	Use of pesticides; production of fluorocarbon, chlorinated paraffin wax, and carbon tetrachloride
Chlorinated Dioxins and Dibenzofurans	Manufacture of chemicals such as pesticides and wood preservatives; manufacture of PCBs, solid waste incinerators
Chloroform	Manufacture of fluorocarbon 22 refrigerants and fluoropolymers; manufacture of pharmaceuticals, laboratory use; water chlorination (POTWs); air stripping towers, chemical manufacturing cooling towers; pulp bleaching in paper manufacturing
Chromium VI	Chrome plating, combustion of oil, coal, municipal waste and sewage sludge, used in production of chromium chemicals and paints
Ethylene Dibromide	Pesticide and solvent use; chemical feed stock for dye; manufacturing of pharmaceuticals
Ethylene Dichloride	Manufacture of vinyl chloride, solvents, paints, varnish, and finish removers; metal degreasing, soaps and scouring compound

(Continued on next page)

Table 10-2. Toxic Air Contaminants Identified Under AB 1807 and Federal NESHAPs (continued)

Toxic Emission	Representative Uses and Sources
Ethylene Oxide	Sterilization; fumigation; surfactant manufacturing; ethylene oxide distribution
Formaldehyde	Manufacture of resins, rubber and paper products, dyes, plastics and cosmetics; chemical sterilant, leather tanner, plating, preservative, embalming fluid and fumigant; fuel combustion
Inorganic Arsenic	Pesticide use; herbicide use, arsenic mining; cement, glass, and chemical manufacturing; agricultural burning; waste incineration; secondary lead smelting
Methylene Chloride	Food processing; manufacturing of paint removers, aerosols, degreasers, polyurethane foam, electronics, chemical, and pharmaceuticals
Trichloroethylene	Polyvinylchloride production; adhesive, painting, and coating operation; refrigerant and heat exchange operations; solvent applications; land POTWs; ground aeration; air strippers
Nickel	Production of polyvinylchloride for plastic products, fabrication facilities; landfills; POTWs
Perchlorethylene	Dry cleaning; degreasing, paint, coatings, adhesives, aerosols and chemical production; printing operations
Vinyl Chloride	Asbestos mining and milling; secondary smelting; solid waste and sewage sludge incineration; electroplating and electrical equipment manufacturing; cement manufacturing

Table 10-3. District-Recommended Models for Risk Assessments

Application	Source Type	Land Use	Model
Flat	Point, Area[2]	Rural, Urban	ISC2
Complex	Point	Rural	COMPLEXI, RTDM
		Urban	COMPLEXI, SHORTZ
	Area[2]	Rural, Urban	ISC2

Notes: 1. The District assumes urban conditions for all projects in the Basin. The project proponent should provide justification if rural conditions are assumed.
2. Ground level or near ground level, non-buoyant emission.

Table 10-4. Acutely Hazardous Materials

Acetone cyanohydrin	Trans-1,4-dichlorobutene	Nickel carbonyl
Acrolein	Dichloroethyl ether	Nitric acid
Acrylonitrite	Dimethyldichlorosilane	Nitric oxide
Acrylyl chloride	Dimethylhydrazine	Nitrobenzene
Allyl alcohol	Dimethyl phosphorochloridothioate	Parathion
Allylamine	Epichlorohydrin	Peracetic acid
Ammonia (anhydrous)	Ethylenediamine	Perchloromethylmercaptan
Ammonia (aqueous solution, conc. ≥20%)	Ethyleneimine	Phenol (liquid)
Aniline	Ethylene oxide	Phosgene
Antimony pentafluoride	Fluorine	Phosphine
Arsenous trichloride	Formaldehyde	Phosphorous oxychloride
Arsine	Formaldehyde cyanohydrin	Phosphorous trichloride
Benzal chloride	Furan	Piperidine
Benzenamine, 3-(trifluoromethyl)-	Hydrazine	Propionitrile
Benzotrichloride	Hydrochloric acid (solution, conc. ≥20%)	Propyl chloroformate
Benzyl chloride	Hydrocyanic acid	Propyleneimine
Benzyl cyanide	Hydrogen chloride (anhydrous)	Propylene oxide
Benzyl trichloride	Hydrogen fluoride	Pyridine, 2-methyl-5-vinyl-
Boron trifluoride	Hydrogen peroxide (conc. ≥52%)	Sulfur dioxide
Boron trifluoride compound with methyl ether (1:1)	Hydrogen selenide	Sulfuric acid
Bromine	Hydrogen sulfide	Sulfur tetrafluoride
Carbon disulfide	Iron, pentacarbonyl-	Sulfur trioxide
Chlorine	Isobutyronitrile	Tetramethyllead
Chlorine dioxide	Isopropyl chloroformate	Tetranitromethane
Chloroethanol	Lactonitrile	Thiophenol
Chloroform	Methacrylonitrile	Titanium tetrachloride
Chloromethyl ether	Methyl bromide	Toluene 2,4-diisocyanate
Chloromethyl methyl ether	Methylene chloride	Toluene 2,6-diisocyanate
Crotonaldehyde	Methylene chloroformate	Toluene diisocyanate (unspecified isomer)
Crotonaldehyde (E)-	Methyl hydrazine	Trichloroethylsilane
Cyanogen chloride	Methyl isocyanate	Trimethylchlorosilane
Cyclohexylamine	Methyl mercaptan	Vinyl acetate monomer
Diborane	Methyl thiocyanate	Vinyl chloride
	Methyltrichlorosilane	

Acutely hazardous materials are substances which pose a risk of causing death, injury, or serious adverse effects to human health or the environment from short-term or accidental release. Listed in the table are substances commonly in use within the Basin which may pose an acute health hazard during a short-term or accidental release.

Table 10-5. Toxic Air Contaminants of Concern for Acute Exposure

Ammonia	Hydrogen Sulfide
Acrolein	Lead
Arsine	Maleic Anhydride
Benzyl Chloride	Inorganic Mercury
Carbon Tetrachloride	Methyl Chloroform
Chlorine	Methylene Chloride
Copper and Compounds	Nickel Compounds
1,4-Dioxane	Nitrogen Dioxide
Ethylene Glycol Methyl Ether	Ozone
Ethylene Glycol Ethyl Ether	Perchloroethylene (Tetrachloroethylene)
Ethylene Glycol Monoethyl Ether Acetate	Phosgene
Ethylene Glycol Monobutyl Ether	Propylene Oxide
Formaldehyde	Selenium
Hydrochloric Acid	Sodium Hydroxide
Hydrogen Cyanide	Sulfates
Hydrogen Fluoride	Sulfur Dioxide
	Xylenes

Listed in this table are substances commonly in use within the Basin which may pose an acute health hazard during routine short-term release.

MITIGATING THE IMPACT OF A PROJECT

CHAPTER 11

CEQA requires public agencies to take responsibility for protecting the environment. In regulating public or private projects, agencies are expected to avoid or minimize environmental damage. The purpose of an EIR is to identify the significant effects of a project on the environment, identify alternatives to the project, and indicate the manner in which significant impacts can be mitigated or avoided (PRC Section 21002.1). CEQA further states that a public agency should not approve a project as proposed, if there are feasible alternatives or mitigation measures that would substantially lessen any significant effects on the environment (unless all feasible mitigation has been applied and overriding considerations are made pursuant to CEQA Guidelines Section 15093).

If the impacts cannot be mitigated below the significance threshold, they must nevertheless be reduced. CEQA describes various types of mitigation as follows:

(a) Avoiding the impact altogether by not taking a certain action or part of an action

(b) Minimizing impacts by limiting the degree or magnitude of the action and its implementation

(c) Rectifying the impact by repairing, rehabilitating, or restoring the impacted environment

(d) Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action

(e) Compensating for the impact by replacing or providing substitute resources or environments

Section 15041 (a) of the State CEQA Guidelines states that the lead agency has the authority to require changes in any or all activities involved in a project in order to lessen or avoid significant effects on the environment. With regard to any aspects of a project over which the District acts as a responsible agency, the District has the authority to also require that changes be made to those aspects of the project over which the responsible agency has authority. The District as a commenting agency has a duty to recommend mitigation to lessen air quality impacts as the local agency responsible for air quality.

Mobile source emissions in the SCAB and construction-related PM10 emissions in the Coachella Valley are of particular concern to the District. In addition to CEQA requirements, mitigation of impacts are necessary to achieve the federal and state ambient air quality standards. Specifically, all future sources of emissions, including those associated with land development, must be mitigated to the greatest extent possible to expeditiously achieve ambient air quality standards.

11.1 Overview of Mitigation Measures

This chapter contains a menu of mitigation measures that project proponents and local governments can use to select those measures that are feasible to mitigate the project's impact. According to CEQA Guidelines Section 15364, feasible means capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental, legal, social, and technological factors. Lead agencies are responsible for determining the feasibility of mitigation measures. In instances where a project has a significant impact, CEQA requires that feasible mitigation measures be applied to the project in order to reduce cumulative impacts and to reduce individually significant impacts (Section 9.5, Chapter 9). The District considers a project to be mitigated to a level of insignificance if its impact is mitigated below the thresholds in Chapter 6. Refer to Chapter 6 to determine when an impact is significant.

A project which incorporates all feasible mitigation measures and/or CEQA options for mitigation (refer to CEQA Guidelines Section 15370 (a)(e)) is considered to have substantially mitigated air quality impacts pursuant to CEQA Guidelines Section 15093 (b). However, if the project's emissions are still over the significance level and the agency decides to approve the project, the lead agency must prepare a Statement of Overriding Considerations pursuant to CEQA.

The Handbook establishes mitigation measures for reducing emissions associated with the construction and operation of a project. These lists are not exhaustive. Both lead agencies and project proponents are encouraged to identify and quantify additional mitigation measures appropriate to individual projects.

11.2 Criteria for Mitigation Measures

The project's net emissions will determine the impact that the project will have after mitigation measures are applied. Net project emissions are determined by subtracting the emission reductions due to mitigation measures from the total project emissions. The District recommends that only mitigation measures which meet the following criteria (which are summarized in Table 11-1) can be used in calculating a project's emission reductions to determine if the project could have a significant air quality impact.

1. The effect of the mitigation measures should coincide with the cause of the impact.

Mitigation measures should be linked to the phase of construction or operation that is generating the impact to be mitigated. Project proponents should implement the mitigation measure in concert with the activity that will generate the impact. For example, if the emissions caused by idling vehicles exiting a congested parking lot are mitigated by the institution of a staggered work schedule, that work schedule should commence when the project is initially occupied. In some cases, interim mitigation measures will need to be implemented until the final mitigation is in place (i.e., transit line to be built at a later date, serving as mitigation).

Large projects that have several construction and operational phases should be linked to the particular phase that creates the impact that the measures are mitigating. In addition, if the project is to be developed in phases and it is determined that mitigation measures need to become progressively more stringent in order to reduce emissions, standards that act as triggers should be identified. For example, a predetermined number of trips generated by the project could serve as a trigger for requiring the implementation of a shuttle service at a shopping center.

2. The agency responsible for implementing the mitigation measures should have the resources to carry out the mitigation.

When ensuring that the mitigation measures will be implemented, it is imperative that the financial resources be available to carry out the mitigation measures. It is particularly important to demonstrate the availability of funding where the mitigation involves capital expenditures. In most cases, the project proponent can demonstrate financial resources for capital improvements by, for example, posting a bond or entering into an enforceable development agreement with the local government.

3. To ensure implementation and enforcement, the mitigation should be enforceable by a legally binding commitment.

Mitigation measures should meet the test of enforceability. Agencies can utilize mechanisms such as recording the conditions of approval (including the mitigation measures) on the property title, including conditions in developer agreements, posting bonds, adopting a local ordinance, drawing up a legal agreement between the project proponent and the jurisdiction to implement the measures or by placing phasing requirements on projects to assure a measure is in place before the next stage of a project proceeds. It is the responsibility of the lead agency to determine the appropriate mechanism. For public projects, lead agencies should request a verification by the responsible public agency that the public improvement will be constructed in time to reduce the impact.

4. The mitigation measures should define the basis for their monitoring and enforcement.

Assumptions used to quantify the effectiveness of the mitigation measure should be used as the basis to determine implementation. For example, if a telecommunications program is used as a mitigation measure to reduce ROC emissions from work trips, the assumptions (e.g., that one percent of the work force will work at home each day) used in quantifying its effectiveness should become the basis for determining whether or not a mitigation measure is being implemented.

Quantitative standards should be used whenever possible. If it is not possible to quantify the mitigation measure, qualitative standards are appropriate. Only when all quantitative mitigation measures reasonably available to the project have been applied should qualitative measures be used. More details on use of qualitative analyses are provided in Section 11.9.

5. The mitigation measure can be reasonably accomplished within a reasonable time frame by the project proponent.

The lead agency should determine that the mitigation measures selected are reasonable, that targets can be met within the stated time frame, and that the measures to be taken are within the project proponent's legal authority. Interim targets should be established for mitigation measures that have a long lead time (more than five years).

6. Public agencies should verify the effectiveness assumed for any public improvements or permitting requirements that are used as mitigation measures.

If mitigation measures are to be implemented by an agency other than the lead agency or the project proponent, the responsible agency should verify the ability of the measure to reduce the project emissions. The following questions should be asked to ascertain the validity and effectiveness of the measure:

(1) What is the effectiveness of the improvement or permitting requirement in reducing the impact?

(2) During what time frame will the measure be implemented?

(3) Is constrained funding available for public improvements (i.e., federal, state, or local commitment to provide the funds)?

(4) Is the project proponent seeking a permit subject to the permitting requirements?

For example, if a project will generate fewer vehicle trips and therefore less emissions after the development of a rail transit line, then before the reductions can be credited, the county transportation commission should be consulted through the CEQA review process. The effectiveness of the rail line for reducing trips should also be ascertained: Are trips being reduced within the same time frame assumed for the project? Have federal, state, or local funds been set aside for the improvement?

For most transportation improvements, planners can consult with the county transportation commission. If a transportation improvement is not in the biennial element of the Regional Transportation Improvement Program (RTIP) or identified in the Regional Mobility Plan as having funding, it should not be used as a quantifiable mitigation measure, unless the transportation improvement will be privately funded through a development agreement enforceable against the project proponent.

11.3 Mitigation Measures Related to Construction

In many cases, the largest impact on air quality by land use projects is from emissions produced by construction. Construction emissions are often dismissed as short term impacts and not examined as thoroughly as are emissions associated with the long term operation of the project. Emissions from construction, however, can be significant. Because widespread growth is anticipated in the SCAB along with corresponding increases in construction activity, mitigating the impact of construction on air quality should be emphasized. For example, grading one acre of land without implementation of mitigation measures can contribute 55 pounds of PM10 a day. The PM10 problem in the Coachella Valley is largely caused by wind-blown dust in the desert areas. However, the second largest source of PM10 is from construction activities.

The District's Rule 403 governs construction projects and other fugitive dust-generating activities. Rule 403 is primarily based on emission standards and does not contain project-specific mitigation measures. As such, Rule 403 should be considered as a performance standard to any specific mitigation measures required for any proposed project. Copies of Rule 403 and its Implementation Handbook can be obtained from the District's Public Information Center at (909) 396-3600.

The mitigation measures to reduce air quality impacts of construction, demolition, or renovation activities are identified in Tables 11-2, 11-3, and 11-4. Mitigation measures are categorized by the source of emissions to be reduced. The percentage of emission reductions that can be expected from implementation of mitigation measures is identified as that measure's control efficiency. The estimated efficiencies represent the percent reduction in emissions anticipated from one of three source categories from a project's construction activities (on-road mobile sources, off-road mobile sources, and PM10 emissions). Efficiencies may differ for each pollutant depending on the mitigation measure, emission source, and specific process affected. Wherever possible, a range of likely efficiencies are provided. Using any efficiencies within this range should be supported by reviewing: a) the favorable factors listed for each mitigation measure in Appendix 11, and b) the packaging guidance in Section 11.10. Additional justification can also be presented by the air quality analysis. The assumptions that were used to determine these efficiencies are in Appendix 11. The assumptions (i.e., actions and/or setting) used in determining the control efficiency of the mitigation measure should become the basis for determining whether or not a mitigation measure is implemented. Where there are no control efficiencies identified, a qualitative evaluation is appropriate. See Section 11.9 for more details on performing a qualitative analysis.

The efficiencies listed in Tables 11-2, 11-3, and 11-4 along with the assumptions in Appendix 11, represent data from case studies and reports, sources of which are referenced at the end of this Chapter. In some cases, data for particular mitigation measures was unavailable. As such, these measures may be quantified in the future as more programs are implemented and monitored for results. Other quantified data are subject to change as new information becomes available. In addition, these anticipated reductions are representative of conditions in the South Coast Air Basin and portions of SEDAB under the jurisdiction of the District and as such may not be applicable to other air basins.

Planners may use one of two methods to quantify construction mitigation measures: (1) the control efficiencies provided in screening Tables 11-2, 11-3, and 11-4; or (2) quantification calculation procedures described in Appendix 11. The control efficiencies in the screening tables are based on region-wide data and assumptions, and should be applied to the appropriate source category of unmitigated emissions (refer to Chapter 9) to determine net emissions. Other sources of emissions should be identified as appropriate for the project using the information in Appendix 11 and added to the final total of unmitigated project emissions. An example of how to account for emissions by pollutant and source category is provided in Table 11-9.

Figure 11-1 provides a graphic illustration of the process used to identify a project's unmitigated emissions using the screening tables. As is shown in the shaded portion of the figure, once a project's unmitigated emissions have been calculated, quantified mitigation measures can be applied to reduce the potential air quality impact. Step-by-step instructions for using the screening tables to determine unmitigated emissions are described in Table 11-1. These instructions correspond with the unshaded portion of Figure 11-1. Appendix 11 identifies calculation procedures, emission factors, and assumptions necessary to determine the effectiveness of various mitigation measures and thus to determine project specific reductions in emissions.

An example of a summary table that can be used to determine net project emissions is provided in Table 11-5. Information provided in a similar format should be included in the EIR.

11.4 Mitigation Measures Related to Operation

Emissions resulting from operation of a project are critical because these impacts continue throughout the life of the project. It is important to remember that even in those cases where the emissions related to operation are less than construction-related impacts, the operational emissions create long-term impacts on air quality.

District-recommended mitigation measures to reduce air quality impacts of operational activities are identified in Tables 11-6 and 11-7, in addition to the design-related mitigation measures which were identified in Table 5-5. The mitigation measures are categorized by land use and by the emission sources within each land use category. The percentage of emission reductions that can be expected from implementation of mitigation measures is identified as that measure's control efficiency. The estimated efficiencies represent the percent of reduction in emissions anticipated from one of two source categories associated with the project's operations activities (on-road mobile sources or stationary sources). Efficiencies may differ for each pollutant depending on the mitigation measure, emission source, and specific process affected. Wherever possible, a range of likely results is provided. Using any efficiencies within this range should be supported by reviewing: a) the favorable factors listed for each mitigation measure in Appendix 11, and b) the packaging guidance in Section 11.10. Additional justification can also be presented by the air quality analysis. The assumptions used in determining these efficiencies are in Appendix 11. The assumptions (i.e., actions and/or setting) used in determining the control efficiency of the mitigation measure should become the basis for determining if a mitigation measure is implemented. Where there are no control efficiencies identified, a qualitative evaluation is appropriate. See Section 11.9 for more details on performing a qualitative analysis.

The efficiencies listed in Table 11-6 and 11-7, along with the assumptions in Appendix 11, represent data from case studies and reports, sources of which are referenced at the end of this Chapter. In some cases, data for particular mitigation measures was unavailable. As such, these measures may be quantified in the future as more programs are implemented and monitored for results. Other quantified data are subject to change as new information becomes available. In addition, these anticipated reductions are representative of conditions in the South Coast Air Basin and portions of the SEDAB under the District's jurisdiction and as such may not be applicable to other air basins.

Furthermore, any site plan design and building design mitigation measures identified in Section 5.5 that are already incorporated into the project should be quantified if possible or should be qualitatively discussed. See Section 5.5 for further discussion of design-related mitigation measures and Section 11.8 for caveats in using such measures as quantifiable mitigations.

There are three methods planners can employ to quantify operation mitigation measures: (1) the control efficiencies provided in screening Tables 11-5 and 11-6; (2) the quantification calculation procedures described in Appendix 11; or (3) the MAAQI model. The control efficiencies in the screening tables are based on region-wide data and assumptions and should be applied to the appropriate source category of unmitigated emissions (refer to Chapter 9) to determine net emissions. Examples of how to use the screening tables are discussed in Section 11.3. Appendix 11 identifies calculation procedures, emission factors, and assumptions necessary to determine the effectiveness of various mitigation measures to determine project specific reductions in emissions. The MAAQI model can also be used to quantify mitigation measures. This model can determine net emissions either based on pre-set mitigation measures that rely on county averages, or planners can input project specific data to determine efficiency. Chapter 9 provides additional discussion on the MAAQI model. In addition, the District's MAAQI model manual may be consulted.

In addition, many models and studies have identified procedures for analyzing transportation control measures, and estimating travel and emission effects of implementing transportation control measures. These resources provide more complex methodologies for determining a mitigation measure's effectiveness and can be used in lieu of the simplified approaches in this Handbook.

A summary table that can be used to determine net project emissions is provided in Table 11-8. Information provided in a similar format should be included in the EIR.

11.5 Other Mitigation Measures

Project proponents and local planners are also encouraged to identify other types of mitigation not suggested in this Handbook or in the 1991 AQMP. Local governments and project proponents are often in the best position to identify unique mitigation measures. For example, in an urban area, a community may have designated an extensive network of bicycling paths. This community could require access, dedications for future bicycle pathways and support facilities (e.g., showers, lockers, and storage areas) to encourage travel by bicycles rather than by automobile. Such specific mitigation for the community is best developed at the local level.

As with the other mitigation measures, the EIR should quantify the effectiveness of unique mitigation measures whenever possible. In those instances where quantification is not possible, a qualitative analysis should be provided. Lastly, the assumptions used to determine the effectiveness and the source from which estimates were obtained should be identified and the guidelines for preparing such an analysis in Section 11.9 consulted.

11.6 Mitigation for Cumulative Impacts

The District recommends that all cumulatively significant projects apply feasible mitigation measures to a project's contribution to reduce region-wide cumulative impacts. Refer to Chapter 11 for an identification of mitigation measures and the potential for emissions reductions.

11.7 Off-Site Mitigation

A project with a significant air quality impact may be able to mitigate the impact below the threshold of significance by reducing emissions off-site through off-site improvements. Off-site emission reductions can come either from stationary or mobile sources. For example, NOx emissions from vehicle trips could be reduced by installing solar water heaters in a residential development. The off-site mitigation measures should meet the same standards as on-site mitigation, and be enforceable and quantifiable. The emission reductions resulting from off-site mitigation can only be credited within the same pollutant. Reducing emissions for one pollutant and crediting it to another is not permissible.

Off-site improvements can include the following:

- Park-and-ride lots
- HOV bypass lane
- Class 1 bike path
- Transit shelters and benches
- Contributions to transit
- HOV capital improvements
- Clean fuel dispensing station
- Contributions to a local shuttle service
- Purchase of clean fuel vehicle for another facility
- Purchase of clean fuel transit buses
- Purchase of CNG school buses

11.8 Quantification Issues

There are four key issues relating to quantifying emission reductions that planners need to consider. These involve adding the emission reductions for different mitigation measures to determine net emissions associated with the project; selecting efficiencies for mitigation measures; determining whether the assumptions used to determine the effectiveness of the mitigation measures are reasonable; and determining emission reduction credits for site plan and building design mitigation measures.

Adding Emission Reductions. In order to determine net emissions for a project, the emission reductions attributed to each mitigation measure applied to the project need to be subtracted from the project's unmitigated emissions. The screening tables in Chapters 9 and 11 have been developed in such a way that planners can apply the efficiencies from mitigation measures identified in the tables in Chapter 11 to the project's emissions that are derived by using the tables in Chapter 9. Mitigation measures have been divided into five source categories to correspond with the five source categories listed in the Chapter 9 screening tables. These include three source categories for construction mitigation:

- o On-road mobile emissions associated with construction work trips (Table 11-2)
- o Off-road mobile emissions associated with construction equipment (Table 11-3), and
- o PM10 emissions from grading, etc. (Table 11-4);

and two source categories for operation mitigation:

- o On-road mobile emissions associated with vehicle trips (Table 11-6)
- o Area source emissions associated with energy consumption (Table 11-7).

The percentage efficiency for any mitigation measure in Tables 11-2 through 11-7 should be applied to the corresponding source category table in Chapter 9 (Tables 9-1 through 9-4 and 9-7, 9-8). The resulting emission reductions should be subtracted from the unmitigated emissions derived in Chapter 9.

The efficiencies in each of the five tables are generally additive, with the following exceptions:

1) Table 11-3 (Mitigation for Off-Road Mobile Source - Construction) assumes that only one of the four mitigation measures can be applied to any construction site;

2) Table 11-4 (Mitigation for PM10 Emissions - Construction) efficiencies apply when only one measure within a source category (e.g., grading, paved roads, or unpaved roads) is applied. If more than one mitigation measure within a source category is applied, the efficiency of the second measure must be adjusted to account for the reduction in unmitigated PM10 emissions from the first measure. To quantify this impact, see Table A11-9 of the Appendix to Chapter 11 for specific direction.

The same procedures can be used when quantifying unmitigated emissions using the methodologies in the Appendix to Chapter 9 and in quantifying emission reductions using the methodologies in the Appendix to Chapter 11.

Selecting Efficiencies. The screening tables that identify efficiencies for mitigation measures often provide a range of efficiencies. Planners should select efficiencies that best coincide with the on-site characteristics for the project as well as the community the project is located in. The low and high numbers represent the range of efficiencies planners can select from. Unless justified, the low end of the range should be used. Planners can use the favorable factors identified in Appendix 11 to justify a higher rate of efficiency. In addition, planners can use the guidance in Section 11.10 to select the higher end of the range when there may be synergistic effects between packages of mitigation measures and the low end when there may be neutral or conflicting effects. Finally, a third criterion should be considered when applying mobile source mitigation measures in Table 11-6, where the ranges of effectiveness also reflect how much of a project's daily trip generation is due to the type of trip being mitigated. For example, a restaurant generates a significant number of daily vehicle trips, most of which are non-work (e.g., customer) trips. Consequently, a mitigation measure that reduces employee work trips is likely to reduce few trips relative to the facility's total daily trips. In such a case, the low end of the efficiency range is appropriate. On the other hand, a commercial office project's daily trips are largely work-related.

The two previous criteria noted above should be used to select a value within the efficiency range for all mitigation measures. For mitigation measures in Table 11-6, the trip generation criteria should also be considered as the primary criterion for selecting a value.

Assumptions. Another of the key quantification issues that planners face is determining whether or not the reduction in emissions assumed through the implementation of mitigation measures is "reasonable." The test of reasonableness depends on two primary factors: (1) the assumptions used in determining the reduction, and (2) the emission factors used to calculate the emissions. For mitigation measures identified in this Handbook, planners can refer to the mitigation measure effectiveness numbers in Tables 11-2, 11-3, 11-4, 11-6, and 11-7 to assess whether or not the percentage of reduction is reasonable.

In situations where planners are unsure of the reasonableness of assumptions, planners can confer with the District and/or make the assumptions enforceable. This can be accomplished by requiring that the assumptions used in determining the effectiveness, and thus the net impact of the project on air quality, are also used as the measurement of whether or not a mitigation measure has been implemented. For example, if it is assumed that five percent of the work trips to the site will be reduced through telecommuting, then the mitigation monitoring program should use the five percent participation rate as the indicator of whether a measure has been implemented pursuant to AB 3180.

Vehicle trips are generally the greatest source of emissions from the operation of a project. As such, the assumptions about trip reduction are critical to assessing the overall impact of a project on air quality. In particular, the use of transit as mitigation and assignment of future trips to transit and other modes of travel should be reviewed. It is important that projects depending on transit or other modes of travel to reduce vehicle trips use appropriate trip assignment percentages. A trip assignment percentage refers to that percentage of future trips projected to be made by a single occupant vehicle, carpool/vanpool, transit, walking, bicycling, etc. Transit agencies should verify that service is available and passenger capacity exists to support the assumptions. In addition, the number of trips to be mitigated through measures such as carpooling programs needs to be "reasonable."

Emission reductions for site plan and building design mitigation measures. While mitigation measures can be added to a proposed project, some mitigation may have already been incorporated into the site plan and/or building design (Section 5.5), and have become a part of the project's description.

These design measures can be credited for quantified emission reductions only if energy or mobile source credits were not already included in the project's non-mitigated analysis of impacts. For example, a development that will include bicycle shower and locker facilities may take credit for reducing vehicle trips in the traffic study of the environmental analysis. In turn, the calculation of the project's non-mitigated emissions may reflect such a design measure. However, additional credit may not be taken in the project's mitigation measure analysis, as the vehicle trip and emissions reductions would be double-counted.

11.9 Qualitative Analysis

In mitigating the air quality impacts of a development proposal, quantitative mitigation measures should be used to the extent possible to demonstrate reduction of emissions below thresholds of significance. However, not all effective mitigation measures can reasonably be quantified. Once all reasonably available mitigation measures have been applied to a project, it is appropriate to apply qualitative measures whose specific emission reductions are not known. Such a qualitative analysis can be used to further reduce air quality impacts of a project.

Qualitative mitigation measures can also be used to mitigate significant impacts to below the thresholds of significance identified in Chapter 6. In making such a finding, the air quality analysis should identify the rationale used to arrive at such a determination. Use of non-quantified mitigation measures to reduce significant amounts of emissions should be used with discretion, however, as many non-quantified measures are unlikely to produce substantial reductions.

An air quality analysis that describes the effectiveness of implementing non-quantified mitigation measures should address, but not be limited to, the following issues:

1. What is the source category (e.g., Work Trips, Energy Use, Congestion Relief) being affected and how significant are emissions from that category? For example, work commute trips constitute the majority of vehicular trips to office worksites. Mobile source emissions may in turn constitute the majority of total emissions from these land uses. Consequently, a mitigation measure that would reduce work commute trips to an office park has the potential to reduce a significant amount of vehicle trips and the corresponding emissions. Conversely, a mitigation measure that reduces energy use from swimming pools is likely to have a much smaller emissions reduction potential.

2. What are the pollutants affected by the emission source category? For each source category, measures reduce ROC, CO, NOx, PM10, and SOx to varying degrees. For example, energy use primarily generates NOx emissions while construction grading and demolition creates significant levels of PM10. Consequently, a mitigation measure that reduces emissions from demolition and grading activities during the construction phase may reduce substantial amounts of PM10 but is unlikely to reduce substantial levels of ROC, CO, NOx, or SOx. The qualitative analysis should identify the pollutants associated with the emission source category and draw conclusions accordingly.

3. Are there favorable factors associated with a mitigation measure? As with the quantified mitigation measures, the success of any mitigation measure is largely dependent on the project setting. This can include site-specific conditions and/or characteristics in the local vicinity. Favorable factors can improve the effectiveness of a mitigation measure and facilitate greater emission reductions. The analysis should identify all those factors which are likely to produce more favorable results.

4. Are any of these measures, when combined with other proposed mitigation, likely to complement or impact the effectiveness of any other measures? Some combinations of measures can produce synergistic or non-complementary reactions that increase or decrease the effectiveness of the actions. The analysis should identify whether the qualitative mitigation measures are likely to produce such reactions with other measures and identify potential impacts (See Section 11.10 below).

11.10 Packaging of Mitigation Measures

In many cases the most effective way to reduce a project's impact is to package mitigation measures. In selecting a package of mitigation measures, a lead agency and/or project proponent takes into account several criteria, including the nature of the significant impact requiring mitigation, those measures that are most reasonable and cost-effective, and the applicability of the measures to the project.

Another important criterion for packaging should be to combine mitigation measures that will improve and maximize their aggregate effectiveness. While Tables 11-2, 11-3, 11-4, 11-6, and 11-7 attempt to quantify the effectiveness of isolated mitigation measures, the actual effectiveness of many measures is affected by other measures within the same source category that are implemented as part of a package. Mitigation measures can complement one another or detract from their individual effectiveness depending on upon site-specific and local conditions. The ways in which mitigation measures interact can be divided into three basic groups: Neutral, Synergistic, and Non-Complementary.

Neutral measures. These measures exhibit no change in effects when combined. Neutral actions generally fall into two categories: combinations that address different sources of emissions and combinations that affect different targets within a source of emissions. For example, mitigation measure from one source of emissions such as energy reduction are most likely to have a neutral affect on another source that reduces vehicle trips to the site. In addition, two neutral measures can target different markets within the same source of emissions without affecting the effectiveness of each such as when some mitigation measures target work trips and other measures target non-work trips.

Synergistic measures. These measures are complementary to the extent that the combined effects are greater than the sum of the effects if the two measures were implemented separately. For example, incorporating a mitigation measure that provides an on-site transit stop is more effective when discounted transit passes are provided to employees. These measures should be the primary focus of packaging efforts. At the present time, there are no procedures for providing extra emission reductions for these types of packages, however by packaging measures that have synergistic effects the likelihood of the measures successfully mitigating the impact is increased.

Non-complementary measures. These measures reduce the effectiveness of one another when combined. When implemented together, the combined efficiency in reducing emissions is less than the sum of the benefit in implementing each measure individually. For example, measures that address the same target market as in the case of seeking to reduce the number of work trips to a site by encouraging telecommuting and compressed work schedules (e.g. working 40 hours in 4 days) could result in less emission reductions than if the telecommuting measure was packaged with ridesharing incentives.

Steps for Developing Effective Packages of Mitigation Measures. In selecting and evaluating a package of mitigation measures, planners and/or project proponents should consider the following steps:

1. Identify those mitigation measures that will have neutral effects on the remainder of measures in the proposed package. For these measures, estimate the emission reduction efficiency assuming that the packaging will not affect the effectiveness of these mitigation measures.

2. Identify whether the package includes combinations of measures that are potentially non-complementary. Determine if this package of mitigation measures is likely to result in less emission reductions due to the conflict. If so, revise the package to reduce the conflict.

3. Identify whether the package includes combinations of measures that are potentially synergistic. For synergistic mitigation measures, it may be appropriate to base the effectiveness on the higher end of the range if the project site and community are consistent with the favorable factors identified for each measure in Appendix 11.

References

Transportation Control Measure Analysis Procedures, Final Report, Systems Applications International for ARB, November 25, 1991.

Estimating Travel and Emission Effects of TCMs, System Applications International for EPA, September 30, 1991.

Figure 11-1. Flow Chart for Applying Mitigation Measures

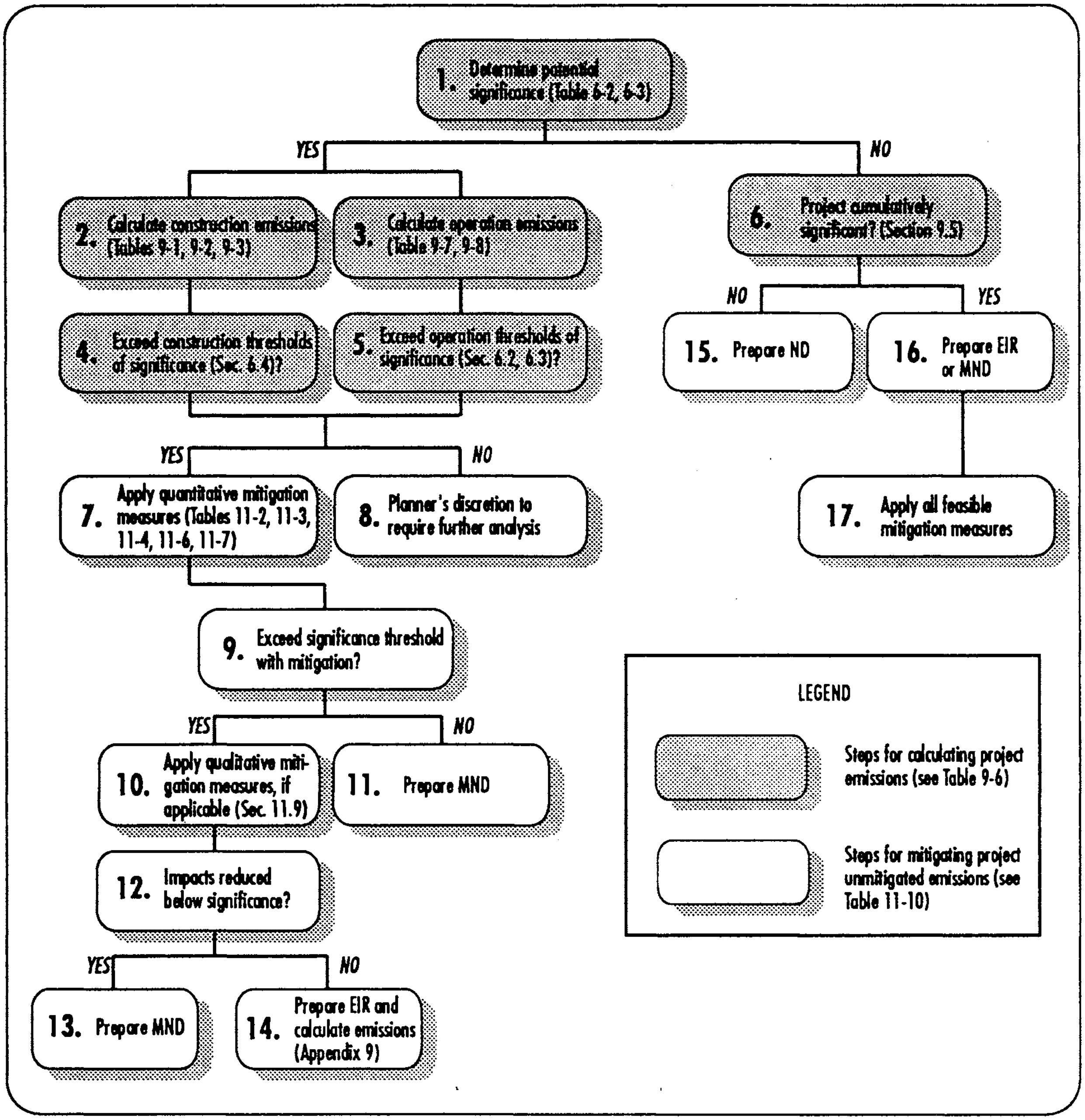


Table 11-1. Criteria for Mitigation Measures

1. Implementation of mitigation should coincide with environmental impact.
2. Adequate resources should be available to ensure implementation of mitigation.
3. Mitigation should be enforceable by a legally binding commitment.
4. Standards should be defined for monitoring and enforcing mitigation.
5. Mitigation should be able to be reasonably accomplished within a reasonable timeframe.
6. Public projects and other agencies' permit conditions should be verified when identified as mitigation.

Table 11-2. Mitigation for On-Road Mobile Source Emissions - Construction

Mitigation Measure	Emission Reduction Efficiency*			
	ROC	NO_x	CO	PM10
• Configure construction parking to minimize traffic interference	NQ			
• Provide temporary traffic control during all phases of construction activities to improve traffic flow (e.g., flag person)	NQ			
• Schedule construction activities that affect traffic flow to off-peak hours (e.g., between 7:00 p.m. and 6:00 a.m. and between 10:00 a.m. and 3:00 p.m.)	NQ			
• Develop a trip reduction plan to achieve a 1.5 AVR for construction employees	0.1-2.2%	0.1-2.9%	0.1-2.9%	0.1-2.9%
• Implement a shuttle service to and from retail services and food establishments during lunch hours	0.1-1.0%	0.1-1.3%	0.1-1.3%	0.1-1.3%
• Develop a construction traffic management plan that includes, but is not limited to:	NQ			
- Rerouting construction trucks off congested streets				
- Consolidating truck deliveries				
- Providing dedicated turn lanes for movement of construction trucks and equipment on- and off-site				
• Prohibit truck idling in excess of two minutes	NQ			
NQ = Not Quantified				

* These efficiencies represent additive reductions from unmitigated on-road mobile source construction emissions (Table 9-3) The resulting emission reductions can be subtracted from the ummitigated totals. These data will be updated as more information becomes available. More detailed descriptions of mitigation measures are included in Appendix 11.

When efficiency is provided as a range:
if project-specific efficiency is unknown, use the lowest number given;
if project-specific efficiency is utilized, provide supporting analysis and documentation.

Table 11-3. Mitigation for Off-Road Mobile Source Emissions - Construction

Mitigation Measure	Emission Reduction Efficiency*			
	ROC	NO_X	CO	PM10
• Methanol-fueled pile drivers	54%	+29%	25%	95%
• Suspend use of all construction equipment operations during second stage smog alerts. For daily forecast, call (800) 242-4022 (L.A. and Orange counties) or (800) 367-4710 (San Bernardino and Riverside counties)	NQ			
• Prevent trucks from idling longer than two minutes	NQ			
• Use electricity from power poles rather than temporary diesel power generators	99%	97%	98%	98%
• Use electricity from power poles rather than temporary gasoline power generators	99%	96%	99%	98%
• Use of methanol or natural gas on-site mobile equipment instead of diesel	54%	+29%	25%	95%
• Use of propane- or butane-powered on-site mobile equipment instead of gasoline	53%	+53%	96%	18%
NQ = Not Quantified				

* These efficiencies represent additive reductions from unmitigated on-road mobile source construction emissions (Table 9-1) The resulting emission reductions can be subtracted from the unmitigated totals. These data will be updated as more information becomes available. More detailed descriptions of mitigation measures are included in Appendix 11.

Table 11-4. Mitigation for PM10 Emissions - Construction

Mitigation Measure	Emission Reduction Efficiency*			
	ROC	NO_x	CO	PM10
GRADING				
• Apply non-toxic soil stabilizers according to manufacturers' specification to all inactive construction areas (previously graded areas inactive for ten days or more)				30-65%
• Replace ground cover in disturbed areas as quickly as possible				15-49%
• Enclose, cover, water twice daily or apply non-toxic soil binders according to manufacturers' specifications, to exposed piles (i.e., gravel, sand, dirt) with 5% or greater silt content				30-74%
• Water active sites at least twice daily				34-68%
• Suspend all excavating and grading operations when wind speeds (as instantaneous gusts) exceed 25 mph				NQ
• Monitor for particulate emissions according to District-specified procedures. For information, call (714) 396-3600.				NQ
• All trucks hauling dirt, sand, soil, or other loose materials are to be covered or should maintain at least two feet of freeboard (i.e., minimum vertical distance between top of the load and the top of the trailer) in accordance with the requirements of CVC Section 23114				7-14%
PAVED ROADS				
• Sweep streets at the end of the day if visible soil material is carried onto adjacent public paved roads (recommend water sweepers with reclaimed water)				25-60%
• Install wheel washers where vehicles enter and exit unpaved roads onto paved roads, or wash off trucks and any equipment leaving the site each trip				40-70%

NQ = Not Quantified

* These efficiencies represent additive reductions from unmitigated PM10 construction emissions (Table 9-3). The resulting emission reductions can be subtracted from the unmitigated subtotals (Unpaved Road, Paved Road, Demolition, Grading, Asbestos). These data will be updated as more information becomes available. More detailed descriptions of mitigation measures are included in Appendix 11.

** Additive reductions: Reductions in emissions obtained from one source category, then added to that from another source category.

When efficiency is provided as a range:
if project-specific efficiency is unknown, use the lowest number given;
if project-specific efficiency is utilized, provide supporting analysis and documentation.

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Table 11-4. Mitigation for PM10 Emissions - Construction (continued)

Mitigation Measure	Emission Reduction Efficiency*			
	ROC	NO_x	CO	PM10
UNPAVED ROADS				
• Apply water three times daily, or non-toxic soil stabilizers according to manufacturers' specifications, to all unpaved parking or staging areas or unpaved road surfaces				45-85%
• Traffic speeds on all unpaved roads to be reduced to 15 mph or less				40-70%
• Pave construction roads that have a traffic volume of more than 50 daily trips by construction equipment, 150 total daily trips for all vehicles				92.5%
• Pave all construction access roads at least 100 feet on to the site from the main road				92.5%
• Pave construction roads that have a daily traffic volume of less than 50 vehicular trips				92.5%
NQ = Not Quantified				

* These efficiencies represent additive reductions from unmitigated PM10 construction emissions (Table 9-2). The resulting emission reductions can be subtracted from the unmitigated subtotals (Unpaved Road, Paved Road, Demolition, Grading, Asbestos). These data will be updated as more information becomes available. More detailed descriptions of mitigation measures are included in Appendix 11.

** Additive reductions: Reductions in emissions obtained from one source category, then added to that from another source category.

When efficiency is provided as a range:
if project-specific efficiency is unknown, use the lowest number given;
if project-specific efficiency is utilized, provide supporting analysis and documentation.

Table 11-5. Identifying Net Construction Emissions

Source	Unmitigated Emissions (lbs a day/pollutant)	Mitigation Measures	Mitigation Efficiencies	Net Emissions ROC	NOx	PM10	CO
Grading/ Demolition Fugitive Dust							
Fugitive Dust from Roads							
Construction Equipment							
Work Trips							
Non-Work Trips							
Truck Trips							
Energy Usage							
Traffic Impacts							
Unmitigated Emissions:							
Total Net Project Emissions:							

Key: Unmitigated Emissions (white cells)
Mitigated Emissions (shaded cells)

Table 11-6a. Mitigation for On-Road Mobile Source Emissions - Operation (Residential)

Mitigation Measure	Emission Reduction Efficiency*			
	ROC	NO_x	CO	PM10
• Include satellite telecommunications centers in residential subdivisions	0.1-0.7%	0.1-0.9%	0.1-0.9%	0.1-0.9%
• Establish a shuttle service from residential subdivisions to commercial core areas	0.1-0.2%	0.1-0.3%	0.1-0.3%	0.1-0.3%
• Construct on-site or off-site bus turnouts, passenger benches, and shelters	0.2-1.9%	0.2-2.5%	0.2-2.5%	0.2-2.5%
• Construct off-site pedestrian facility improvements, such as overpasses and wider sidewalks	0.1-0.3%	0.1-0.4%	0.1-0.4%	0.1-0.4%
• Include retail services within or adjacent to residential subdivisions	1.0-4.0%	1.3-6.0%	1.3-6.0%	1.3-6.0%
• Provide shuttles to major rail transit centers or multi-modal stations	0.1-0.3%	0.1-0.5%	0.1-0.5%	0.1-0.5%
• Contribute to regional transit systems (e.g., right-of-way, capital improvements, etc.)	NQ			
• Synchronize traffic lights on streets impacted by development	4.0-8.0%	4.0-8.0%	4.0-8.0%	4.0-8.0%
• Construct, contribute, or dedicate land for the provision of off-site bicycle trails linking the facility to designated bicycle commuting routes	0.1-0.6%	0.1-0.8%	0.1-0.8%	0.1-0.8%

NQ = Not Quantified

* These efficiencies represent additive reductions from facility operations, specifically unmitigated emissions from On-Road Mobile Sources (i.e., Work Trips, Non-Work Trips, Congestion Relief, Truck Trips, Off-Road Vehicles). These efficiencies can be subtracted from the corresponding unmitigated emissions from this category (Table 9-7). These data will be updated as more information becomes available. More detailed descriptions of mitigation measures are included in Appendix 11.

When efficiency is provided as a range:
if project-specific efficiency is unknown, use the lowest number given;
if project-specific efficiency is utilized, provide supporting analysis and documentation.

Table 11-6b. Mitigation for On-Road Mobile Source Emissions - Operation (Commerical)

Mitigation Measure	Emission Reduction Efficiency*			
	ROC	NO_X	CO	PM10
• Provide preferential parking spaces for carpools and vanpools and provide 7'2" minimum vertical clearance in parking facilities for vanpool access	0.1-1.0%	0.1-1.3%	0.1-1.3%	0.1-1.3%
• Implement on-site circulation plan in parking lots to reduce vehicle queuing	NQ			
• Improve traffic flow at drive-throughs by designing separate windows for different functions and by providing temporary parking for orders not immediately ready for pickup	NQ			
• Provide video-conference facilities	NQ			
• Set up resident worker training programs to improve job/ housing balance	NQ			
• Implement home dispatching system where employees receive routing schedule by phone instead of driving to work	Negl.	0.1%	0.1%	0.1%
• Develop a program to minimize the use of fleet vehicles during smog alerts (for businesses not subject to Regulation XV or XII)	NQ			
• Use low-emission fleet vehicles - TLEV - ULEV - LEV - ZEV	NQ			
• Reduce employee parking spaces for those businesses subject to Regulation XV	0.1-2.2%	0.1-2.9%	0.1-2.9%	0.1-2.9%
NQ = Not Quantified Negl. = Negligible (less than 0.05%)				

* These efficiencies represent additive reductions from facility operations, specifically unmitigated emissions from On-Road Mobile Sources (i.e., Work Trips, Non-Work Trips, Congestion Relief, Truck Trips, Off-Road Vehicles). These efficiencies can be subtracted from the corresponding unmitigated emissions from this category (Table 9-7). These data will be updated as more information becomes available. More detailed descriptions of mitigation measures are included in Appendix 11.

When efficiency is provided as a range:
if project-specific efficiency is unknown, use the lowest number given;
if project-specific efficiency is utilized, provide supporting analysis and documentation.

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Table 11-6b. Mitigation for On-Road Mobile Source Emissions - Operation (Commerical) (continued)

Mitigation Measure	Emission Reduction Efficiency*			
	ROC	NO_x	CO	PM10
• Implement a lunch shuttle service from a worksite(s) to food establishments	0.4-1.5%	0.5-1.8%	0.5-1.8%	0.5-1.8%
• Implement compressed work-week schedules where weekly work hours are compressed into fewer than five days				
- 9/80	0.8-7.6%	1.0-10.0%	1.0-10.0%	1.0-10.0%
- 4/40	1.5-15.3%	2.0-20.0%	2.0-20.0%	2.0-20.0%
- 3/36	3.1-40.0%	4.0-40.0%	4.0-40.0%	4.0-40.0%
• Develop a trip reduction plan to achieve 1.5 AVR for businesses with less than 100 employees or multi-tenant worksites	0.1-2.2%	0.1-2.9%	0.1-2.9%	0.1-2.9%
• Utilize satellite offices rather than regular worksite to reduce VMT	0.1%	0.1-0.2%	0.1-0.2%	0.1-0.2%
• Establish a home-based telecommuting program	0.1-1.6%	0.1-2.1%	0.1-2.1%	0.1-2.1%
• Provide on-site child care and after-school facilities or contribute to off-site development within walking distance	0.1%	0.1-0.2%	0.1-0.2%	0.1-0.2%
• Require retail facilities or special event centers to offer travel incentives such as discounts on purchases for transit riders	NQ			
• Provide on-site employee services such as cafeterias, banks, etc.	0.2-3.4%	0.3-4.5%	0.3-4.5%	0.3-4.5%
• Establish a shuttle service from residential core areas to the worksite	0.1-0.3%	0.1-0.5%	0.1-0.5%	0.1-0.5%
• Construct on-site or off-site bus turnouts, passenger benches, or shelters	0.1-1.0%	0.1-1.3%	0.1-1.3%	0.1-1.3%

NQ = Not Quantified

* These efficiencies represent additive reductions from facility operations, specifically unmitigated emissions from On-Road Mobile Sources (i.e., Work Trips, Non-Work Trips, Congestion Relief, Truck Trips, Off-Road Vehicles). These efficiencies can be subtracted from the corresponding unmitigated emissions from this category (Table 9-7). These data will be updated as more information becomes available. More detailed descriptions of mitigation measures are included in Appendix 11.

When efficiency is provided as a range:
if project-specific efficiency is unknown, use the lowest number given;
if project-specific efficiency is utilized, provide supporting analysis and documentation.

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Table 11-6b. Mitigation for On-Road Mobile Source Emissions - Operation (Commerical) (continued)

Mitigation Measure	Emission Reduction Efficiency*			
	ROC	NO_X	CO	PM10
• Implement a pricing structure for single-occupancy employee parking and/or provide discounts to ridesharers	1.5-11.0%	2.0-15.5%	2.0-15.5%	2.0-15.5%
• Include residential units within a commercial project	3.1-13.7%	4.0-18.0%	4.0-18.0%	4.0-18.0%
• Utilize parking in excess of code requirements as on-site park-n-ride lots or contribute to construction of off-site lots	0.1%	0.1-0.2%	0.1-0.2%	0.1-0.2%
• Any two of the following:				
– Construct off-site bicycle facility improvements, such as bicycle trails linking the facility to designated bicycle commuting routes, or on-site improvements, such as bicycle paths	0.2-2.4%	0.3-3.2%	0.3-3.2%	0.3-3.2%
– Include bicycle parking facilities, such as bicycle lockers and racks	See Above			
– Include showers for bicycling employees' use	See Above			
• Any two of the following:				
– Construct off-site pedestrian facility improvements, such as overpasses, wider sidewalks	0.2-1.2%	0.2-1.6%	0.2-1.6%	0.2-1.6%
– Construct on-site pedestrian facility improvements, such as building access which is physically separated from street and parking lot traffic and walk paths	See Above			
– Include showers for pedestrian employees' use	See Above			
• Provide shuttles to major rail transit stations and multi-modal centers	0.1-0.3%	0.1-0.5%	0.1-0.5%	0.1-0.5%

* These efficiencies represent additive reductions from facility operations, specifically unmitigated emissions from On-Road Mobile Sources (i.e., Work Trips, Non-Work Trips, Congestion Relief, Truck Trips, Off-Road Vehicles). These efficiencies can be subtracted from the corresponding unmitigated emissions from this category (Table 9-7). These data will be updated as more information becomes available. More detailed descriptions of mitigation measures are included in Appendix 11.

When efficiency is provided as a range:
if project-specific efficiency is unknown, use the lowest number given;
if project-specific efficiency is utilized, provide supporting analysis and documentation.

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Table 11-6b. Mitigation for On-Road Mobile Source Emissions - Operation (Commerical) (continued)

Mitigation Measure	Emission Reduction Efficiency*			
	ROC	NO_x	CO	PM10
• Contribute to regional transit systems (e.g., right-of-way, capital improvements)	NQ			
• Charge visitors to park	1.5-11.0%	2.0-15.5%	2.0-15.5%	2.0-15.5%
• Synchronize traffic lights on streets impacted by development	4.0-8.0%	4.0-8.0%	4.0-8.0%	4.0-8.0%
• Reschedule truck deliveries and pickups for off-peak hours	NQ			
• Set up paid parking systems where drivers pay at walkup kiosk and exit via a stamped ticket to reduce emissions from queuing vehicles	NQ			
• Require on-site truck loading zones	NQ			
• Implement or contribute to public outreach programs	NQ			
• Require employers not subject to Regulation XV to provide commuter information areas	0.1-0.4%	0.1-0.5%	0.1-0.5%	0.1-0.5%

NQ = Not Quantified

* These efficiencies represent additive reductions from facility operations, specifically unmitigated emissions from On-Road Mobile Sources (i.e., Work Trips, Non-Work Trips, Congestion Relief, Truck Trips, Off-Road Vehicles). These efficiencies can be subtracted from the corresponding unmitigated emissions from this category (Table 9-7). These data will be updated as more information becomes available. More detailed descriptions of mitigation measures are included in Appendix 11.

When efficiency is provided as a range:
if project-specific efficiency is unknown, use the lowest number given;
if project-specific efficiency is utilized, provide supporting analysis and documentation.

Table 11-6c. Mitigation for On-Road Mobile Source Emissions - Operation (Industrial)

Mitigation Measure	Emission Reduction Efficiency*			
	ROC	NO_x	CO	PM10
• Provide preferential parking spaces for carpools and vanpools and provide 7'2" minimum vertical clearance in parking facilities for vanpool access	0.1-1.0%	0.1-0.3%	0.1-0.3%	0.1-0.3%
• Implement on-site circulation plan in parking lots to reduce vehicle queuing	NQ			
• Set up resident worker training programs to improve job/ housing balance	NQ			
• Implement home dispatching system where employees receive routing schedule by phone instead of driving to work	Negl.	0.1%	0.1%	0.1%
• Develop a program to minimize the use of fleet vehicles during smog alerts (for businesses not subject to Regulation XV or XII)	NQ			
• Use low-emission fleet vehicles - TLEV - ULEV - LEV - ZEV	NQ			
• Require employers not subject to Regulation XV to provide commuter information areas	Negl.-0.6%	Negl.-0.8%	Negl.-0.8%	Negl.-0.8%
• Reduce employee parking spaces for those businesses subject to Regulation XV	0.1-2.2%	0.1-2.9%	0.1-2.9%	0.1-2.9%

NQ = Not Quantified   Negl. = Negligible (less than 0.05%)

* These efficiencies represent additive reductions from facility operations, specifically unmitigated emissions from On-Road Mobile Sources (i.e., Work Trips, Non-Work Trips, Congestion Relief, Truck Trips, Off-Road Vehicles). These efficiencies can be subtracted from the corresponding unmitigated emissions from this category (Table 9-7). These data will be updated as more information becomes available. More detailed descriptions of mitigation measures are included in Appendix 11.

When efficiency is provided as a range:
if project-specific efficiency is unknown, use the lowest number given;
if project-specific efficiency is utilized, provide supporting analysis and documentation.

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Table 11-6c. Mitigation for On-Road Mobile Source Emissions - Operation (Industrial) (continued)

Mitigation Measure	Emission Reduction Efficiency*			
	ROC	NO_x	CO	PM10
• Implement compressed work-week schedules where weekly work hours are compressed into fewer than five days - 9/80 - 4/40 - 3/36	 0.8-7.6% 1.5-15.3% 3.1-40.0%	 1.0-10.0% 2.0-20.0% 4.0-40.0%	 1.0-10.0% 2.0-20.0% 4.0-40.0%	 1.0-10.0% 2.0-20.0% 4.0-40.0%
• Offer first right of refusal, low-interest loans, or other incentives to employees who purchase or rent local residences	NQ			
• Develop a trip reduction plan to achieve 1.5 AVR for businesses with less than 100 employees or multi-tenant worksites	0.1-2.2%%	0.1-2.9%	0.1-2.9%	0.1-2.9%
• Provide on-site child care and after-school facilities or contribute to development within walking distance	0.1%	0.1-0.2%	0.1-0.2%	0.1-0.2%
• Provide on-site employee services such as cafeterias, banks, etc.	0.2-3.4%	0.3-4.5%	0.3-4.5%	0.3-4.5%
• Establish a shuttle service from residential core areas to the worksite	0.1-0.3%	0.1-0.5%	0.1-0.5%	0.1-0.5%
• Construct on-site or off-site bus turnouts, passenger benches, or shelters	0.1-1.0%	0.1-1.3%	0.1-1.3%	0.1-1.3%
• Implement a pricing structure for single-occupancy employee parking and/or provide discounts to ridesharers	1.5-11.0%	2.0-15.5%	2.0-15.5%	2.0-15.5%
• Utilize parking in excess of code requirements as on-site park-n-ride lots or contribute to construction of off-site lots	0.1%	0.1-0.2%	0.1-0.2%	0.1-0.2%
NQ = Not Quantified				

* These efficiencies represent additive reductions from facility operations, specifically unmitigated emissions from On-Road Mobile Sources (i.e., Work Trips, Non-Work Trips, Congestion Relief, Truck Trips, Off-Road Vehicles). These efficiencies can be subtracted from the corresponding unmitigated emissions from this category (Table 9-7). These data will be updated as more information becomes available. More detailed descriptions of mitigation measures are included in Appendix 11.

When efficiency is provided as a range:
if project-specific efficiency is unknown, use the lowest number given;
if project-specific efficiency is utilized, provide supporting analysis and documentation.

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Table 11-6c. Mitigation for On-Road Mobile Source Emissions - Operation (Industrial) (continued)

Mitigation Measure	Emission Reduction Efficiency*			
	ROC	NO_X	CO	PM10
• Any two of the following:				
– Construct off-site bicycle facility improvements, such as bicycle trails linking the facility to designated bicycle commuting routes, or on-site improvements, such as bicycle paths	0.2-2.4%	0.3-3.2%	0.3-3.2%	0.3-3.2%
– Include bicycle parking facilities, such as bicycle lockers and racks	See Above			
– Include showers for bicycling employees' use	See Above			
• Any two of the following:				
– Construct off-site pedestrian facility improvements, such as overpasses, wider sidewalks	0.2-1.2%	0.2-1.6%	0.2-1.6%	0.2-1.6%
– Construct on-site pedestrian facility improvements, such as building access which is physically separated from street and parking lot traffic and walk paths	See Above			
– Include showers for pedestrian employees' use	See Above			
• Provide shuttles to major rail transit stations and multi-modal centers	0.1-0.3%	0.1-0.5%	0.1-0.5%	0.1-0.5%
• Contribute to regional transit systems (e.g., right-of-way, capital improvements)	NQ			
• Synchronize traffic lights on streets impacted by development	4.0-8.0%	4.0-8.0%	4.0-8.0%	4.0-8.0%

NQ = Not Quantified

* These efficiencies represent additive reductions from facility operations, specifically unmitigated emissions from On-Road Mobile Sources (i.e., Work Trips, Non-Work Trips, Congestion Relief, Truck Trips, Off-Road Vehicles). These efficiencies can be subtracted from the corresponding unmitigated emissions from this category (Table 9-7). These data will be updated as more information becomes available. More detailed descriptions of mitigation measures are included in Appendix 11.

When efficiency is provided as a range:
if project-specific efficiency is unknown, use the lowest number given;
if project-specific efficiency is utilized, provide supporting analysis and documentation.

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Table 11-6c. Mitigation for On-Road Mobile Source Emissions- Operation (Industrial) (continued)

Mitigation Measure	Emission Reduction Efficiency*			
	ROC	NO_x	CO	PM10
• Reschedule truck deliveries and pickups for off-peak hours	NQ			
• Implement a lunch shuttle from a worksite(s) to food establishments	0.4-1.5%	0.5-1.8%	0.5-1.8%	0.5-1.8%
• Require on-site truck loading zones	NQ			
• Install aerodynamic add-on devices to heavy-duty trucks	NQ			
• Implement or contribute to public outreach programs	NQ			
• Reduce ship cruising speeds in the inner harbor	NQ			
• Use low-emission fuels or electrify airport ground service vehicles	NQ			
• Engine tuning for marine vessels (e.g., injection timing retard)	NQ			
• Reduce number of aircraft engines used during idling	NQ			
• Install monitoring system to control airport shuttles	NQ			
• Use centralized ground power systems for airport service vehicles	NQ			
NQ = Not Quantified				

* These efficiencies represent additive reductions from facility operations, specifically unmitigated emissions from On-Road Mobile Sources (i.e., Work Trips, Non-Work Trips, Congestion Relief, Truck Trips, Off-Road Vehicles). These efficiencies can be subtracted from the corresponding unmitigated emissions from this category (Table 9-7). These data will be updated as more information becomes available. More detailed descriptions of mitigation measures are included in Appendix 11.

When efficiency is provided as a range:
if project-specific efficiency is unknown, use the lowest number given;
if project-specific efficiency is utilized, provide supporting analysis and documentation.

Table 11-7a. Mitigation for Stationary Source Emissions - Operation (Residential)

Mitigation Measure	Emission Reduction Efficiency*			
	ROC	NO_X	CO	PM10
• Use solar or low-emission water heaters	11%	9.5%	10%	4.5%
• Use central water heating systems	9%	8%	8.5%	4%
• Use built-in energy-efficient appliances	2.5%	3%	3%	6.5%
• Provide shade trees to reduce building heating/cooling needs	Negl.	Negl.	Negl.	0.5%
• Use energy-efficient and automated controls for air conditioners	–	Negl.	–	0.5%
• Use double-glass-paned windows	4.5%	4%	4.5%	2.5%
• Use energy-efficient low-sodium parking lot lights	–	–	–	0.5%
• Provide adequate ventilation systems for enclosed parking facilities	–	Negl.	Negl.	Negl.
• Use lighting controls and energy-efficient lighting	Negl.	Negl.	Negl.	0.5%
• Use fuel cells in residential subdivisions to produce heat and electricity	Negl.	1.5%	1%	7%
• Orient buildings to the north for natural cooling and include passive solar design (e.g., daylighting)	14%	13%	13.5%	10.5%
• Use light-colored roof materials to reflect heat	1.5%	1.5%	1.5%	1.5%
• Increase walls and attic insulation beyond Title 24 requirements	14%	13%	13%	7.5%

Negl. = Negligible (less than 0.05%)

* These efficiencies represent additive reductions from facility operations, specifically unmitigated emissions from Stationary Sources (i.e., Energy Use, Area Source, Stationary Source). These efficiencies can be subtracted from the corresponding unmitigated emissions from this category (Table 9-8). These data will be updated as more information becomes available.
More detailed descriptions of mitigation measures are included in Appendix 11.

Table 11-7b. Mitigation for Stationary Source Emissions - Operation (Commerical)

Mitigation Measure	Emission Reduction Efficiency*			
	ROC	NO_x	CO	PM10
• Use solar or low-emission water heaters	0.5%	0.5%	0.5%	0.5%
• Use central water heating systems	0.5%	0.5%	0.5%	0.5%
• Provide shade trees to reduce building heating/cooling needs	0.5%	0.5%	0.5%	1%
• Use energy-efficient and automated controls for air conditioners	1%	1%	1%	1.5%
• Use double-glass-paned windows	3.5%	3%	3%	2.5%
• Use energy-efficient low-sodium parking lot lights	Negl.	Negl.	Negl.	Negl.
• Provide adequate ventilation systems for enclosed parking facilities	–	–	–	0.5%
• Use lighting controls and energy-efficient lighting	3%	8.5%	7%	19.5%
• Use light-colored roof materials to reflect heat	1%	1%	1%	0.5%
• Increase walls and attic insulation beyond Title 24 requirements	10%	9%	9.5%	7%
• Orient buildings to the north for natural cooling and include passive solar design (e.g., daylighting)	11%	13.5%	12.5%	17.5%

Negl. = Negligible (less than 0.05%)

* These efficiencies represent additive reductions from facility operations, specifically unmitigated emissions from Stationary Sources (i.e., Energy Use, Area Source, Stationary Source). These efficiencies can be subtracted from the corresponding unmitigated emissions from this category (Table 9-8). These data will be updated as more information becomes available.
More detailed descriptions of mitigation measures are included in Appendix 11.

Table 11-7c. Mitigation for Stationary Source Emissions - Operation (Industrial)

Mitigation Measure	Emission Reduction Efficiency*			
	ROC	NO_X	CO	PM10
• Provide shade trees to reduce building heating/cooling needs	Negl.	Negl.	Negl.	0.5%
• Use energy-efficient and automated controls for air conditioning	Negl.	Negl.	Negl.	1%
• Use double-glass-paned windows	Negl.	0.5%	Negl.	1%
• Use energy efficient low-sodium parking lot lights	Negl.	0.5%	Negl.	1%
• Provide adequate ventilation systems for enclosed parking facilities	Negl.	Negl.	Negl.	Negl.
• Use lighting controls and energy-efficient lighting	Negl.	1%	0.5%	2.5%
• Use light-colored roof materials to reflect heat	Negl.	Negl.	Negl.	0.5%
• Orient buildings to the north for natural cooling and include passive solar design (e.g., daylighting)	2%	3%	2.5%	5.5%
• Increase walls and attic insulation beyond Title 24 requirements	Negl.	1%	0.5%	3%
• Improved storage and handling of source materials	NQ	NQ	NQ	NQ
• Materials substitution (e.g., use water-based paints, life-cycle analysis)	NQ	NQ	NQ	NQ
• Modify manufacturing processes (e.g., reduce process stages, closed-loop systems, materials recycling)	0.5%	2%	1.5%	6%
• Resource recovery systems that redirect chemicals to new production processes	3.5%	3%	3%	1.5%

NQ = Not Quantified   Negl. = Negligible (less than 0.05%)

* These efficiencies represent additive reductions from facility operations, specifically unmitigated emissions from Stationary Sources (i.e., Energy Use, Area Source, Stationary Source). These efficiencies can be subtracted from the corresponding unmitigated emissions from this category (Table 9-8). These data will be updated as more information becomes available.
More detailed descriptions of mitigation measures are included in Appendix 11.

Table 11-8. Identifying Net Operation Emissions

Source	Unmitigated Emissions (lbs a day/pollutant)	Mitigation Measures	Mitigation Efficiencies	Net Emissions ROC	NOx	PM10	CO
Fugitive Dust from Roads							
Work Trips							
Non-Work Trips							
Truck Trips							
Congestion							
Off-Road Vehicles (i.e., forklifts, ships, trains, etc.)							
Energy Usage							
Stationary Equipment							
Unmitigated Emissions:							
Total Net Project Emissions:							

Key: Unmitigated Emissions (white box)
Mitigated Emissions (shaded box)

Table 11-9. Examples of Calculating Reductions from Mitigation Measures

Project: 210 SINGLE-FAMILY DWELLING UNITS	(Lbs/Day)			
	ROC	NOx	CO	PM10
Unmitigated Operation Emissions	**56.74**	**52.32**	**697.00**	**4.34**
Significance Thresholds	55.00	55.00	550.00	150.00
Significant?	Yes	No	Yes	No
Amount Needed to Reduce Emissions Below Level of Significance	-1.74	0.00	-147.00	0.00
Mitigation Measures				
1. Include Satellite Telecommunications Center	-0.11	-0.10	-1.39	-0.01
2. Include Retail Services in or within 1/4 mile	-1.42	-1.31	-17.43	-0.11
3. Establish/Contribute to Shuttle Service	-0.11	-0.10	-1.39	-0.01
4. Construct On-Site Bus Turnouts	-0.17	-0.16	-2.09	-0.01
Total Reduction	**-1.82**	**-1.67**	**-22.30**	**-0.14**
Total Mitigated Emissions	**54.92**	**50.65**	**674.70**	**4.20**
Significant?	**No**	**No**	**Yes**	**No**

Note: Qualitative measures can also be applied when all feasible quantitative reductions have been made.

Project: 190,000 SQ. FT., MULTI-TENANT OFFICE BUILDING	(Lbs/Day)			
	ROC	NOx	CO	PM10
Unmitigated Operation Emissions	**57.05**	**37.57**	**561.42**	**5.88**
Significance Thresholds	55.00	55.00	550.00	150.00
Significant?	Yes	No	Yes	No
Amount Needed to Reduce Emissions Below Level of Significance	-2.05	0.00	-11.42	0.00
Mitigation Measures				
1. Establish Telecommuting Program	-0.11	-0.08	-1.12	-0.01
2. Implement Parking Pricing	-1.71	-1.13	-16.84	-0.18
3. Provide On-Site Employee Services	-0.17	-0.15	-2.25	-0.02
4. Provide Child Care Center	-0.06	-0.04	-0.56	-0.01
Total Reduction	**-2.05**	**-1.39**	**-20.77**	**-0.22**
Total Mitigated Emissions	**55.00**	**36.18**	**540.65**	**5.66**
Significant?	**No**	**No**	**No**	**No**

Note: Qualitative measures can also be applied when all feasible quantitative reductions have been made.

Table 11-10. Steps for Mitigating Project Unmitigated Emissions (Screening Analysis)

(The following steps correspond to the unshaded portion of the flow chart in Figure 11-1.)

7. If a project is significant, apply all feasible mitigation for construction and/or operation. To calculate emission reductions, multiply the percent efficiency by the unmitigated emissions from the same source category, then subtract the result from unmitigated emissions. The following lists unmitigated emission sources and corresponding mitigation measures: 9-1 and 11-3 (Total Construction); 9-2 and 11-4 (Construction PM10); Table 9-3 and 11-2 (Construction Workers' Travel); 9-7 and 11-6 (Operation Mobile); and 9-8 and 11-7 (Operation Stationary).

8. If the project's construction and operation impacts are not significant, the lead agency has the discretion to require further analysis of impacts if the project has other potential air quality impacts (Section 6.2).

9. Compare construction and operation emissions to the thresholds of significance (Section 6.2).

10. If the project's construction AND/OR operation emissions remain above significance thresholds, apply qualitative mitigation measures that have not been quantified (Section 11.9). These can be found in Tables 11-2, 11-3, 11-4, 11-6, or 11-7, or can represent unlisted measures.

11. If the project's construction AND operation impacts are reduced below the thresholds of significance, an MND is appropriate.

12. Determine if the project's construction AND/OR operation emissions still exceed the thresholds of significance.

13. If construction AND operation emissions fall below thresholds of significance, an MND is appropriate.

14. If construction AND operation emissions remain above the significance thresholds, an EIR should be prepared. Appendices 9 and 11 should be used to calculate specific emissions.

15. If a project is not cumulatively significant, an ND is appropriate.

16. If a project is cumulatively significant, an EIR or MND is appropriate. Appendices 9 and 11 should be used to calculate project-specific emissions.

17. Apply all feasible mitigation measures.

ASSESSING CONSISTENCY WITH APPLICABLE REGIONAL PLANS

CHAPTER 12

Information should be provided in the EIR to determine consistency of a project with the AQMP and other applicable regional plans. Consistency is different from conformity. Consistency is a CEQA requirement. Conformity is a federal Clean Air Act requirement. Specifically, the federal Clean Air Act prohibits federal departments, agencies, or other agencies acting on behalf of the federal government, and the Metropolitan Planning Organization (MPO) which is SCAG from engaging in, supporting in any way, providing financial assistance for, licensing or permitting, or approving any activity that does not conform to the AQMP. For projects involving federal approval, the federal agency is the lead agency for making the conformity finding. In the case of transportation plans and programs, the MPO, SCAG, is responsible for conformity of its actions. The EPA is developing guidance for determining conformity of non-transportation related projects and actions, and transportation projects, plans, and programs. Refer to this guidance when preparing a conformity analysis.

Use the guidelines provided in this chapter for assessing consistency with regional plans relating to air quality as required under CEQA.

12.1 Overview of Consistency with Regional Plans

Section 15125 of the State CEQA Guidelines requires that EIRs analyze and discuss any inconsistencies between the proposed project and applicable General Plans and regional plans. As such, the EIR should address the General Plans and regional plans in the SCAB, Coachella Valley, and Antelope Valley that are applicable to the project.

Specifically, the EIR should discuss the project's consistency with the current AQMP or Coachella Valley PM10 State Implementation Plan (if the project is located in the Coachella Valley). In addition, several of the underlying key assumptions for both the air quality plans should be included in the analysis as well:

- o Assumptions such as the number and location of population, housing units, and employment from the SCAG Growth Management Plan (GMP).
- o Assumptions concerning type, size, and location of transportation infrastructure from SCAG's Regional Mobility Plan (RMP).
- o Consistency with a local government's Air Quality Element or air quality related policies in other General Plan Elements, if the local government has adopted such policies.

The purpose of the consistency finding is to determine if a project is inconsistent with the assumptions and objectives of the regional air quality plans, and thus if it would interfere with the region's ability to comply with federal and state air quality standards. If the project is inconsistent, local governments should consider project modifications or inclusion of mitigation to eliminate the inconsistency. It is important to note that even if a project is found consistent it could still have a significant impact on air quality under CEQA. For example, if the analysis demonstrates a project is consistent with the regional air quality plans and local Air Quality Element, that does not mean that the project could not also have a significant effect on air quality by exceeding the significance thresholds.

12.2 Consistency with AQMP/PM10 Plan

The consistency determination at the environmental review stage in the planning process plays an essential role in local agency project review by linking local planning (e.g. General Plan and Specific Plans) to the AQMP and PM10 Plan in the following ways. It fulfills the CEQA goal of fully informing local agency decision makers of the environmental costs of projects under consideration and does so at a stage early enough to ensure that air quality concerns are fully addressed. It provides the local agency with ongoing information assuring local decision makers that they are making real contributions to the clean air goals contained in the 1991 AQMP and PM10 Plan. Only new or amended General Plan Elements, Specific Plans, and significant projects need to undergo a consistency review. This is because the AQMP control strategy is based on projections from local General Plans. As such, projects consistent with local General Plans are considered consistent with the air quality related regional plans.

Consistency with the AQMP and PM10 Plan means that a project is consistent with the goals, objectives, and assumptions in the respective plan to achieve the federal and state air quality standards. As part of assessing consistency with the AQMP, consistency should also be assessed with the following regional plans:

- **AQMP/PM10 Plan**

If the project is in the SCAB or SEDAB (under District's jurisdiction), consistency with the AQMP (and PM10 plan for the Coachella Valley) should be assessed. Section 12.3 provides guidance in performing a consistency analysis. In addition to assessing consistency with the AQMP, a project should also be assessed with two of the regional planning documents prepared by SCAG that relate to air quality: the Growth Management Plan, and the Regional Mobility Plan.

Growth Management Plan (GMP). The growth projections and location of population should be compared to the growth the project will generate. That is important because the GMP was used to determine the control strategy needed to attain the federal and state clean air standards, while accommodating future growth. This can be accomplished by comparing the project's density, location, and land use pattern with the adopted local General Plan and associated zoning ordinance and maps that were in place in 1989 when the GMP was adopted. If the project will result in a significant change in the density, location, and land use pattern, then it is considered to be inconsistent with the GMP. For General Plan amendments and projects involving a significant change to the General Plan, a comparison to the growth projections in the appropriate regional statistic area (RSA) for the build-out year should be performed to determine consistency.

Regional Mobility Plan (RMP). If the project is a transportation project, it should be compared to the assumptions in the RMP concerning the type, size, and location of the project. The comparison is necessary because many of these transportation projects are relied upon in the AQMP to reduce emissions.

- **Congestion Management Plan (CMP)**

Projects should be compared to the CMP goals to retain and obtain certain levels of service on roadways. When the impact of a project will be reduced by transit use, the trip assignment that the project assumes must be consistent with the transit provider's assumptions. The local CMP should be consulted when assessing consistency. Consistency with the CMP is important to air quality because vehicles traveling at slower speeds generate more pollution than those traveling at higher speeds (up to 55 mph).

- **Consistency With General Plans**

Both CEQA and the California planning, zoning and development laws require projects to be consistent with the jurisdiction's General Plan. The EIR should identify if the local government has an Air Quality Element or has incorporated air quality goals and objectives into another element of the General Plan. This project should be evaluated for consistency with the appropriate element. Examples of air quality related goals that can be included in a General Plan are identified in Table 12-1.

12.3 AQMP Consistency

New or amended General Plan Elements (including land use zoning and density amendments), Specific Plans, and significant projects must be analyzed for consistency with the AQMP. There are two key indicators of consistency:

(1) Whether the project will not result in an increase in the frequency or severity of existing air quality violations or cause or contribute to new violations, or delay timely attainment of air quality standards or the interim emission reductions specified in the AQMP (except as provided for CO in Section 9.4 for relocating CO hot spots).

(2) Whether the project will exceed the assumptions in the AQMP in 2010 or increments based on the year of project build-out and phase (Table 12-2).

In order to address the first criterion, an air quality modeling analysis that identified the projects impact on air quality will need to be performed. As with the CO analysis, the "No Project" ambient concentration should be determined using information from District monitoring stations (refer to Chapter 9). In order to be found consistent, the analysis will need to demonstrate that the project's emissions will not increase the frequency or the severity of existing violations, or contribute to a new violation at the project. The violations that are referred to are the state and federal criteria pollutant ambient air quality standards (refer to Chapter 3). The analysis must look at each phase and build-out, and include a no-project and project alternatives analysis.

Consistency with the AQMP assumptions is determined by performing an analysis of the project with the assumptions in the AQMP for the year 2010. Table 12-2 identifies the types of projects and assumptions they should be compared with. Additionally, those types of land uses identified need to undergo an emissions analysis. The information regarding specific assumptions can be obtained from the District or SCAG. When specific information for a build-out year is not available, data that is available between the two nearest dates can be interpolated to estimate the assumptions for the interim years.

If the air quality modeling demonstrates that the project is inconsistent with the AQMP, the project can be modified and mitigation measures applied. However, before a determination of consistency can be made, the project must quantitatively demonstrate that such modifications or mitigation measures fully offset the negative impact on air quality, such that the project can be found consistent with the applicable regional plan; otherwise the project is considered significant. Any mitigation applied to reduce the impact must meet the test of having adequate funding, a legally binding commitment to ensure implementation, and a showing that it will be implemented simultaneous with the impact.

12.4 Consistency Findings

CEQA states that an agency has the authority to approve projects with the potential to cause significant adverse environmental impacts (California Public Resource Code 21002 and State CEQA Guidelines 15092 and 15093). Thus, even if a project is found inconsistent with the AQMP and a net degradation of Basin air quality could occur, a local agency may approve a discretionary land use project or a government project that results in unmitigated air pollutant emissions.

On the other hand, some state and federal statutes affect local agency discretion to trade off social, economic, or other benefits for significant impacts on air quality. The federal Clean Air Act establishes requirements to prevent air quality degradation beyond established standards. The SCAB exceeds federal standards for five pollutants at this time. The AQMP represents the regional plan for attaining both the federal and state clean air goals. Therefore, any findings of overriding considerations for projects that are not consistent with the AQMP should consider the potential ramifications. Specifically, that the region will not be able to achieve the air quality standards within the time frame specified in law, potential restrictions on federal funding, imposition of a federal plan and regulations, federal sanctions and/or the need for regulation of additional sources in order to make up the emission reductions lost.

References

Federal Clean Air Act, Section 176 (c).

Guidance for Determining Conformity of Transportation Plans, Programs, and Projects with Clean Air Act Implementation Plans During Phase 1 of the Interim Period, EPA, June 1991.

Table 12-1. Examples of Air Quality Policies for General Plan Elements

General Plan Element	Policy
Land Use	Ensure land use compatibility for sensitive uses Integrate land uses and densities that support transit corridors
Circulation	Integrate Congestion Management Program requirements Provide local shuttle services
Conservation	Plant trees to reduce carbon dioxide Integrate solid waste requirements from AB 939 Incorporate city-wide energy reduction goals
Open Space	Encourage urban infill to reduce trip lengths
Housing	Provide for housing development to support type of job growth
Noise	Facilitate off-peak period truck operations in areas not adjacent to residential developments
Safety	Protect sensitive uses from exposure to air toxics Prepare contingency plans for emergencies
Redevelopment	Provide resident working training programs to improve jobs/housing balance Use tax increment financing for air quality beneficial to infrastructure improvements
Air Quality	Reduce energy use in public buildings Change local government administrative practices (e.g. phone-in registration for city programs, etc.) Make transportation demand management a priority Implement 1991 AQMP and CO Plan control measures

Table 12-2. Key Assumptions

Land Use	Assumption
Airports	Number of Flights, Million Air Passengers (MAP)
Electrical Generating Facilities	Electrical Demand (KWG hours)
Petroleum or Gas Refineries	Fuel Refined
Designation of Drilling District	Fuel Refined
Water Ports	Cargo Tons, Ship Berths
Solid Waste Disposal Sites	Tons of Solid Waste
General Plans, Specific Plans, Residential Projects, Wastewater Facilities/Interceptors	Population Number and Location, Regional Housing Needs Assessment
Off-Shore Oil Facilities	OCS Emissions

This list of land uses and assumptions is not exhaustive.

THE DISTRICT AS A RESPONSIBLE AGENCY

CHAPTER 13

According to the State CEQA Guidelines, a responsible agency is a public agency that proposes to carry out or approve an aspect of the project for which a lead agency is preparing environmental documentation. The District is a responsible agency for aspects of projects requiring District permits. The District is a commenting agency for those portions of a project not subject to a District permit. As a responsible agency, the District will review, comment, and establish mitigation whenever necessary to reduce air quality impacts for those aspects of the project relating to the District's permit. For example, a hospital would probably require permits from the District (boilers, sterilization apparatus, etc.), and as such, the District would be a responsible agency under CEQA for those aspects of the project relating to the permit. For the other aspects of the project that could impact air quality such as non-work vehicle trips, the District would recommend mitigation measures for reducing these environmental impacts as a commenting agency.

Most of the District permits are considered to be either ministerial or exempt (statutorily or categorically), or to have a non-significant effect on air quality. (Refer to District CEQA Guidelines, Articles 18, 19, 20 and 21.) As such, the environmental documentation prepared by the lead agency should in most cases be sufficient to cover the District's subsequent permit action. In those cases, where the District action is not considered to be ministerial or exempt, the environmental documentation prepared by the lead agency should include an environmental analysis description and recommended mitigation for any impacts resulting from the District permit, if that document is intended to suffice for the District permit.

13.1 Thresholds for District Permits

Currently, the District uses the thresholds for significance specified in this Handbook for determining which projects requiring District permits could have a significant effect on the environment. When the District's CEQA Guidelines are revised, these thresholds may be revised. A number of qualitative thresholds have also been identified.

Projects requiring District permits may significantly affect the environment when any of the following is involved:

- Criteria emissions that are not regulated under a District rule with an established emissions limitation over the following thresholds--
  - 55 pounds per day for ROC
  - 55 pounds per day for NOx
  - 150 pounds per day for PM10
  - 550 pounds per day for CO
  - 150 pounds per day for SOx
- Carcinogenic or toxic air contaminants identified in Rule 1401 are emitted from the project that exceed the maximum individual cancer risk of one in one million or 10 in one million if the project is constructed with best available control technology for toxics (T-BACT).
- The project may result in the accidental release of an acutely hazardous air pollutant.
- The project could emit an air contaminant not regulated by District Rules, but that is on the federal or state air toxics list (Appendix 3).

Refer to Table 4-1 in Chapter 4 which provides a list of land uses likely to involve equipment that will meet these criteria. For these projects, the District assesses the environmental documentation already prepared for the land use approval by the local government. If that analysis is sufficient, the District will not require additional environmental documentation. If the analysis is not sufficient, the District will assume a lead agency role for the District permits, if authorized pursuant to CEQA Guidelines Section 15052, or prepare a subsequent EIR, if appropriate, pursuant to CEQA Guidelines Section 15162, since the project could have potentially significant air quality impacts.

13.2 Environmental Analysis

The District has determined that in some situations various air pollution control equipment may generate cross-media environmental impacts, or in some cases the reduction of one air pollutant may result in an increase in another air pollutant. A cross-media impact refers to the removal of a contaminant from one medium, such as air, and release to another medium, such as water. Cross-media impacts should be identified and discussed as part of the environmental documentation for the project. These impacts may require analysis in a CEQA document to determine the significance of the impact. If necessary, suitable mitigation measures will be required.

Cross-media impacts should be investigated during the Initial Study for all significant projects where the District is a responsible agency to determine whether there is the potential for a significant impact. When an EIR is prepared for the project, the environmental documentation should include an analysis of cross-media impacts, and based on that analysis, incorporate a finding that the cross-media impact is either significant or insignificant.

The environmental analysis should identify the control technology to be used and any potential cross-media impacts. The purpose of the analysis is to identify multi-media impacts as a result of the permitting action. Since these potential environmental impacts are within the responsibility of agencies other than the District, these other agencies should be consulted through the CEQA review process to determine if the impact is significant and what recommendations for mitigation should be made. Often the responsible agency will be a water supply agency, Regional Water Quality Control Board, wastewater treatment agency, and agency responsible for solid waste disposal. The analysis of the potential cross-media impacts should be performed whenever the District has a subsequent permitting responsibility and an EIR is being prepared.

The significance of a cross-media impact should be determined by the thresholds established by the responsible agency (e.g., sanitation district, water quality control board, etc.). To date, only the Solid Waste Management Boards have established a threshold of significance, which is a ten percent increase in the capacity utilization of a solid waste disposal facility.

There will be some cases where the District will not be able to use another agency's environmental documentation. An example would be environmental documents considered by the District to have insufficient analysis of the potential environmental impacts. Projects with significant emissions, involving toxic emissions, or threatened releases of acutely hazardous materials most likely will fall in this category. In other instances, the project proponent may not know which specific control technology will be used in the project, and in that case, the environmental analysis will need to wait until the applicant applies for the permit.

Appendix 13 describes the specific control technologies, potential cross-media impacts of the different control technologies, and identification of agencies that should be consulted as responsible or commenting agencies. The analysis described in Appendix 13 must be followed for EIRs where the District will be taking a subsequent permit action.

DISTRICT REVIEW AND COMMENTING PROCESS

CHAPTER 14

The air quality analysis in an EIR (or other environmental documentation) is often so technical that only a specialist in air quality can ensure that it is adequate. This is particularly true as evaluation of impacts becomes more complex and concern over toxic emissions grows. Given the severity of air quality problems already plaguing the region and the certainty of continued population growth, it is imperative that air quality analyses be adequate in relation to CEQA standards. In addition, CEQA Guidelines Section 15086 requires lead agencies to consult responsible agencies, other agencies which exercise authority over resources which may be affected by the project, and any person who has special expertise with respect to any environmental impact involved. The District, therefore, has established a program for reviewing and commenting on the air quality analyses in environmental documents submitted to the District pursuant to CEQA Guidelines Sections 15086, 15087, and 15096.

This chapter should be consulted prior to the public review period of an EIR (or other environmental documentation) for any project deemed to have a significant impact on air quality. Refer to Chapter 6 for a listing of the types of projects and emission thresholds that determine which projects are significant.

14.1 Purpose of the District's CEQA Program

The District, as commenting or responsible agency for air quality issues, evaluates the air quality analysis in environmental documents to ensure impacts are accurately identified and mitigation applied to lessen the impact. Lead agencies can be confident that the environmental documents that meet the District's standards for performing an air quality analysis are adequate for decision making.

The District's CEQA program is also intended to provide the framework within which the District will fulfill its role, under CEQA and the Health and Safety Code, as the agency responsible for protecting air quality. Thus, the District is responsible for commenting on any project that may have an adverse impact on air quality within its jurisdictional boundaries (Health and Safety Code, Section 40412). The District is considered to be a responsible agency for any project for which a subsequent District permit is required (refer to Chapter 3) and also has authority over projects that could affect air quality. CEQA (Section 15086) requires the lead agency to consult with and request comments on the draft EIR (or other environmental documentation) from responsible agencies and other involved agencies.

14.2 Role of the District

The District, acting as a commenting and/or responsible agency under CEQA, will review the EIR (or other environmental documentation) and comment on the adequacy of the air quality analysis, as well as recommend mitigation measures. The District will review the air quality analysis according to its uniform standards (refer to Section 14.4). While the Handbook provides general guidance, the District's comment letter is the project-specific review for adequacy under CEQA.

This does not mean, however, that the District's CEQA program moves the District into the role of lead agency with respect to the air quality portion of an EIR (or other environmental documentation).

14.3 District's CEQA Program

The District will review and comment on the air quality analysis in an environmental document on regionally significant projects during the public review period. The lead agency should send all significant projects with air quality impacts to the District.

In order to determine which projects are considered significant from an air quality perspective, refer to Chapter 6. In order to facilitate the District's review, the following items should be submitted to the District:

- Draft EIR or other environmental documentation
- Any technical appendices that relate to air quality (including traffic impact analysis, growth forecasts, etc.)
- Name and address of the person to whom the District should submit comments
- Date public comments are due
- Mitigation Monitoring Program, if available

This information should be sent to:

CEQA Coordinator
Office of Planning and Technology Advancement
21865 East Copley Drive
P.O. Box 4939
Diamond Bar, CA 91765-0939

Early consultation with the District can ensure that the EIR adequately addresses air quality issues. The District recommends that project proponents and/or local governments consult with the District if the project is an extremely large project encompassing several hundred acres or attracts a large number of trips (such as a stadium, new town, etc.), or if regardless of size the project has the potential to emit substantial amounts of air pollutants, or if project proponents would like to explore innovative mitigation measures for the project (such as energy fuel cells). A planner or project proponent can consult with the District prior to the completion of the EIR or even earlier during the project design phase by contacting the CEQA Coordinator through the District's Local Government/CEQA Unit.

The District will review each portion of the EIR that could have an impact on air quality. In addition to the section entitled "Air Quality," for example, sections that describe impacts on mobility, and hence determine vehicle miles traveled must be considered because transportation contributes substantial emissions. Consideration of air quality relates to such concerns as the levels of congestion experienced at roadway intersections. Waste management issues may also involve air toxics, as can advanced technology and new processes with new materials.

The District will carefully review the air quality analysis and the mitigation measures. At the conclusion of the District's review, local governments will receive a letter identifying any deficiencies in the air quality analysis and recommending mitigation measures.

The flow chart in Figure 14-1 illustrates District involvement in the CEQA process.

14.4 Criteria for the Performance of an Air Quality Analysis

To determine if an air quality analysis is adequate to assess and mitigate a project's impact, a series of criteria has been developed. The District will use these criteria when reviewing the adequacy of an air quality analysis and in recommending mitigation measures. As such, the Districts comments will be based on the following:

(1) Air Quality Analysis

- All emission sources from construction and operation are quantified with the most current emission factors and methodologies.
- Assumptions used in calculating emissions are reasonable.
- Project employs the appropriate environmental document.

- o Cumulative impact analysis is reasonable.
- o All alternatives are quantified, at a minimum using the screening tables in Chapter 9.
- o The baseline information identified in Chapter 8 is included in the EIR.
- o A consistency analysis has been performed consistent with Chapter 12.

(2) Mitigation Measures

- o Assumptions used in quantifying mitigations are reasonable.
- o Mitigation measures are included to reduce cumulative impact from projects.
- o Mitigation measures included are appropriate to use.
- o Mitigation measures are enforceable as described in Chapter 11.

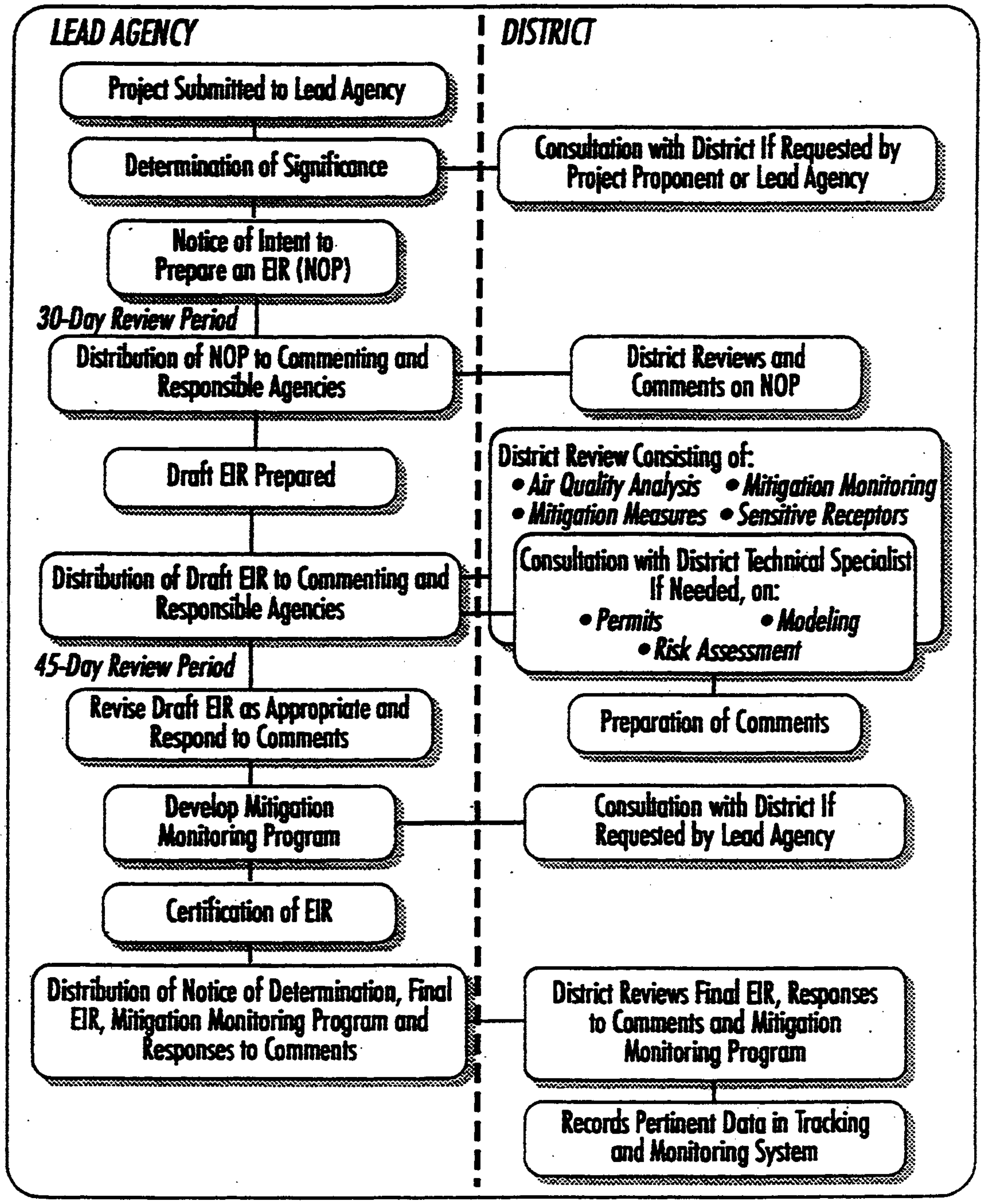
(3) Mitigation Monitoring

- o The lead agency commits to including standards for measuring whether or not air quality mitigation measures have been implemented.
- o The lead agency commits to remedial action if air quality mitigation is not implemented.

(4) Toxics

- o An impact screening assessment is performed when sensitive receptors are to be sited within a quarter mile of a known source of toxic air pollutants.
- o The potential of an accidental release of an acutely hazardous material into the air has been analyzed.

Figure 14-1. District Review of Environmental Documents



IMPLEMENTING AND MONITORING MITIGATION

CHAPTER 15

Pursuant to AB 3180 (California Public Resources Code), CEQA requires public agencies to monitor and to report on any mitigation required on an approved project. This ensures that the mitigation will be implemented and the environment protected. Mitigation measures, once implemented, should be judged for their effectiveness. Refer to Chapter 11 for further information on developing appropriate mitigation measures. A mitigation monitoring program includes several key components. A checklist is provided in Table 15-1 to assist planners in preparing the mitigation plan.

15.1 Mitigation Monitoring Plan Components

The District recommends that mitigation monitoring plans contain the components described below. The District believes these components are important to fulfilling the monitoring and reporting requirements of CEQA. They will also assist in ensuring that mitigation measures reduce air quality impacts.

Communicating Mitigation Measures and Reporting Requirements. Frequently, the requirements for mitigating impacts and reporting are not properly explained to those responsible. For example, mitigation measures related to construction, such as street sweeping, should be explained to the construction site manager and to contractors. Business owners need to be aware of mitigation measures related to operation, such as transit passes for shoppers at malls. One method of ensuring that those responsible are properly informed is to have contractors and business owners certify, at the time they are issued a business license, that they are aware of and will commit to employing the mitigation measures identified for that project. Mitigation measures could also be recorded on the title of properties, thereby informing future owners of the requirements.

Identification of Agency Responsible for Monitoring. The governmental body responsible for monitoring each mitigation measure should be clearly identified. The lead agency is responsible for the majority of the mitigation measures (including those recommended by commenting agencies).

Identification of Implementation Time Frame. The time frame for implementing the mitigation measures should be identified for each measure. Identification could consist of pinpointing a step in the project approval process when the measure should be implemented, setting a trigger such as when a project produces a certain number of vehicle trips, identifying a project phase, or simply selecting a date.

Establishment of Specific Compliance Criteria. In order to adequately monitor a mitigation measure, it is imperative that the measure have a quantifiable standard or a specific set of actions identified for determining whether or not it has been implemented. Compliance criteria can be the assumptions used in quantifying the mitigation measures, the standard established as a trigger for additional mitigation measures, or criteria based on a qualitative assessment such as odors. (Refer to Chapter 11.)

Identification of Remedial Actions. The program should identify remedial actions that the local government can take, including such measures as fines or court orders. Lead Agencies may also wish to consider having the program provide for the substitution of a more effective mitigation measure by the responsible agency if the current measure proves ineffective. This latter suggestion is not required by CEQA, but could provide an insurance policy for assumed mitigation effects.

Reporting Mechanism and Requirements. The program should state the method of reporting and its requirements. Further it should specify the frequency of monitoring, designate the monitoring party (i.e., building department, planning department, fire department), and identify any agency that should receive periodic activity reports.

An outline of the key components is provided in Table 15-1. This outline can be used as a checklist for determining if the appropriate components are included in the mitigation monitoring program.

15.2 Monitoring and Reporting of Mitigation Measures

In order to determine if measures are being implemented and if the measures are effectively reducing the impact, CEQA requires that a monitoring and reporting system be established. Local governments need to establish a monitoring and reporting system for projects for which they are the lead agency. The District also has a role in local government monitoring and reporting systems when it is a responsible agency for the project.

- **Local Government Monitoring and Reporting Programs**

The key issues in monitoring are: frequency of monitoring, and at what stage in the project permit/construction process mitigation should be monitored. The frequency of monitoring mitigation measures should be based on the duration of implementation of the measures and the amount of monitoring necessary to ensure that measures are implemented. For construction mitigation measures, monitoring during both scheduled building inspections and at a pre-established frequency (such as once a week) is desirable. If the construction phase is extremely long, or if emissions exceed the PM10 standard, or the project is very complex, the local government may want to require continual on-site monitoring.

Operational mitigation measures should be monitored at least once a year, or more frequently if:

- The project is to be developed in phases
- Land uses other than those anticipated during project approval are present
- The project's impacts are extremely significant
- The mitigation measures protect sensitive receptors

Monitoring may be linked to a specific step in the planning process that requires local government approval or inspections. Examples of such steps include:

- Final subdivision map approval
- Grading permit
- Land use clearance permit
- Building permit
- Construction inspections
- Occupancy permit
- Business license
- Discretionary permit annual review

The flow chart in Figure 15-1 identifies types of mitigation measures that can be monitored in each development phase. This is intended to be a general list. Since local government planning processes vary, other steps in the planning process may also exist that can be used to monitor implementation. Table 15-1 provides a sample checklist for monitoring and reporting air quality mitigation measures. Figure 15-2 provides a sample outline of a mitigation monitoring program that contains all the components recommended in Section 15.1. Figure 15-3 provides a sample reporting form to assist local governments in tracking and determining effectiveness of mitigation measures.

Local governments have the authority to levy charges, fees, or assessments to pay for the monitoring and reporting program. Local governments have an opportunity to use the information gathered through the monitoring program to determine if a mitigation measure is effective. The January/February 1989 issue of California Planner suggested that if the measures are not as effective as intended and the impact remains substantial, the local government may substitute a more effective measure. While not specifically required by CEQA, Lead Agencies can exercise this approach at their option.

- **District and Monitoring and Reporting Programs**

The District is involved in local government monitoring and reporting programs as both a responsible agency and technical resource to local governments. The AB 3180 also requires the District to adopt a mitigation monitoring program for mitigation measures imposed on projects for which the District is the lead agency. As a responsible agency, the District can only impose mitigation measures that are related to the District's permitting authority. For example, the District would be responsible for monitoring mitigation measures relating to the permitting process imposed on projects where the District is a responsible agency under CEQA; however, the District is not responsible for monitoring mitigation measures that it has recommended in the role of a commenting agency. The District can be both a responsible agency for aspects of a project relating to District permitting and a commenting agency relating to other aspects of the project.

The District will, if necessary, recommend mitigation measures when it reviews and comments on a project. In addition, the District may specify required mitigation measures relating to the District's subsequent permitting action and submit monitoring and reporting requirements for these measures. The District will work with local governments to coordinate monitoring of District permit-related mitigation measures when applicable.

The District can assist local governments in monitoring certain mitigation measures by providing its technical expertise or by using District permitting and enforcement activities, particularly when measures relate to District permits; by evaluating air quality monitoring samples; and by making District inspections. In those cases in which local governments identify the District as a responsible monitoring agency for air quality mitigation measures, both the EIR and mitigation monitoring program **must** be submitted for District review and comments.

15.3 Enforcement

Measures that are critical to mitigating the impact should be legally enforceable. Enforcement depends largely on the implementation mechanism and specificity of the measures. The easiest measures to enforce are those that clearly identify who is going to do what by when. When mitigation fees are involved, it is important to identify when in the planning process the fee should be paid, how much the fee is (or the mechanism for determining the fee), and what the fee is to be used for (identification of the particular program or improvement).

AB 3180 (Cortese), which codified mitigation monitoring requirements, does not provide additional sanctions for local governments to impose if monitoring reveals that the mitigation measures or changes to the project have not been implemented. Local governments can, however, use existing sanctions available to them, such as stop work orders, fines, and restitutions. In addition, a variety of enforceable mechanisms are available to local planners to ensure that the air quality mitigation measures are implemented.

- **Examples of the Enforceable Mechanisms for Mitigation Measures**

Conditions of Approval on Discretionary Permits. Air quality mitigation measures can become conditions of approval on discretionary permits (e.g., conditional use permits, variances, design review permits, subdivision maps, etc.). Local governments have the authority to condition projects as long as the conditions are reasonably related to the discretionary permit. Mitigation measures are related to the project in the sense that through the environmental process these measures have been deemed necessary to reduce the potential environmental impact of the project.

Most mitigation measures are tied to conditions of approval as they relate to a particular step in the planning process. For example, if a mitigation measure that required the planting of shade trees to reduce electrical energy usage had been included in an EIR, a requirement could be made that such trees be planted prior to the issuance of an occupancy permit.

Impact, Mitigation, or Improvement Fees. Local governments are empowered to exact impact, mitigation, or improvement fees from developments as long as the fee meets the nexus test. In most cases, the environmental documentation can establish a nexus by showing that the fee will be used to offset the impact and fund its amelioration.

Impact or mitigation fees support mitigation measures such as transportation demand management (TDM) programs where the program will benefit properties in addition to the project site. Improvement fees are best suited for mitigation measures that involve capital improvements, such as traffic light synchronization, where the improvement involves expenditure of funds beyond the funding that can be reasonably exacted from the project.

Conditions, Covenants, and Restrictions. Through the discretionary permitting process, local governments can require that certain mitigation measures be recorded on a property's conditions, covenants, and restrictions (CC&Rs). CC&Rs can govern aspects of a project including land uses, development standards, responsibilities of property owners and associations, and any other requirements unique to the area covered under the CC&Rs.

Mitigation measures included in CC&Rs may be recorded on the title of the property and made available to future owners and concerned citizens through the county recorder's office. In that way, CC&Rs are effective implementation mechanisms for long-term operational mitigation measures (such as ridesharing requirements) and measures that are expected to be carried out by an association of the owners of individual lots (such as maintaining low-energy lights in the common parking area of a planned unit development). CC&Rs are also effective in ensuring mitigation of projects that are to be built out over a series of several years, such as Specific Plans that will serve as the guide for all future development of the project.

Improvement Securities. Through local ordinances, local government can require project proponents to furnish a security for the performance of any act, agreement, or work. Improvement securities include bonds, deposits with a local agency, a trust account, instrument or letter of credit, or lien. Local governments commonly use improvement securities for items such as construction of capital improvements. Improvement securities can also be used to assure implementation of air quality mitigation measures. Improvement securities would permit a local government to carry out the work if the project proponent failed to implement the measure. Examples include: traffic light synchronization, bus turnouts and passenger benches, and recycling collection service.

Development Agreements. Local governments have the authority to enter into development agreements with any property owner. Development agreements can specify the permitted uses on the property, the density or intensity of use, the maximum height and size of proposed buildings, provisions for reservation or dedication of land for public purposes, and terms and conditions relating to financing public facilities and subsequent reimbursement. The development agreement may include conditions, terms, restrictions, and requirements for subsequent discretionary actions. While development agreements are not specifically entered into to implement mitigation measures, development agreements, if instituted, should incorporate such measures.

The most appropriate measures for inclusion in a development agreement are design and land use related, such as support services in business parks, operational mitigation measures such as participation in a transportation management association, dedications for uses such as bicycle lanes and public transit, and financing of public facilities such as rail transit line extensions. In addition, development agreements are beneficial in establishing trigger mechanisms and requirements for additional mitigation measures, if the existing measures do not prove adequate.

Memorandum of Understanding. Local governments are empowered to enter into memoranda of understanding (MOUs) with other public agencies, private developers, etc., to facilitate a public interest or cause. Mitigating environmental impacts, including those on air quality, fall within these parameters. MOUs are most useful in implementing measures that require a long term commitment on behalf of the project proponent, a partnership between the local government and project proponent, or an enforceable mechanism. For example, an MOU would be appropriate where the commitment calls for the operation of a shuttle service between residences and a commercial district, requiring a long-term enforceable agreement to ensure appropriate implementation.

Figure 15-1. Monitoring Mitigation Measures

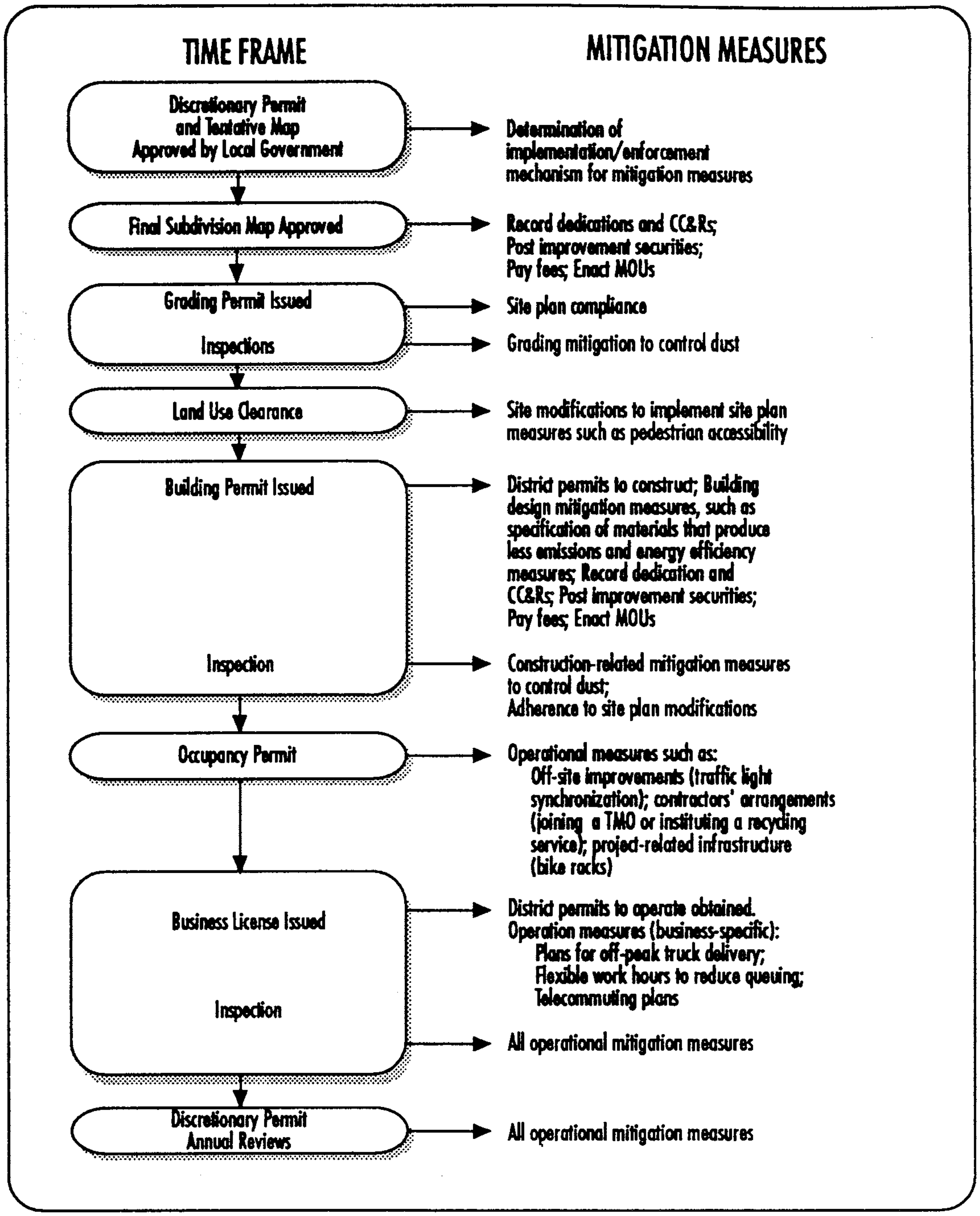


Figure 15-2. Monitoring Program Outline

Project Case No.: ______________________

Description of Project: ______________________

Address: ______________________

Certification.
The following have been given copies of the monitoring program:

YES	Date		YES	Date	
☐	________	Project Proponent	☐	________	Responsible Agencies
☐	________	Construction Contractor	☐	________	Code Reinforcement
☐	________	Business Owners	☐	________	Planning

Reporting Requirements: The monitoring report should be completed for each inspection or plan check and sent to the appropriate agencies.

Frequency of Monitoring:

Pre-construction

- ☐ By a specific date
- ☐ Prior to each permit issuance
- ☐ Other (specify) ________

Occupancy

- ☐ For each new or renewal of business license
- ☐ Once a year
- ☐ Other (specify) ________

Construction

- ☐ During regular building inspections
- ☐ Once a week
- ☐ On-site continuous monitoring required
- ☐ By a specific date
- ☐ Other (specify) ________

(Continued on next page)

Figure 15-2. Monitoring Program Outline (continued)

Compliance Provisions

If the monitoring program identifies any measure as ineffective in reducing the impact for which it has been imposed, the local government will substitute that measure with a more effective measure.

Mitigation Measures

Mitigation Measure	Compliance Criteria	Responsible Monitoring Agency	Remedial Action
Prior to Subdivision Map Approval			
Prior to Grading Permit			
Prior to Land Use Clearance Permit			
Prior to Building Permit			
During Construction Inspections			
Prior to Issuance of Occupancy Permit			
Business License			
Discretionary Permit Annual Review			
Other			

Figure 15-3. Monitoring Program Report

Monitoring Program Report

Date of Site Visit: ______________ Plan Check: ______________________

Purpose: ____

Monitoring Phase: ____________________________________

☐ Pre-construction

☐ Construction

☐ Occupancy

Project Case Number: ________________________________

Description of Project: ______________________________

Project Address: ____________________________________

Status of Mitigation Measures

Yes	Yes (but not effective)	No	Description of Measure	Compliance Criteria
____	____	____	1. ____________	____________
____	____	____	2. ____________	____________
____	____	____	3. ____________	____________
____	____	____	4. ____________	____________
____	____	____	5. ____________	____________
____	____	____	6. ____________	____________
____	____	____	7. ____________	____________
____	____	____	8. ____________	____________
____	____	____	9. ____________	____________
____	____	____	10. ____________	____________

(Continued on next page)

Figure 15-3. Monitoring Program Report (continued)

For each measure not implemented or not effective, complete the following:

Measure No.	Follow-Up Visit Scheduled	Remedial Action Implemented (Identify Action)	Follow-Up Action

Copies Distributed to:

__________ Public Works
__________ Enforcement
__________ Planning
__________ Project Planner
__________ Responsible Agencies (List)
____
__________ Others (List) __________

I hereby certify that I have visited the project site and that the above information is true to the best of my knowledge.

Name of City Official: ____________________

Signature: ____________________

Date:

Date of Next Inspection: __________

Table 15-1. Mitigation Monitoring Checklist

Requirement	Yes	No
1. Have the mitigation measures and reporting requirements been communicated?		
2. Have entities responsible for monitoring each measure been identified?		
3. Has a time frame for implementation of each mitigation measure been identified?		
4. Have specific compliance criteria been identified for each measure?		
5. Have remedial actions been identified?		
6. Does the program identify the method of reporting and reporting requirements?		

REPORTING ON PROJECT DISPOSITION

CHAPTER 16

The need for local governments to report to the District on environmental analysis is important for a number of reasons:

- to take credit for actions local governments take to reduce emissions under the AQMP (i.e., reductions from mitigation measures applied to projects)
- to reassess the key assumptions that were used in determining the appropriate attainment strategy that was included in the AQMP (i.e., population projections, etc.)
- to assess cumulative impacts of insignificant projects
- To comply with CEQA

Credit for Local Government Actions. The District is responsible for demonstrating that the SCAB, Coachella Valley and Antelope Valley are making sufficient progress in attaining the federal and state ambient air quality standards. Therefore, the District must show that emissions within its jurisdiction are being reduced and must substantiate its progress through quantitative reporting. In the past, the District has not been able to quantitatively demonstrate reductions in emissions from local government actions, despite the mitigation measures now in force. Therefore, the District is requesting that local governments voluntarily participate in monitoring programs.

When the lead agencies report on the disposition of environmental documents for projects, the District is able to document emission reductions. These reports will also document the progress of local governments in implementing the 1991 AQMP since a heightened CEQA involvement process was included as a control measure (M-H-1) in the Plan. Documenting the contributions of local governments in implementing the AQMP is critical. Without the cooperation of local governments, the region could face a situation in which emission reductions would need to be made up through the application of more stringent regulations and the regulation of smaller sources, and contingency measures would need to be implemented. Additionally, federal funds for transportation and wastewater treatment facilities could be restricted.

Most importantly, recent gains toward cleaning up the air could be set back, and the region would not be able to meet the federal and state ambient air quality standards within the 20-year time frame set out in the 1991 AQMP.

Assessing AQMP Assumptions. The AQMP must set out a comprehensive emissions reduction strategy that demonstrates attainment of National Ambient Air Quality Standards by the deadlines established in the federal Clean Air Act for each type of pollutant. In addition, the AQMP strategy must also achieve federal and state targets for interim emissions reductions. The AQMP strategy forecasts emission levels, based in part on SCAG's forecasts of future employment, population, and travel in the region. SCAG's forecasts reflect trends in the many complex forces which determine regional growth: births, deaths, immigration, emigration, shifts in regional, state, national and international economic factors; and changes in local land use plans and policies. It is important to monitor and regularly update forecasts of future emissions, employment, population, and travel. It is also important that new and existing development implement the measures which the AQMP assumes they will perform.

Cumulative Impacts. Individually, projects may not have a significant impact on air quality, however when considered together the impact may be significant. Annual reporting will assist the District in assessing the impacts that the unmitigated emissions from projects are having on the attainment strategy contained in the AQMP.

CEQA Reporting. CEQA Guidelines Section 15095 requires that lead agencies provide a final certified EIR to responsible agencies. The District requests a copy of the final certified EIR whenever it is a responsible or commenting agency under CEQA. In addition, CEQA Guidelines Section 21092.5

requires lead agencies to provide written responses to public agencies on comments made by that agency at least ten days prior to certifying the final EIR for the project.

Ten days prior to certifying the final EIR, the lead agency should provide the District with written responses to comments made by the District.

Project environmental documentation which the District has commented on should be sent to the District. Specifically, the lead agency should transmit the final environmental documentation and the mitigation monitoring program, along with a District reporting form (see Figure 16-1). The District will use the information on the reporting form relating to unmitigated and mitigated emissions to document local government efforts in implementing the AQMP. In addition, if the project proponent will be applying for a District permit which is covered by the environmental document, it should be submitted to Engineering when the permit is applied for. At that time, the District will make a determination as to whether the environmental documentation is sufficient to cover the District's permitting activity. In addition, the District will request annual reporting of all projects to document region-wide cumulative impacts. SCAG monitors local government actions to assess the key assumptions, such as population forecasts, that went into the AQMP.

16.1 Reporting on Environmental Documents

Local governments are requested to report on the disposition of all significant projects. Refer to Chapter 6 for a list of projects deemed to be significant.

The report should be made to the District within 60 days of approval of the project by the lead agency. The information submitted to the District should include the following:

- Final certified EIR or Mitigated Negative Declaration (MND)
- Mitigation monitoring program
- Completed reporting form

The project disposition reporting form is divided into three sections. Section I requests information on the lead agency, project location, and State Clearinghouse and District project identification numbers (the District assigns identification numbers only to those projects that it has reviewed and commented upon). It is imperative that information on the estimated year of construction and build-out be included on the reporting form.

Section II requests specific information regarding the type and size of the project. The District needs a definitive description of the project in order to quantitatively determine the emission reduction benefits of the CEQA program. It is preferable that planners provide the number of units or square feet of facilities whenever possible. Use acres only when estimates of square footage are not available.

In Section III, planners should identify the emissions produced by the project prior to mitigation (unmitigated emissions), the emissions reductions from mitigation (mitigated emissions), and the emissions that the project will produce with mitigation being applied (net emissions). If the EIR or MND was prepared in accordance with the CEQA Handbook, these emissions estimates should be readily available.

The completed reporting form, along with the final certified EIR or MND, mitigation monitoring program, and response to District comments should be sent to:

CEQA Coordinator
South Coast Air Quality Management District
21865 East Copley Drive
P.O. Box 4939
Diamond Bar, CA 91765-0939

If you have any questions about reporting or completing the reporting form, contact the CEQA Coordinator at (909) 396-3109.

SCAQMD Reporting Form for EIRs and Mitigated Negative Declarations

This form should be filled out and mailed to the District for each regionally significant project approved by the Lead Agency whether or not the District has formally commented on the draft environmental document. Please attach this form to a copy of the final certified EIR or MND, and the mitigation monitoring program, and send to:

CEQA Coordinator
SCAQMD
Office of Planning and Rules
21865 E. Copley Drive
P.O. Box 4939
Diamond Bar CA 91765-0939

Section I Basic Information

Lead Agency: ____________________ Address: ____________________
____

Contact Person: ____________________ Phone: ____________________

Name of Project: ____________________ Address: ____________________
____

State Clearinghouse Number: ____________________ SCAQMD Number: ____________________

Estimated Date of Construction: ____________________ Estimated Date of Build Out: ____________________

Is SCAQMD the responsible agency for the project? ____________________

Section II Project Description

Type of Land Use	Use	Units/Acres/Square Feet
Residential		
Commercial		
Industrial		
Public		
Transportation		
Specific Plan		

General Plan Amendment: ____________________

Ordinance: ____________________

Other (Please Specify): ____________________

(Continued on next page)

SCAQMD Reporting Form, Continued

Section III Project Emissions

	Total Construction Emissions			Total Operational Emissions		
Pollutant	Total Unmitigated Emissions	Mitigated Emissions	Net Emissions	Total Unmitigated Emissions	Mitigated Emissions	Net Emissions
ROC						
NOx						
CO						
SOx						
PM10						
Toxics						

Figure A3-1. Relative Contribution By Source Category of Emissions

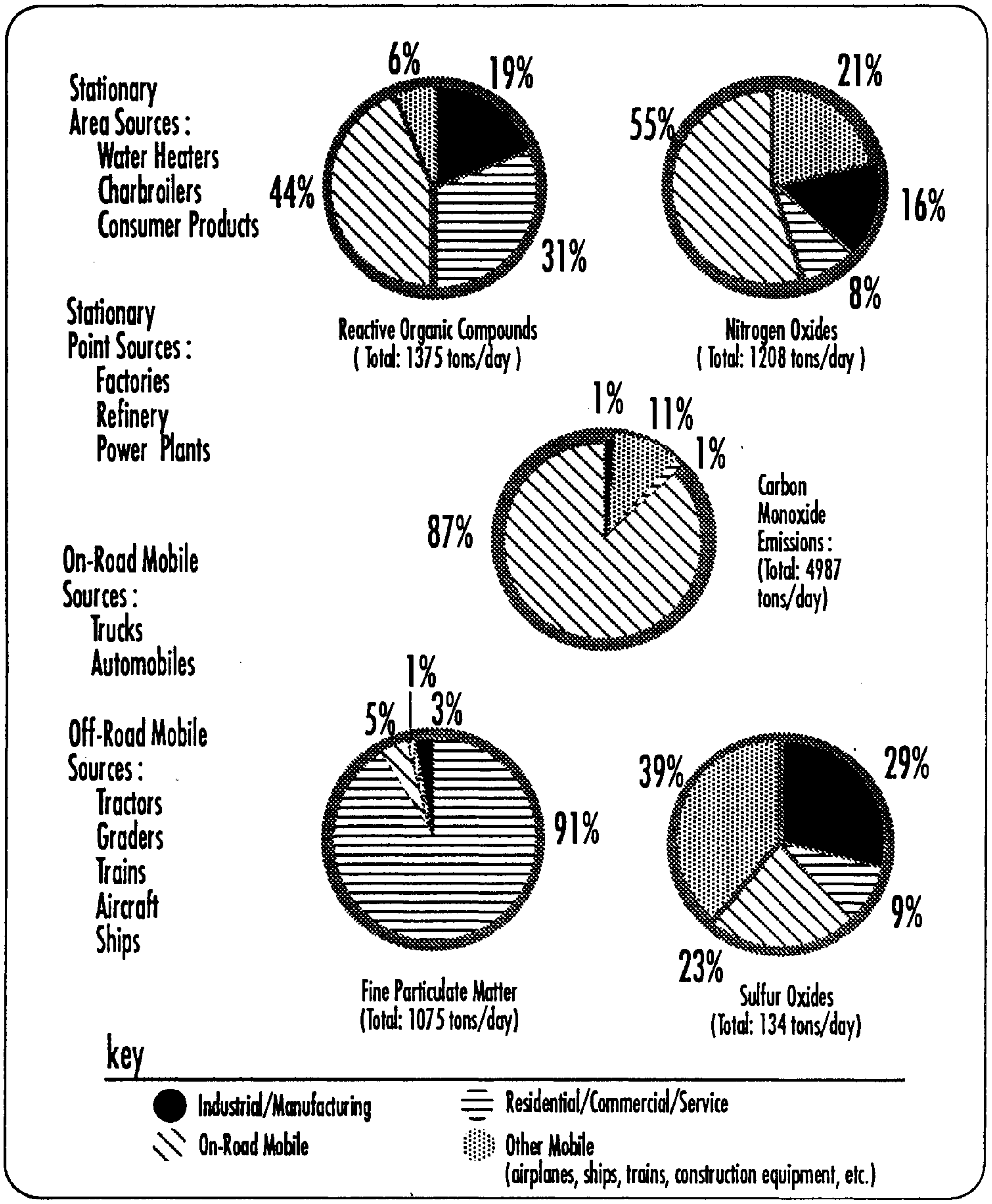


Table A3-1. Air Toxics Subject to Regulations

Substance	State	Federal	Rule 1401 & Rule 212
Acetaldehyde	■		■
Acrylamide			■
Acrylonitrile			■
Inorganic Arsenic	■	■	■
Asbestos	■	■	■
Benzene	■	■	■
Benzidene			■
Beryllium		■	■
Bis(2-chloroethyl)ether			■
Bis(chloromethyl)ether			■
1,3-Butadiene	■		■
Cadmium	■		■
Carbon Tetrachloride	■		■
Chlorinated Dioxins and Dibenzofurans	■		■
Chloroform	■		■
Chromium Hexavalent	■		■
3,3 Dichlorobenzidene			■
2,4 Dinitrotoluene			■
1,4 Dioxane			■
Diphenylhydrazine			■
Epichlorohydrin			■
Ethylene Dibromide	■		■
Ethylene Dichloride	■		■
Ethylene Oxide	■		■
Formaldehyde	■		■
Hexachlorobenzene			■
Hexachlorocyclohexane			
Technical grade			■
Alpha isomer			■
Mercury		■	
Methylene Chloride	■		■
Nickel	■		
Refinery dust			■
Subsulfide			■
Nitrosamines			
Dimethylnitrosamine			■
Diethylnitrosamine			■
Dibutylnitrosamine			■
N-nitrososopyrrolidine			■
N-nitrosodiphenylamine			■
N-nitroso-N-ethylurea			■
N-nitroso-N-methylurea			■
Perchloroethylene	■		
Polynuclear Aromatic Hydrocarbons (PAH)			
Benz(a)anthracene			■
Benzo(a)pyrene			■
Benzo(b)fluoranthene			■
Benzo(k)fluoranthene			■
Chrysene			■
Dibenz(a,h)anthracene			■
Indenopyrene			■
Polychlorinated biphenyls			■
Radionuclides		■	
Trichloroethylene	■		■
2,4,6 Trichlorophenol			■
Vinyl Chloride	■	■	■

State refers to those compounds identified under AB 1807; Federal refers to NESHAPs.

1990 AIR QUALITY DATA
SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT

Source/ Receptor Area No.	Location of Air Monitoring Station	Carbon Monoxide: Max. Conc. in PPM 1-Hour	Carbon Monoxide: Max. Conc. in PPM 8-Hour	Carbon Monoxide: No. Days Standard Exceeded, Federal ≥ 9.5 PPM 8-Hr.	Carbon Monoxide: No. Days Standard Exceeded, Federal > 35 PPM 1-Hr.	Carbon Monoxide: No. Days Standard Exceeded, State ≥ 9.1 PPM 8-Hr.	Carbon Monoxide: No. Days Standard Exceeded, State > 20 PPM 1-Hr.	Ozone: Max. Conc. in PPM 1-Hour	Ozone: No. Days Standard Exceeded, Federal > .12 PPM 1-Hour	Ozone: No. Days Standard Exceeded, State > .09 PPM 1-Hour	Nitrogen Dioxide: Max. Conc. in PPM 1-Hour	Nitrogen Dioxide: Average Compared to Federal Standard[a)] AAM in PPM	Nitrogen Dioxide: Average Compared to Federal Standard[a)] % Above Std.	Nitrogen Dioxide: No. Days Std. Exc'd. State > .25 PPM 1-Hour	Sulfur Dioxide: Max. Conc. in PPM 1-Hour	Sulfur Dioxide: Max. Conc. in PPM 24-hour	Sulfur Dioxide: Average Compared to Federal Standard,[b)] AAM in PPM	Sulfur Dioxide: No. Days Std. Exc'd.[c)] Federal > .14 PPM 24-Hr.	Sulfur Dioxide: No. Days Std. Exc'd.[c)] State > .25/ ≥ .05 PPM 1/24-Hr.[d)]	Visibility: Location	Visibility: Days not Meeting State Std.[e)]
1	Los Angeles	13	9.9	1	0	1	0	.20	32	70	.28	.0467	0	3	.02	.013	.0017	0	0/0	Los Angeles	154
2	W. Los Angeles	15	8.0	0	0	0	0	.16	8	30	.20	.0324	0	0	.02*	.009*	.0021*	0*	0/0*	International	
3	Hawthorne	19	12.7	10	0	11	0	.10	0	3	.23	.0339	0	0	.31	.035	.0035	0	1/0		
4	Long Beach	11	9.1	0	0	1	0	.12	0	5	.27	.0393	0	1	.05	.013	.0031	0	0/0	Long Beach	155
5	Whittier	12	9.0	0	0	0	0	.19	21	47	.23	.0428	0	0	.04	.009	.0016	0	0/0	Airport	
6	Reseda	19	14.9	10	0	11	0	.19	41	108	.19	.0340	0	0	.02*	.010*	.0015*	0*	0/0*		
7	Burbank	16	13.0	8	0	8	0	.20	40	95	.23	.0479	0	0	.02	.011	.0018	0	0/0	Burbank	180
8	Pasadena	16	10.0	1	0	1	0	.26	69	118	.23	.0474	0	0	.02*	.008*	.0015*	0*	0/0*	Airport	
9	Azusa	7	5.1	0	0	0	0	.23	84	133	.21	.0410	0	0	.03*	.008*	.0011*	0*	0/0*		
9	Glendora	NM	NM	NM	NM	NM	NM	.29	103	147	.19	.0377	0	0	NM	NM	NM	NM	NM		
10	Pomona	13	7.5	0	0	0	0	.24	60	104	.21	.0555	3.7	0	NM	NM	NM	NM	NM		
11	Pico Rivera	13	9.4	1	0	1	0	.19	43	85	.27	.0499	0	2	.04*	.014*	.0043*	0*	0/0*		
12	Lynwood	24	16.8	42	0	44	7	.15	3	11	.26	.0408	0	1	.04	.012	.0033	0	0/0	William J. Fox	14
13	Santa Clarita	11	4.6	0	0	0	0	.23	62	115	.15	.0316	0	0	.01*	.004*	.0009*	0*	0/0*	Airport	
14	Lancaster[f)]	11	8.3	0	0	0	0	.15	7	52	.09	.0200	0	0	NM	NM	NM	NM	NM	(Lancaster)	
16	La Habra	19	9.6	2	0	2	0	.21	35	76	.22	.0447	0	0	.03	.007	.0011	0	0/0		
17	Anaheim	17	11.7	1	0	1	0	.18	11	34	.21	.0469	0	0	.02*	.009*	.0018*	0*	0/0*		
17	Los Alamitos	NM	NM	NM	NM	NM	NM	.17	7	29	NM	NM	NM	NM	.03	.009	.0019	0	0/0		
18	Costa Mesa	13	10.7	4	0	5	0	.15	3	12	.22	.0272	0	0	.02	.008	.0007	0	0/0		
19	El Toro	9	5.6	0	0	0	0	.19	11	32	NM	NM	NM	NM	NM	NM	NM	NM	NM		
22	Norco	NM	NM	NM	NM	NM	NM	.17	13	41	NM	NM	NM	NM	NM	NM	NM	NM	NM		
23	Rubidoux	10	6.3	0	0	0	0	.29	90	142	.16	.0336	0	0	.03	.005	.0003	0	0/0		
23	Riverside	15	7.3	0	0	0	0	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	March Field	200
24	Perris	NM	NM	NM	NM	NM	NM	.19	62	116	.11*	.0282*	0*	0*	NM	NM	NM	NM	NM	(Riverside)	
25	Lake Elsinore	NM	NM	NM	NM	NM	NM	.19	36	80	NM	NM	NM	NM	NM	NM	NM	NM	NM		
28	Hemet	NM	NM	NM	NM	NM	NM	.22	20	60	NM	NM	NM	NM	NM	NM	NM	NM	NM		
29	Banning	NM	NM	NM	NM	NM	NM	.22	43	75	NM	NM	NM	NM	NM	NM	NM	NM	NM		
30	Palm Springs	5	2.3	0	0	0	0	.17	27	73	.09	.0206	0	0	NM	NM	NM	NM	NM		
30	Indio	NM	NM	NM	NM	NM	NM	.16	10	47	NM	NM	NM	NM	NM	NM	NM	NM	NM		
32	Upland	9	6.6	0	0	0	0	.29	64	113	.19	.0411	0	0	.01*	.006*	.0012*	0*	0/0*		
33	Ontario	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	Ontario	250
34	Fontana	6	4.9	0	0	0	0	.27	92	132	.20	.0393	0	0	.01	.003	.0001	0	0/0	Airport	
34	San Bernardino	9	6.0	0	0	0	0	.29	78	129	.20	.0343	0	0	.01*	.001*	.0001*	0*	0/0*	Norton AFB	200
35	Redlands	NM	NM	NM	NM	NM	NM	.30	81	131	NM	NM	NM	NM	NM	NM	NM	NM	NM	(San Bernardino)	
37	Crestline	NM	NM	NM	NM	NM	NM	.33	103	144	NM	NM	NM	NM	NM	NM	NM	NM	NM		

* - Less than 12 full months of data. Monitoring discontinued.
PPM - Parts by volume per million parts of air.
AAM - Annual Arithmetic Mean.
NM - Pollutant not monitored.
a) - The federal standard is annual arithmetic mean NO_2 greater than 0.0534 PPM.
b) - The federal standard is annual arithmetic mean SO_2 greater than 80 ug/m3 (0.03 PPM). No location exceeded the standard in 1990.
c) - The other federal standards (3-hour average > 0.50 PPM; AAM > 0.03 PPM) were not exceeded.
d) - Twenty-four hour average $SO_2 \geq 0.05$ PPM with 1-hour Ozone ≥ 0.10 PPM, or with 24-hour TSP ≥ 100 ug/m^3.
e) - Visibility data are comparable to previous state standard. Visibility standard is less than 10 miles for hours with relative humidity less than 70%. Monitoring using equipment required by current standard is expected to begin in 1991.
f) - Station relocated in February 1990.

SOUTH COAST
AIR QUALITY MANAGEMENT DISTRICT
9150 Flair Drive
El Monte, CA 91731

1990 AIR QUALITY DATA
SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT

Source/ Receptor Area No.	Location of Air Monitoring Station	Suspended Particulates PM10[g)]						Particulates TSP[h)]			Lead[h)]				Sulfate[h)]	
				No. (%) Samples Exceeding Standard: Federal	No. (%) Samples Exceeding Standard: State	Annual Averages [i)]							Quarters/Months Exceeding Standard: Federal	Quarters/Months Exceeding Standard: State		No. (%) Samples Exceeding Standard: State
		Number of Samples	Max. Conc. in ug/m^3 24-hour	>150 ug/m^3 24-Hour	>50 ug/m^3 24-Hour	AAM Conc. ug/m^3	AGM Conc. ug/m^3	Number of Samples	Max. Conc. in ug/m^3 24-Hr.	AGM Conc. ug/m^3	Max. Mo. Conc. ug/m^3	Max. Qtrly. Conc. ug/m^3	>1.5 ug/m^3 Qrtly Avg.	≥1.5 ug/m^3 Mo. Avg.	Max. Conc. in ug/m^3 24-Hr.	≥25 ug/m^3 24-Hr.
1	Los Angeles	60	152	1(1.7)	31(51.7)	53.2	48.3	60	211	98.7	0.09	0.09	0	0	25.3	1(1.7)
2	W. Los Angeles	NM	NM	NM	NM	NM	NM	54	163	62.1	NM	NM	NM	NM	24.8	0
3	Hawthorne	60	127	0	17(28.3)	41.2	37.6	61	186	73.8	0.08	0.06	0	0	24.8	0
4	Long Beach	58	119	0	14(24.1)	44.3	40.6	61	188	81.9	0.09	0.07	0	0	22.6	0
5	Whittier	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
6	Reseda	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
7	Burbank	60	161	1(1.7)	28(46.7)	52.3	47.6	60	191	89.2	0.08	0.07	0	0	25.9	1(1.7)
8	Pasadena	NM	NM	NM	NM	NM	NM	57	142	69.5	NM	NM	NM	NM	28.4	1(1.8)
9	Azusa	60	127	0	30(50.0)	54.9	47.9	61	228	104.4	NM	NM	NM	NM	16.0	0
9	Glendora	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
10	Pomona	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
11	Pico Rivera	NM	NM	NM	NM	NM	NM	60	195	92.9	0.13	0.11	0	0	21.1	0
12	Lynwood	NM	NM	NM	NM	NM	NM	59	233	102.2	0.14	0.11	0	0	28.1	1(1.7)
13	Santa Clarita	57	93	0	15(26.3)	43.3	38.6	NM	NM	NM	NM	NM	NM	NM	NM	NM
14	Lancaster[j)]	58	342	2(3.4)	22(37.9)	52.9	43.8	28*	217*	78.9*	NM	NM	NM	NM	6.0*	0*
16	La Habra	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
17	Anaheim	59	158	1(1.7)	20(33.9)	49.1	43.1	58	422	91.3	0.10	0.06	0	0	18.3	0
17	Los Alamitos	NM	NM	NM	NM	NM	NM	60	834	103.4	NM	NM	NM	NM	16.8	0
18	Costa Mesa	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
19	El Toro	55	88	0	16(29.1)	43.1	39.7	30*	132*	78.2*	NM	NM	NM	NM	13.4*	0*
22	Norco	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
23	Rubidoux	61	207	3(4.9)	46(75.4)	78.4	66.9	61	274	110.1	0.08	0.05	0	0	19.9	0
23	Riverside	NM	NM	NM	NM	NM	NM	59	223	96.0	0.08	0.05	0	0	19.3	0
24	Perris	61	250	3(4.9)	32(52.5)	58.9	49.6	30*	232*	71.6*	NM	NM	NM	NM	12.9*	0*
25	Lake Elsinore	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
28	Hemet	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
29	Banning	54	89	0	11(20.4)	35.4	29.4	30*	167*	60.4*	NM	NM	NM	NM	8.6*	0*
30	Palm Springs	59	83	0	9(15.3)	34.5	30.5	30	170*	57.4*	NM	NM	NM	NM	5.6*	0*
30	Indio	59	520	4(6.8)	41(69.5)	79.3	64.9	29*	1485*	130.5*	NM	NM	NM	NM	7.0*	0*
32	Upland	NM	NM	NM	NM	NM	NM	60	289	93.0	0.07	0.05	0	0	18.7	0
33	Ontario	59	185	4(6.8)	37(62.7)	71.7	61.0	29*	243*	90.6*	NM	NM	NM	NM	19.9*	0*
34	Fontana	59	475	3(5.1)	43(72.9)	77.6	62.7	59	1770	115.6	NM	NM	NM	NM	18.3	0
34	San Bernardino	60	235	2(3.3)	35(58.3)	65.0	54.8	60	289	100.9	0.07	0.05	0	0	17.3	0
35	Redlands	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
37	Crestline	59	88	0	11(18.6)	36.6	31.1	30*	124*	46.7*	NM	NM	NM	NM	6.6*	0*

* - Less than 12 full months of data. Monitoring discontinued.

ug/m^3 - Micrograms per cubic meter of air.

AGM - Annual Geometric Mean.

g) - PM10 suspended particulates samples were collected every 6 days using the size-selective inlet high volume sampler with quartz filter media (PM10 refers to fine particles with aerodynamic diameter of 10 micrometers or less).

h) - Total suspended particulates, lead, and sulfate were determined from samples collected every 6 days by the high volume sampler method, on glass fiber filter media. Federal TSP standard superseded by PM10 standard, July 1, 1987.

i) - Federal PM10 standard is AAM > 50 ug/m^3; state standard is AGM > 30 ug/m^3.

j) - Station relocated in February 1990.

1991 AIR QUALITY

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT

Source/ Receptor Area No.	Location of Air Monitoring Station	Carbon Monoxide: Max. Conc. in ppm 1-Hour	Carbon Monoxide: Max. Conc. in ppm 8-Hour	Carbon Monoxide: No. Days Standard Exceeded, Federal ≥ 9.5 ppm 8-Hr.	Carbon Monoxide: No. Days Standard Exceeded, Federal > 35 ppm 1-Hr.	Carbon Monoxide: No. Days Standard Exceeded, State ≥ 9.1 ppm 8-Hr.	Carbon Monoxide: No. Days Standard Exceeded, State > 20 ppm 1-Hr.	Ozone: Max. Conc. in ppm 1-Hour	Ozone: No. Days Standard Exceeded, Federal > .12 ppm 1-Hour	Ozone: No. Days Standard Exceeded, State > .09 ppm 1-Hour	Nitrogen Dioxide: Max. Conc. in ppm 1-Hour	Nitrogen Dioxide: Average Compared to Federal Standard[a)] AAM in ppm	Nitrogen Dioxide: Average Compared to Federal Standard[a)] % Above Std.	Nitrogen Dioxide: No. Days Std. Exc'd. State > .25 ppm 1-Hour	Sulfur Dioxide: Max. Conc. in ppm 1-Hour	Sulfur Dioxide: Max. Conc. in ppm 24-hour	Sulfur Dioxide: Average Compared to Federal Standard[b)] AAM in ppm	Sulfur Dioxide: No. Days Std. Exc'd.[c)] Federal > .14 ppm 24-Hr.	Sulfur Dioxide: No. Days Std. Exc'd.[c)] State > .25/ ≥ .05 ppm 1/24-Hr.[d)]	Visibility: Location	Visibility: Days not Meeting State Std.[e)]
1	Los Angeles	12	9.0	0	0	0	0	.19	23	59	.38	.0493	0	5	.02	.012	.0017	0	0/0	Los Angeles	159
2	W. Los Angeles	10	6.1	0	0	0	0	.18	9	37	.25	.0278	0	0	NM	NM	NM	NM	NM	International	
3	Hawthorne	18	11.3	7	0	10	0	.11	0	17	.21*	.0298*	0*	0*	.12	.019	.0040	0	0/0		
4	Long Beach	14	9.3	0	0	1	0	.11	0	4	.28	.0411	0	2	.14	.016	.0043	0	0/0	Long Beach	198
5	Whittier	13	7.5	0	0	0	0	.19	23	59	.22	.0394	0	0	.07	.010	.0016	0	0/0	Airport	
6	Reseda	16	13.5	7	0	8	0	.22	53	100	.17	.0399	0	0	NM	NM	NM	NM	NM		
7	Burbank	13	10.6	8	0	12	0	.22	55	101	.29	.0468	0	2	.01	.010	.0009	0	0/0	Burbank	195
8	Pasadena	14	9.5	2	0	2	0	.23	70	112	.32	.0502	0	2	NM	NM	NM	NM	NM	Airport	
9	Azusa	8	5.9	0	0	0	0	.28	73	111	.25	.0450	0	0	NM	NM	NM	NM	NM		
9	Glendora	NM	NM	NM	NM	NM	NM	.32	91	134	.23	.0430	0	0	NM	NM	NM	NM	NM		
10	Pomona	11	7.1	0	0	0	0	.24	60	97	.22	.0550	3.0	0	NM	NM	NM	NM	NM		
11	Pico Rivera	11	9.1	0	0	1	0	.26	48	86	.25	.0469	0	0	NM	NM	NM	NM	NM		
12	Lynwood	30	17.4	36	0	41	4	.16	1	20	.26	.0437	0	2	.05	.015	.0030	0	0/0	William J. Fox	9
13	Santa Clarita	9	5.1	0	0	0	0	.24	65	118	.17	.0324	0	0	NM	NM	NM	NM	NM	Airport	
14	Lancaster	10	7.1	0	0	0	0	.14	8	62	.11	.0145	0	0	NM	NM	NM	NM	NM	(Lancaster)	
16	La Habra	18	8.0	0	0	0	0	.21	28	62	.20	.0426	0	0	.04	.012	.0012	0	0/0		
17	Anaheim	21	8.6	0	0	0	1	.25	11	41	.20	.0448	0	0	NM	NM	NM	NM	NM		
17	Los Alamitos	NM	NM	NM	NM	NM	NM	.17	10	37	NM	NM	NM	NM	.03	.010	.0011	0	0/0		
18	Costa Mesa	10	8.1	0	0	0	0	.17	5	23	.16	.0260	0	0	.04	.010	.0007	0	0/0		
19	El Toro	8	4.8	0	0	0	0	.24	10	29	NM	NM	NM	NM	NM	NM	NM	NM	NM		
22	Norco	NM	NM	NM	NM	NM	NM	.22	54	103	NM	NM	NM	NM	NM	NM	NM	NM	NM		
23	Rubidoux	8	7.4	0	0	0	0	.24	79	139	.16	.0351	0	0	.02	.007	.0002	0	0/0		
23	Riverside	14	6.9	0	0	0	0	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	March Field	247
24	Perris	NM	NM	NM	NM	NM	NM	.20	71	128	NM	NM	NM	NM	NM	NM	NM	NM	NM	(Riverside)	
25	Lake Elsinore	NM	NM	NM	NM	NM	NM	.20	45	93	NM	NM	NM	NM	NM	NM	NM	NM	NM		
26	Temecula	5*	4.0*	0*	0*	0*	0*	.17*	3*	18*	.21*	.0164*	0*	0*	NM	NM	NM	NM	NM		
28	Hemet	NM	NM	NM	NM	NM	NM	.19	23	66	NM	NM	NM	NM	NM	NM	NM	NM	NM		
29	Banning	NM	NM	NM	NM	NM	NM	.20	31	64	NM	NM	NM	NM	NM	NM	NM	NM	NM		
30	Palm Springs	5	2.5	0	0	0	0	.18	22	72	.09	.0208	0	0	NM	NM	NM	NM	NM		
30	Indio	NM	NM	NM	NM	NM	NM	.18	13	48	NM	NM	NM	NM	NM	NM	NM	NM	NM		
31	Blythe	NM	NM	NM	NM	NM	NM	.09*	0*	0*	NM	NM	NM	NM	NM	NM	NM	NM	NM		
32	Upland	7*	4.6*	0*	0*	0*	0*	.27	67	103	.21	.0428	0	0	NM	NM	NM	NM	NM		
33	Ontario	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	Ontario	240
34	Fontana	6*	4.4*	0*	0*	0*	0*	.29	74	120	.19	.0377	0	0	.05	.010	.0005	0	0/0	Airport	
34	San Bernardino	8	7.0	0	0	0	0	.25	79	127	.16	.0355	0	0	NM	NM	NM	NM	NM	Norton AFB	231
35	Redlands	NM	NM	NM	NM	NM	NM	.25	91	145	NM	NM	NM	NM	NM	NM	NM	NM	NM	(San Bernardino)	
37	Crestline	NM	NM	NM	NM	NM	NM	.27	90	148	NM	NM	NM	NM	NM	NM	NM	NM	NM		

ppm - Parts per million parts of air, by volume.
AAM - Annual Arithmetic Mean.
NM - Pollutant not monitored.
* - Less than 12 full months of data. May not be representative.
a) - The federal standard is annual arithmetic mean NO_2 greater than 0.0534 ppm.
b) - The federal standard is annual arithmetic mean SO_2 greater than 80 ug/m^3 (0.03 ppm). No location exceeded the standard in 1991.
c) - The other federal standards(3-hour avg. SO_2 > 0.50 ppm and 24-hour avg. SO_2 > 0.14 ppm) were not exceeded.
d) - One-hour avg. SO_2 > .25 ppm or twenty-four hour average SO_2 ≥ 0.05 ppm with 1-hour ozone ≥ 0.10 ppm or 24-hour TSP ≥ 100 ug/m^3.
e) - Visibility data are comparable to previous state standard. Standard is visibility less than 10 miles for hours with relative humidity less than 70%. Monitoring using equipment required by current standard will begin in 1992.

SOUTH COAST
AIR QUALITY MANAGEMENT DISTRICT
21865 East Copley Drive
Diamond Bar, CA 91765

1991 AIR QUALITY

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT

Source/ Receptor Area No.	Location of Air Monitoring Station	Suspended Particulates PM10 f)						Particulates TSP g)			Lead g)				Sulfate g)	
				No. (%) Samples Exceeding Standard		Annual Averages h)							Quarters/Months Exceeding Standard i)			No. (%) Samples Exceeding Standard
				Federal	State								Federal	State		State
		Number of Samples	Max. Conc. in ug/m³ 24-Hour	>150 ug/m³ 24-Hour	>50 ug/m³ 24-Hour	AAM Conc. ug/m³	AGM Conc. ug/m³	Number of Samples	Max. Conc. in ug/m³ 24-Hr.	AGM Conc. ug/m³	Max. Mo. Conc. ug/m³	Max. Qtrly. Conc. ug/m³	>1.5 ug/m³ Qrtly Avg.	≥1.5 ug/m³ Mo. Avg.	Max. Conc. in ug/m³ 24-Hr.	≥25 ug/m³ 24-Hr.
1	Los Angeles	57	151	1(1.8)	31(54.4)	57.1	51.4	60	183	93.2	0.21	0.14	0	0	23.1	0
2	W. Los Angeles	NM	NM	NM	NM	NM	NM	59	106	59.0	NM	NM	NM	NM	20.9	0
3	Hawthorne	60	79	0	14(23.3)	38.6	35.4	59	153	65.9	0.08	0.06	0	0	24.7	0
4	Long Beach	46*	92*	0*	11(23.9)*	40.0*	37.0*	60	197	65.1	0.08	0.07	0	0	19.9	0
5	Whittier	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
6	Reseda	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
7	Burbank	60	133	0	30(50.0)	54.9	49.1	56	184	88.2	0.10	0.07	0	0	18.6	0
8	Pasadena	NM	NM	NM	NM	NM	NM	56	141	71.2	NM	NM	NM	NM	20.1	0
9	Azusa	57	137	0	39(68.4)	66.3	59.7	59	211	94.3	NM	NM	NM	NM	19.2	0
9	Glendora	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
10	Pomona	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
11	Pico Rivera	NM	NM	NM	NM	NM	NM	54	211	89.8	0.19	0.14	0	0	21.6	0
12	Lynwood	NM	NM	NM	NM	NM	NM	59	200	97.1	0.17	0.10	0	0	22.4	0
13	Santa Clarita	59	81	0	25(42.4)	46.5	42.6	NM	NM	NM	NM	NM	NM	NM	NM	NM
14	Lancaster	57	780	3(5.3)	11(19.3)	56.8	38.1	NM	NM	NM	NM	NM	NM	NM	NM	NM
16	La Habra	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
17	Anaheim	59	146	0	14(23.7)	45.2	40.0	59	187	77.2	0.08	0.06	0	0	20.6	0
17	Los Alamitos	NM	NM	NM	NM	NM	NM	60	176	79.6	NM	NM	NM	NM	16.9	0
18	Costa Mesa	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
19	El Toro	59	94	0	9(15.3)	36.6	33.6	NM	NM	NM	NM	NM	NM	NM	NM	NM
22	Norco	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
23	Rubidoux	60	179	2(3.3)	41(68.3)	76.0	65.4	60	271	111.2	0.06	0.05	0	0	14.8	0
23	Riverside	NM	NM	NM	NM	NM	NM	60	191	90.6	0.08	0.06	0	0	12.8	0
24	Perris	60	113	0	26(43.3)	48.8	43.0	NM	NM	NM	NM	NM	NM	NM	NM	NM
25	Lake Elsinore	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
26	Temecula	44*	66*	0*	9(20.5)*	38.4*	36.1*	NM	NM	NM	NM	NM	NM	NM	NM	NM
28	Hemet	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
29	Banning	57	87	0	17(29.8)	37.8	31.3	NM	NM	NM	NM	NM	NM	NM	NM	NM
30	Palm Springs	56	197	1(1.8)	14(25.0)	42.9	36.6	NM	NM	NM	NM	NM	NM	NM	NM	NM
30	Indio	59	340	3(5.1)	37(62.7)	69.0	59.8	NM	NM	NM	NM	NM	NM	NM	NM	NM
31	Blythe	30*	112*	0*	9(30.0)*	44.4*	40.8*	NM	NM	NM	NM	NM	NM	NM	NM	NM
32	Upland	NM	NM	NM	NM	NM	NM	60	182	79.7	0.08	0.07	0	0	19.0	0
33	Ontario	58	158	1(1.7)	39(67.2)	68.4	60.3	NM	NM	NM	NM	NM	NM	NM	NM	NM
34	Fontana	54	127	0	35(64.8)	63.1	57.7	59	537	109.3	NM	NM	NM	NM	20.2	0
34	San Bernardino	60	163	1(1.7)	41(68.3)	60.6	52.0	59	215	96.0	0.06	0.05	0	0	18.3	0
35	Redlands	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
37	Crestline	48*	105*	0*	6(12.5)*	39.3*	34.8*	NM	NM	NM	NM	NM	NM	NM	NM	NM

ug/m³ - Micrograms per cubic meter of air.
AAM - Annual Arithmetic Mean. AGM - Annual Geometric Mean.
* - Less than 12 full months of data. May not be representative.
f) - PM10 suspended particulate samples were collected every 6 days using the size-selective inlet high volume sampler with quartz filter media (PM10 refers to fine particles, with aerodynamic diameter of 10 micrometers or less).
g) - Total suspended particulates, lead, and sulfate were determined from samples collected every 6 days by the high volume sampler method, on glass fiber filter media. Federal TSP standard superceded by PM10 standard, July 1, 1987.
h) - Federal PM10 standard is AAM > 50 ug/m³; state standard is AGM > 30 ug/m³.
i) - As part of a special monitoring program, the District initiated monitoring of lead concentrations in January 1991 at five sites immediately downwind of major secondary lead smelters. The quarterly federal standard was exceeded at one location, Commerce - Sheila (3rd quarter), and the monthly state standard was exceeded at two locations, Commerce - Sheila (four exceedances), and Industry - 7th St. (one exceedance). Maximum concentrations were 3.66 ug/m³, monthly average, and 2.31 ug/m³, quarterly average at Commerce - Sheila.

1992 AIR QUALITY
SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT

Source/ Receptor Area No.	Location of Air Monitoring Station	Carbon Monoxide: No. Days of Data	Max. Conc. in ppm 1-hour	Max. Conc. in ppm 8-hour	2nd High Conc. ppm 8-hour	No. Days Standard Exceeded a) Federal ≥ 9.5 ppm 8-hr.	State ≥ 9.1 ppm 8-hr.	State > 20 ppm 1-hr.	Ozone: No. Days of Data	Max. Conc. in ppm 1-hour	2nd High Conc. ppm 1-hour	No. Days Standard Exceeded Federal > .12 ppm 1-hour	State > .09 ppm 1-hour	Nitrogen Dioxide: No. Days of Data	Max. Conc. in ppm 1-hour	Average Compared to Federal Standard b) AAM in ppm	% above std.	No. Days Std. Exc'd State > .25 ppm 1-hour	Sulfur Dioxide: No. Days of Data	Max. Conc. in ppm 1-hour	Max. Conc. in ppm 24-hour	Average Compared to Federal Standard c) AAM in ppm	No. Days Std. Exc'd State > .25/ > .04 ppm 1/24-hr. d)
1	Los Angeles	363	12	9.5	8.0	2	2	0	365	.20	.18	23	57	366	.30	.0404	.0	1	366	.05	.010	.0015	0/0
2	W. Los Angeles	366	11	5.9	5.7	0	0	0	366	.17	.17	12	45	364	.30	.0284	.0	1	--	--	--	--	--
3	Hawthorne	366	18	12.3	11.3	7	11	0	366	.15	.12	1	11	359	.19	.0320	.0	0	366	.15	.035	.0057	0/0
4	Long Beach	366	10	8.1	7.3	0	0	0	366	.15	.15	6	19	361	.18	.0389	.0	0	366	.11	.026	.0037	0/0
5	Whittier	366	12	9.4	7.7	0	1	0	366	.22	.18	32	60	366	.21	.0376	.0	0	366	.03	.009	.0008	0/0
6	Reseda	363	13	9.9	8.1	1	1	0	366	.17	.16	25	82	358	.17	.0318	.0	0	--	--	--	--	--
7	Burbank	365	13	10.5	9.8	3	4	0	366	.22	.22	47	115	362	.19	.0501	.0	0	366	.03	.009	.0010	0/0
8	Pasadena	362	11	7.3	7.1	0	0	0	364	.27	.24	71	128	365	.22	.0423	.0	0	--	--	--	--	--
9	Azusa	366	6	4.9	4.3	0	0	0	366	.27	.26	91	141	366	.15	.0403	.0	0	--	--	--	--	--
9	Glendora	--	--	--	--	--	--	--	354	.30	.29	118	164	342	.16	.0353	.0	0	--	--	--	--	--
10	Pomona	364	12	8.3	6.9	0	0	0	366	.26	.24	56	99	362	.18	.0507	.0	0	--	--	--	--	--
10	Diamond Bar	--	--	--	--	--	--	--	122*	.16*	.16*	11*	23*	--	--	--	--	--	--	--	--	--	--
11	Pico Rivera	366	11	8.6	7.7	0	0	0	366	.26	.23	45	101	366	.27	.0443	.0	1	--	--	--	--	--
12	Lynwood	366	28	18.8	16.4	31	36	5	366	.17	.16	4	17	366	.25	.0455	.0	0	366	.06	.014	.0031	0/0
13	Santa Clarita	365	8	3.7	3.7	0	0	0	365	.22	.21	71	127	365	.11	.0276	.0	0	--	--	--	--	--
14	Lancaster	363	9	5.4	5.3	0	0	0	366	.17	.17	25	78	359	.16	.0169	.0	0	--	--	--	--	--
16	La Habra	363	21	9.1	8.0	0	1	1	365	.21	.19	31	52	364	.17	.0379	.0	0	366	.02	.009	.0006	0/0
17	Anaheim	366	15	9.4	8.6	0	1	0	366	.22	.19	22	46	358	.21	.0394	.0	0	--	--	--	--	--
17	Los Alamitos	--	--	--	--	--	--	--	366	.18	.16	9	30	--	--	--	--	--	366	.10	.013	.0011	0/0
18	Costa Mesa	366	13	9.1	8.3	0	1	0	359	.15	.14	3	21	364	.23	.0249	.0	0	366	.02	.010	.0006	0/0
18	Newport Beach	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
19	El Toro	363	10	7.3	4.8	0	0	0	366	.16	.16	9	31	--	--	--	--	--	--	--	--	--	--
22	Norco	--	--	--	--	--	--	--	366	.23	.18	16	57	--	--	--	--	--	--	--	--	--	--
23	Rubidoux	366	7	5.3	4.6	0	0	0	366	.26	.24	75	142	365	.23	.0304	.0	0	366	.02	.006	.0002	0/0
23	Riverside	344	11	6.1	6.0	0	0	0	--	--	--	--	--	--	--	--	--	--	31*	.05*	.026*	.0178*	0/0*
24	Perris	--	--	--	--	--	--	--	364	.21	.19	83	147	--	--	--	--	--	--	--	--	--	--
25	Lake Elsinore	--	--	--	--	--	--	--	366	.17	.16	24	87	--	--	--	--	--	--	--	--	--	--
26	Temecula	345	5	4.0	3.6	0	0	0	351	.13	.13	2	8	332	.12	.0196	.0	0	--	--	--	--	--
28	Hemet	--	--	--	--	--	--	--	366	.15	.14	5	45	--	--	--	--	--	--	--	--	--	--
29	Banning	--	--	--	--	--	--	--	366	.16	.16	19	66	--	--	--	--	--	--	--	--	--	--
30	Palm Springs	280*	5*	2.4*	2.0*	0*	0*	0*	341	.15	.15	21	69	277*	.09*	.0210*	.0*	0*	--	--	--	--	--
30	Indio	--	--	--	--	--	--	--	366	.14	.14	8	45	--	--	--	--	--	--	--	--	--	--
31	Blythe	--	--	--	--	--	--	--	338	.09	.08	0	0	--	--	--	--	--	--	--	--	--	--
32	Upland	--	--	--	--	--	--	--	366	.28	.26	81	136	366	.14	.0396	.0	0	--	--	--	--	--
33	Ontario	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
34	Fontana	--	--	--	--	--	--	--	366	.28	.25	88	144	363	.14	.0344	.0	0	365	.02	.012	.0012	0/0
34	San Bernardino	366	7	5.9	5.1	0	0	0	366	.28	.24	85	141	360	.13	.0356	.0	0	--	--	--	--	--
35	Redlands	--	--	--	--	--	--	--	366	.27	.23	103	159	--	--	--	--	--	--	--	--	--	--
37	Crestline	--	--	--	--	--	--	--	366	.28	.25	103	160	--	--	--	--	--	--	--	--	--	--

ppm - Parts by volume Per Million parts of air.
AAM - Annual Arithmetic Mean.
-- - Pollutant Not Monitored. * - Less than 12 full months of data. May not be representative.
a) - The federal 1-hour standard (1-hour average CO > 35 ppm) was not exceeded.
b) - The federal standard is annual arithmetic mean NO_2 greater than 0.0534 ppm.
c) - The federal standard is annual arithmetic mean SO_2 greater than 80 $\mu g/m^3$ (0.03 ppm). No location exceeded this standard. The other federal standards (3-hour average > 0.50 ppm, and 24-hour average > 0.14 ppm) were not exceeded either.
d) - Days maximum 1-hour average SO_2 or maximum 24-hour moving average SO_2 exceeded state standards (1-hour > 0.25 ppm/24-hour average > 0.04 ppm).

SOUTH COAST
AIR QUALITY MANAGEMENT DISTRICT
21865 East Copley Drive
Diamond Bar, CA 91765

1992 AIR QUALITY
SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT

Source/ Receptor Area No.	Location of Air Monitoring Station	Suspended Particulates PM10 e): No. Days of Data	PM10: Max. Conc. in µg/m³ 24-hour	PM10: No. (%) Samples Exceeding Standard: Federal >150 µg/m³ 24-hour	PM10: No. (%) Samples Exceeding Standard: State >50 µg/m³ 24-hour	PM10: Annual Averages g): AAM Conc. µg/m³	PM10: Annual Averages g): AGM Conc. µg/m³	Particulates TSP f): No. Days of Data	TSP: Max. Conc. in µg/m³ 24-hour	TSP: Annual Averages: AAM Conc. µg/m³	TSP: Annual Averages: AGM Conc. µg/m³	Lead f): Max. Mo. Conc. µg/m³	Lead: Max. Qtrly. Conc. µg/m³	Lead: Quarterly/Monthly Exceeding Standard: Federal >1.5 µg/m³ Qtrly. Avg.	Lead: Quarterly/Monthly Exceeding Standard: State ≥1.5 µg/m³ Mo. Avg.	Sulfate f): Max. Conc. in µg/m³ 24-hour	Sulfate: No. (%) Samples Exceeding Standard: State ≥25 µg/m³ 24-hour	Visual Range: No. Days of Data i)	Visual Range: No. Days Exceeding State Standard j)
1	Los Angeles	61	137	0	22(36.1)	48.0	44.1	62	192	83.4	76.8	.16	.11	0	0	19.4	0	--	--
2	W. Los Angeles	--	--	--	--	--	--	59	126	47.4	42.6	--	--	--	--	12.3	0	--	--
3	Hawthorne	54*	67*	0*	5(9.3)*	32.7*	30.2*	51*	113*	60.3*	56.9*	.05*	.05*	0*	0*	17.6*	0*	--	--
4	Long Beach	57	67	0	11(19.3)	38.6	36.6	58	120	65.1	61.7	.07	.05	0	0	22.6	0	--	--
5	Whittier	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
6	Reseda	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
7	Burbank	58	222	2(3.4)	18(31.0)	49.0	42.0	59	563	78.2	67.0	.16	.09	0	0	12.9	0	--	--
8	Pasadena	--	--	--	--	--	--	60	134	55.7	50.7	--	--	--	--	11.5	0	--	--
9	Azusa	61	107	0	24(39.3)	47.4	39.7	59	190	81.6	67.6	--	--	--	--	16.8	0	120	23
9	Glendora	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
10	Pomona	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
10	Diamond Bar	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
11	Pico Rivera	--	--	--	--	--	--	60	153	80.9	74.9	.15	.10	0	0	17.0	0	--	--
12	Lynwood	--	--	--	--	--	--	60	151	82.5	77.7	.11	.08	0	0	18.7	0	--	--
13	Santa Clarita	60	84	0	8(13.3)	35.3	30.9	--	--	--	--	--	--	--	--	--	--	--	--
14	Lancaster	59	68	0	5(8.5)	32.4	29.5	--	--	--	--	--	--	--	--	--	--	--	--
16	La Habra	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
17	Anaheim	56	88	0	11(19.6)	39.6	36.7	61	130	63.2	58.5	.05	.03	0	0	16.0	0	--	--
17	Los Alamitos	--	--	--	--	--	--	60	122	67.9	63.8	--	--	--	--	16.0	0	--	--
18	Costa Mesa	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
18	Newport Beach	60	84	0	4(6.7)	31.3	28.8	--	--	--	--	--	--	--	--	--	--	--	--
19	El Toro	60	83	0	5(8.3)	34.4	31.6	--	--	--	--	--	--	--	--	--	--	--	--
22	Norco	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
23	Rubidoux	61	126	0	39(63.9)	62.5	52.5	61	207	105.8	90.7	.03	.03	0	0	12.3	0	--	--
23	Riverside	--	--	--	--	--	--	61	161	86.6	77.5	.03	.03	0	0	12.1	0	--	--
24	Perris	58	115	0	24(41.4)	44.7	38.4	--	--	--	--	--	--	--	--	--	--	--	--
25	Lake Elsinore	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
26	Temecula	57	88	0	2(3.5)	30.9	28.0	--	--	--	--	--	--	--	--	--	--	--	--
28	Hemet	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
29	Banning	46*	89*	0*	8(17.4)*	34.3*	29.5*	--	--	--	--	--	--	--	--	--	--	--	--
30	Palm Springs	60	175	1(1.7)	4(6.7)	29.6	24.3	--	--	--	--	--	--	--	--	--	--	--	--
30	Indio	59	117	0	18(30.5)	43.4	39.2	--	--	--	--	--	--	--	--	--	--	--	--
31	Blythe	26*	242*	1(3.8)*	7(26.9)*	43.2*	32.7*	--	--	--	--	--	--	--	--	--	--	--	--
32	Upland	--	--	--	--	--	--	61	150	74.7	66.7	.04	.04	0	0	13.2	0	--	--
33	Ontario	59	649	2(3.4)	39(66.1)	78.9	62.5	--	--	--	--	--	--	--	--	--	--	--	--
34	Fontana	53*	105*	0*	31(58.5)*	56.1*	48.9*	60	186	102.1	87.5	--	--	--	--	13.4	0	--	--
34	San Bernardino	60	136	0	36(60.0)	56.7	48.7	60	217	98.4	85.0	.05	.04	0	0	12.9	0	142	55
35	Redlands	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
37	Crestline	26*	62*	0*	2(7.7)*	33.3*	30.1*	--	--	--	--	--	--	--	--	--	--	--	--

µg/m³ - Micrograms per cubic meter of air.
AGM - Annual Geometric Mean. AAM - Annual Arithmetic Mean.
-- - Pollutant Not Monitored. * - Less than 12 full months of data. May not be representative.
e) - PM10 samples were collected every 6 days using the size-selective inlet high volume sampler with quartz filter media. (PM10 refers to the finer suspended particles, consisting of particles with diameter less than approximately 10 micrometers.)
f) - Total suspended particulates, lead, and sulfate were determined from samples collected every 6 days by the high volume sampler method, on glass fiber filter media. Federal TSP standard superseded by PM10 standard, July 1, 1987.
g) - Federal PM10 standard is AAM > 50 µg/m³; state standard is AGM > 30 µg/m³.
h) - Special monitoring immediately downwind of stationary sources of lead was carried out at several locations in 1992. The maximum monthly average recorded was 0.80 µg/m³, at Commerce - 61st Street. The maximum quarterly average recorded was 0.48 µg/m³, at Industry - 7th Street.
i) - No. Days of Data = total number of days sampled minus number of days with insufficient data due to high humidity.
j) - Days with suspended particles in sufficient amount to give an 8-hour average (10 am - 6 pm, PST) visual range less than 10 miles (extinction coefficient greater than 0.23 km⁻¹) with relative humidity less than 70%.

TABLE A6–1
ASSUMPTIONS FOR CHAPTER 6 SCREENING TABLES

The following is a list of methodologies and defaults used in the preparation of the screening tables in Chapter 6.

TABLE 6-2 PROJECTS OF POTENTIAL SIGNIFICANCE FOR AIR QUALITY – OPERATION

METHODOLOGY	TABLE A-9-5
Defaults	
Regional trip length	10.7
Trips	ITE TRIP GENERATION MANUAL
Percent hot and cold starts	TABLE A-9-5-M
EMFAC7EP	TABLE A-9-5-J-2 35 MPH AREA 2

TABLE 6-3 PROJECTS OF POTENTIAL SIGNIFICANCE FOR AIR QUALITY – CONSTRUCTION

METHODOLOGY	TABLE A-9-3
Defaults	
Energy consumption for construction exhaust emissions	TABLE A-9-3-F
Emission factors for each criteria pollutant	TABLE A-9-3-A

\BLE 6-3 PM10 PROJECT SIGNIFICANCE

METHODOLOGIES	
UNPAVED ROADS	TABLE A-9-9-D
PAVED ROADS	TABLE A-9-9-C
DEMOLITION	TABLE A-9-9
Defaults	
Unpaved road silt loading and road type	TABLE A-9-9-D-1
Mean vehicle speed	TABLE A-9-9-D-2
Mean number of wheels and weight	TABLE A-9-9-D-3
Precipitation conditions and number of days	TABLE A-9-9-D-4

TABLE A6 - 2

SIGNIFICANCE THRESHOLD ESTIMATING METHODOLOGY FOR TABLE 6 - 2 IN CHAPTER 6

A = B/C

Where,

A = Land Use Significance Thresholds in Units Expressed As Number of Dwelling Units, Square Footage, Acres, Number of Students, Etc.
(The Units in which significance thresholds are expressed should match those units used for "F" in the following formula.)

B = Emissions in Pounds Per Day Significance Threshold

C = (**{[U] x** [(F x Y x G x R) + (F x Y x W x S1) + (F x Y x Z x S2) **+ (F x Y x T)]} + {F x Y x V}**)/(**U x** 454)
(For pollutants other than reactive organic compounds (ROC), the underlined and bolded portion of the formula is not needed. Therefore, use 1.0 for "U," and 0.0 for "T" and "V.")

Where,

C = Mobile Sources Related Information About Each Land Use Type
(For operation related impacts, the majority of the emissions are associated with mobile sources, not with electricity and natural gas consumption. Therefore, we used oxides of nitrogen (NOx) and ROC emissions data from mobile sources to determine these thresholds. Between NOx and ROC, whichever gave the more stringent significance threshold was listed in Table 6 - 2 of Chapter 6 by land use type.)

U = Factor that determines number of vehicles from average daily trips
= 1.0 for one-way trip, and when estimating emissions for pollutants other than ROC
(One-way trip is a trip from one location, e.g. home, to given land use type.)
= 2.0 for two-way trips.
(Two-way trips include two one-way trips. In this combination, the first one-way trip is a trip from one location, e.g. home, to given land use type, and the second trip is a trip from given land use type to previous location, e.g. home or another destination or location.)

Note: If Table A9 - 5 - A - 1 or ITE Manual Trip Rates are utilized for "F," U should be 2.0

F = The highest of the weekend or weekday trip rates
(If unknown, use Table A9 - 5 - A - 1)

Y = Number of work days.
(For daily impact use 1.0, for quarterly impact use 65 to 91 days, and for yearly impact use 261 to 365 days.)

G = The highest of the weekend and weekday trip-length

R = Running exhaust emission factor in grams per mile (VMT)

W = Percent cold start trips (ADTs)
(If unknown, use Table A9 - 5 - M)

S1 = Cold start emission factor in grams per trip (ADT)

Z = Percent hot start trips (ADTs)
(If unknown, use Table A9 - 5 - M)

S2 = Hot start emission factor in grams per trip (ADT)

T = Hot soak emission factor in grams per trip (ADT)
(For pollutants other than ROC, use 0.0)

V = Diurnal emission factor in grams per vehicle (NOV)
(For pollutants other than ROC, use 0.0)

TABLE A6 - 3

SIGNIFICANCE THRESHOLD ESTIMATING METHODOLOGY FOR TABLE 6 - 3 IN CHAPTER 6

A = **[(B x C x D)/(E x F)]** x [G];
H = **{[(I) x (J)]/[K]}** x [G]

(The underlined and bolded portion of both the formulae will determine daily construction thresholds. "G" in both the formulae is a multiplier to estimate quarterly or annual thresholds.)

Where,

A = Land Use Significance Thresholds in Units Expressed As Gross Square Footage of Construction per day, quarter or year depending upon the value for "G"

B = Pounds Per Day Construction Significance Threshold
(Even though daily threshold is set at 100 pounds per day for NOx, for worst-case scenario the SCAQMD used 55 pounds per day limit, which was based on quarterly construction limit of 2.5 tons for NOx emissions)

C = Total Construction Days to Complete the Proposed Project
(For worst-case scenario, the SCAQMD assumed 91 days to construct the project. If "G" is going to be 365 days, the SCAQMD recommends using the same value for "C," i.e., 365 days)

D = 1,000,000 million BTUs, i.e. the unit emission factor is expressed in
(See Table A9 - 3 - A for NOx emissions from diesel-powered stationary equipment)

E = BTUs of thermal energy consumed per square foot of construction
(If unknown, use Table A9 - 3 - H. Please note that Table A9 - 3 - H values are national estimates, not specific to construction in Southern California)

F = Pounds of NOx or any other pollutant emissions per million BTUs thermal energy consumption
(See Table A9 - 3 - A for NOx emission factors for diesel-powered stationary equipment)

G = Number of days to determine daily, quarterly or yearly thresholds of significance
(Use 1.0 for daily thresholds in square footage; use 91.0 for quarterly thresholds in square footage; and use 365.0 for yearly thresholds in square footage)

H = Land Use Significance Thresholds in Units Expressed As Vehicle Miles Traveled, Cubic Feets and Acres per day, quarter or year depending upon the value for "G"

I = Pounds Per Day Construction Significance Threshold for PM10
(150 Pounds per day)

J = 1 Vehicle miles traveled, 1 acre, etc., i.e. the unit emission factor is expressed in
(See Table A9 - 9 for PM10 emission factors and associated units)

K = Pounds of PM10 emissions per vehicle miles traveled, cubic feet demolished, acres graded
(See Table A9 - 9 for PM10 emission factors for various fugitive-dust-causing activities)

Appendix 8 DESCRIPTION OF REGIONAL CLIMATE AND ITS EFFECT ON AIR QUALITY

Section 15125 of the State CEQA Guidelines requires that "an EIR must include a description of the environment in the vicinity of the project, as it exists before commencement of the project, from both a local and regional perspective." The air quality information in the Environmental Setting section of the EIR should include a discussion of climate, the existing quality of ambient air at the proposed project site, and significant air pollutant sources, both stationary and mobile. The following information has been excerpted and paraphrased from several District publications and may be used in EIR preparation.

Climate. The distinctive climate of the SCAB is determined by its terrain and geographical location. The Basin is a coastal plain with connecting broad valleys and low hills, bounded by the Pacific Ocean in the southwest quadrant with high mountains forming the remainder of the perimeter. The general region lies in the semi-permanent high pressure zone of the eastern Pacific. As a result, the climate is mild, tempered by cool sea breezes. This usually mild climatological pattern is interrupted infrequently by periods of extremely hot weather, winter storms, or Santa Ana winds.

Figure A8-1 shows the terrain of the SCAB from the coast to the Basin boundary line which follows a general path approximating mountain ridges. The high desert is shown north of the SCAB and the low desert to the east.

Temperature. The annual average temperature varies little throughout the 6600-square-mile Basin, averaging 62°F. However, with a less pronounced oceanic influence, the eastern portion shows greater variability in annual minimum and maximum temperatures. The city of San Bernardino, for example, has an annual average temperature range from 37°F to 97°F, while the city of Santa Monica has an annual range between 47 to 75°F. All portions of the Basin have had recorded temperatures well above 100°F in recent years. January is usually the coldest month at all stations, and July and August are usually the hottest months.

For site-specific analysis, temperatures selected represent the lowest average temperature when assessing CO and NO_x impacts and the highest average temperature when assessing ROC.

Rainfall. Practically all of the annual rainfall in the Basin falls during the November-April period. Summer rainfall normally is restricted to widely scattered thundershowers near the coast and slightly heavier shower activity in the east and over the mountains. Annual average rainfall varies from nine inches in Riverside to fourteen inches in downtown Los Angeles, but higher amounts are measured at foothill locations. Monthly and yearly rainfall totals are extremely variable. Rainy days vary from five to ten percent of all days in the Basin, the frequency of such days being higher near the coast.

Humidity. Although the SCAB has a semi-arid climate, the air near the surface is surprisingly moist because of the presence of a shallow marine layer on most days. Except for infrequent periods when dry, continental air is brought into the Basin by off-shore winds, the ocean effect is dominant. Periods with heavy fog are frequent; and low stratus clouds, sometimes referred to as "high fog" are a characteristic climate feature. Annual average relative humidity is 70% at the coast and 57% in the eastern part of the Basin.

Wind. With very light average wind speeds, the Basin's atmosphere has a limited capability to disperse air contaminants horizontally. Downtown Los Angeles wind speed averages 5.7 miles per hour with little seasonal variation. Summer wind speeds average slightly higher than winter wind speeds. Inland areas record slightly lower wind speeds than downtown Los Angeles, while coastal wind speeds average about two miles per hour higher than downtown Los Angeles. The dominant daily wind pattern is a daytime sea breeze and a nighttime land breeze, as shown in Figure A8-1. This regime is broken only by occasional winter storms and infrequent strong northeasterly Santa Ana flows from the mountains and deserts north of the Basin.

On practically all spring and early summer days, most of the pollution produced during an individual day is moved out of the Basin through mountain passes or is lifted by the warm, vertical currents produced by the heating of mountain slopes. In those seasons, the Basin can be "flushed" of pollutants by a transport of ocean air of sixty miles or more during the afternoon. From late summer through the winter months, the flushing is less pronounced because of lighter wind speeds and the earlier appearance of off-shore (drainage) winds. With extremely stagnant wind flow, the drainage winds may begin near the mountains by late afternoon. Pollutants remaining in the Basin are trapped and begin to accumulate during the night and the following morning. A low average morning (6:00 a.m. to noon) wind speed in pollution source areas is an important indicator of stagnation potential. In Los Angeles, the average morning wind speed is 5 mph; on about 244 days per year it is equal to, or less than 5 mph.

Cloudiness. Because of persistent low inversions and cool coastal ocean water, morning fog and low stratus clouds are common. However, 73% of possible sunshine is recorded in downtown Los Angeles, an important factor considering the necessary role of sunshine in the process of producing photochemical smog. There are 185 clear days (zero to 0.3 of the sky obscured by clouds), 106 partly cloudy days (0.4 to 0.7 cloud cover) and 74 cloudy days (0.8 to full cloud cover) each year on average. Cloudiness is slightly less in the eastern portions of the Basin and about 25% greater along the coast.

Inversions. The vertical dispersion of air pollutants in the SCAB is hampered by the presence of a persistent temperature inversion in the layers of the atmosphere near the surface of the earth. Because of expansional cooling, the temperature usually decreases with altitude. A reversal of this state of the atmosphere, wherein temperature increases with altitude, is termed an inversion, which can exist at the surface or at any height above the ground. The height of the base of the inversion at any given time is known as the "mixing height." The mixing height can change under conditions when the top of the inversion does not change. Usually, inversions are lower before sunrise than during the daylight hours. The mixing height normally increases as the day progresses, because the sun warms the ground, which in turn warms the surface air layer. As this heating continues, the temperature of the surface layer approaches the potential temperature of the base of the inversion layer. When these temperatures become equal, the inversion layer begins to erode at its lower edge. If enough warming takes place, the inversion layer becomes weaker and weaker and finally "breaks." The surface air layers can then mix upward without limit. This phenomenon is frequently observed in the middle to late afternoon on hot summer days when the smog appears to clear up suddenly. Winter inversions frequently break up by mid-morning, thereby preventing contaminant build-up. The net input of pollutants into the Basin atmosphere from mobile and stationary sources varies little by season. Pollutants enter the surface air layers and can mix with less contaminated air from anywhere below the inversion base. The contaminants in the surface layers tend to diffuse and form a relatively uniform mixture (in some cases higher concentrations exist immediately below the inversion base) all the way up to the mixing height. They cannot rise through the inversion. As a result, these air pollutants become more and more concentrated unless the inversion layer lifts, is broken, or unless surface winds are strong enough to disperse the pollutants horizontally. The combination of low wind speeds and low inversions produces the greatest concentration of pollutants. On days of no inversion or on days of winds averaging over 15 mph, there will be no important smog effects, summer or winter. In the winter, the greatest pollution problems are carbon monoxide and oxides of nitrogen because of extremely low inversions and air stagnation during the late night and morning hours and the lack of intense sunlight which is needed for the photochemical reactions.

In the summer, the longer daylight hours and the brighter sunshine combine to cause a reaction between hydrocarbons and oxides of nitrogen to form more of the typical photochemical smog. Carbon monoxide is not as great a problem in summer because inversions are not as low and intense in the surface boundary layer (within one hundred feet of the ground) as in winter (though the higher summer time inversions typically are stronger and last much later in the day) and because horizontal ventilation is better in summer.

Along the southern California coast, surface air temperatures are relatively cool. The resultant shallow layer of cool air at the surface, coupled with warm, dry, subsiding air from aloft produces early morning inversions on about 87% of the days. The Basin-wide average occurrence of inversions at the ground surface is eleven days per month; the averages vary from two days in June to 22 days in December and January. Higher inversions, but less than 2500 feet above sea level, occur 22 days each month; occurring on an average of 25 days in June/July to 4 days in December and January. Restricted maximum mixing heights, 3500 feet above sea level or less, average 191 days each year.

The potential for high concentrations varies seasonally for many contaminants. During late spring, summer, and early fall, light winds, low mixing heights, and brilliant sunshine combine to produce conditions favorable for the maximum production of photochemical oxidants, mainly ozone.

During the spring and summer, when fairly deep marine layers are frequently found in the Basin, sulfate concentrations are at their peak.

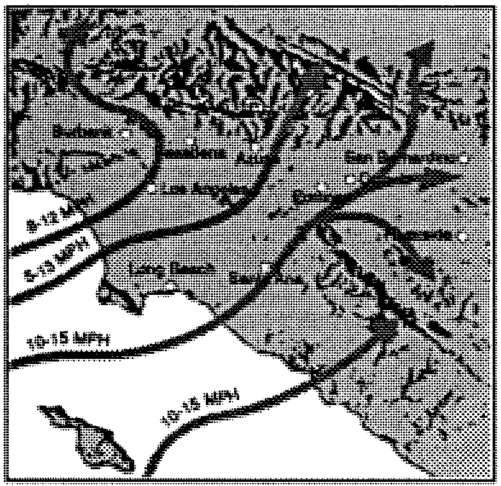
When strong inversions are formed on winter nights, and are coupled with near-calm winds, carbon monoxide (CO) from automobile exhausts becomes highly concentrated. The highest yearly CO values are generally measured during November, December, January and February.

Reference

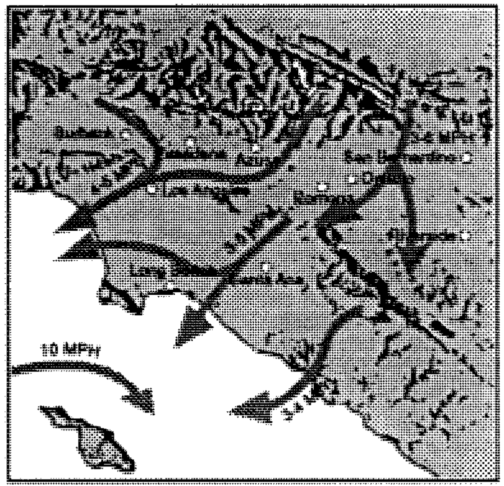
A Climatological Air Quality Profile, California South Coast Air Basin. Available from the District's Public Information Center.

(APPND_8)

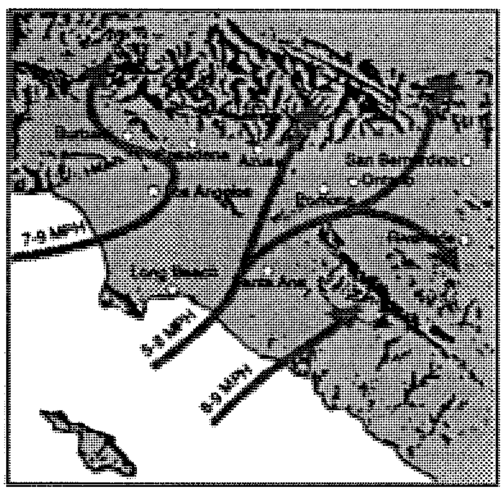
Figure A8-1. Dominant Wind Patterns in the Basin



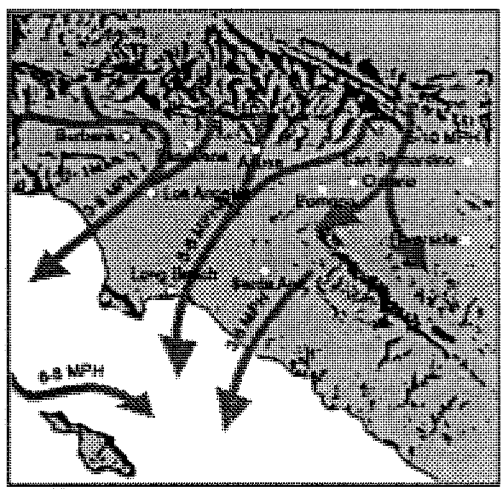
TYPICAL SUMMER DAYTIME OCEAN WINDS
(Noon to 7:00 PM)



TYPICAL SUMMER NIGHT DRAINAGE WINDS
(Midnight to 5:00 AM)



TYPICAL WINTER DAYTIME OCEAN WINDS
(Noon to 5:00 PM)



TYPICAL WINTER NIGHT DRAINAGE WINDS
(Midnight to 7:00 AM)

CONTENTS
APPENDIX TO CHAPTER 9

Contents to Appendix to Chapter 9 (continued)

(TOC_APX9)

TOPIC GROUPINGS
FOR INFORMATION IN THE APPENDIX TO CHAPTER 9

For Information on These Topics **See Page**

(TOCA_CH9)

TABLE A9 - 1
SUMMARY OF ESTIMATED
DAILY CONSTRUCTION, DEMOLITION & RENOVATION-RELATED EMISSIONS

PROJECT NAME:

PREPARED BY: DATE:

Source	Emissions in Pounds per Day					
	Reference	CO	ROC	NOx	SOx	PM10
STATIONARY CONSTRUCTION EQUIPMENT						
Gasoline Engines	Table A9 - 3					
Diesel Engines	Table A9 - 3					
VEHICULAR						
Work Trips	Table A9 - 5					
Non-Work Trips	Table A9 - 5					
Truck Trips	Table A9 - 5					
Traffic Impacts	Table A9 - 5					
MOBILE CONSTRUCTION EQUIPMENT						
Diesel-Powered	Table A9 - 8					
Gasoline-Powered	Table A9 - 8					
UST/PM10						
Paved Roads	Table A9 - 9					
Unpaved Roads	Table A9 - 9					
Storage Piles	Table A9 - 9					
Paved Parking Lots	Table A9 - 9					
Unpaved Parking Lots	Table A9 - 9					
Storage Piles	Table A9 - 9					
Earthmoving Storage Pile Filling	Table A9 - 9					
Demolition	Table A9 - 9					
ENERGY USE						
SCE	Table A9 - 11					
LADWP	Table A9 - 11					
Natural Gas	Table A9 - 12					
ASBESTOS	Table A9 - 10					
BUILDING MATERIALS	Table A9 - 13					
OTHER						
TOTALS						
Emissions (lbs/day)						
SCAQMD Thresholds (lbs/day)		550	75	100	150	150
Project's Significance (Yes or No)						

TABLE A9 - 2
SUMMARY OF ESTIMATED
DAILY OPERATION-RELATED EMISSIONS

PROJECT NAME: ______________________________

PREPARED BY: ______________________ DATE: ______________

Source	Emissions in Pounds per Day					
	Reference	CO	ROC	NOx	SOx	PM10
STATIONARY						
(List Sources Qualified)	Table A9 - 4					
VEHICULAR						
Work Trip	Table A9 - 5					
Non-Work Trip	Table A9 - 5					
Truck Trip	Table A9 - 5					
Traffic Impacts	Table A9 - 5					
OFF-ROAD MOBILE:						
(List Sources Qualified)						
DUST/PM10						
Paved Roads	Table A9 - 9					
Unpaved Roads	Table A9 - 9					
Storage Piles	Table A9 - 9					
Paved Parking Lots	Table A9 - 9					
Unpaved Parking Lots	Table A9 - 9					
ENERGY USE						
SCE	Table A9 - 11					
LADWP	Table A9 - 11					
Natural Gas	Table A9 - 12					
OTHER						
TOTALS						
Emissions (lbs/day)						
SCAQMD Thresholds (lbs/day)		550	55	55	150	150
Project's Significance (Yes or No)						

INFORMATION
FOR
STATIONARY EQUIPMENT EMISSIONS
AND
CONSTRUCTION ENERGY CONSUMPTION EMISSIONS

TABLE A9 - 3

ESTIMATING EXHAUST EMISSIONS FROM STATIONARY HEAVY-DUTY ENGINES AND CONSTRUCTION ENERGY CONSUMPTION (Pounds Per Day)

E = F x G x H*; or
E = K x L**

Where,

E = Emissions from stationary or heavy duty engines in pounds per day or quarter

F = Actual capacity used in horsepower or BTUs per hour for each electricity generating engine per day or per quarter *(If unknown, use maximum rated capacity of the engine which is usually included in SCAQMD permits, manufacturer's specifications, or use Table A9 - 3 - C.* Also, use *Table A9 - 3 - G, or Table A9 - 3 - H BTU values taken from a report on* Energy and Labor in the Construction Sector, *Hannon, B., et. al., Science, 1978, 202: 837 - 847 for value of BTUs per project or total construction period ***. If these BTU values are used, convert those BTU per project values to BTUs per hour of construction by taking into consideration the estimated years and number of hours per day for your project.)*

G = Daily or quarterly actual hours of operation to utilize (F) capacity of the engine *(If unknown, use 8, 16 or 24 hours per day depending on the number of shifts in a day, 65 to 91 days depending on the number of work days in a quarter, or 261 to 365 days depending on the number of work days in a year.)*

H = Emission factors in pounds per horsepower-hour or pounds per million (1,000,000) BTUs (*see Table A9 - 3 - A*; or *see manufacturer's data for emission factors before control.*)

K = Actual amount of fuel burned in gallons, tons or cubic feet (*if unknown, use Table A9 - 3 - C or E*)

L = Emission factors in pounds per thousand gallons, tons or cubic feet (*see Table A9 - 3 - B*) of fuel used.

* Emission factors are based on mechanical (horsepower) or thermal (BTUs) energy output from an engine

** Emission factors are based on amount of fuel used

*** As much as possible use Table A9 - 8 to estimate emissions from mobile construction equipment. Use these values and associated methodology only when it is impossible to generate project-specific information.

TABLE A9 - 3 - A

EMISSION FACTORS (H) FOR EACH CRITERIA POLLUTANT (With 100% Load)

Pollutant Type	CO		ROC		NOx		SOx		PM10	
Fuel Type ****	R	T	R	T	R	T	R	T	R	T
(Pounds Per Horsepower-Hour) [1] and [2]										
Diesel	0.0019	--	0.0006	--	0.0086	--	0.0006	--	0.0003	--
Gasoline	0.0872	--	0.0033	--	0.0023	--	0.0001	--	0.0001	--
(Pounds Per Million BTUs)										
Distilled Oil, or Diesel	0.735	0.11	0.23	0.034	3.38	0.49	0.225	1.01	0.12	0.018
Gasoline	34.26	--	1.28	--	0.89	--	0.046	--	0.028	--

**** See R & T note from Table A9 - 3 - B

[1] When using emissions factors expressed in horsepower-hour, they should be multiplied by efficiency factors "S" from Table A9 - 3 - C.

[2] For generators, when using emissions factors expressed in horsepower-hour, they should be further multiplied by efficiency factor "U" from Table A9 - 3 - C.

TABLE A9 - 3 - B

EMISSION FACTORS (L) FOR EACH CRITERIA POLLUTANT (With 100% Load)

Pollutant Type	CO		ROC		NO_X		SO_X		PM10	
Fuel Type ****	R	T	R	T	R	T	R	T	R	T
					(Pounds/1000 Gallons)					
Gasoline	3,940.0	- -	147.7	- -	102.0	- -	5.31	- -	3.23	- -
Distilled Oil, or Diesel	102.0	15.4	32.1	4.77	469.0	67.8	31.2	140.0[s][1]	16.75	2.5
Residual Crude Oil	102.0		32.1		469.0		155.0		16.75	
Keronaptha Jet Fuel	102.0	15.4	32.1	4.77	469.0	67.8	6.2	6.2	16.75	2.5
					(Pounds/Ton)					
Jet Fuel	- -	150.0	- -	1.7	- -	1.0	- -	0.5	- -	2.5

**** Electricity generation engine type: R = Reciprocating; T = Turbine (If unknown, use emission factors for reciprocating engines.)

[1][s] Percent sulfur content of the fuel. *(Please see Rule 431.2 for the applicable project-related fuel sulfur content factor, and multiply 140.0 by [s] to obtain project-related SO_X emission factor.)*

Source: Instruction for the Emission Data System Review and Update Report, ARB, January 1988.

TABLE A9 - 3 - C

POWER (ELECTRICITY) GENERATED (F) OR FUEL CONSUMED (K)

F (Horsepower) = ({[(K/G or M/N) x O/P x Q/R] x S} - T) x U; or

K (Gallons) = G x ({[P x R x F] + [P x R x T x U]}/{O x [U x S x Q]}), or

if maximum brake horsepower-hour is known, use Table A9 - 3 - E to estimate gallons of fuel consumed per hour

Where,

F = Actual horsepower used for each power (electricity) generating engine (*If unknown, use maximum rated capacity of the engine, which may be obtained from the SCAQMD permit or manufacturer's specifications*)

G = Actual daily hours of operation of the engine (*If unknown, use 8, 16 or 24 hours depending on the number of shifts*)

K = Actual amount of fuel burned in gallons, tons or cubic feet (*if unknown, see Table A9 - 3 - E*)

M = Maximum amount of fuel needed on hourly basis (*see manufacturer's data or Table A9 - 3 - E*)

N = One Hour (*gallons per more than one hour should be converted to gallons per hour rate*)

O = Heat or energy content of the fuel in BTUs (*see Table A9 - 3 - D*) on per gallon basis

P = One gallon or cubic feet of fuel

Q = One horsepower-hour

R = Heat or energy content of the one horsepower-hour in BTUs (*a conversion factor*)

S = Efficiency of internal combustion engine (*use 0.371 or 37.1 percent; or see manufacturer's data*)

T = Energy consumed by the radiator fan, etc. (*use 40 horsepower; or see manufacturer's data*)

Note: Value for "T" may be included in generator efficiency factor "U", please consult manufacturer's data. If yes, use 1.0 for "T"

U = Generator efficiency (*use 0.9326 or 93.26 percent; or see manufacturer's data*)

TABLE A9 - 3 - D

THERMAL ENERGY CONTENT OF THE FUEL CONSUMED
(in BTUs)

Fuel Type	BTUs	Per Unit
Kerosine (Jet Fuels, JP-Types)	133,330	Per Gallon
Diesel	138,700	Per Gallon
Gasoline	115,000	Per Gallon
Fuel Oil	142,000	Per Gallon
Methanol	62,700	Per Gallon
LPG (C_3 + C_4)	101,830	Per Gallon
Natural Gas	1,050	Per Cubic Feet
Landfill Gas	525	Per Cubic Feet
Coal	12,800	Per Pound

TABLE A9 - 3 - E

FUEL USAGE ESTIMATES PER HORSEPOWER-HOUR

(Estimated Horsepower x Estimated Hours of Usage = Brake Horsepower-Hour)
(For Example, 500 Brake Horsepower x 8 Hours Used = 4,000 Brake Horsepower-Hours)

Fuel Type	Fuel Usage/Horsepower-hour
Diesel	0.05 Gallons
Gasoline	0.12 Gallons
Fuel Oil	0.05 Gallons
Methanol	0.12 Gallons
LPG, Propane, Butane	0.07 Gallons
Natural Gas	7.5 Cubic Feet

TABLE A9 - 3 - F******

NUMBER OF UNITS AND HOURS OF OPERATION AT 100% LOAD THAT WILL PUT STATIONARY ENGINES OVER THE CONSTRUCTION THRESHOLD OF 100 POUNDS OF OXIDES OF NITROGEN (NOx) EMISSIONS DAILY

ENGINE CATEGORY (DIESEL-FUELED)	MAXIMUM HOURS	# OF UNITS ***** 8 HRS	16 HRS
40 - 69.9 Horsepower	79+	10	5
70 - 89.9 Horsepower	57+	7	4
90 - 99.9 Horsepower	49+	6	3
100 - 150.9 Horsepower	34	4	2
151 - 199.9 Horsepower	28	3	1
200 - 299.9 HorsePower	21	2	1
300 - 499.9 HorsePower	13+	1	- -
500 - 799.9 HorsePower	9	1	- -
800 - 1337.0 HorsePower	4	- -	- -

***** To determine the number of pieces of equipment, the number of maximum hours was divided by the estimated hours of operation.

****** Table A9 - 3 - F shall only be used as a reference in selecting the amount of potential equipment that may be needed for the project. It shall not be used for estimating emissions. Manufacturers' emission data should be used to determine emission estimates. If manufacturers' data is not available, use applicable tables from appendices. If manufacturer's emission data is used, make sure that the data is developed using EPA, ARB or SCAQMD approved test protocols.

TABLE A9 - 3 - G

THERMAL ENERGY CONSUMPTION PER DOLLAR OF CONSTRUCTION FOR ESTIMATING CONSTRUCTION EXHAUST EMISSIONS

(BTUs Per Dollar of Construction Value)

Use Table A9 - 17 - C to Determine Construction Value of the Project

Direction To Use The Default Values From This Table

in formula E = (F x G) x H, where,

$$(F \times G) = \left\{ \frac{M1, \text{ or } M2, \text{ or, } M3 \times \text{Total construction value for project or each land use type}}{\text{Number of construction days or months for the project or for that land use type}} \right\}$$

Please keep in mind that emission factors are for one million BTUs.
Therefore, H = Value for diesel emission factor from Table A9 - 3 - A should be divided by 1,000,000

Land Use Type	On-Site C. E. E.* (M1)	Material Transport T. E. E.** (M2)	Total P. C. E.*** (M3)
New Building Construction:			
Residential Alterations and Additions	6,502	1,082	7,585
Conservation and Development Facilities	10,685	1,779	12,464
Military Facilities	9,803	1,632	11,435
Sewer Facilities	9,677	1,611	11,288
Water Supply Facilities	9,286	1,546	10,832
Gas Utility Facilities	17,640	2,937	20,577
Electric Utility Facilities	8,392	1,397	9,789
Telephone and Telegraph Facilities	8,397	1,397	9,789
Local Transit Facilities	7,862	1,309	9,171
New Non-Building Construction:			
Highways	39,213	2,028	41,241
Railroads	24,599	1,272	25,871
Petroleum Pipelines	46,662	2,413	49,075
Oil and Gas Wells	37,057	1,916	38,973
Oil and Gas Exploration	29,449	1,523	30,972
Other Non-building Facilities	28,372	1,467	29,839
Repair And Maintenance Construction for:			
Residential Units	10,020	962	10,982
(Same as above for dormitories, high-rise apartments, garden apartments, single-family housing, and two- to four-family housing.)			
Farm Residential Buildings	14,260	1,369	15,629
Other Service Stations	19,260	1,849	21,109
(Equipment Repair Service Stations at Farms, Landfills, Garbage Transfer Stations, etc.)			
Other Buildings	9,940	954	10,894
Conservation and Development Facilities	18,760	1,801	20,561
Military Facilities	12,480	1,198	13,678
Sewer Facilities	9,000	864	9,864
Water Supply Facilities	12,380	1,188	13,568
Gas Utility Facilities	16,620	1,595	18,215
Electric Utility Facilities	5,280	507	5,787
Telephone and Telegraph Facilities	7,100	682	7,782
Local Transit Facilities	9,700	931	10,631
Highways	15,200	1,459	16,659
Railroads	15,520	1,490	17,010
Petroleum Pipelines	23,440	2,250	25,690
Oil and Gas Wells	21,820	2,095	23,915
Other Non-Building Facilities	12,400	1,190	13,590

(*) (**) (***) -- See notes below Table A9 - 3 - H.

TABLE A9 - 3 - H

THERMAL ENERGY CONSUMPTION PER SQUARE FOOT FOR ESTIMATING CONSTRUCTION EXHAUST EMISSIONS (BTUs Per Square Foot)

Directions To Use The Default Values From This Table

in formula E = (F x G) x H, where,

$$(F \times G) = \left\{ \frac{\text{N1, or N2, or, N3 x Total gross square feet for the project or for each land use type}}{\text{Number of construction days or months for the project or for that land use type}} \right\}$$

Please keep in mind that emission factors are for one million BTUs.
Therefore, H = Value for diesel emission factor from Table A9 - 3 - A should be divided by 1,000,000

Land Use Type	On-Site C. E. E.* (N1)	Material Transport T. E. E.** (N2)	Total P. C. E. E.*** (N1+N2 = N3)
New Building Construction:			
Religious Buildings	158,760	26,430	185,190
Hospital Buildings	216,720	36,079	252,799
Stores and Restaurants	118,440	19,717	138,157
Hotels and Motels	154,980	25,800	180,780
Office Buildings	206,640	34,401	241,041
Educational Buildings	175,140	29,157	204,297
Dormitories	180,180	29,996	210,176
High-Rise Apartments	93,240	15,522	108,762
Garden Apartments	81,900	13,634	95,534
Single-Family Housing	88,200	14,683	102,883
Two- to Four-Family Housing	79,380	13,215	92,595
Farm Residential Buildings	70,560	11,747	82,307
Farm Site Service Stations	18,900	3,146	22,046
(Equipment Repair Service Stations at Farms, Landfills, Garbage Transfer Stations, etc.)			
Other Non-Farm Buildings	182,700	30,415	213,115
Car Garages and Service Stations	97,020	16,151	113,171
Warehouses	70,560	11,747	82,307
Industrial Buildings	122,220	20,347	142,567

* C. E. E. Includes construction equipment and worker's travel exhaust emissions.
Use this methodology to estimate construction equipment exhaust emissions only when project-specific equipment and worker's travel information is not available to enable the use of methodology provided in Table A9 - 8 of this handbook.

** T. E. E. Includes truck exhaust emissions.
Use this methodology to estimate truck or material transport exhaust emissions only when project-specific material handling information is not available to enable use of methodology provided in Table A9 - 5 with emission factors provided in Tables A9 - 5 - K - 1 through 10 of this Handbook.

*** P. C. E. E. Project construction-related exhaust emissions.

Source: <u>Energy and Labor in the Construction Sector</u>, Hannon, B., et. al., Science, 1978, 202:837-847 for value of BTUs per project on total construction period.

TABLE A9 - 4

SOURCES OF STATIONARY SOURCE EMISSION FACTORS

1. California Air Resources Board, 1988, Instructions for the Emission Data System Review and Update Report, January 1988*.

2. United States Environmental Protection Agency, 1981, Compilation of Air Pollution Emission Factors, April 1981.

3. United States Environmental Protection Agency, 1979, Compilation of Air Pollution Emission Factors - AP - 42, Sec. 6.13.1, Supplement 9, July 1979.

4. United States Environmental Protection Agency, 1973, Air Pollution Engineering Manual, May 1973.

5. United States Environmental Protection Agency, 1987, Estimating Releases and Waste Treatment Efficiencies for the Toxic Chemical Release Inventory Form, December 1987.

6. United States Environmental Protection Agency, 1988, Toxic Air Pollutant Emission Factors - A Compilation for Selected Air Toxic Compounds and Sources, October 1988.

7. United States Environmental Protection Agency, 1988, Gap Filling PM10 Emission Factors for Selected Open Area Dust Sources, March, 1988.

8. United States Environmental Protection Agency, 1988, Control of Open Fugitive Dust Sources, September, 1988.

9. United States Environmental Protection Agency, 1991, Non-Road Engine and Vehicle Emission Study, November, 1991*.

10. United States Environmental Protection Agency, 1985, Assessment of Heavy-Duty Gasoline and Diesel Vehicles in California: Population and Use Patterns, Prepared in July 1985 by Yuji Horie and Richard Rapoport of Pacific Environmental Services, Inc., July, 1985 (Contract Number A2-155-32).

11. United States Environmental Protection Agency, 1987, National Emission Standards for Asbestos -- Background Information for Proposed Standards.

12. SCAQMD's Rules and Regulations.

13. SCAQMD's staff reports (most recent published) for applicable source-specific rules.

* Many of these sources also include emission factors for mobile equipment utilized at stationary sources

Note: These sources are available at the District library located at 21865 Copley Drive in Diamond Bar, California 91765.

INFORMATION
FOR
VEHICULAR EMISSIONS
IMPACT ON BACKGROUND LEVELS

TABLE A9 - 5

ESTIMATING EMISSIONS FROM ON-ROAD VEHICLE TRAVEL (Pounds Per Day)****

(The highest of the Daily VMT, ADT, NOV and Speed Values have to be selected between Weekdays and Weekends. Emission Factors have to be selected from Tables A9 - 5 - J - 1 through A9 - 5 - J - 10 for Passenger Vehicles and from A9 - 5 - K - 1 through A9 - 5 - K - 10 for Trucks Depending Upon which County the Project is Located in, and Year (Build-out or Construction))

E* = [(D x F x Y x G) x (H, or I)]/[454] for SOx & Pb; AND,
E** = {[(D x F x Y x G) x (N)] + [(D x F x Y x G) x (O)]}/{454} for PM10; and, for CO and NOx *see next page*.

Where,

D = The project size in square feet, number of units, number of flights, etc.

F = The highest of the weekday and weekend trips (Use two-way or round trips to estimate daily emissions) rate in same unit as the value for "D".
(Use Institute of Transportation Engineers (ITE) manual (latest edition), or traffic impact analysis (TIA) data, or defaults in Table A9 - 5 - A - 1, or defaults in Table A9 - 5 - A - 2.)

Y = For daily impacts use 1.0. Otherwise, use number of work-days (65 to 91) in a quarter.

G = The highest trip-length of the weekday or weekend in miles.
(Use ITE Manual (latest edition), TIA data or defaults in Table A9 - 5 - D and Table A9 - 5 - E.)

Do not subtract 3.59 miles from estimated trip-length when calculating CO or NOx emissions from running exhaust emissions.

E* = Emissions of SOx and Pb (lead) in pounds per day from on-road vehicle travel

H***** = SOx: Adjusted using "Burden" output to obtain vehicle miles traveled based emission factors. There are no evaporative running losses associated with SOx.
(See Table A9 - 5 - L for passenger vehicles and trucks.)

I***** = Pb (Lead): Adjusted using "Burden" output to obtain vehicle miles traveled based emission factors. There are no evaporative running losses associated with Pb.
(See Tables A9 - 5 - L for passenger vehicles and trucks.)

E** = Emissions of PM10 in pounds per day from on-road vehicle travel

N***** = PM10: EMFAC7 running exhaust factor. There are no evaporative running losses associated with PM10.
(See Tables A9 - 5 - J - 1 through A9 - 5 - J - 10 for passenger vehicles, from A9 - 5 - K - 1 through A9 - 5 - K - 10 for trucks, from A11 - 5 - H - 1 through A11 - 5 - H - 10 for buses, and Table A9 - 5 - N for motorcycles.)

O***** = PM10: EMFAC7 running tire-wear factor. There are no evaporative running losses associated with PM10.
(See Tables A9 - 5 - J - 1 through A9 - 5 - J - 10 for passenger vehicles, from A9 - 5 - K - 1 through A9 - 5 - K - 10 for trucks, from A11 - 5 - H - 1 through A11 - 5 - H - 10 for buses, and Table A9 - 5 - N for motorcycles.)

***** Use *AM Peak Speeds* to select emission factors for CO and NOx; use *Off Peak Speeds* to select emission factors for ROCs; use *PM Peak Speeds* for SOx, PM10 and Pb (Lead).

Table A9 - 5 (Cont.)

(The highest of the Daily VMT, ADT, NOV and Speed Values have to be selected between Weekdays and Weekends. Emission Factors have to be selected from Tables A9 - 5 - J - 1 through A9 - 5 - J - 10 for Passenger Vehicles and from A9 - 5 - K - 1 through A9 - 5 - K - 10 for Trucks Depending Upon which County the Project is Located in, and Year (Build-out or Construction))

E*** = {[(D x F x Y x G) x (J or K)] + [(D x F x Y x W) x (L1, or M1)] + [(D x F x Y x Z) x (L2, or M2)]}/{454} for CO, and NOx;
and, *See next page* for ROCs.

Where,

D = The project size in square feet, number of units, number of flights, etc.

F = The highest of the weekday and weekend trips (Use 2 way or round trips to estimate daily emissions) rate in same unit as the value for "D"
(Use ITE manual (latest edition), TIA data or defaults in Table A9 - 5 - A - 1 or Table A9 - 5 - A - 2.)

Y = For daily impacts use 1.0. Otherwise, use number of work-days (65 to 91) in a quarter.

G = The highest of the weekday or weekend trip-length in miles.
(Use ITE Manual (latest edition), TIA data or defaults in Table A9 - 5 - D and Table A9 - 5 - E.)

Do not subtract 3.59 miles from estimated trip-length when calculating carbon monoxide or oxides of nitrogen emissions from running exhaust emissions. Because cold and hot starts were determined using 3.59 miles traveling distance, in the past, many persons were subtracting 3.59 miles from the estimated trip-length. The District recommends not to do that for running exhaust emissions using emission factors included in this handbook.

E*** = Emissions of carbon monoxide and oxides of nitrogen in pounds per day from on-road vehicle travel

J = Carbon Monoxide or CO: EMFAC7 Running exhaust emission factors. There are no evaporative running losses associated with CO.
(See Tables A9 - 5 - J - 1 through A9 - 5 - J - 10 for passenger vehicles, from A9 - 5 - K - 1 through A9 - 5 - K - 10 for trucks, from A11 - 5 - H - 1 through A11 - 5 - H - 10 for buses, and Table A9 - 5 - N for motorcycles.)

K = Oxides of Nitrogen or NOx: EMFAC7 Running exhaust emission factors. There are no evaporative running losses associated with NOx.
(See Tables A9 - 5 - J - 1 through A9 - 5 - J - 10 for passenger vehicles, from A9 - 5 - K - 1 through A9 - 5 - K - 10 for trucks, from A11 - 5 - H - 1 through A11 - 5 - H - 10 for buses, and Table A9 - 5 - N for motorcycles.)

EMFAC start-ups do not include evaporative running losses.
Estimate the cold start emissions only for those daily trips which are associated with start or re-start of the vehicles one or more hours after the engine was previously turned off. Use 0.0, if not applicable.

W = Percent cold start trips. *(If unknown, use Table A9 - 5 - M to determine percent cold start trips.)*

L1 = Carbon Monoxide: EMFAC7 Cold start emission factors.
(See Tables A9 - 5 - J - 1 through A9 - 5 - J - 10 for passenger vehicles, from A9 - 5 - K - 1 through A9 - 5 - K - 10 for trucks, from A11 - 5 - H - 1 through A11 - 5 - H - 10 for buses, and Table A9 - 5 - N for motorcycles.)

M1 = Oxides of Nitrogen : EMFAC7 Cold start emission factors
(See Tables A9 - 5 - J - 1 through A9 - 5 - J - 10 for passenger vehicles, from A9 - 5 - K - 1 through A9 - 5 - K - 10 for trucks, from A11 - 5 - H - 1 through A11 - 5 - H - 10 for buses, and Table A9 - 5 - N for motorcycles.)

Estimate the hot start emissions only for those daily trips which are associated with re-start of the vehicles within less than one hour. Use 0.0, if not applicable.

Z = Percent hot start trips. *(Use ITE Manual or TIA. If unknown, use Table A9 - 5 - M to determine percent hot start trips.)*

L2 = Carbon Monoxide: EMFAC7 Hot start emission factors
(See Tables A9 - 5 - J - 1 through A9 - 5 - J - 10 for passenger vehicles, from A9 - 5 - K - 1 through A9 - 5 - K - 10 for trucks, from A11 - 5 - H - 1 through A11 - 5 - H - 10 for buses, and Table A9 - 5 - N for motorcycles.)

M2 = Oxides of Nitrogen : EMFAC7 Hot start emission factors
(See Tables A9 - 5 - J - 1 through A9 - 5 - J - 10 for passenger vehicles, from A9 - 5 - K - 1 through A9 - 5 - K - 10 for trucks, from A11 - 5 - H - 1 through A11 - 5 - H - 10 for buses, and Table A9 - 5 - N for motorcycles.)

TABLE A9 - 5 (Cont. from Previous Page)

(The highest of the Daily VMT, ADT, NOV and Speed Values have to be selected between Weekdays and Weekends. Emission Factors have to be selected from Tables A9 - 5 - J - 1 through A9 - 5 - J - 10 for Passenger Vehicles and from A9 - 5 - K - 1 through A9 - 5 - K - 10 for Trucks Depending Upon which County the Project is Located in, and Year (Build-out or Construction))

E**** = {[D x F x Y x G x R] + [D x F x Y x W x S1] + [D x F x Y x Z x S2] + [D x F x Y x T] + [{(D x F x Y)/(U)} x V]}/{454} for ROC.

Where,

D = The project size in square feet, number of units, number of flights, etc.

F = The highest of the weekday or weekend trip (Use 2 way or round trips to estimate daily emissions) rate in same unit as the value for "D".
(Use ITE manual (latest edition), TIA data or defaults in Table A9 - 5 - A - 1 or Table A9 - 5 - A - 2.)

Y = For daily impacts use 1.0. Otherwise, use number of work-days (65 to 91) in a quarter.

G = The highest of the weekday or weekend trip-length in miles.
(Use ITE Manual (latest edition), TIA data or defaults in Table A9 - 5 - D and Table A9 - 5 - E.)

Do not subtract 3.59 miles from estimated trip-length when calculating carbon monoxide or oxides of nitrogen emissions from running exhaust and evaporative (R) emissions. Cold and hot starts are determined using 3.59 miles traveling distance. Therefore, in the past, 3.59 miles were removed from the estimated trip-length. The District recommends not to do such subtraction for running exhaust emissions using emission factors included in this handbook.

E**** = Emissions of reactive organic compounds in pounds per day from on-road vehicle travel

R = Reactive organic gases or ROCs: EMFAC7 Running exhaust emission factors. There are evaporative running losses associated with ROCs.
(See Tables A9 - 5 - J - 1 through A9 - 5 - J - 10 for passenger vehicles, from A9 - 5 - K - 1 through A9 - 5 - K - 10 for trucks, from A11 - 5 - H - 1 through A11 - 5 - H - 10 for buses, and Table A9 - 5 - N for motorcycles.)

Estimate cold start emissions only for those daily trips which are associated with start or re-start of the vehicles one or more hours after the engine was previously turned off. EMFAC starts do not include evaporative losses.

W = Percent cold start trips. *(If unknown, use Table A9 - 5 - M to determine percent cold start trips.)*

S1 = Reactive organic gases : EMFAC7 Cold start emission factors.
(See Tables A9 - 5 - J - 1 through A9 - 5 - J - 10 for passenger vehicles, from A9 - 5 - K - 1 through A9 - 5 - K - 10 for trucks, from A11 - 5 - H - 1 through A11 - 5 - H - 10 for buses, and Table A9 - 5 - N for motorcycles.)

Estimate hot start emissions only for those daily trips which are associated with re-start of the vehicles within less than one hour. Use 0.0, if not applicable.

Z = Percent hot start trips. *(Use ITE Manual or TIA. If unknown, use Table A9 - 5 - M to determine percent hot start trips.)*

S2 = Reactive organic gases: EMFAC7 Hot start emission factors
(See Tables A9 - 5 - J - 1 through A9 - 5 - J - 10 for passenger vehicles, from A9 - 5 - K - 1 through A9 - 5 - K - 10 for trucks, from A11 - 5 - H - 1 through A11 - 5 - H - 10 for buses, and Table A9 - 5 - N for motorcycles.)

Estimate hot soak emissions for all daily trips including all cold and hot start trips. Hot soak emissions do not include any exhaust emissions. Hot soak emissions are evaporative emissions after turning off the vehicle.

T = Reactive Organic Compounds: EMFAC7 Hot-Soak evaporative emission factors

Estimate diurnal emissions for total number of vehicles addressed in this analysis including those vehicles with cold and hot start trips. Diurnal emissions are evaporative emissions caused by vehicle being parked in the areas where there is a potential for an increase in the ambient temperature. Temperature changes could result from parking the car in direct sunlight, or in shaded areas.

U = Number of trips that will occur per car per day or per car per quarter (65 to 91 days). If unknown, use 2.0 for two one-way trip, and use 1.0 for one one-way trip.

V = Reactive Organic Compounds: EMFAC7 Diurnal evaporative emission factor
(See Tables A9 - 5 - J - 1 through A9 - 5 - J - 10 for passenger vehicles, from A9 - 5 - K - 1 through A9 - 5 - K - 10 for trucks, from A11 - 5 - H - 1 through A11 - 5 - H - 10 for buses, and Table A9 - 5 - N for motorcycles.)

******

The default tables are included on the following pages. The default tables provide information for 1987 and 2010. A straight line interpolation should be used to determine appropriate default between these two years. Each table provides a number of options based on the information known about the project. These tables are meant to provide guidance. Project proponent or local governments may have project specific information that could be used instead. For truck related default values please use EPA Report for the Contract Number A2-155-32 on Assessment of Heavy-Duty Gasoline and Diesel Vehicles in California: Population and Use Patterns, Prepared in July 1985 by Yuji Horie, Richard Rapoport of Pacific Environmental Services, Inc. Available at SCAQMD Library.

TABLE A9 - 5 - A

DETERMINING ADT AND NOV

(NOTES FOR TABLES A9 - 5 - A and A9 - 5 - B)

Diurnal emissions are related to the number of vehicles (NOV), start-up and hot soak emissions are related to the average daily trips (ADT). ADT is used to determine NOV by dividing it by 2.0 or multiplying it by 0.5. ADT is also used to determine vehicle miles traveled (VMT) by multiplying ADT with trip length, which is needed for running exhaust and evaporative emissions. Tables A9 - 5 - A and A9 - 5 - B will help determine ADT and NOV. VMT, NOV and ADT related emissions associated with 2-person, 3-person and transit vehicles should be included as emissions after implementation of mitigation measure. VMT, NOV and ADT related emissions associated with 1- person work trips and 1-person non-work trips should be included as non-mitigated project related emissions. Additional mitigation measures should be included to reduce number of 1-person work and non-work trips and vehicles from the project, and associated emissions. To quantify mitigation measures, please see Appendix 11.

TABLE A9 - 5 - A - 1

AVERAGE TRIP GENERATION RATES FOR CATEGORIES OF LAND USES BASED ON NUMBER OF VARIABLES (in Number of Two-Way Trips per Day)

Land Use	Per Unit of Measure	ADT (Weekday)	ADT (Weekend) Sat.	Sun.
Furniture Store	1000 GSF	4.34	4.94	4.64
Walk-In Bank	Employee	67.39	18.63	11.59
Walk-In Bank	1000 GSF	140.61	38.88	24.17
Drive-In Bank	Employee	72.79	17.77	5.09
Drive-In Bank	1000 GSF	265.21	65.98	18.88
Drive-In Bank	Window	411.17	133.81	34.44
Walk-In Sav and Loan	Employee	30.50	54.17	3.17
Walk-In Sav and Loan	1000 GSF	61.00	108.33	6.33
Drive-In Sav and Loan	Employee	49.44		
Drive-In Sav and Loan	1000 GSF	74.17		
Drive-In Sav and Loan	Window	445.00		
Insurance Building	Employee	2.45*		
Insurance Building	1000 GSF	11.45*		
Building and Lumber Sto	1000 GSF	30.56	30.93	17.85
Building and Lumber Sto	Acre	149.12	150.92	98.15
Special Retail Center	1000 GSF	40.67	42.04	20.43
Discount Store	1000 GSF	70.13	72.69	42.95
Hardware Paint Store	Employee	53.21	85.61	71.22
Hardware Paint Store	1000 GSF	51.29	82.52	68.65
Hardware Paint Store	Acre	545.77	878.08	730.51
Garden Center	Employee	22.13	38.19	30.71
Garden Center	1000 GSF	36.08	72.71	58.46
Garden Center	Acre	96.21	144.04	115.81
Quality Restaurant	1000 GSF	96.51	92.65	72.63
Quality Restaurant	Seat	2.86	2.74	2.15
Sit Down Restaurant	1000 GSF	205.36	229.34	209.46
Fast Food w/out Drv Thru	1000 GSF	786.22	822.89	693.25
Fast Food with Drv Thru	1000 GSF	632.12	686.04	515.67
New Car Sales	Employee	24.04	10.55	5.26
New Car Sales	1000 GSF	47.91	21.03	10.48
Service Station	Pump*	133.00*		
Service Station		748.00		
Car Wash (Self Service)	Wash Stall	108.00	11.20	

TABLE A9 - 5 - A - 1 (Cont.)

AVERAGE TRIP GENERATION RATES FOR CATEGORIES OF LAND USES BASED ON NUMBER OF VARIABLES (in Number of Two-Way Trips per Day)

Land Use	Per Unit of Measure	ADT (Weekday)	ADT (Weekend) Sat.	Sun.
Supermarket	1000 GSF	125.50*	177.59	166.44
Convenience Market	1000 GSF	737.99	863.10	758.45
Wholesale Market	Employee	8.21	1.94	2.80
Wholesale Market	1000 GSF	6.73	1.59	2.30
Wholesale Market	Acre	128.25	30.38	43.81
Corp. H.Q. Building	Employee	2.19		
Corp. H.Q. Building	1000 GSF	6.27		
Corp. H.Q. Building	*Acre	141.77*		
Corp. H.Q. Building	Parking Space*	2.66*		
Medical Office Building	Employee	8.84	4.02	0.64
Medical Office Building	1000 GSF	34.17	8.96	1.55
Government Office Building	Employee	12.00		
Government Office Building	1000 GSF	68.93		
State Motor Vehicle Department	Employee	44.54	2.39	1.70
State Motor Vehicle Department	1000 GSF	166.02	9.46	6.74
U.S. Post Office	1000 GSF	87.12	48.69	28.81
U.S. Post Office	Employee	24.51	13.69	8.10
Civic Center	Employee	6.09		
Civic Center	1000 GSF	25.00		
Office Park	Employee	3.50	0.56	0.26
Office Park	1000 GSF	11.42	1.64	0.76
Office Park	Acre	195.11	29.33	13.69
Research Center	Employee	2.67	0.57	0.33
Research Center	1000 GSF	7.70	1.90	1.11
Research Center	Acre	79.61	22.47	13.27
Business Park	Employee	4.58	0.78	0.41
Business Park	1000 GSF	14.37	2.91	1.50
Business Park	Acre	159.75	32.61	16.78
Building and Lumber Store	Employee	24.69	24.99	14.98
Military Base	Employee	1.78	2.64	1.67
Military Base	Vehicle	0.86		
Elementary School	Employee	13.39		
Elementary School	1000 GSF	10.72		
Elementary School	Student	1.09		
High School	Student	1.38	0.77	0.23
High School	Employee	16.79		
High School	1000 GSF	10.90		
Community College	Student	1.33		
Community College	1000 GSF	12.87		
Community College	Employee	10.06		
University	Student	2.37	1.30	
Church/Synagogue	1000 GSF	9.32	9.70	36.63
Day Care Center	Employee	33.20	2.61	2.45
Day Care Center	Student	4.65	0.39	0.37
Day Care Center	1000 GSF	79.26	6.21	5.83
Day Care Center	Parking Space	1.18*		
Cemetery	Acre	4.16	4.28	4.11
Library	Employee	49.50	38.69	14.61
Library	1000 GSF	45.50	35.56	2.51

TABLE A9 - 5 - A - 1 (Cont.)

AVERAGE TRIP GENERATION RATES FOR CATEGORIES OF LAND USES BASED ON NUMBER OF VARIABLES (in Number of Two-Way Trips per Day)

Land Use	Per Unit of Measure	ADT (Weekday)	ADT (Weekend) Sat.	Sun.
Hospital	Employee	5.17	4.36	3.32
Hospital	1000 GSF	16.78	13.01	9.85
Hospital	Bed	11.77	9.37	7.17
Nursing Home	Employee	4.03	3.39	3.72
Nursing Home	Occup, Bed	2.60	2.15	2.36
Clinic	1000 GSF	23.79*	13.54	24.10
Clinic	Employee	5.89	3.35	5.97
~~County Park~~	~~Acres~~	~~2.99~~	~~12.14~~	~~4.68~~
Marina	Employee	251.46*		
Marina	Boat Berth	2.96	3.22	6.40
Marina	Acre	20.93	24.85	34.49
Golf Course	Employee	20.63	25.28	23.25
Golf Course	Acre	8.33	7.54	8.06
Golf Course	Holes	37.59	42.43	41.70
Golf Course	Parking Space	6.62*		
Movie w/out Matinee	Employee	53.12	67.56	55.73
Movie w/out Matinee	Seat	1.76	2.24	1.85
Movie w/out Matinee	1000 GSF	77.79	98.93	81.61
Movie w/out Matinee	Parking Space	6.18*		
Movie w/out Matinee	Screen	220.00	376.00	314.00
Movie with Matinee	Screen	153.33	529.47	392.82
Stadium	Employee	22.16*		
Stadium	Parking Space	0.54*		
Horse Race Track	Employee	2.87		
Horse Race Track	Acre	43.00		
Horse Race Track	Parking Space	1.07*		
Tennis Courts	Employee	66.67	55.67	75.67
Tennis Courts	Court	33.33	27.83	37.83
Tennis Courts	Acre	16.26	13.58	18.46
Tennis Courts	1000 GSF	32.93*		
Tennis Courts	Member	0.12*		
Racquet Club	Employee	47.02	43.22	41.86
Racquet Club	Court	42.90	31.77	30.57
Racquet Club	1000 GSF	12.14	17.14	23.16
Racquet Club	Member	0.40		
Recreational Homes	Dwelling Unit	3.16	3.07	2.93
Recreational Homes	Acre	1.33	1.29	1.24
Res Planned Unit Devel	Dwelling Unit	7.44	6.42	5.09
Res Planned Unit Devel	Acre	46.78		
Hotel	Occup. Room	8.70	10.50	8.48
Hotel	Employee	14.34	12.27	8.92
Business Hotel	Occup. Room	7.27		
Business Hotel	Employee	72.67		
Motel	Occup. Room	10.19	8.84	7.39
Motel	Employee	12.81	12.40	10.37
Resort Hotel	Room	10.16*		
Resort Hotel	Occup. Room	10.16	11.25	8.81
Resort Hotel	Employee	10.27	13.81	10.82
Recreational	Acre	3.63*		
Recreational	Employee	23.53*		

TABLE A9 - 5 - A - 1 (Cont.)

AVERAGE TRIP GENERATION RATES FOR CATEGORIES OF LAND USES BASED ON NUMBER OF VARIABLES (in Number of Two-Way Trips per Day)

Land Use	Per Unit of Measure	ADT (Weekday)	ADT (Weekend) Sat.	Sun.
Park	Employee	96.16		
Park	Acre	36.54		
Park	Parking Space	7.58		
Park	Picnic Site	84.79		
City Park	Employee	51.09*		
City Park	Acre	2.23		5.90
County Park	Employee	25.99*		
County Park	Acre	2.99	12.14	4.68
County Park	Parking Space	2.11*		
State Park	Employee	60.19		
State Park	Acre	0.50	0.61	0.66
State Park	Picnic Site	6.62	6.42	12.27
State Park	Parking Space	1.05*		
State Park	Camp Site	8.60*		
Water Slide Park	Site	500.00*		
Water Slide Park	Parking Space	1.67		
Utilities	Employee	1.06		
Utilities	Acre	2.62		
Single Fam Detached House	Dwelling Unit	9.55	10.19	8.78
Single Fam Detached House	Person	2.55	2.74	2.40
Single Fam Detached House	Vehicle	6.27	7.16	6.26
Single Fam Detached House	Acre	27.61	35.13	29.56
Apartment	Dwelling Unit	6.47		
Apartment	Person	3.27	3.23	2.95
Apartment	Vehicle	4.80	4.87	4.05
Apartment (post 1973)	Dwelling Unit	6.28		
Low-Rise Apartment	Oc. Dwelling Unit	6.59	7.16	6.07
Low-Rise Apartment	Person			
High-Rise Apartment	Dwelling Unit	4.20	4.98	3.65
High-Rise Apartment	Person	1.78		
Residential Condominium	Dwelling Unit	5.68	5.67	4.84
Residential Condominium	Person	2.50	2.60	2.26
Residential Condominium	Vehicle	3.33	3.31	2.87
High-Rise Res. Condo	Dwelling Unit	4.18	4.31	3.43
Mobile Home Park	Ocp. Dwelling Unit	4.81	4.97	4.34
Mobile Home Park	Person	2.40	2.33	2.04
Mobile Home Park	Vehicle	3.38	3.43	2.94
Mobile Home Park	Acre	39.13	35.83	31.82
Retirement Community	Ocp. Dwlng Unit	3.30*	2.76	2.32
Congregate Care Facility	Ocp. Dwlng Unit	2.15		
Waterports	Ship Berth	171.52		
Waterports	Acre	11.93		
Commercial Airport	Employee	13.40	12.20	14.70
Commercial Airport	Ave Flights/Day	104.73	98.46	119.61
Commercial Airport	Comm Flights/Day	122.21	113.04	137.71
General Aviation Airport	Employee	21.45	11.71	14.59
General Aviation Airport	Ave Flights/day	2.59	1.98	1.87
General Aviation Airport	based aircraft	6.61	4.11	4.82
Truck Terminal	Employee	6.98	1.47	0.92

TABLE A9 - 5 - A - 1 (Cont.)

AVERAGE TRIP GENERATION RATES FOR CATEGORIES OF LAND USES BASED ON NUMBER OF VARIABLES (in Number of Two-Way Trips per Day)

Land Use	Per Unit of Measure	ADT (Weekday)	ADT (Weekend) Sat.	Sun.
Truck Terminal	1000 GSF	9.85		
Truck Terminal	Acre	81.86	17.28	10.79
Bus Park n Ride Station	Parking Space	4.18		
General Light Industry	Employee	3.02	0.48	0.26
General Light Industry	1000 GSF	6.97	1.32	0.68
General Light Industry	Acre	51.80	8.73	4.42
General Heavy Industry	Employee	0.82		
General Heavy Industry	1000 GSF	1.50		
General Heavy Industry	Acre	6.75		
Industrial Park	Employee	3.34	1.14	0.34
Industrial Park	1000 GSF	6.97	2.49	0.73
Industrial Park	Acre	62.90	34.23	10.11
Manufacturing	Employees	2.09	0.87	0.36
Manufacturing	1000 GSF	3.85	1.49	0.62
Manufacturing	Acre	38.88	33.40	13.91
Warehousing	Employee	3.89	1.00	0.65
Warehousing	1000 GSF	4.88	1.22	0.79
Warehousing	Acre	56.08	13.16	8.54
Mini Warehouse	Employee	56.28	50.28	38.91
Mini Warehouse	1000 GSF	2.61	2.33	1.78
Mini Warehouse	Storage Unit	0.28	0.25	0.18
Mini Warehouse	Acre	39.97	35.71	26.83
General Office	Employees (25-50)	6.00		
General Office	Employees (50-100)	5.32		
General Office	Employees (100-200)	4.74		
General Office	Employees (200-300)	4.22		
General Office	Employees (300-400)	3.94		
General Office	Employees (400-500)	3.76		
General Office	Employees (500-600)	3.62		
General Office	Employees (600-700)	3.51		
General Office	Employees (700-800)	3.42		
General Office	Employees (800-900)	3.34		
General Office	Employees (900-1000)	3.28		
General Office	Employees (1000-1200)	3.22		
General Office	Employees (1200-1600)	3.12		
General Office	Employees (1600 or More)	2.98		
General Office	1000 GSF (10-25)	24.60		
General Office	1000 GSF (25-50)	19.72		
General Office	1000 GSF (50-100)	16.58		
General Office	1000 GSF (100-200)	14.03		
General Office	1000 GSF (200-300)	11.85		
General Office	1000 GSF (300-400)	10.77		
General Office	1000 GSF (400-500)	9.96		
General Office	1000 GSF (500-600)	9.45		
General Office	1000 GSF (600-700)	9.05		
General Office	1000 GSF (700-800)	8.75		
General Office	1000 GSF (800 or More)	8.46		
Shopping Center	1000 GLA (10-50)	167.59	215.39	
Shopping Center	1000 GLA (50-100)	91.65	118.36	
Shopping Center	1000 GLA (100-200)	70.67	91.46	

TABLE A9 - 5 - A - 1 (Cont.)

AVERAGE TRIP GENERATION RATES FOR CATEGORIES OF LAND USES BASED ON NUMBER OF VARIABLES (in Number of Two-Way Trips per Day)

Land Use	Per Unit of Measure	ADT (Weekday)	ADT (Weekend) Sat.	Sun.
Shopping Center	1000 GLA (200-300)	54.50	70.67	
Shopping Center	1000 GLA (300-400)	46.81	60.78	
Shopping Center	1000 GLA (400-500)	42.02	54.61	
Shopping Center	1000 GLA (500-600)	38.65	50.26	
Shopping Center	1000 GLA (600-800)	36.35	46.96	
Shopping Center	1000 GLA (800-1000)	33.88	42.20	
Shopping Center	1000 GLA (1000-1200)	32.09	38.83	
Shopping Center	1000 GLA (1200-1400)	30.69	36.29	
Shopping Center	1000 GLA (1400-1600)	29.56	34.27	
Shopping Center	1000 GLA (1600 or More)	28.61	32.61	

GLA = Gross Leasable Area

GSF = Gross Square Feet

Source: Institute of Transportation Engineers. Trip Generation, 5th Edition. 1991.

* Institute of Transportation Engineers. Trip Generation, 4th Edition. 1987.

Note: To use the methodologies in Table A9 - 5 of Appendix 9, the highest ADT for a given land use should be used.

TABLE A9 - 5 - A - 2

INPUT ASSUMPTIONS TO DETERMINE PROJECT-RELATED AVERAGE DAILY TRIPS BASED ON NUMBER OF VEHICLES, WORKERS OR DWELLING UNITS ESTIMATED FOR THE PROJECT

(in Number of One-way Trips per Day)

For the project, first estimate total number of dwelling units, vehicles and workers (employees). Then use the following daily rates to determine work and non-work related average daily trips (ADT). If estimated using all three rates, use the highest ADT value to estimate ADT-related emissions. To determine one way trips, multiply number of project related vehicles, or dwelling units or employees with the following rate. To determine two way trips (round trips), double the estimated one way trips. All non-work trips from Table A9 - 5 - A - 2 should be assumed as 1-person non-work trips.

	Average Daily Trip Rate by County							
County Type	Los Angeles		Orange		Riverside		San Bernardino	
Trip-types per / Year	1987	2010	1987	2010	1987	2010	1987	2010
Work Trips Per								
Dwelling Unit	1.62	1.63	2.13	2.15	1.58	1.57	1.57	1.57
Vehicle	0.95	0.96	1.07	1.09	0.90	0.89	0.91	0.89
Worker (See Table A9 - 17)	1.26	1.32	1.38	1.47	1.41	1.46	1.37	1.35
Non-Work Trips Per								
Dwelling Unit	7.39	7.37	8.57	8.66	7.90	7.69	8.39	8.04
Vehicle	4.35	4.34	4.32	4.36	4.48	4.35	4.77	4.57
Worker (See Table A9 - 17)	5.72	5.96	5.55	5.90	7.05	7.14	7.21	6.89

Source: CalTrans

TABLE A9 - 5 - B

INPUT ASSUMPTIONS TO ESTIMATE NUMBER OF VEHICLES (NOV). ASSOCIATED WITH WORK TRIPS

(Percent of the Number of Employees Traveling to Work or Work Related Average Daily Trips)

For the project, first estimate total number of persons traveling from home to work and vice versa using Table A9 - 5 - A, TIA or ITE Manual. Then use the following percentages to determine number of passenger vehicles and number of transit vehicles needed for the project. To determine number of project related 1-, or 2-, or 3- or multi- person vehicles or average daily trips divide project related population or average two way daily trips with 100 and then multiply the answer with the following rate.

Type of Vehicle	Passenger Vehicle (Automobile)						Transit		Persons
Mode Split	1-Person		2-Person		3-Person		Multi-Person		Travel/
County Year	1987	2010	1987	2010	1987	2010	1987	2010	Year
Los Angeles	72.88	69.7	11.72	13.0	7.09	9.1	8.31	8.2	100/yr
Orange	77.42	74.5	12.47	13.1	7.43	8.6	2.68	3.8	100/yr
Riverside	76.20	79.0	13.97	12.3	8.55	7.7	1.28	1.0	100/yr
San Bernardino	76.89	77.7	13.19	12.8	7.91	8.3	2.01	1.2	100/yr

The "Home to Work" auto occupancy rate for the region is averaged 1.135. An average occupancy for all trips is 1.394. Mode split used in calculating emissions should take into account availability and whether or not the project is subject to the District's Regulation XV.

Source: SCAG's 1987 and 2010 Base Year Travel Information Digest, December 1990

TABLE A9 - 5 - C

INPUT ASSUMPTIONS TO ESTIMATE AVERAGE DAILY TRIPS BY TRIP-TYPE
(Percent of Total ADT)

For the project, first estimate pro... related average daily trips (ADT) using Table A9 - 5 - A - 1, Table A9 - 5 - A - 2 and Table A9 - 5 - I-, or ITA or ... Manual. Then use th... ollowing percentages to determine average daily trips by trip-types. This breakdown of trip-types will help determine which trip length to use to estimate vehicle miles traveled (VMT) for each trip-type. To determine average daily trips by trip-types, divide total project related ADT by 100 and multiply the answer by the appropriate percent ADT rate from the following table. If project related work-ADT is known, project related non-work-ADT can be estimated using the ADT rates from the following table, and vice versa. For example, to estimate project related non-work trips, divide project related work-ADT by 39.3 and multiply the answer by 60.7; to estimate project related work trips, divide project related non-work-ADT by 60.7 and multiply the answer by 39.3. Then, use the appropriate work or non-work related percent ADT rates to divide these ADTs. This is needed to apply appropriate trip length to estimate VMT. VMT = ADT x Trip Length. (Trip lengths are provided in the next Table A9 - 5 - D.)

	Average Daily Trips' Percents by Region, County and Trip-Types									
County Type	Los Angeles		Orange		Riverside		San Brnrdino		Regional*	
Trip-types Year	1987	2010	1987	2010	1987	2010	1987	2010	1987	2010
Work Trips	38.76	38.88	41.20	41.29	38.76	38.88	38.76	38.88	39.27	39.39
Non-Work Trips	61.24	61.12	58.80	58.71	61.24	61.12	61.24	61.12	60.73	60.61
Home to Work	11.93	7.07	12.68	7.51	11.93	7.07	11.93	7.07	8.0	2.0
Other to Work	26.83	31.81	28.52	33.78	26.83	31.81	26.83	31.81	18.0	9.0
Home to Centers (Mitigation)	--	10.30	--	9.89	--	10.30	--	*10.30*		*15.0*
Home to Other	33.10	26.78	31.78	25.73	33.10	26.78	33.10	26.78	40.0	39.0
Other to Other	18.21	15.11	17.48	14.51	18.21	15.11	18.21	15.11	22.0	22.0
Home to Shop	9.93	8.93	9.54	8.58	9.93	8.93	9.93	8.93	12.0	13.0

Source: SCAG's 1987 and 2010 Base Year Travel Information Digest, December 1990

TABLE A9 - 5 - D

INPUT ASSUMPTIONS TRIP LENGTH TO ESTIMATE VMT
(One-Way Distance Traveled for Each Trip-Type in Miles)

Multiply ADT for each trip-type with the trip lengths from the following table to obtain vehicle miles traveled (VMT) by trip-type. VMT is used to estimate running exhaust and evaporative emissions. Multiply VMT by the appropriate emission factor. Emissions for each trip type should then be added to the estimate of total vehicular emissions. To select appropriate emission factors for the speeds by trip-type (see Table A9 - 5 - F).

	Average Trip Lengths or Distances Traveled by County									
County Type	Los Angeles		Orange		Riverside		San Brnrdino		Regional*	
Trip-types Year	1987	2010	1987	2010	1987	2010	1987	2010	1987	21010
Work Trips	9.6	10.8	10.9	11.6	17.7	17.0	13.9	13.6	10.7	11.7
Non-Work Trips	5.6	6.3	5.6	6.5	7.8	9.6	7.0	7.9	6.6	6.9
Home to Work	9.6	10.8	10.9	11.6	17.7	17.0	13.9	13.6	10.7	11.7
Other to Work	7.63	8.03	8.66	8.63	14.06	12.64	11.04	10.11	8.5	8.7
Home to Other	5.85	6.85	5.85	7.07	8.15	10.43	7.32	8.59	6.9	7.5
Other to Other	5.94	5.93	5.94	6.12	8.27	9.04	7.42	7.44	7.0	6.5
Home to Shop	5.18	5.39	5.18	5.56	7.21	8.21	6.47	6.76	6.1	5.9

* Regional Averages Source: SCAG Travel Demand Model: 2010 RM P89

TABLE A9 - 5 - E

FREEWAY/NON-FREEWAY AND WORK/NON-WORK VMT AND ADT PERCENT ASSUMPTIONS, BY PERIOD OF DAY
(in Percent)

First estimate project related ADT. By using the following ADT rates determine work and nonwork related percent of ADT for that time period. Using these rates determine vehicle miles traveled by trip-type. By using the following VMT rates determine percent VMT on freeways and non-freeways for that time period. Use next table to determine speeds. Speeds are needed to determine emission factors to be used.

Travel Period of the Day		Percent VMT By Road-Type and Period of the Day							
		AM Peak		Off Peak		PM Peak		Daily	
Trip-Types	Year	1987	2010	1987	2010	1987	2010	1987	2010
Percent VMT Traveled									
on Freeways		51.1	51.1	52.2	52.2	47.0	47.0	50.6	50.6
on Non-freeways		48.9	48.9	47.8	47.8	53.0	53.0	49.4	49.4
		Percent ADT By Trip-Type and Period of the Day							
Percent Trips Associated With									
Work-ADT		58.88	58.95	26.47	26.6	32.46	32.61	--	--
Non work- ADT		41.12	41.05	73.53	73.4	67.54	67.38	--	--

Source: Based on LARTS (Prepared by CalTrans District 7, November 15, 1991)

TABLE A9 - 5 - F

INPUT ASSUMPTIONS TO DETERMINE SPEEDS BY TRIP-TYPE
(Miles per Hour)

Include an assumption for the road-type. Select recommended default for the travel period of the day for each pollutant. Include the appropriate speed for each trip-type. Select the emission factors from Tables 9 - 5 - J, K, L, or N for that speed. Then use the formula at the beginning of Table A9 - 5. Weighted average between weekday and weekend speeds should be determined for each time period before selecting the emission factor.

Travel Period of the Day		Traveling Speeds by Counties, Road-type and Period of the Day							
		AM Peak*		Off Peak*		PM Peak*		Daily	
Area Types Road-Types	Year	1987	2010	1987	2010	1987	2010	1987	2010
*Recommended Defaults		(CO, and NOx)		(ROCs)		(SOx, PM10 & Pb)			
Regional Average Speeds		27.925	24.25	39.05	37.0	23.55	18.875	31.275	27.425
HOV (mitigation)		*34.0*	*31.0*	*58.0*	*53.0*	*35.0*	*28.0*	*49.0*	*40.0*
Freeways		33.0	33.0	51.0	49.0	29.0	26.0	40.0	38.0
Non-Freeway		18.7	16.0	27.7	26.0	14.7	12.0	20.7	17.7
Major		17.0	15.0	29.0	28.0	15.0	12.0	21.0	18.0
Primary		21.0	15.0	29.0	25.0	15.0	11.0	22.0	17.0
Secondary		18.0	18.0	25.0	25.0	14.0	13.0	19.0	18.0
County Average Speeds									
Los Angeles		24.0	21.0	34.0	33.0	18.0	15.0	26.0	23.0
Orange County		22.0	21.0	36.0	36.0	19.0	18.0	27.0	26.0
Riverside		40.0	27.0	46.0	42.0	34.0	22.0	41.0	32.0
San Bernardino		34.0	27.0	39.0	35.0	30.0	20.0	35.0	28.0

Source: Based on LARTS (Prepared by CalTrans District 7, Nov. 15, 1991).

* Use *AM Peak Speeds* to select emission factors for CO, and NOx, use *Off Peak Speeds* to select emission factors for ROC; use *PM Peak Speeds* for SOx, PM10 and Pb.

TABLE A9 – 5 – G

PERCENT VEHICLE MILES TRAVELED (VMT), AVERAGE DAILY TRIPS (ADT), AND NUMBER OF VEHICLES (NOV) IN USE IN THE DISTRICT, BY YEAR AND VEHICLE TYPE

Source: EMFAC7E Factors/B7C Draft Trends/Fuel, computer print-out of 8/9/1990 by California Air Resources Board

		PASSENGER			TRUCKS		
COUNTY	YEAR	VMT	ADT	NOV	VMT	ADT	NOV
Los Angeles							
	1991	88.94	87.91	88.10	10.27	11.42	8.55
	1993	88.90	87.81	87.96	10.31	11.51	8.63
	1995	88.85	87.72	87.85	10.36	11.59	8.69
	1997	88.81	87.64	87.70	10.41	11.66	8.77
	1999	88.76	87.50	87.56	10.46	11.79	8.84
	2001	88.72	87.46	87.44	10.50	11.81	8.92
	2003	88.68	87.36	87.33	10.55	11.91	8.99
	2005	88.64	87.28	87.22	10.59	11.99	9.07
	2007	88.60	87.20	87.11	10.63	12.06	9.14
	2009	88.56	87.13	87.02	10.68	12.13	9.21
Orange							
	1991	88.61	88.38	87.56	10.69	10.94	8.43
	1993	88.59	88.34	87.44	10.71	10.97	8.46
	1995	88.58	88.31	87.31	10.73	10.99	8.51
	1997	88.59	88.28	87.31	10.72	11.01	8.50
	1999	88.60	88.26	87.30	10.72	11.03	8.49
	2001	88.60	88.23	87.29	10.72	11.04	8.48
	2003	88.61	88.21	87.27	10.72	11.06	8.47
	2005	88.61	88.19	87.24	10.72	11.07	8.47
	2007	88.61	88.17	87.22	10.72	11.09	8.47
	2009	88.61	88.15	87.20	10.73	11.10	8.46
Riverside							
	1991	87.09	86.53	86.04	12.51	13.06	9.96
	1993	87.00	86.71	86.03	12.62	12.88	9.94
	1995	86.93	86.88	86.01	12.70	12.72	9.96
	1997	86.87	87.05	86.08	12.77	12.56	9.90
	1999	86.83	87.19	86.13	12.81	12.42	9.86
	2001	86.79	87.29	86.15	12.86	12.33	9.85
	2003	86.77	87.39	86.20	12.89	12.24	9.82
	2005	86.74	87.47	86.23	12.92	12.16	9.79
	2007	86.71	87.55	86.27	12.96	12.09	9.77
	2009	86.69	87.61	86.30	12.98	12.02	9.74
San Bernardino							
	1991	85.74	86.04	85.21	13.75	13.43	10.33
	1993	85.66	85.93	85.10	13.84	13.54	10.42
	1995	85.59	85.83	84.98	13.92	13.64	10.52
	1997	85.55	85.74	84.97	13.96	13.73	10.55
	1999	85.51	85.65	84.97	14.01	13.82	10.57
	2001	85.46	85.53	84.93	14.06	13.93	10.62
	2003	85.40	85.42	84.88	14.12	14.04	10.67
	2005	85.36	85.32	84.83	14.17	14.14	10.72
	2007	85.32	85.22	84.77	14.21	14.23	10.77
	2009	85.28	85.14	84.74	14.25	14.32	10.80

TABLE A9 – 5 – G (Cont.)
PERCENT VEHICLE MILES TRAVELED (VMT), AVERAGE DAILY TRIPS (ADT), AND NUMBER OF VEHICLES (NOV) IN USE IN THE DISTRICT, BY YEAR AND VEHICLE TYPE

Source: EMFAC7E Factors/B7C Draft Trends/Fuel, computer print-out of 8/9/1990 by California Air Resources Board

		MOTORCYCLES			BUSES		
COUNTY	YEAR	VMT	ADT	NOV	VMT	ADT	NOV
Los Angeles							
	1991	0.60	0.66	3.31	0.19	0.02	0.04
	1993	0.60	0.66	3.36	0.18	0.02	0.04
	1995	0.60	0.67	3.42	0.18	0.02	0.04
	1997	0.61	0.68	3.49	0.18	0.02	0.04
	1999	0.61	0.69	3.55	0.18	0.02	0.04
	2001	0.61	0.70	3.60	0.17	0.02	0.04
	2003	0.61	0.71	3.64	0.17	0.02	0.04
	2005	0.60	0.71	3.67	0.17	0.02	0.04
	2007	0.60	0.71	3.70	0.16	0.02	0.04
	2009	0.60	0.72	3.73	0.16	0.02	0.04
Orange							
	1991	0.60	0.67	3.99	0.10	0.01	0.02
	1993	0.60	0.68	4.07	0.10	0.01	0.02
	1995	0.59	0.69	4.15	0.10	0.01	0.02
	1997	0.59	0.70	4.17	0.10	0.01	0.02
	1999	0.59	0.70	4.19	0.09	0.01	0.02
	2001	0.58	0.71	4.21	0.09	0.01	0.02
	2003	0.58	0.72	4.24	0.09	0.01	0.02
	2005	0.58	0.72	4.26	0.09	0.01	0.02
	2007	0.58	0.73	4.29	0.09	0.01	0.02
	2009	0.58	0.73	4.31	0.09	0.01	0.02
Riverside							
	1991	0.34	0.40	3.98	0.06	0.01	0.02
	1993	0.32	0.40	4.00	0.06	0.01	0.02
	1995	0.31	0.39	4.02	0.06	0.01	0.02
	1997	0.30	0.38	4.00	0.06	0.01	0.02
	1999	0.29	0.37	3.98	0.06	0.01	0.02
	2001	0.29	0.37	3.97	0.06	0.01	0.02
	2003	0.28	0.36	3.96	0.06	0.01	0.02
	2005	0.27	0.36	3.95	0.06	0.01	0.02
	2007	0.27	0.36	3.94	0.06	0.01	0.02
	2009	0.27	0.35	3.93	0.06	0.01	0.02
San Bernardino							
	1991	0.47	0.52	4.44	0.04	0.005	0.01
	1993	0.46	0.53	4.47	0.03	0.005	0.01
	1995	0.46	0.53	4.49	0.04	0.005	0.01
	1997	0.45	0.53	4.47	0.04	0.005	0.01
	1999	0.44	0.53	4.45	0.03	0.005	0.01
	2001	0.44	0.53	4.44	0.04	0.005	0.01
	2003	0.44	0.53	4.44	0.03	0.005	0.01
	2005	0.44	0.54	4.45	0.04	0.005	0.01
	2007	0.44	0.54	4.45	0.03	0.005	0.01
	2009	0.44	0.54	4.45	0.03	0.005	0.01

Fleet mix is essential to determine which emission factor to use. Passenger vehicles include autos and light-duty trucks. Trucks include all medium-duty, light-heavy, medium-heavy, and heavy-heavy-duty trucks. Tables A9 - 5 - J -1 through 9 and Table A9 - 5 - L provide emission factors for passenger vehicles and Tables 9 - 5 - K - 1 through 9 and Table A9 - 5 - L provide emission factors for trucks. Traffic impact analysis should provide the fleet mix for each project. If the fleet mix is unknown, use Table A9 - 5 - G to determine the fleet mix. These percentages should be used for the project specific analysis to determine project related VMT, ADT and NOVs contribution to the Basin. These should not be used for roadway analysis, such as a micro-scale CO analysis. CalTrans defines 3 axles and more as a truck. For roadway truck percentages, see ARB's report on Assessment of Heavy-duty Gasoline and Diesel Vehicles in California: Population and Use Pattern, Yuji Horie and Richard Rapoport of Pacific Environmental Services, Inc.

TABLE A9 - 5 - H

RELATIONSHIP BETWEEN TRIP SPEED AND NUMBER OF VEHICLES (ROAD CAPACITY) PASSING A CERTAIN POINT IN ONE HOUR BY ROAD TYPE

(mph and Number of Vehicles per Hour)

(This table may be used for modeling purposes.)

The traffic impact analysis should provide the number of vehicles on nearby roads. To analyze the air quality impacts from level of service (LOS) of nearby roads due to the project, use the following information on speeds. Select the emission factors from Tables A9 - 5 - J, K, L, or N to estimate emissions associated with congestion and see Table 9 - 5 - P - 1 or 2 for composite emission factor methodologies. Congestion contributes to the decrease in the assigned speed for that road type. Subtract existing emissions from project related emissions (due to congestion) to determine the project impact. To determine fleet mix based on road types please use EPA report for the Contract Number A2-155-32 on Assessment of Heavy-Duty Gasoline and Diesel Vehicles in California: Population and Use Patterns, Prepared in July 1985 by Yuji Horie, Richard Rapoport of Pacific Environmental Services, Inc. Passenger vehicles include all autos and light-duty trucks. Trucks include all medium-duty, light-heavy, medium-heavy, and heavy-heavy-duty trucks.

	Traveling Speed/Number of Vehicles Per Hour Per Lane							
County Type	Los Angeles		Orange		Riverside		San Bernardino	
Road Type — Year	1987	2010	1987	2010	1987	2010	1987	2010
Freeways								
Speed/One Hour	55	55	60	60	60	60	60	60
Vehicle Capacity	/1650	/1650	/1750	/1750	/1750	/1750	/1750	/1750
Non-Freeway								
Speed/One Hour	20	20	28.3	28.3	33.33	33.33	38.33	38.33
Vehicle Capacity	/550	/550	/575	/575	/600	/600	/800	/800
Major Arterial								
Speed/One Hour	20	20	30	30	35	35	40	40
Vehicle Capacity	/600	/600	/625	/625	/650	/650	/800	/800
Primary Arterial								
Speed/One Hour	20	20	30	30	35	35	40	40
Vehicle Capacity	/550	/550	/575	/575	/600	/600	/800	/800
Secondary Arterial								
Speed/One Hour	20	20	25	25	30	30	35	35
Vehicle Capacity	/500	/500	/525	/525	/550	/550	/800	/800
HOV Lanes (Mitigation Measure)								
Speed/One Hour	60	60	60	60	60	60	N/A	
Vehicle Capacity	/1750	/1750	/1750	/1750	/1770	/1750		

INFORMATION
FOR
TEMPERATURES, AREAS, AND EMISSION FACTORS

TABLE A9 - 5 - I

ESTIMATING TEMPERATURES NEEDED TO CHOOSE COMPOSITE EMISSION FACTORS

The air quality analysis in environmental documents (EIR, NDs, MNDs, etc.) should include emission estimates using average speed, vehicle miles traveled (VMT), average daily trips (ADT) and number of vehicles (NOVs). Composite emission factors are provided in Table A9 - 5 - J, A9 - 5 - K, A9 - 5 - L and A9 - 5 - N of the Appendix 9.

COMPOSITE EMISSION FACTORS

Emission factors associated with gasoline vehicles equipped with and without catalytic converters were combined. These combined factors were added to the diesel-fueled vehicles emission factors to estimate a weighted average between three fuels. For passenger vehicles, the weighted average was for light-duty automobiles and light-duty trucks, and for materials hauling vehicles, the weighted average was for medium-duty, light-heavy-duty, medium-heavy-duty, and heavy-heavy-duty trucks as defined by the California Air Resources Board.

TEMPERATURES FOR EACH POLLUTANT TYPE AND AREA TYPE

Table A9 - 5 - J, A9 - 5 - K, A9 - 5 - L and A9 - 5 - N provide emissions factors for the Areas 1-3.

Area 1	Orange County
Area 2	Los Angeles County
Area 3	Riverside County and San Bernardino County

Temperatures for each area were selected using worst-case scenarios. The ten highest exceedance days experienced, in the counties and subcounties within the District, were examined to determine the worst-case temperatures. Each exceedance day had six two-hour time periods in which high levels were observed. Temperature readings between four time periods were selected. Morning temperatures were averaged for time periods between 6 a.m to 8 a.m., and 9 a.m. to 11 a.m. for each County. For the remainder of the exceedance day, the temperatures between 12 p.m. to 2 p.m., and 3 p.m. to 5 p.m. were averaged for each County.

The lowest temperatures were selected for carbon monoxide (CO) and oxides of nitrogen (NOx), because at lower temperatures incomplete combustion occurs that leads to high CO and NOx emissions. CO emission factors for all areas were adjusted to 60°F. For Area 1, NOx emission factors were adjusted to 70°F, for Area 2 to 75°F, and for Area 3 to 80°F. Temperature correction factors for PM10, sulfur and lead are not currently available. The enclosed emission factors are based on room temperatures (i.e., 75°F) for these three pollutants.

The District takes limited measurements of reactive organic compounds (ROCs). Temperature estimates are based on the 10 worst ozone exceedance days. Ozone is formed from reactions between ROC and NOx in the presence of sunlight. Greater levels of ozone are formed at higher temperatures. ROC emission increases are high during high temperatures due to evaporative and combustive emissions, with minimal evaporative emissions during cooler weather. For Areas 1 and 2, ROC emission factors were adjusted to 85°F, while for Area 3, these were adjusted to 100°F. (0.92 factor was used to convert Total Organic Compounds to Reactive Organic Gases.) Following are the pollutant concentrations exceedance day temperatures and selected temperatures for the composite emission factors:

Time of the Day	Exceedance Temperature 6-11	Exceedance Temperature 12-14	Exceedance Temperature 15-17	Temperatures For Each Area (°F)
Carbon Monoxide (CO)				
Orange (Area 1)	60	71	66	60
Los Angeles Coastal (Area 2)	57.5	70	65	60
Los Angeles Inland (Area 2)	60.5	73	64	60
Riverside (Area 3)	64	75	68	60
San Bernardino (Area 3)	62.5	79	73	60
Oxides of Nitrogen (NOx)				
Orange (Area 1)	71	82	77	70
Los Angeles Coastal (Area 2)	67.5	76	72	75
Los Angeles Inland (Area 2)	82.5	91	83	75
Riverside (Area 3)	77	87	81	80
San Bernardino (Area 3)	82.5	93	86	80
Reactive Organic Compounds (ROC)				
Orange (Area 1)	75	83	80	85
Los Angeles Coastal (Area 2)	71	78	75	85
Los Angeles Inland (Area 2)	83.5	93.5	88	85
Riverside (Area 3)	88.25	99.5	96	100
San Bernardino (Area 3)	86.0	99.5	97	100

Tables A9 - 5 - J - 1 thru 10, and Table A9 - 5 - L
Emission factors for passenger vehicles

Tables A9 - 5 - K - 1 thru 10, and Table A9 - 5 - L
Emission factors for trucks

Tables A9 - 5 - N - 1 thru 3
Emission factors for motorcycles

Tables A11 - 5 - H - 1 thru 10
Emission factors for buses

TABLE A9 - 5 - J

EMISSION FACTORS FOR ESTIMATING PASSENGER VEHICLE EMISSIONS

USE

TABLE A9 - 5 - L

FOR ESTIMATING OXIDES OF SULFUR AND LEAD EMISSIONS FROM PASSENGER VEHICLES

USE

TABLE A9 - 14 - A

FOR PASSENGER VEHICLE-RELATED
VEHICLE MILES TRAVELED (VMT)
AVERAGE DAILY TRIPS (ADT) AND NUMBER OF VEHICLES (NOV)
IN COUNTYWIDE AND REGIONWIDE FLEET MIX
AND

TABLE A9 - 5 - G*

FOR THEIR PERCENTAGES

USE

TABLE A9 - 5 - P - 1 AND 2

FOR DETERMINING COMPOSITE EMISSION FACTOR BETWEEN
FOUR DIFFERENT TYPES OF VEHICLES TOGETHER, SUCH AS,
PASSENGER VEHICLES, MOTORCYCLES AND BUSES
INCLUDING MATERIAL HAULING VEHICLES
AND
BETWEEN RUNNING, HOT AND COLD START EMISSION FACTORS FOR
THE PASSENGER VEHICLES

(* IF PROJECT-SPECIFIC FLEET MIX DATA IS NOT AVAILABLE,
USE TABLE A9 - 5 - G TO DETFRMINE PROJECT-RELATED
FLEET MIX DATA)

TABLE 5 - J - 1

MFAC7EP EMISSION FACTORS FOR SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT

Vehicles with Gross Vehicle Weight 6,000 Pounds and less***

Calendar Year 1991

Vehicle Speed (Miles per Hour)	Running Exhaust and Evaporative (Grams per Mile)*										
	Carbon Monoxide			Reactive Organic Compounds			Oxides of Nitrogen			PM10 Exhaust	PM10 Tire Wear
	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	FOR ALL AREA	FOR ALL AREA
5	40.70	40.76	41.51	3.51	3.51	4.73	1.22	1.22	1.20	0.01	0.10
10	21.07	21.10	21.47	1.97	1.97	2.90	1.10	1.10	1.08	0.01	0.10
15	14.55	14.57	14.81	1.42	1.42	2.19	1.00	1.01	0.98	0.01	0.10
20	11.05	11.06	11.24	1.11	1.12	1.75	0.93	0.93	0.91	0.01	0.10
25	8.86	8.87	9.02	0.91	0.91	1.43	0.88	0.88	0.86	0.01	0.10
30	7.37	7.38	7.50	0.75	0.28	1.16	0.85	0.85	0.83	0.01	0.10
35	6.30	6.31	6.41	0.62	0.23	0.91	0.83	0.83	0.81	0.01	0.10
40	5.51	5,52	5.61	0.50	0.19	0.69	0.82	0.82	0.80	0.01	0.10
45	4.93	4.94	5.02	0.40	0.15	0.49	0.83	0.83	0.81	0.01	0.10
50	4.49	4.49	4.57	0.35	0.13	0.39	0.96	0.96	0.93	0.01	0.10
55	4.09	4.09	4.16	0.32	0.12	0.35	1.25	1.25	1.22	0.01	0.10
60	7.87	7.88	8.02	0.41	0.15	0.45	1.55	1.55	1.51	0.01	0.10
65	17.98	18.00	18.30	0.70	0.26	0.77	1.85	1.86	1.81	0.01	0.10
COLD START* (Grams/Trip)	93.50	93.49	93.38	5.20	5.21	5.38	2.89	2.90	2.85		
HOT START* (Grams/Trip)	12.72	12.74	13.02	1.37	1.38	1.55	1.68	1.68	1.66		
HOT SOAK* (Grams/Trip)	----	-----	-----	2.11	2.11	2.13	-----	-----	-----		
DIURNAL** (Grams/Vehicle/Day)	-----	-----	-----	5.01	5.01	5.01	-----	-----	-----		

Example of one daily trip:

Vehicle Start (Start-up)	Running + Evaporative ----------------->	Vehicle Start (Hot Soak)
Parking	Diurnal ----------------->	Restart (Start-up)

* Vehicle Miles Traveled (VMT)/Average Daily Trips (ADT) -weighted emission factors:
Includes VMT/ADT from diesel-fueled vehicles (2.25%), gasoline-fueled vehicles equipped with catalyst (93.58%), and gasoline-fueled vehicles not equipped with catalyst (4.18%).

** Number of Vehicles (NOV)-weighted emission factors:
Includes NOV from diesel-fueled vehicles (2.40%), gasoline-fueled vehicles equipped with catalyst (89.51%), and gasoline-fueled vehicles not equipped with catalyst (8.1%).

*** Vehicles with gross vehicle weight 6,000 pounds and less:
Includes ARB's light automobiles, light-duty trucks, vans, station wagons and 4x4 trucks.

(SG10PV11.WK1)

TABLE A9 - 5 - J - 2

EMFAC7EP EMISSION FACTORS FOR SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT
Vehicles with Gross Vehicle Weight 6,000 Pounds and Less***
Calendar Year 1993

Vehicle Speed (Miles per Hour)	Running Exhaust and Evaporative (Grams per Mile)*										
	Carbon Monoxide			Reactive Organic Compounds			Oxides of Nitrogen			PM10 Exhaust	PM10 Tire Wear
	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	FOR ALL AREA	FOR ALL AREA
5	32.90	32.96	33.53	2.54	2.54	3.30	1.06	1.07	1.04	0.01	0.10
10	17.53	17.55	17.84	1.38	1.38	1.93	0.95	0.96	0.94	0.01	0.10
15	12.43	12.44	12.64	0.97	0.97	1.41	0.87	0.87	0.85	0.01	0.10
20	9.45	9.47	9.61	0.75	0.75	1.12	0.80	0.80	0.79	0.01	0.10
25	7.55	7.57	7.68	0.61	0.61	0.91	0.75	0.75	0.74	0.01	0.10
30	6.27	6.28	6.38	0.51	0.51	0.74	0.72	0.72	0.71	0.01	0.10
35	5.35	5.36	5.44	0.42	0.42	0.59	0.69	0.69	0.67	0.01	0.10
40	4.68	4.69	4.76	0.34	0.34	0.45	0.68	0.68	0.66	0.01	0.10
45	4.16	4.17	4.24	0.29	0.29	0.35	0.68	0.68	0.67	0.01	0.10
50	3.77	3.78	3.83	0.26	0.26	0.29	0.78	0.78	0.76	0.01	0.10
55	3.43	3.44	3.49	0.23	0.23	0.26	1.02	1.02	1.00	0.01	0.10
60	6.63	6.64	6.74	0.30	0.30	0.34	1.26	1.26	1.23	0.01	0.10
65	15.13	15.15	15.39	0.51	0.52	0.58	1.51	1.51	1.48	0.01	0.10
COLD START* (Grams/Trip)	89.18	89.18	89.21	4.72	4.73	4.76	2.69	2.69	2.66		
HOT START* (Grams/Trip)	12.17	12.20	12.45	1.11	1.12	1.35	1.48	1.48	1.45		
HOT SOAK* (Grams/Trip)	-----	-----	-----	1.31	1.31	1.32	-----	-----	-----		
DIURNAL** (Grams/Vehicle/Day)	-----	-----	-----	3.22	3.22	3.22	-----	-----	-----		

Example of one daily trip:

Vehicle Start (Start-up) --- Running + Evaporative ---> Vehicle Start (Hot Soak)

Parking --- Diurnal ---> Restart (Start-up)

* Vehicle Miles Traveled (VMT)/Average Daily Trips (ADT)-weighted emission factors:
Includes VMT/ADT from diesel-fueled vehicles (1.64%), gasoline-fueled vehicles equipped with catalyst (95.83%), and gasoline-fueled vehicles not equipped with catalyst (2.53%).

** Number of Vehicles (NOV)-weighted emission factors:
Includes NOV from diesel-fueled vehicles (2.00%), gasoline-fueled vehicles equipped with catalyst (92.72%), and gasoline-fueled vehicles not equipped with catalyst (5.28%).

*** Vehicles with gross vehicle weight 6,000 pounds and less:
Includes ARB's light automobiles, light-duty trucks, vans, station wagons and 4x4 trucks.

(SG10PV1

TABLE A - 5 - J - 3
EMFAC7EP EMISSION FACTORS FOR SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT
Vehicles with Gross Vehicle Weight 6,000 Pounds and less***
Calendar Year 1995

	Running Exhaust and Evaporative (Grams per Mile)*										
Vehicle Speed	Carbon Monoxide			Reactive Organic Compounds			Oxides of Nitrogen			PM10 Exhaust	PM10 Tire Wear
(Miles per Hour)	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	FOR ALL AREA	FOR ALL AREA
5	25.53	25.57	26.00	1.91	1.91	2.67	0.94	0.94	0.93	0.01	0.10
10	14.21	14.23	14.45	1.03	1.03	1.54	0.84	0.84	0.83	0.01	0.10
15	10.44	10.46	10.61	0.72	0.72	1.12	0.77	0.77	0.75	0.01	0.10
20	8.00	8.01	8.13	0.56	0.56	0.89	0.70	0.70	0.69	0.01	0.10
25	6.40	6.41	6.50	0.45	0.45	0.71	0.66	0.66	0.65	0.01	0.10
30	5.32	5.32	5.40	0.37	0.37	0.58	0.61	0.61	0.60	0.01	0.10
35	4.54	4.54	4.61	0.31	0.31	0.45	0.59	0.59	0.58	0.01	0.10
40	3.97	3.97	4.03	0.26	0.26	0.36	0.57	0.57	0.56	0.01	0.10
45	3.54	3.54	3.60	0.22	0.22	0.28	0.56	0.56	0.55	0.01	0.10
50	3.20	3.21	3.25	0.19	0.19	0.23	0.64	0.64	0.63	0.01	0.10
55	2.90	2.91	2.95	0.18	0.18	0.22	0.85	0.85	0.83	0.01	0.10
60	5.60	5.61	5.70	0.23	0.23	0.27	1.05	1.05	1.03	0.01	0.10
65	12.81	12.83	13.02	0.38	0.38	0.46	1.25	1.25	1.22	0.01	0.10
COLD START* (Grams/Trip)	81.98	82.00	82.10	4.36	4.37	4.34	2.52	2.52	2.50		
HOT START* (Grams/Trip)	10.90	10.92	11.12	0.96	0.96	1.15	1.30	1.31	1.24		
HOT SOAK* (Grams/Trip)	----	----	----	1.11	1.11	1.11	----	----	----		
DIURNAL** (Grams/Vehicle/Day)	----	----	----	2.90	2.90	2.91	----	----	----		

Example of one daily trip:

	Running + Evaporative	
Vehicle Start (Start-up)	----------------->	Vehicle Start (Hot Soak)

	Diurnal	
Parking	----------------->	Restart (Start-up)

* Vehicle Miles Traveled (VMT)/Average Daily Trips (ADT) -weighted emission factors:
Includes VMT/ADT from diesel-fueled vehicles (1.11%), gasoline-fueled vehicles equipped with catalyst (97.32%), and gasoline-fueled vehicles not equipped with catalyst (1.57%).

** Number of Vehicles (NOV)-weighted emission factors:
Includes NOV from diesel-fueled vehicles (1.54%), gasoline-fueled vehicles equipped with catalyst (95.06%), and gasoline-fueled vehicles not equipped with catalyst (3.40%).

*** Vehicles with gross vehicle weight 6,000
Includes ARB's light automobiles, light- 4 trucks.

(SG10PV15.WK1)

TABLE A9 - 5 - J - 4
EMFAC7EP EMISSION FACTORS FOR SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT
Vehicles with Gross Vehicle Weight 6,000 Pounds and less***
Calendar Year 1997

	Running Exhaust and Evaporative (Grams per Mile)*										
Vehicle Speed	Carbon Monoxide			Reactive Organic Compounds			Oxides of Nitrogen			PM10 Exhaust	PM10 Tire Wear
(Miles per Hour)	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	FOR ALL AREA	FOR ALL AREA
5	19.92	19.97	20.26	1.65	1.65	2.17	0.84	0.85	0.84	0.005	0.10
10	11.60	11.63	11.79	0.88	0.88	1.25	0.75	0.75	0.75	0.005	0.10
15	8.84	8.86	8.98	0.61	0.61	0.90	0.68	0.68	0.68	0.005	0.10
20	6.81	6.83	6.92	0.47	0.47	0.71	0.62	0.62	0.62	0.005	0.10
25	5.45	5.46	5.54	0.38	0.38	0.57	0.58	0.58	0.58	0.005	0.10
30	4.53	4.54	4.61	0.31	0.31	0.45	0.54	0.54	0.53	0.005	0.10
35	3.88	3.89	3.94	0.25	0.25	0.36	0.51	0.51	0.51	0.005	0.10
40	3.39	3.40	3.44	0.21	0.21	0.52	0.49	0.49	0.49	0.005	0.10
45	3.03	3.03	3.08	0.17	0.17	0.21	0.48	0.48	0.48	0.005	0.10
50	2.74	2.74	2.78	0.16	0.16	0.18	0.55	0.55	0.54	0.005	0.10
55	2.48	2.49	2.52	0.15	0.15	0.17	0.72	0.72	0.71	0.005	0.10
60	4.80	4.81	4.88	0.18	0.18	0.21	0.88	0.88	0.87	0.005	0.10
65	10.97	10.99	11.14	0.31	0.32	0.36	1.05	1.05	1.04	0.005	0.10
COLD START* (Grams/Trip)	74.78	74.82	74.98	4.10	4.11	4.02	2.39	2.40	2.38		
HOT START (Grams/Trip)	9.47	9.49	9.64	0.91	0.92	1.07	1.26	1.26	1.16		
HOT SOAK* (Grams/Trip)	----	----	----	0.94	0.94	0.95	----	----	----		
DIURNAL** (Grams/Vehicle/Day)	----	----	----	2.63	2.63	2.64	----	----	----		

Example of one daily trip:

	Running + Evaporative	
Vehicle Start (Start-up)	---------------->	Vehicle Start (Hot Soak)
	Diurnal	
Parking	---------------->	Restart (Start-up)

* Vehicle Miles Traveled (VMT)/Average Daily Trips (ADT) -weighted emission factors:
Includes VMT/ADT from diesel-fueled vehicles (0.68%), gasoline-fueled vehicles equipped with catalyst (98.45%), and gasoline-fueled vehicles not equipped with catalyst (0.87%).

** Number of Vehicles (NOV)-weighted emission factors:
Includes NOV from diesel-fueled vehicles (1.04%), gasoline-fueled vehicles equipped with catalyst (97.03%), and gasoline-fueled vehicles not equipped with catalyst (1.93%).

*** Vehicles with gross vehicle weight 6,000 pounds and less:
Includes ARB's light automobiles, light-duty trucks, vans, station wagons and 4x4 trucks.

(SG10PV1[illegible]K1)

TABL' - 5 - J - 5
..FAC7EP EMISSION FACTORS FOR SOUT. ..AST AIR QUALITY MANAGEMENT DISTR...
Vehicles with Gross Vehicle Weight 6,000 Pounds and less***
Calendar Year 1999

Vehicle Speed (Miles per Hour)	Running Exhaust and Evaporative (Grams per Mile)*										
	Carbon Monoxide			Reactive Organic Compounds			Oxides of Nitrogen			PM10 Exhaust	PM10 Tire Wear
	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	FOR ALL AREA	FOR ALL AREA
5	15.61	15.65	15.87	1.33	1.33	1.75	0.73	0.73	0.76	0.005	0.10
10	9.48	9.51	9.64	0.69	0.69	0.99	0.65	0.66	0.68	0.005	0.10
15	7.45	7.47	7.57	0.48	0.48	0.72	0.59	0.59	0.61	0.005	0.10
20	5.76	5.77	5.85	0.37	0.37	0.56	0.53	0.54	0.55	0.005	0.10
25	4.60	4.62	4.68	0.29	0.29	0.44	0.49	0.49	0.51	0.005	0.10
30	3.83	3.85	3.90	0.23	0.23	0.35	0.46	0.46	0.48	0.005	0.10
35	3.29	3.30	3.34	0.20	0.20	0.28	0.44	0.44	0.45	0.005	0.10
40	2.88	2.89	2.92	0.16	0.16	0.21	0.42	0.42	0.43	0.005	0.10
45	2.55	2.56	2.59	0.13	0.13	0.16	0.40	0.41	0.42	0.005	0.10
50	2.30	2.31	2.34	0.12	0.12	0.14	0.46	0.46	0.47	0.005	0.10
55	2.09	2.10	2.13	0.11	0.11	0.13	0.60	0.60	0.62	0.005	0.10
60	4.08	4.09	4.15	0.14	0.14	0.16	0.74	0.74	0.77	0.005	0.10
65	9.34	9.36	9.49	0.24	0.24	0.28	0.89	0.90	0.92	0.005	0.10
COLD START* (Grams/Trip)	68.40	68.45	68.61	3.63	3.63	3.55	2.20	2.21	2.20		
HOT START* (Grams/Trip)	7.96	7.99	8.12	0.71	0.71	0.83	1.11	1.12	0.89		
HOT SOAK* (Grams/Trip)	----	-----	-----	0.76	0.76	0.76	-----	-----	-----		
DIURNAL** (Grams/Vehicle/Day)	-----	-----	-----	2.21	2.21	2.21	-----	-----	-----		

Example of one daily trip:

Vehicle Start (Start-up) --- Running + Evaporative ---> Vehicle Start (Hot Soak)

Parking --- Diurnal ---> Restart (Start-up)

* Vehicle Miles Traveled (VMT)/Average Daily Trips (ADT) -weighted emission factors:
Includes VMT/ADT from diesel-fueled vehicles (0.39%), gasoline-fueled vehicles equipped with catalyst (99.38%), and gasoline-fueled vehicles not equipped with catalyst (0.23%).

** Number of Vehicles (NOV)-weighted emission factors:
Includes NOV from diesel-fueled vehicles (0.68%), gasoline-fueled vehicles equipped with catalyst (98.78%), and gasoline-fueled vehicles not equipped with catalyst (0.54%).

*** Vehicles with gross vehicle weight 6,000 pounds and less:
Includes ARB's light automobiles, light-duty trucks, vans, station wagons and 4x4 trucks.

(SG10PV19.WK1)

TABLE A9 - 5 - J - 6

EMFAC7EP EMISSION FACTORS FOR SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT
Vehicles with Gross Vehicle Weight 6,000 Pounds and less***
Calendar Year 2001

Vehicle Speed (Miles per Hour)	Running Exhaust and Evaporative (Grams per Mile)*										
	Carbon Monoxide			Reactive Organic Compounds			Oxides of Nitrogen			PM10 Exhaust	PM10 Tire Wear
	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	FOR ALL AREA	FOR ALL AREA
5	12.23	12.28	12.44	1.05	1.06	1.38	0.66	0.67	0.67	0.005	0.10
10	7.76	7.79	7.90	0.55	0.55	0.78	0.59	0.59	0.60	0.005	0.10
15	6.27	6.30	6.38	0.38	0.38	0.56	0.53	0.54	0.54	0.005	0.10
20	4.87	4.89	4.96	0.28	0.29	0.43	0.49	0.49	0.49	0.005	0.10
25	3.90	3.91	3.96	0.23	0.23	0.34	0.44	0.45	0.45	0.005	0.10
30	3.24	3.25	3.30	0.19	0.19	0.27	0.42	0.42	0.42	0.005	0.10
35	2.78	2.79	2.83	0.16	0.16	0.22	0.39	0.39	0.39	0.005	0.10
40	2.43	2.44	2.47	0.13	0.13	0.16	0.37	0.38	0.38	0.005	0.10
45	2.17	2.18	2.20	0.11	0.11	0.13	0.36	0.36	0.37	0.005	0.10
50	1.95	1.96	1.98	0.10	0.10	0.11	0.41	0.41	0.41	0.005	0.10
55	1.78	1.78	1.81	0.09	0.09	0.10	0.53	0.54	0.54	0.005	0.10
60	3.46	3.47	3.52	0.12	0.12	0.14	0.66	0.66	0.67	0.005	0.10
65	7.90	7.93	8.04	0.19	0.19	0.22	0.79	0.80	0.80	0.005	0.10
COLD START* (Grams/Trip)	62.48	62.55	62.71	3.01	3.02	2.98	1.94	1.95	1.95		
HOT START* (Grams/Trip)	6.67	6.70	6.83	0.57	0.58	0.67	0.97	0.98	0.72		
HOT SOAK* (Grams/Trip)	-----	-----	-----	0.61	0.61	0.61	-----	-----	-----		
DIURNAL** (Grams/Vehicle/Day)	-----	-----	-----	1.77	1.77	1.78	-----	-----	-----		

Example of one daily trip:

	Running + Evaporative	
Vehicle Start (Start-up)	----------------->	Vehicle Start (Hot Soak)
	Diurna	
Parking	----------------->	Restart (Start-up)

* Vehicle Miles Traveled (VMT)/Average Daily Trips (ADT) -weighted emission factors:
Includes VMT/ADT from diesel-fueled vehicles (0.22%), gasoline-fueled vehicles equipped with catalyst (99.68%), and gasoline-fueled vehicles not equipped with catalyst (0.1%).

** Number of Vehicles (NOV)-weighted emission factors:
Includes NOV from diesel-fueled vehicles (0.43%), gasoline-fueled vehicles equipped with catalyst (99.36%), and gasoline-fueled vehicles not equipped with catalyst (0.21%).

*** Vehicles with gross vehicle weight 6,000 pounds and less:
Includes ARB's light automobiles, light-duty trucks, vans, station wagons and 4x4 trucks.

(SG10PV[illegible])

TABLE A9 - 5 - J - 7
EMFAC7EP EMISSION FACTORS FOR SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT
Vehicles with Gross Vehicle Weight 6,000 Pounds and less***
Calendar Year 2003

	Running Exhaust and Evaporative (Grams per Mile)*										
Vehicle Speed	Carbon Monoxide			Reactive Organic Compounds			Oxides of Nitrogen			PM10 Exhaust	PM10 Tire Wear
(Miles per Hour)	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	FOR ALL AREA	FOR ALL AREA
5	11.37	11.42	11.55	0.85	0.85	1.09	0.57	0.58	0.59	0.005	0.10
10	7.48	7.51	7.60	0.44	0.45	0.61	0.51	0.51	0.52	0.005	0.10
15	6.19	6.22	6.29	0.30	0.30	0.43	0.46	0.46	0.47	0.005	0.10
20	4.82	4.84	4.90	0.23	0.23	0.33	0.41	0.42	0.42	0.005	0.10
25	3.86	3.87	3.92	0.19	0.19	0.27	0.38	0.38	0.39	0.005	0.10
30	3.21	3.22	3.26	0.15	0.15	0.21	0.36	0.36	0.37	0.005	0.10
35	2.76	2.77	2.80	0.12	0.12	0.16	0.33	0.34	0.34	0.005	0.10
40	2.41	2.42	2.45	0.10	0.10	0.13	0.32	0.32	0.33	0.005	0.10
45	2.14	2.15	2.17	0.09	0.09	0.10	0.31	0.31	0.32	0.005	0.10
50	1.93	1.94	1.96	0.08	0.08	0.09	0.35	0.35	0.35	0.005	0.10
55	1.75	1.76	1.78	0.07	0.07	0.09	0.46	0.46	0.47	0.005	0.10
60	3.42	3.44	3.47	0.10	0.10	0.11	0.56	0.57	0.57	0.005	0.10
65	7.83	7.87	7.96	0.16	0.16	0.18	0.68	0.68	0.69	0.005	0.10
COLD START* (Grams/Trip)	57.53	57.60	57.72	2.47	2.47	2.44	1.70	1.72	1.71		
HOT START* (Grams/Trip)	5.58	5.62	5.74	0.57	0.59	0.66	0.84	0.84	0.69		
HOT SOAK* (Grams/Trip)	----	----	----	0.48	0.48	0.49	----	----	----		
DIURNAL** (Grams/Vehicle/Day)	----	----	----	1.37	1.37	1.38	----	----	----		

Example of one daily trip:

	Running + Evaporative	
Vehicle Start (Start-up)	---------------->	Vehicle Start (Hot Soak)
	Diurnal	
Parking	---------------->	Restart (Start-up)

* Vehicle Miles Traveled (VMT)/Average Daily Trips (ADT) -weighted emission factors:
Includes VMT/ADT from diesel-fueled vehicles (0.13%), gasoline-fueled vehicles equipped with catalyst (99.83%), and gasoline-fueled vehicles not equipped with catalyst (0.04%).

** Number of Vehicles (NOV)-weighted emission factors:
Includes NOV from diesel-fueled vehicles (0.29%), gasoline-fueled vehicles equipped with catalyst (99.62%), and gasoline-fueled vehicles not equipped with catalyst (0.09%).

*** Vehicles with gross vehicle weight 6,000 pounds and less:
Includes ARB's light automobiles, light-duty trucks, vans, station wagons and 4x4 trucks.

(SG10PV23.WK1)

TABLE A9 - 5 - J - 8
EMFAC7EP EMISSION FACTORS FOR SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT
Vehicles with Gross Vehicle Weight 6,000 Pounds and less***
Calendar Year 2005

Vehicle Speed (Miles per Hour)	Running Exhaust and Evaporative (Grams per Mile)*										
	Carbon Monoxide			Reactive Organic Compounds			Oxides of Nitrogen			PM10 Exhaust	PM10 Tire Wear
	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	FOR ALL AREA	FOR ALL AREA
5	7.89	7.93	8.03	0.92	0.92	0.84	0.50	0.51	0.51	0.005	0.10
10	5.34	5.37	5.44	0.33	0.34	0.46	0.44	0.45	0.46	0.005	0.10
15	4.50	4.53	4.58	0.23	0.23	0.33	0.39	0.40	0.41	0.005	0.10
20	3.51	3.53	3.57	0.17	0.17	0.25	0.36	0.37	0.37	0.005	0.10
25	2.81	2.83	2.86	0.14	0.14	0.20	0.33	0.33	0.34	0.005	0.10
30	2.34	2.35	2.38	0.11	0.11	0.16	0.30	0.31	0.31	0.005	0.10
35	2.00	2.02	2.04	0.09	0.09	0.12	0.29	0.29	0.30	0.005	0.10
40	1.76	1.77	1.79	0.08	0.08	0.10	0.27	0.27	0.28	0.005	0.10
45	1.56	1.57	1.59	0.07	0.07	0.08	0.26	0.27	0.27	0.005	0.10
50	1.41	1.41	1.43	0.06	0.06	0.07	0.29	0.30	0.30	0.005	0.10
55	1.28	1.28	1.30	0.05	0.05	0.06	0.38	0.39	0.40	0.005	0.10
60	2.50	2.51	2.54	0.08	0.08	0.09	0.48	0.48	0.49	0.005	0.10
65	5.71	5.74	5.81	0.12	0.12	0.14	0.57	0.58	0.59	0.005	0.10
COLD START* (Grams/Trip)	53.27	53.37	53.48	1.99	1.99	1.97	1.48	1.50	1.50		
HOT START* (Grams/Trip)	4.73	4.77	4.89	0.35	0.35	0.41	0.72	0.73	0.44		
HOT SOAK* (Grams/Trip)	----	----	----	0.40	0.40	0.40	----	----	----		
DIURNAL** (Grams/Vehicle/Day)	----	----	----	1.04	1.04	1.04	----	----	----		

Example of one daily trip:

	Running + Evaporative	
Vehicle Start (Start-up)	----------------->	Vehicle Start (Hot Soak)
	Diurnal	
Parking	----------------->	Restart (Start-up)

* Vehicle Miles Traveled (VMT)/Average Daily Trips (ADT) -weighted emission factors:
Includes VMT/ADT from diesel-fueled vehicles (0.09%), gasoline-fueled vehicles equipped with catalyst (99.91%), and gasoline-fueled vehicles not equipped with catalyst (0.0%).

** Number of Vehicles (NOV)-weighted emission factors:
Includes NOV from diesel-fueled vehicles (0.21%), gasoline-fueled vehicles equipped with catalyst (99.79%), and gasoline-fueled vehicles not equipped with catalyst (0.0%).

*** Vehicles with gross vehicle weight 6,000 pounds and less:
Includes ARB's light automobiles, light-duty trucks, vans, station wagons and 4x4 trucks.

(SG10PV2[illegible]K1)

TABL[illegible] - 5 - J - 9
[illegible]FAC7EP EMISSION FACTORS FOR SOU[illegible] [illegible]AST AIR QUALITY MANAGEMENT DIS[illegible]
Vehicles with Gross Vehicle Weight 6,000 Pounds and less***
Calendar Year 2007

Vehicle Speed (Miles per Hour)	Running Exhaust and Evaporative (Grams per Mile)*										
	Carbon Monoxide			Reactive Organic Compounds			Oxides of Nitrogen			PM10 Exhaust	PM10 Tire Wear
	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	FOR ALL AREA	FOR ALL AREA
5	6.61	6.66	6.74	0.50	0.51	0.64	0.43	0.44	0.45	0.005	0.10
10	4.57	4.60	4.66	0.26	0.26	0.35	0.38	0.39	0.40	0.005	0.10
15	3.89	3.92	3.97	0.18	0.18	0.25	0.35	0.35	0.36	0.005	0.10
20	3.05	3.07	3.11	0.13	0.14	0.19	0.31	0.32	0.32	0.005	0.10
25	2.44	2.45	2.48	0.11	0.11	0.15	0.29	0.30	0.30	0.005	0.10
30	2.03	2.04	2.06	0.08	0.09	0.13	0.27	0.27	0.27	0.005	0.10
35	1.74	1.75	1.77	0.07	0.07	0.10	0.25	0.26	0.26	0.005	0.10
40	1.52	1.53	1.55	0.06	0.06	0.07	0.23	0.24	0.24	0.005	0.10
45	1.35	1.36	1.38	0.05	0.05	0.06	0.22	0.23	0.23	0.005	0.10
50	1.22	1.23	1.24	0.04	0.04	0.05	0.25	0.26	0.26	0.005	0.10
55	1.10	1.11	1.13	0.04	0.04	0.05	0.34	0.34	0.35	0.005	0.10
60	2.17	2.18	2.21	0.05	0.05	0.06	0.42	0.42	0.43	0.005	0.10
65	4.94	4.98	5.04	0.10	0.10	0.11	0.49	0.50	0.51	0.005	0.10
COLD START* (Grams/Trip)	49.96	50.07	50.18	1.60	1.60	1.58	1.32	1.33	1.33		
HOT START* (Grams/Trip)	4.13	4.18	4.31	0.28	0.28	0.32	0.64	0.65	0.35		
HOT SOAK* (Grams/Trip)	----	-----	-----	0.33	0.33	0.34	-----	-----	-----		
DIURNAL** (Grams/Vehicle/Day)	-----	-----	-----	0.75	0.75	0.75	-----	-----	-----		

Example of one daily trip:

	Running + Evaporative	
Vehicle Start (Start-up)	---------------->	Vehicle Start (Hot Soak)

	Diurnal	
Parking	---------------->	Restart (Start-up)

* Vehicle Miles Traveled (VMT)/Average Daily Trips (ADT) -weighted emission factors:
Includes VMT/ADT from diesel-fueled vehicles (0.05%), gasoline-fueled vehicles equipped with catalyst (99.95%), and gasoline-fueled vehicles not equipped with catalyst (0.0%).

** Number of Vehicles (NOV)-weighted emission factors:
Includes NOV from diesel-fueled vehicles (0.11%), gasoline-fueled vehicles equipped with catalyst (99.89%), and gasoline-fueled vehicles not equipped with catalyst (0.0%).

*** Vehicles with gross vehicle weight 6,000 pounds and less:
Includes ARB's light automobiles, light-duty trucks, vans, station wagons and 4x4 trucks.

(SG10PV27.WK1)

TABLE A9 - 5 - J - 10

EMFAC7EP EMISSION FACTORS FOR SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT
Vehicles with Gross Vehicle Weight 6,000 Pounds and less***
Calendar Year 2009

Vehicle Speed (Miles per Hour)	Running Exhaust and Evaporative (Grams per Mile)*										
	Carbon Monoxide			Reactive Organic Compounds			Oxides of Nitrogen			PM10 Exhaust	PM10 Tire Wear
	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	FOR ALL AREA	FOR ALL AREA
5	5.73	5.78	5.86	0.39	0.39	0.50	0.38	0.39	0.40	0.005	0.10
10	4.04	4.08	4.13	0.20	0.20	0.27	0.34	0.35	0.35	0.005	0.10
15	3.48	3.51	3.56	0.13	0.14	0.19	0.30	0.31	0.32	0.005	0.10
20	2.73	2.75	2.79	0.11	0.11	0.15	0.28	0.29	0.29	0.005	0.10
25	2.18	2.20	2.23	0.09	0.09	0.12	0.26	0.26	0.26	0.005	0.10
30	1.82	1.83	1.86	0.07	0.07	0.10	0.23	0.24	0.24	0.005	0.10
35	1.56	1.57	1.59	0.06	0.06	0.08	0.22	0.23	0.23	0.005	0.10
40	1.36	1.37	1.39	0.05	0.05	0.06	0.21	0.21	0.22	0.005	0.10
45	1.22	1.23	1.24	0.04	0.04	0.05	0.20	0.20	0.21	0.005	0.10
50	1.10	1.11	1.12	0.03	0.03	0.04	0.22	0.23	0.23	0.005	0.10
55	0.99	1.00	1.01	0.03	0.03	0.04	0.29	0.30	0.30	0.005	0.10
60	1.93	1.95	1.98	0.04	0.04	0.05	0.36	0.37	0.38	0.005	0.10
65	4.43	4.47	4.53	0.08	0.08	0.09	0.43	0.44	0.45	0.005	0.10
COLD START* (Grams/Trip)	47.53	47.65	47.75	1.30	1.30	1.28	1.19	1.21	1.20		
HOT START* (Grams/Trip)	3.71	3.76	3.89	0.22	0.23	0.26	0.57	0.58	0.28		
HOT SOAK* (Grams/Trip)	----	-----	-----	0.29	0.29	0.29	-----	-----	-----		
DIURNAL** (Grams/Vehicle/Day)	-----	-----	-----	0.53	0.54	0.54	-----	-----	-----		

Example of one daily trip:

Vehicle Start (Start-up) ---- Running + Evaporative ----> Vehicle Start (Hot Soak)

Parking ---- Diurnal ----> Restart (Start-up)

* Vehicle Miles Traveled (VMT)/Average Daily Trips (ADT) -weighted emission factors:
Includes VMT/ADT from diesel-fueled vehicles (0.03%), gasoline-fueled vehicles equipped with catalyst (99.97%), and gasoline-fueled vehicles not equipped with catalyst (0.0%).

** Number of Vehicles (NOV)-weighted emission factors:
Includes NOV from diesel-fueled vehicles (0.07%), gasoline-fueled vehicles equipped with catalyst (99.93%), and gasoline-fueled vehicles not equipped with catalyst (0.0%).

*** Vehicles with gross vehicle weight 6,000 pounds and less:
Includes ARB's light automobiles, light-duty trucks, vans, station wagons and 4x4 trucks.

(SG10PV?

TABLE A9 - 5 - K

EMISSION FACTORS FOR ESTIMATING MATERIAL HAULING VEHICLE EMISSIONS

USE

TABLE A9 - 5 - L

FOR ESTIMATING OXIDES OF SULFUR AND LEAD EMISSIONS FROM MATERIAL HAULING VEHICLES

USE

TABLE A9 - 14 - A

FOR MATERIAL HAULING VEHICLE-RELATED
VEHICLE MILES TRAVELED (VMT)
AVERAGE DAILY TRIPS (ADT) AND NUMBER OF VEHICLES (NOV)
IN COUNTYWIDE AND REGIONWIDE FLEET MIX
AND

TABLE A9 - 5 - G*

FOR THEIR PERCENTAGES

USE

TABLE A9 - 5 - P - 1 AND 2

FOR DETERMINING COMPOSITE EMISSION FACTOR BETWEEN
FOUR DIFFERENT TYPES OF VEHICLES TOGETHER, SUCH AS,
PASSENGER VEHICLES, MOTORCYCLES AND BUSES
INCLUDING MATERIAL HAULING VEHICLES
AND
BETWEEN RUNNING, HOT AND COLD START EMISSION FACTORS FOR
THE MATERIAL HAULING VEHICLES

(* IF PROJECT-SPECIFIC FLEET MIX DATA IS NOT AVAILABLE,
USE TABLE A9 - 5 - G TO DETERMINE PROJECT-RELATED
FLEET MIX DATA)

Changed November 1993

TABLE A9 - 5 - K - 1

EMFAC7EP EMISSION FACTORS FOR SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT
Vehicles with Gross Vehicle Weight 6,001 Pounds and Up***
Calendar Year 1991

Vehicle Speed (Miles per Hour)	Running Exhaust and Evaporative (Grams per Mile)*										
	Carbon Monoxide			Reactive Organic Compounds			Oxides of Nitrogen			PM10 Exhaust	PM10 Tire Wear
	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	FOR ALL AREA	FOR ALL AREA
5	84.40	82.50	74.48	7.73	7.62	8.19	8.60	8.25	10.20	0.565	0.175
10	53.78	52.33	47.33	5.00	4.90	5.41	7.51	7.20	8.76	0.565	0.175
15	38.02	37.01	33.53	3.60	3.52	3.98	6.76	6.49	7.77	0.565	0.175
20	28.52	27.78	25.20	2.75	2.70	3.09	6.28	6.04	7.12	0.565	0.175
25	22.54	21.97	19.94	2.19	2.15	2.49	6.00	5.76	6.72	0.565	0.175
30	18.70	18.23	16.54	1.79	1.76	2.05	5.87	5.63	6.53	0.565	0.175
35	16.28	15.86	14.38	1.51	1.48	1.72	5.88	5.64	6.51	0.565	0.175
40	14.87	14.48	13.11	1.31	1.28	1.47	6.02	5.77	6.66	0.565	0.175
45	14.28	13.88	12.54	1.16	1.14	1.29	6.30	6.04	7.00	0.565	0.175
50	14.40	13.97	12.59	1.07	1.04	1.18	6.84	6.56	7.64	0.565	0.175
55	15.19	14.71	13.20	1.01	0.99	1.11	7.71	7.41	8.68	0.565	0.175
60	19.07	18.62	16.68	1.07	1.05	1.18	8.87	8.52	10.08	0.565	0.175
65	27.63	27.37	24.53	1.31	1.30	1.43	10.43	10.02	12.02	0.565	0.175
COLD START* (Grams/Trip)	48.49	47.11	47.20	2.99	2.91	3.29	2.00	1.94	1.93		
HOT START* (Grams/Trip)	4.37	4.22	4.32	0.76	0.74	0.85	0.92	0.89	0.85		
HOT SOAK* (Grams/Trip)	-----	-----	-----	1.43	1.60	1.63	-----	-----	-----		
DIURNAL** (Grams/Vehicle/Day)	-----	-----	-----	5.75	5.75	5.75	-----	-----	-----		

Example of one daily trip:

	Running + Evaporative	
Vehicle Start (Start-up)	----------------->	Vehicle Start (Hot Soak)
	Diurnal	
Parking	----------------->	Restart (Start-up)

* Vehicle Miles Traveled (VMT) or Average Daily Trips (ADT)-weighted emission factors:
Includes VMT or ADT from diesel-fueled vehicles (33.33%), gasoline-fueled vehicles equipped with catalyst (46.02%), and gasoline-fueled vehicles not equipped with catalyst (20.65%).

** Number of Vehicles (NOV)-weighted emission factors:
Includes NOV from diesel-fueled vehicles (33.33%), gasoline-fueled vehicles equipped with catalyst (37.74%), and gasoline-fueled vehicles not equipped with catalyst (28.93%).

*** Vehicles with gross vehicle weight 6,001 pounds and up:
Includes ARB's medium-duty and light/heavy-duty, medium/heavy-duty and heavy/heavy-duty vehicles, e.g.: construction and demolition materials hauling trucks.

(SG10H[illegible]1)

TABLE) - 5 - J - 9

EMFAC7EP EMISSION FACTORS FOR SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT
Vehicles with Gross Vehicle Weight 6,000 Pounds and less***
Calendar Year 2007

	Running Exhaust and Evaporative (Grams per Mile)*										
Vehicle Speed	Carbon Monoxide			Reactive Organic Compounds			Oxides of Nitrogen			PM10 Exhaust	PM10 Tire Wear
(Miles per Hour)	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	FOR ALL AREA	FOR ALL AREA
5	6.61	6.66	6.74	0.50	0.51	0.64	0.43	0.44	0.45	0.005	0.10
10	4.57	4.60	4.66	0.26	0.26	0.35	0.38	0.39	0.40	0.005	0.10
15	3.89	3.92	3.97	0.18	0.18	0.25	0.35	0.35	0.36	0.005	0.10
20	3.05	3.07	3.11	0.13	0.14	0.19	0.31	0.32	0.32	0.005	0.10
25	2.44	2.45	2.48	0.11	0.11	0.15	0.29	0.30	0.30	0.005	0.10
30	2.03	2.04	2.06	0.08	0.09	0.18	0.27	0.27	0.27	0.005	0.10
35	1.74	1.75	1.77	0.07	0.07	0.10	0.25	0.26	0.26	0.005	0.10
40	1.52	1.53	1.55	0.06	0.06	0.07	0.23	0.24	0.24	0.005	0.10
45	1.35	1.36	1.38	0.05	0.05	0.06	0.22	0.23	0.23	0.005	0.10
50	1.22	1.23	1.24	0.04	0.04	0.05	0.25	0.26	0.26	0.005	0.10
55	1.10	1.11	1.13	0.04	0.04	0.05	0.34	0.34	0.35	0.005	0.10
60	2.17	2.18	2.21	0.05	0.05	0.06	0.42	0.42	0.43	0.005	0.10
65	4.94	4.98	5.04	0.10	0.10	0.11	0.49	0.50	0.51	0.005	0.10
COLD START* (Grams/Trip)	49.96	50.07	50.18	1.60	1.60	1.58	1.32	1.33	1.33		
HOT START* (Grams/Trip)	4.13	4.18	4.31	0.28	0.28	0.32	0.64	0.65	0.35		
HOT SOAK* (Grams/Trip)	-----	-----	-----	0.33	0.33	0.34	-----	-----	-----		
DIURNAL** (Grams/Vehicle/Day)	-----	-----	-----	0.75	0.75	0.75	-----	-----	-----		

Example of one daily trip:

```
                          Running + Evaporative
Vehicle Start      ---------------->      Vehicle Start
(Start-up)                                (Hot Soak)

                          Diurnal
Parking            ---------------->      Restart
                                          (Start-up)
```

* Vehicle Miles Traveled (VMT)/Average Daily Trips (ADT) -weighted emission factors:
Includes VMT/ADT from diesel-fueled vehicles (0.05%), gasoline-fueled vehicles equipped with catalyst (99.95%), and gasoline-fueled vehicles not equipped with catalyst (0.0%).

** Number of Vehicles (NOV)-weighted emission factors:
Includes NOV from diesel-fueled vehicles (0.11%), gasoline-fueled vehicles equipped with catalyst (99.89%), and gasoline-fueled vehicles not equipped with catalyst (0.0%).

*** Vehicles with gross vehicle weight 6,000 pounds and less:
Includes ARB's light automobiles, light-duty trucks, vans, station wagons and 4x4 trucks.

(SG10PV27.WK1)

TABLE A9 - 5 - J - 10
EMFAC7EP EMISSION FACTORS FOR SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT
Vehicles with Gross Vehicle Weight 6,000 Pounds and less***
Calendar Year 2009

	Running Exhaust and Evaporative (Grams per Mile)*										
Vehicle Speed	Carbon Monoxide			Reactive Organic Compounds			Oxides of Nitrogen			PM10 Exhaust	PM10 Tire Wear
(Miles per Hour)	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	FOR ALL AREA	FOR ALL AREA
5	5.73	5.78	5.86	0.39	0.39	0.50	0.38	0.39	0.40	0.005	0.10
10	4.04	4.08	4.13	0.20	0.20	0.27	0.34	0.35	0.35	0.005	0.10
15	3.48	3.51	3.56	0.13	0.14	0.19	0.30	0.31	0.32	0.005	0.10
20	2.73	2.75	2.79	0.11	0.11	0.15	0.28	0.29	0.29	0.005	0.10
25	2.18	2.20	2.23	0.09	0.09	0.12	0.26	0.26	0.26	0.005	0.10
30	1.82	1.83	1.86	0.07	0.07	0.10	0.23	0.24	0.24	0.005	0.10
35	1.56	1.57	1.59	0.06	0.06	0.08	0.22	0.23	0.23	0.005	0.10
40	1.36	1.37	1.39	0.05	0.05	0.06	0.21	0.21	0.22	0.005	0.10
45	1.22	1.23	1.24	0.04	0.04	0.05	0.20	0.20	0.21	0.005	0.10
50	1.10	1.11	1.12	0.03	0.03	0.04	0.22	0.23	0.23	0.005	0.10
55	0.99	1.00	1.01	0.03	0.03	0.04	0.29	0.30	0.30	0.005	0.10
60	1.93	1.95	1.98	0.04	0.04	0.05	0.36	0.37	0.38	0.005	0.10
65	4.43	4.47	4.53	0.08	0.08	0.09	0.43	0.44	0.45	0.005	0.10
COLD START* (Grams/Trip)	47.53	47.65	47.75	1.30	1.30	1.28	1.19	1.21	1.20		
HOT START* (Grams/Trip)	3.71	3.76	3.89	0.22	0.23	0.26	0.57	0.58	0.28		
HOT SOAK* (Grams/Trip)	----	----	----	0.29	0.29	0.29	----	----	----		
DIURNAL** (Grams/Vehicle/Day)	----	----	----	0.53	0.54	0.54	----	----	----		

Example of one daily trip:

Vehicle Start (Start-up) —— Running + Evaporative ——> Vehicle Start (Hot Soak)

Parking —— Diurnal ——> Restart (Start-up)

* Vehicle Miles Traveled (VMT)/Average Daily Trips (ADT) -weighted emission factors:
Includes VMT/ADT from diesel-fueled vehicles (0.03%), gasoline-fueled vehicles equipped with catalyst (99.97%), and gasoline-fueled vehicles not equipped with catalyst (0.0%).

** Number of Vehicles (NOV)-weighted emission factors:
Includes NOV from diesel-fueled vehicles (0.07%), gasoline-fueled vehicles equipped with catalyst (99.93%), and gasoline-fueled vehicles not equipped with catalyst (0.0%).

*** Vehicles with gross vehicle weight 6,000 pounds and less:
Includes ARB's light automobiles, light-duty trucks, vans, station wagons and 4x4 trucks.

(SG10PV[illegible]VK1)

TABLE A9 - 5 - K

EMISSION FACTORS FOR ESTIMATING MATERIAL HAULING VEHICLE EMISSIONS

USE

TABLE A9 - 5 - L

FOR ESTIMATING OXIDES OF SULFUR AND LEAD EMISSIONS FROM MATERIAL HAULING VEHICLES

USE

TABLE A9 - 14 - A

FOR MATERIAL HAULING VEHICLE-RELATED
VEHICLE MILES TRAVELED (VMT)
AVERAGE DAILY TRIPS (ADT) AND NUMBER OF VEHICLES (NOV)
IN COUNTYWIDE AND REGIONWIDE FLEET MIX
AND

TABLE A9 - 5 - G*

FOR THEIR PERCENTAGES

USE

TABLE A9 - 5 - P - 1 AND 2

FOR DETERMINING COMPOSITE EMISSION FACTOR BETWEEN
FOUR DIFFERENT TYPES OF VEHICLES TOGETHER, SUCH AS,
PASSENGER VEHICLES, MOTORCYCLES AND BUSES
INCLUDING MATERIAL HAULING VEHICLES
AND
BETWEEN RUNNING, HOT AND COLD START EMISSION FACTORS FOR
THE MATERIAL HAULING VEHICLES

(* IF PROJECT-SPECIFIC FLEET MIX DATA IS NOT AVAILABLE,
USE TABLE A9 - 5 - G TO DETERMINE PROJECT-RELATED
FLEET MIX DATA)

TABLE A9 - 5 - K - 1
EMFAC7EP EMISSION FACTORS FOR SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT
Vehicles with Gross Vehicle Weight 6,001 Pounds and Up***
Calendar Year 1991

	Running Exhaust and Evaporative (Grams per Mile)*										
Vehicle Speed	Carbon Monoxide			Reactive Organic Compounds			Oxides of Nitrogen			PM10 Exhaust	PM10 Tire Wear
(Miles per Hour)	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	FOR ALL AREA	FOR ALL AREA
5	84.40	82.50	74.48	7.73	7.62	8.19	8.60	8.25	10.20	0.565	0.175
10	53.78	52.33	47.33	5.00	4.90	5.41	7.51	7.20	8.76	0.565	0.175
15	38.02	37.01	33.53	3.60	3.52	3.98	6.76	6.49	7.77	0.565	0.175
20	28.52	27.78	25.20	2.75	2.70	3.09	6.28	6.04	7.12	0.565	0.175
25	22.54	21.97	19.94	2.19	2.15	2.49	6.00	5.76	6.72	0.565	0.175
30	18.70	18.23	16.54	1.79	1.76	2.05	5.87	5.63	6.53	0.565	0.175
35	16.28	15.86	14.38	1.51	1.48	1.72	5.88	5.64	6.51	0.565	0.175
40	14.87	14.48	13.11	1.31	1.28	1.47	6.02	5.77	6.66	0.565	0.175
45	14.28	13.88	12.54	1.16	1.14	1.29	6.30	6.04	7.00	0.565	0.175
50	14.40	13.97	12.59	1.07	1.04	1.18	6.84	6.56	7.64	0.565	0.175
55	15.19	14.71	13.20	1.01	0.99	1.11	7.71	7.41	8.68	0.565	0.175
60	19.07	18.62	16.68	1.07	1.05	1.18	8.87	8.52	10.08	0.565	0.35
65	27.63	27.37	24.53	1.31	1.30	1.43	10.43	10.02	12.02	0.565	0.35
COLD START* (Grams/Trip)	48.49	47.11	47.20	2.99	2.91	3.29	2.00	1.94	1.93		
HOT START* (Grams/Trip)	4.37	4.22	4.32	0.76	0.74	0.85	0.92	0.89	0.85		
HOT SOAK* (Grams/Trip)	——	——	——	1.43	1.60	1.63	——	——	——		
DIURNAL** (Grams/Vehicle/Day)	——	——	——	5.75	5.75	5.75	——	——	——		

Example of one daily trip:

	Running + Evaporative	
Vehicle Start (Start-up)	---------------->	Vehicle Start (Hot Soak)
	Diurnal	
Parking	---------------->	Restart (Start-up)

* Vehicle Miles Traveled (VMT) or Average Daily Trips (ADT)-weighted emission factors:
Includes VMT or ADT from diesel-fueled vehicles (33.33%), gasoline-fueled vehicles equipped with catalyst (46.02%), and gasoline-fueled vehicles not equipped with catalyst (20.65%).

** Number of Vehicles (NOV)-weighted emission factors:
Includes NOV from diesel-fueled vehicles (33.33%), gasoline-fueled vehicles equipped with catalyst (37.74%), and gasoline-fueled vehicles not equipped with catalyst (28.93%).

*** Vehicles with gross vehicle weight 6,001 pounds and up:
Includes ARB's medium-duty and light/heavy-duty, medium/heavy-duty and heavy/heavy-duty vehicles, e.g.; construction and demolition materials hauling trucks.

(SG10HD1[illegible]KI)

TABLE A' 5 - K - 2

EMFAC7EP EMISSION FACTORS FOR SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT

Vehicles with Gross Vehicle Weight 6,001 Pounds and Up***

Calendar Year 1993

Vehicle Speed (Miles per Hour)	Running Exhaust and Evaporative (Grams per Mile)*										
	Carbon Monoxide			Reactive Organic Compounds			Oxides of Nitrogen			PM10 Exhaust	PM10 Tire Wear
	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	FOR ALL AREA	FOR ALL AREA
5	73.49	71.92	65.84	6.49	6.39	6.98	7.97	7.64	9.43	0.47	0.19
10	46.95	45.75	42.01	4.21	4.11	4.61	6.97	6.69	8.11	0.47	0.19
15	33.39	32.56	29.96	3.04	2.96	3.38	6.30	6.04	7.21	0.47	0.19
20	25.08	24.48	22.54	2.32	2.27	2.62	5.86	5.62	6.61	0.47	0.19
25	19.83	19.36	17.84	1.85	1.80	2.10	5.60	5.37	6.25	0.47	0.19
30	16.46	16.07	14.80	1.52	1.48	1.74	5.48	5.25	6.06	0.47	0.19
35	14.31	13.97	12.86	1.29	1.26	1.47	5.48	5.26	6.05	0.47	0.19
40	13.05	12.73	11.70	1.11	1.09	1.27	5.62	5.38	6.19	0.47	0.19
45	12.49	12.16	11.15	1.00	0.97	1.13	5.87	5.62	6.50	0.47	0.19
50	12.54	12.18	11.15	0.92	0.90	1.04	6.37	6.09	7.09	0.47	0.19
55	13.16	12.76	11.63	0.87	0.85	0.98	7.17	6.88	8.04	0.47	0.19
60	16.74	16.39	14.88	0.91	0.90	1.03	8.23	7.90	9.32	0.47	0.19
65	24.75	24.61	22.26	1.11	1.10	1.23	9.66	9.27	11.10	0.47	0.19
COLD START* (Grams/Trip)	46.17	44.77	45.50	2.76	2.68	2.90	2.02	1.96	1.97		
HOT START* (Grams/Trip)	4.42	4.27	4.36	0.72	0.69	0.81	0.95	0.92	0.88		
HOT SOAK* (Grams/Trip)	-----	-----	-----	0.90	1.02	1.04	-----	-----	-----		
DIURNAL** (Grams/Vehicle/Day)	-----	-----	-----	3.64	3.64	3.64	-----	-----	-----		

Example of one daily trip:

	Running + Evaporative	
Vehicle Start (Start-up)	---------------->	Vehicle Start (Hot Soak)
	Diurnal	
Parking	---------------->	Restart (Start-up)

* Vehicle Miles Traveled (VMT) or Average Daily Trips (ADT)-weighted emission factors:
Includes VMT or ADT from diesel-fueled vehicles (33.33%), gasoline-fueled vehicles equipped with catalyst (46.02%), and gasoline-fueled vehicles not equipped with catalyst (20.65%).

** Number of Vehicles (NOV)-weighted emission factors:
Includes NOV from diesel-fueled vehicles (33.33%), gasoline-fueled vehicles equipped with catalyst (37.74%), and gasoline-fueled vehicles not equipped with catalyst (28.93%).

*** Vehicles with gross vehicle weight 6,001 pounds and up:
Includes ARB's medium-duty and light/heavy-duty, medium/heavy-duty and heavy/heavy-duty vehicles, e.g.; construction and demolition materials hauling trucks.

(SG10HD13.WK1)

TABLE A9 - 5 - K - 3
EMFAC7EP EMISSION FACTORS FOR SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT
Vehicles with Gross Vehicle Weight 6,001 Pounds and Up***
Calendar Year 1995

	Running Exhaust and Evaporative (Grams per Mile)*										
Vehicle Speed	Carbon Monoxide			Reactive Organic Compounds			Oxides of Nitrogen			PM10 Exhaust	PM10 Tire Wear
(Miles per Hour)	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	FOR ALL AREA	FOR ALL AREA
5	58.79	57.23	53.35	5.79	5.68	6.33	7.48	7.16	8.87	0.385	0.19
10	38.11	36.98	34.61	3.77	3.67	4.20	6.55	6.28	7.64	0.385	0.19
15	27.27	26.49	24.84	2.72	2.65	3.09	5.92	5.67	6.79	0.385	0.19
20	20.49	19.92	18.69	2.09	2.03	2.39	5.50	5.28	6.23	0.385	0.19
25	16.18	15.73	14.77	1.66	1.61	1.92	5.26	5.04	5.89	0.385	0.19
30	13.41	13.05	12.25	1.36	1.33	1.58	5.15	4.93	5.72	0.385	0.19
35	11.66	11.34	10.63	1.15	1.12	1.34	5.16	4.94	5.71	0.385	0.19
40	10.63	10.33	9.67	1.00	0.97	1.16	5.27	5.04	5.84	0.385	0.19
45	10.18	9.87	9.23	0.90	0.87	1.03	5.51	5.26	6.12	0.385	0.19
50	10.22	9.89	9.22	0.83	0.80	0.95	5.97	5.71	6.67	0.385	0.19
55	10.74	10.37	9.64	0.78	0.76	0.91	6.72	6.44	7.56	0.385	0.19
60	13.48	13.14	12.13	0.82	0.80	0.94	7.71	7.39	8.77	0.385	0.19
65	19.54	19.33	17.70	0.99	0.98	1.11	9.04	8.67	10.43	0.385	0.19
COLD START* (Grams/Trip)	43.33	41.93	43.23	2.64	2.55	2.72	2.03	1.97	2.01		
HOT START* (Grams/Trip)	4.31	4.16	4.25	0.68	0.66	0.78	0.95	0.91	0.90		
HOT SOAK* (Grams/Trip)	-----	-----	-----	0.77	0.87	0.88	-----	-----	-----		
DIURNAL** (Grams/Vehicle/Day)	-----	-----	-----	3.12	3.12	3.12	-----	-----	-----		

Example of one daily trip:

Vehicle Start (Start-up) --- Running + Evaporative ---> Vehicle Start (Hot Soak)

Parking --- Diurnal ---> Restart (Start-up)

* Vehicle Miles Traveled (VMT) or Average Daily Trips (ADT)-weighted emission factors:
Includes VMT or ADT from diesel-fueled vehicles (33.33%), gasoline-fueled vehicles equipped with catalyst (46.02%), and gasoline-fueled vehicles not equipped with catalyst (20.65%).

** Number of Vehicles (NOV)-weighted emission factors:
Includes NOV from diesel-fueled vehicles (33.33%), gasoline-fueled vehicles equipped with catalyst (37.74%), and gasoline-fueled vehicles not equipped with catalyst (28.93%).

*** Vehicles with gross vehicle weight 6,001 pounds and up:
Incl[illegible] ARB's medium-duty and light/heavy-duty, medium/heavy-duty and heavy/heavy-duty vehicles, e.g.; construction and demolition materials hauling trucks.

(SG10HD15.[illegible]

TABLE A 5 - K - 4
EMFAC7EP EMISSION FACTORS FOR SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT
Vehicles with Gross Vehicle Weight 6,001 Pounds and Up***
Calendar Year 1997

	Running Exhaust and Evaporative (Grams per Mile)*										
Vehicle Speed	Carbon Monoxide			Reactive Organic Compounds			Oxides of Nitrogen			PM10 Exhaust	PM10 Tire Wear
(Miles per Hour)	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	FOR ALL AREA	FOR ALL AREA
5	48.53	47.06	44.86	5.16	5.05	5.73	6.96	6.65	8.31	0.32	0.19
10	31.77	30.73	29.43	3.37	3.27	3.82	6.08	5.81	7.14	0.32	0.19
15	22.90	22.19	21.27	2.45	2.37	2.81	5.49	5.24	6.34	0.32	0.19
20	17.23	16.71	16.03	1.87	1.81	2.18	5.10	4.87	5.81	0.32	0.19
25	13.60	13.19	12.66	1.49	1.45	1.75	4.87	4.65	5.49	0.32	0.19
30	11.27	10.93	10.49	1.23	1.19	1.45	4.76	4.54	5.32	0.32	0.19
35	9.79	9.49	9.10	1.04	1.01	1.22	4.76	4.54	5.30	0.32	0.19
40	8.91	8.63	8.27	0.90	0.87	1.06	4.86	4.63	5.42	0.32	0.19
45	8.51	8.23	7.87	0.81	0.78	0.94	5.09	4.84	5.69	0.32	0.19
50	8.53	8.23	7.85	0.75	0.72	0.87	5.52	5.25	6.21	0.32	0.19
55	8.94	8.60	8.19	0.71	0.69	0.83	6.21	5.93	7.04	0.32	0.19
60	11.19	10.87	10.24	0.74	0.72	0.85	7.14	6.82	8.17	0.32	0.19
65	16.20	16.01	14.87	0.87	0.86	1.00	8.31	7.93	9.66	0.32	0.19
COLD START* (Grams/Trip)	38.61	37.50	39.03	2.63	2.55	2.56	2.05	1.99	2.05		
HOT START* (Grams/Trip)	4.24	4.11	4.18	0.82	0.80	0.95	1.03	1.00	0.99		
HOT SOAK* (Grams/Trip)	-----	-----	-----	0.66	0.74	0.75	-----	-----	-----		
DIURNAL** (Grams/Vehicle/Day)	-----	-----	-----	2.66	2.66	2.66	-----	-----	-----		

Example of one daily trip:

Vehicle Start (Start-up)	Running + Evaporative ---------------->	Vehicle Start (Hot Soak)
Parking	Diurnal ---------------->	Restart (Start-up)

* Vehicle Miles Traveled (VMT) or Average Daily Trips (ADT)-weighted emission factors:
Includes VMT or ADT from diesel-fueled vehicles (33.33%), gasoline-fueled vehicles equipped with catalyst (46.02%), and gasoline-fueled vehicles not equipped with catalyst (20.65%).

** Number of Vehicles (NOV)-weighted emission factors:
Includes NOV from diesel-fueled vehicles (33.33%), gasoline-fueled vehicles equipped with catalyst (37.74%), and gasoline-fueled vehicles not equipped with catalyst (28.93%).

*** Vehicles with gross vehicle weight 6,001 pounds and up:
Includes ARB's medium-duty and light/heavy-duty, medium/heavy-duty and heavy/heavy-duty vehicles, e.g.; construction and demolition materials hauling trucks.

(SG10HD17.WK1)

TABLE A9 - 5 - K - 5
EMFAC7EP EMISSION FACTORS FOR SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT
Vehicles with Gross Vehicle Weight 6,001 Pounds and Up***
Calendar Year 1999

Vehicle Speed (Miles per Hour)	Running Exhaust and Evaporative (Grams per Mile)*										
	Carbon Monoxide			Reactive Organic Compounds			Oxides of Nitrogen			PM10 Exhaust	PM10 Tire Wear
	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	FOR ALL AREA	FOR ALL AREA
5	40.65	39.28	38.33	5.18	5.06	5.21	6.59	6.27	7.89	0.275	0.19
10	26.83	25.87	25.39	3.37	3.26	3.48	5.74	5.47	6.77	0.275	0.19
15	19.44	18.79	18.44	2.43	2.35	2.57	5.17	4.93	6.00	0.275	0.19
20	14.64	14.16	13.90	1.86	1.80	2.00	4.79	4.57	5.49	0.275	0.19
25	11.56	11.19	10.99	1.48	1.43	1.60	4.57	4.35	5.18	0.275	0.19
30	9.58	9.27	9.10	1.21	1.17	1.33	4.45	4.24	5.02	0.275	0.19
35	8.32	8.05	7.90	1.02	0.99	1.12	4.45	4.23	5.00	0.275	0.19
40	7.57	7.32	7.18	0.90	0.86	0.98	4.55	4.32	5.11	0.275	0.19
45	7.22	6.96	6.82	0.80	0.77	0.87	4.75	4.51	5.36	0.275	0.19
50	7.22	6.94	6.79	0.74	0.71	0.81	5.16	4.89	5.85	0.275	0.19
55	7.56	7.25	7.07	0.70	0.67	0.76	5.82	5.53	6.64	0.275	0.19
60	9.47	9.19	8.83	0.73	0.71	0.79	6.69	6.37	7.71	0.275	0.19
65	13.74	13.58	12.80	0.86	0.85	0.91	7.87	7.49	9.19	0.275	0.19
COLD START* (Grams/Trip)	34.16	33.18	34.95	2.43	2.36	2.39	2.03	1.97	2.05		
HOT START* (Grams/Trip)	3.79	3.69	3.73	0.70	0.68	0.81	1.00	0.97	0.97		
HOT SOAK* (Grams/Trip)	-----	-----	-----	0.54	0.62	0.63	-----	-----	-----		
DIURNAL** (Grams/Vehicle/Day)	-----	-----	-----	2.32	2.32	2.32	-----	-----	-----		

Example of one daily trip:

	Running + Evaporative	
Vehicle Start (Start-up)	----------------->	Vehicle Start (Hot Soak)
	Diurnal	
Parking	----------------->	Restart (Start-up)

* Vehicle Miles Traveled (VMT) or Average Daily Trips (ADT)-weighted emission factors:
Includes VMT or ADT from diesel-fueled vehicles (33.33%), gasoline-fueled vehicles equipped with catalyst (46.02%), and gasoline-fueled vehicles not equipped with catalyst (20.65%).

** Number of Vehicles (NOV)-weighted emission factors:
Includes NOV from diesel-fueled vehicles (33.33%), gasoline-fueled vehicles equipped with catalyst (37.74%), and gasoline-fueled vehicles not equipped with catalyst (28.93%).

*** Vehicles with gross vehicle weight 6,001 pounds and up:
Includes ARB's medium-duty and light/heavy-duty, medium/heavy-duty and heavy/heavy-duty vehicles, e.g.; construction and demolition materials hauling trucks.

(SG10HD K1)

TABLE / - 5 - K - 6
EMFAC7EP EMISSION FACTORS FOR SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT
Vehicles with Gross Vehicle Weight 6,001 Pounds and Up***
Calendar Year 2001

Vehicle Speed (Miles per Hour)	Running Exhaust and Evaporative (Grams per Mile)*										
	Carbon Monoxide			Reactive Organic Compounds			Oxides of Nitrogen			PM10 Exhaust	PM10 Tire Wear
	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	FOR ALL AREA	FOR ALL AREA
5	37.85	36.33	35.86	3.81	3.70	3.97	6.29	5.97	7.61	0.24	0.19
10	25.20	24.16	23.96	2.53	2.44	2.73	5.47	5.20	6.51	0.24	0.19
15	18.29	17.58	17.43	1.86	1.79	2.05	4.91	4.67	5.77	0.24	0.19
20	13.76	13.24	13.13	1.44	1.38	1.61	4.55	4.32	5.28	0.24	0.19
25	10.86	10.46	10.38	1.15	1.11	1.30	4.32	4.10	4.97	0.24	0.19
30	9.00	8.67	8.60	0.96	0.92	1.09	4.21	4.00	4.81	0.24	0.19
35	7.82	7.53	7.46	0.81	0.78	0.93	4.21	3.99	4.79	0.24	0.19
40	7.13	6.86	6.79	0.71	0.68	0.81	4.30	4.07	4.89	0.24	0.19
45	6.80	6.53	6.46	0.64	0.61	0.73	4.49	4.24	5.14	0.24	0.19
50	6.81	6.51	6.44	0.59	0.57	0.68	4.87	4.61	5.60	0.24	0.19
55	7.15	6.82	6.72	0.56	0.53	0.64	5.50	5.22	6.36	0.24	0.19
60	8.90	8.59	8.34	0.58	0.56	0.65	6.34	6.02	7.40	0.24	0.19
65	12.72	12.51	11.87	0.66	0.65	0.73	7.48	7.10	8.83	0.24	0.19
COLD START* (Grams/Trip)	31.31	30.63	32.35	2.14	2.09	2.12	2.02	1.98	2.07		
HOT START* (Grams/Trip)	3.46	3.38	3.40	0.56	0.55	0.66	0.97	0.95	0.96		
HOT SOAK* (Grams/Trip)	-----	-----	-----	0.46	0.53	0.53	-----	-----	-----		
DIURNAL** (Grams/Vehicle/Day)	-----	-----	-----	1.96	1.96	1.96	-----	-----	-----		

Example of one daily trip:

	Running + Evaporative	
Vehicle Start (Start-up)	---------------->	Vehicle Start (Hot Soak)
	Diurnal	
Parking	---------------->	Restart (Start-up)

* Vehicle Miles Traveled (VMT) or Average Daily Trips (ADT)-weighted emission factors:
Includes VMT or ADT from diesel-fueled vehicles (33.33%), gasoline-fueled vehicles equipped with catalyst (46.02%), and gasoline-fueled vehicles not equipped with catalyst (20.65%).

** Number of Vehicles (NOV)-weighted emission factors:
Includes NOV from diesel-fueled vehicles (33.33%), gasoline-fueled vehicles equipped with catalyst (37.74%), and gasoline-fueled vehicles not equipped with catalyst (28.93%).

*** Vehicles with gross vehicle weight 6,001 pounds and up:
Includes ARB's medium-duty and light/heavy-duty, medium/heavy-duty and heavy/heavy-duty vehicles, e.g.; construction and demolition materials hauling trucks.

(SG10HD21.WK1)

TABLE A9 - 5 - K - 7

EMFAC7EP EMISSION FACTORS FOR SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT

Vehicles with Gross Vehicle Weight 6,001 Pounds and Up***

Calendar Year 2003

Vehicle Speed	Running Exhaust and Evaporative (Grams per Mile)*										
	Carbon Monoxide			Reactive Organic Compounds			Oxides of Nitrogen			PM10 Exhaust	PM10 Tire Wear
(Miles per Hour)	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	FOR ALL AREA	FOR ALL AREA
5	30.32	29.06	29.74	3.69	3.57	4.24	6.15	5.83	7.42	0.22	0.19
10	20.35	19.49	20.04	2.46	2.36	2.88	5.35	5.07	6.36	0.22	0.19
15	14.88	14.30	14.67	1.80	1.72	2.14	4.80	4.55	5.62	0.22	0.19
20	11.21	10.79	11.07	1.39	1.33	1.67	4.44	4.20	5.13	0.22	0.19
25	8.86	8.53	8.75	1.12	1.07	1.35	4.21	3.99	4.83	0.22	0.19
30	7.35	7.07	7.26	0.92	0.88	1.12	4.11	3.89	4.68	0.22	0.19
35	6.39	6.15	6.30	0.79	0.75	0.96	4.09	3.87	4.65	0.22	0.19
40	5.80	5.58	5.71	0.69	0.66	0.84	4.18	3.95	4.75	0.22	0.19
45	5.52	5.29	5.42	0.62	0.59	0.75	4.37	4.12	4.98	0.22	0.19
50	5.49	5.25	5.38	0.57	0.54	0.69	4.74	4.47	5.44	0.22	0.19
55	5.73	5.46	5.59	0.54	0.52	0.66	5.36	5.07	6.18	0.22	0.19
60	7.20	6.95	6.95	0.56	0.53	0.67	6.18	5.86	7.20	0.22	0.19
65	10.43	10.29	9.98	0.64	0.62	0.76	7.29	6.91	8.60	0.22	0.19
COLD START* (Grams/Trip)	28.91	28.65	30.09	1.84	1.82	1.83	1.99	1.98	2.05		
HOT START* (Grams/Trip)	3.25	3.12	3.12	0.47	0.45	0.54	0.97	0.93	0.94		
HOT SOAK* (Grams/Trip)	-----	-----	-----	0.39	0.46	0.46	-----	-----	-----		
DIURNAL** (Grams/Vehicle/Day)	-----	-----	-----	1.67	1.67	1.67	-----	-----	-----		

Example of one daily trip:

	Running + Evaporative	
Vehicle Start (Start-up)	----------------->	Vehicle Start (Hot Soak)
	Diurnal	
Parking	----------------->	Restart (Start-up)

* Vehicle Miles Traveled (VMT) or Average Daily Trips (ADT)-weighted emission factors:
Includes VMT or ADT from diesel-fueled vehicles (33.33%), gasoline-fueled vehicles equipped with catalyst (46.02%), and gasoline-fueled vehicles not equipped with catalyst (20.65%).

** Number of Vehicles (NOV)-weighted emission factors:
Includes NOV from diesel-fueled vehicles (33.33%), gasoline-fueled vehicles equipped with catalyst (37.74%), and gasoline-fueled vehicles not equipped with catalyst (28.93%).

*** Vehicles with gross vehicle weight 6,001 pounds and up:
Includes ARB's medium-duty and light/heavy-duty, medium/heavy-duty and heavy/heavy-duty vehicles, e.g.; construction and demolition materials hauling trucks.

(SG10HD[illegible]K1)

TABLE [illegible]-5-K-8
EMFAC7EP EMISSION FACTORS FOR SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT
Vehicles with Gross Vehicle Weight 6,001 Pounds and Up***
Calendar Year 2005

	Running Exhaust and Evaporative (Grams per Mile)*										
Vehicle Speed	Carbon Monoxide			Reactive Organic Compounds			Oxides of Nitrogen			PM10 Exhaust	PM10 Tire Wear
(Miles per Hour)	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	FOR ALL AREA	FOR ALL AREA
5	28.32	26.99	28.02	3.37	3.24	3.91	6.03	5.70	7.30	0.205	0.19
10	19.11	18.22	18.98	2.26	2.16	2.68	5.24	4.95	6.24	0.205	0.19
15	13.99	13.40	13.91	1.67	1.59	2.00	4.69	4.44	5.52	0.205	0.19
20	10.55	10.12	10.51	1.30	1.23	1.57	4.33	4.10	5.04	0.205	0.19
25	8.33	7.99	8.30	1.04	0.99	1.26	4.11	3.89	4.74	0.205	0.19
30	6.91	6.63	6.88	0.86	0.82	1.05	4.01	3.78	4.58	0.205	0.19
35	6.00	5.75	5.97	0.73	0.70	0.90	3.99	3.76	4.55	0.205	0.19
40	5.46	5.23	5.42	0.65	0.62	0.79	4.07	3.84	4.65	0.205	0.19
45	5.19	4.96	5.15	0.58	0.55	0.71	4.26	4.00	4.88	0.205	0.19
50	5.17	4.93	5.11	0.54	0.51	0.66	4.62	4.35	5.33	0.205	0.19
55	5.41	5.13	5.32	0.51	0.49	0.63	5.23	4.94	6.06	0.205	0.19
60	6.74	6.49	6.57	0.52	0.50	0.64	6.04	5.70	7.06	0.205	0.19
65	9.68	9.52	9.32	0.59	0.57	0.71	7.13	6.73	8.44	0.205	0.19
COLD START* (Grams/Trip)	26.74	26.31	28.01	1.60	1.57	1.59	1.96	1.93	2.04		
HOT START* (Grams/Trip)	3.00	2.94	2.93	0.39	0.39	0.47	0.93	0.92	0.93		
HOT SOAK* (Grams/Trip)	-----	-----	-----	0.36	0.42	0.42	-----	-----	-----		
DIURNAL** (Grams/Vehicle/Day)	-----	-----	-----	1.46	1.47	1.47	-----	-----	-----		

Example of one daily trip:

	Running + Evaporative	
Vehicle Start (Start-up)	---------------->	Vehicle Start (Hot Soak)
	Diurnal	
Parking	---------------->	Restart (Start-up)

* Vehicle Miles Traveled (VMT) or Average Daily Trips (ADT)-weighted emission factors:
Includes VMT or ADT from diesel-fueled vehicles (33.33%), gasoline-fueled vehicles equipped with catalyst (46.02%), and gasoline-fueled vehicles not equipped with catalyst (20.65%).

** Number of Vehicles (NOV)-weighted emission factors:
Includes NOV from diesel-fueled vehicles (33.33%), gasoline-fueled vehicles equipped with catalyst (37.74%), and gasoline-fueled vehicles not equipped with catalyst (28.93%).

*** Vehicles with gross vehicle weight 6,001 pounds and up:
Includes ARB's medium-duty and light/heavy-duty, medium/heavy-duty and heavy/heavy-duty vehicles, e.g.; construction and demolition materials hauling trucks.

(SG10HD25.WK1)

TABLE A9 - 5 - K - 9

EMFAC7EP EMISSION FACTORS FOR SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT
Vehicles with Gross Vehicle Weight 6,001 Pounds and Up***
Calendar Year 2007

Vehicle Speed (Miles per Hour)	Running Exhaust and Evaporative (Grams per Mile)*										
	Carbon Monoxide			Reactive Organic Compounds			Oxides of Nitrogen			PM10 Exhaust	PM10 Tire Wear
	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	FOR ALL AREA	FOR ALL AREA
5	25.05	23.97	25.48	2.90	2.77	3.13	5.92	5.58	7.22	0.195	0.195
10	16.99	16.26	17.34	1.98	1.88	2.21	5.13	4.83	6.17	0.195	0.195
15	12.57	12.10	12.83	1.48	1.39	1.68	4.59	4.33	5.45	0.195	0.195
20	9.51	9.16	9.71	1.15	1.09	1.33	4.23	3.99	4.97	0.195	0.195
25	7.52	7.25	7.68	0.93	0.88	1.09	4.01	3.78	4.67	0.195	0.195
30	6.23	6.01	6.37	0.77	0.73	0.91	3.90	3.67	4.52	0.195	0.195
35	5.41	5.21	5.52	0.67	0.63	0.79	3.89	3.66	4.49	0.195	0.195
40	4.90	4.72	4.99	0.59	0.55	0.69	3.97	3.73	4.59	0.195	0.195
45	4.64	4.45	4.72	0.53	0.50	0.62	4.15	3.89	4.81	0.195	0.195
50	4.58	4.39	4.65	0.49	0.46	0.58	4.50	4.22	5.25	0.195	0.195
55	4.76	4.53	4.81	0.46	0.44	0.55	5.10	4.79	5.97	0.195	0.195
60	6.05	5.86	6.04	0.47	0.45	0.56	5.89	5.55	6.96	0.195	0.195
65	9.00	8.95	8.83	0.53	0.50	0.60	6.97	6.56	8.33	0.195	0.195
COLD START* (Grams/Trip)	25.59	25.24	26.97	1.41	1.39	1.42	1.94	1.92	2.03		
HOT START* (Grams/Trip)	2.85	2.81	2.79	0.35	0.34	0.42	0.91	0.90	0.92		
HOT SOAK* (Grams/Trip)	----	----	----	0.34	0.40	0.39	----	----	----		
DIURNAL** (Grams/Vehicle/Day)	----	----	----	1.30	1.30	1.30	----	----	----		

Example of one daily trip:

Vehicle Start (Start-up) --- Running + Evaporative ---> Vehicle Start (Hot Soak)

Parking --- Diurnal ---> Restart (Start-up)

* Vehicle Miles Traveled (VMT) or Average Daily Trips (ADT)-weighted emission factors:
Includes VMT or ADT from diesel-fueled vehicles (33.33%), gasoline-fueled vehicles equipped with catalyst (46.02%), and gasoline-fueled vehicles not equipped with catalyst (20.65%).

** Number of Vehicles (NOV)-weighted emission factors:
Includes NOV from diesel-fueled vehicles (33.33%), gasoline-fueled vehicles equipped with catalyst (37.74%), and gasoline-fueled vehicles not equipped with catalyst (28.93%).

*** Vehicles with gross vehicle weight 6,001 pounds and up:
Includes ARB's medium-duty and light/heavy-duty, medium/heavy-duty and heavy/heavy-duty vehicles, e.g.; construction and demolition materials hauling trucks.

(SG10HD[illegible]VK1)

TABLE A9 5 - K - 10
EMFAC7EP EMISSION FACTORS FOR SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT
Vehicles with Gross Vehicle Weight 6,001 Pounds and Up***
Calendar Year 2009

	Running Exhaust and Evaporative (Grams per Mile)*										
Vehicle Speed	Carbon Monoxide			Reactive Organic Compounds			Oxides of Nitrogen			PM10 Exhaust	PM10 Tire Wear
(Miles per Hour)	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	FOR ALL AREA	FOR ALL AREA
5	23.21	22.03	22.98	2.93	2.80	3.34	5.90	5.55	6.80	0.17	0.185
10	15.80	15.01	15.69	2.01	1.90	2.30	5.11	4.81	5.86	0.17	0.185
15	11.65	11.13	11.61	1.49	1.40	1.72	4.58	4.31	5.22	0.17	0.185
20	8.81	8.43	8.79	1.16	1.09	1.34	4.22	3.97	4.80	0.17	0.185
25	6.96	6.66	6.94	0.94	0.88	1.09	3.99	3.75	4.53	0.17	0.185
30	5.77	5.52	5.76	0.78	0.74	0.91	3.89	3.65	4.40	0.17	0.185
35	5.01	4.79	4.99	0.67	0.63	0.78	3.87	3.63	4.38	0.17	0.185
40	4.55	4.34	4.52	0.59	0.55	0.68	3.95	3.70	4.48	0.17	0.185
45	4.31	4.11	4.28	0.53	0.50	0.61	4.13	3.86	4.69	0.17	0.185
50	4.28	4.07	4.23	0.49	0.46	0.57	4.49	4.20	5.10	0.17	0.185
55	4.45	4.21	4.38	0.47	0.44	0.55	5.08	4.77	5.78	0.17	0.185
60	5.57	5.35	5.47	0.47	0.45	0.55	5.87	5.51	6.69	0.17	0.185
65	8.07	7.96	7.94	0.53	0.51	0.61	6.94	6.52	7.95	0.17	0.185
COLD START* (Grams/Trip)	24.44	24.16	25.90	1.28	1.27	1.30	1.94	1.92	2.02		
HOT START* (Grams/Trip)	2.73	2.70	2.66	0.31	0.31	0.38	0.90	0.89	0.92		
HOT SOAK* (Grams/Trip)	-----	-----	-----	0.33	0.38	0.37	-----	-----	-----		
DIURNAL** (Grams/Vehicle/Day)	-----	-----	-----	1.18	1.18	1.18	-----	-----	-----		

Example of one daily trip:

	Running + Evaporative	
Vehicle Start (Start-up)	----------------->	Vehicle Start (Hot Soak)
	Diurnal	
Parking	----------------->	Restart (Start-up)

* Vehicle Miles Traveled (VMT) or Average Daily Trips (ADT)-weighted emission factors:
Includes VMT or ADT from diesel-fueled vehicles (33.33%), gasoline-fueled vehicles equipped with catalyst (46.02%), and gasoline-fueled vehicles not equipped with catalyst (20.65%).

** Number of Vehicles (NOV)-weighted emission factors:
Includes NOV from diesel-fueled vehicles (33.33%), gasoline-fueled vehicles equipped with catalyst (37.74%), and gasoline-fueled vehicles not equipped with catalyst (28.93%).

*** Vehicles with gross vehicle weight 6,001 pounds and up:
Includes ARB's medium-duty and light/heavy-duty, medium/heavy-duty and heavy/heavy-duty vehicles, e.g.; construction and demolition materials hauling trucks.

(SG10HD29.WK1)

TABLE A9 - 5 - L

EMFAC EMISSION FACTORS FOR SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT

Oxides of Sulfur and Lead Emissions

Year	Vehicles with Gross Vehicle Weight up to 6,000 Pounds*** (grams per mile)						Vehicles with Gross Vehicle Weight 6,000 Pounds and Greater*** (grams per mile)					
	OXIDES of SULFUR			LEAD			OXIDES of SULFUR			LEAD		
	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3
1991												
1993	0.07	0.07	0.07	0.00016	0.00016	0.00017	0.44	0.44	0.44	0.0017	0.0017	0.0017
1995	0.06	0.06	0.06	0.00011	0.00012	0.00012	0.33	0.33	0.33	0.0011	0.0011	0.0011
1997	0.06	0.06	0.06	N/A	N/A	N/A	0.32	0.32	0.32	0.0010	0.0010	0.0010
1999	0.06	0.06	0.06	N/A	N/A	N/A	0.31	0.31	0.31	0.0007	0.0007	0.0007
2001	0.05	0.05	0.05	N/A	N/A	N/A	0.30	0.30	0.30	0.0007	0.0007	0.0007
2003	0.05	0.05	0.05	N/A	N/A	N/A	0.30	0.30	0.30	0.0007	0.0007	0.0007
2005	0.05	0.05	0.05	N/A	N/A	N/A	0.30	0.30	0.30	0.0004	0.0004	0.0004
2007	0.05	0.05	0.05	N/A	N/A	N/A	0.29	0.29	0.29	0.0004	0.0004	0.0004
2009	0.05	0.05	0.05	N/A	N/A	N/A	0.28	0.28	0.28	0.0004	0.0004	0.0004

Emissions (pounds per day) = (*VMT x EMISSION FACTOR)/454

*VMT = Vehicle Miles Traveled per Day

INFORMATION
FOR
PERCENT HOT STARTS
AND PERCENT COLD STARTS

TABLE A9 - 5 - M

INPUT ASSUMPTIONS FOR PERCENT HOT START TRIPS AND COLD START TRIPS, BY LAND USE TYPE

	Percent Of Average Daily Trips	
Project Type	% Hot Start Trips	% Cold Start Trips
Residential		
Single Family Detached Housing	- -	100
Apartment	- -	100
Residential Condominium	- -	100
Mobile Home Park	- -	100
Retirement Community	- -	100
Congregate Care Facilities	- -	100
Commercial		
Hotel	25	75
General Office Building	30	70
Office Park	30	70
Retail General Merchandise	80	20
Nursery/Garden Center	75	25
Shopping Centers	20	80
Quality Restaurant	50	50
Fast Food/With Drive Through	90	10
New Car Sales	50	50
Service Station	90	10
Car Wash	95	5
Supermarket	70	30
Convenience Market	95	5
Furniture Store	85	15
Video Arcade	10	90
Walk-in Bank	85	15
Industrial		
Truck Terminal	95	5
Industrial Park	30	70
Mini-warehouse	10	90
Government/Institutions		
Utilities	75	25
Military Base	15	85
Elementary School	90	10
High School	25	75
University/College	25	75
Church/Synagogue	50	50
Day Care Center	50	50
Library	85	15
Hospital	50	50
Nursing Homes	25	75
Clinics	75	25

TABLE A9 - 5 - M (Cont.)

INPUT ASSUMPTIONS FOR PERCENT HOT START TRIPS AND COLD START TRIPS

	Percent Of Average Daily Trips	
Project Type	% Hot Start Trips	% Cold Start Trips
Recreation		
City Park	--	100
Water Slide Park	--	100
Marina	20	80
Golf Course	50	50
Movie Theatre with Matinee	5	95
Stadium	5	95
Racquet Club	5	95
Unique Sources		
Waterports	50	50
Commercial Airports	50	50
Bus Park-n-Ride Station	5	95
Cemetery	25	75

Source:

Cold and hot start percentages provided in Table A9 - 5 - M are District assumptions based on ITE manual. For each land-use type (except for a few such as mail delivery, UPS delivery, etc.); all employee-related trips were assumed to be with cold start. Visitors and other short trips were assumed to be with hot starts. Both assumptions were combined to determine above reported hot and cold start percentages. The District recommends use of these percentages only when project-specific data is not available.

Cold start trips result when car is started after one sitting for one hour or more. An example would be cars used to commute to work then not being used until lunch hour trips. In this case both work-trips and lunch trips will be with cold starts. Hot start trips are those trips when car is re-started before one hour of non-use. An example would be a mini-market or gas station where visitors' cars are turned off for less than one hour before they are re-started.

TABLE A9 - 5 - M - 1

INPUT ASSUMPTIONS FOR PERCENT HOT AND COLD START TRIPS
(Expressed in Percent of Vehicles On Roadways)

Percent Hot (H) and Cold (C) Starts by Road-type and Period of the Day				
Travel Period of the Day Area Types Road-Types	AM Peak*	OFF Peak*	PM Peak*	Daily
*Recommended Defaults	(CO, and NOx)	(ROC)		
	H C	H C	H C	H C
Inside the County Business District				
Regional Average Cold Starts	10 and 20	20 and 30	40 and 70	25 and 55
Regional Average Cold Starts	5 and 15	15 and 45	30 and 50	20 and 40
Regional Average Cold Starts	1 and 6	5 and 20	25 and 40	15 and 25
Fringe Areas (non-urban) **	10 and 20	25 and 60	40 and 65	25 and 50
Fringe Areas (non-urban) ***	5 and 15	20 and 25	30 and 45	20 and 35
Fringe Areas (non-urban) ****	1 and 15	10 and 20	15 and 40	10 and 30
Outer Arterials **	15 and 25	30 and 50	30 and 60	30 and 60
Outer Arterials ***	10 and 20	15 and 25	20 and 45	20 and 30
Outer Arterials ****	5 and 15	10 and 15	15 and 30	15 and 20
Local & Collector Streets **	10 and 20	35 and 50	35 and 55	30 and 40
Outer Arterials ***	5 and 20	15 and 35	25 and 40	25 and 30
Outer Arterials ****	5 and 15	10 and 15	15 and 25	15 and 25
Within Urban And Its Fringe Areas (Non-urban Areas Closer and Urban Areas)				
Inbound Expressways **	3 and 5	15 and 20	20 and 30	15 and 20
Inbound Expressways ***	2 and 4	10 and 20	15 and 25	10 and 20
Inbound Expressways ****	1 and 3	10 and 15	15 and 25	10 and 25
Outbound Expressways **	1 and 3	15 and 20	15 and 20	10 and 15
Outbound Expressways ***	1 and 3	10 and 20	10 and 20	10 and 15
Outbound Expressways ****	1 and 3	10 and 15	10 and 15	10 and 15
Outer Portion of Urban Areas				
Inbound Expressways **	3 and 5	2 and 4	2 and 4	3 and 5
Inbound Expressways ***	2 and 4	2 and 4	2 and 4	3 and 5
Inbound Expressways ****	1 and 3	1 and 3	1 and 3	2 and 4
Outbound Expressways **	3 and 5	2 and 4	15 and 20	10 and 15
Outbound Expressways ***	2 and 4	2 and 4	10 and 20	10 and 15
Outbound Expressways ****	1 and 3	1 and 3	10 and 15	10 and 15
Outside the County Business District				
Special Generators	25 and 40	30 and 50	45 and 60	20 and 30
Special Generators	15 and 25	20 and 25	30 and 35	25 and 55
Special Generators	15 and 20	10 and 20	20 and 30	20 and 30

* Use *AM Peak Speeds* to select running emission factors for CO, and NOx with hot and cold trips; *and*, use *Off Peak Speeds* to select running emission factors for PM10 with hot and cold trips.

Table A9 - 5 - M - 1 includes the percent of hot and cold starts on various types of roadways. These percentages may be used for analysis of pollutants in Table A9 - 5 - P and Q as well as to determine project related emission estimates. After determining the number of vehicles on a road, use Table A9 - 5 - M - 1 to determine % cold start and hot start. Remaining vehicles will be at stabilized levels. Then use Table A9 - 5 - M - 3 to determine % passenger vehicles, trucks, motorcycles and buses for each of the hot and cold start vehicles on that road. Use Table A9 - 5 - G to determine % passenger vehicles, trucks, motorcycles and buses for stabilized vehicles on that road.

The information provided on Table A9 - 5 - M - 1 is from federal EPA Table 26, entitled, For Suggested Ranges of Values of the Percentages of Vehicles Operating in the Cold Mode for Various Conditions of Time and Location. The table includes information for three different cases as follows:

**	Case 1:	No access time added
***	Case 2:	1-minute additional access time
****	Case 3:	2.5-minute additional access time

These cases are identified in Table A9 - 5 - M - 1 by an asterisk.

TABLE A9 - 5 - M - 2

INPUT ASSUMPTIONS FOR PERCENT COLD AND HOT START TRIPS
(Expressed in Percent of Vehicle Type for Each County in the District)

Year	Passenger		Trucks		All Vehicle Types*	
	Cold Starts % PV	Hot Starts % PV	Cold Starts % Trucks	Hot Starts % Trucks	Cold Starts % All Vehicles	Hot Starts % All Vehicles
ORANGE COUNTY						
1991	52.23	47.77	46.70	53.30	51.50	48.50
1993	52.54	47.46	48.25	51.75	51.95	48.05
1995	52.72	47.28	49.36	50.64	52.22	47.78
1997	52.85	47.15	50.13	49.87	52.42	47.58
1999	52.97	47.03	50.66	49.34	52.58	47.42
2001	52.98	47.02	51.05	48.95	52.64	47.36
2003	52.99	47.01	51.32	48.68	52.67	47.32
2005	53.00	47.00	51.50	48.50	52.70	47.30
2007	53.00	47.00	51.62	48.38	52.71	47.29
2009	53.00	47.00	51.73	48.27	52.72	47.28
LOS ANGELES COUNTY						
1991	52.23	47.77	46.58	53.42	51.47	48.54
1993	52.54	47.46	48.15	51.85	51.92	48.08
1995	52.72	47.28	49.28	50.72	52.20	47.80
1997	52.85	47.15	50.07	49.93	52.35	47.65
1999	53.00	47.00	50.91	49.09	52.55	47.45
2001	53.00	47.00	51.22	48.78	52.74	47.26
2003	53.00	47.00	51.45	48.55	52.75	47.25
2005	53.00	47.00	51.60	48.40	52.76	47.24
2007	53.00	47.00	51.69	48.31	52.77	47.23
2009	53.00	47.00	51.72	48.28	52.78	47.22
SAN BERNARDINO COUNTY						
1991	52.23	47.77	46.67	53.33	51.38	48.62
1993	52.54	47.46	48.22	51.78	51.86	48.14
1995	52.71	47.29	49.33	50.67	52.15	47.85
1997	52.85	47.15	50.10	49.90	52.37	47.63
1999	52.97	46.33	50.64	49.36	52.54	47.46
2001	52.98	47.01	51.03	48.97	52.61	47.39
2003	52.99	47.01	51.30	48.70	51.66	47.34
2005	53.00	47.00	51.48	48.52	52.68	47.32
2007	53.00	47.00	51.60	48.40	52.70	47.30
2009	53.00	47.00	51.71	48.29	52.71	47.29
RIVERSIDE COUNTY						
1991	52.23	47.77	46.59	53.41	51.41	48.59
1993	52.54	47.46	48.21	51.89	51.90	48.10
1995	52.72	47.28	49.35	50.65	52.21	47.78
1997	52.85	47.15	50.15	49.85	52.43	47.57
1999	52.97	47.03	50.70	49.30	52.61	47.39
2001	52.98	47.01	51.10	48.90	52.68	47.32
2003	52.99	47.01	51.38	48.62	52.73	47.27
2005	53.00	47.00	51.55	48.45	52.75	47.25
2007	53.00	47.00	51.68	48.32	52.77	47.23
2009	53.00	47.00	51.79	48.21	52.79	47.21

* For all counties and for all years buses have 0.0 % cold starts and 0.0 % hot starts (Source: ARB)

* For all counties and for all years motorcycles have 34.30 % cold starts and 65.70 % hot starts

Source: ARB Computer outputs, "Predicted California Vehicle Emissions".

TABLE A9 - 5 - M - 3

INPUT ASSUMPTIONS FOR PERCENT COLD AND HOT START TRIPS

(% Associated with Type of Vehicle in Total (Ttl) Cold and Hot Starts and % Cold and Hot Starts Associated with Each Type of Vehicle in Total (Ttl) Average Daily Trips)

Year	V % of Ttl Cold			V % of Ttl Hot			% Cold of ADTs			% Hot of ADTs		
	PVs	Trucks	Mtrcycls	PVs	Trucks	Mtrcycls	PVs	Trucks	Mtrcycls	PVs	Trucks	Mtrcycls
ORANGE COUNTY												
1991	89.61	9.94	00.45	88.36	10.96	0.67	98.50	0.75	0.75	10.39	90.06	99.55
1993	89.33	10.21	00.45	88.32	10.99	0.69	98.76	0.62	0.62	10.66	89.78	99.55
1995	89.12	10.42	00.46	88.28	11.02	0.70	98.96	0.52	0.52	10.88	89.58	99.54
1997	88.98	10.56	00.46	88.25	11.04	0.70	99.09	0.45	0.45	11.02	89.44	99.54
1999	88.88	10.66	00.46	88.23	11.06	0.71	99.18	0.41	0.41	11.12	89.34	99.54
2001	88.79	10.74	00.47	88.21	11.08	0.71	99.27	0.37	0.36	11.21	89.26	99.54
2003	88.72	10.81	00.47	88.18	11.09	0.72	99.32	0.34	0.34	11.28	89.19	99.53
2005	88.69	10.86	00.47	88.16	11.11	0.73	99.36	0.32	0.32	11.33	89.14	99.53
2007	88.63	10.90	00.47	88.14	11.13	0.73	99.38	0.31	0.31	11.37	89.10	99.53
2009	88.60	10.93	00.48	88.12	11.15	0.73	99.40	0.30	0.30	11.41	89.06	99.53
LOS ANGELES COUNTY												
1991	89.23	10.33	00.44	87.93	11.42	0.66	98.43	0.78	0.78	10.77	89.66	99.56
1993	88.89	10.67	00.44	87.83	11.50	0.66	98.70	0.65	0.65	11.11	89.33	99.56
1995	88.61	10.94	00.44	87.74	11.59	0.67	98.92	0.54	0.54	11.39	89.05	99.56
1997	88.39	11.16	00.45	87.56	11.67	0.68	98.96	0.52	0.52	11.61	88.84	99.55
1999	88.17	11.38	00.45	86.34	11.75	0.66	97.65	1.18	1.18	11.83	88.61	99.55
2001	87.79	11.45	00.44	97.39	11.78	0.67	99.48	0.26	0.26	12.20	88.55	99.56
2003	87.80	11.62	00.45	87.34	11.86	0.68	97.60	1.20	1.20	10.71	89.11	99.55
2005	87.81	11.72	00.46	87.20	11.94	0.69	99.22	0.39	0.39	12.18	88.28	99.54
2007	87.71	11.82	00.46	87.22	12.07	0.71	99.36	0.32	0.32	12.28	88.18	99.54
2009	87.62	11.92	00.47	87.14	12.04	0.72	99.39	0.30	0.30	12.38	88.08	99.53
SAN BERNARDINO COUNTY												
1991	87.46	12.19	00.35	86.04	13.42	0.53	98.46	0.77	0.77	12.54	87.81	99.65
1993	87.06	12.58	00.35	85.93	13.53	0.53	98.58	0.65	0.65	12.94	87.42	99.65
1995	86.75	12.90	00.35	85.83	13.64	0.54	98.83	0.53	0.53	13.25	87.10	99.65
1997	86.51	13.14	00.35	85.73	13.73	0.54	99.00	0.50	0.50	13.49	86.86	99.65
1999	86.34	13.32	00.35	85.64	13.83	0.54	99.11	0.44	0.44	13.67	86.67	99.65
2001	86.14	13.51	00.35	85.53	13.93	0.54	99.21	0.39	0.39	13.86	86.49	99.65
2003	85.96	13.68	00.35	85.41	14.05	0.54	99.28	0.36	0.36	14.03	86.32	99.65
2005	85.83	13.82	00.35	85.31	14.14	0.54	99.33	0.32	0.32	14.17	86.18	99.65
2007	85.71	13.94	00.35	85.22	14.24	0.55	99.36	0.32	0.32	14.29	86.06	99.65
2009	85.59	14.06	00.35	85.10	14.33	0.55	99.39	0.30	0.30	14.41	85.94	99.64
RIVERSIDE COUNTY												
1991	87.76	11.96	00.28	86.39	13.04	0.42	98.32	0.84	0.84	12.24	88.04	99.72
1993	87.64	12.09	00.27	86.58	13.02	0.41	98.67	0.67	0.67	12.36	87.91	99.73
1995	87.59	12.15	00.26	86.75	12.85	0.40	98.94	0.53	0.53	12.41	87.85	99.74
1997	87.61	12.13	00.25	86.92	12.69	0.39	99.13	0.44	0.44	12.39	87.86	99.75
1999	87.66	12.09	00.25	87.07	12.54	0.38	99.25	0.38	0.38	12.34	87.91	99.75
2001	87.71	12.05	00.24	87.20	12.42	0.37	99.36	0.32	0.32	12.29	87.95	99.76
2003	87.75	12.01	00.24	87.30	12.33	0.37	99.43	0.29	0.29	12.25	87.98	99.76
2005	87.79	11.97	00.24	87.39	12.25	0.36	99.48	0.26	0.26	12.21	88.03	99.76
2007	87.85	11.92	00.23	87.47	12.17	0.36	99.52	0.24	0.24	12.15	88.08	99.77
2009	87.89	11.87	00.23	87.54	12.10	0.36	99.55	0.23	0.23	12.10	88.13	99.77

First six columns: for percentages associated with each vehicle type from total cold starts or hot starts, Last six columns: for hot and cold start percentages associated with each vehicle type from total average daily trips. Bus ADTs, cold starts & hot starts are not included in the totals used to create above data. (Source: ARB)

TABLE A9 - 5 - N

EMISSION FACTORS FOR ESTIMATING MOTORCYCLE EMISSIONS

USE

TABLE A9 - 14 - A

FOR MOTORCYCLE-RELATED
VEHICLE MILES TRAVELED (VMT)
AVERAGE DAILY TRIPS (ADT) AND NUMBER OF VEHICLES (NOV)
IN COUNTYWIDE AND REGIONWIDE FLEET MIX
AND

TABLE A9 - 5 - G*

FOR THEIR PERCENTAGES

USE

TABLE A9 - 5 - P - 1 AND 2

FOR DETERMINING COMPOSITE EMISSION FACTOR BETWEEN
FOUR DIFFERENT TYPES OF VEHICLES TOGETHER, SUCH AS,
PASSENGER VEHICLES, MATERIAL HAULING VEHICLES AND BUSES
INCLUDING MOTORCYCLES
AND
BETWEEN RUNNING, HOT AND COLD START EMISSION FACTORS FOR
MOTORCYCLES

(* IF PROJECT-SPECIFIC FLEET MIX DATA IS NOT AVAILABLE,
USE TABLE A9 - 5 - G TO DETERMINE PROJECT-RELATED
FLEET MIX DATA)

TABLE A9 - 5 - N - 1

EMISSION FACTORS FOR MOTORCYCLES AT 75°F
(Grams per Mile)
Reactive Organic Compounds

	YEARS									
Speed	1991	1993	1995	1997	1999	2001	2003	2005	2007	2009
	Running Exhaust Emission Factors at 75°F Total Organic Compound (TOC)									
5	10.73	9.9	9.82	9.92	10.07	10.18	10.24	10.27	10.28	10.28
10	5.66	5.22	5.18	5.23	5.31	5.36	5.40	5.41	5.42	5.42
15	3.99	3.68	3.65	3.68	3.74	3.78	3.80	3.81	3.82	3.82
20	3.23	2.98	2.96	2.99	3.03	3.06	3.08	3.09	3.10	3.10
25	2.77	2.55	2.53	2.56	2.60	2.62	2.64	2.65	2.65	2.65
30	2.41	2.23	2.21	2.23	2.36	2.29	2.30	2.31	2.31	2.31
35	2.13	1.97	1.95	1.97	2.00	2.02	2.03	2.04	2.04	2.04
40	1.93	1.78	1.77	1.79	1.81	1.83	1.84	1.85	1.85	1.85
45	1.82	1.68	1.66	1.68	1.71	1.72	1.73	1.74	1.74	1.74
50	1.77	1.63	1.62	1.63	1.66	1.67	1.68	1.69	1.69	1.69
55	1.70	1.57	1.56	1.57	1.60	1.62	1.62	1.63	1.63	1.63
60	1.50	1.38	1.37	1.38	1.40	1.42	1.43	1.43	1.43	1.43
65	1.03	0.95	0.94	0.95	0.96	0.98	0.98	0.98	0.98	0.99

(To Obtain Temperature Corrected Emission Factor, Multiply Above Emission Factors with the Following Temperature Correction Factors For the Appropriate Area)

	Running Exhaust Temperature Correction Factors									
Area 1 and 2	1.00	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03
Area 3	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07

(To Convert TOCs to ROCs, Multiply Above Temperature Corrected Emission Factor With 0.92)

	Cold Start TOC at 75°F									
	11.21	10.36	10.28	10.39	10.55	10.66	10.72	10.75	10.76	10.77

(To Obtain Temperature Corrected Emission Factor, Multiply Above Emission Factors with the Following Temperature Correction Factors For the Appropriate Area)

	Cold Start Temperature Correction Factor									
Area 1 and 2	0.85	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
Area 3	0.65	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66

(To Convert TOCs to ROCs, Multiply the Above Emission Factor With 0.92 After Temperature Correction)

	Hot Start at 75°F									
	3.95	3.68	3.66	3.70	3.76	3.80	3.82	3.83	3.83	3.83

(To Obtain Temperature Corrected Emission Factor, Multiply Above Emission Factors with the Following Temperature Correction Factors For the Appropriate Area)

	Hot Start Temperature Correction Factors									
Area 1 and 2	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38
Area 3	2.06	2.07	2.07	2.07	2.07	2.07	2.07	2.07	2.07	2.07

(To Convert TOCs to ROCs, Multiply the Above Emission Factor With 0.92 After Temperature Correction)

	Hot Soak Emission Factors									
All Areas	1.60	0.92	0.81	0.76	0.76	0.76	0.76	0.76	0.76	0.76

	Diurnal Emission Factors									
All Areas	4.74	2.99	2.74	2.63	2.62	2.62	2.62	2.62	2.62	2.62

Note: See Tables A9 - 5 - N - 1- a and A9 - 5 - N - 1 - b for temperature corrected ROC emissions factors.

Table A9 – 5 – N –1 – a
AREA 1 and AREA 2
TEMPERATURE CORRECTED EMISSION FACTORS FOR MOTORCYCLES
(Grams Per Mile)
REACTIVE ORGANIC COMPOUNDS (ROC)

SPEED	1991	1993	1995	1997	1999	2001	2003	2005	2007	2009
5	9.87	9.38	9.31	9.40	9.54	9.65	9.70	9.73	9.74	9.74
10	5.21	4.95	4.91	4.96	5.03	5.08	5.12	5.13	5.14	5.14
15	3.67	3.49	3.46	3.49	3.54	3.58	3.60	3.61	3.62	3.62
20	2.97	2.82	2.80	2.83	2.87	2.90	2.92	2.93	2.94	2.94
25	2.55	2.42	2.40	2.43	2.46	2.48	2.50	2.51	2.51	2.51
30	2.22	2.11	2.09	2.11	2.24	2.17	2.18	2.19	2.19	2.19
35	1.96	1.87	1.85	1.87	1.90	1.91	1.92	1.93	1.93	1.93
40	1.78	1.69	1.68	1.70	1.72	1.73	1.74	1.75	1.75	1.75
45	1.67	1.59	1.57	1.59	1.62	1.63	1.64	1.65	1.65	1.65
50	1.63	1.54	1.54	1.54	1.57	1.58	1.59	1.60	1.60	1.60
55	1.56	1.49	1.48	1.49	1.52	1.54	1.54	1.54	1.54	1.54
60	1.38	1.31	1.30	1.31	1.33	1.35	1.36	1.36	1.36	1.36
65	0.95	0.90	0.89	0.90	0.91	0.93	0.93	0.93	0.93	0.94
Cold start	8.77	8.20	8.13	8.22	8.35	8.43	8.48	8.51	8.51	8.52
Hot start	2.36	2.23	2.22	2.25	2.28	2.31	2.32	2.33	2.33	2.33
Hot Soak	1.60	0.92	0.81	0.76	0.76	0.76	0.76	0.76	0.76	0.76
Diurnal	4.74	2.99	2.74	2.63	2.62	2.62	2.62	2.62	2.62	2.62

Table A9 – 5 – N –1 – b
AREA 3
TEMPERATURE CORRECTED EMISSION FACTORS FOR MOTORCYCLES
(Grams Per Mile)
REACTIVE ORGANIC COMPOUNDS (ROC)

SPEED	1991	1993	1995	1997	1999	2001	2003	2005	2007	2009
5	10.25	9.45	9.38	9.47	9.62	9.72	9.78	9.81	9.82	9.82
10	5.41	4.99	4.95	4.99	5.07	5.12	5.16	5.17	5.18	5.18
15	3.81	3.51	3.49	3.51	3.57	3.61	3.63	3.64	3.65	3.65
20	3.08	2.85	2.83	2.86	2.89	2.92	2.94	2.95	2.96	2.96
25	2.65	2.44	2.42	2.44	2.48	2.50	2.52	2.53	2.53	2.53
30	2.30	2.13	2.11	2.13	2.25	2.19	2.20	2.21	2.21	2.21
35	2.03	1.88	1.86	1.88	1.91	1.93	1.94	1.95	1.95	1.95
40	1.84	1.70	1.69	1.71	1.73	1.75	1.76	1.77	1.77	1.77
45	1.74	1.60	1.59	1.60	1.63	1.64	1.65	1.66	1.66	1.66
50	1.69	1.56	1.55	1.56	1.59	1.59	1.60	1.61	1.61	1.61
55	1.62	1.50	1.49	1.50	1.53	1.55	1.55	1.56	1.56	1.56
60	1.43	1.32	1.31	1.32	1.34	1.36	1.37	1.37	1.37	1.37
65	0.98	0.91	0.90	0.91	0.92	0.94	0.94	0.94	0.94	0.95
Cold start	14.23	13.15	13.05	13.19	13.39	13.53	13.61	13.65	13.66	13.67
Hot start	7.49	6.97	6.94	7.01	7.13	7.20	7.24	7.26	7.26	7.26
Hot Soak	1.60	0.92	0.81	0.76	0.76	0.76	0.76	0.76	0.76	0.76
Diurnal	4.74	2.99	2.74	2.63	2.62	2.62	2.62	2.62	2.62	2.62

Table A9 - 5 - N - 2

EMISSION FACTORS FOR MOTORCYCLES at 75°F
(Grams per Mile)
Carbon Monoxide and Oxides of Sulfur

Speed	1991	1993	1995	1997	1999	2001	2003	2005	2007	2009
					Running Exhaust Emission Factors at 75°F					
					Carbon Monoxide (CO)					
5	62.71	62.59	61.89	61.83	61.82	61.81	Same Factors As Year 2001			
10	30.13	29.83	29.76	29.73	29.72	29.72	↓			
15	19.77	19.59	19.54	19.52	19.52	19.51	↓			
20	15.15	15.02	14.99	14.97	14.97	14.97	↓			
25	12.39	12.29	12.27	12.26	12.25	12.25	↓			
30	10.40	10.32	10.30	10.29	10.29	10.29	↓			
35	8.89	8.83	8.81	8.81	8.80	8.80	↓			
40	7.84	7.79	7.78	7.77	7.77	7.77	↓			
45	7.23	7.18	7.18	7.17	7.17	7.17	↓			
50	6.94	6.90	6.89	6.89	6.88	6.88	↓			
55	6.70	6.67	6.67	6.66	6.66	6.66	↓			
60	6.00	5.98	5.98	5.97	5.97	5.97	↓			
65	4.30	4.29	4.29	4.29	4.29	4.29	↓			

(To Obtain Temperature Corrected Emission Factor, Multiply Above Emission Factors with the Following Temperature Correction Factors For the Appropriate Area)

	1991	1993	1995	1997	1999	2001	2003	2005	2007	2009
					Running Exhaust Temperature Correction Factors					
All Areas	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01
					Cold Start at 75°F					
All Areas	65.98	65.29	65.08	65.02	65.01		65.00	65.00	Same as Year 2001	

(To Obtain Temperature Corrected Emission Factor, Multiply Above Emission Factors with the Following Temperature Correction Factors For the Appropriate Area)

	1991	1993	1995	1997	1999	2001	2003	2005	2007	2009
					Cold Start Temperature Correction Factor					
All Areas	1.54	Same as Year 1991			Same as Year 1991			Same as Year 1991		
					Hot Start at 75°F					
All Areas	9.51	9.44	9.43	9.42		Same as Year 1997				

(To Obtain Temperature Corrected Emission Factor, Multiply Above Emission Factors with the Following Temperature Correction Factors For the Appropriate Area)

	1991	1993	1995	1997	1999	2001	2003	2005	2007	2009
					Hot Start Temperature Correction Factors					
All Areas	0.51	Same as Year 1991			Same as Year 1991			Same as Year 1991		
					Oxides of Sulfur (SOx)					
					(Tons/District Total Vehicle Miles Traveled (VMT) by Motorcycles/Day)					
All Areas		**0.08**			**0.09**			**0.10**		
Years		(1991 and 1993)			(1995 to 2001)			(2003 to 2009)		
VMT		**278,570,000**		**304,232,000**		**329,894,000**		**355,555,000**		**381220000**
Years		*(1993)*		*(1997)*		*(2001)*		*(2005)*		*(2009)*
VMT	N/A		**291,401,000**		**317,065,000**		**342,727,000**		**368,388,000**	
Years			*(1995)*		*(1999)*		*(2003)*		*(2007)*	

Emissions in Grams per Mile = [(Tons/Day) x (907.18) x (1,000.0)]/[VMT For That Year]
Project Related Emissions = (Emissions in Grams Per Mile) x (Project Related VMT)

Note: See Table A-9-5-N-2-a for temperature corrected CO emission factors.
See Table A-9-5-N-2-b for temperature corrected SOx emission factors.
See Table A-9-5-N-3 for PM10 and Lead emission factors.

Table A9 – 5 – N –2 – a
AREA 1, AREA 2 and AREA 3
TEMPERATURE CORRECTED EMISSION FACTORS FOR MOTORCYCLES
(Grams Per Mile)
CARBON MONOXIDE (CO)

SPEED	1991	1993	1995	1997	1999	2001	2003	2005	2007	2009
5	63.34	63.22	62.51	62.45	62.44	62.43	62.43	62.43	62.43	62.43
10	30.63	30.13	30.06	30.03	30.02	30.02	30.02	30.02	30.02	30.02
15	19.97	19.79	19.74	19.72	19.72	19.71	19.71	19.71	19.71	19.71
20	15.30	15.17	15.14	15.12	15.12	15.12	15.12	15.12	15.12	15.12
25	12.51	12.41	12.39	12.38	12.37	12.37	12.37	12.37	12.37	12.37
30	10.50	10.42	10.40	10.39	10.39	10.39	10.39	10.39	10.39	10.39
35	8.98	8.92	8.90	8.90	8.89	8.89	8.89	8.89	8.89	8.89
40	7.92	7.87	7.86	7.85	7.85	7.85	7.85	7.85	7.85	7.85
45	7.30	7.25	7.25	7.24	7.24	7.24	7.24	7.24	7.24	7.24
50	7.01	6.97	6.96	6.96	6.95	6.95	6.95	6.95	6.95	6.95
55	6.77	6.74	6.74	6.73	6.73	6.73	6.73	6.73	6.73	6.73
60	6.06	6.04	6.04	6.03	6.03	6.03	6.03	6.03	6.03	6.03
65	4.34	4.33	4.33	4.33	4.33	4.33	4.33	4.33	4.33	4.33
Cold star	101.61	100.55	100.22	100.13	100.12	100.10	100.10	100.10	100.10	100.10
Hot start	4.85	4.81	4.81	4.80	4.80	4.80	4.80	4.80	4.80	4.80

Table A9 – 5 – N –2 – b
AREA 1, AREA 2 and AREA 3
TEMPERATURE CORRECTED EMISSION FACTORS FOR MOTORCYCLES
(Grams Per Mile)
OXIDES OF SULFUR (SOx)

SPEED	1991	1993	1995	1997	1999	2001	2003	2005	2007	2009
N/A	N/A	0.0003	0.0003	0.0003	0.0003	0.0002	0.0003	0.0003	0.0002	0.0002

Table A9 - 5 - N - 3
EMISSION FACTORS FOR MOTORCYCLES AT 75°F
(Grams per Mile)
Oxides of Nitrogen (NOx) and Lead

Speed	1991	1993	1995	1997	1999	2001	2003	2005	2007	2009
					YEARS					
					Running Exhaust Emission Factors at 75°F					
					Oxides of Nitrogen (NOx)					
5	0.69	Same Factors As Year 1991 ↓				Same Factors As Year 1991 ↓				
10	0.62									
15	0.64									
20	0.69									
25	0.77									
30	0.85									
35	0.91									
40	0.96									
45	1.00									
50	1.05									
55	1.16									
60	1.44									
65	2.11									
					Running Exhaust Temperature Correction Factors					
Area 1 and 2	1.03	Same Factors As Year 1991				Same Factors As Year 1991				
Area 3	0.955	Same Factors As Year 1991				Same Factors As Year 1991				
					Cold Start at 75°F					
	0.68	0.69		Same Factor as Year 1993						
					Cold Start Temperature Correction Factor					
Area 1 and 2	0.88	Same as Year 1991			Same as Year 1991			Same as Year 1991		
Area 3	1.155	Same as Year 1991			Same as Year 1991			Same as Year 1991		
					Hot Start at 75°F					
	0.86	Same as Year 1991			Same as Year 1991			Same as Year 1991		
					Hot Start Temperature Correction Factors					
Area 1 and 2	1.04	Same as Year 1991			Same as Year 1991			Same as Year 1991		
Area 3	0.94	Same as Year 1991			Same as Year 1991			Same as Year 1991		

Lead

(For All Years and Speeds For All Areas)

Lead	0.0 tons per day

Note: See Table A9 - 5 - N - 3 - a and A9 - 5 - N - 3 - b for temperature corrected NOx emission factors.

Table A9 – 5 – N –3 – a
AREA 1 and AREA 2
TEMPERATURE CORRECTED EMISSION FACTORS FOR MOTORCYCLES
(Grams Per Mile)
OXIDES OF NITROGEN (NOx)

SPEED	1991	1993	1995	1997	1999	2001	2003	2005	2007	2009
5	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71
10	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64
15	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66
20	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71
25	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
30	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
35	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
40	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
45	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03
50	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
55	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19
60	1.48	1.48	1.48	1.48	1.48	1.48	1.48	1.48	1.48	1.48
65	2.17	2.17	2.17	2.17	2.17	2.17	2.17	2.17	2.17	2.17
Cold start	0.60	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61
Hot start	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89

Table A9 – 5 – N –3 – b
AREA 3
TEMPERATURE CORRECTED EMISSION FACTORS FOR MOTORCYCLES
(Grams Per Mile)
OXIDES OF NITROGEN (NOx)

SPEED	1991	1993	1995	1997	1999	2001	2003	2005	2007	2009
5	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66
10	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
15	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61
20	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66
25	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74
30	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81
35	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
40	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
45	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
50	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
55	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11
60	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38
65	2.02	2.02	2.02	2.02	2.02	2.02	2.02	2.02	2.02	2.0[illegible]
Cold start	0.79	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.8[illegible]
Hot start	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81

Table A9 – 5 – N –3 – c
AREA 1, AREA 2 and AREA 3
TEMPERATURE CORRECTED EMISSION FACTORS FOR MOTORCYCLES
(Grams Per Mile)
RUNNING PM10

	1991	1993	1995	1997	1999	2001	2003	2005	2007	2009
TIRE WEAR										
	N/A	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
EXHAUST										
	N/A	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

INFORMATION
FOR
FUEL CONSUMPTION IN VEHICULAR SOURCES

TABLE A9 - 5 - O

FORECASTED FUEL CONSUMPTION SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT

Fuel Consumption by Fuel Type And Vehicle Type

(Gallons Per VMT)

Year	Vehicles with Gross Vehicle Weight up to 6,000 Pounds						Vehicles with Gross Vehicle Weight 6,000 Pounds and Greater***					
	AUTOMOBILES			LIGHT-DUTY TRUCKS			MEDIUM-DUTY			HEAVY-DUTY		
	NCAT	CAT	DIESEL	NCAT	CAT	DIESEL	NCAT	CAT	DIESEL	NCAT	CAT	DIESEL
1991												
1993	0.08	0.04	0.03	0.09	0.05	0.04	0.10	0.09	N/A	0.18	0.18	0.18
1995	0.08	0.04	0.03	0.09	0.05	0.04	0.10	0.09	N/A	0.18	0.18	0.17
1997	0.08	0.04	0.03	0.09	0.05	0.04	0.10	0.09	N/A	0.18	0.18	0.17
1999	0.07	0.04	0.03	0.08	0.05	0.04	0.10	0.09	N/A	0.18	0.18	0.16
2001	0.06	0.04	0.03	0.07	0.05	0.04	0.10	0.09	N/A	0.18	0.18	0.16
2003	0.06	0.04	0.03	0.07	0.05	0.04	0.10	0.09	N/A	0.18	0.18	0.16
2005	0.00	0.04	0.03	0.00	0.05	0.04	0.00	0.08	N/A	0.18	0.18	0.15
2007	0.00	0.03	0.03	0.00	0.05	0.04	0.00	0.08	N/A	0.18	0.18	0.15
2009	0.00	0.03	0.03	0.00	0.05	0.04	0.00	0.08	N/A	0.18	0.18	0.15

Fuel Consumption (Gallons per day or per quarter) = (*Daily or quarterly project related VMT x Gallons per VMT)

*VMT = Vehicle Miles Traveled per Day or per Quarter

For total VMT in the county please see Table A - 9 - 14 - A

NCAT = Gasoline-fueled vehicles without catalyst

CAT = Gasoline-fueled vehicles with catalyst

Diesel = Diesel-fueled vehicles

INFORMATION
FOR
ESTIMATING ROLLBACK 8-HOUR AND 1-HOUR PPM
LEVELS OF POLLUTANTS

TABLE A9 - 5 - P

ESTIMATING ROLLBACK 8-HOUR PPM LEVELS FOR FUTURE YEARS

(Note: Values used in examples were created, therefore, may not match with values in referenced tables. When performing project-specific analysis always use values from referenced tables and project-specific data. Do not use values from our example in your analysis. For future year CO adjustment factors use Table A9 - 9.)

E = ({F x G} + {[G x H] + [(I x G x H) x (J/K)]}) *(See Table A9 - 5 - Q for 1-Hour Levels)*

Where,

E = Rollback 8-hour PPM levels for the future year.
F = Percent contribution of that pollutant to ambient levels by stationary (direct) sources. *(District's reports for Air Quality Management Plan or see Table A3 - 1.)*
G = The highest 8-hour concentration in PPM for the previous three years *(Use the last 3 years of air quality monitoring data.)*
H = Percent contribution of that pollutant to ambient levels by mobile (indirect) sources. *(District's reports for Air Quality Management Plan or see Table A3 - 1.)*
I = Percent VMT Growth for that future year

= [100 x (Future Year VMT - Current Year VMT)]/[Current Year VMT]

To determine percent increase in VMT, use Table A9 - 14 - A of this Handbook.

J = Composite (between all autos, trucks, motorcycles, buses, etc.) on-road vehicle emission factor for the future year in grams per mile. See Table A9 - 5 - P - 1
K = Composite (between passenger vehicles, trucks and other on-road vehicles) emission factor for the current year in grams per mile. See Table A9 - 5 - P - 1

NOTE: Even though the following methodologies in Table A9 - 5 - P - 1 and 2 are included under a methodology that estimates background levels in ppm, these can also be used to estimate composite grams per mile emissions for Caline 4 ppm levels needed to determine CO, NOx and PM10 hot spots, and mass emissions needed to establish project significance.

- o *Table A9 - 5 - P - 1 to determine composite emission factor expressed in grams per mile; and,*
- o *Table A9 - 5 - P - 2 to determine composite emission factor expressed in grams per minute.*

TABLE A9 - 5 - P - 1

ESTIMATING COMPOSITE EMISSION FACTORS IN GRAMS PER MILE (FOR CALINE 4, BACKGROUND LEVELS OR MASS EMISSIONS)

(J) or (K) = $[(B \times B_{CHS}) + (M \times M_{CHS}) + (P \times P_{CHS}) + (T \times T_{CHS})]/(B + M + P + T)$

Where,

J = Composite emission factor for future year **in Grams per Mile**

K = Composite emission factor for current year **in Grams per Mile**

B = Bus percent ADT from Table A9 - 5 - G. (If 0.5 %, use 0.5, not 0.005)

B_{CHS} = Bus related composite emission factor between hot start, cold start and stabilized mode

= $(\{B_C \times [(C_C/A_B) + (D_{RE})]\} + \{B_H \times [(C_H/A_B) + (D_{RE})]\} + \{B_S \times D_{RE}\})/(B_C + B_H + B_S)$

Where,

B_C = Bus percent cold start estimates from Table A9 - 5 - M - 1 (Caline 4) or 2 (Background or Mass)
(If Table A9 - 5 - M - 1 is used to determine hot and cold start percentages by the road type, use Table A9 - 5 - M - 3 percentages to determine hot and cold start related fleet mix and Table A9 - 5 - G percentages to determine stabilized vehicles related fleet mix)

C_C = Bus cold start emission factor in **grams per trip** from Table A11 - 5 - H

A_B = Bus travel related trip length in miles. If unknown, use 3.59 miles.

D_{RE} = Bus running emission factor in **grams per mile** from Table A11 - 5 - H

B_H = Bus percent hot start estimates from Table A9 - 5 - M - 1 (Caline 4) or 2 (Background or Mass)

C_H = Bus hot start emission factor in **grams per trip** from Table A11 - 5 - H

B_S = Bus percent stabilized estimates, if Table A9 - 5 - M - 1 is used for hot and cold start %
= $[100 - (B_C + B_H)$

M = Motorcycle percent ADT from Table A9 - 5 - G. (If 0.6 %, use 0.6, not 0.006)

M_{CHS} = Motorcycle related composite emission factor between hot start, cold start and stabilized mode

= $(\{M_C \times [(N_C/A_M) + (O_{RE})]\} + \{M_H \times [(N_H/A_M) + (O_{RE})]\} + \{M_S \times O_{RE}\})/(M_C + M_H + M_S)$

Where,

M_C = Motorcycle percent cold start estimates from Table A9 - 5 - M - 1 (Caline 4) or 2 (Background or Mass)
(If Table A9 - 5 - M - 1 is used to determine hot and cold start percentages for the road type, use Table A9 - 5 - M - 3 percentages to determine hot and cold start related fleet mix and Table A9 - 5 - G percentages to determine stabilized vehicles related fleet mix)

N_C = Motorcycle cold start emission factor in **grams per trip** from Table A9 - 5 - N (1, 2 or 3)

A_M = Motorcycle travel related trip length in miles. If unknown, use 3.59 miles.

O_{RE} = Motorcycle running emission factor in **grams per mile** from Table A9 - 5 - N (1, 2, or 3)

M_H = Motorcycle percent hot start estimates from Table A9 - 5 - M - 1 (Caline 4) or 2 (Background or Mass)

N_H = Motorcycle hot start emission factor in **grams per trip** from Table A9 - 5 - N (1, 2, or 3)

M_S = Motorcycle percent stabilized estimates, if Table A9 - 5 - M - 1 is used for hot and cold start %
= $[100 - (M_C + M_H)$

P = Passenger vehicle ADT from Table A9 - 5 - G. (If 85.0 %, use 85.0, not 0.85)

P_{CHS} = Passenger vehicle related composite emission factor between hot start, cold start and stabilized mode

= $(\{P_C \times [(Q_C/A_P) + (R_{RE})]\} + \{P_H \times [(Q_H/A_P) + (R_{RE})]\} + \{P_S \times R_{RE}\})/(P_C + P_H + P_S)$

Where,

P_C	=	Passenger vehicle percent cold start estimates from Table A9 - 5 - M - 1 (Caline 4) or 2 (Background or Mass) *(If Table A9 - 5 - M - 1 is used to determine hot and cold start percentages for the road type, use Table A9 - 5 - M - 3 percentages to determine hot and cold start related fleet mix and Table A9 - 5 - G percentages to determine stabilized vehicles related fleet mix)*
Q_C	=	Passenger vehicle cold start emission factor in **grams per trip** from Table A9 - 5 - J
A_P	=	Passenger vehicle travel related trip length in miles. If unknown, use 3.59 miles.
R_{RE}	=	Passenger Vehicle running emission factor in **grams per mile** from Table A9 - 5 - J
P_H	=	Passenger vehicle percent hot start estimates from Table A9 - 5 - M - 1 (Caline 4) or 2 (Background or Mass)
Q_H	=	Passenger vehicle hot start emission factor in **grams per trip** from Table A9 - 5 - J
P_S	=	Passenger vehicle percent stabilized estimates, if Table A9 - 5 - M - 1 is used for hot and cold start % = $[100 - (P_C + P_H)$

T = Trucks or material hauling vehicle ADT from Table A9 - 5 - G. (If 10.0 %, use 10.0, not 0.10)

T_{CHS} = Truck related composite emission factor between hot start, cold start and stabilized mode

$$= (\{T_C \times [(U_C/A_T) + (V_{RE})]\} + \{T_H \times [(U_H/A_T) + (V_{RE})]\} + \{T_S \times V_{RE}\})/(T_C + T_H + T_S)$$

Where,

T_C	=	Truck percent cold start estimates from Table A - 9 - 5 - M - 1 (Caline 4) or 2 (Background or Mass) *(If Table A9 - 5 - M - 1 is used to determine hot and cold start percentages for the road type, use Table A9 - 5 - M - 3 percentages to determine hot and cold start related fleet mix and Table A9 - 5 - G percentages to determine stabilized vehicles related fleet mix)*
U_C	=	Truck cold start emission factor in **grams per trip** from Table A9 - 5 - K
A_T	=	Truck travel related trip length in miles. If unknown, use 3.59 miles.
V_{RE}	=	Truck running emission factor in **grams per mile** from Table A9 - 5 - K
T_H	=	Truck percent hot start estimates from Table A9 - 5 - M - 1 (Caline 4) or 2 (Background or Mass)
U_H	=	Truck hot start emission factor in **grams per trip** from Table A9 - 5 - K
T_S	=	Truck percent stabilized estimates, if Table A9 - 5 - M - 1 is used for hot and cold start % = $[100 - (T_C + T_H)$

TABLE A9 - 5 - P - 2

ESTIMATING COMPOSITE EMISSION FACTORS IN GRAMS PER MINUTE

J* or K* = {[W x Y]/60

Where,

J*	=	Composite emission factor for future year in grams per minute
K*	=	Composite emission factor for current year in grams per minute
W	=	Freeflow (5 mph or higher) or congested (Lower than 5 mph) travel speed expressed in miles per hour *(see Table A9 - 5 - F for freeflow speeds)*
Y	=	Composite emission factor expressed in gms per mile at W mph *(Use Table A9 - 5 - P - 1 methodology to estimate grams per mile composite emission factors)*

Use the following methodologies to estimate project emissions:

If the distance traveled is in meters (as required in CALINE 4 model)

E* = (L x Y)/(1609.3), where,

E* = Emissions in gms for distance traveled at W mph speed

L* = Actual distance traveled in meters at W mph speed

If the distance traveled is in miles (as required in the mass-emission estimating model, Table A9 - 5)

E* = (L* x Y), where,

L* = Actual distance traveled in miles at W mph speed

TABLE A9 - 5- Q

ESTIMATING ROLLBACK 1-HOUR PPM LEVELS FOR FUTURE YEARS

(Parts Per Million or PPM)

(Note: Values used in examples were created, therefore, may not match with values in referenced tables. When performing project-specific analysis always use values from referenced tables and project-specific data. Do not use values from our example in your analysis.)

E = (F)/(G)

Where,

E = Rollback 1-hour PPM levels for the future year.
F = Rollback 8-hour PPM levels for the future year.
(Use Table A9 - 5 - P to determine the value for F.)
G = The highest persistent factor among previous three years.
(*To determine* 1- to 8-hour *persistent factor, use the last 3 years of air quality monitoring data.*)
= (H)/(I)

where,

H = 8-hour concentrations for each of the previous three years
I = 1-hour concentrations for each of the previous three years

TABLES FOR ESTIMATING GASOLINE AND DIESEL FUELING EMISSIONS

TABLE A9 - 6

ESTIMATING EMISSIONS FROM GASOLINE AND DIESEL FUELING ACTIVITY (Pounds Per Day)

E = [(F/365) x ((G1, G2 or J)/H)] x I

Where,

E	=	Emissions of Reactive Organic Compounds (ROC) or Benzene* From Gasoline Station During Fueling and Storage
F	=	Amount of Gasoline Dispensed in Gallons per Year (If Unknown, Use 248,000,000 Gallons Per Year For Stations with both controls, Phase I and Phase II; 12,900,000 per year for stations without any Control and 20,900,000 per year for stations with only Phase I Control.)
G1, G2 or J	=	Emission Factor per 1,000 gallons Dispensed
H	=	1000; Because the emission factor is used for 1000 gallons
I	=	0.92; Use only to convert Total Organic Compounds (TOC) Emissions to ROC emissions. (Do not use "I" for Benzene)

TABLE A9 - 6 - A

EMISSION FACTORS (G1) FOR EACH CRITERIA POLLUTANT FOR INDIVIDUAL ACTIVITIES ASSOCIATED WITH ORIGINAL (REMOVED) EQUIPMENT

(For composite activities emission factor (G2) please see third column of Table A - 9 - 6 - B)

(Pounds Per 1000 Gallons)

Pollutant Type	CO	TOC	NOx	SOx	PM10
Stage I (Storage Tank Loading and Storing)					
Storage					
Breath-Underground Tank	N/A	1.0	N/A	N/A	N/A
Loading					
Splash Filling	N/A	11.50	N/A	N/A	N/A
Sub-Fill No Control	N/A	7.30	N/A	N/A	N/A
Unloading	N/A	1.00	N/A	N/A	N/A
Sub-Fill Balanced	N/A	0.30	N/A	N/A	N/A
Stage II (Motor Vehicle Fueling)					
No Vapor Control	N/A	11.00	N/A	N/A	N/A
No Liquid Control	N/A	0.67	N/A	N/A	N/A
Vapor Controlled	N/A	0.90	N/A	N/A	N/A

N/A = Not Applicable

TABLE A9 - 6 - B

EMISSION FACTORS (J) FOR BENZENE* AND EQUIVALENT EMISSION FACTORS (G2) FOR TOC IN VEHICULAR FUELING AND STORING COMPOSITE ACTIVITIES (Pounds per 1000 Gallons)

(NOTE: Benzene is identified as a carcinogenic air contaminant, which should be quantified using above methodology)

	Benzene Emissions (J)	TOC Emissions (G2)
Phase I and II Control	0.0138 lbs. / 1000 gallons	1.725 lbs. / 1000 gallons
Phase I Only	0.0974 lbs. / 1000 gallons	12.175 lbs. / 1000 gallons
No Control	0.1696 lbs. / 1000 gallons	21.200 lbs. / 1000 gallons

* **If ROC (E) is estimated using "G2" emission factors, benzene emissions can be estimated by the following methodology: $[(E_{ROC}) \times (J)]/[(G2 \times (0.92)]$**

SOURCE: Proposed Airborne Toxic Control Measure for Emissions of Benzene from Retail Service Stations. July 9, 1987

INFORMATION
FOR
AVERAGE VEHICLE RIDERSHIP DETERMINATION

TABLE A9 - 7
ESTIMATING PROJECT-RELATED EXISTING OR CURRENT AVERAGE VEHICLE RIDERSHIP OR OCCUPANCY
(Based on the District's Regulation XV)

CAVR = [F]/[G]; *OR*
CAVR = [{A x B} + {C x D}]/[{(A/E*)xB} + {(C/E*)xD}]

Where,

CAVR = Current or Pre-Mitigation Average Vehicle Ridership

To improve AVR, the number of cars associated with the following should be eliminated or reduced;

F = Average Persons Arriving in Vehicles at the Project Site; and,
G = Average Cars Arriving at the Project Site; *OR*
A = Total Number of 1-Way or 2-Way Trips made with Automobiles, trucks, etc. by 1 Person in 1 Vehicle per Week;
B = Number of Days Trips made with Automobiles, trucks, etc. by 1 Person in 1 Vehicle per Week;
C = Total Number of 1-Way or 2-Way Trips made with Motorcycles by 1 Person on 1 Motorcycle per Week;
D = Number of Days Trips made with Motorcycles by 1 Person on 1 Motorcycle per Week;
E* = 1.0 or 2.0; (*Used to Determine Number of Cars Arriving at the Project Site*).

* If A and C were One-Way Trips, then A and C will be divided by 1.0 To obtain Number of Cars.

* If A and C were Two-Way Trips, then A and C will be divided by 2.0 to obtain Number of Cars.

To improve AVR, the number of cars arriving at the project site must be reduced.
Use Table 11-5 methodologies from Appendix 11 for emission reductions after implementation of each mitigation measure that reduces number of cars arriving at the project site.

AVR for the Vehicles Staying Home but Used for Other Trips = 1/1 = 1.00

Even though the following information is not needed to estimate the work-related AVR, this information should be provided in an environmental document as Non-work Related AVR. Use the following information for Appendix 11 methodologies to estimate emissions from Non-work trips. *The 1991 AQMP states that 5% of the following trips were for Home to Other trips*:

Non-work 1-Way Project Trips = [{(J+K+L+M+N+O+P+Q+R+U) x 0.05} + {(S+T) x V}]; Where,

J = Number of Persons Walked 1-way
K = Number of Persons Traveled 1-way by Bicycle
M = Number of Persons did not travel to the project site due to days off from 3/36 work week
N = Number of Persons did not travel to the project site due to days off from 4/40 work week
O = Number of persons did not travel to the project site due to days off from 9/80 work week
P = Number of persons did not travel to the project site due to vacation
Q = Number of persons did not travel to the project site due to sick leave
R = Number of persons did not travel to the project site because they were absent for reasons other than vacation and sick leaves
S = Number of persons did not travel to the project site because it was Saturday
T = Number of persons did not travel to the project site because it was Sunday
V = Percent Weekend Trips to other

Note: 1-way trip is trip to work.

INFORMATION
FOR
MOBILE EQUIPMENT EMISSIONS

TABLE A9 - 8

ESTIMATING EMISSIONS FROM MOBILE *** EQUIPMENT (EXHAUST AND EVAPORATIVE TYPE) (Pounds Per Day)

E* = (F x G) x H; or
E** = (F x G) x (K x L x M)

Use Table A9 - 3 of this Handbook with information provided in Tables A9 - 8 - C and A9 - 8 - D

Where,

- E* = Time specific exhaust emissions of criteria pollutants in pounds per day or pounds per quarter
- F = Source population or number of equipment with the same characteristic information****
  (Please see Tables A9 - 8 - A, B, C, D and E for the types of equipment for which this formula can be used)
- G = Daily hours or quarterly hours of operation per day per F type equipment
  (If unknown, use 8, 16 or 24 hours depending on the number of shifts in a day, use 65 to 91 days per quarter depending on the number of work days in a quarter, and use 261 to 365 days per year depending on the number of work days in a year.)
- H = Time specific emission factors in pounds per hour per F type equipment
  (Please see Table A9 - 8 - A for time specific emission factors)
- E** = Mechanical energy output specific exhaust emissions of criteria pollutants in pounds per day
- K = Average rated mechanical energy output for F type equipment in horsepower
  (Please see Table A9 - 8 - C for average rated horsepower)
- L = Mechanical energy output specific emission factors at 100 % load in pounds per horsepower-hour
- M = Fraction for typical load factor *(If unknown, use value from Table A9 - 8 - D divided by 100)*

* Use this formula only when hours of operation of each equipment is available

** Use this formula only when mechanical energy output in horsepower and hours of operation is known.

*** Contact California Air Resources Board (El Monte, California Branch) to obtain the copy of the most recent version of regulations on exhaust emission standards and performance specifications for mobile (off-road) equipment.

**** For an initial study, use Table A9 - 8 - E to estimate number of equipments that can be operated in a day without exceeding construction thresholds.

TABLE A9 - 8 - A

EXHAUST EMISSION FACTORS (H) FOR EACH CRITERIA POLLUTANT

(Pounds Per Hour)

Note: As much as possible use the following emission factors from Table A9 - 8 - A. If these emission factors cannot be applied to your project then only use emission factors provided in Table A9 - 8 - B.

Equipment Type	CO		ROC		NOx		SOx		PM10	
***	G	D	G	D	G	D	G	D	G	D
Fork Lift - 50 Hp	14.0	0.18	0.5	0.053	0.018	0.441	-	-	0.003	0.031
Fork Lift - 175 Hp	43.97	0.52	1.53	0.17	0.92	1.54	-	-	0.123	0.093
Trucks: Off-Highway	-	1.8	-	0.19	-	4.17	-	0.45	-	0.26
Tracked Loader	-	0.201	-	0.095	-	0.83	-	0.076	-	0.059
Tracked Tractor	-	0.35	-	0.12	-	1.26	-	0.14	-	0.112
Scraper	-	1.25	-	0.27	-	3.84	-	0.46	-	0.41
Wheeled Dozer	-	-	-	-	-	-	-	0.35	-	0.165
Wheeled Loader	15.57	0.572	0.515	0.23	0.518	1.9	0.023	0.182	0.03	0.17
Wheeled Tractor	9.53	3.58	0.351	0.18	0.43	1.27	0.015	0.09	0.024	0.14
Roller	13.41	0.30	0.59	0.065	0.362	0.87	0.0185	0.067	0.026	0.05
Motor Grader	12.10	0.151	0.40	0.039	0.32	0.713	0.017	0.086	0.021	0.061
Miscellaneous	17.02	0.675	0.543	0.15	0.412	1.7	0.023	0.143	0.026	0.14

*** Fuel types: G = Gasoline-Powered; and D = Diesel-Powered

Source: AP-42 Report, September 1985, Federal Environmental Protection Agency

TABLE A9 - 8 - B
EXHAUST EMISSION FACTORS (L) AT 100% LOAD FOR EACH CRITERIA POLLUTANT

(4-stroke and 2-stroke description applies only to gasoline-powered equipment)

(Pounds Per Horsepower-Hour)

As much as possible use emission factors provided in Table A9 - 8 - A. The following emission factors should be used only if emission factors from previous Table cannot be used. As a last source to estimate construction related exhaust emissions use Tables A9 - 3 - G and A9 - 3 - H. These tables provide methodology to estimate construction related BTU values for a project. Convert daily BTU consumption to daily horsepower-hour (multiply BTUs by 0.000393) consumption and then use the following emission factors.

Equipment Type	CO		ROC		NOx		SOx		PM10	
***	Diesel	Gasl.	Diesel	Gasl	Diesel	Gasl.	Diesel	Gasl.	Diesel	Gasl.
Paving Equp (4-strk)	0.010	0.83	0.002	0.042	0.024	0.004	0.002	0.0005	0.001	0.00025
Paving Equip (2-strk)	0.010	2.04	0.002	0.896	0.024	0.0006	0.002	0.0005	0.001	0.00845
Plate Compctr (4-strk)	0.007	0.83	0.002	0.043	0.020	0.004	0.002	0.0005	0.001	0.00025
Plate Compctr (2-Strk)	0.007	2.04	0.002	0.897	0.020	0.0006	0.002	0.0005	0.001	0.00845
Bore/Drill Rig (4-strk)	0.020	0.57	0.003	0.025	0.024	0.011	0.002	0.0005	0.0015	0.00005
Bore/Drill Rig (2-strk)	0.020	2.04	0.003	0.897	0.024	0.0006	0.002	0.0005	0.0015	0.00845
ChainSaws>4HP(2-Strk)	-.-	2.15	- -	0.684	- -	0.0021	- -	0.0008	- -	0.00143
Tmpr/Rammr (2-Strk)	- -	2.04	- -	0.897	- -	0.0006	- -	0.0005	- -	0.00845
Tampers/Rammers	- -	0.83	- -	0.043	- -	0.004	- -	0.0005	- -	0.00025
Skid-Steer Loader	0.020	0.44	0.004	0.018	0.021	0.44	0.002	0.0005	0.0015	0.00005
Rubber Tired Loaders	0.011	0.47	0.002	0.021	0.023	0.012	0.002	0.0005	0.0015	0.00005
Trctr/Lodr/Bckho	0.015	0.57	0.003	0.025	0.022	0.011	0.002	0.0005	0.001	0.00005
Terminal Tractors	0.013	0.026	0.003	0.57	0.031	0.011	0.002	0.0006	0.0015	0.00005
Excavators	0.011	0.57	0.001	0.025	0.024	0.011	0.002	0.0005	0.0015	0.00005
Trenchers	0.020	0.57	0.003	0.026	0.022	0.011	0.002	0.0005	0.0015	0.00005
Rollers	0.007	0.85	0.002	0.049	0.020	0.005	0.002	0.0006	0.001	0.00025
Other Cnstrctn Equip	0.020	0.57	0.003	0.025	0.024	0.011	0.002	0.0005	0.0015	0.00005
Cement/Mortar Mix	0.010	0.83	0.002	0.040	0.024	0.004	0.002	0.0005	0.001	0.00025
Asphalt Pavers	0.007	0.57	0.001	0.025	0.023	0.011	0.002	0.0005	0.001	0.00005
Concrete Saws	0.020	0.003	0.024	0.043	0.002	0.004	0.003	0.0005	0.001	0.00025
Crushing Equipment	0.020	0.57	0.003	0.025	0.024	0.011	0.002	0.0005	0.0015	0.00005
Aerial Lifts	0.013	0.57	0.003	0.025	0.031	0.011	0.002	0.0006	0.0015	0.00005
Rough Terrain Fork Lifts	0.022	0.57	0.003	0.025	0.018	0.011	0.002	0.0005	0.0015	0.00005
Crushing Equipment	0.020	0.57	0.003	0.025	0.024	0.011	0.002	0.0005	0.0015	0.00005
Fork Lifts	0.013	0.57	0.003	0.025	0.031	0.011	0.002	0.0006	0.0015	0.00005
Cranes	0.009	0.57	0.003	0.025	0.023	0.011	0.002	0.0005	0.0015	0.00005
Sprayers	0.008	0.62	0.005	0.029	0.017	0.011	0.002	0.0006	0.0015	0.00025
Dumpers/Tendors	0.006	0.83	0.002	0.043	0.021	0.004	0.002	0.0005	0.0015	0.00025
Signal Boards	0.011	0.83	0.002	0.043	0.018	0.004	0.002	0.0005	0.001	0.00025
Sweepers/Scrubbers	0.013	0.57	0.003	0.025	0.031	0.011	0.002	0.0006	0.0015	0.00005
Sweepers/Scrubbers	0.013	0.57	0.003	0.025	0.031	0.011	0.002	0.0006	0.0015	0.00005
Generator sets <50 HP	0.011	1.479	0.002	0.054	0.018	0.002	0.002	0.0006	0.001	0.00025
Gnrtr <50 HP (2-stroke)	0.011	2.036	0.002	0.893	0.018	0.0006	0.002	0.0006	0.001	0.00845
Pressur Washer <50 HP	0.011	1.479	0.002	0.054	0.018	0.002	0.002	0.0006	0.001	0.00025
Hydro Power Units	0.008	0.913	0.005	0.038	0.017	0.005	0.002	0.0006	0.0015	0.00025
Welders <50 HP	0.011	1.479	0.002	0.054	0.018	0.002	0.002	0.0006	0.001	0.00025
Pumps <50 HP	0.011	1.479	0.002	0.054	0.018	0.002	0.002	0.0006	0.001	0.00025
Air Cmpressor <50 HP	0.011	1.479	0.002	0.054	0.018	0.002	0.002	0.0006	0.001	0.00025
Surfacing Equipment	- -	0.83	- -	0.043	- -	0.004	- -	0.0005	- -	0.00025
2-Wheeled Tractors	- -	0.600	- -	0.032	- -	0.0058	- -	0.0005	- -	0.00025
Shredder >5 HP	- -	1.479	- -	0.056	- -	0.0018	- -	0.0004	- -	0.0004
Concrete Pavers	0.01	- -	0.002	- -	0.022	- -	0.002	- -	0.001	- -
Rubber Tired Dozers	0.01	- -	0.002	- -	0.021	- -	0.002	- -	0.0005	- -
Off-Highway Tractors	0.032	- -	0.005	- -	0.026	- -	0.002	- -	0.002	- -
Skidder	0.011	- -	0.002	- -	0.025	- -	0.002	- -	0.0015	- -
Crawler Tractors	0.011	- -	0.002	- -	0.023	- -	0.002	- -	0.001	- -
Grader	0.008	- -	0.003	- -	0.021	- -	0.002	- -	0.001	- -
Scraper	0.011	- -	0.001	- -	0.019	- -	0.002	- -	0.0015	- -

TABLE A9 - 8 - C

FUEL CONSUMPTION AND NUMBER OF HOURS OF OPERATION FOR AVERAGE-RATED HORSEPOWER CAPACITY AT 100 % LOAD

(*All values are taken from November 1991 Nonroad Engine and Vehicle Emission Study and averaged*)
(NTIS PB92 - 126960, EPA 460/3-91-02, or EPA 21A - 2001)

The following information should be used only if Table A9 - 8 - A and Table A9 - 8 - B emission factors and related methodology cannot be used, or to estimate approximate fuel consumption in gallons if horsepower rating and hours of operation are known.

DIESEL (0.066 Gals/Hp-Hr)				GASOLINE (0.16 Gals/Hp-Hr)		
Equipment Type	Horsepower	Gallons	Hrs at 100 % Load	Horsepower	Gallons	Hrs at 100 % Load
Skid-Steer Loader	39.0	16.72	6	31.0	10.0	2
Wheel or Rubber Tired Loader	147	59.5	6	77.0	34.2	3
Tractors/Loaders	77	39.27	8	63.0	32.1	3
Airport Terminal Tractors	96	5.7	1	82.0	5.71	0.4
Excavators	56	28.56	8	80.0	40.8	3
Trenchers	60	30.60	8	27.0	2.6	1
Rollers	99	50.49	8	17.0	3.00	1
Other Construction Equipment	161	82.11	8	150.0	76.5	3
Cement and Mortar Mix	11	3.0	4	7.0	1.2	1
Paving Equipment	99	50.49	8	7.0	1.0	1
Asphalt Pavers	91	46.41	8	31.0	15.8	3
Plate Compactors	8	2.00	4	5.0	0.94	1
Concrete Saws (Cutting Concrete)	56	28.56	8	13.0	1.4	1
Crushing Equipment	127	64.77	8	60.0	30.6	3
Aerial Lifts	43	21.93	8	36.0	18.36	3
Rough Terrain Fork Lifts	93	47.43	8	88.0	44.8	3
Fork Lifts	83	42.33	8	62.0	18.0	2
Cranes	194	96.94	8	55.0	28.05	3
Sprayers	92	46.92	8	24.0	1.5	4
Dumpers/Tendors	23	11.73	8	9.0	3.0	2
Signal Boards (Routing Boards)	11.22	6.0	8	8.0	1.1	1
Bore/Drill Rigs (Groundwater)	209	106.59	8	54.0	27.5	3
Sweepers/Scrubbers	97	49.47	8	39.0	19.8	3
Generator sets <50 HP	22	11.22	8	11.0	1.0	1
Pressure Washers <50 HP	21	10.71	8	7.0	0.75	1
Hydro Power Units	35	17.85	8	14.0	5.0	2
Welders <50 HP	35	17.85	8	19.0	3.25	1
Pumps <50 HP	23	11.73	8	7.0	0.7	1
Air Compressors <50 HP	37	18.87	8	9.0	1.13	1
Landscape Loader	55	23.00	6	-.-	-.-	-.-
Backhoe Loader	79	21.0	3.5	-.-	-.-	-.-
Log Loader	116	50.8	7	-.-	-.-	-.-
Excavator (Utility)	34.2	28.23-	13	-.-	-.-	-.-
Excavator (Construction)	151.7	94.61	9	-.-	-.-	-.-
Surfacing Equipment (All Gasoline)	-.-	-.-	-.-	8.0	1.0	1
Tampers/Rammers (All Gasoline)	-.-	-.-	-.-	4.0	0.94	1
2-Wheeled Tractors (All Gasoline)	-.-	-.-	-.-	7.0	2.67	2
Shredder >5 HP (All Gasoline)	-.-	-.-	-.-	8.0	1.0	1
Chain Saws >4 HP (All Gasoline)	-.-	-.-	-.-	6.0	0.2	2

TABLE A9 - 8 - C (Cont.)

DIESEL (0.066 Gallons/Hp-Hr)				GASOLINE (0.16 Gallons/Hp-Hr)		
Equipment Type	Horsepower	Gallons	Hrs at 100 % Load	Horsepower	Gallons	Hrs at 100 % Load
Crawler Dozer (All Diesel)	102.9	54.25	8	-.-	-.-	-.-
Rubber Tired Dozers (All Diesel)	356	181.56	8	-.-	-.-	-.-
Crawler Tractors (All Diesel)	157	80.07	8	-.-	-.-	-.-
Tractor (Utility Compact)	29.4	7.53	4	-.-	-.-	-.-
Tractor (Utility General Purpose)	69	21.53	5	-.-	-.-	-.-
Fellers/Bunchers (All Diesel)	183	144.0	12	-	-.-	
Concrete Pavers (All Diesel)	130	66.3	8	-.-	-.-	-.-
Skidder (All Diesel)	134	63.95	7	-.-	-.-	-.-
Off-Highway Trucks (All Diesel)	489	249.39	8	-.-	-.-	-.-
Grader (All Diesel)	156.6	81.36	8	-.-	-.-	-.-
Scraper (All Diesel)	266.76	124.5	7	-.-	-.-	-.-

TABLE A9 - 8 - D

TYPICAL LOAD FACTORS FOR MOBILE (OFF-ROAD) EQUIPMENT

(*All values are taken from November 1991 Nonroad Engine and Vehicle Emission Study and averaged*)
(NTIS PB92 - 126960, EPA 460/3-91-02, or EPA 21A - 2001)

The following information should be used only if emission factors from Table A9 - 8 - B and related emission estimating methodology is used.

DIESEL		GASOLINE
Equipment Type	Load Factor Percent or %)	Load Factor (Percent or %)
Crawler Dozer (All Diesel)	59	-.-
Rubber Tired Dozers (All Diesel)	59	-.-
Crawler Tractors (All Diesel)	57.5	-.-
Tractor (Utility Compact)	46.5	-.-
Tractor (Utility General Purpose)	46.5	-.-
Fellers/Bunchers (All Diesel)	71	-.-
Concrete Pavers (All Diesel)	62	-.-
Skidder (All Diesel)	61.5	-.-
Off-Highway Trucks (All Diesel)	41	-.-
Grader (All Diesel)	57.5	-.-
Scraper (All Diesel)	66	-.-

TABLE A9 - 8 - D (Cont.)

DIESEL		GASOLINE
Equipment Type	Load Factor (Percent or %)	Load Factor (Percent or %)
Skid-Steer Loader	51.5	58
Wheel Loader	46.5	-.-
Rubber Tired Loaders	54	54
Tractors/Loaders/Backhoes	46.5	48
Airport Terminal Tractors	82	78
Excavators	58	78
Trenchers	69.5	66
Rollers	57.5	62
Other Construction Equipment	62	48
Cement and Mortar Mixer	56	59
Paving Equipment	53	59
Asphalt Pavers	59	66
Plate Compactors	43	55
Concrete Saws (Cutting Concrete)	73	78
Crushing Equipment	78	85
Aerial Lifts	50.5	46
Rough Terrain Fork Lifts	47.5	63
Fork Lifts	30	30
Cranes	43	47
Sprayers	50	50
Dumpers/Tendors	38	41
Signal Boards (Routing Boards)	82	76
Bore/Drill Rigs (Groundwater)	75	79
Sweepers/Scrubbers	68	71
Generator sets <50 HP	74	68
Pressure Washers <50 HP	30	30
Hydro Power Units	48	55
Welders <50 HP	45	51
Pumps <50 HP	74	69
Air Compressors <50 HP	48	56
Landscape Loader	46.5	-.-
Backhoe Loader	46.5	-.-
Log Loader	46.5	-.-
Excavator (Utility)	58	-.-
Excavator (Construction)	58	-.-
Surfacing Equipment (All Gasoline)	-.-	49
Tampers/Rammers (All Gasoline)	-.-	55
2-Wheeled Tractors (All Gasoline)	-.-	62
Shredder >5 HP (All Gasoline)	-.-	36
Chain Saws >4 HP (All Gasoline)	-.-	50

TABLE A9 - 8 - E

NUMBER OF CONSTRUCTION EQUIPMENT THAT WILL EXCEED SCAQMD DAILY THRESHOLDS AT 100 PERCENT LOAD

(Based on Emission Factors from Table A9 - 8 - A)

(The following table provides pieces of equipment that can be operated for each category and emissions for that equipment category which will still remain within daily thresholds during 8-hour construction activity.)

EQUIPMENT TYPE	GASOLINE-OPERATED	DIESEL-OPERATED
DETERMINING FACTOR	CARBON MONOXIDE THRESHOLDS (550 Pounds/Day)	OXIDES OF NITROGEN THRESHOLDS (100 Pounds Per Day)
Wheeled Loader	4	6+
Wheeled Tractor	7	9+
Roller	5	14+
Fork Lift - 50 HP	4	28
Fork Lift - 175 HP	4+	8
Trucks: Off-Highway	- -	3
Tracked Loader	- -	15
Tracked Tractor	- -	9+
Scraper	- -	3+
Motor Grader	5+	17
Miscellaneous	4	7

\+ *An Additional Equipment in this Category may be Operated for 4 or Less Hours Per Day, and Remain Below the District New Threshold Levels for That Equipment Category*

Note: Table A9 - 8 - E shall only be used as a reference in selecting the amount of potential equipment that may be needed for the project. It shall not be used for estimating emissions. Manufacturers' emission data should be used to determine emission estimates. If manufacturers' data is not available, use applicable tables from appendices. If manufacturers' data is used, make sure that the data is developed using EPA, ARB and SCAQMD approved test protocols.

INFORMATION FOR PM10 EMISSIONS FROM FUGITIVE DUST CREATED DURING CONSTRUCTION AND OPERATION OF THE PROJECT

TABLE A9 - 9

ESTIMATING PM10 EMISSIONS FROM FUGITIVE DUST
(CONSTRUCTION SITES, AND OPERATION OF COMMERCIAL, RESIDENTIAL FACILITIES AND INDUSTRIES SUCH AS QUARRIES, ROCK-CRUSHING, ETC.)
(POUNDS PER DAY)

SOURCE TYPE	SOURCE-RELATED ESTIMATIONS	MULTIPLY BY	EMISSION FACTORS (F)	REFERENCE TO TABLES*****	EMISSIONS (Pounds/Day) (E)
Passenger Vehicle/ On Paved Roadways (without street cleaning)	_____ VMT per DAY (Use Table A9 - 9 - A)	X	_______, or (0.33 lbs/mile)*	Table A9 - 9 - B	________
Passenger Vehicle/ On Paved Roadways (with street cleaning)	_____ VMT per DAY (Use Table A9 - 9 - A)	X	_______, or (0.018 lbs/mile)*	Table A9 - 9 - B	________
Passenger Vehicle/ On Unpaved Roads	_____ VMT per DAY (Use Table A9 - 9 - A)	X	______, or (5.56 lbs/mile)*	Table A9 - 9 - D	________
Trucks on Paved Roadways (without street cleaning)	_____ VMT per DAY (Use Table A9 - 9 - A)	X	______, or (2.00 lbs/mile)*	Table A9 - 9 - C	________
Trucks on Paved Roadways (with street cleaning)	_____ VMT per DAY (Use Table A9 - 9 - A)	X	______, or (0.40 lbs/mile)*	Table A9 - 9 - D	________
Trucks On Unpaved Roads	_____ VMT per DAY (Use Table A9 - 9 - A)	X	______, or (23.0 lbs/mile)*	Table A9 - 9 - D	________

TABL (Cont.)

ESTIMATING PM10 EMISSIONS FROM FUGITIVE DUST (POUNDS PER DAY)

SOURCE TYPE	SOURCE-RELATED ESTIMATIONS	MULTIPLY BY	EMISSION FACTORS (F)	REFERENCE TO TABLES*****	EMISSIONS (Pounds/Day) (E)
Passenger Vehicle/ Paved Parking Lots (without street cleaning)	______ # of Vehicles per Day	X	_____ x A** lbs/vehicle; or (0.33 x A** lbs/vehicle)*	Table A9 - 9 - B	______
Passenger Vehicle/ Paved Parking Lots (with street cleaning)	______ # of Vehicles per Day	X	_____ x A** lbs/vehicle; or (0.018 x A** lbs/vehicle)*	Table A9 - 9 - B	______
Passenger Vehicle/ Unpaved Parking Lots	______ # of Vehicles per Day	X	_____ x A** lbs/vehicle; or (5.56 x A** lbs/vehicle)*	Table A9 - 9 - D	______
Trucks/Paved Parking Lots (without street cleaning)	______ # of Vehicles per Day	X	_____ x A** lbs/vehicle; or (2.00 x A** lbs/vehicle)*	Table A9 - 9 - C	______
Trucks/Paved Parking Lots (with street cleaning)	______ # of Vehicles per Day	X	_____ x A** lbs/vehicle; or (0.40 x A** lbs/vehicle)*	Table A9 - 9 - C	______
Trucks Vehicles/ Unpaved Parking Lots	______ # of Vehicles per Day	X	_____ x A** lbs/vehicle; or (23.0 x A** lbs/vehicle)*	Table A9 - 9 - D	______

TABLE A9 - 9 (Cont.)

ESTIMATING PM10 EMISSIONS FROM FUGITIVE DUST (POUNDS PER DAY)

SOURCE TYPE	SOURCE-RELATED ESTIMATIONS	MULTIPLY BY	EMISSION FACTORS (F)	REFERENCE TO TABLES*****	EMISSIONS (Pounds/Day) (E)
Open Storage Piles	_____ Acres of Area Covered by Storage Piles per Day	X	______, or (85.6 lbs/day/acre)*	Table A9 - 9 - E	________
	- OR -				
	_____ Square Feet of Area Covered by Storage Piles per Day	X	______, or (1.97 lbs/day/ 1000 square feet)*	Table A9 - 9 - E	________
Dirt/Debris Pushing Operations	____ # of Bulldozers x ____ Hours of Operation per Day	X	______, or (21.8 lbs/hour)*	Table A9 - 9 - F	________
Storage Pile Filling or Truck Dumping	_____ Tons of Material Handled per Day	X	__________, or (0.009075 lbs/ton)*	Table A9 - 9 - G	________
Truck Filling or Storage Pile Emptying	_____ Tons of Materials Handled per Day	X	__________, or (0.02205 lbs/ton)*	EPA MRI Report	________
Demolition	_____ Cubic Feet of building volume Demolished	X	__________, or (0.00042 lbs PM10/ cubic feet of building volume)*	Table A9 - 9 - H	________

TABL. (Cont.)

ESTIMATING PM10 EMISSIONS FROM FUGITIVE DUST (POUNDS PER DAY)

SOURCE TYPE	SOURCE-RELATED ESTIMATIONS	MULTIPLY BY	EMISSION FACTORS (F)	REFERENCE TO TABLES***	EMISSIONS (Pounds/Day) (E)
Graded Surface	_____ Acres of Area Graded	X	N/A or, (26.4 lbs/Day/Acre)*	EPA MRI Report	_______
Top Soil Removal (15 Cubic Meter Pan Scraper) Earthmoving	_____ VMT per DAY (Table A9 - 9 - A)	X	N/A or, (20.0 lbs/mile)*	EPA MRI Report	_______
(Cut and Fill Operation) (15 Cubic Meter Pan Scraper) Dirt Hauling	_____ VMT per DAY (Table A9 - 9 - A)	X	N/A or, (4.3 lbs/mile)*	EPA MRI Report	_______
w/Truck	_____ VMT per DAY (Table A9 - 9 - A)	X	N/A or, (10.0 lbs/mile)*	EPA MRI Report	_______

* Default value

Example: Estimated Value, or Estimate Emission Factors Using Project Specific Data and Appropriate Tables

Default Value — Use this value instead of estimating project specific emission factor

** A = (L + W) x C

where,

L = Length of the parking lot in feet

W = Width of the parking lot in feet

C = 0.000189, a conversion factor to convert feet to miles

Note If value of (L + W) is unknown, use the following methodology to best estimate that value: Multiply the width of a carspace by 3.0 and add it to the length of that carspace. Multiply the addition by number of cars estimated for that parking lot or a project. For a normal size passenger carspace, width is 10 ft and length is 20 ft; for a compact size passenger carspace, width is 7 ft and length is 15 ft.

Thus, for a normal size passenger carspace, A = (((10 x 3) + (20)) x # of normal size vehicles or car spaces) x 0.000189; and for a compact size passenger carspace, A = (((7 x 3) + (15)) x # of compact size vehicles or car spaces) x 0.000189

Parking Space Default Values:

(For project-specific data, consult with city planners or environmental documents)

TABLE A9 - 9 (Cont.)

ESTIMATING PM10 EMISSIONS FROM FUGITIVE DUST (POUNDS PER DAY)

1 parking space per 300 sq. ft. of commercial construction.
1 parking space per 1000 sq. ft of industrial park, warehouse-type construction.
1 parking space per 500 sq. ft of industrial manufacturing-type construction.

2 car spaces/family unit of single-family housing construction.
1 car space/1 bdrm unit of multi-family housing construction.
2 car spaces/2 or more bdrm units of multi-family housing construction.

*** Tables with examples to estimate emissions and project specific emission factors

TABLE A9 - 9 - A
ESTIMATING VEHICLE MILES TRAVELED FOR DUST EMISSIONS

V = W x (X/Y) x Z

This formula can also be used for estimating vehicle miles traveled (VMT) for Table A9 - 5 of this Handbook

Where,

V = Vehicle Miles Traveled or VMT (*Use this VMT to estimate fugitive dust and PM10 from fugitive on roads in Table A9 - 9*).

W = Traveled Distance or Trip Length in miles (*For unpaved haul road, please see Example - 1 for unpaved country road, see Example - 2.*)

X = Number of vehicles (*See environmental document or analysis for Tables 9 - 5 and 9 - 17*).

Y = One Hour

Z = Travel times in hours (*See environmental document or analysis for Tables 9 - 5 and 9 - 17*)

EXAMPLE - 1

EXAMPLE FOR AN UNPAVED <u>HAUL</u> ROAD
(Estimated VMT = 9,000 with the following input assumptions)
(Please do not copy these assumptions, use the project specific data)

	Input Example	Input Examples
W =	Distance	5 miles
X =	Number of Vehicles per hour	150
Z =	Hours of Dust-Causing Activity	12

EXAMPLE - 2

EXAMPLE FOR AN UNPAVED <u>COUNTRY</u> ROAD
(Estimated VMT = 13,500 with the following input assumptions)
(Please do not copy these assumptions, use the project specific data)

	Input Example	Input Examples
W =	Distance	5 miles
X =	Number of Vehicles per hour	150
Z =	Hours of Dust-Causing Activity	18

Note In above two examples hours of dust-causing activities was changed; therefore, VMT was changed from 9,000 to 13,500 miles. Use project specific estimates.

TABLE A9 - 9 - B

ESTIMATING EMISSIONS FROM PASSENGER VEHICLE TRAVEL ON PAVED ROADS

E* = V x F (without street cleaning); or,
E** = V x G (with street cleaning and is dependent on type of road)

Where,

- E* = Emissions for passenger vehicles on paved roads and paved parking lots without street cleaning.
- V = Vehicle miles Traveled *(See Table A9 - 9 - A to estimate VMT associated with passenger vehicles.)*
- F = Default Emission Factor *(without street cleaning)* of 0.33 Pounds per Mile Traveled
- E** = Emissions for passenger vehicles on paved roads and paved parking lots with street cleaning.
- G = Emission factors *(with street cleaning and is dependent on type of road)* from Sierra Research (*See Table A9 - 9 - B - 1*)

TABLE A9 - 9 - B - 1

PAVED ROAD EMISSION FACTORS - PASSENGERS CARS WITH STREET CLEANING

(Pounds of PM10/Vehicle Mile Traveled)

Road Type	G (lb/VMT)
Local Streets	0.018
Collector Streets	0.013
Major Streets/Highways	0.0064
Freeways	0.00065

TABLE A9 - 9 - C

ESTIMATING EMISSIONS FROM TRUCK TRAVEL ON PAVED ROADS

E = V x F

Where,

- E = Emissions for Truck Travel on paved roads and paved parking lots without street cleaning.
- V = Vehicle miles Traveled (*See Table A9 - 9 - A to estimate VMT associated with trucks.*)
- F = Emission Factor for Truck Travel on paved roads and paved parking lots without street cleaning.

  $0.77 \times \{(G \times 0.35)^{0.3}\}$ in pounds per miles traveled

  Where,

  G = Surface silt loading in ounces/square yards (*Please see Table A9 - 9 - C - 1 for the type of roads and the silt loading*)

TABLE A9 - 9 - C - 1

PAVED ROAD SILT LOADING (G) AND ROAD TYPE - TRUCK TRAVEL
(G = Ounces per square yard of road)

Road Type	G (oz/yd^2)
Construction sites (without cleaning)	8.85
Construction sites (with cleaning)	0.04
Industrial Sites (in operation)	2.95
Local Streets	0.04
Collector Streets	0.03
Major Streets/Highways	0.012
Freeway	0.00065

EXAMPLES

Examples of Estimating Emission Factor (F) for Truck on Local Road
(F = pounds per Vehicle Miles Traveled)

Truck on	F (lb/VMT)
Example 1 Local Road	$F = 0.77 x ([(G = 0.04) x 0.35]^{0.3})$ = 0.214
Example 2 Construction Site (without cleaning)	$F = 0.77 x ([(G = 8.85) x 0.35]^{0.3})$ = 1.081

TABLE A9 - 9 - D

ESTIMATING EMISSIONS FROM VEHICLE TRAVEL ON UNPAVED ROADS

E = V x F

Where,

E* = Emissions for Vehicle Travel on unpaved roads and unpaved parking lots.

V = Vehicle Miles Traveled (*See Table A9 - 9 - A to estimate VMT associated with passenger vehicles.*)

F = Emission Factor for Vehicle Travel on unpaved roads and unpaved parking lots.
$2.1 \times [G/12] \times [H/30] \times \{[J/3]^{0.7}\} \times \{[I/4]^{0.5}\} \times \{[365 - K]/365\}$ in pounds per miles traveled

Where,

G = Surface silt loading in percent (*Please see Table A9 - 9 - D - 1 for the type of road and the silt loading for that road*)

H = Mean vehicle speed in miles per hour (*Please see Table A9 - 9 - D - 2 for the speed assumptions*)

I = Mean number of wheels on vehicles (*Please see Table A9 - 9 - D - 3 for number of wheels corresponding to the mean vehicle weight*)

J = Mean vehicle weight in tons (*Please see Table A9 - 9 - D - 3 for mean vehicle weight corresponding to the mean number of wheels*)

K = Mean number of days per year with at least 0.01 inches of precipitation (*Please see Table A9 - 9 - D - 4 for number of days of precipitation for the project area*)

TABLE A9 - 9 - D - 1

UNPAVED ROAD SILT LOADING AND ROAD TYPE
(G = Percent)

Road Type	G
Gravel Road	4.0
Sand/Gravel Plant Road	6.0
Mining Haul Road	8.0
Crushed Limestone Road	10.0
Mountain Roads	12.0
Stone Quarrying Plant Roads	14.0
Farm Road	16.0
Copper Smelting Plant	18.0
Coal Mine Haul Road (freshly Scraped)	24.0
City and County Road	28.0

TABLE A9 - 9 - D - 2

MEAN VEHICLE SPEEDS
(H = Miles per Hour)

Scenario Description	H
Recommended Maximum	15.0
Maximum Allowable	25.0
Worst-case	35.0

TABLE A9 - 9 - D - 3

MEAN NUMBER OF WHEELS (I) AND MEAN NUMBER WEIGHT (J) OF THE VEHICLE

Vehicle Type	Weight of the Vehicle (J)	Number of Wheels (I)
Autos, Light Duty Pick-up Trucks, & Vans	2,000 to 6,000	4
Light Duty Vans and Utility Vehicles	6,001 to 10,000	4 to 6
Motor Homes, Medium Duty Flat-bed Trucks and Multi-stop Trucks	10,001 to 16,000	6 to 8
Heavy-Duty Flat-bed Trucks and Delivery Vans	16,001 to 19,500	6 to 10
Light/Heavy duty garbage dump and ready mix Concrete Trucks, Heavy/Heavy duty fuel and Waste Dump Trucks	19,501 to 33,000	10
Tractor Trailer Trucks	33,001 or More	18 to 30

TABLE A9 - 9 - D - 4

PRECIPITATION CONDITIONS AND NUMBER OF DAYS
(K = Number of Days)

Number of Days	K
Worst-case desert/drought	2.0
Worst-case SCAB/drought	10.0
Average year for desert	18.0
Average year for SCAB	34.0
Average year for mountains	40.0

EXAMPLES

Examples of Estimating Emission Factor (F) for Truck on Local Road
(F = pounds per vehicle miles traveled)

Example 1 Truck to Pick-up Goods in Drought Conditions

(F = 2.1 x [(G=28)/12] x [(H=35)/30] x [(J=(10,000 lbs/2,000)/3)^0.7] x [(I=6/4)^0.5] x [{365 - (K=10)}/365]) = 9.73

Example 2 Truck on Haul Road in Drought Conditions

(F = 2.1 x [(G=28)/12] x [(H=12)/30] x [(J=(70,000 lbs/2,000)/3)^0.7] x [(I=18/4)^0.5] x [{365-(K=2)}/365]) = 23.08

TABLE A9 - 9 - E

ESTIMATING EMISSIONS FROM WIND EROSION OF STORAGE PILES
(Pounds/Day/Acre)

E = (1.7 x [G/1.5] x [365-H]/235] x [I/15]) x J

Where,

E = PM10 Emissions from wind erosion of storage piles in pounds per day per acre

G = Silt content of aggregate in percent (*Please see Table A9 - 9 - E - 1 for the type of aggregate in storage pile and silt content.*)

H = Number of Days with $\geq$ 0.25 mm (0.01 inch) of precipitation per year (*Please see Table A9 - 9 - E - 2 for number of days in the project area.*)

I = Percentage of time that the unobstructed wind speed exceeds 12 miles per hour or 5.4 meters/second at mean pile height.

J = Fraction of Total Suspended Particulates which is estimated at 0.5.

TABLE A9 - 9 - E - 1

SILT CONTENT AND TYPES OF AGGREGATES IN ACTIVE STORAGE PILES
(G = Silt Content of Aggregate in Percent)

Types of Aggregates	G
Limestones	0.5
Sinter	0.7
Crushed Limestones	1.5
Slag and Coke	5.0
Coal	6.0
Overburden	7.5
Blended Ore and Dirt	15.0
Flue Dust	18.0

TABLE A9 - 9 - E - 2

PRECIPITATION CONDITIONS AND NUMBER OF DAYS
(H = Number of Days)

Number of Days	H
Worst-case desert/drought	2.0
Worst-case SCAB/drought	10.0
Average year for desert	18.0
Average year for SCAB	34.0
Average year for mountains	40.0

EXAMPLE

Examples of Estimating Emissions (E) from a Storage Pile
(E = pounds per day per acre)

(E = {1.7 x [(G=15% = 0.15)/1.5] x ({365 - (H=10)}/235]) x [(I = 100 % = 100.0)/15]} x {J = 0.5} = 0.86)

TABLE A9 - 9 - F

ESTIMATING EMISSIONS FROM DIRT PUSHING OR BULLDOZING OPERATIONS
(Pounds/Day)

$E = ([0.45 \times (\{[G]^{1.5}\}/\{[H]^{1.4}\})] \times I) \times J$

Where,

- E = PM10 Emissions from Dirt Pushing (Bulldozer Type Operations)
- G = Silt content of aggregate in percent (*Please see Table A9 - 9 - F - 1 for the type of aggregate in storage pile and the silt content.*)
- H = Moisture Content of the surface material (*Please see Table A9 - 9 - F - 2 for the moisture content and soil condition.*)
- I = 2.2046; a conversion Factor to convert kilograms per hour to pounds per hour.
- J = Hours of Pushing Operation (*User provides the value for J; See environmental documents.*)

TABLE A9 - 9 - F - 1

SILT CONTENT AND TYPES OF AGGREGATES IN ACTIVE STORAGE PILES
(G = Percent)

Types of Dirt	G
Limestones	0.5
Sinter	0.7
Crushed Limestones	1.5
Slag and Coke	5.0
Coal	6.0
Overburden	7.5
Blended Ore and Dirt	15.0
Flue Dust	18.0

TABLE A9 - 9 - F - 2

DIRT CONDITIONS AND MOISTURE CONTENT
(H = Percent)

Dirt Conditions	H
Dry	2.0
Moist	15.0
Wet	50.0

EXAMPLE

Examples of Estimating Emissions (E) for Dirt Pushing Operations
(E = pounds per day)

(E = [(\{0.45 x [(G=15 % = 15.0)$^{1.5}$]\}/\{[(H=2.0 % = 2.0)$^{1.4}$]\}) x I = 2.2046] x [J=4 hours] = 87.36)

TABLE 9 - 9 - G

ESTIMATING EMISSIONS FROM DIRT PILING OR MATERIAL HANDLING
(Pounds/Day)

$E = [0.00112 \times (\{[G/5]^{1.3}\}/\{[H/2]^{1.4}\})] \times [I/J]$

Where,

E = PM10 Emissions from dirt piling or material handling to form a storage pile on ground

G = Mean Wind speed in miles per hour (*user should provide this information in environmental documents, or use 12 miles per hour for daily maximum and 25 miles per hour for worst-case scenario.*)

H = Moisture Content of the surface material (*Please see Table 9 - 9 - G - 1 for the moisture content and soil condition.*)

I = Pounds of dirt handled or stocked in a storage pile per day (*for truck piling please see Table 9 - 9 - G - 2 for guidelines.*)

J = 2,000; a conversion factor to convert pounds of dirt to tons of dirt

TABLE 9 - 9 - G - 1

DIRT CONDITIONS AND MOISTURE CONTENT
(H = Percent)

Dirt Conditions	H
Dry	2.0
Moist	15.0
Wet	50.0

TABLE 9 - 9 - G - 2

MAXIMUM DIRT WEIGHT (I) THAT CAN BE STORED IN A TRUCK
(User should provide the value for H. For truck piling use the following for guidelines)

Vehicle Type	Maximum Weight of the Dirt (I)
Light Duty Pick-up Trucks	(2,000 to 6,000) -* (Wt.** of Empty Truck)
Utility Vehicles	(6,001 to 10,000) - (Wt. of Empty Truck)
Medium Duty Flat-bed Trucks and Multi-stop Trucks	(10,001 to 16,000) - (Wt. of Empty Truck)
Heavy-Duty Flat-bed Trucks	(16,001 to 19,500) - (Wt. of Empty Truck)
Light/Heavy duty garbage dump and ready mix Concrete Trucks	(19,5001 to 33,000) - (Wt. of Empty Truck)
Heavy/Heavy duty waste dump trucks, Tractor Trailer Trucks	(33,001 or More) - (Wt. of Empty Truck)

* "-" = Minus sign or subtraction sign ** "Wt." = Weight

EXAMPLE

Example of Estimating Emissions (E) for Dirt Pushing Operations
(E = pounds per day)

$(E = 0.00112 \times (\{[(G=25\ mph)/5]^{1.3}\}/\{[(H=2.0\ \% = 0.02)/2]^{1.4}\}) \times (I=[10{,}000\ lbs/J = 2{,}000]\ tons) = 28.63)$

TABLE A9 - 9 - H

ESTIMATING EMISSIONS FROM BUILDING WRECKING
(Pounds/Day)

E = 0.00042* x J

Where,
J = Building volume handled per day (*Use environmental documents for the following information*); or
J = (N x O x P)/Q

where,
N = Width of building in feet
O = Length of building in feet
P = Height of building in feet
Q = Number of days required to demolish a building

* = Pounds of PM10 Per Cubic Feet

INFORMATION
FOR
ASBESTOS EMISSIONS DURING
DEMOLITION AND RENOVATION OF PROJECT

TABLE A9 - 10

ESTIMATING ASBESTOS EMISSIONS FROM DEMOLITION AND RENOVATION ACTIVITIES
(POUNDS PER DAY)

SOURCE TYPE	SOURCE-RELATED ESTIMATIONS	MULTIPLY BY	EMISSION FACTORS (F)	REFERENCE TO TABLES**	EMISSIONS (E) (Pounds/Day)
Asbestos Removal or Asbestos in Structural Debris	____ Ft^3 of Building Disturbed/Day	X	________, or (0.00006 lbs/ft^3)*	Table 9 - 10 - A	________

* Default value

Example: Estimated Value ________, or Estimate Emission Factors Using Project Specific Data and Appropriate Tables
Default Value — Use this value instead of estimating project specific emission factor

** Tables with examples to estimate emissions and project specific emission factors

TABLE A9 - 10 - A

ESTIMATING EMISSIONS FROM DRY REMOVAL OF ASBESTOS

(*Emissions associated with wet removal of asbestos should be included as emissions after implementation of mitigation measure.* See Table 11 - 10 Appendix 11.)
(Pounds/Day)

E = {[(F/G) x (H/I) x (J/K) x (L/M) x (N/O) x (P)]/[(Q) x (R) x (S/T) x (N/O)]}

Where,

E = Asbestos emissions during the dry asbestos removal activities
Ft^3 = Cubic feet
F = Typical number of fibers counted per cubic meter of work area
(5×10^6 to 80×10^6 fibers per cubic meter is the range of asbestos concentration in a typical work area.)
G = 35.315 cubic feet, a conversion factor to convert 1 cubic meter into cubic feet
H = 1.0 nanograms, a weight of 30 asbestos fibers
I = 30.0, number of fibers weigh equivalent to 1 nanogram
J = 2.2046 pounds, a conversion factor to convert 1 kilogram into pounds
K = 10^{12} nanograms, a conversion factor to convert 1 kilogram into nanograms
L = Volume of air released during M hours to the atmosphere during air changes
Usually, equals to = U x V x W x X

Where,

U = Width of a room from which air escapes or is released
V = Length of a room from which air escapes or is released
W = Height of a room from which air escapes or is released
X = number of rooms from which air escapes or is released

M = Rate in Hours by which (L) amount of air is released to the atmosphere
N = 0.0283 cubic meters, a conversion factor to convert 1 cubic foot to cubic meters
O = 1 cubic foot
P = Total number of hours the air is released to the atmosphere
Q = V/r; where,
V = Volume of asbestos bearing surfaces, i.e.,

For Ceiling: a x b x c
For Pipelines: $\{(a \times c \times pi \times [(OD)^2/4]) - (a \times c \times pi \times [(ID)^2/4])\}$

For rectangular or square object:

a = Width of the asbestos bearing object
b = Length of the asbestos bearing object
c = Number of asbestos bearing objects
pi = 3.14159265

For circular surface:

a = Length of asbestos bearing object
b = Square of outer and/or inner diameter
c = Number of asbestos bearing objects

R = Thickness of in-place asbestos in inches; in same unit (Foot) as a, b, OD and ID
S = 0.083 feet, a conversion factor to convert 1 inch
T = 1.0 inch

OD = Outer diameter of the pipeline
ID = Inner diameter of the pipeline [OD - (2R)]

EXAMPLE

Example of Estimating Emissions from Dry Removal of Asbestos From a Ceiling

Source: SCAQMD's Ru . 1403 staff report

F = 15×10^6 fibers per cubic meter of work area
(5×10^6 to 80×10^6 fibers per cubic meter is the range of asbestos concentration in a typical work area.

L = 2,250 Ft^3 of air released during M hours to the atmosphere (U=15 feet, V=15 feet, W=10 feet, & X = 1)

M = 1 Hour (rate of one change per hour)

P = 8 Hours (for 8 hour shift with the rate of one change per hour)

Q = 225 square feet of asbestos bearing surface (a = 15, b = 15, c = 1) for rectangular objects; or [*For pipelines (a x c) x (pi x {[(b = outer diameter)^2]/4.0}) - (pi x {[(b = inner diameter)^2]/4.0})*]

R = 0.5 inches [For Pipelines *(a x c) x (pi x {[(b = outer diameter at the asbestos thickness)^2]/4.0}) - (pi x {[(b = inner diameter at the asbestos thickness)^2]/4.0})*]

E = *{[(15x10^6/35.315)x(1/30)x(2.2046/10^{12})x(2250/1)x(0.0283/1)x(8)]/[(225)x(0.5)x(0.083/1) x (0.0283/1)]}*

= 0.00006 pounds of asbestos per cubic feet of structure demolished or renovated

TABLE A9 - 10 - A - 1

INPUT ASSUMPTIONS TO DETERMINE ASBESTOS EMISSIONS FROM DEMOLITION AND RENOVATION ACTIVITIES AT SINGLE-UNIT DWELLING

BLDG	LOCATION OF ASBESTOS	In Place Amount	ASBESTOS CONTENT Thickness	ASBESTOS REMOVED Demolition	ASBESTOS REMOVED Renovation
Model A	**Furnace**	**72 Ft^2**	**3.0 inch/T**	**18.0 Ft^3**	**18.0 Ft^3**
	Ducts 5.0 inch	60 Ft	2.0 inch/P	18.0 Ft^3	- -
	Waste Generated	4.0 $Yard^3$	3 $Yard^3$		
Model B	**Furnace**	**72 Ft^2**	**3.0 inch/T**	**18.0 Ft^3**	**18.0 Ft^3**
	Ducts 5.0 inch	60 Ft	2.0 inch/P	18.0 Ft^3	18.0 Ft^3
	Walls (Interior)	112 Ft^2	0.6 inch/B	6.0 Ft^3	- -
	Waste Generated		5.0 $Yard^3$	4 $Yard^3$	
Model C	**Furnace**	**72 Ft^2**	**3.0 inch/T**	**18.0 Ft^3**	- -
	Ducts 5.0 inch	60 Ft	2.0 inch/P	18.0 Ft^3	- -
	Walls (Exterior)	1,184 Ft^2	0.3 inch/A-C Shingles	25.0 Ft^3	- -
	Ceiling	1,288 Ft^2	0.5 Inch/S	54.0 Ft^3	54.0 Ft^3
	Waste Generated			12.0 $Yard^3$	5 $Yard^3$

TABLE A9 - 10 - A - 2

INPUT ASSUMPTIONS TO DETERMINE ASBESTOS EMISSIONS FROM DEMOLITION AND RENOVATION ACTIVITIES AT THESE STRUCTURES

BLDG	LOCATION OF ASBESTOS	In Place Amount	ASBESTOS CONTENT Thickness	ASBESTOS REMOVED Demolition	ASBESTOS REMOVED Renovation
Small School	**Boiler**	**100 Ft^2**	**2.5 inch/T**	**21.0 Ft^3**	- -
Size	Steam Piping	30.7 Ft^3	- -	- -	- -
43,200 Ft^2	Exposed 2.5 inch	100 Ft	1.0 inch/P	- -	- -
	Concealed 0.75 inch	1500 Ft	1.0 inch/P	- -	- -
	Hot Water Piping			30.7 Ft^3	
	Concealed 2.0 inch	200 Ft	0.25 inch/C	- -	- -
	Concealed 1.0 inch	350 Ft	0.25 inch/C	- -	- -
	Ceiling	43,200 Ft^2	0.5 inch/S	1,800 Ft^3	1,800 Ft^3
	Waste Generated			207 $Yard^3$	200 $Yard^3$

Ft Feet
Ft^2 Square Feet
Ft^3 Cubic Feet
T Trowelled-on Asbestos Material
P Premolded Asbestos Material
B Wallboard Asbestos Material
C Corrugated Paper Asbestos Material
A-C A/C, i.e., Asbestos/Cement Material
S Sprayed-on Asbestos Material

TABLE A9 - 10 - A - 2 (Cont.)

INPUT ASSUMPTIONS TO DETERMINE ASBESTOS EMISSIONS FROM DEMOLITION AND RENOVATION ACTIVITIES AT VARIOUS STRUCTURES

BLDG	LOCATION OF ASBESTOS		ASBESTOS CONTENT In Place Amount	Thickness	ASBESTOS REMOVED Demolition	Renovation
Medium School		**Boiler**	**450 Ft²**	**2.0 inch/P**	**98.0 Ft³**	- -
Size		Steam Piping			63.0 Ft³	- -
122,800 Ft²	Exposed 3.0 inch		65 Ft	1.0 inch/P	- -	- -
	Concealed 2.0 inch		165 Ft	2.5 inch/P	- -	- -
	Concealed 1.0 inch		1,800 Ft	2.5 inch/P	- -	- -
		Hot Water Piping				- -
	Concealed 2.0 inch		360 Ft	0.25 inch/C	- -	- -
	Concealed 1.0 inch		45 Ft	0.25 inch/C	- -	- -
		Structural Steel			8,295 Ft³	- -
	Columns 10.0 inch		1,600 Ft	2.5 inch/S	- -	- -
	Beams 6.0 inch		22,500 Ft	1.5 inch/S	- -	
		Ceiling	103,000 Ft²	0.5 inch/S	4,629 Ft³	4,631 Ft³
Cafeteria		Boiler	45 Ft²	2.0 inch/P	- -	
		Steam Piping				- -
	Exposed 2.5 inch		36 Ft	1.0 inch/P	- -	- -
	Concealed 0.75 inch		135 Ft	1.0 inch/P	- -	- -
		Ceiling	8,100 Ft²	0.5 inch/S		
Gymnasium						
		Furnace	90 Ft²	2.0 inch/T		- -
	Hot Water Pipes 2.0 inch			135 Ft	0.25 inch/C	- -
		Airducts	495 Ft²	0.25 inch/C	- -	
	Beams 18.0 inch		630 Ft	1.5 inch/S	- -	
	Waste Generated				1,457 Yard³	514 Yard³
Large School		**Boiler (2)**	**1,000 Ft²**	**3.0 inch/T**	**312.0 Ft³**	- -
Size		Steam Piping			320.0 Ft³	- -
271,000 Ft²	Exposed 3.0 inch		140 Ft	1.0 inch/P	- -	- -
	Concealed 2.0 inch		1,200 Ft	1.0 inch/P	- -	- -
	Concealed 1.0 inch		4,000 Ft	1.0 inch/P	- -	- -
		Hot Water Piping- -				
	Concealed 2.0 inch		800 Ft	0.25 inch/C	- -	- -
	Concealed 1.0 inch		100 Ft	0.25 inch/C	- -	- -
		Structural Steel			18,482 Ft³	- -
	Columns 10.0 inch		3,500 Ft	2.5 inch/S	- -	- -
	Beams 6.0 inch		50,000 Ft	1.5 inch/S	- -	- -
		Ceiling	227,0000 Ft²	0.5 inch/S	10,208 Ft³	10,208 Ft³
Cafeteria		Boiler	100 Ft²	2.5 inch/P		- -
		Steam Piping				- -
	Exposed 2.0 inch		80 Ft	1.0 inch/P	- -	- -
	Concealed 1.0 inch		300 Ft	1.0 inch/P	- -	- -
		Ceiling	18,000 Ft²	0.5 inch/S		
Gymnasium						
		Furnace	200 Ft²	2.5 inch/T		- -
	Hot Water Pipes 2.0 inch			300 Ft	0.25 inch/C	- -
		Airducts	1,100 Ft²	0.25 inch/C		- -
	Beams 18.0 inch		1,400 Ft	1.5 inch/S		- -
	Waste Generated				3,259 Yard³	1,135 Yard³

TABLE A9 - 10 - A - 2 (Cont.)

INPUT ASSUMPTIONS TO DETERMINE ASBESTOS EMISSIONS FROM DEMOLITION AND RENOVATION ACTIVITIES AT VARIOUS STRUCTURES

BLDG	LOCATION OF ASBESTOS		ASBESTOS CONTENT			
			In Place Amount	Thickness	ASBESTOS REMOVED Demolition	Renovation
Small Office Building		**Boiler**	**100 Ft^2**	**3.0 inch/T**	**25.0 Ft^3**	--
		Boiler Stack	40 Ft^2	1.5 inch/P	5.0 Ft^3	--
Size		Steam Piping			15.3 Ft^3	--
7,200 Ft^2	Exposed 2.0 inch		70 Ft	1.0 inch/P	--	--
	Concealed 1.0 inch		250 Ft	1.0 inch/P	--	--
		Hot Water Piping				--
	Concealed 1.0 inch		100 Ft	1.0 inch/C	--	--
		Ceiling	7,200 Ft^2	0.5 inch/S	300.0 Ft^3	300.0 Ft^3
	Waste Generated				38.0 $Yard^3$	34.0 $Yard^3$
Medium Office Building		**Boiler**	**350 Ft^2**	**3.0 inch/T**	**75.0 Ft^3**	--
Size		Steam Piping			66.2 Ft^3	--
36,000 Ft^2	Exposed 3.0 inch		120.0 Ft	1.0 inch/P	--	--
	Concealed 2.0 inch		100 Ft	1.0 inch/P	--	--
	Concealed 1.0 inch		450 Ft	1.0 inch/P	--	--
		Hot Water Piping				--
	Concealed 2.0 inch		150 Ft	1.0 inch/C	--	--
	Concealed 1.0 inch		450 Ft	1.0 inch/C	0 0-	--
		Ceiling	36,000 Ft^2	1.0 inch/S	300.0 Ft^3	3000.0 Ft^3
	Waste Generated				349 $Yard^3$	334 $Yard^3$
Large Office Building		**Boilers (2)**	**800 Ft^2**	**3.0 inch/T**	**200.0 Ft^3**	
		Steam Piping			434 Ft^3	
Size	Exposed 3.0 inch		360 Ft	1.0 inch/P	--	--
288,000 Ft^2	Concealed 2.0 inch		650 Ft	1.0 inch/P	--	--
	Concealed 1.0 inch		3,300 Ft	1.0 inch/P	--	--
		Hot Water Piping				--
	Exposed 2.0 inch		1,100 Ft	1.0 inch/P	--	--
	Concealed 1.0 inch		3,300 Ft	1.0 inch/P	--	--
		Ceiling	38,000 Ft^2	0.5 inch/S	24,000 Ft^3	24,000 Ft^3
		Structural Steel	--	--	21,500 Ft^3	--
	Columns 12.0 inch		3,900 Ft	3.0 inch/S	--	--
	Beams 6.0 inch		58,000 Ft	1.5 inch/S	--	--
		Ceiling	288,000 Ft^2	1.0 inch/S	24,000 Ft^3	24,000 Ft^3
	Waste Generated				5,128 $Yard^3$	2,666 $Yard^3$

TABLE A9 - 10 - A - 2 (Cont.)

INPUT ASSUMPTIONS TO DETERMINE ASBESTOS EMISSIONS FROM DEMOLITION AND RENOVATION ACTIVITIES AT VARIOUS STRUCTURES

BLDG	LOCATION OF ASBESTOS	ASBESTOS CONTENT In Place Amount	Thickness	ASBESTOS REMOVED Demolition	Renovation
Small Hotel	**Boiler**	**440 Ft^2**	**3.0 inch/T**	**110 Ft^3**	--
Size	Steam Piping			185.0 Ft^3	10 Ft^3
69,320 Ft^2	Exposed 3.0 inch	120 Ft	1.0 inch/P	--	--
	Concealed 2.0 inch	170 Ft	1.0 inch/P	--	--
	Concealed 1.0 inch	900 Ft	1.0 inch/P	--	--
	Hot Water Piping				--
	Concealed 2.0 inch	290 Ft	1.0 inch/P	--	--
	Concealed 1.0 inch	900 Ft	1.0 inch/P	--	--
	Structural Steel	--	--	5,542 Ft^3	--
	Columns 10.0 inch	--	--	--	--
	Beams 6.0 inch	--	--	--	--
	Ceiling	2,400 Ft^2	1.0 inch/S	200.0 Ft^3	2.00 Ft^3
	Waste Generated			671 $Yard^3$	24 $Yard^3$
Large Hotel	**Boilers (2)**	**860 Ft^2**	**3.0 inch/T**	**215.0 Ft^3**	--
Size	Steam Piping			348.0 Ft^3	30.0 Ft^3
221,184 Ft^2	Exposed 3.0 inch	360 Ft	1.0 inch/P	--	--
	Concealed 2.0 inch	500 Ft	1.0 inch/P	--	--
	Concealed 1.0 inch	2,600 Ft	1.0 inch/P	--	--
	Hot Water Piping				--
	Concealed 2.0 inch	860 Ft	1.0 inch/P	--	--
	Concealed 1.0 inch	2,600 Ft	1.0 inch/P	--	--
	Structural Steel			16,625 Ft^3	--
	Columns 12.0 inch	3,000 Ft	3.0 inch/T	--	--
	Beams 6.0 inch	45,000 Ft	1.5 inch/T	--	--
	Ceiling	3,750 Ft^2	1.0 inch/S	308.0 Ft^3	313 Ft^3
	Waste Generated			1,487 $Yard^3$	39 $Yard^3$
Small Store	**Boiler**	**100 Ft^2**	**3.0 inch/T**	**25 Ft^3**	**25 Ft^3**
Size	Boiler Stack	40 Ft^2	1.5 inch/P	5 Ft^3	3 Ft^3
	Steam Piping			11.0 Ft^3	3 Ft^3
2,800 Ft^2	Exposed 2.0 inch	70 Ft	1.0 inch/P	--	--
	Concealed 1.0 inch	100 Ft	1.0 inch/P	--	--
	Hot Water Piping				--
	Concealed 1.0 inch	40 Ft	1.0 inch/P	--	--
	Waste Generated			4.0 $Yard^3$	4 $Yard^3$
Medium Store	**Boiler**	**100 Ft^2**	**3.0 inch/T**	**25 Ft^3**	**25 Ft^3**
Size	Boiler Stack	60 Ft^2	1.5 inch/P	7.5 Ft^3	--
	Steam Piping			36.0 Ft^3	10.6 Ft^3
65,700m Ft^2	Exposed 2.0 inch	190 Ft	2.0 inch/P	--	--
	Concealed 1.0 inch	600 Ft	2.0 inch/P	--	--
	Waste Generated			8.0 $Yard^3$	4 $Yard^3$

TABLE A9 - 10 - A - 2 (Cont.)

INPUT ASSUMPTIONS TO DETERMINE ASBESTOS EMISSIONS FROM DEMOLITION AND RENOVATION ACTIVITIES AT VARIOUS STRUCTURES

BLDG	LOCATION OF ASBESTOS	ASBESTOS CONTENT In Place Amount	Thickness	ASBESTOS REMOVED Demolition	Renovation
Small Hospital	**Boiler**	**100 Ft^2**	**3.0 inch/T**	**25.0 Ft^3**	**25.0 Ft^3**
	Boiler Stack	40 Ft^2	1.5 inch/P	5.0 Ft^3	5.0 Ft^3
Size	Steam Piping			63.0 Ft^3	- -
14,400 Ft^2	Exposed 2.0 inch	70 Ft	1.0 inch/P	- -	- -
	Concealed 1.0 inch	420 Ft	1.0 inch/P	- -	- -
	Hot Water Piping				- -
	Concealed 1.0 inch	600 Ft	1.0 inch/C	49.1 Ft^3	3.0 Ft^3
	Ceiling	800 Ft^2	0.5 inch/S	33.3 Ft^3	
	Waste Generated			207 $Yard^3$	200 $Yard^3$
Medium Hospital	**Boiler (2)**	**450 Ft^2**	**3.0 inch/T**	**112.0 Ft^3**	**112.0 Ft^3**
	Stacks (2)	100 Ft^2	1.0 inch/P	8.3 Ft^3	8.3 Ft^3
Size	Steam Piping			419.0 Ft^3	419.0 Ft^3
60,000 Ft^2	Exposed 3.0 inch	60 Ft	1.0 inch/P	- -	- -
	Concealed 2.0 inch	1,500 Ft	1.0 inch/P	- -	- -
	Concealed 1.0 inch	2,500 Ft	1.0 inch/P	- -	- -
	Hot Water Piping				- -
	Concealed 2.0 inch	1,500 Ft	1.0 inch/C	- -	- -
	Concealed 1.0 inch	2,500 Ft	1.0 inch/C	- -	- -
	Structural Steel			11,380 Ft^3	- -
	Columns 10.0 inch	9,400 Ft	2.5 inch/S	- -	- -
	Beams 6.0 inch	14,400 Ft	1.5 inch/S	- -	
	Waste Generated			1,324 $Yard^3$	14 $Yard^3$
Large Hospital	**Boilers (2)**	**900 Ft^2**	**3.0 inch/T**	**225.0 Ft^3**	**225.0 Ft^3**
	Stacks (2)	225 Ft^2	1.0 inch/P	18.8 Ft^3	18.8 Ft^3
Size	Steam Piping			3,015 Ft^3	26.2 Ft^3
316,000 Ft^2	Exposed 3.0 inch	400 Ft	1.0 inch/P	- -	- -
	Concealed 2.0 inch	6,580 Ft	1.0 inch/P	- -	- -
	Concealed 1.0 inch	24,000 Ft	1.0 inch/P	- -	- -
	Hot Water Piping				- -
	Exposed 3.0 inch	400 Ft	1.0 inch/P	- -	- -
	Concealed 2.0 inch	6,580 Ft	1.0 inch/P	- -	- -
	Concealed 1.0 inch	24,00 Ft	1.0 inch/P	- -	- -
	Ceiling	38,000 Ft^2	0.5 inch/S	1,583 Ft^3	
	Waste Generated			538 $Yard^3$	30 $Yard^3$
Small Industry	**Boiler**	**1500 Ft^2**	**2.5.0 inch/T**	**312 Ft^3**	**312 Ft^3**
Size	Steam Piping	500 ft	1.2 inch/P	78.5 Ft^3	1.9 Ft^3
	Boiler Exhaust Duct	214 ft^2	0.5 inch/T	44 $Yard^3$	8.9 Ft
	Waste Generated			44 $Yard^3$	37 $Yard^3$
Medium Industry	**Boilers**	**10,000 Ft^2**	**2.5 inch/T**	**215.0 Ft^3**	**2,083 Ft^3**
Size	12 inch Steam Piping	1,500 Ft	1.2 inch/P	471.2 Ft^3	6.9 Ft^3
	Boiler Exhaust Duct	680 Ft^2	0.5 inch/T	28.3 Ft^3	28.3 Ft^3
	Waste Generated			287.0 $Yard^3$	236.0 $Yard^3$

Table A9 - 10 - A - 3

EXAMPLES OF INDUSTRIES WHERE ASBESTOS IS FOUND IN MANUFACTURING PROCESSES

Paper Manufacturing (Table 5-64, Page 5-55)*	Coatings And Sealants Manufacturing (Table 5-69, Page 5-63)*
Friction Material Manufacturing (Table 5-65, Page 5-56)*	Gaskets and Packing Manufacturing (Table 5-70, Page 5-63)*
Vinyl/Asbestos Floor Tile Manufacturing (Table 5-67, Page 5-60)*	Chlorine Manufacturing (Table 5-72, Page 5-64)*
Asbestos-Reinforced Plastics (Table 5-68, Page 5-61)*	Asphalt Concrete Manufacturing (Table 5-73, Page 5-66)*
Phenolic Modeling Compounds Manufacturing (Table 5-68, Page 5-61)*	Asbestos Milling (Table 5-63, Page 5-52)*
Asbestos/Cement Products Manufacturing (Table 5-66, Page 5-58)*	Asbestos Textiles Manufacturing (Table 5-71, Page 5-64)*
Brake-Shoe Rebuilding Plant (Table 5-74, Page 5-66)*	Prefabricator of A/C Building Products (Table 5-75, Page 5-68)*
Shotgun Shell Manufacturing Asbestos Board Fabrication (Table 5-76, Page 5-68)*	Asbestos Drilling Fluids (Petroleum Industry)

* Use These Tables For Model Parameters. These Tables are provided in EPA Report Titled, National Emission Standards For Asbestos -- Background Information For Proposed Standards, 1987

INFORMATION
FOR
ENERGY CONSUMPTION IN VARIOUS STRUCTURES

TABLE A9 - 11

EMISSIONS FROM ELECTRICITY CONSUMPTION BY LAND USES
(Pounds Per Day)

E = ({[F x G]/365}/1000) x H

Where,

E = Emissions of criteria pollutants in pounds per day due to electricity consumption by land uses
F = Gross square foot (*see Environmental Document*) of each type of land use except for residential uses; *or*
= Number of units for residential land use (*see Environmental Document*)
G = Electricity usage rate to determine annual usage (*see Table A9 - 11 - A*)
Varies according to the type of land use (*see Environmental Document*)
H = Emission factors in pounds per megawatt-hours (*see Table A9 - 11 - B*)
Varies according to the type of criteria pollutant

TABLE A9 - 11 - A

ELECTRICITY USAGE RATE (G)
(To Determine Annual Consumption, Kilowatt-hours)

Land Use Type	Unit Type	Usage Rate Average for Southern California Edison and Los Angeles Dept. of Water and Power
Residential	Kilowatt-hour/Unit/Year	5,626.50
Food Store	Kilowatt-hour/Square feet/Year	53.30
Restaurant	Kilowatt-hour/Square feet/Year	47.45
Hospitals	Kilowatt-hour/Square feet/Year	21.70
Retail	Kilowatt-hour/Square feet/Year	13.55
College/University	Kilowatt-hour/Square feet/Year	11.55
High School	Kilowatt-hour/Square feet/Year	10.50
Elementary School	Kilowatt-hour/Square feet/Year	5.90
Office	Kilowatt-hour/Square feet/Year	12.95
Hotel/Motel	Kilowatt-hour/Square feet/Year	9.95
Warehouse	Kilowatt-hour/Square feet/Year	4.35
Miscellaneous	Kilowatt-hour/Square feet/Year	10.50

TABLE A9 - 11 - B

EMISSION FACTORS (H) FOR EACH CRITERIA POLLUTANT FROM CONSUMPTION OF ELECTRICITY
(Pounds Per Megawatt-Hours)

Pollutant Type	CO	ROC	NOx	SOx	PM10
	0.20	0.01	1.15	0.12	0.04

TABLE A9 - 11 - C

ESTIMATING REMAINING EMISSIONS OF EACH POLLUTANT AFTER REMOVING CONTRIBUTED FRACTIONS BY EACH SOURCE CATEGORY

$N = [(E - (O_1 + O_2 + O_3 + \ldots\ldots\ldots\ldots O_n)$

Where,

N = Remaining Non-mitigated Electricity consumption emissions after the removal of all source categories for which mitigation measures are included.

E = Total Non-mitigated Electricity Consumption Emissions of a Criteria Pollutant. (*See above methodology*)

$O_1, O_2, O_3, \ldots\ldots O_n$ = Emissions of a Criteria Pollutant Associated with Each Source Category for which mitigation measures are included. (See Table A9 - 11 - D)

TABLE A9 - 11 - D

ESTIMATING PRE-MITIGATION EMISSIONS OF EACH POLLUTANT FOR EACH SOURCE CATEGORY

$O_1, O_2, O_3 \ldots\ldots O_n = [(E_R \times I_1)]$, *OR* $[(E_R \times I_2)]$, *OR* $[(E_R \times I_3)]$, *OR*.......... $[(E_R \times I_n)]$

Where,

$O_1, O_2, O_3 \ldots\ldots O_n$ = Source Category's Market Segment of Total Non-mitigated Emissions
(*See Table A9 - 11 - D to determine which source category the mitigation measure is going to impact to obtain emission reductions. Use respective percent value to extract the fraction of non-mitigated emissions associated with that source category.*)

E = Total Non-mitigated Electricity Consumption Emissions of Each Pollutant.
(*Utilizing Table A9 - 11 - A and Table A9 - 11 - B* methodologies)

$I_1, I_2, I_3, \ldots\ldots I_n$ = Percent of Total Non-mitigated Emissions For Each Source Category
(*See Table A9 - 11 - E to determine which source category the mitigation measure is going to impact to obtain emission reductions. Use respective percent value (fraction) for I to extract the fraction of non-mitigated emissions associated with that source category.*)

TABLE A9 - 11 - E

SOURCE CATEGORIES (I) OF PRE-MITIGATION ENERGY USE IN RESIDENTIAL, COMMERCIAL AND INDUSTRIAL SECTORS

(Committee Draft Energy Efficiency Report, 1990, California Energy Commission)

(Percent of the Total Pre-mitigation Energy Use Per Project)

Source Category	Electricity (Percent)	Source Category	Electricity (Percent)
Residential		**Commercial**	
Lighting	13.70	Indoor lighting	38.24
Cooking	4.50	Outdoor lighting	4.55
Refrigeration	20.40	Refrigeration	11.26
Freezer	3.90	Cooking	1.04
Dishwasher:		Ventilation	9.92
Hot water wash	0.80	Space heating	2.52
Dishwshr Motor	2.40	Space cooling	19.19
Furnace fan	1.60	Water heating	0.87
Clothes Dryer	6.80	Office Equipment	1.86
Clothes Washer:		Miscellaneous	10.57
Hot water wash	1.30	**Industrial**	
Motor	0.90	Services including:	15.90
Space Heating	7.60	(Transport, Communication & Utilities)	
Space Cooling	7.00	Unclassified industries	1.96
Water heating:		Other industries	10.87
Non-solar	3.20	Process Industries	22.20
Solar	0.04	Pollution Control	3.30
Pump	0.20	Motors	16.19
Swimming pool heating:		Space cooling/Ventilation	12.03
Non-solar	0.060	Refrigeration	1.53
Solar	0.90	Street lighting	2.23
Pump	3.40	Lighting	7.54
Water Bed	2.80	Process heat	5.49
Color TV	4.80	Process Electric	0.59
Miscellaneous	0.180	Miscellaneous	13.70

TABLE A9 - 12

ESTIMATING EMISSIONS FROM NATURAL GAS CONSUMPTION BY LAND USE (Pounds Per Day)

$E = (\{[F \times G]/30\}/1000000) \times H$

Where,

E = Emissions of criteria pollutants due to natural gas consumption land uses

F = Gross square foot of each type of land use (*see Environmental Document*) except for residential and industrial uses; or
= Number of units for residential land use (*see Environmental Document*); or
= Number of meters (per business) as in an industrial park (*see Environmental Document*)

G = Natural gas usage rate to determine daily usage (*see Table A9 - 12 - A*)
Varies according to the type of land use

H = Emission factors in pounds per million cubic feet (*see Table A9 - 12 - B*)
Varies according to the type of criteria pollutant

TABLE A9 - 12 - A

NATURAL GAS USAGE RATE (G)

(To Determine Daily Consumption)

Land Use Type	Unit Type	Usage Factor
Residential		
Single Family Units	Cubic Feet/Unit/Month	6,665.0
Multi-Family Units	Cubic Feet/Unit/Month	4,011.5
Nonresidential		
Industrial	Cubic Feet/Customer/Month	241,611
Hotel/Motel	Cubic Feet/Square Feet/Month,	4.8
Retail/Shopping Centers	Cubic Feet/Square Feet/Month	2.9
Office	Cubic Feet/Square Feet/Month	2.0

TABLE A9 - 12 - B

EMISSION FACTORS (H) FOR EACH CRITERIA POLLUTANT From Consumption of Natural Gas

(Pounds Per Million Cubic Feet)

CO	ROC	NOx	SOx	PM10
20.0	5.3	80.0 (*for Residential Use*); or 120.0 (*for Nonresidential Use*)	Negligible	0.2

TABLE A9 - 12 - C

ESTIMATING REMAINING EMISSIONS OF EACH POLLUTANT AFTER REMOVING CONTRIBUTED FRACTIONS BY EACH SOURCE CATEGORY

$N = [E - (O_1 + O_2 + O_3 + \ldots\ldots O_n)]$

Where,

N = Remaining Non-mitigated Natural Gas consumption emissions after the removal of all source categories for which mitigation measures are included.

E = Total Non-mitigated Natural Gas Consumption Emissions of a Criteria Pollutant. (*See above methodology*)

$O_1, O_2, O_3, \ldots\ldots O_n$ = Emissions of a Criteria Pollutant Associated with Each Source Category for which mitigation measures are included. (See Table A9 - 12 - D)

TABLE A9 - 12 - D

ESTIMATING PRE-MITIGATION EMISSIONS OF EACH POLLUTANT FOR EACH SOURCE CATEGORY

$O_1, O_2, O_3 \ldots\ldots O_n = [(E_R \times I_1)]$, *OR* $[(E_R \times I_2)]$, *OR* $[(E_R \times I_3)]$, *OR*......... $[(E_R \times I_n)]$

Where,

$O_1, O_2, O_3 \ldots\ldots O_n$ = Source Category's Market Segment of Total Non-mitigated Emissions (*See Table A9 - 12 - D to determine which source category the mitigation measure is going to impact to obtain emission reductions. Use respective percent value to extract the fraction of non-mitigated emissions associated with that source category.*)

E = Total Non-mitigated Natural Gas Consumption Emissions of Each Pollutant. (*Utilizing Table A9 - 12 - A and Table A9 - 12 - B* methodologies)

$I_1, I_2, I_3, \ldots\ldots I_n$ = Percent of Total Non-mitigated Emissions For Each Source Category (*See Table A9 - 12 - E to determine which source category the mitigation measure is going to impact to obtain emission reductions. Use respective percent value (fraction) for I to extract the fraction of non-mitigated emissions associated with that source category.*)

TABLE A9 - 12 - E

SOURCE CATEGORIES (I) OF PRE-MITIGATION ENERGY USE IN RESIDENTIAL, COMMERCIAL AND INDUSTRIAL SECTORS

(Committee Draft Energy Efficiency Report 1990, California Energy Commission)

(Percent of the Total Pre-mitigation Energy Use Per Project)

Source Category	Natural Gas (Percent)	Source Category	Natural Gas (Percent)
Residential		**Commercial**	
Lighting	0.0	Indoor lighting	0.00
Cooking	5.50	Outdoor lighting	0.00
Refrigeration	0.0	Refrigeration	0.46
Freezer	0.0	Cooking	6.32
Dishwasher:		Ventilation	0.00
Hot water wash	8.9	Space heating	27.10
Dshwshr Motor	0.0	Space cooling	7.87
Furnace fan	0.0	Water heating	9.92
Clothes Dryer	2.10	Office Equipment	0.00
Clothes Washer:		Miscellaneous	48.33
Hot water wash	8.90	**Industrial**	
Motor	0.00.	Services including:	3.99
Space Heating	45.70	(Transport, Communication & Utilities)	
Space Cooling	1.00	Unclassified industries	0.89
Water heating:		Other industries	0.00
Non-solar	22.20	Process Industries	37.39
Solar	0.10	Pollution Control	0.77
Pump	0.00	Motors	0.00
Swimming pool heating:		Space cooling/Ventilation	0.00
Non-solar	6.60	Refrigeration	0.00
Solar	1.00	Street lighting	0.00
Pump	0.00	Lighting	0.00
Water Bed	0.00	Process heat	0.00
Color TV	0.00	Process Electric	25.04
Miscellaneous	1.6	Miscellaneous	0.00

INFORMATION
FOR
ARCHITECTURAL COATINGS AND OTHER COATING MATERIALS

TABLE A9 - 13

ESTIMATING EVAPORATIVE EMISSIONS FROM ARCHITECTURAL COATINGS AND BUILDING MATERIALS (Pounds Per Day)

E = [(F x G)/(1,000)] x [H]

Where,

E = Non-mitigated emissions of Reactive Organic Compounds (ROCs) from architectural coatings.
(These emissions will be during exterior finish and interior finish phases of the project construction. If these phases are overlapping with other phases of the construction, these emissions should be combined with ROC emissions from other phases. These combined emissions should be used to determine project significance.)

F = Pounds of ROC emissions. (If unknown, use Table A9 - 13 - B for this value. These values are expressed for 1000 square feet area to be coated 1 mil thick .)

G = Total exterior and/or interior area to be coated
(If unknown, use Table A9 - 13 - C methodology to determine this value. Thickness should always be expressed in "mils" for this methodology to work.)

H = Required "mils" of coating thickness for the project. *(If unknown, use 17.5 mils for exterior and interior walls, and 3 mils for wood and metal surfaces. Also, use Table A9 - 13 - A for mil thickness default values for coatings on various surfaces.)*

TABLE A9 - 13 - A

DRY FILM THICKNESS (H) (Mils)

Surface Type	Thickness
Wood/Metal	1 < 4
Concrete/Masonry	5 < 30

TABLE A9 - 13 - B

ESTIMATING NON-MITIGATED EMISSIONS OF REACTIVE ORGANIC COMPOUNDS (ROCs) FROM ARCHITECTURAL COATINGS

(Value for "F" in Pounds for 25 % Transfer Efficiency of Air Atomized Spray Equipment.)

(This table provides VOC[1] (ROC) emissions for 1 mil thick 1000 square feet area for all VOC limits included in Rule 1113. Rule 1113 should be consulted for corresponding coating types.)

Rule 1113 limits (Grams/Liter)	Rule 1113 limits (Pounds/Gallon)	Coatings (Gallons/1000 SF)	Clean-up Solvents Percent	ROCs (F) Lbs/1,000 SF
Conventional Coatings				
*(Conventional coatings assumed to have 66.26 percent by weight solids, and 10.45 pounds per gallon density.)***				
780	6.49	20.67	10.0	149.34
730	6.07	13.78	10.0	93.77
680	5.66	10.78	10.0	68.97
650	5.41	9.54	10.0	58.62
600	4.99	7.75	10.0	44.38
580	4.83	7.29	10.0	40.60
550	4.58	6.53	10.0	34.69
500	4.16	5.77	10.0	28.24
High Solid Coatings				
*(High solids coatings assumed to have 77.35 percent by weight solids, and 11.33 pounds per gallon density.)***				
420	3.49	16.64	15.0	21.91
400	3.33	15.58	15.0	20.75
350	2.91	11.28	20.0	16.98
346	2.88	11.16	20.0	16.86
304	2.53	9.65	20.0	15.27
234	1.95	7.22	20.0	12.67
Water Based Coatings				
*(Water-based coatings assumed to have 47.67 percent by weight solids, and 10.54 pounds per gallon density.)***				
310	2.58	20.00	5.0	22.85
262	2.18	16.47	5.0	19.25
258	2.15	16.25	5.0	19.03
253	2.10	15.87	5.0	18.65
250*	**2.08**	**15.72**	**5.0**	**18.50**
244	2.03	14.89	5.0	17.59
217	1.81	13.28	5.0	15.97
152	1.26	8.98	5.0	11.6
148	1.23	8.76	5.0	11.39
103	0.86	5.96	5.0	8.51
75	0.62	4.18	5.0	6.66

* If unknown use 2.08 pounds/gallon VOC coatings for exterior walls.

** ARB's test results in 1988 report for Rule 1113 sales survey.

1. Architectural coating emissions are currently expressed in terms of Volatile Organic Compounds (VOC), however, the term VOC has been incorporated under the larger category of Reactive Organic Compounds (ROC). *(See Chapter 3, Section 3.1, Ozone, of this Handbook for clarification)*

ASSUMPTIONS:

1. The use of solvents in the cleaning and painting of the structures will generate Volatile Organic Compound emissions.
2. Non-mitigated VOCs are those which should not exceed Rule 1113 limits as coating is applied to the surface.
3. After removing % volume of VOC (non-exempt solvent), water and exempt solvents, what remains is the % volume of solids.
4. Non-exempt solvent density is 7.36 pounds per gallon of solvent.
5. Exempt solvent (1, 1, 1 -TCA) density is 11.06 pounds per gallon of solvent.
6. Water density is 8.337 pounds per gallon.
7. Water percent by weight is assumed to be 3.5 times higher than that of exempt solvent in the coating. (ARB's test results in 1988 report for Rule 1113 sales survey.)
8. For non-mitigated emissions, transfer efficiency is 25 percent of solids applied to the surface.
9. Mathematical formulation indicates that 1 gallon of solids will cover 1 mil (0.001 inch) thick a 1604 square foot area. For the same amount of coating if thickness is increased, the size of the area that can be coated with that amount of paint will be proportionally decreased. For the same size of the area if thickness is increased, the amount of coating will be proportionally increased.

TABLE A9 - 13 - C

ESTIMATING SURFACE AREA TO BE COATED (G)

Estimate interior and exterior area to be covered by using the following methodologies:

Residential Structures:

Method 1.

It was estimated that every square foot of floor space would require the coating equivalent of 2.7 square feet of surface area. This may actually be an underestimate, but allows for non-coated surfaces such as windows, fireplaces, cabinets, overhead recessed ceiling lighting, etc.

For single family units consider 1/7 acre of floor surface or lot size per unit (ARB Report March 1990).
For multi-family units 1/20 acre lot size per unit (ARB Report March 1990).

Method 2.

Exterior Wall

1,280 square feet of exterior wall per single-family unit; or,
1,800 square feet of exterior wall on average for other than single-family units.
(Energy and Labor in the Construction Sector, Hannon, et.al.).

Interior Wall

The exterior wall amount can be tripled to consider interior walls, ceiling coatings, trim, etc.

Non-residential Structures:

For nonresidential structures (schools, shopping malls, etc.) rooms will be larger in size, ceilings will be acoustic panels type. In this case, each of the floor areas can be multiplied by 2.0 to obtain the total area to be coated.

Emissions from exterior and interior walls should be estimated and reported separately. These emissions should be combined with emissions from other construction activities.

TABLES TO ESTIMATE CUMULATIVE IMPACTS

TABLE A9 - 14

OPTIONAL CUMULATIVE IMPACT ANALYSIS BASED ON ARB PERFORMANCE STANDARDS

STANDARDS

Rate Of Growth In Vehicle Miles Traveled Must Not Exceed The Rate Of Growth In Population During The Life-span Of The General Plan, Specific Plan, Redevelopment Plan And Project Developments

If A/B > C/D The project is cumulatively significant for population related activities; and, the additional vehicle miles traveled (VMT), average daily trips (ADT) and/or number of vehicles (NOVs) has to be mitigated to the extent feasible before writing the Overriding Consideration.

And/Or

If E/F > G/H The project is cumulatively significant for employment related activities; and, the additional vehicle miles traveled (VMT), average daily trips (ADT) and/or number of vehicles (NOVs) has to be mitigated to the extent feasible before writing the Statement of Overriding Consideration.

Where,

Utilize growth in population to estimate impact on cumulative population related VMT, ADT, or NOV

- A = Calculated or estimated population related VMT, ADT or NOV due to the project development for the build-out year;
- B = Anticipated cumulative population related VMT, ADT or NOV for each county; see Table A9 14 - A;
- C = Calculated or estimated project related population due to the project development for the build-out year
- D = Expected or Anticipated cumulative population for the City or County in the Growth Management Plan and/or by SCAG for the build-out year;

Utilize growth in employment to estimate impact on cumulative employment related VMT, ADT, or NOV

- E = Calculated or estimated employment related VMT, ADT or NOV for each County please see Table A9 - 14 - A;
- G = Calculated or estimated project related employment due to the project development for the build-out year
- H = Expected or anticipated cumulative employment for the City or County in the Growth Management Plan and/or by SCAG for the build-out year.

TABLE A9 – 14 – A (Cont.)
VEHICLES MILES TRAVELED (VMT), AVERAGE DAILY TRIPS (ADT) AND NUMBER OF VEHICLES (NOV)
Anticipated values for (B) or (F) by California Air Resources Board

COUNTY	YEAR	PASSENGER VMT	PASSENGER ADT	PASSENGER NOV	TRUCKS VMT	TRUCKS ADT	TRUCKS NOV
Los Angeles							
	1991	146,985,000	17,439,537	4,675,939	16,968,000	2,264,666	453,677
	1993	151,751,395	17,764,296	4,744,948	17,606,802	2,327,741	465,623
	1995	156,512,871	18,088,461	4,818,539	18,251,492	2,389,348	476,877
	1997	161,264,510	18,411,738	4,883,763	18,902,069	2,449,486	488,401
	1999	166,015,164	18,636,482	4,948,814	19,555,591	2,511,120	499,895
	2001	170,768,770	19,059,188	5,014,073	20,213,037	2,574,251	511,520
	2003	175,521,393	19,383,357	5,079,540	20,875,389	2,642,163	523,116
	2005	180,270,080	19,707,319	5,144,838	21,537,742	2,707,247	535,239
	2007	185,016,799	20,031,364	5,210,009	22,204,019	2,770,836	546,813
	2009	189,762,535	20,355,046	5,275,098	22,873,241	2,834,176	558,382
Orange							
	1991	50,188,320	5,993,388	1,508,130	6,052,430	741,585	145,137
	1993	53,229,172	6,225,234	1,558,423	6,437,085	772,840	150,854
	1995	56,276,911	6,458,209	1,608,722	6,813,890	803,837	156,887
	1997	59,336,454	6,692,321	1,676,519	7,180,883	834,558	163,235
	1999	62,395,998	6,926,428	1,744,314	7,547,875	865,286	169,585
	2001	65,450,622	7,160,065	1,810,504	7,917,811	896,132	175,822
	2003	68,505,247	7,393,707	1,875,085	8,288,729	926,974	182,058
	2005	71,558,888	7,627,342	1,939,667	8,660,627	957,819	188,297
	2007	74,615,480	7,860,972	2,004,263	9,029,582	988,689	194,541
	2009	77,670,105	8,094,597	2,068,888	9,401,481	1,019,581	200,791
Riverside							
	1991	18,698,632	1,600,795	414,270	2,685,717	241,612	47,976
	1993	20,360,230	1,719,243	433,136	2,953,602	255,391	50,065
	1995	22,025,763	1,837,944	451,209	3,217,561	269,119	52,229
	1997	23,693,263	1,956,923	472,309	3,481,521	282,385	54,327
	1999	25,361,747	2,075,910	493,215	3,742,537	295,792	56,476
	2001	27,030,232	2,194,850	514,773	4,003,553	309,925	58,883
	2003	28,697,732	2,313,807	537,831	4,263,588	324,049	61,290
	2005	30,365,232	2,432,778	560,895	4,524,604	338,174	63,698
	2007	32,034,700	2,551,722	583,963	4,786,601	352,287	66,107
	2009	33,702,201	2,670,690	607,043	5,047,617	366,417	68,519
San Bernardino							
	1991	20,824,572	2,325,791	589,788	3,340,219	362,967	71,531
	1993	22,342,539	2,448,566	620,030	3,611,048	385,701	75,913
	1995	23,861,489	2,571,719	650,417	3,879,914	408,663	80,520
	1997	25,387,325	2,695,277	686,712	4,141,911	431,571	85,250
	1999	26,912,178	2,818,821	723,986	4,407,833	454,819	90,105
	2001	28,428,177	2,941,645	760,404	4,678,662	479,138	95,073
	2003	29,945,160	3,064,458	796,807	4,950,472	503,793	100,166
	2005	31,462,143	3,187,291	832,285	5,222,282	528,129	105,146
	2007	32,978,142	3,310,107	867,778	5,494,092	552,860	110,264
	2009	34,495,124	3,432,942	904,395	5,765,901	577,251	115,262

TABLE A9 – 14 – A (Cont.)
VEHICLES MILES TRAVELED (VMT), AVERAGE DAILY TRIPS (ADT) AND NUMBER OF VEHICLES (NOV)
Anticipated values for (B) or (F) by California Air Resources Board

		MOTORCYCLES			BUSES		
COUNTY	YEAR	VMT	ADT	NOV	VMT	ADT	NOV
Los Angeles							
	1991	999,000	130,005	175,683	310,000	4,460	2,230
	1993	1,032,000	134,270	181,446	314,000	4,524	2,262
	1995	1,065,000	138,535	187,376	319,000	4,588	2,294
	1997	1,103,000	142,800	194,081	323,000	4,652	2,326
	1999	1,141,000	147,065	200,773	328,000	4,716	2,358
	2001	1,174,000	152,921	206,586	331,000	4,768	2,384
	2003	1,202,000	156,551	211,524	334,000	4,810	2,405
	2005	1,230,000	160,181	216,449	337,000	4,850	2,425
	2007	1,258,000	163,811	221,366	340,000	4,892	2,446
	2009	1,286,000	167,441	226,271	343,000	4,934	2,467
Orange							
	1991	340,000	45,320	68,666	58,000	842	421
	1993	359,000	47,884	72,551	60,000	870	435
	1995	378,000	50,448	76,436	62,000	898	449
	1997	396,000	52,826	80,040	64,000	926	463
	1999	414,000	55,205	83,644	66,000	956	478
	2001	432,000	57,627	87,313	68,000	982	491
	2003	451,000	60,090	91,046	70,000	1,006	503
	2005	469,000	62,555	94,781	72,000	1,030	515
	2007	488,000	65,019	98,514	73,000	1,052	526
	2009	506,000	67,484	102,248	75,000	1,076	538
Riverside							
	1991	72,000	7,473	19,162	13,000	188	94
	1993	75,000	7,854	20,139	15,000	206	103
	1995	79,000	8,220	21,078	16,000	224	112
	1997	82,000	8,560	21,948	17,000	242	121
	1999	85,000	8,896	22,811	18,000	260	130
	2001	89,000	9,248	23,713	20,000	278	139
	2003	92,000	9,632	24,697	21,000	296	148
	2005	96,000	10,015	25,679	22,000	312	156
	2007	100,000	10,398	26,661	23,000	330	165
	2009	104,000	10,782	27,645	24,000	346	173
San Bernardino							
	1991	114,000	14,143	30,746	9,000	126	63
	1993	121,000	14,979	32,562	9,000	134	67
	1995	127,000	15,818	34,387	10,000	142	71
	1997	134,000	16,619	36,128	11,000	152	76
	1999	140,000	17,443	37,920	11,000	160	80
	2001	147,000	18,293	39,768	12,000	168	84
	2003	155,000	19,190	41,718	12,000	176	88
	2005	162,000	20,065	43,620	13,000	184	92
	2007	169,000	20,940	45,521	13,000	192	96
	2009	176,000	21,841	47,481	14,000	200	100

TABLE A9 - 15

OPTIONAL CUMULATIVE IMPACT ANALYSIS
BASED ON
THE 1991 AQMP PERFORMANCE STANDARDS

STANDARD

One Percent Per Year Red_ction In Project Emissions
During The Life-span Of The General Plan

$A = \{B\} - \{[(C)^{\wedge(D)}] \times [B]\}$

Where,

A = Emission reduction in pounds for given year
B = Starting cumulative emissions
C = 0.99, a fraction for remaining emissions (The fraction assumes that 100 pounds are unmitigated cumulative emissions. Using the procedures outlined in Chapter 9, 1 percent or 1 pound of this 100 pounds of unmitigated emissions must be eliminated for given year)
D = Number of years

EXAMPLE

B = 500 pounds of Unmitigated cumulative emissions in 1993 beginning of the project development
C = 0.99

For first year A = 500 - (500 x 0.99) = 5.0 per year from 1993 onward should be reduced (approximately)

Year	Starting Emissions		Remaining Emissions	= Cumulative Emission Reduction
1993	500.00	-	N.A.	= 0 Project Starts to Operate
1994	500.00	-	495.00	= 5.00 pounds of reduction in cumulative emissions
1995	495.00	-	490.05	= 4.95 pounds of reduction in cumulative emissions
1996	490.05	-	485.15	= 4.90 pounds of reduction in cumulative emissions
1997	485.15	-	480.30	= 4.85 pounds of reduction in cumulative emissions
1998	480.30	-	475.50	= 4.80 pounds of reduction in cumulative emissions
1999	475.50	-	470.74	= 4.75 pounds of reduction in cumulative emissions
2000	470.74	-	466.03	= 4.71 pounds of reduction in cumulative emissions
2001	466.03	-	461.37	= 4.66 pounds of reduction in cumulative emissions
2002	461.37	-	456.76	= 4.61 pounds of reduction in cumulative emissions
2003	456.76	-	452.19	= 4.57 pounds of reduction in cumulative emissions
2004	452.19	-	447.69	= 4.52 pounds of reduction in cumulative emissions
2005	447.69	-	443.19	= 4.48 pounds of reduction in cumulative emissions
2006	443.19	-	438.76	= 4.43 pounds of reduction in cumulative emissions
2007	438.76	-	434.37	= 4.39 pounds of reduction in cumulative emissions
2008	434.37	-	430.03	= 4.34 pounds of reduction in cumulative emissions
2009	430.03	-	425.73	= 4.30 pounds of reduction in cumulative emissions
2010	425.73	-	421.47	= 4.26 pounds of reduction in cumulative emissions
2011	421.47	-	417.26	= 4.21 pounds of reduction in cumulative emissions
Total				= 82.74 pounds of reduction in 17 years

A reduction in cumulative impacts should continue at the rate of approximately 5 pounds per year
N.A. = Not applicable in start year.

TABLE A9 - 16

OPTIONAL CUMULATIVE IMPACT ANALYSIS BASED ON THE CALIFORNIA CLEAN AIR ACT PERFORMANCE STANDARDS 1.5 AVERAGE VEHICLE RIDERSHIP (AVR)

G = H - C

where,

G = Needed Reduction in Number of Vehicles to Achieve Targeted AVR
H = Current Number of Vehicles = D/E

where,

D = Average Daily (Weighted using weekday and weekend Travel data) Number of Persons Traveling in vehicles for the buildout year = A + B + L1

Where,

To improve the AVR, trips associated with the following should be eliminated or reduced.

A = Number of Persons Traveled in 4+ Person vehicles 1-way **Alone**
B = Number of Persons Traveled in 2 Person Motorcycles 1-way **Alone**
L1 = Number of Persons Traveled 1-way but No Survey Response
(If Not Applicable, Use 0.0)
(*Treat these as A, i.e., traveling* Alone *in 4+ Person Vehicles*)
E = Estimated AVR for the City or County
without implementation of TCM mitigation measures
(*To Estimate buildout year AVR, Use Table 9-7 methodology*)
C = Number of Allowed Vehicles = D/F; Where,
D = Average Daily (Weighted using weekday and weekend travel data)
Number of Persons Traveling in buildout year
F = Targeted AVR for the City or County for the buildout year
(*If unknown, Use 1.5, the California Clean Air Act requirement*)

Examples of Cumulative Work Trips AVR

Cumulative AVR for 1 Person Traveled to Work 1-Way by One vehicle	= 1/1 = 1.0
Cumulative AVR for 2 Persons Traveled to Work 1-way by One vehicle	= 2/1 = 2.0
Cumulative AVR for 3 Persons Traveled to Work 1-way by One vehicle	= 3/1 = 3.0
Cumulative AVR for 4 Persons Traveled to Work 1-way by One vehicle	= 4/4 = 4.0
Cumulative AVR for 7 Persons Traveled to Work 1-way by One Van	= 7/1 = 7.0
Cumulative AVR for 15 Persons Traveled to Work 1-way by One Subscription or planned bus	= 15/1 = 15.0
Cumulative AVR for 15 Persons Traveled to Work 1-way by One Public transit (rail/buses)	= 15/1 = 15.0
Cumulative AVR for 1 Person Traveled to Work 1-way to Report to Another Site	= 1/1 = 1.0

(1991 AQMP states that 5% of following trips were for Home to other)

Example of Non-Work Trip AVR for the Vehicles Not Used for Work trips but Used for Other Trips = 1/1
Non-work 1-Way Cumulative Trips = [{(J+K+L+M+N+O+P+Q+R+U) x 0.05} + {(S+T)xV}]; Where,

L = Number of Persons Travel did not travel due to Telecommuting at home
J = Number of Persons Traveled 1-way by Walk
V = Percent Weekend Trips to other
K = Number of Persons Traveled 1-way by Bicycle
M = Number of Persons did not travel to the project site due to days off from 3/36 work week
N = Number of Persons did not travel to the project site due to days off from 4/40 work week
O = Number of persons did not travel to the project site due to days off from 9/80 work week
P = Number of persons did not travel to the project site due to vacation
Q = Number of persons did not travel to the project site due to sick leave
R = Number of persons did not travel to the project site because they were absent for reasons other than vacation and sick leaves
S = Number of persons did not travel to the project site because it was Saturday (Weekend)
T = Number of persons did not travel to the project site because it was Sunday (Weekend)
U = Number of persons did not use cars due the mitigations described to estimate various AVRs above

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INFORMATION
FOR
ESTIMATING
NUMBER OF CONSTRUCTION EMPLOYEES

TABLE A9 - 17
ESTIMATING THE NUMBER OF ON-SITE CONSTRUCTION EMPLOYEES
(Number of Employees Per Project)

E* = ((F x G x H)/1,000,000) x I; or, ***
E** = (G x H)/1,000,000) x I; ***

Where,

E = Number of Construction Employees
F = Gross square footage of that type of construction for which the value for (G) will be selected
(Refer to project description of environmental documents)
G = Construction Value
(If unknown, use cost values from Table A9 - 17 - C)
H = Full time employment rate for construction related on-site[1] and off-site[2] activities.
(If unknown, see Table A9 - 17 - A)
I = Rate of on-site construction employment
(If unknown, see Table A9 - 17 - B)

1. "on-site" means at the construction site and does not include employees needed to move goods; and
2. "off-site" means employees needed at the goods (cement, walls, nails, etc.) manufacturing sites and goods transportation*** activities. For CEQA there is no need to estimate impact associated with employees needed at the goods manufacturing sites, however, impact associated with employees*** needed to transport goods to the project site should be estimated and included in the environmental documents.
3. In order to estimate employees needed to transport goods use the methodology suggested in Energy and Labor in the Construction Sector, B. Hannon, R. Stein, and D. Serber, Science, 1978, 202: 837-847.

* *For E* use information from column labelled as dollars/gross square foot.*

** *For E** use the methodology suggested in footnote of the Table A9 - 17 - C and historical values provided in the third column of this table (New Valuation) or estimate current values by applying seasonal and annual rate changes provided in the Composite Index Example column of this table to the historical values provided in the New Valuation column of this table.*

*** To determine employee related Average Daily Trips, use Tables A9 - 5 - A - 1 or A9 - 5 - A - 2.

TABLE A9 - 17 - A

FULL TIME EMPLOYMENT FACTORS (H) ASSOCIATED WITH THE CONSTRUCTION INDUSTRY****

Land Use Type	FTE Factor (H)
o Building Construction (Construction of New Residential, and Non-Residential)	9.2
o Non-building Construction (Construction of parking lots roadways, etc.)	8.78
o Demolition/Renovation/Repairs	9.15

TABLE A9 - 17 - B

PERCENT RATE (I) OF ON-SITE CONSTRUCTION JOBS****

Land Use Type	Percent Values/100 (I)
o Building Construction (Construction of New Residential, and Non-Residential Structures)	0.392
o Non-building Construction (Construction of parking lots roadways, etc.)	0.458
o Demolition/Renovation/Repairs	0.602

**** *Use the values as provided in Tables A9 - 17 - A and A9 - 17 - B*

TABLE A9 - 17 - C

LAND USE TYPES (F) AND CONSTRUCTION COST (G) (DOLLARS PER SQUARE FOOT, PREVIOUS COSTS, AND SEASONAL AND ANNUAL % CHANGE RATES)

Land Use Type	Derived Cost Rate Dollars/Gross Square Foot	Average Project Valuation Year 1988	Composite Index Example Dec '88	Jan '88	Year 1978
Renovation, Repairs and Demolition					
Building- Residential		119,758.00	-11.6	-11.2	+9.0
Non-building - Residential		237,648,000.00	-18.7	-5.6	+5.8
Nonbuilding/Heavy Construction Activities					
Streets and Highways		59,612,000.00	-22.1	+0.4	+0.3
Bridges (inc. elev. hwys)		9,805,000.00	+212.3	-20.0	+10.8
Sewerage and Waste Systems		29,175,000.00	+117.9	+11.9	-33.1
Electric Power and Heating Systems		22,372,000.00	-57.7	-33.3	-49.0
River, Harbor, and Flood Control Systems		17,265,000.00	-67.2	-15.7	-11.1
Water Supply Systems		38,590,000.00	-4.2	+15.6	+41.4
Dams and Reservoirs		836,000.00	-82.3	-83.3	+7.7
Other Nonbuilding		70,546,000.00	+9.2	+56.3	+23.6
Building - Residential					
2-4 Unit Structures		40,774,000.00	-51.1	-58.2	-20.3
Single family dwelling units	55.70	978,406,000.00	+6.2	+6.9	+2.9
5-More Units (Apartments)	58.73	165,351,000.00	-40.6	-64.0	-25.4
Nonbuilding - Nonresidential					
Service Stations		3,145,000.00	-29.3	-23.7	+23.1
Amusements and Recreation		8,822,000.00	-16.8	+0.3	+48.0
Other Non-residential Buildings		81,964,000.00	-2.9	-26.2	-11.3
Hospital	112.46	78,472,000.00	+19.3	+109.8	-3.1
Industrial Buildings	31.75	136,763,000.00	+1.8	+6.7	-13.2
Office Buildings	59.98	105,434,000.00	-50.7	-44.6	-17.2
Public Garages	28.16	113,350,000.00	+572.4	n/a	+2.7
Stores and Mercantiles	45.15	132,401,000.00	-8.6	+18.1	+22.0
Hotel and motel	67.34	23,711,000.00	-32.2	-40.4	-43.5
Schools	64.91				
Churches	60.71				
Convalescent Hospitals	86.83				
Medical Offices	74.70				
Banks	91.12				
Public Buildings	78.24				
Warehouses	27.32				
Theaters	63.88				
Auditorium	61.65				
Restaurants	67.85				
Bowling Alleys	39.74				

For quick computation of present replacement costs from dependable historical costs, use Comparative Cost Index tables of Section 98 reflecting the latest quarters. These are published by Marshall Valuation Service (Marshall and Swift - printed in U.S.A.) January, April, July and October of each year. The index values are developed by taking into consideration seasonal and annual changes. In order to estimate current (Yr 1989) cost divide current index value by former (Yr 1988) index value, multiply the answer with known cost (yr 1988 cost).

Source: Residential building cost data are from the U.S. Department of Commerce, Bureau of the Census, and Construction Industry Research Board. Nonresidential building cost data are from the U.S. Department of Commerce, Bureau of the Census, Security Pacific National Bank, and Construction Industry Research Board. Nonbuilding costs are from Dodge Division of McGraw-Hill and compiled by Construction Industry Research Board.

Note: Commercial Construction usually assumes 3-7 acres/$1,000,000 and built in 11 months.

ASSUMPTIONS
FOR
THE SCREENING TABLES IN
CHAPTERS 6 AND 9

TABLE A9 - 18
ASSUMPTIONS FOR THE SCREENING TABLES IN CHAPTERS 6 AND 9

The following is a list of methodologies and defaults used in the preparation of the screening tables used in Chapters 6 and 9.

TABLE 6-2 PROJECTS OF POTENTIAL SIGNIFICANCE FOR AIR QUALITY - OPERATION
TABLE 9-4 ESTIMATING MOBILE SOURCE OPERATION EMISSIONS

METHODOLOGY	Table A9 - 5
DEFAULTS	
REGIONAL TRIP LENGTH	10.7
TRIPS	ITE TRIP GENERATION MANUAL
PERCENT HOT AND COLD STARTS	Table A9 - 5 - M
EMFAC7EP	Table A9 - 5 - J - 2
	35 MPH
	AREA 2

TABLE 9-1 ESTIMATING ON-ROAD CONSTRUCTION EMISSIONS

METHODOLOGY	Table A9 - 5, A9 - 6
DEFAULTS	
REGIONAL TRIP LENGTH	10.7
TRIPS	ITE TRIP GENERATION MANUAL
PERCENT HOT AND COLD STARTS	Table A9 - 5 - M
EMFAC7EP	Table A9 - 5 - J - 2
	35 MPH
	AREA 2
FULL-TIME CONSTRUCTION RATE	Table A9 - 6 - A
RATE OF ONSITE CONSTRUCTION JOBS	Table A9 - 6 - B
LAND USE CONSTRUCTION VALUE	Table A9 - 6 - C
WORKER TRIP RATE	Table A9 - 5 - A

TABLE 6-3 PROJECTS OF POTENTIAL SIGNIFICANCE FOR AIR QUALITY - CONSTRUCTION
TABLE 9-2 ESTIMATING OFF-ROAD CONSTRUCTION EMISSIONS

METHODOLOGY	Table A9 - 3
DEFAULTS	
ENERGY CONSUMPTION FOR CONSTRUCTION EXHAUST EMISSIONS	Table A9 - 3 - M
EMISSION FACTORS FOR EACH CRITERIA POLLUTANT	Table A9 - 3 - A

TABLE 6-3 PM10 PROJECT SIGNIFICANCE
TABLE 9-3 ESTIMATING CONSTRUCTION PM10 EMISSIONS

METHODOLOGY	
UNPAVED ROADS	Table A9 - 9 - D
PAVED ROADS	Table A9 - 9 - C
DEMOLITION	Table A9 - 9
DEFAULTS	
UNPAVED ROAD SILT LOADING AND ROAD TYPE	Table A9 - 9 - D - 1
MEAN VEHICLE SPEED	Table A9 - 9 - D - 2
MEAN NUMBER OF WHEELS AND WEIGHT	Table A9 - 9 - D - 3
PRECIPITATION CONDITIONS AND NUMBER OF DAYS	Table A9 - 9 - D - 4

TABLE 9-5 ESTIMATING AREA SOURCE OPERATION EMISSIONS

METHODOLOGY	Table A9 - 11
DEFAULTS	
ANNUAL CONSUMPTION OF KILOWATT HOURS	Table A9 - 11 - A
EMISSION FACTOR FOR EACH CRITERIA POLLUTANT	Table A9 - 11 - B

TECHNICAL ADDENDUM

CARBON MONOXIDE TRANSPORTATION PROJECT PROTOCOL

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TECHNICAL ADDENDUM

1. General

A Gaussian based line source model is to be used, as appropriate, to assess the effects of specific projects on local CO concentrations. An example of such a model is the Caltrans supported CALINE4 model.

The CALINE4 model is the most commonly used line source model in California. The technical assumptions contained in this Addendum are for use with this model. The use of CAL3QHC or TEXIN II models may require modification of these assumptions.

Use of alternative line source models, while not discouraged, must be agreeable to the local air district.

2. Background CO Levels

An important element in a microscale analysis of the CO concentrations expected as a result of particular projects, is the "background" concentration levels of CO upon which to add the estimated CO concentrations expected from the proposed project.

The model analysis must be carefully designed so as to minimize duplication of CO concentrations resulting from traffic otherwise accounted for in "background" CO levels.

The objective of the model analysis is to determine the incremental change in the CO concentration level between the "no project" alternative, and the CO concentration level resulting if the proposed project is constructed. The resultant incremental CO concentration levels are to be added to the background CO level and compared to the CO standards.

The appropriate "background" CO level shall be the estimated ambient levels determined either by using the CO concentration levels as measured by a nearby permanent monitoring station, or by the use of project-specific monitoring.

Unless otherwise agreed to by the sponsors and the local air district, a project-specific monitoring program shall consist of 4 months of continuous sampling during the winter CO season (November thru February). The sampling shall be in accordance with 40 CFR 58; Appendices A, D and E; and shall achieve a 90% data completeness. Sampling shall be at location(s) so as to both minimize duplication of CO concentrations resulting from traffic otherwise accounted for in the model analysis, and appropriately account for CO concentration levels from other major sources.

The "background" or ambient CO levels used in the analysis must be reflective of the same time of day as the traffic volumes used in the project analysis.

In the CO nonattainment area of the South Coast Air Basin, "background" levels for future years shall be estimated by application of factors to the base year "background" levels. The factors are directly proportional to the estimated future year total CO emissions, within each air quality analysis zone, as estimated by the South Coast AQMD in a manner consistent with SCAG's most recent transportation plan or program conformity analysis. The current estimated future year total CO emissions are attached.

3. Receptor Sites

A key element in the CALINE analysis is the location used to calculate the expected CO concentrations for comparison to the standards. These location(s) are termed the critical receptor sites. The critical receptor site(s) shall be at location(s) which are estimated to be representative of the highest CO concentrations expected in the area potentially effected by the proposed project.

Generally, receptor sites shall be representative of locations where there is a reasonable expectation of continuous human exposure during the time period(s) coinciding with peak CO concentrations. Receptor site(s) shall be located in a manner consistent with EPA's "microscale" criteria contained in 40 CFR 58. The location(s) shall be representative of existing and reasonably expected future land development projects.

Additionally, the receptor site(s) are to be selected reflective of meteorology, background CO levels, and the traffic/operational characteristics of the nearby existing and proposed transportation facilities.

Frequently, it is necessary to analyze multiple receptor sites in order to identify the critical site(s) with the highest CO concentrations with and/or without the proposed project. Once identified, the CO concentrations at the critical receptor site(s) will be used to judge the acceptability of the proposed project under the applicable laws.

If the project is unusually complex, or if the CO an lysis appears potentially a deciding issue as to whether the project is allowed to proceed, sponsors should consult with the local air district regarding selection of the critical receptor site(s). This should be accomplished as early as possible in the process.

4. Calculation of 8-hour CO Concentrations - Persistence Factors

Estimated 8-hour CO concentrations expected to occur in the area are calculated by use of the persistence factor from the 1-hour levels estimated to occur at the 8-hour receptor sites. This factor is the ratio between the 1-hour and 8-hour CO concentrations as measured at the nearest representative permanent monitoring station.

Because the persistence factor really represents a combination of both the traffic persistence and the meteorological persistence, the preferred method is to use monitoring data to calculate the 1-hour to 8-hour ratio, as it would inherently include both traffic and meteorological conditions.

The persistence factor should be based on values obtained using the 10-highest non-overlapping 8-hour concentrations obtained from the latest three CO seasons of monitoring data. The ratio of the 8-hour concentration to the highest 1-hour concentration in each of the non-overlapping 8-hour periods is determined, and the average of the 10 values is used as the persistence factor.

Optimally the use of three seasons of CO monitoring data should be utilized to establish the 8-hour concentrations at the project site. However, two seasons of CO monitoring performed subject to 40CFR58 would be acceptable. If less than two years of information is available then the persistence factor values from the table below should be utilized.

Factor	Setting
0.6	Attainment areas
0.7	Nonattainment areas
0.8	Urban area with persistent stagnation and/or congestion

5. Ambient Air Temperature

For purposes of initial estimating, the lowest winter (November thru February) mean minimum temperature over a representative three-year period may be used. Temperature Adjustments for the time of day analyzed are noted on Table 3120.1 of the Caltrans "Air Quality Technical Analysis Notes" - AQTAN - (1988).

A more accurate estimation is achieved by using the temperatures associated with the actual time periods during which the historic high CO events in the area have occurred.

6. Vehicle Mix

The vehicle type distribution must be compatible with the version of EMFAC utilized in the analysis, and representative of the facility analyzed.

Heavy duty gas trucks are the most critical classification. The "Annual Truck Traffic Reports," available from Caltrans, contain the average daily percentage of trucks on State Highways. Time period adjustment factors must be applied to these percentages to more accurately reflect the targeted time period of the air quality analysis. (See Table 3130.2 of the AQTAN, 1988).

7. Percent Cold & Hot Starts

Vehicle emissions are especially sensitive to the percentages of cold starts within the vehicle mix. To a much lesser extent, emissions are also sensitive to hot starts.

The start-up phase is defined as the first 505 seconds or 3.59 miles. A cold start is defined as occurring after 1 hour of off time for a catalytic equipped vehicle, or 4 hours for a non-catalytic equipped vehicle.

For initial estimating purposes on urban freeways, these percentages are able to be estimated with Equation 2 from Section 3140 of the AQTAN (1988). Further, AQTAN Sections 3140, 6134, and 6221 (1988) contain simplified methods for making approximate estimates.

For initial estimating on non-freeways, cold and hot starts should be estimated at 95% and 5%, respectively.

In non-freeway situations, the range of the percent of cold starts can vary widely. More accurate estimates are able to be achieved through a project specific analysis, and may be utilized with appropriate documentation.

8. Speed

The vehicle operating conditions (speeds, accelerations, etc.) should represent the average conditions on the route, or element thereof, during the hour(s) analyzed. The present and projected conditions should be obtained from speed profiles or appropriate traffic models.

9. Surface Roughness

Surface Roughness affects the mechanical turbulence, thus the dispersion of the pollutants near the ground. Surface roughness is to be 15% of the average canopy height, and should be limited between 3 and 400 cm. As the calculations are not very sensitive to changes in surface roughness; generally, a rough order of magnitude estimate, based on the predominate land use, is sufficient.

10. Mixing Height

A mixing height of 1000 meters should be used, bypassing the mixing height algorithm, unless the local air district indicates otherwise.

11. Wind Speed

Unless the local air district indicates otherwise, the wind speeds in Table 4127.1 from the AQTAN (1988) may be assumed for estimating purposes.

12. Wind Direction

For estimating purposes, the "worst" wind angle is to be used. In order to determine the "worst" wind angle, it is necessary to calculate CO levels at the receptor site for a range of alternative angles at 10 degree increments. The "worst" wind angle, is the angle, within 1 degree, which results in the highest CO concentration at the receptor site.

13. Stability Class

Stability class describes the potential of atmospheric conditions to disperse pollutants through the process of turbulent diffusion. The line source model is not very sensitive to changes in the stability class. Unless the local air district indicates otherwise, the stability classes in Table 4127.1 from the AQTAN (1988) may be assumed for estimating purposes.

14. Sigma Theta

Sigma theta is the standard deviation of the wind direction. With receptors close to the roadway and parallel winds (a typical worst case scenario), changes in sigma theta can have a very dramatic effect on predicted concentrations. Unless the local air district indicates otherwise, the sigma thetas in Table 4127.1 from the AQTAN (1988) may be assumed for estimating purposes.

APPENDIX 10 SUMMARY OF GUIDELINES FOR LAND USE ANALYSIS WITH AIR TOXICS

The EIR that considers air toxics as well as criteria pollutants will differ in a few respects from the conventional EIR, *but the differences are critical*. The additional analyses will determine what kinds and level of mitigation are required and what residual impact cannot be eliminated if the project is pursued.

Substantial technical complexity may be involved in assessing air toxics. Publications prepared by the District and the ARB can be helpful. Assistance with understanding technical aspects may be obtained from the District. Of necessity, analysis involving air toxics will follow the basic approach used in preparing a risk assessment.

An outline listing elements needed for such an approach follows.

A. Description of the Facility and the Area of Planning Concern

- o The usual content provided under the project's "Setting"
- o Focused description of each operation which may release air toxics including actual facility operating hours and release characteristics

B. Emissions Sources--a flow diagram of all process flows for a toxics-emitting facility, identifying:

- o Specific processes with a potential for emissions
- o Devices associated with emitting processes
- o Estimate of number of possible accidental release sites
  - valves
  - flanges
  - locations, devices sensitive to seismic events
- o All locations of possible exhaust release locations

C. Substances Emitted:

- o Quantities expected to be released, from all emission points
  - routine releases
  - accidental releases, with probability for the causative event
- o How releases take place (source data for modeling)
- o Emission control equipment and its efficiency

D. Possible Modeling Approaches and Requirements:

- o Available and suitable modeling approaches
- o Information requirements for modeling
  - Terrain: Flat, or complex topography
  - Degree of urbanization
  - Meteorological data available

E. Receptor Data:

- o Particularly sensitive receptor points
- o Commercial receptors
- o Zone of potential impact defined as an area with a 1 in 2 million risk
- o Exposed population: size, character (census tracts)
- o Type of exposure: inhalation, non-inhalation

F. Estimation of Health Risk:

- o Cancer risk analysis
  - Individual excess cancer risk for sensitive receptors
  - Individual excess cancer risk for commercial receptor

- Population excess cancer burden including both sensitive and commercial receptors

o Estimation of non-cancer health effects (if identifiable) and description of non-cancer effects (both chronic and acute) for each air toxic emitted

Planning for air toxics must first establish what emissions may result if the project is carried out, together with where, how, and when they may be released. The District Engineering staff will need to be consulted for data estimates. The District Modeling staff can be consulted for emissions estimates used in modeling. Data must be site- and facility- specific. As noted in Chapter 5, risk assessments prepared under AB 2588, when available, are a useful starting point for the planning analysis. Source and surrounding receptor locations must be characterized with a particular view toward the kind and extent of risk which may result from the project. Conventional features such as terrain, building characteristics of surroundings, and population distribution and character are also essential.

(APPND_10)

CONTENTS
APPENDIX TO CHAPTER 11

Contents, Appendix to Chapter 11 (continued)

Contents, Appendix to Chapter 11 (continued)

(Ch11_toc)

TOPIC GROUPINGS
FOR TABLES IN THE APPENDIX TO CHAPTER 11

For Tables on These Topics **See Page**

For Tables on These Topics **See Page**

(TOCCH11A)

TABLE A11 - 1
SUMMARY OF ESTIMATED DAILY EMISSIONS FOR CONSTRUCTION, DEMOLITION & RENOVATION AFTER MITIGATION

PROJECT NAME:

PREPARED BY: DATE:

Source	Emissions in Pounds per Day					
	Reference	CO	ROC	NOx	SOx	PM10
STATIONARY CONSTRUCTION EQUIPMENT						
Gasoline Engines	Table A11 - 3					
Diesel Engines	Table A11 - 3					
VEHICULAR						
Work Trips	Table A11 - 5					
Non-Work Trips	Table A11 - 5					
Truck Trips	Table A11 - 5					
Traffic Impacts	Table A11 - 5					
MOBILE CONSTRUCTION EQUIPMENT						
Diesel-Powered	Table A11 - 8					
Gasoline-Powered	Table A11 - 8					
DUST/PM10						
Paved Roads	Table A11 - 9					
Unpaved Roads	Table A11 - 9					
Storage Piles	Table A11 - 9					
Paved Parking Lots	Table A11 - 9					
Unpaved Parking Lots	Table A11 - 9					
Storage Piles	Table A11 - 9					
Earthmoving Storage Pile Filling	Table A11 - 9					
Demolition	Table A11 - 9					
ENERGY USE						
SCE	Table A11 - 11					
LADWP	Table A11 - 11					
Natural Gas	Table A11 - 12					
ASBESTOS	Table A11 - 10					
BUILDING MATERIALS	Table A11 - 13					
OTHER						
TOTALS						
Emissions (lbs/day)						
SCAQMD Thresholds (lbs/day)						
Project's Significance (Yes or No)						

TABLE A11 - 2
SUMMARY OF ESTIMATED DAILY OPERATION-RELATED EMISSIONS AFTER MITIGATION

PROJECT NAME:

PREPARED BY: DATE:

Source	Emissions in Pounds per Day					
	Reference	CO	ROC	NOx	SOx	PM10
STATIONARY						
(List Sources Qualified)	Table A11 - 4					
VEHICULAR						
Work Trip	Table A11 - 5					
Non-Work Trip	Table A11 - 5					
Truck Trip	Table A11 - 5					
Traffic Impacts	Table A11 - 5					
OFF-ROAD MOBILE:						
(List Sources Qualified)						
DUST/PM10						
Paved Roads	Table A11 - 9					
Unpaved Roads	Table A11 - 9					
Storage Piles	Table A11 - 9					
Paved Parking Lots	Table A11 - 9					
Unpaved Parking Lots	Table A11 - 9					
ENERGY USE						
SCE	Table A11 - 11					
LADWP	Table A11 - 11					
Natural Gas	Table A11 - 12					
OTHER						
TOTALS						
Emissions (lbs/day)						
SCAQMD Thresholds (lbs/day)						
Project's Significance (Yes or No)						

TABLES FOR ESTIMATING STATIONARY EQUIPMENT EMISSIONS AFTER IMPLEMENTATION OF MITIGATION MEASURES

Mitigation Measures That Reduce Emissions Associated With Gasoline- and Diesel- Powered Stationary Equipment

- Replace Gasoline- and Diesel-Powered Stationary Equipment With Natural-Gas-Powered Stationary Equipment;
- Replace Gasoline- and Diesel-Powered Stationary Equipment With LPG (Propane and Butane)-Gas-Powered Stationary Equipment; or,
- Replace Gasoline- and Diesel-Powered Stationary Equipment With Battery-Powered Stationary Equipment; and/or
- Replace Reciprocating Stationary Engines with Turbine Stationary Engines.

TABLE A11 - 3

ESTIMATING EMISSIONS AFTER IMPLEMENTATION OF MITIGATION MEASURES THAT REDUCE EMISSIONS FROM STATIONARY OR HEAVY-DUTY ENGINES
(Pounds Per Day)

M = R + N

Where,

M = Mitigated Stationary Equipment Emissions After Implementation of Mitigation Measures
(Use Table A9 - 3 to Estimate Non-mitigated Emissions from Original Stationary Equipment)

R = Remaining or Residual Non-mitigated Emissions From Remaining Original Equipment
= {[E x (1 - {F/G})]; Where,

- E = Non-Mitigated Emissions from Table A9 - 3
- F = Number of Removed Original (and Replaced with New) Stationary Equipment
- G = Number of Original Stationary Equipment
(Used to Estimate Non-Mitigated Emissions (E) in Table A9 - 3 of Appendix 9)

N = New Emissions per Million BTUs From Replacement Equipment
= {V x (H/I)}; Where,

- V = Emissions from Removed Original Equipment
= [(E x {F/G}]
- H = New Emission Factor Per Million BTUs** For New (*or Replaced*) Equipment
(Please see Table A11 - 3 - A or C);
- I = Emission Factor per Million BTUS For Original Equipment
(Please see Table A11 - 3 - B or D)

** *BTUs = British Thermal Units*

TABLE A11 - 3 - A

Emission Factors (H) for Each Criteria Pollutant for New Equipment
(Pounds Per Million BTUs)

Pollutant Type	CO		ROC		NOx		SOx		PM10	
Fuel Type *****	R	T	R	T	R	T	R	T	R	T
(Industrial/Commercial Type)										
Propane	1.267	- -	0.815	- -	1.365	- -	0.003	- -	0.025	- -
Butane	1.267	- -	0.815	- -	1.365	- -	0.003	- -	0.025	- -
(Cogeneration Type)										
Natural Gas (Methane)	0.4095	0.1095	0.079	0.012	3.2381	0.3933	0.0006	0.0006	0.0048	0.0067
(Turbine Aircraft Type Engine Testing)										
Natural Gas (Methane)	- -	0.1143	- -	0.0066	- -	0.2857		0.0006		0.0067

***** Electricity generation engine type: R = Reciprocating; and T = Turbine
If unknown, use emission factors for reciprocating engines

TABLE A11 - 3 - B

Emission Factors (I) for Each Criteria Pollutant for Original (Removed) Equipment
(Pounds Per Million [1,000,000] BTUs)

Pollutant Type	CO		ROC		NOx		SOx		PM10	
Fuel Type *****	R	T	R	T	R	T	R	T	R	T
Distilled Oil, or Diesel	0.735	0.11	0.23	0.034	3.38	0.49	0.225	1.01	0.12	0.018
Gasoline	34.26	- -	1.28	- -	0.89	- -	0.046	- -	0.028	- -

TABLE A11 - 3 - C

Emission Factors for (H) Each Criteria Pollutant for New Equipment (The following emission factors should be converted to emissions per million BTUs))

Pollutant Type Fuel Type *****	CO R	 T	ROC R	 T	NOx R	 T	SOx R	 T	PM10 R	 T
				(Pounds/Megawatt-Hours [1] and [2])						
Electricity	0.2	--	0.01	--	1.15	--	0.12	--	0.04	--
Dual Fuel (Oil/Gas)	7.9	--	2.0	--	24.14	--	0.94	--	1.48	--
				(Pounds/One Thousand [1,000] Gallons)						
Propane	129.0	--	83.0	--	139.0	--	0.35	--	2.5	--
Butane	129.0	--	83.0	--	139.0	--	0.35	--	2.5	--
				(Pounds/Million [1,000,000] Cubic Feet)						
Process Gas*	--	--	83.0	--	--	--	--	--	--	--
Landfill Gas	--	--	--	--	--	--	--	--	--	--
				(Cogeneration Type)						
Natural Gas (Methane)	430.0	115.0	82.9	12.6	3,400.0	413.0	0.6	0.6	5.0	7.0
				(Turbine Aircraft Engine Testing)						
Natural Gas (Methane)	--	120.0	--	6.9	--	300.0	--	0.6	--	7.0

[1] When using emissions factors expressed in megawatt-hour, they should be adjusted using efficiency factors "S" from Table A9-3-C.

[2] For generators, when using emissions factors expressed in megawatt-hour, they should be further adjusted using efficiency factor "U" from Table A9-3-C.

* 525 BTUs per cubic feet of process gas

TABLE A11 - 3 - D

Emission Factors for (I) Each Criteria Pollutant for Original (Removed) Equipment (The following emission factors should be converted to emissions per million BTUs)

Pollutant Type Fuel Type *****	CO R	 T	ROC R	 T	NOx R	 T	SOx R	 T	PM10 R	 T
				(Pounds/Megawatt-Hours [1] and [2])						
Diesel	2.51	--	0.79	--	11.55	--	0.77	--	0.41	--
Gasoline	117.0	--	4.39	--	3.03	--	0.16	--	0.10	--
				(Pounds/1,000 Gallons)						
Diesel	102.0	15.4	32.1	4.77	469.0	67.8	31.2	140.0[s]	16.75	2.5
Gasoline	3,940.0	--	147.7	--	102.0	--	5.31	--	3.235	--
Residual Crude Oil	102.0	--	32.10	--	469.0	--	155.0	--	16.75	--
Keronaptha Jet Fuel	102.0	15.4	32.1	4.77	469.0	67.8	6.2	6.2	16.75	2.5
(Diesel/Kerosene Mixture)										
				(Pounds/Ton)						
Jet Fuel (Turbine)	--	150.0	--	1.7	--	1.0	--	0.5	--	2.5

[1] and [2] See explanation given under Table A11 - 3 - C

[s] Percent sulfur content of the fuel. *(Please see Rule 431.2 for the applicable project related fuel sulfur content factor, and multiply 140.0 with [s] to obtain project related SOx emission factor.)*

***** Electricity generation engine type: R = Reciprocating; and T = Turbine
If unknown, use emission factors for reciprocating engines

TABLES FOR ESTIMATING EMISSION REDUCTIONS FROM MITIGATION MEASURES FOR WHICH A METHODOLOGY IS NOT INCLUDED

TABLE A11 - 4

SOURCES OF EMISSION FACTORS FOR QUANTIFYING STATIONARY SOURCE* EMISSIONS

SCAQMD's Best Available Control Technologies Guidelines should be Consulted for Mitigating Emissions from Stationary Equipment.

1. California Air Resources Board, 1988, Instructions for the Emission Data System Review and Update Report, January 1988.

2. United States Environmental Protection Agency, 1981, Compilation of Air Pollution Emission factors, April 1981.

3. United States Environmental Protection Agency, 1979, Compilation of Air Pollution Emission factors - AP - 42, Sec. 6.13.1, Supplement 9, July 1979.

4. United States Environmental Protection Agency, 1973, Air Pollution Engineering Manual, May 1973.

5. United States Environmental Protection Agency, 1987, Estimating Releases and Waste Treatment Efficiencies for the Toxic Chemical Release Inventory Form, December 1987.

6. United States Environmental Protection Agency, 1988, Toxic Air Pollutant Emission Factors - A Compilation For Selected Air Toxic Compounds And Sources, October 1988.

7. United States Environmental Protection Agency, 1988, Gap Filling PM10 Emission FActors for Selected Open Area Dust Sources, March, 1988.

8. United States Environmental Protection Agency, 1988, Control of Open Fugitive Dust Sources, September, 1988.

9. United States Environmental Protection Agency, 1991, NonRoad Engine and Vehicle Emission Study, November, 1991.

10. United States Environmental Protection Agency, 1985, Assessment of Heavy-Duty Gasoline and Diesel Vehicles in California: Population and Use Patterns, Prepared in July 1985 by Yuji Horie, and Richard Rapoport of Pacific Environmental Services, Inc., July, 1985 (Contract Number A2-155-32).

11. SCAQMD's Rules and Regulations

12. SCAQMD's staff reports (the most recent) for applicable source specific rules.

* Many of these sources also include emission factors for mobile equipment utilized at stationary sources

Note: These sources are available at the District library located at 21865 Copley Drive in Diamond Bar, California 91765.

TABLE A11 - 4 - A

GENERAL METHODOLOGY TO DETERMINE EMISSION REDUCTIONS

(Table for estimating emissions from mitigation measures for which a methodology is not included in Appendix 11)

REMAINING ORIGINAL EMISSIONS
AFTER
THE IMPLEMENTATION OF MITIGATION MEASURE
= {[Nonmitigated Emissions] x [1 - ({# of Source Removed}/{# of Original Source})]}
or
= {[Nonmitigated Emissions] x [(# of Remaining Source)/(# of Original Source)]}

EMISSIONS REDUCTION FROM THE IMPLEMENTATION
OF
MITIGATION MEASURE
= {[Nonmitigated Emissions] - [Post-Mitigation Remaining Original Emissions]}

PERCENT REDUCTION FROM THE IMPLEMENTATION
OF
MITIGATION MEASURE
{[100 x (Emissions Reduction After Mitigation)]/[Nonmitigated Emissions]}

TABLE A11 - 5

METHODOLOGIES TO ESTIMATE EMISSIONS AFTER IMPLEMENTATION OF MITIGATION MEASURES THAT REDUCE VEHICULAR EMISSIONS

Implementation of mitigation measures will have direct impacts on emissions from on-road mobile sources. These direct impacts may be expressed as increases in average vehicle ridership (AVR), reductions in average daily trips, trip lengths, or congestion. It is assumed that indirect impacts may include a slight increase in nonwork trips and increased work trips by substitute traveling modes and activities. For example the 1991 AQMP projects that employer trip reduction programs, may result in an approximate 5% increase in nonwork trips. Nevertheless, there will be an overall benefit from these strategies. In addition, whenever a methodology for calculating reactive organic gases includes removal of diurnal emissions, they are also added back, as a vehicle still emits ROC emissions when not in use. Separate methodologies are provided in this table to estimate net emissions after implementation of a mitigation measure.

MITIGATION MEASURES THAT REDUCE TRIPS

Tables A11 - 5 - A and A11 - 5 - B identify mitigation measures that reduce vehicle trips to or from a facility.

Table A11 - 5 - A includes measures that reduce vehicle trips by shifting the mode of transportation from a single occupacy vehicle to a high occupancy vehicle. While emissions are reduced from eliminating a trip, new emissions are created by utilizing a motorized vehicle for the substitute trip. Therefore, the entire range of emissions associated with the replacement mode must be factored added back in. Examples include measures that increase carpooling, transit ridership, or shuttle services.

Table A11 - 5 - B includes mitigation measures that reduce vehicle trips by eliminating the need to travel altogether or shifting the mode of transportation from a single occupancy vehicle to a non-motorized mode. These mitigation measures eliminate emissions from a vehicle trip with no trip (i.e., telecommuting, alternative work weeks), or a non-emitting mode (i.e., bicycling, walking).

NON-MITIGATED EMISSIONS

To determine net emissions after implementation of mitigation measure, all methodologies will begin with non-mitigated emissions. Non-mitigated emissions are obtained by using Table A9 - 5 of Appendix 9. The following summarizes how these emissions were estimated.

A = Total Non-mitigated Vehicular Emissions = W + X + Y + Z;

where,

- W = Non-mitigated Average Daily One-way Trips x Multiplier (Use 2.0 to obtain two-way or round trips, otherwise muliply by 1.0) x Original Trip length x Running Emission Factors
- X = Non-mitigated Average Daily One-way Trips x Multiplier (Use 2.0 to obtain two-way or round trips, otherwise muliply by 1.0) x Start-up Emission Factors
- Y = Non-mitigated Average Daily One-way Trips x Multiplier (Use 2.0 to obtain two-way or round trips, otherwise muliply by 1.0) x Hot-Soak Emission Factors. (only ROC)
- Z = Non-mitigated Average Daily Trips/Divider (Use 2.0 only for two-way or round trips, otherwise divide by 1.0) x Diurnal Emission Factors. (only ROC)

TABLES FOR ESTIMATING VEHICULAR EMISSIONS AFTER THE IMPLEMENTATION OF MITIGATION MEASURES THAT REDUCE TRIPS BY UTILIZING SUBSTITUTE MOTORIZED VEHICLES

Mitigation Measures That Reduce Emissions Associated With Reduction in Average Daily Trips With an Increase in Vehicle Miles Traveled by Substitute Vehicles

- Establish or Contribute to Shuttle Service from Residential Subdivisions to or Non-Residential Developments to Rail or Multi-Modal Transit Stations
- Establish or Contribute to Shuttle Service from Residential Subdivision to Commercial Core Areas
- Require Retail and Special Event Centers to Offer Consumers Travel Incentives (Discounted or Free Transit Passes to Clients, Discounts on Purchases for Transit Riders, and Other Promotional Events)
- Provide On-Site Bus and Shuttle Turnouts, Passenger Benches, and Shelters or Contribute to Off-Site Improvements
- Provide Preferential Parking Spaces for Carpools and Vanpools
- Develop a Trip Reduction Plan to Achieve a 1.5 AVR or Higher for Multi-Tenant Buildings or Businesses with Fewer than 100 Employees
- Include Residential Units Within Commercial Developments or Contribute Towards Its Development Off-Site
- Require Retail Facilities and Special Event Centers to Offer Transit Incentives (e.g., Discounted or Free Transit Rides, Discounts on Purchases or Admission for Transit Riders)
- Implement or Contribute to Public Outreach and Ridesharing Education Programs
- Employers Provide Employees Incentives for Ridesharing or Charge for Single Occupant Vehicles to Encourage Ridesharing
- Charge to Park for Non-Employees or Provide Discounts to High Occupancy Vehicles
- Require Future Employers Not Subject to Regulation XV to Provide Centrally Located Commuter Area Offering Information on Transportation Alternatives
- Reduce Employee Parking Spaces for Those Employers Subject to Regulation XV
- Contribute to Regional Transit Systems (e.g., Funding for Capital Improvements, Dedication of Right-of-Way)
- Implement a Trip Reduction Plan to Achieve a 1.5 AVR or Higher for Construction Employees (Construction Activities)
- Establish or Contribute to Shuttle Service to and From Construction Sites to Retail and Food Establishments During Lunch Hours (Construction)

TABLE A11 - 5 - A

METHODOLOGY FOR VEHICLE TRIP REDUCTION BY UTILIZING SUBSTITUTE MOTORIZED VEHICLES

This methodology calculates net emissions after implementation of mitigation measures that reduce vehicle trips, however substitute vehicle trips cause an increase in vehicle miles traveled. While a vehicle trip is eliminated, the mode shift to a high occupancy vehicles i.e., buses, carpools, shuttles, result in an incremental increase in VMT and emissions. Diurnal emissions need to be added because a vehicle still emits emissions sitting in a carport or garage.

N = {[{(A x {1-[C/B]})] + [({C/D} x Q) + {R + S} + {X}]/[454]} + {I}

Where,

N = Net Emissions In Pounds Per Day After Implementation of Average Daily Trip (ADT) Reduction Measures

A = Total Non-mitigated Vehicular Emissions
(*Resulted from Table A9 - 5 or Appendix 9 Methodologies*); or,
= (A x {1-[C/B]}) of the above calculations; Residual Emissions of the above calculations, if emission reductions caused by other mitigation measures are reduced.
(*Resulted from Table A11 - 5 or Appendix 11 Methodologies*).

B = Total Original Number of Average Vehicle Trips Generated By the Project
(*Trips used to estimate value for "A" in Table A9 - 5 from Appendix 9 Methodologies*)
To estimate ADT reduced due to the participation in Trip Reduction program, Use Table A9 - 5 Methodologies from Appendix 9, and the Needed Data from Table A11 - 5 - A - 1.

C = Number of Trips Reduced from the Original Work Site after Implementation of the Mitigation Measure
(See Table A11 - 5 - A - 4 for methodologies to calculate "C" that are specific to individual mitigation measures
To estimate diurnal emissions associated with trip reduction

D = 2.0, if non-mitigated vehicular emissions were for 2-way or round trips; or
= 1.0, if non-mitigated vehicular emissions were for 1-way trips

Q = EMFAC7EP Diurnal Emission Factors (*Applicable only to ROC*) in grams per NOV.
Please estimate running exhaust, running evaporative, start-up, and hot soak emissions for the following modes. (Also estimate diurnal emissions for all replacement modes i.e., R, S and X.)
To Estimate Emissions Associated with the Following Travel Modes, Use Table A9 - 5 Methodologies from Appendix 9 and the Needed Data from Table A11 - 5 - A - 3.

R = Replacement or Additional Emissions in grams per day Associated with Employees Traveling in Personal Cars (reduced from original work trips) to other work sites with shorter traveling distance, or to original work sites work with improved AVR. (If not applicable to your project, enter 0.0); and/or

S = Replacement or Additional Emissions in grams per day Associated with Employees Traveling in Buses to other work sites with shorter traveling distance, or to original work sites with improved AVR. (If not applicable to your project, enter 0.0); and/or Any other traveling mode
To Estimate Emissions Associated with Replacement Trips to Other Work Sites with Shorter Traveling Distance or to Original Work Sites with Improved AVR, Use Table A9 - 5 Methodologies from Appendix 9 and the Appropriate Data from Table A11 - 5 - A - 2.

X = Replacement or Additional Emissions in grams per day Associated with Employees Traveling in Personal Cars to other work sites with shorter traveling distance. Please estimate all (running exhaust and evaporative, start-up, and hot soak emissions and do not estimate diurnal emissions associated with these trips (If not applicable to your project, enter 0.0).
To Estimate Emissions Associated with Nonwork Trips Made by the Personal Vehicles of Home-based employees, Use Table A9 - 5 Methodologies from Appendix 9 and the Needed Data from TABLE A11 - 1 - B.

I = Non-Work Related Emissions in pounds per day Associated with use of Reduced Cars for personal trips; (If not applicable to your project, enter 0.0);
= [(B x D x E x F x H)/(454)];

where,

- B = Number of Vehicles Reduced After Implementation of Mitigation Measure = (L - O)
- D = 0.05; Five percent of cars reduced and used for personal travel such as home to other or shop travel.
- E = Number of Trips per Vehicle per Day (*For Round-trip Use 2, and One-way Trip Use 1*)
- F = Trip Length for Home to Shop or Home to Other
- H = Running Emission Factors In Grams Per Mile At New Speed (based on New Speed for the Non-work Trip).

TABLE A11 - 5 - A - 1

DATA NEED FOR DETERMINING DIRECT IMPACTS

Impacts	Data Need	At Home	Other Work Site
Reduced Work Trips			
	# of Employees Participating Per Day	______	______
	# of Days of the Week	______	______
	Average Daily Trip Rate/Employee	______	______

TABLE A11 - 5 - A - 2

DATA NEED FOR DETERMINING INDIRECT IMPACTS (ADDITION OF NEW AVERAGE DAILY NONWORK TRIPS)

Impacts	Data Need	At Home	Other Work Site
Added Nonwork Trips			
	# of Employees Participating Per Day	______	______
	# of Days of the Week	______	______
	Average Daily Trip Rate/Employee	______	______

TABLE A11 - 5 - A - 3

DATA NEED FOR DETERMINING INDIRECT IMPACT (ADDITION OF NEW AVERAGE DAILY WORK TRIPS)

Impacts	Travel Modes	Data Need	At Home	Other Work Sites
Added Work Trips By Vehicle Type				
	o Cars or Motorcycles **(See Table A9 - 5 - J, L and N for Emission Factors)**			
		# of Employees Participating per Day	______	______
		# of Days of the Week	______	______
		Average Daily Trip Rate/Employee	______	______
		Average Trip Length	______	______
		Average Speed	______	______
	o Buses **(See Table A11 - 5 - H for Emission Factors)**			
		# of Employees Participating per Day	______	______
		# of Days of the Week	______	______
		Average Daily Trip Rate per Employee	______	______
		Average Trip Length	______	______
		Average Speed	______	______
	o Shuttles			
		# of Employees Participating per Day	______	______
		# of Days of the Week	______	______
		Average Daily Trip Rate Per Employee	______	______
		Average Trip Length	______	______
		Average Speed	______	______

TABLE A11 - 5 - A - 4

TRIP DEPENDENT INPUT ASSUMPTIONS MEASURES FOR VEHICLE TRIP REDUCTION BY UTILIZING SUBSTITUTE MOTORIZED VEHICLES

Mitigation measures for which,

$$C = K \times (L/M) \times O \times 2$$

Where,

- C = Number of Trips Reduced from the Original Work Site after Implementation of the Mitigation Measure *(See Table A11 - 5 - A methodology to use "C")*
- K = Number of employees anticipated to Participate in Trip Reduction mitigation measure per day
- L = Number of Days per Week Employees will Participate in the Mitigation Measure *(Based on 5-day work week assumption)*
- M = Number of Days per Week for which Work Trips are Estimated in Appendix 9
- O = Number of Daily Trips per Worker *(Use TIA Report or ITE Manual 5th Edition or Table A9 - 5 - A - 2 or assume 1.26 trips/worker)*

Mitigation Measure	Emission Source	Range of Input Assumptions K	L	Favorable Factors
Trip reduction plan to achieve a 1.5 AVR for construction employees	Work Trips Construction	1-5%	1-2	Large construction site with a substantial pool of workers with long construction phases and limited parking in staging area or vicinity
Preferential parking spaces for carpools and vanpools and provide a minimum vertical clearance of 7'2" in parking facilities to permit access to vanpools	Work Trips	1-5%	1-2.5	Large employers that must draw from regional employment base that results in significant commutes. Employers of 1,000+ best for vanpool results.
Provide on-site bus transit stops with turnouts, passenger shelters, or benches to encourage use or contribute to off-site development	Work Trips	1-5%	1-2.5	Worksites in dense, urban CBDs where parking demand exceeds supply and transit alternatives are not readily available. Parking pricing that provides discounts to HOVs, bus stop location no more than 1,000 feet from employee entrance. Free or reduced transit fare passes.

Mitigation measures for which,

$$C = K \times E \times (L / M) \times 2$$

Where,

C = Number of Trips Reduced from the Original Work Site after Implementation of the Mitigation Measure
(See Table A11 - 5 - A methodology to use "C")

K = Number of construction workers anticipated to Participate in Trip Reduction mitigation measure per day

or

K1 = Number of workers anticipated to Participate in Trip Reduction mitigation measure per day.

E = Average Non-Work Lunch Trip Rate per Day per Worker
(Use TIA Report or assume 2)

L = Number of Days per Week Construction Workers will Participate in the Mitigation Measure
(Assume 1 to 2.5, based on 5-day work week)

M = Number of Days per Week for which Work Trips are Estimated in Appendix 9

Mitigation Measures	Emission Source	Range of Input Assumptions K	Favorable Factors
Establish or contribute to shuttle service from construction site to retail and food services during lunch hours	Non-Work Trips Construction	1-5%	Large construction site with substantial pool of workers. Areas with significant lunch and food services. Remote construction where mobile food service is difficult or prohibited

Mitigation Measures	Emission Source	Range of Input Assumptions K1	Favorable Factors
Establish or contribute to shuttle service from general worksites to retail and food services during lunch hours	Non-Work Trips	5-50%	Large employers in office park settings more than 1/4 mile from lunchtime destinations. Any worksites without on-site food services.

Mitigation measures for which,

$C = G \times (H + I) \times F \times O \times 2$

Where,

C = Number of Trips Reduced from the Original Work Site after Implementation of the Mitigation Measure
(See Table A11 - 5 - A methodology to use "C")

G = Estimated Trip Reduction from Mitigation Measure

H = Average Daily Work Trip Generation from a Residence
(See Table A9 - 5 - A - 2 or assume 1.62)

I = Average Daily Non-Work Trip Generation from a Residence
(See Table A9 - 5 - A - 2 or assume 7.39)

F = Units of Size of Affected Existing or New Land Use(s) for Trip Generation per Attraction Rate

O = Number of Daily Trips per Worker
(Use TIA Report or ITE Manual 5th Edition or Table A9 - 5 - A - 2 or assume 1.26 trips/worker)

Mitigation Measures	Emission Source	Range of Input Assumptions G	Favorable Factors
Include residential units within commercial development or contribute towards its development to reduce VT and/or VMT	Work Trips Non-Work Trips	4-18%	Land use mixes, sizes, numbers of employees, proximity and length of bike/walking lanes/paths Pedestrian-friendly urban design. Comparable match between employment & resident job skills. Most effective when housing to jobs ratio exceeds 1:3

Mitigation measures for which,

C = J x K x L x O x W x 2

Where,

C= Number of Trips Reduced from the Original Work Site after Implementation of the Mitigation Measure
(See Table A11 - 5 - A methodology to use "C")

J = Percentage Required Trip Reduction
([Target AVR - Baseline AVR]/[Baseline AVR])

K = Number of employees anticipated to Participate in Trip Reduction mitigation measure per day

L = Percentage of single occupant vehicles arriving per day at worksite *(default, 70%)*

O = Number of Daily Trips per Worker
(Use TIA Report or ITE Manual 5th Edition or Table A9 - 5 - A - 2 or assume 1.26 trips/worker)

W = Worksite's long-term ability to meet the Required Trip Reduction AVR target (percentage)
(For example, 10% for a worksite that is able to reduce 10% of its necessary 27% target (1.5-1.1)/1.5)

Mitigation Measures	Emission Source	Range of Input Assumptions K	Favorable Factors
Develop a trip reduction plan to achieve a 1.5 AVR for multi-tenant worksites with businesses not subject to Regulation XV or with fewer than 100 employees	Work Trips Commute Trips	1-25%	Worksites with common parking facilities and nearby transit alternatives within 1,000 ft of employee entrance. Multi-tenant worksites where aggregate total exceeds 200 and where business operating hours are standard for most employers

Mitigation measures for which,

$C = G \times K \times L \times O \times 2$

Where,

C = Number of Trips Reduced from the Original Work Site after Implementation of the Mitigation Measure
(See Table A11 - 5 - A methodology to use "C")

G = Estimated Trip Reduction from Mitigation Measure

K = Number of employees anticipated to Participate in Trip Reduction mitigation measure per day

L = Percentage of single occupant vehicles arriving per day at worksite
(Default, 70%)

O = Number of Daily Trips per Worker
(Use TIA Report or ITE Manual 5th Edition or Table A9 - 5 - A - 2 or assume 1.26 trips/worker)

Mitigation Measure	Emission Source	Range of Input Assumptions G	Range of Input Assumptions K	Favorable Factors
Require future employers not subject to Regulation XV to provide centrally located commuter area offering information on transportation alternatives	Work Trips	1-20%	2-3%	Worksites in jurisdictions that require trip reduction plans from non-Regulation XV employers. Those with standard business hours. Worksites in dense urban areas where transit alternatives, parking deficits, large local employee base, and congestion increase ridesharing mode split. Worksites where TMOs planned or required with at least 1 coordinator per 4,000 employees

Mitigation measures for which,

$C = (K \times P \times O \times 2) + (K1 \times P1 \times O1 \times 2)$*

Where,

C = Number of Trips Reduced from the Original Work Site after Implementation of the Mitigation Measure
(See Table A11 - 5 - A methodology to use "C")

K = Number of employees anticipated to Participate in Trip Reduction mitigation measure per day

P = Average Percent Increase in Daily Employee Work Trips on Transit Expected With Shuttle

O = Number of Daily Work Trips per Dwelling Unit
(Use TIA Report or ITE Manual 5th Edition or Table A9 - 5 - A - 2 or assume 1.62 trips/DU)

K1 = Number of residents anticipated to Participate in Trip Reduction mitigation measure per day

P1 = Average Percent Increase in Daily Resident Non-Work Trips on Transit Expected With Shuttle

O1 = Number of Daily Non-Work Trips per Dwelling Unit
(Use TIA Report or ITE Manual 5th Edition or Table A9 - 5 - A - 2 or assume 7.39 trips/DU)

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* This two-part formula accounts for potential vehicle trip reductions from both work and non-work trips from a new residential development to a transit station or worksite. If work trips /ffrom home only will be reduced, use the first half of the formula; if non-work trips are to be reduced, use the second half.

Mitigation Measures	Emission Source	Range of Input Assumptions K/K1	P/P1	Favorable Factors
Establish or contribute to shuttle service from residential subdivisions to rail or multi-modal transit stations	Work Trips Non-Work Trips	1-5%	1-5%	Large projects located in major or housing employment centers where access to rail station within 5 miles can increase commuter rail ridership
Establish or contribute to a shuttle service from residential subdivision to commercial core areas	Work Trips Non-Work Trips	1-5%		Dense subdivision or area with significant adjoining housing core within 5 miles of significant work centers

Quantification was based on previous case studies.
(Including estimates of "C," or percentage reduction in unmitigated vehicle trips)

QUANTIFIED MITIGATION MEASURES

Mitigation Measures	Emission Source	Range of Input Assumptions C	Favorable Factors
Reduce employee parking spaces for those employers subject to Regulation XV	Work Trips		Worksites in dense CBDs where parking demand exceeds supply, employees are charged to park, significant transit alternatives exist, and on-street parking on nearby residential streets is restricted
Implement or contribute to public outreach and ridesharing education programs	Work Trips Non-Work Trips	1 2.5%	Extent of ridesharing program and promotions.
Employers provide employees incentives for ridesharing or charge for single occupant vehicles to encourage ridesharing	Work Trips	2.5-15%0	For vanpool or carpool subsidy programs, trip reduction is dependent on extent of the incentive. Programs that don't charge HOVs, large employers of 500+, employers that draw on regional labor pool, resulting in longer average commutes of over 15 miles.
Charge to park for non-employees or provide discounts to high occupancy vehicles	Non-Work Trips	2.5 - 15%	Project sites in dense, CBDs where parking options are limited and parking charges exceed $6.0.

UNQUANTIFIED MITIGATION MEASURES

Mitigation Measures	Emission Source	Range of Input Assumptions C	Favorable Factors
Require retail facilities or special event centers to offer transit incentives (e.g., discounted or free transit rides, discounts on purchases or admissions for transit riders)	Non-Work Trips		
Contribute to regional transit systems (e.g., funding for capital improvements, dedication of right-of-way)	Work Trips Non-Work Trips		

TABLES FOR ESTIMATING VEHICULAR EMISSIONS AFTER THE IMPLEMENTATION OF MITIGATION MEASURES THAT REDUCE TRIPS BY ELIMINATING A TRIP ALTOGETHER OR UTILIZING A SUBSTITUTE NON-MOTORIZED MODE

Mitigation Measures
That Reduce Emissions Associated With
Reduction in Average Daily Trips Without an Increase in Vehicle Miles Traveled

- Include Neighborhood Telecommunication Centers in Residential Subdivisions.
- Provide On-Site Child Care Facilities and/or After-School Care Facilities or Contribute to Development Within 1/4 Mile of the Worksite to Reduce VT and/or VMT
- Include Retail Services within or Adjacent to Residential Subdivisions such as Grocery Markets, Copy Centers, Restaurants, Banks, and Day-care, or Contribute to Its Development Within 1/4 Mile to Allow Residents to Walk or Bicycle
- Include Residential Development Within Commercial Core Areas, or Business Districts.
- Provide On-site Employee Services such as Cafeterias, Banks, Grocery Stores, and Other Common Services.
- Implement Compressed Work Week Schedules in Which Weekly Full-Time Hours are Compressed into Fewer than the Normal Five Days (4/40, 9/80, 3/36).
- Establish a Home-Based Telecommuting Program for Employees.
- Construct Off-site Pedestrian Facilities, such as, Overpasses, Wider Sidewalks, Safe Lighting, and Access to Buildings that are Physically Separated From Street and Parking Lot Traffic.
- Construct, Contribute, or Dedicate Land for the Provision of Off-site Bicycle Trails Linking the Facility to Designated Bicycle Commuting Routes.
- Provide Bicycle Parking Facilities, Some of Which are Secured Lockers
- Provide Shower Facilities in Non-Residential Development to Support Bicycle or Pedestrian Travel Modes
- Provide Video Conferencing Facilities

TABLE A11 - 5 - B

METHODOLOGY FOR VEHICLE TRIP REDUCTION BY ELIMINATING A TRIP ALTOGETHER OR UTILIZING A SUBSTITUTE NON-MOTORIZED MODE

This methodology calculates net emissions after implementation of mitigation measures that cause a reduction in vehicle trips only and does not add vehicle miles traveled by replacement trips. Implementation of these mitigation measures will have direct impacts on emissions from on-road mobile sources, including a reduction in average daily trips, trip lengths, or congestion. It is assumed that indirect impacts may include a slight increase in nonwork trips. It is assumed that indirect impacts may include a slight increase in nonwork trips and increased work trips by substitute traveling modes and activities. In addition, whenever calculating reactive organic compound emissions, removal of diurnal emissions are always added back, as a vehicle still emits ROC emissions when not in use. Separate methodologies are provided in this table to estimate net emissions after implementation of a mitigation measure.

$N = \{[(A \times \{1-[C/B]\})] + [(\{C/D\} \times Q)]/[454]\} + \{I\}$

N = Net Emissions In Pounds Per Day After Implementation of Average Daily Trip (ADT) Reduction Measures

A = Total Non-mitigated Vehicular Emissions In Pounds Per Day
(From Table A9 - 5 or Appendix 9 Methodologies);

or,

= (A x {1-[C/B]}) of previous calculations; Residual Emissions of previous calculations, if emission reductions caused by other mitigation measures are eliminated in Table A11- 5 - A from Appendix 11 Methodologies.

B = Total Number of Original Average Vehicle Trips Generated By the Project
(Trips Used to Estimate value for "A" in Table A9 - 5 from Appendix 9 Methodologies)
To Estimate ADT Eliminated due to the Participation in Trip Reduction Programs, Use Table A9 - 5 Methodologies from Appendix 9, and the Needed Data from Table A11 - 5 - B - 1.

C = Number of Trips Eliminated from the Original Work Site after Implementation of the Mitigation Measure
(To calculate "C", see Table A11 - 5 - B - 2 for methodologies specific to individual mitigation measures
To estimate diurnal emissions associated with eliminated trips use

D = 2.0, if non-mitigated vehicular emissions were for 2-way or round trips; or
= 1.0, if non-mitigated vehicular emissions were for 1-way trips.

Q = EMFAC7EP Diurnal Emission Factors (*Applicable only to ROC*) in grams per NOV
To Estimate Emissions Associated with Nonwork Trips Made by the Personal Vehicles of Home-based employees, Use Table A9 - 5 Methodologies from Appendix 9 and the Needed Data from Table A11 - B - 1

I = Non-Work Related Emissions In Pounds Per Day Associated with use of Eliminated Cars for personal trips; (If not applicable to your project, enter 0.0);
$= [(B \times D \times E \times F \times H)/(454)]$;

Where,

- B = Eliminated Vehicles After Implementation of Mitigation Measure
  = (L - O)
- D = 0.05; Five percent of eliminated cars used for personal travel such as home to other or shop travel.
- E = Number of Trips per Vehicle per Day
  (For Round-trip Use 2, and One-way Trip Use 1)
- F = Trip Length for Home to Shop or Home to Other (*1-way*)
- H = Running Emission Factors In Grams Per Mile With New Speed for New Non-Work Trip

TABLE A11 - 5 - B - 1

DATA NEED FOR DETERMINING DIRECT IMPACTS

Impacts	Data Need	At Home	Other Work Site
Reduced Work Trips			
	# of Employees Participating Per Day	________	________
	# of Days of the Week	________	________
	Average Daily Trip Rate per Employee	________	________

TABLE A11 - 5 - B - 2

TRIP DEPENDENT INPUT ASSUMPTIONS
MEASURES FOR VEHICLE TRIP REDUCTION BY ELIMINATING A TRIP ALTOGETHER OR UTILIZING A SUBSTITUTE NON-MOTORIZED MODE

Mitigation measures for which,

$$C = K \times (L / M) \times O \times 2$$

Where

C = Number of Trips Eliminated from the Original Work Site after Implementation of the Mitigation Measure
(To use the value of "C", see Table A11 - 5 - B methodology)

K = Number of employees anticipated to Participate in Trip Reduction mitigation measure per day

L = Number of Days per Week Employees will Participate in the Mitigation Measure

M = Number of Days per Week for which Work Trips are Estimated in Appendix 9

O = Number of Daily Trips per Worker.
(*Use TIA Report or ITE Manual 5th Edition or Table A9 - 5 - A - 2 or assume 1.26 trips/worker*)

Mitigation Measures	Emission Source	Range of Input Assumptions K	L	Favorable Factors
ANY TWO OF THE FOLLOWING:				
Develop or contribute to off-lighted site bicycle improvements (e.g., development of bicycle route system, bicycle trails linking the facility to designated bicycle routes) or on-site bicycle paths == & == Provide bicycle parking facilities, some of which are secured lockers == & == Provide shower facilities in non-residential development to support bicycling or pedestrian travel modes	Work Trips	3-10%	1-3	Worksites with existing, bike paths nearby. Nearby residential areas within 5 of worksite with local street miles on thoroughfares with low speed access limits (35 mph and below). Comfortable climate and reasonable air quality in vicinity, and bicycle paths which logically connect neighborhoods and destinations. 1 shower and 8 lockers per 200 employees
BOTH OF THE FOLLOWING:				
Develop or contribute to off-site pedestrian improvements (e.g., overpasses, wider sidewalks) or on-site pedestrian improvements (e.g., exclusive walkway, building access physically separated from street and parking lot traffic == & == Shower facilities in non-residential development to support bicycling or pedestrian travel modes	Work Trips Non-Work Trips	2-5%	1-3	Worksites with existing, lighted pedestrian paths nearby. Residential areas within 1/4 mile of worksite with local street access on thoroughfares with low speed limits (35 mph and below). Comfortable climate and reasonable air quality in vicinity, walkable streets and pedestrian-friendly amenities. Areas with grid street system that maximizes access to destination while minimizing walking distance
Require a telecommuting program that allows employees to work at home	Work Trips	1-10%	1-2	Worksites with general office and information industries that accommodate work-at- home strategies where computers, telephones, faxes, etc. can link employees to the workplace. Large employers that attract workers from a regional base, necessitating long commutes for many

Mitigation measures for which,

C = K x (L / M) x O x 2

Where,

- C = Number of Trips Eliminated from the Original Work Site after Implementation of the Mitigation Measure
  (To use the value of "C", see Table A11 - 5 - B methodology)
- K = Number of employees anticipated to Participate in Trip Reduction mitigation measure per day
- L = Number of Days per Week Employees will Participate in the Mitigation Measure
- M = Number of Days per Week for which Work Trips are Estimated in Appendix 9
- O = Number of Daily Trips per Worker
  (Use TIA Report or ITE Manual 5th Edition or Table A9 - 5 - A - 2 or assume 1.26 trips/worker)

Mitigation Measures	Emission Source	Range of Input Assumptions K	L	M	Favorable Factors
Implement compressed work week schedules where weekly full-time hours are compressed into fewer working days (e.g., 4/40, 9/80, or 3/36)	Work Trips (9/80 schedule)	10-100%	1	10	Worksites with employers on flexible work schedules where a business can either close for an entire day or operate with a smaller employee pool each day. Maximum VT reductions occur only when the worksite is closed to allow all employees to have same day off
	(4/40 schedule)	10-100%	1	5	
	(3/36 schedule)	10-100%	2	5	

Mitigation measures for which,

$C = (R / S) \times (L / M) \times O \times 2$

Where,

C = Number of Trips Eliminated from the Original Work Site after Implementation of the Mitigation Measure
(To use the value of "C", see Table A11 - 5 - B methodology)

R = Number of Residents who Are New Telecommuters

S = Average vehicle occupancy for work trips
(Before implementation, default = 1.13)

L = Number of Days per Week Residents will Participate in the Mitigation Measure

M = Number of Days per Week for which Work Trips are Estimated in Appendix 9

O = Number of Daily Trips per Dwelling Unit
(Use TIA Report or ITE Manual 5th Edition or Table A9 - 5 - A - 2 or assume 1.62 trips/DU)

Mitigation Measures	Emission Source	Range of Input Assumptions R	Range of Input Assumptions L	Favorable Factors
Include neighborhood telecommunications center in residential subdivision or contribute to development within 1/4 mile to allow local residents to walk/bike to center	Work Trips	1-5%	1-2	Comparable match between resident job skills and white-collar, information-based employers likely to use such a center. Large subdivision

Mitigation measures for which,

$C = (G \times H \times F \times (L/M) \times 2) + (G1 \times H1 \times F \times (L/M) \times 2)$*

Where,

- C = Number of Trips Eliminated from the Original Work Site after Implementation of the Mitigation Measure
  (To use the value of "C", see Table A11 - 5 - B methodology)
- G = Estimated Work Trip Reduction from Mitigation Measure
- H = Average Daily Work Trip Generation per Dwelling Unit
  (See Table A9 - 5 - A - 2 or assume 1.62)
- F = Units of Size of Affected Existing or New Land Use(s) for Trip Generation Rate
  (i.e., Dwelling Units)
- L = Number of Days per Week Residents will Participate in the Mitigation Measure
  (Assume 5 days for work trips and 1-2 days for non-work trips)
- M = Number of Days per Week for which Work or Non-Work Trips are Estimated in Appendix 9
- G1 = Estimated Non-Work Trip Reduction from Mitigation Measure
- H1 = Average Daily Non-Work Trip Generation per Dwelling Unit
  (See Table A9 - 5 - A - 2 or assume 7.39)

---

* This two-part formula estimates the reduction in daily vehicle trips assuming the inclusion of commercial uses in a residential subdivision will attract both work (new employment) and non-work trips. If work or non-work trips are not expected to decrease from this measure, enter "0" for G or G1.

Mitigation Measures	Emission Source	Range of Input Assumptions G/G1	Favorable Factors
Include retail services within or adjacent (1/4 mile) of residential subdivisions such as grocery markets, copy centers, restaurants, banks, etc.	Work Trips Non-Work Trips	4-13%	Projects which include commercial uses likely to be used everyday or on frequent basis, & which are centrally located to increase the appeal of walking/bicycling to the use. Also dependent on match of new jobs to the job skills of potential residents

Measures measures for which,

$C = G \times H \times K \times H2 \times (L/M) \times 2$

Where,

- C = Number of Trips Eliminated from the Original Work Site after Implementation of the Mitigation Measure
  (To use the value of "C", see Table A11 - 5 - B methodology)
- G = Estimated Trip Reduction from Mitigation Measure
- H = Average Daily Non-Work Trip Generation per Worker
  (See Table A9 - 5 - A - 2 or assume 5.72)
- K = Number of employees anticipated to Participate in Trip Reduction mitigation measure/day
- L = Number of Days per Week Workers will Participate in the Mitigation Measure
  (Default assumption: 3-5 days)
- M = Number of Days per Week for which Non-Work Trips are Estimated in Appendix 9
- H2 = Percent of Daily Non-Work Trips Performed During Work Day e.g., Lunch, breaks
  (Default assumption, 35%)

QUANTIFIED MITIGATION MEASURES

Mitigation Measures	Emission Source	Range of Input Assumptions G	K	Favorable Factors
Provide on-site employee services such as cafeterias, banks, grocery stores, and other common services	Non-Work Trips	10-50%	25-50%	On-site services needed by employees on a regular basis. Extent of services, size of cafeteria, lack of similar services within 5 mile radius of worksite
Provide on-site child care facilities and/or after school care facilities or contribute to such development within 1/4 mile of worksite to reduce VT and/or VMT	Non-Work Trips	1-10%	1-10	Worksites with large employers, locations in office parks where pooling of resources to create common child care facility. Employers who rely on regional labor force, necessitating longer commutes for some employees. Proximity to pre- or elementary schools. Pleasant environment and amenities at the center

UNQUANTIFIED MITIGATION MEASURES

Mitigation Measures	Emission Source	Range of Input Assumptions: G	Range of Input Assumptions: K	Favorable Factors
Provide video conference facilities or contribute to development in office parks or multi-tenant worksites	Work Trips	29%*		* Up to 29% reduction in work trips from meeting participants has been documented

TABLES FOR ESTIMATING VEHICULAR EMISSIONS AFTER THE IMPLEMENTATION OF MITIGATION MEASURES THAT REDUCE VEHICLE MILES TRAVELED

Mitigation Measures That Reduce Emissions Associated With Reduction in Average Daily Vehicle Miles Traveled with No Decrease in Average Daily Trips

- **Implement Home Dispatching Systems Where Employees Receive Routing Schedule by Phone Instead of Driving to Work.**
- **Utilize Satellite Offices Rather than Regular Worksite for Multi-Sited Employers to Reduce Employee VMT.**
- **Construct or Contribute to Development of Off-Site Park-n-Ride Lots or Designate Parking Spaces in Excess of Code Requirements for Park-n-Ride.**

TABLE A11 - 5 - C

METHODOLOGY FOR VEHICLE MILES TRAVELED REDUCTION (VMT REDUCTION)

This methodology calculates net emissions after implementation of mitigation measures that reduce vehicle miles traveled (VMT) without reducing vehicle trips. As these measures do not affect the number of vehicles and employees, average daily trips will be the same as those used to estimate non-mitigated emissions, though new and weighted average trip lengths will be less. Emission reductions are due to reductions in trip length, running exhaust, and evaporative emissions. Diurnal emissions do not need to be added, having been estimated in the non-mitigated emissions. Since the travel mode remains the same, there are no additional or substitute emissions from increased nonwork trips.

N = [A - {Y x (E / F)}]

- N = Net Emissions In Pounds Per Day After Implementation of Vehicle Miles Traveled (VMT) Reduction Measures
- A = Total Non-mitigated Vehicular Emissions (*From Table A9 - 5 or Appendix 9 Methodologies*) In Pounds Per Day;
- Y = Total Non-mitigated Vehicular Running Exhaust and Evaporative Emissions In Pounds Per Day; (*From Table A9 - 5 or Appendix 9 Methodologies*)
- F = Original Trip Length (*Used to determine VMT in Table A9 - 5 of Appendix 9 to estimate non-mitigated running exhaust and running evaporative emissions in "A."*).
- E = Average (Shorter or Reduced) Daily Trip Length or Traveling Distance After Implementation of Mitigation Measure *(See Table A11 - 5 - C - 1 and A11 - 5 - C - 2 for more variables specific to particular mitigation measures)*
  = P1 x [F - (H x I/G)] (*Weighted Average Daily Trip Length*)

  Where,
  - P1 = Number of Employees Participating in VMT Reduction Measures
  - F = Original Trip Length (*Used to determine VMT in Table A9 - 5 of Appendix 9 to estimate non-mitigated running exhaust and running evaporative emissions in "A."*).
  - G = Number of Days Traveled with Original Trip Length or the Distance to the project site.
  - H = New Trip Length or New Traveling Distance (*Associated with the mitigation measure*)
  - I = Number of Days Traveled with New Trip Length or New Distance to Other Work Sites.
    (I and G should equal to Number of Days [Maximum 7.0] used to Determine Non-mitigated Vehicular Emissions Using Original Trip Length in Table A9 - 5 of Appendix 9.)

TABLE A11 - 5 - C - 1

DATA NEED FOR DETERMINING DIRECT IMPACTS (REDUCTION IN AVERAGE TRIP LENGTH)

Impacts	Data Need	Other Work Sites	Project Site
	Non-mitigated Vehicular Emissions (A)	______	______
	Non-mitigated Running Vehicular Emissions (Y)	______	______
	% of Employees Participating (P1)	______	______
	New Trip Length (H)	______	______
	# of Days of the Week with New Trip Length (I)	______	______
	Original Trip Length (F)	______	______
	# of Days of the Week with Original Trip Length (G)	______	______

TABLE A11 - 5 - C - 2

TRIP DEPENDENT INPUT ASSUMPTIONS (E)
MEASURES THAT REDUCE VEHICLE MILES TRAVELED WITHOUT A DECREASE IN VEHICLE TRIPS

Mitigation Measures	Emission Source	Range of Input Assumptions P1	I	H	Favorable Factors
Implement home dispatching system where employees receive routing schedule by phone instead of driving to work ** Assume anywhere from 1/10 to 1/4 of "F"	Work Trips	1-25%	1-3	**	Worksites where construction and sales employers expected. Employers in urbanizing areas, commercial/industrial areas that rely on workers to commute from outlying residential areas

Mitigation Measures	Emission Source	Range of Input Assumptions P1	I	H	Favorable Factors
Require use of satellite offices rather than regular worksite for multi-sited employers to reduce VMT by allowing them to report to the nearest worksite ** Assume anywhere from 1/10 to 1/4 of "F"	Work Trips	1-5%	1-5	**	Worksites where large employers of 1000+ & multiple branch offices throughout the region are anticipated. Work-geared to information-based industries that can reassign worksite destinations for its employees or permit occasional use of other satellite offices

Mitigation Measures for which

$$E = [(0.5 \times V \times I) + \{(1 - 0.5) \times F \times G\}]/(I + G)$$

where

V = Number of Parking Spaces Set Aside for Park-N-Ride Spaces (Project-specific Input)

Mitigation Measures	Emission Source	Range of Input Assumptions G	I	H	Favorable Factors
Construct or contribute to development of off-site park-n-ride lots or designate parking in excess of code requirements for park-n-ride	Work Trips Non-Work Trips	1-3	**		Park-n-ride location near transit station or freeway w/convenient access/proximity to residential concentrations w/i 5 mi. HOV lanes on freeways enhance use of park-n-rides, larger lots of 300+ spaces

** Assume 1/6 of "F"

TABLES FOR ESTIMATING VEHICULAR EMISSIONS AFTER THE IMPLEMENTATION OF MITIGATION MEASURES THAT IMPROVE AVERAGE VEHICLE RIDERSHIP

Mitigation Measures That Reduce Emissions Associated With Increased Average Vehicle Ridership

- o Establish or Contribute to Shuttle Service from Residential Subdivision to Commercial Core Areas.
- o Construct On-site or Off-site Bus Turn-outs, Passenger Benches and Shelters or Contribute to Off-Site Development.
- o Require Retail and Special Event Facilities to Offer Customers Travel Incentives such as Discounted or Free Transit to Clients, or Discounts on Purchases or Admission for Transit Riders and Other Promotional Type Events.
- o Reduce Employee Parking Spaces for Those Employers Subject to Regulation XV.
- o Require Future Employers Not Subject to Regulation XV to Provide Centrally Located Commuter Information Area Offering Information on Transportation Alternatives.
- o Develop a Trip Reduction Plan to Achieve 1.5 AVR or Higher, for Multi Tenant Worksites or Businesses with Less than 100 Employees.
- o Provide or Contribute to Shuttle Service from Residential Subdivisions to Major Transit Centers.
- o Contribute to Regional Transit Systems (i.e., Right of Way, Capital Improvements, etc.).
- o Provide Preferential Parking Spaces for Carpools and Vanpools.
- o Provide Minimum Vertical Clearance of 7'2" in Parking Facilities to Permit Access for Vanpools
- o Develop a Trip Reduction Plan to Achieve a 1.5 AVR or Higher for Construction Employees (CONSTRUCTION)

TABLE A11 -5 - D

METHODOLOGY FOR AVERAGE VEHICLE RIDERSHIP IMPROVEMENT (INCREASED AVR)

This methodology calculates net emissions after implementation of mitigation measures that improve Average Vehicle Ridership (AVR). AVR is defined as the number of employees arriving at a site divided by the number of cars arriving at the project site. Even after implementation of mitigation measures, the number of employees arriving at the project site will be the same as that assumed for non-mitigated emissions. However, the average number of cars arriving at the project site will be less, resulting in emission reductions. Since this methodology removes all emissions associated with eliminated trips, diurnal emissions associated with these eliminated vehicles must be added back. Net emission reductions will be affected if vehicle trips are eliminated, as increased availability of vehicles at home may increase non-work trips by up to 5%.

It must be noted that while these measures reduce the number of cars arriving to the worksite, the reduction in vehicle trip emissions will be largely negated if ridesharers drive individually to carpool meeting points or park-n-ride lots, as there are additional emissions from these travel modes. All mitigation measures that a) reduce Vehicle Trips with an Increase in VMT and b) reduce VMT result in secondary impacts, namely an increase in Average Vehicle Ridership. Consequently, mitigation measures that increase AVR will have the same direct impacts as indicated in either Table A11 - 5 - A or A11 - 5 - C.

N = [A x (J/M)] + [V] + [W] + [X] + [Y] + [Z] + [I], or
N = [A x (O/L)] + [V] + [W] + [X] + [Y] + [Z] + [I], if K is equal to N; or
N = [A x (J/M) x (N/K)] + [V] + [W] + [X] + [Y] + [Z] + [I], if K is not equal to N.
(*For Mitigation Measure to Work Effectively, the Value for K Should be Equal or Greater than the Value for N*)

N = Net Emissions After Implementation of Mitigation Measures That Improve Average Vehicle Ridership
A = Total Non-mitigated Vehicular Emissions
(*Resulted from Table A9 - 5 or Appendix 9 Methodologies*);
J = Original Average Vehicle Ridership
= K/L; Where,
- K = Original Number of Persons Arriving at the Project Site Before Implementation of Mitigation.
(*Used to Estimate Non-mitigated Emissions, "A," using Table A9 - 5 of Appendix 9*).
- L = Original Number of Cars Arriving at the Project Site Before Implementation of Mitigation.
(*Used to Estimate Non-mitigated Emissions in Appendix 9*)

M = New Improved Average Vehicle Ridership After Implementation of Mitigation Measure
= N/O; Where,
- N = Weighted Average Daily Number of Persons Arriving at the Project Site
= {[P x Q] + [K x R]}/{Q + R}
  - P = New (Reduced) Number of Persons Arriving at the Project Site After Implementation of Mitigation Measure.
  - Q = Number of Days New (Reduced) Number of Persons Traveled to the Project Site After Implementation of Mitigation Measure.
  - R = Number of Days Original (Appendix 9) Number of Persons Traveled to the Project Site After Implementation of Mitigation Measure.
- O = Weighted Average Daily Number of Cars Arriving at the Project Site
= {[S x T] + [L x U]}/{T + U}
  - S = Reduced No. of Cars Arriving at the Site After Implementation of Mitigation Measure.

T = Number of Days New (Reduced) Number of Cars Traveled to the Project Site After Implementation of Mitigation Measure.

U = Number of Days Original (Appendix 9) Number of Cars Traveled to the Project Site After Implementation of Mitigation Measure.
(*The Total of Q and R, and T and U Should be Equal to Number of Days [Maximum Would be 7.0] Used to Determine Non-mitigated Vehicular Emissions Using Original Number of Cars in Table A9 - 5 of Appendix 9.*)

V = Diurnal ROC Emissions Pounds Per Day Associated with Removed Cars
(*This Addition is Only for ROC*)
= (B x C)/454; where,
B = Removed Vehicles After Implementation of Mitigation Measure = (L - O)
C = Diurnal ROC Emission Factor In Grams Per NOV
(*This Emission Factor is Only for ROC*)

Please estimate running exhaust, running evaporative, start-up, and hot soak emissions with the following modes. Also estimate diurnal emissions for all other modes except for R and X mode of transport, i.e., removed vehicles reused with shorter trip lengths.

To estimate emissions associated with the following (various) Travel Modes, Use Table A9 - 5 Methodologies from Appendix 9 and the Needed Data from TABLE A11 - 1 - C.

W = Additional Emissions In Pounds Per Day After Implementation of Mitigation Measure or with Improved AVR Associated with Certain Number of Employees Traveling in Personal Cars (Removed) to Other Work Sites with Shorter Traveling Distance
(*If not applicable to the project, enter 0.0*); *and/or*

X = Additional Emissions In Pounds Per Day After Implementation of Mitigation Measure or with Improved AVR Associated with Certain Number of Employees Traveling in Buses (Removed) to Other Work Sites with Shorter Traveling Distance
(*If not applicable to the project, enter 0.0*); *and/or*

Y = Additional Emissions In Pounds Per Day After Implementation of Mitigation Measure or with Improved AVR Associated with Certain Number of Employees Traveling in Shuttles (Removed) to Other Work Sites with Shorter Traveling Distance
(*If not applicable to the project, enter 0.0*); *and/or*

Z = Additional Emissions In Pounds Per Day Associated with Certain Number of Employees Traveling in Personal Cars to to Pick Up Employees At Their Houses
(*If not applicable to the project, enter 0.0*); *and/or*

To estimate emissions associated with Nonwork Trips made by the Personal Vehicles of Home-based employees, Use Table A9 - 5 Methodologies from Appendix 9 and the Needed Data from TABLE A11 - 1 - B.

I = Non-Work Related Emissions Associated with Use of Removed Cars for Personal Trips;
(*If not applicable to the project, enter 0.0*);
= (B x D x E x F x H)/454; where,
B = Removed Vehicles After Implementation of Mitigation Measure = (L - O)
D = 0.05; Five Percent of Removed Cars Used for Personal Travel Such as Home to Other or Shop Travel.
E = Number of Trips per Vehicle per Day
(*For Round-Trip Use 2, and One-way Trip Use 1*)
F = Trip Length for Home to Shop or Home to Other
G = New Speed For this Short Travel
H = Emission Factors In Grams Per Mile With New Speed

TABLE A11 -5 - D - 1

AVERAGE VEHICLE RIDERSHIP DEPENDENT DATA NEEDED TO DETERMINE DIRECT IMPACTS (REDUCTION IN CARS ARRIVING AT THE PROJECT SITE) (AVR = Number of Persons Arriving At a Site/Number of Cars Arriving at That Site)

Mitigation Measures	Participation	Current or Original Impact		Estimated Impact	
		# Cars Arriving	Current AVR	# Cars Ariving	New AVR
e.g., Shuttle Service from Home to Work	15 out of 100	100	100/100+1.0	(100-30)=70	100/70=1.4

TABLES FOR ESTIMATING VEHICULAR EMISSIONS AFTER THE IMPLEMENTATION OF MITIGATION MEASURES THAT RELY ON PRICING STRATEGIES

Mitigation Measures
That Rely on Pricing Strategies
Reduce Emissions Associated With
Average Daily Trips and Vehicle Miles Traveled

- Provide Employees with Cash Allowances for Ridesharing
- Charge Employees or Visitors to Park, or Provide Discounts to High Occupancy Vehicles
- Pay or Provide Employer Incentives Not to Drive Once a Week

TABLE A11 - 5 - E

METHODOLOGY TO DETERMINE IMPACT OF PRICING STRUCTURES

Mitigation measures with pricing structures will have the same direct impacts as indicated for those same measures in Tables A11 - 5 - A, B, C or D of Appendix 11 (i.e., increase in Average Vehicle Ridership (AVR), and/or reduction in Average Daily Trips (ADT) with increase in VMT by substitute travel modes, Average Daily Trips (ADT) without an increase in VMT or Vehicle Miles Traveled (VMT) with no reduction in ADT). Methodologies and data needed should be the same as described in those four tables. Because the variables that determine vehicle trips and/or VMT reductions from a pricing standpoint are dependent on a myriad of influences, methodologies based on pricing are not provided. For example, the efficiency of a mitigation measure in reducing vehicle trips may be dependent on the allowance paid to employee by the employer or vice versa. If an employer increases the allowance for parking by 50 cents, it may linearly increase AVR by 0.1 or remove 10 average daily trips and 5 cars, or reduce average trip length by 2 miles. These results are largely based on demand elasticities. Consequently, any data that follows is based on published studies that compared pricing strategies with travel demand.

TABLE A11 - 5 - E - 1

DATA NEEDED FOR DETERMINING DIRECT IMPACTS (REMOVED AVERAGE DAILY TRIPS FROM ORIGINAL AVERAGE DAILY TRIPS)

Impacts	Data Need	At Home	Other Site	Project Site
Reduced Work Trips				
	Type of Mitigation Measure:			
	e.g. Cash Allowance for Ridesharing			
	$5.00/Day of Participation			
	(Pre-Parking Charges)			
	Cash Allowance For That Mitigation Measure			
	# of Employees Participating Per Day	N/A	______	______
	# of Days of the Week	N/A	______	______
	Average Daily Trip Rate/Employee	N/A	______	______

TABLE A11 - 5 - E - 2

DATA NEEDED FOR DETERMINING INDIRECT IMPACTS (ADDITION OF NEW AVERAGE DAILY NONWORK TRIPS)

Impacts	Data Need	At Home	Other Site	Project Site
Added Nonwork Trips				
	Type of Mitigation Measure:			
	e.g. Cash Allowance for Ridesharing			
	Cash Allowance For That Mitigation Measure			
	$5.00/Day of Participation			
	(Pre-Parking Charges)			
	# of Employees Participating Per Day	N/A	______	______
	# of Days of the Week	N/A	______	______
	Average Daily Trip Rate/Employee	N/A	______	______
	Average Trip Length	N/A	______	______
	Average Speed	N/A	______	______

TABLE A11 - 5 - E - 3

DATA NEED FOR DETERMINING INDIRECT IMPACT (ADDITION OF NEW AVERAGE DAILY WORK TRIPS)

Impacts	Travel Modes	Data Need	At Home	Other Site	Project Site
Added Work Trips By Vehicles From Homes to Work or Work Centers					
	Type of Mitigation Measure:				
	e.g. Cash Allowance for Ridesharing				
	Cash Allowance for That Mitigation Measure				
	$ 5.00/Day of Participation (Pre-Parking Charges)				
	o Cars				
	# of Employees Participating Per Day	N/A	______	______	______
	# of Days of the Week	N/A	______	______	______
	Average Daily Trip Rate/Employee	N/A	______	______	______
	Average Trip Length	N/A	______	______	______
	Average Speed	N/A	______	______	______
	o Buses				
	# of Employees Participating Per Day	N/A	______	______	______
	# of Days of the Week	N/A	______	______	______
	Average Daily Trip Rate/Employee	N/A	______	______	______
	Average Trip Length	N/A	______	______	______
	Average Speed	N/A	______	______	______
	o Shuttles				
	# of Employees Participating Per Day	N/A	______	______	______
	# of Days of the Week	N/A	______	______	______
	Average Daily Trip Rate/Employee	N/A	______	______	______
	Average Trip Length	N/A	______	______	______
	Average Speed	N/A	______	______	______

TABLE A11 - 5 - E - 4

DATA NEED FOR DETERMINING DIRECT IMPACTS (REMOVED TRIP LENGTH FROM ORIGINAL TRIP LENGTH) (CAUSING REDUCTION IN VMT)

Impacts	Data Need	Other Work Site	Project Site
Reduced VMT	Type of Mitigation Measure: e.g. Cash Allowance for Ridesharing		
	Cash Allowance For That Mitigation Measure $ 5.00/Day of Participation (Pre-Parking Charges)		
	New Trip Length (G)	______	______
	# of Days of the Week with New Trip Length (H)	______	______
	Original Trip Length (I)	______	______
	# of Days of the Week with Original Trip Length (F)	______	______

TABLE A11 - 5 - E - 5

PRICE DEPENDENT INPUT ASSUMPTIONS TO DETERMINE DIRECT IMPACTS (REDUCTION IN ADT)

Mitigation Measure	Cash Amount Per Day $	Percent Reduction in Average Daily Trips
Cash Allowances for Ridesharing (Pre-Parking Charges)	Less Than 1.0	**
	1.0	**
	2.0	**
	3.0	**
	4.0	**
	5.0	**
	10.0	**
	Other	**
Charge to Park (After Any Subsidies)	Less Than 1.0	**
	1.0	4.0%
	2.0	9.0%
	3.0	1.8%-15.0%
	4.0	20.0%
	5.0	25.0%
	6.0	31.0%
	Other	**
Pay or Provide Employer Incentives to Not Drive	**	

** Input assumptions to be included as information becomes available

TABLES FOR ESTIMATING VEHICULAR EMISSIONS AFTER THE IMPLEMENTATION OF MITIGATION MEASURES THAT REDUCE CONGESTION AND IMPROVE SPEED WITH INCREASED NUMBER OF VEHICLES

Mitigation Measures That Reduce Emissions Associated With On- and Off-Road Congestion

OPERATION

- Implement On-Site Circulation Plan in Parking Lots to Reduce Emissions From Queuing Vehicles
- Improve Traffic Flow at Drive-Throughs by Designing Separate Windows for Different Functions and Providing Temporary Parking for Orders That Are Not Immediately Ready for Pickup
- Construct On- or Off-Site Bus Turnouts, Passenger Benches, and Shelters
- Synchronize Traffic Lights on Streets Impacted by Development
- Reschedule Truck Deliveries and Pickups for Off-Peak Hours
- Implement Staggered Work Hours So That Employees Arrive and Depart From Work Stations at Different Times and Reduce Vehicle Queuing
- Set Up Paid Parking System Where Drivers Pay at a Walkup Kiosk and Exit Via a Stamped Ticket to Reduce Vehicle Queuing
- Require On-Site Truck Loading Zones

CONSTRUCTION

- Configure Construction Parking to Minimize Traffic Interference
- Provide Temporary Traffic Control During All Phases of Construction Activities to Improve Traffic Flow, Such as Providing a Flag Person to Direct Traffic and Ensure Safe Movements Off the Site
- Schedule Off-Site Cut-and-Fill Transport and Other Construction Activities to Off-Peak Hours (i.e., Between 7:00 p.m. and 6:00 a.m. and Between 10:00 a.m. and 3:00 p.m.)
- Develop a Construction Traffic Management Plan That Includes, But Is Not Limited to: a) Rescheduling Goods Movements for Off-Peak Hours; b) Rerouting Construction Trucks Off Congested Streets; c) Consolidating Truck Deliveries; d) Providing Dedicated Turn Lanes for Movement of Construction Trucks and Equipment On- and Off-Site

TABLE A11 - 5 - F

METHODOLOGY FOR REDUCED CONGESTION (INCREASED NUMBER OF VEHICLES WITH IMPROVED SPEED)

This methodology calculates the net emissions after implementation of mitigation measures that cause a reduction only in traffic congestion. The number of vehicles traveling on roadways over a given period of time will increase due to improved speeds and improved circulation. Improved speed will improve the corresponding emission factor for the traveling vehicle, causing a reduction in emissions.

$$N = [A \times (E/F) \times (G/H)]$$

N = Net Emissions After Implementation of Average Daily Trip (ADT) Reduction Measures
A = Total Non-mitigated Vehicular Emissions
(*Resulting from Table A9 - 5 of Appendix 9 Methodologies*)
E = New Number of Vehicles on the Same Road After Implementation of Mitigation Measure (*Traffic Study*)
F = Original Number of Vehicles on That Road Used for Original LOS (*Traffic Study Input*)
E = New Number of Vehicles on the Same Road After Implementation of Mitigation Measure (*Traffic Study*)
G = New Speed-Dependent Emission Factors
H = Original Speed-Dependent Emission Factor (*Table A9-5 of Appendix 9*)

TABLE A11 - 5 - F - 1

RELATIONSHIP BETWEEN TRIP SPEED AND NUMBER OF VEHICLES (ROAD CAPACITY) PASSING A CERTAIN POINT IN ONE HOUR, BY ROAD TYPE (MPH AND NUMBER OF VEHICLES PER HOUR)

Traffic impact analysis should provide number of vehicles on nearby roads. To determine fleet mix (passenger and trucks) on the following road types please use EPA report Contract Number A2-155-32 on Assessment of Heavy-Duty Gasoline and Diesel Vehicles in California: Population and Use Patterns, Prepared in July 1985 by Yuji Horie, Richard Rapoport of Pacific Environmental Services, Inc. Passenger vehicles include all autos and light-duty trucks; trucks include all medium-duty, light-heavy, medium-heavy, and heavy-heavy-duty trucks.

Traveling Speed/Number of Vehicles Crossing an Intersection Per Hour

County	Los Angeles		Orange		Riverside		San Bernardino	
Road Type / Year	1987	2010	1987	2010	1987	2010	1987	2010
Freeways								
Speed/One Hour	55	55	60	60	60	60	60	60
Vehicle Capacity	/1650	/1650	/1750	/1750	/1750	/1750	/1750	/1750
Non-Freeway								
Speed/One Hour	20	20	28.3	28.3	33.33	33.33	38.33	38.33
Vehicle Capacity	/550	/550	/575	/575	/600	/600	/800	/800
Major Arterial								
Speed/One Hour	20	20	30	30	35	35	40	40
Vehicle Capacity	/600	/600	/625	/625	/650	/650	/800	/800
Primary Arterial								
Speed/One Hour	20	20	30	30	35	35	40	40
Vehicle Capacity	/550	/550	/575	/575	/600	/600	/800	/800
Secondary Arterial								
Speed/One Hour	20	20	25	25	30	30	35	35
Vehicle Capacity	/500	/500	/525	/525	/550	/550	/800	/800

TABLES FOR ESTIMATING VEHICULAR EMISSIONS AFTER THE IMPLEMENTATION OF MITIGATION MEASURES THAT REDUCE THE USE OF GASOLINE- AND DIESEL-FUELED VEHICLES

Mitigation Measures That Reduce Emissions Associated With Gasoline- and Diesel-Fueled Vehicles By Utilizing Alternate Fuel-Fueled Vehicles

- Use Low-Emission Vehicles (LEVs) (Scheduled Penetration Between 1998 and 2004)
- Use Ultra Low Emission Vehicles (ULEVs) (Scheduled Penetration Between 1998 and 2010)
- Use Zero Emission Vehicles (ZEVs) (Scheduled Penetration Between 1998 and 2010)
  (*For Percent Penetration See Attached Table*)

SOURCE: ARB's Staff Report for Proposed Regulations for Low-Emission Vehicles and Clean Fuel

TABLE A11 - 5 - G

METHODOLOGY FOR REDUCED NUMBER OF GASOLINE-FUELED AND DIESEL-FUELED VEHICLES WITH INCREASED NUMBER OF ALTERNATE FUEL-FUELED VEHICLES

This methodology is for net emissions after implementation of mitigation measures that cause a reduction only in the number of gasoline- and diesel-fueled vehicles.

N = [A x {1 - L}] + [{(F x L) x (ADT Rate*) x (Trip Length**) x (New Running Exhaust and Evaporative Emission Factor***)} + {(F x L) x (ADT Rate*) x (New Start-Up Emission Factor***)} + {(F x L) x (ADT Rate*) x (New Hot-Soak Emission Factor***)} + {(F x L) x (New Diurnal Emission Factor***)}; Where,

N = Net Emissions After Implementation of Measures that Reduce Diesel- and Gasoline-fueled Vehicles.
A = Total Nonmitigated Vehicular Emissions
(*Resulting from Table A9 - 5 or Appendix 9 Methodologies* for the First Mitigation Measure);
Please repeat the same formula for each type of alternatively fueled vehicle. When repeating the formula use net emissions from previous calculations as nonmitigated emissions.
(Note: Please note all vehicle categories (LEVs, ULEVs and ZEVs) fueled with varieties of fuels will have the same emissions factor, i.e., emission factor will be dependent on vehicle category and not fuel category. The emission factor is not fuel dependent.)
F = Original Number of Project-Related Gasoline-and Diesel-Fueled Vehicles (*Traffic Study Input*)
L = Fraction or Percent Vehicles Replaced With Alternate Fuel-Fueled Vehicles
(Mitigations should at least utilize the same percent substitutions for that build-out year as indicated in Table A11 - 5 - G - 1. If a lower percent is utilized, please provide reasons for not utilizing available percent penetration rate.)

(F x L) = New (Reduced) Number of Alternatively Fueled Vehicles
After Implementation of Mitigation Measure (*Traffic Study*)

* For ADT Rates, Please See Table A9 - 5 of Appendix 9 or Traffic Analysis Used to Estimate Nonmitigated Emissions (A)

** For Trip Length, Please See Table A9 - 5 of Appendix 9 or Traffic Analysis Used to Estimate Nonmitigated Emissions (A).

*** For Emission Factors Contact California Air Resources Board or Manufacturers of the New Vehicles.

(If Emission Factors are not available, please indicate potential emission reduction by using Fractions provided in ARB's Staff Report on Clean Fuel Regulation, and make a statement to indicate that additional emissions from substitute vehicles will be estimated when emission factors are available for substitute vehicles.)

Note: ADT and Trip Length data should be weighted for the average of seven days, i.e., five days for workdays and two days for weekends.

TABLE A11 - 5 - G - 1

ALTERNATE FUEL-FUELED VEHICLE PENETRATION SCHEDULE
Passenger Vehicles or Vehicles Gross Vehicle Weight of 6,000 Pounds or Less
(Percent)

	LEV/TLEV	ULEV	ZEV	Year	LEV/TLEV	ULEV	ZEV
1998	48	2	2	2005	--	80	20
1999	73	2	2	2006	--	80	20
2000	96	2	2	2007	--	65	35
2001	90	5	5	2008	--	65	35
2002	85	10	5	2009	--	50	50
2003	75	15	10	2010	--	50	50
2004	50	40	10	2011(Unknown)	U	U	U

*LEV = Low-Emission Vehicle; TLEV = Transitional Low-Emission Vehicle; ULEV = Ultra-Low-Emission Vehicle; ZEV = Zero-Emission Vehicle; (see Glossary of this Handbook for ARB definition of each electric vehicle category).

TABLE A11 - 5 - G - 2

ALTERNATE FUEL-FUELED VEHICLE PENETRATION SCHEDULE
(Grams Per Mile)

Reactive Organic Gases	TLEV	LEV	ULEV	ZEV
Up to 50,000 Miles				
Low-Emission Vehicles	0.115	0.069	0.037	0.0
Gasoline Standards For Flexible and Dual-Fuel Low-Emission Vehicles	0.23	0.115	0.069	0.0
Up to 100,000 Miles				
Low-Emission Vehicles	0.143	0.083	0.051	0.0
Gasoline Standards For Flexible and Dual-Fuel Low-Emission Vehicles	0.28	0.143	0.083	0.0

Carbon Monoxide	TLEV	LEV	ULEV	ZEV
Up to 50,000 Miles				
Low-Emission Vehicles	3.4	3.4	1.7	0.0
Gasoline Standards For Flexible and Dual-Fuel Low-Emission Vehicles	3.4	3.4	1.7	0.0
Up to 100,000 Miles				
Low-Emission Vehicles	4.2	4.2	2.1	0.0
Gasoline Standards For Flexible and Dual-Fuel Low-Emission Vehicles	4.2	4.2	2.1	0.0

Oxides of Nitrogen	TLEV	LEV	ULEV	ZEV
Up to 50,000 Miles				
Low-Emission Vehicles	0.4	0.2	0.2	0.0
Gasoline Standards For Flexible and Dual-Fuel Low-Emission Vehicles	0.4	0.2	0.2	0.0
Up to 100,000 Miles				
Low-Emission Vehicles	0.6	0.3	0.3	0.0
Gasoline Standards For Flexible and Dual-Fuel Low-Emission Vehicles	0.6	0.3	0.3	0.0

TABLE A11 - 5 - G - 3

1993 - 1998 ALTERNATE FUEL-FUELED VEHICLE EMISSION FACTORS
(Grams Per Mile)

YEARS		DISTANCE TRAVELED (Miles)	ROC (Grams per Miles)	CO (Grams per Miles)	NOx (Grams per Miles)	Notes
1993 - 1994						
	Primary	Up to 50,000 Miles	0.23	3.4	0.4	- -
		50,00 to 100, 000	0.23	3.4	0.7	- -
		100,00	0.29	4.2	- -	1993 Option Only
	Secondary	Up to 50,000 Miles	0.36	7.0	0.4	- -
		50,00 to 100, 000	0.36	7.0	0.7	Optional
		100,00	0.42	8.3	1.0	Diesel Option

TABLE A11 - 5 - H

EMISSION FACTORS FOR ESTIMATING BUS EMISSIONS

USE

TABLE A9 - 14 - A

FOR BUS RELATED
VEHICLE MILES TRAVELED (VMT)
AVERAGE DAILY TRIPS (ADT) AND NUMBER OF VEHICLES (NOV)
IN
COUNTYWIDE AND REGIONWIDE FLEET MIX
AND

TABLE A9 - 5 - G*

FOR THEIR PERCENTAGES

USE

TABLE A9 - 5 - P - 1 AND 2

FOR DETERMINING COMPOSITE EMISSION FACTOR BETWEEN
FOUR DIFFERENT TYPES OF VEHICLES TOGETHER, SUCH AS,
PASSENGER VEHICLES, MATERIAL HAULING VEHICLES AND
MOTORCYCLES
INCLUDING BUSES
AND
BETWEEN RUNNING, HOT AND COLD START EMISSION FACTORS FOR
THE BUSES

(* IF PROJECT-SPECIFIC FLEET MIX DATA IS NOT AVAILABLE,
USE TABLE A9 - 5 - G TO DETERMINE PROJECT RELATED
FLEET MIX DATA)

Table A11 - H - 1
EMFAC7EP EMISSION FACTORS FOR SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT
Buses or Multi-Person Vehicles***
Calendar Year 1991

Vehicle Speed (Miles per Hour)	Running Exhaust and Evaporative (Grams per Mile)*										
	Carbon Monoxide			Reactive Organic Compounds			Oxides of Nitrogen			PM10 Exhaust	PM10 Tire Wear
	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	FOR ALL AREA	FOR ALL AREA
5	63.73	63.73	63.73	9.83	9.83	9.83	37.15	37.15	37.15	2.31	0.66
10	43.95	43.95	43.95	7.72	7.72	7.72	30.82	30.82	30.82	2.31	0.66
15	31.71	31.71	31.71	6.19	6.19	6.19	26.49	26.49	26.49	2.31	0.66
20	23.95	23.95	23.95	5.08	5.08	5.08	23.60	23.60	23.60	2.31	0.66
25	18.93	18.93	18.93	4.26	4.26	4.26	21.78	21.78	21.78	2.31	0.66
30	15.66	15.66	15.66	3.65	3.65	3.65	20.83	20.83	20.83	2.31	0.66
35	13.55	13.55	13.55	3.20	3.20	3.20	20.63	20.63	20.63	2.31	0.66
40	12.28	12.28	12.28	2.87	2.87	2.87	21.18	21.18	21.18	2.31	0.66
45	11.64	11.64	11.64	2.62	2.62	2.62	22.53	22.53	22.53	2.31	0.66
50	11.55	11.55	11.55	2.46	2.46	2.46	24.83	24.83	24.83	2.31	0.66
55	12.00	12.00	12.00	2.36	2.36	2.36	28.36	28.36	28.36	2.31	0.66
60	13.04	13.04	13.04	2.30	2.30	2.30	33.56	33.56	33.56	2.31	0.66
65	14.83	14.83	14.83	2.30	2.30	2.30	41.14	41.14	41.14	2.31	0.66
COLD START* (Grams/Trip)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
HOT START* (Grams/Trip)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
HOT SOAK* (Grams/Trip)	----	----	----	N/A	N/A	N/A	----	----	----		
DIURNAL** (Grams/Vehicle/Day)	----	----	----	N/A	N/A	N/A	----	----	----		

Example of one daily trip:

Running + Evaporative
Vehicle Start (Start-up) ------------------> Vehicle Start (Hot Soak)

Diurnal
Parking ------------------> Restart (Start-up)

Please see Table A9 - 5 - I for Areas and Associated Temperatures.

* Vehicle Miles Traveled (VMT)/Average Daily Trips (ADT) -weighted emission factors:
Includes VMT/ADT from diesel-fueled vehicles (100%), gasoline-fueled vehicles equipped with catalyst (0.0%), and gasoline-fueled vehicles not equipped with catalyst (0.0%).

** Number of Vehicles (NOV)-weighted emission factors:
Includes NOV from diesel-fueled vehicles (100%), gasoline-fueled vehicles equipped with catalyst (0.0%), and gasoline-fueled vehicles not equipped with catalyst (0.0%).

*** Buses or multi-person vehicles (Vehicles with 20 person per vehicle)
Does not include trains or airplanes.

(SG10BS11.WK1)

Table A11 - 5 - H - 2
EMFAC7EP EMISSION FACTORS FOR SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT
Buses or Multi-Person Vehicles***
Calendar Year 1993

Vehicle Speed (Miles per Hour)	Running Exhaust and Evaporative (Grams per Mile)*										
	Carbon Monoxide			Reactive Organic Compounds			Oxides of Nitrogen			PM10 Exhaust	PM10 Tire Wear
	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	FOR ALL AREA	FOR ALL AREA
5	64.95	64.95	64.95	9.73	9.73	9.73	35.61	35.61	35.61	2.16	0.66
10	44.78	44.78	44.78	7.65	7.65	7.65	29.54	29.54	29.54	2.16	0.66
15	32.32	32.32	32.32	6.14	6.14	6.14	25.40	25.40	25.40	2.16	0.66
20	24.41	24.41	24.41	5.03	5.03	5.03	22.62	22.62	22.62	2.16	0.66
25	19.29	19.29	19.29	4.22	4.22	4.22	20.88	20.88	20.88	2.16	0.66
30	15.96	15.96	15.96	3.62	3.62	3.62	19.96	19.96	19.96	2.16	0.66
35	13.81	13.81	13.81	3.17	3.17	3.17	19.78	19.78	19.78	2.16	0.66
40	12.51	12.51	12.51	2.84	2.84	2.84	20.30	20.30	20.30	2.16	0.66
45	11.86	11.86	11.86	2.60	2.60	2.60	21.60	21.60	21.60	2.16	0.66
50	11.77	11.77	11.77	2.44	2.44	2.44	23.80	23.80	23.80	2.16	0.66
55	12.23	12.23	12.23	2.33	2.33	2.33	27.18	27.18	27.18	2.16	0.66
60	13.29	13.29	13.29	2.28	2.28	2.28	32.16	32.16	32.16	2.16	0.66
65	15.11	15.11	15.11	2.28	2.28	2.28	39.43	39.43	39.43	2.16	0.66
COLD START* (Grams/Trip)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
HOT START* (Grams/Trip)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
HOT SOAK* (Grams/Trip)	----	----	----	N/A	N/A	N/A	----	----	----		
DIURNAL** (Grams/Vehicle/Day)	----	----	----	N/A	N/A	N/A	----	----	----		

Example of one daily trip:

	Running + Evaporative	
Vehicle Start (Start-up)	----------------->	Vehicle Start (Hot Soak)
	Diurnal	
Parking	----------------->	Restart (Start-up)

Please see Table A9 - 5 - I for Areas and Associated Temperatures.

* Vehicle Miles Traveled (VMT)/Average Daily Trips (ADT) -weighted emission factors:
Includes VMT/ADT from diesel-fueled vehicles (100%), gasoline-fueled vehicles equipped with catalyst (0.0%), and gasoline-fueled vehicles not equipped with catalyst (0.0%).

** Number of Vehicles (NOV)-weighted emission factors:
Includes NOV from diesel-fueled vehicles (100%), gasoline-fueled vehicles equipped with catalyst (0.0%), and gasoline-fueled vehicles not equipped with catalyst (0.0%).

*** Buses or multi-person vehicles (Vehicles with 20 person per vehicle)
Does not include trains or airplanes.

(SG10BS13.WK1)

Table A - 5 - H - 3
EMFAC7EP EMISSION FACTORS FOR SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT
Buses or Multi-Person Vehicles***
Calendar Year 1995

Running Exhaust and Evaporative (Grams per Mile)*

Vehicle Speed (Miles per Hour)	Carbon Monoxide			Reactive Organic Compounds			Oxides of Nitrogen			PM10 Exhaust	PM10 Tire Wear
	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	FOR ALL AREA	FOR ALL AREA
5	66.00	66.00	66.00	9.74	9.74	9.74	34.66	34.66	34.66	2.03	0.66
10	45.51	45.51	45.51	7.65	7.65	7.65	28.76	28.76	28.76	2.03	0.66
15	32.84	32.84	32.84	6.14	6.14	6.14	24.72	24.72	24.72	2.03	0.66
20	24.80	24.80	24.80	5.03	5.03	5.03	22.02	22.02	22.02	2.03	0.66
25	19.60	19.60	19.60	4.22	4.22	4.22	20.32	20.32	20.32	2.03	0.66
30	16.21	16.21	16.21	3.62	3.62	3.62	19.43	19.43	19.43	2.03	0.66
35	14.04	14.04	14.04	2.84	2.84	2.84	19.25	19.25	19.25	2.03	0.66
40	12.72	12.72	12.72	2.60	2.60	2.60	19.76	19.76	19.76	2.03	0.66
45	12.06	12.06	12.06	2.44	2.44	2.44	21.02	21.02	21.02	2.03	0.66
50	11.96	11.96	11.96	2.33	2.33	2.33	23.17	23.17	23.17	2.03	0.66
55	12.42	12.42	12.42	2.28	2.28	2.28	26.46	26.46	26.46	2.03	0.66
60	15.36	15.36	15.36	2.28	2.28	2.28	31.31	31.31	31.31	2.03	0.66
65	15.11	15.11	15.11	2.28	2.28	2.28	38.38	38.38	38.38	2.03	0.66
COLD START* (Grams/Trip)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
HOT START* (Grams/Trip)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
HOT SOAK* (Grams/Trip)	----	----	----	N/A	N/A	N/A	----	----	----		
DIURNAL** (Grams/Vehicle/Day)	----	----	----	N/A	N/A	N/A	----	----	----		

Example of one daily trip:

Vehicle Start (Start-up)	Running + Evaporative ---------------->	Vehicle Start (Hot Soak)
Parking	Diurnal ---------------->	Restart (Start-up)

Please see Table A9 - 5 - I for Areas and Associated Temperatures.

* Vehicle Miles Traveled (VMT)/Average Daily Trips (ADT) -weighted emission factors:
Includes VMT/ADT from diesel-fueled vehicles (100%), gasoline-fueled vehicles equipped with catalyst (0.0%), and gasoline-fueled vehicles not equipped with catalyst (0.0%).

** Number of Vehicles (NOV)-weighted emission factors:
Includes NOV from diesel-fueled vehicles (100%), gasoline-fueled vehicles equipped with catalyst (0.0%), and gasoline-fueled vehicles not equipped with catalyst (0.0%).

*** Buses or multi-person vehicles (Vehicles with 20 person per vehicle)
Does not include trains or airplanes.

(SG10BS15.WK1)

Table A11 - 5 - H - 4
EMFAC7EP EMISSION FACTORS FOR SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT
Buses or Multi-Person Vehicles***
Calendar Year 1997

Vehicle Speed (Miles per Hour)	Running Exhaust and Evaporative (Grams per Mile)*										
	Carbon Monoxide			Reactive Organic Compounds			Oxides of Nitrogen			PM10 Exhaust	PM10 Tire Wear
	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	FOR ALL AREA	FOR ALL AREA
5	66.63	66.63	66.63	9.84	9.84	9.84	32.08	32.08	32.08	1.64	0.66
10	45.94	45.94	45.94	7.73	7.73	7.73	26.62	26.62	26.62	1.64	0.66
15	33.15	33.15	33.15	6.20	6.20	6.20	22.88	22.88	22.88	1.64	0.66
20	25.04	25.04	25.04	5.09	5.09	5.09	20.38	20.38	20.38	1.64	0.66
25	19.79	19.79	19.79	4.27	4.27	4.27	18.81	18.81	18.81	1.64	0.66
30	16.37	16.37	16.37	3.65	3.65	3.65	17.98	17.98	17.98	1.64	0.66
35	14.17	14.17	14.17	3.20	3.20	3.20	17.82	17.82	17.82	1.64	0.66
40	12.84	12.84	12.84	2.87	2.87	2.87	18.29	18.29	18.29	1.64	0.66
45	12.17	12.17	12.17	2.63	2.63	2.63	19.46	19.46	19.46	1.64	0.66
50	12.08	12.08	12.08	2.47	2.47	2.47	21.45	21.45	21.45	1.64	0.66
55	12.54	12.54	12.54	2.36	2.36	2.36	24.00	24.00	24.00	1.64	0.66
60	13.63	13.63	13.63	2.30	2.30	2.30	28.00	28.00	28.00	1.64	0.66
65	15.50	15.50	15.50	2.30	2.30	2.30	35.00	35.00	35.00	1.64	0.66
COLD START* (Grams/Trip)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
HOT START* (Grams/Trip)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
HOT SOAK* (Grams/Trip)	----	----	----	N/A	N/A	N/A	----	----	----		
DIURNAL** (Grams/Vehicle/Day)	----	----	----	N/A	N/A	N/A	----	----	----		

Example of one daily trip:

	Running + Evaporative	
Vehicle Start (Start-up)	---------------->	Vehicle Start (Hot Soak)
	Diurnal	
Parking	---------------->	Restart (Start-up)

Please see Table A9 - 5 - I for Areas and Associated Temperatures.

* Vehicle Miles Traveled (VMT)/Average Daily Trips (ADT) -weighted emission factors:
Includes VMT/ADT from diesel-fueled vehicles (100%), gasoline-fueled vehicles equipped with catalyst (0.0%), and gasoline-fueled vehicles not equipped with catalyst (0.0%).

** Number of Vehicles (NOV)-weighted emission factors:
Includes NOV from diesel-fueled vehicles (100%), gasoline-fueled vehicles equipped with catalyst (0.0%), and gasoline-fueled vehicles not equipped with catalyst (0.0%).

*** Buses or multi-person vehicles (Vehicles with 20 person per vehicle)
Does not include trains or airplanes.

(SG10BS17.WK1)

Table A - 5 - H - 5
EMFAC7EP EMISSION FACTORS FOR SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT
Buses or Multi-Person Vehicles***
Calendar Year 1999

Vehicle Speed (Miles per Hour)	Running Exhaust and Evaporative (Grams per Mile)* Carbon Monoxide AREA1	Carbon Monoxide AREA2	Carbon Monoxide AREA3	Reactive Organic Compounds AREA1	Reactive Organic Compounds AREA2	Reactive Organic Compounds AREA3	Oxides of Nitrogen AREA1	Oxides of Nitrogen AREA2	Oxides of Nitrogen AREA3	PM10 Exhaust FOR ALL AREA	PM10 Tire Wear FOR ALL AREA
5	67.23	67.23	67.23	9.92	9.92	9.92	31.49	31.49	31.49	1.51	0.66
10	46.36	46.36	46.36	7.78	7.78	7.78	26.12	26.12	26.12	1.51	0.66
15	33.45	33.45	33.45	6.25	6.25	6.25	22.46	22.46	22.46	1.51	0.66
20	25.26	25.26	25.26	5.12	5.12	5.12	20.00	20.00	20.00	1.51	0.66
25	19.97	19.97	19.97	4.30	4.30	4.30	18.46	18.46	18.46	1.51	0.66
30	16.52	16.52	16.52	3.68	3.68	3.68	17.65	17.65	17.65	1.51	0.66
35	14.30	14.30	14.30	3.23	3.23	3.23	17.49	17.49	17.49	1.51	0.66
40	12.95	12.95	12.95	2.89	2.89	2.89	17.96	17.96	17.96	1.51	0.66
45	12.28	12.28	12.28	2.65	2.65	2.65	19.10	19.10	19.10	1.51	0.66
50	12.19	12.19	12.19	2.48	2.48	2.48	21.05	21.05	21.05	1.51	0.66
55	12.66	12.66	12.66	2.37	2.37	2.37	24.04	24.04	24.04	1.51	0.66
60	13.75	13.75	13.75	2.32	2.32	2.32	28.44	28.44	28.44	1.51	0.66
65	15.64	15.64	15.64	2.32	2.32	2.32	34.87	34.87	34.87	1.51	0.66
COLD START* (Grams/Trip)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
HOT START* (Grams/Trip)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
HOT SOAK* (Grams/Trip)	——	——	——	N/A	N/A	N/A	——	——	——		
DIURNAL** (Grams/Vehicle/Day)	——	——	——	N/A	N/A	N/A	——	——	——		

Example of one daily trip:

	Running + Evaporative	
Vehicle Start (Start-up)	----------------->	Vehicle Start (Hot Soak)
	Diurnal	
Parking	----------------->	Restart (Start-up)

Please see Table A9 - 5 - I for Areas and Associated Temperatures.

* Vehicle Miles Traveled (VMT)/Average Daily Trips (ADT) -weighted emission factors:
Includes VMT/ADT from diesel-fueled vehicles (100%), gasoline-fueled vehicles equipped with catalyst (0.0%), and gasoline-fueled vehicles not equipped with catalyst (0.0%).

** Number of Vehicles (NOV)-weighted emission factors:
Includes NOV from diesel-fueled vehicles (100%), gasoline-fueled vehicles equipped with catalyst (0.0%), and gasoline-fueled vehicles not equipped with catalyst (0.0%).

*** Buses or multi-person vehicles (Vehicles with 20 person per vehicle)
Does not include trains or airplanes.

(SG10BS19.WK1)

Table A11 - 5 - H - 6
EMFAC7EP EMISSION FACTORS FOR SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT
Buses or Multi–Person Vehicles***
Calendar Year 2001

Vehicle Speed (Miles per Hour)	Running Exhaust and Evaporative (Grams per Mile)* — Carbon Monoxide AREA1	Carbon Monoxide AREA2	Carbon Monoxide AREA3	Reactive Organic Compounds AREA1	Reactive Organic Compounds AREA2	Reactive Organic Compounds AREA3	Oxides of Nitrogen AREA1	Oxides of Nitrogen AREA2	Oxides of Nitrogen AREA3	PM10 Exhaust FOR ALL AREA	PM10 Tire Wear FOR ALL AREA
5	67.64	67.64	67.64	9.92	9.92	9.92	31.48	31.48	31.48	1.42	0.66
10	46.64	46.64	46.64	7.79	7.79	7.79	26.12	26.12	26.12	1.42	0.66
15	33.65	33.65	33.65	6.25	6.25	6.25	22.45	22.45	22.45	1.42	0.66
20	25.42	25.42	25.42	5.12	5.12	5.12	20.00	20.00	20.00	1.42	0.66
25	20.09	20.09	20.09	4.30	4.30	4.30	18.45	18.45	18.45	1.42	0.66
30	16.62	16.62	16.62	3.69	3.69	3.69	17.65	17.65	17.65	1.42	0.66
35	14.38	14.38	14.38	3.23	3.23	3.23	17.48	17.48	17.48	1.42	0.66
40	13.03	13.03	13.03	2.90	2.90	2.90	17.95	17.95	17.95	1.42	0.66
45	12.36	12.36	12.36	2.65	2.65	2.65	19.09	19.09	19.09	1.42	0.66
50	12.26	12.26	12.26	2.48	2.48	2.48	21.04	21.04	21.04	1.42	0.66
55	12.73	12.73	12.73	2.37	2.37	2.37	24.03	24.03	24.03	1.42	0.66
60	13.84	13.84	13.84	2.32	2.32	2.32	28.43	28.43	28.43	1.42	0.66
65	15.74	15.74	15.74	2.32	2.32	2.32	34.86	34.86	34.86	1.42	0.66
COLD START* (Grams/Trip)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
HOT START* (Grams/Trip)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
HOT SOAK* (Grams/Trip)	----	----	----	N/A	N/A	N/A	----	----	----		
DIURNAL** (Grams/Vehicle/Day)	----	----	----	N/A	N/A	N/A	----	----	----		

Example of one daily trip:

	Running + Evaporative	
Vehicle Start (Start–up)	---------------->	Vehicle Start (Hot Soak)
	Diurnal	
Parking	---------------->	Restart (Start–up)

Please see Table A9 – 5 – I for Areas and Associated Temperatures.

* Vehicle Miles Traveled (VMT)/Average Daily Trips (ADT) –weighted emission factors:
Includes VMT/ADT from diesel–fueled vehicles (100%), gasoline–fueled vehicles equipped with catalyst (0.0%), and gasoline–fueled vehicles not equipped with catalyst (0.0%).

** Number of Vehicles (NOV)–weighted emission factors:
Includes NOV from diesel–fueled vehicles (100%), gasoline–fueled vehicles equipped with catalyst (0.0%), and gasoline–fueled vehicles not equipped with catalyst (0.0%).

*** Buses or multi–person vehicles (Vehicles with 20 person per vehicle)
Does not include trains or airplanes.

(SG10BS21.WK1)

Table A - 5 - H - 7
EMFAC7EP EMISSION FACTORS FOR SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT
Buses or Multi-Person Vehicles***
Calendar Year 2003

	Running Exhaust and Evaporative (Grams per Mile)*										
Vehicle Speed	Carbon Monoxide			Reactive Organic Compounds			Oxides of Nitrogen			PM10 Exhaust	PM10 Tire Wear
(Miles per Hour)	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	FOR ALL AREA	FOR ALL AREA
5	67.80	67.80	67.80	10.01	10.01	10.01	31.26	31.26	31.26	1.23	0.66
10	46.75	46.75	46.75	7.86	7.86	7.86	25.94	25.94	25.94	1.23	0.66
15	33.73	33.73	33.73	6.30	6.30	6.30	22.30	22.30	22.30	1.23	0.66
20	25.48	25.48	25.48	5.17	5.17	5.17	19.86	19.86	19.86	1.23	0.66
25	20.14	20.14	20.14	4.33	4.33	4.33	18.33	18.33	18.33	1.23	0.66
30	16.66	16.66	16.66	3.72	3.72	3.72	17.53	17.53	17.53	1.23	0.66
35	14.42	14.42	14.42	3.26	3.26	3.26	17.36	17.36	17.36	1.23	0.66
40	13.06	13.06	13.06	2.92	2.92	2.92	17.83	17.83	17.83	1.23	0.66
45	12.39	12.39	12.39	2.68	2.68	2.68	18.96	18.96	18.96	1.23	0.66
50	12.29	12.29	12.29	2.50	2.50	2.50	20.90	20.90	20.90	1.23	0.66
55	12.76	12.76	12.76	2.39	2.39	2.39	23.86	23.86	23.86	1.23	0.66
60	13.87	13.87	13.87	2.35	2.35	2.35	28.24	28.24	28.24	1.23	0.66
65	15.78	15.78	15.78	2.35	2.35	2.35	34.62	34.62	34.62	1.23	0.66
COLD START* (Grams/Trip)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
HOT START* (Grams/Trip)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
HOT SOAK* (Grams/Trip)	----	----	----	N/A	N/A	N/A	----	----	----		
DIURNAL** (Grams/Vehicle/Day)	----	----	----	N/A	N/A	N/A	----	----	----		

Example of one daily trip:

Vehicle Start (Start-up) --- Running + Evaporative ---> Vehicle Start (Hot Soak)

Parking --- Diurnal ---> Restart (Start-up)

Please see Table A9 - 5 - I for Areas and Associated Temperatures.

* Vehicle Miles Traveled (VMT)/Average Daily Trips (ADT) -weighted emission factors:
Includes VMT/ADT from diesel-fueled vehicles (100%), gasoline-fueled vehicles equipped with catalyst (0.0%), and gasoline-fueled vehicles not equipped with catalyst (0.0%).

** Number of Vehicles (NOV)-weighted emission factors:
Includes NOV from diesel-fueled vehicles (100%), gasoline-fueled vehicles equipped with catalyst (0.0%), and gasoline-fueled vehicles not equipped with catalyst (0.0%).

*** Buses or multi-person vehicles (Vehicles with 20 person per vehicle)
Does not include trains or airplanes.

(SG10BS23.WK1)

Table A11 - 5 - H - 8
EMFAC7EP EMISSION FACTORS FOR SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT
Buses or Multi-Person Vehicles***
Calendar Year 2005

Vehicle Speed (Miles per Hour)	Running Exhaust and Evaporative (Grams per Mile)*										
	Carbon Monoxide			Reactive Organic Compounds			Oxides of Nitrogen			PM10 Exhaust	PM10 Tire Wear
	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	FOR ALL AREA	FOR ALL AREA
5	67.93	67.93	67.93	10.06	10.06	10.06	31.17	31.17	31.17	1.12	0.66
10	46.84	46.84	46.84	7.89	7.89	7.89	25.86	25.86	25.86	1.12	0.66
15	33.80	33.80	33.80	6.33	6.33	6.33	22.23	22.23	22.23	1.12	0.66
20	25.53	25.53	25.53	5.20	5.20	5.20	19.80	19.80	19.80	1.12	0.66
25	20.17	20.17	20.17	4.36	4.36	4.36	18.27	18.27	18.27	1.12	0.66
30	16.69	16.69	16.69	3.74	3.74	3.74	17.47	17.47	17.47	1.12	0.66
35	14.45	14.45	14.45	3.28	3.28	3.28	17.31	17.31	17.31	1.12	0.66
40	13.09	13.09	13.09	2.93	2.93	2.93	17.77	17.77	17.77	1.12	0.66
45	12.41	12.41	12.41	2.69	2.69	2.69	18.91	18.91	18.91	1.12	0.66
50	12.31	12.31	12.31	2.51	2.51	2.51	20.84	20.84	20.84	1.12	0.66
55	12.79	12.79	12.79	2.40	2.40	2.40	23.80	23.80	23.80	1.12	0.66
60	13.90	13.90	13.90	2.36	2.36	2.36	28.16	28.16	28.16	1.12	0.66
65	15.81	15.81	15.81	2.36	2.36	2.36	34.52	34.52	34.52	1.12	0.66
COLD START* (Grams/Trip)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
HOT START* (Grams/Trip)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
HOT SOAK* (Grams/Trip)	——	——	——	N/A	N/A	N/A	——	——	——		
DIURNAL** (Grams/Vehicle/Day)	——	——	——	N/A	N/A	N/A	——	——	——		

Example of one daily trip:

	Running + Evaporative	
Vehicle Start (Start-up)	----------------->	Vehicle Start (Hot Soak)
	Diurnal	
Parking	----------------->	Restart (Start-up)

Please see Table A9 - 5 - I for Areas and Associated Temperatures.

* Vehicle Miles Traveled (VMT)/Average Daily Trips (ADT) -weighted emission factors:
Includes VMT/ADT from diesel-fueled vehicles (100%), gasoline-fueled vehicles equipped with catalyst (0.0%), and gasoline-fueled vehicles not equipped with catalyst (0.0%).

** Number of Vehicles (NOV)-weighted emission factors:
Includes NOV from diesel-fueled vehicles (100%), gasoline-fueled vehicles equipped with catalyst (0.0%), and gasoline-fueled vehicles not equipped with catalyst (0.0%).

*** Buses or multi-person vehicles (Vehicles with 20 person per vehicle)
Does not include trains or airplanes.

(SG10BS25.WK1)

Table A - 5 - H - 9
EMFAC7EP EMISSION FACTORS FOR SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT
Buses or Multi-Person Vehicles***
Calendar Year 2007

	Running Exhaust and Evaporative (Grams per Mile)*										
Vehicle Speed	Carbon Monoxide			Reactive Organic Compounds			Oxides of Nitrogen			PM10 Exhaust	PM10 Tire Wear
(Miles per Hour)	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	FOR ALL AREA	FOR ALL AREA
5	68.01	68.01	68.01	10.08	10.08	10.08	31.14	31.14	31.14	1.075	0.66
10	46.89	46.89	46.89	7.91	7.91	7.91	25.84	25.84	25.84	1.075	0.66
15	33.84	33.84	33.84	6.36	6.36	6.36	22.21	22.21	22.21	1.075	0.66
20	25.56	25.56	25.56	5.21	5.21	5.21	19.78	19.78	19.78	1.075	0.66
25	20.20	20.20	20.20	4.37	4.37	4.37	18.26	18.26	18.26	1.075	0.66
30	16.71	16.71	16.71	3.74	3.74	3.74	17.46	17.46	17.46	1.075	0.66
35	14.46	14.46	14.46	3.28	3.28	3.28	17.30	17.30	17.30	1.075	0.66
40	13.10	13.10	13.10	2.94	2.94	2.94	17.76	17.76	17.76	1.075	0.66
45	12.42	12.42	12.42	2.70	2.70	2.70	18.89	18.89	18.89	1.075	0.66
50	12.33	12.33	12.33	2.52	2.52	2.52	20.82	20.82	20.82	1.075	0.66
55	12.80	12.80	12.80	2.41	2.41	2.41	23.77	23.77	23.77	1.075	0.66
60	13.91	13.91	13.91	2.36	2.36	2.36	28.13	28.13	28.13	1.075	0.66
65	15.83	15.83	15.83	2.36	2.36	2.36	34.49	34.49	34.49	1.075	0.66
COLD START* (Grams/Trip)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
HOT START* (Grams/Trip)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
HOT SOAK* (Grams/Trip)	——	——	——	N/A	N/A	N/A	——	——	——		
DIURNAL** (Grams/Vehicle/Day)	——	——	——	N/A	N/A	N/A	——	——	——		

Example of one daily trip:

```
                        Running + Evaporative
Vehicle Start        ----------------->        Vehicle Start
(Start-up)                                     (Hot Soak)

                             Diurnal
Parking              ----------------->        Restart
                                               (Start-up)
```

Please see Table A9 - 5 - I for Areas and Associated Temperatures.

* Vehicle Miles Traveled (VMT)/Average Daily Trips (ADT) -weighted emission factors:
Includes VMT/ADT from diesel-fueled vehicles (100%), gasoline-fueled vehicles equipped with catalyst (0.0%), and gasoline-fueled vehicles not equipped with catalyst (0.0%).

** Number of Vehicles (NOV)-weighted emission factors:
Includes NOV from diesel-fueled vehicles (100%), gasoline-fueled vehicles equipped with catalyst (0.0%), and gasoline-fueled vehicles not equipped with catalyst (0.0%).

*** Buses or multi-person vehicles (Vehicles with 20 person per vehicle)
Does not include trains or airplanes.

(SG10BS27.WK1)

Table A11 - 5 - H - 10
EMFAC7EP EMISSION FACTORS FOR SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT
Buses or Multi-Person Vehicles***
Calendar Year 2009

	Running Exhaust and Evaporative (Grams per Mile)*										
Vehicle Speed	Carbon Monoxide			Reactive Organic Compounds			Oxides of Nitrogen			PM10 Exhaust	PM10 Tire Wear
(Miles per Hour)	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	AREA1	AREA2	AREA3	FOR ALL AREA	FOR ALL AREA
5	68.05	68.05	68.05	10.10	10.10	10.10	31.12	31.12	31.12	1.05	0.66
10	46.92	46.92	46.92	7.93	7.93	7.93	25.82	25.82	25.82	1.05	0.66
15	33.86	33.86	33.86	6.37	6.37	6.37	22.19	22.19	22.19	1.05	0.66
20	25.57	25.57	25.57	5.22	5.22	5.22	19.77	19.77	19.77	1.05	0.66
25	20.21	20.21	20.21	4.38	4.38	4.38	18.24	18.24	18.24	1.05	0.66
30	16.72	16.72	16.72	3.75	3.75	3.75	17.45	17.45	17.45	1.05	0.66
35	14.47	14.47	14.47	3.29	3.29	3.29	17.29	17.29	17.29	1.05	0.66
40	13.11	13.11	13.11	2.94	2.94	2.94	17.74	17.74	17.74	1.05	0.66
45	12.43	12.43	12.43	2.70	2.70	2.70	18.88	18.88	18.88	1.05	0.66
50	12.33	12.33	12.33	2.53	2.53	2.53	20.80	20.80	20.80	1.05	0.66
55	12.81	12.81	12.81	2.42	2.42	2.42	23.76	23.76	23.76	1.05	0.66
60	13.92	13.92	13.92	2.36	2.36	2.36	28.11	28.11	28.11	1.05	0.66
65	15.83	15.83	15.83	2.36	2.36	2.36	34.46	34.46	34.46	1.05	0.66
COLD START* (Grams/Trip)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
HOT START* (Grams/Trip)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
HOT SOAK* (Grams/Trip)	——	——	——	N/A	N/A	N/A	——	——	——		
DIURNAL** (Grams/Vehicle/Day)	——	——	——	N/A	N/A	N/A	——	——	——		

Example of one daily trip:

Running + Evaporative

Vehicle Start (Start-up) ----------------> Vehicle Start (Hot Soak)

Diurnal

Parking ----------------> Restart (Start-up)

Please see Table A9 - 5 - I for Areas and Associated Temperatures.

* Vehicle Miles Traveled (VMT)/Average Daily Trips (ADT) -weighted emission factors:
Includes VMT/ADT from diesel-fueled vehicles (100%), gasoline-fueled vehicles equipped with catalyst (0.0%), and gasoline-fueled vehicles not equipped with catalyst (0.0%).

** Number of Vehicles (NOV)-weighted emission factors:
Includes NOV from diesel-fueled vehicles (100%), gasoline-fueled vehicles equipped with catalyst (0.0%), and gasoline-fueled vehicles not equipped with catalyst (0.0%).

*** Buses or multi-person vehicles (Vehicles with 20 person per vehicle)
Does not include trains or airplanes.

(SG10BS29.WK1)

EXAMPLES OF EMPLOYERS WHO HAVE IMPLEMENTED SUCCESSFUL MITIGATION PROGRAMS THAT INVOLVE PACKAGES OF TRANSPORTATION DEMAND MANAGEMENT INCENTIVES

TABLE A11 - 5 - I

ESTIMATING EMISSIONS FROM THE TCM PACKAGES

Tables A11 - 5 - A through A11 - 5 - F attempt to quantify the effectiveness of a variety of individual, transportation-based mitigation measures. These measures, defined by the California Clean Air Act as "transportation control measures (TCMs)," involve strategies to reduce vehicle trips, vehicle use, vehicle miles traveled, vehicle idling, and traffic congestion for the purposes of reducing motor vehicle emissions. Many TCMs are effective when implemented without supporting measures. However, most are ineffective or less effective when implemented in isolation. This helps to explain the difficulty in quantifying the impact of a particular, isolated mitigation measure, as measures are usually effected as part of a transportation program. Therefore disaggregating the impacts of a multi-pronged TCM program is difficult.

To address this issue, the following table summarizes a variety of employers who have implemented and monitored the results of successful programs which utilized a package of transportation-based mitigation measures. The success of each program is attributed to a specific menu of related measures. Based on monitored results, the impacts of each case study are characterized in terms of reductions in vehicle trip (VT), vehicle miles traveled (VMT) and/or improvements in average vehicle ridership (AVR).

The purpose of this table is to supplement Tables A11 - 5 - A through A11 - 5 - F and assist local government decision-makers, air quality analysts, employers, and other private entities to determine the best package of transportation-based mitigation measures for their needs. To this end, the summary reflects a variety of circumstances, based on the following criteria:

- Type of land use or employer,
- Size of employer,
- Local conditions surrounding the employer, based on the following definitions:

  Urban: Jurisdiction characterized by moderate to dense population and development intensity.

  Urbanizing: Jurisidiction characterized by low to moderate population and development density, with significant growth projected over the next 20 years.

  Rural: Characterized by low population and development intensity, with significant growth projected by the year 2010.

- Accessibility to rail or bus transit facilities.

TABLE A11 - 5 - I

Land Use Site Description	Mitigation Measures (TDM Package)	Factors	Impacts/ Results
o Industrial office o 13,000 employees o Urban community	o Subscription bus Program o "Ride-Guide" carpooling program o Vanpool program o Staggered work hours	o Employer flextime policy - min 8 hr. o contract with transit operator - pick-up at home, three fare options max. ridership 250 employees o Avg round trip of van 50 miles - monthly charge $ 46 vanpool.	o 1,124 VTs reduced or 9.7% reduction in vehicle trips; AVR 1.21
o Office o 400 employees o Urban (CBD) o Transit accessible	o Transportation allowance program o Restricted on-site parking (limitation in parking capacity) o HOV subsidies	o Parking facility is limited o Parking is priced - $ 40 per month; Transit users $ 15 monthly pass discount, carpoolers park free	o AVR 1.40
o Office o 980 employees o Urbanizing community o Transit accessible	o Direct subsidy to employees using commute alternatives (coupon system) o Preferential parking o Vanpool o Marketing through posters, memos, brochures	o Monthly reimbursement = $ 30, depending on mix modes used by employees; o Subsidized van service; o Avg round trip of van ranges between 60-80 miles o Passengers charged $40 a month	o AVR 1.55; o Reduction of vehicle trip rate from 82.4 daily one-way trips per employee to 63.4, a 22% reduction.
o Office o Urban community (CBD) o Transit accessible o 1,100 employees	o Constrained on-site parking o Parking charge o Transit subsidies o Vanpool subsidy o Good marketing and promotion by management - corporate-supported plan.	o Additional offsite parking available through lease - $ 30 a month per employee; o On site spaces = $110 per month per employee; 36% of all employees use transit to work o Constrained parking - 223 spaces - 5 employees per space = 1.05 spaces per 1,000 Sq. Ft. o Parking charge: 2-person carpool = $ 75 per month 3-person = $ 40 per month 4-person or more = $ 10 per month o Transit subsidies: $15 - $30 per month o Vanpool subsidies $10 - $30 per month	o Removal of 7.8 ADTs per 100 employees = 86 ADTs reduced per day; o 13.6% VT reduction

TABLE A11 - 5 - I (CONT.)

Land Use Site Description	Mitigation Measures (TDM Package)	Factors	Impacts/ Results
o Manufacturing o 125 employees o Urban community	o Preferential parking spaces o Promotional commuter fairs, bulletin boards, newsletter o Guaranteed ride home o Rideshare subsidy o Transit subsidy	o On-site transportation coordinator o Rideshare subsidy $15 monthly o Transit subsidy $15 monthly o 200 parking spaces o Limited rail and bus service opportunities o 15 preferential parking spaces	o 1.09 AVR increased to 1.23 AVR
o Office o 321 employees o Urbanizing community o Transit accessible	o ETC on-site o Direct ridesharing/vanpooling subsidy o Free passes to special activities o Discounted transit and train passes o Preferential parking	o Drawings and promotional support o $20 per month to employees for ridesharing o $25 per month to employees for vanpooling 20 parking spaces reserved for ridesharers o Computerized rideshare matching o 438 parking spaces o Bicycle paths and wide sidewalks to site o Transit, signalized intersections, and light rail available	o 1.03 AVR increased to 1.24 AVR o 40 daily trips reduced
o Municipal Government o Urban community o 166 employees	o ETC on-site o Raffles and giveaways o Preferential parking spaces o Transit discounts o Guaranteed ride home o Commuter shuttle service o Flextime	o Ride matching service o Daily raffle tickets o Awarded for ridesharing o 124 parking spaces	o 1.09 AVR increased to 1.15 AVR o 8 daily one-way trips o 5% VT reduction
o Utility company o 134 employees o Urban community	o Preferential parking spaces o Guaranteed ride home o Transit subsidy o Flextime o On-site cafeteria o Vanpool program	o $63 a month per employee for transit o Commuter hot-line 24 - hour telephone line (trip reduction plan) o Free pick-up and delivery service to light rail transit o 97 parking spaces o On-street parking	o AVR 1.28

TABLE A11 - 5 - I (CONT.)

Land Use Site Description	Mitigation Measures (TDM Package)	Factors	Impacts/ Results
o Insurance office o 249 employees o Urban community	o Compressed work week o Vanpool/carpool subsidies o Quarterly drawings for prizes	o Subsidize carpool participants - $5 per month drivers - $20 per month o Management support o News bulletin, flyers, active promotion of program o Sidewalks, signalization and crosswalks	o 1.19 AVR
o New car dealership o 228 employees o Urban community	o Preferential parking o Flextime o Guaranteed ride home	o Employee recognition o Prize drawings o Rideshare matching services o 140 parking spaces o Freeway accessibility o Transit accessible o Special driving privileges for management personnel that rideshare	o 1.03 AVR increase to 1.38 AVR o 56 one-way trips reduced o 25% VT reduction
o Industrial/Manufacturing o 217 employees o Urban community	o Vanpool/carpool subsidies o Compressed work week o Preferential parking o Guaranteed ride home o ETC on-site	o Rideshare subsidy of $15 a month o Quarterly prizes for ridesharing o Ridesharing match service o Brochures, posters, announcements to promote ridesharing o Freeway accessibility o 144 parking spaces	o 1.03 AVR increase to 1.18 o 27 one-way trips reduced; o 13% VT reduction
o Industrial/Manufacturing o Urbanizing community o 171 employees	o Preferential parking o Compressed work week o Guaranteed ride home	o 48 preferential parking spaces o Quarterly drawing for prizes	o 1.09 AVR increase to 1.33 AVR o 28 one-way trips reduced; o 17% VT reduction

TABLE A11 - 5 - I (CONT.)

Land Use Site Description	Mitigation Measures (TDM Package)	Factors	Impacts/ Results
o Retail discount store o Urban community o 200 employees o Transit accessible	o Preferential parking o Transit pass subsidy o Flextime o ETC on-site	o 11 preferential parking spaces o Monthly transportation contest o Transportation center for employees o Education in new-hire orientation o Transit subsidy - $15 per month o Transit pass drawing o 900 parking spaces o "User friendly" pedestrian site	o AVR 1.16 increased to 1.39 AVR; o 29 one-way trips reduced; o 17% VT
o Manufacturing/Industrial o Urbanizing community o 182 employees	o Guaranteed ride home o Compressed work week o Telecommuting	o Carpooling information o 162 parking spaces	o AVR 1.37 increased to 1.97 AVR o 40 one-way trips reduced o 30% VT reduction
o Medical supplies o Manufacturing o Urbanizing o Transit oriented o Employees	o Transit subsidy o Carpooling subsidy o Preferential parking o Flextime o Guaranteed ride home o Vanpooling pilot program o Bike racks, lockers, showers	o $1 per day for ridesharing o Matchlist services o Displays, posters, and newsletter promoting ridesharing o Drawings for cash o 50% transit subsidy - $10 per month o 712 parking spaces	o AVR 1.05 increased to 1.22 AVR o 62 one-way trips reduced o 13% VT reduction

TABLES FOR ESTIMATING EMISSIONS FROM REDUCTION IN PETROLEUM PRODUCTS PUMPED AT SERVICE STATIONS AFTER IMPLEMENTATION OF MITIGATION MEASURES

Mitigation Measures That Reduce Emissions Associated With Petroleum Product Fueling Activities (SCAQMD Rule 461 Emissions)

- Provide Electric Outlets for Electric Vehicles in Garages
- Provide Electric Outlets at Service Stations
- Provide Service Stations that Supply Alternate Fuels

TABLE A 11 - 6

ESTIMATING EMISSIONS AFTER IMPLEMENTATION OF MITIGATION MEASURES THAT REDUCE EMISSIONS FROM PETROLEUM PRODUCTS FUELING ACTIVITIES (Pounds Per Day)

This methodology is for net emissions after implementation of mitigation measures that cause a reduction in emissions associated with the amount of gasoline and diesel dispensed due to a reduction in the number of gasoline- and diesel-fueled vehicles.

N = [A x {1 - [O/F]}] + [{A x [O/F])} x {(E OR M)/(G OR D)}], OR
N = [A x {(1 - L)}] + [{A x L)] x {(E OR M)/(G OR D)}

Where,

- A = Total Non-Mitigated Diesel or Gasoline Fuel Dispensing Fugitive Emissions. (*Use Rule 461 Staff Reports* or See Table A9 - 17 in Appendix 9) (*Resulting from Table A9 - 5 or Appendix 9 Methodologies* for the First Mitigation Measure); Please repeat the same formula for each type of alternate fuel-fueled vehicle penetration. when repeating the formula, use net emissions from previous calculations as non-mitigated emissions.
- D = Original Diesel Emission Factor in Pounds per Million BTUs
- E = New or Electricity Consumption Emission Factor in Pounds per Million BTUs
- F = Original Number of Project-Related Gasoline- or Diesel-Fueled Vehicles (*Traffic Study Input*)
- G = Original Gasoline or Diesel Emission Factor in Pounds per Million BTUs
- O = Removed from Original Number of Project-Related Gasoline- or Diesel-Fueled Vehicles
- L = Percent Vehicles Replaced With Alternate Fuel-Fueled Vehicles;

  (F x L) = Alternate Fuel-Fueled Vehicles (contact ARB to obtain fueling emission factors for alternate fuels, i.e., natural gas, methanol, Phase 2 fuel, LPG, etc.).
  (Mitigations should at least utilize the same percent substitutions for that build-out year as indicated in Table A11 - 5 - G - 1. If lower percent is utilized, please provide reasons for not utilizing available percent penetration rate.)
- M = New or Alternate Fuel Emission Factor in Pounds per Million BTUs (contact ARB for fueling emission factors)
- N = Net Emissions After Implementation of Measures that Reduce Diesel and Gasoline Fuel Dispensing Fugitive Emissions.

Note: Dispensing data should be weighted for the average of seven days, i.e., five days for workdays and two days for weekends.

TABLE A11 - 6 - A

DISPENSING EMISSION FACTORS FOR VARIOUS FUELS (Pounds Per Million BTUs)

Fuel Type	CO	ROC	NOx	SOx	PM10
Gasoline (G) (Vapor Control Transfer)	N/A	0.008	N/A	N/A	N/A
Diesel (D) (No Vapor Control Transfer)	N/A	0.079	N/A	N/A	N/A
Electricity (E) (Battery Charging)	0.059	0.0029	0.34	0.035	0.012
Alternate Fuel (M) (Phase 2 Gasoline, Alcohol, CNG (Natural Gas) or LPG (Propane or Butane))*					

* Use California Air Resources Board Staff Report for the Proposed Regulations for Low-Emission Vehicles and Clean Fuels, August 13, 1990.

TABLES FOR ESTIMATING AVERAGE VEHICLE RIDERSHIP AFTER THE IMPLEMENTATION OF MITIGATION MEASURES
(After Reduction in Number of Vehicles Traveled)

- Walk to work or destination
- Bicycle to work or destination
- Telecommute
- Report to another site for work
- Implementation of:
  - 3/36 work week
  - 4/40 work week
  - 9/80 work week
- Use of LPG powered vehicles
- Use of methanol-powered vehicles
- Use of natural gas-powered vehicles
- Use of electricity-powered vehicles
- Travel in 2 to 40 persons per vehicle format

TABLE A11 - 7

ESTIMATING PROJECT-RELATED AVERAGE VEHICLE RIDERSHIP OR OCCUPANCY AFTER THE IMPLEMENTATION OF VARIOUS MITIGATION MEASURES (Based on District Regulation XV)

AVR = Number of Persons Traveled/Number of Cars or Vehicles
(*The Lower the Number of Vehicles, the Greater the AVR*)

AVR = [A + B + C + D + E + F + M + G + H + L1]/[(A/1 + B/1 + C/2 + D/3 + E/4 + F/4 + M/7 + G/12 + H/40 + L1/1)

Where,

AVR	=	Average Vehicle Ridership after implementation of mitigation measures. To improve the AVR, trips associated with the following should be eliminated or reduced.
A	=	Remaining Number of 1-Way Trips in 1-Person 1-Vehicle Format
B	=	Remaining Number of 1-Way Trips in 1-Person 1-Motorcycle Format
L1	=	No survey response 1-Way Trips (Report these trips as "A"; If not applicable, use 0.0) To improve the AVR, more trips associated with the following combination of mitigation measures are needed. If not applicable, use 0 for the following, and use Appendix 11 methodologies for emission reduction
C	=	Number of 1-Way Trips in 2-Person 1-Vehicle Format
D	=	Number of 1-Way Trips in 3-Person 1-Vehicle Format
E	=	Number of 1-Way Trips in 4-Person 1-Vehicle Format
F	=	Number of 1-wAY Trips in More Than 4-Person 1-Vehicle Format
M	=	Number of 1-Way Trips in More Than 7-Person 1-Vehicle Format
G	=	Number of 1-Way Trips in More Than 12-Person 1-Vehicle Format
H	=	Number of 1-Way Trips in More Than 40-Person 1-Vehicle Format

---

The following mitigation measures should be used to determine emission reductions and should not be used to determine post-mitigation AVR.

I	=	Walk 1-way trips
J	=	Bicycle 1-way trips
K	=	Telecommute 1-way trips
L	=	Report to another site 1-way trips
M	=	1-way trips for persons with days off due to a 3/36 work week
N	=	1-way work trips for persons with days off due to a 4/40 work week
O	=	1-way trips for persons with days off due to a 9/80 work week
S	=	Total # of clean fuel vehicles used for commuting from home to work per day of the week
T	=	Number of workdays of the week on which "clean fuel vehicles" are used for commuting from home to work *(if unknown, use 5.0)*
U	=	Total liquid petroleum gas (LPG) vehicles
V	=	Total methanol vehicles
W	=	Total compressed natural gas (CNG) vehicles
Y	=	Total electricity powered vehicles
Z	=	Number of workdays in a week chosen to determine AVR *(if unknown, use 5.0)*
P	=	*1-way trips for persons on vacation*
Q	=	*1-way trips for persons who are on sick leave*
R	=	*1-way trips for persons who are absent for other than vacation and sick leaves*

TABLES FOR ESTIMATING MOBILE EQUIPMENT EMISSIONS AFTER IMPLEMENTATION OF MITIGATION MEASURES

Mitigation Measures That Reduce Emissions Associated With Gasoline- and Diesel- Powered Mobile Equipment

- Replace Gasoline- and Diesel-Powered Mobile Equipment With Natural-Gas-Powered Mobile Equipment;
- Replace Gasoline- and Diesel-Powered Mobile Equipment With LPG (Propane and Butane)-Gas-Powered Mobile Equipment; or,
- Replace Gasoline- and Diesel-Powered Mobile Equipment With Battery-Powered Mobile Equipment (*Electricity usage from existing power outlets supplied by SCE, LADWP, etc. to recharge batteries*)

TABLE A11 - 8

ESTIMATING EMISSIONS AFTER IMPLEMENTATION OF MITIGATION MEASURES THAT REDUCE EMISSIONS FROM MOBILE EQUIPMENT
(Pounds Per Day)

M = R + N

Where,

M = Mitigated Mobile Equipment Emissions After Implementation of Mitigation Measures (*Use Table A9 - 8 to Estimate Non-Mitigated Emissions from Original Mobile Equipment*)

R = Remaining or Residual Non-Mitigated Emissions From Unreplaced Original Mobile Equipment
= {[E x {1 - (F/G)}]; Where,
- E = Non-Mitigated Emissions from Table A9-8 of Appendix 9 (*The District Prefers F Being Equal to G*)
- F = Number of Removed Original (and Replaced with New) Mobile Equipment
- G = Number of Original Mobile Equipment (*Used to Estimate Non-Mitigated Emissions (E) in Table 9-8 of Appendix 9*)

N = New Emissions From Replaced Equipment (*Replacing Removed Original Equipment*)
= {V x (H <u>OR</u> J/I <u>OR</u> K)}; Where,
- V = Removed Emissions (*Emissions of Removed Original Equipment*)
= [E x {F/G}]
- H = New Emission Factor per Million BTU** for New (*For Replaced*) Equipment (*See Table A11 - 8 - A*);
- J = New Emission Factor (EF) per "Converted" unit to EF "Unit" of Original Equipment Converted unit is in the same unit as that for Original Emission Factor; for example, if original EF is in lbs per 1000 gals the new EF should be also in lbs/1000 gals (*See Table A11 - 8 - C*)
- I = Original Emission Factor per Million BTU for Original (for Removed) Equipment*,
<u>OR</u> Use Table A11 - 8 - B***
- K = Original Emission Factor per Unit for Original (for Removed) Equipment*,
<u>OR</u> Use Table A11 - 8 - D***

* *Use emission factors from Table A9 - 8 - A or Table A9 - 8 - B and/or their conversions into per million BTUs per hour*

** *BTU = British Thermal Unit*

*** *Use stationary equipment emission factors found in Table A11-8-B and Table A11 - 8 - D <u>only</u> if emissions for mobile equipment cannot be derived from Tables A9 - 8 - A and A9 - 8 - B*

TABLE A11 - 8 - A

Emission Factors (H) for Each Criteria Pollutant for New Mobile Equipment (Pounds Per Million BTUs)

Pollutant Type / Fuel Type	CO	ROC	NOx	SOx	PM10
	(Industrial/Commercial Type)				
Propane	1.267	0.815	1.365	0.003	0.025
Butane	1.267	0.815	1.365	0.003	0.025
	(Cogeneration or Non-cogeneration Type)				
Natural Gas (Methane)	0.4095	0.079	3.2381	0.0006	0.0048

TABLE A11 - 8 - B

Emission Factors (I) for Each Criteria Pollutant for Original (Removed) Equipment (Pounds Per Million BTUs)

Pollutant Type / Fuel Type	CO	ROC	NOx	SOx	PM10
Distilled Oil, or Diesel	0.735	0.23	3.38	0.225	0.12
Gasoline	34.26	1.28	0.89	0.046	0.028

TABLE A11 - 8 - C

Emission Factors (J) for Each Criteria Pollutant for New Mobile Equipment (The following emission factors should be converted to emissions per million BTUs)

Pollutant Type / Fuel Type	CO	ROC	NOx	SOx	PM10
	(Pounds/Megawatt-Hours [1] and [2])				
Electricity	0.2	0.01	1.15	0.12	0.04
Dual Fuel (Oil/Gas)	7.9	2.0	24.14	0.94	1.48
	(Pounds/One Thousand [1,000] Gallons)				
Propane	129.0	83.0	139.0	0.35	2.5
Butane	129.0	83.0	139.0	0.35	2.5
	(Pounds/Million [1,000,000] Cubic Feet)				
Process Gas*	--	83.0	--	--	--
Landfill Gas	--	--	--	--	--
	(Cogeneration and noncogeneration Type)				
Natural Gas (Methane)	430.0	82.9	3,400.0	0.6	5.0

[1] When using emissions factors expressed in megawatt-hour, they should be adjusted using efficiency factors "S" from Table A9-3-C.

[2] For generators, when using emissions factors expressed in megawatt-hour, they should be further adjusted using efficiency factor "U" from Table A9-3-C.

* 525 BTUs per cubic feet of process gas

TABLE A11 - 8 - D

Emission Factors (K) for Each Criteria Pollutant for Original (Removed) Mobile Equipment
(The following emission factors should be converted to emissions per million BTUs)

Pollutant Type Fuel Type	CO	ROC	NOx	SOx	PM10
	(Pounds/Megawatt-Hours [1] and [2])				
(Reciprocating)					
Diesel	2.51	0.79	11.55	0.77	0.41
Gasoline	117.0	4.39	3.03	0.16	0.10
	(Pounds/1,000 Gallons)				
(Reciprocating)					
Diesel	102.0	32.1	469.0	31.2	16.75
Gasoline	3,940.0	147.7	102.0	5.31	3.235
Residual Crude Oil	102.0	32.10	469.0	155.0	16.75
Keronaptha Jet Fuel (Diesel/Kerosene Mixture)	102.0	32.1	469.0	6.2	16.75
	(Pounds/Ton)				
(Turbine)					
Jet Fuel	150.0	1.7	1.0	0.5	2.5

[1] When using emissions factors expressed in megawatt-hour, they should be adjusted using efficiency factors "S" from Table A9-3-C.

[2] For generators, when using emissions factors expressed in megawatt-hour, they should be further adjusted using efficiency factor "U" from Table A9-3-C.

[s] Percent sulfur content of the fuel. (*Please see Rule 431.2 for the applicable project related fuel sulfur content factor, and multiply 140.0 by [s] to obtain project-related SOx emission factor.*)

TABLE A11 - 8 - E

TYPICAL LOAD FACTORS, ETC FOR MOBILE (OFF-ROAD) EQUIPMENT

(All values are taken from November 1991 Nonroad Engine and Vehicle Emission Study and averaged)

(NTIS PB92 - 126960, EPA 460/3-91-02, or EPA 21A - 2001)

The following information should be used only if emission factors expressed in megawatt-hours are used. Content of this table will be updated as each equipment is made capable of utilizing LPG (Propane and Butane) and CNG (Natural Gas or Methanol).

LPG/CNG		LPG/CNG
Equipment Type	**Load Factor (Percent or %)**	**Load Factor (Percent or %)**
Skid-Steer Loader		
Wheel/Rubber-Tired Loader		
Tractors/Loaders		
Airport Terminal Tractors	78	
Excavators		
Trenchers		
Rollers		
Other Construction Equipment		
Cement and Mortar Mixer		
Paving Equipment		
Asphalt Pavers		
Plate Compactors		
Concrete Saws (Cutting Concrete)		
Crushing Equipment		
Aerial Lifts	46	
Rough Terrain Fork Lifts		
Fork Lifts	30	
Cranes		
Sprayers		
Dumpers/Tendors		
Signal Boards (Routing Boards)		
Bore/Drill Rigs (Groundwater)		
Sweepers/Scrubbers	71	
Generator sets <50 HP		
Pressure Washers <50 HP		
Hydro Power Units		
Welders <50 HP		
Pumps <50 HP	69	
Air Compressors <50 HP		
Landscape Loader		
Backhoe Loader		
Log Loader		
Excavator (Utility)		
Excavator (Construction)		
Surfacing Equipment		
Tampers/Rammers		
2-Wheeled Tractors		
Shredder >5 HP		
Chain Saws >4 HP		

TABLE A11 - 9

ESTIMATING EMISSIONS AFTER IMPLEMENTATION OF MITIGATION MEASURES THAT REDUCE PM10 EMISSIONS FROM CONSTRUCTION ACTIVITIES

(This methodology also estimates emissions from one source category if more than one mitigation measure is implemented towards that same source category.)

M* = [E x (1 - C)] + G + H

M = [E x {(1 - C) x (1 - D) x (1 - F)}] + G + H**

where;

M*	=	Remaining PM10 Emissions from the Same Source Category After Implementation of One Mitigation Measure Affecting the Source
M**	=	Remaining PM10 Emissions from the Same Source Category After Implementation of Two Mitigation Measures Affecting the Same Source Category.
E	=	Unmitigated PM10 Emissions from One Source Category *(from Passenger Vehicles on Paved Surfaces, Table A9 - 9 - C; from Trucks on Paved Surfaces, Table A9 - 9 - C; from Passenger Vehicles on Unpaved Surfaces, Table A9 - 9 - D; and from Bulldozing or Dirt Piling, Tables A9 - 9 - F and A9 - 9 - G)*
C	=	Control Efficiency in Fraction for First Mitigation Measure Applied to Source Emissions *(For more mitigation measures please see Table A11 - 9 - A)*
D	=	Control Efficiency in Fraction for Second Mitigation Measure Applied to Source Emissions *(For more mitigation measures please see Table A11 - 9 - A)*
F	=	Control Efficiency in Fraction for Third Mitigation Measure Applied to Source Emissions. *(For more mitigation measures please see Table A11 - 9 - A)*
G	=	Unmitigated PM10 Emissions from Other Source Categories for Which No Mitigation Has Been Applied Yet. *(If not applicable, use 0.0).*
H	=	Remaining PM10 Emissions from Other Source Categories for Which Mitigation Has Already Been Applied. *(If not applicable, use 0.0).*

TABLE A11 - 9 - A

CONTROL EFFICIENCY OF PM10 MITIGATION MEASURES
Percentage Efficiencies Within the Emission Source Category (C)

Emission Source	Mitigation Measure	Reduction Efficiency	Favorable Factors
Fugitive Dust/ Construction	Apply non-toxic chemical soil** stabilizers according to manufacturers' specifications, to all inactive construction areas (previously graded areas inactive for ten days or more)	30% - 65%*	Stabilizers applied in sufficient concentration to provide erosion protection for at least one year
Fugitive Dust/ Construction	Replace ground cover** in disturbed areas as quickly as possible	15% - 49%*	Small, densely planted ground cover
Fugitive Dust/ Construction	Enclose, cover, water twice daily, or apply non-toxic soil binders**, according to manufacturers' specifications, to exposed stock piles (i.e., gravel, sand, dirt) with 5% or greater silt content	30% - 74%*	Automatic water mist or sprinkler systems should be installed in areas with stock piles
Fugitive Dust/ Construction	Water active sites at least twice daily	34% - 68%*	Water at sufficient frequency to keep soil moist enough♦ so visible plumes are eliminated. ♦ Water content is greater than 12%
Fugitive Dust/ Construction	Suspend all excavating and grading operations when wind speeds (as instantaneous gusts) exceed 25 mph	NQ	
Fugitive Dust/ Construction	Monitor for particulate emissions according to District-specified procedures	NQ	
Fugitive Dust from Roads	All trucks hauling, dirt, sand, soil, or other loose materials are to be covered, or should maintain at least two feet of freeboard in accordance with the requirements of CVC section 23114, (freeboard means vertical space between the top of the load and top of the trailer)	7% - 14%*	Tightly secured covering to truck
Fugitive Dust from Roads	Sweep streets once a day if visible soil materials are carried to adjacent streets (recommend water sweepers with reclaimed water)	25% - 60%*	Sweep streets immediately after period of heaviest vehicular track-out activity

(Continued)

TABLE A11 - 9 - A
(continued)

Emission Source	Mitigation Measure	Reduction Efficiency	Favorable Factors
Fugitive Dust from Roads	Install wheel washers where vehicles enter and exit unpaved roads onto paved roads, or wash off trucks and any equipment leaving the site each trip.	40 - 70%*	Set up truck washing area on paved access road area so subsequent truck travel on unpaved roads can be eliminated
Fugitive Dust from Roads	Pave construction roads that have a traffic volume of more than 50 daily trips by construction equipment, or 150 total daily trips for all vehicles	92.5% (91% for trucks) 94% for Passenger Vehicles)	
Fugitive Dust from Roads	Pave construction access roads at least 100 feet onto the site from main road	92.5% (91% for trucks) (94% for Passenger Vehicles)	
Fugitive Dust from Roads	Pave construction roads that have a daily traffic volume of less than 50 vehicular trips.	92.5% (91% for trucks) (94% for Passenger Vehicles)	
Fugitive Dust from Roads	Apply water three times daily, or apply non-toxic soil stabilizers** according to manufacturers' specifications to all unpaved parking or staging areas or unpaved road surfaces	45%-85%*	Use non-toxic chemical stabilizers that are formulated for use on unpaved road surfaces
Fugitive Dust from Roads	Traffic speeds on all unpaved roads to be reduced to 15 mph or less	40%-70%*	Effective traffic control or signage

* Use the lowest value if better information is not known. If higher than lowest value is used, please provide the supporting analysis and data in the environmental documentation.

** If watering is needed for soil binders on ground covers, additional percentage reductions should not be taken for watering.

EXAMPLE 1

Sample Calculation: PM10 Emissions After Implementation of One Mitigation Measure:

E = 10 lbs of unmitigated PM10 from trucks traveling on unpaved roads
C = 45% reduction from applying water 3 times daily

$$M^* = E \times C\,(1 - C) + G + H$$
$$M^* = 10 \times (1 - 0.45)$$
$$M^* = 5.5 \text{ lbs of remaining PM10 emissions}$$

EXAMPLE 2

Sample Calculation: PM10 Emissions After Implementation of Two Mitigation Measures:

E = 10 lbs of PM10 from unpaved roads
C = Measure 1 reduces 45% from applying water 3 times daily
D = Measure 2 reduces 40% from controlling traffic speeds

$$M^{**} = [E \times \{(1 - C) \times (1 - D)\}]$$
$$M^{**} = 10 \times \{(1 - 0.45) \times (1 - 0.40) + G + H\}$$
$$M^{**} = 3.3 \text{ lbs of remaining PM10 emissions}$$

TABLE A11 - 8 - E

TYPICAL LOAD FACTORS, ETC FOR MOBILE (OFF-ROAD) EQUIPMENT

(All values are taken from November 1991 <u>Nonroad Engine and Vehicle Emission Study</u> and averaged)

(NTIS PB92 - 126960, EPA 460/3-91-02, or EPA 21A - 2001)

The following information should be used only if emission factors expressed in megawatt-hours are used. Content of this table will be updated as each equipment is made capable of utilizing LPG (Propane and Butane) and CNG (Natural Gas or Methanol).

LPG/CNG		LPG/CNG
Equipment Type	**Load Factor (Percent or %)**	**Load Factor (Percent or %)**
Skid-Steer Loader		
Wheel/Rubber-Tired Loader		
Tractors/Loaders		
Airport Terminal Tractors	78	
Excavators		
Trenchers		
Rollers		
Other Construction Equipment		
Cement and Mortar Mixer		
Paving Equipment		
Asphalt Pavers		
Plate Compactors		
Concrete Saws (Cutting Concrete)		
Crushing Equipment		
Aerial Lifts	46	
Rough Terrain Fork Lifts		
Fork Lifts	30	
Cranes		
Sprayers		
Dumpers/Tendors		
Signal Boards (Routing Boards)		
Bore/Drill Rigs (Groundwater)		
Sweepers/Scrubbers	71	
Generator sets <50 HP		
Pressure Washers <50 HP		
Hydro Power Units		
Welders <50 HP		
Pumps <50 HP	69	
Air Compressors <50 HP		
Landscape Loader		
Backhoe Loader		
Log Loader		
Excavator (Utility)		
Excavator (Construction)		
Surfacing Equipment		
Tampers/Rammers		
2-Wheeled Tractors		
Shredder >5 HP		
Chain Saws >4 HP		

TABLE A11 - 9

ESTIMATING EMISSIONS AFTER IMPLEMENTATION OF MITIGATION MEASURES THAT REDUCE PM10 EMISSIONS FROM CONSTRUCTION ACTIVITIES

(This methodology also estimates emissions from one source category if more than one mitigation measure is implemented towards that same source category.)

M* = E x C
M** = E x C x (1-(D x L)

M*	=	Mitigated PM10 Emissions from Source After Implementation of One Mitigation Measure Affecting the Source
M**	=	Mitigated PM10 Emissions from Source After Implementation of Two Mitigation Measures Affecting the Same Source. Assume that Three or More Mitigation Measures Affecting the Same Source Will Not Increase the Efficacy Beyond the First Two Measures
E	=	Unmitigated PM10 Emissions from One Source *(from Passenger Vehicles on Paved Surfaces, Table A9 - 9 - C; from Trucks on Paved Surfaces, Table A9 - 9 - C; from Passenger Vehicles on Unpaved Surfaces, Table A9 - 9 - D; and from Bulldozing or Dirt Piling, Tables A9 - 9 - F and A9 - 9 - G)*
C	=	Control Efficiency of First Mitigation Measure Applied to Emission Source *(For more mitigation measures please see Table A11 - 9 - A)*
D	=	Control Efficiency of Second Mitigation Measure Applied to Emission Source *(For more mitigation measures please see Table A11 - 9 - A)*
L	=	Percent of Unmitigated PM10 affected by the Second Mitigation Measure That Was Not Affected by the First Measure Applied to the Same Source Category (If second mitigation measure is not used, "L" should be 0.0%)

TABLE A11 - 9 - A

CONTROL EFFICIENCY OF PM10 MITIGATION MEASURES
Percentage Efficiencies Within the Emission Source Category (C)

Emission Source	Mitigation Measure	Reduction Efficiency	Favorable Factors
Fugitive Dust/ Construction	Apply non-toxic chemical soil stabilizers according to manufacturers' specifications, to all inactive construction areas (previously graded areas inactive for ten days or more)	30% - 65%*	Stabilizers applied in sufficient concentration to provide erosion protection for at least one year
Fugitive Dust/ Construction	Replace ground cover in disturbed areas as quickly as possible	15% - 49%*	Small, densely planted ground cover
Fugitive Dust/ Construction	Enclose, cover, water twice daily, or apply non-toxic soil binders, according to manufacturers' specifications, to exposed stock piles (i.e., gravel, sand, dirt) with 5% or greater silt content	30% - 74%*	Automatic water mist or sprinkler systems should be installed in areas with stock piles
Fugitive Dust/ Construction	Water active sites at least twice daily	34% - 68%*	Water at sufficient frequency to keep soil moist enough so visible plumes are eliminated
Fugitive Dust/ Construction	Suspend all excavating and grading operations when wind speeds (as instantaneous gusts) exceed 25 mph	NQ	
Fugitive Dust/ Construction	Monitor for particulate emissions according to District-specified procedures	NQ	
Fugitive Dust from Roads	All trucks hauling, dirt, sand, soil, or other loose materials are to be covered, or should maintain at least two feet of freeboard in accordance with the requirements of CVC section 23114, (freeboard means vertical space between the top of the load and top of the trailer)	7% - 14%*	Tightly secured covering to truck
Fugitive Dust from Roads	Sweep streets once a day if visible soil materials are carried to adjacent streets (recommend water sweepers with reclaimed water)	25% - 60%*	Sweep streets immediately after period of heaviest vehicular track-out activity

TABLE A11 - 9 - A
(continued)

Emission Source	Mitigation Measure	Reduction Efficiency	Favorable Factors
Fugitive Dust from Roads	Install wheel washers where vehicles enter and exit unpaved roads onto paved roads, or wash off trucks and any equipment leaving the site each trip.	40 - 70%*	Set up truck washing area on paved access road area so subsequent truck travel on unpaved roads can be eliminated
Fugitive Dust from Roads	Pave construction roads that have a traffic volume of more than 50 daily trips by construction equipment, or 150 total daily trips for all vehicles	92.5% (91% for trucks) 94% for Passenger Vehicles)	
Fugitive Dust from Roads	Pave construction access roads at least 100 feet onto the site from main road	92.5% (91% for trucks) (94% for Passenger Vehicles)	
Fugitive Dust from Roads	Pave construction roads that have a daily traffic volume of less than 50 vehicular trips.	92.5% (91% for trucks) (94% for Passenger Vehicles)	
Fugitive Dust stabilizers from Roads use on	Apply water three times daily, or non-toxic soil stabilizers according to manufacturers' specifications to all unpaved parking or staging areas or unpaved road surfaces	45%-85%*	Use non-toxic chemical that are formulated for unpaved road surfaces
Fugitive Dust or signage from Roads	Traffic speeds on all unpaved roads to be reduced to 15 mph or less	40%-70%*	Effective traffic control

* Use the lowest value if better information is not known. If higher than lowest value is used, please provide the supporting analysis and data in the environmental documentation.

EXAMPLE 1

Sample Calculation: PM10 Emissions After Implementation of One Mitigation Measure:

E = 10 lbs of PM10 from unpaved roads
C = 50% reduction from trucks on unpaved roads

M* = E x C
M* = 10 x 0.5
M* = 5 lbs of mitigated PM10 emissions

EXAMPLE 2

Sample Calculation: PM10 Emissions After Implementation of Two Mitigation Measures:

E = 10 lbs of PM10 from unpaved roads
C = Measure 1 reduces 50% from trucks on unpaved roads
D = Measure 2 reduces 40% from trucks on unpaved roads
L = Measure 2 will affect 10% of the unmitigated PM10 after implementing Measure 1

M** = E x C x (1 - (D x L))
M** = 10 x 0.5 x (1 - (0.4 x 0.1))
M** = 4.8 lbs of unmitigated PM10 emissions

TABLES FOR ESTIMATING ASBESTOS EMISSIONS AFTER THE IMPLEMENTATION OF MITIGATION MEASURES (During Physical Removal of Asbestos-Containing Objects in Sections, or Units, or by Scrapping or Chipping Prior to Demolition or Renovation)

- To Prevent the Release of Fibers, Wet the Asbestos Sufficiently with a Wetting Agent or Other Liquid Such as a Removal Encapsulant with a Fine Spray for Several Hours Before Removal Begins. Use Low-Pressure or Airless Spray Equipment. Cut the Impermeable Outer Jacket or Coating Prior to Wetting. Add Surfactant or Wetting Agent to Water (use 1 ounce of polyoxyethylene ester in 5 gallons of water, or use ethylene glycol).
- Use LEV and a Collection System at Or Near the Point of Asbestos Generation; Use Portable or Mobile Vacuum System or Transportable Pneumatic Conveying Systems.
- Use Manometers to Indicate the Need for Cleaning Main Filter.
- Use Space Exhaust Ventilation and Air Cleaning System with Enclosure of the Asbestos Removal Area.
- Use Portable or Designed Exhaust Ventilation Systems.
- Use Transparent Containment Barriers.
- Use Glove Box or Glove Bag Techniques.
- Use Power Grinding, Sanding, Cutting and Drilling Tools with LEV Systems Connected to a Vacuum Source.
- Use Field Cutting Tools Especially Designed for Cutting Asbestos-Containing Materials Pipes, Sheets, etc.
- Wet Cutting Methods Should Be Used During Construction.
- Use EPA-Recommended Substitute for Asbestos and Asbestos Products.
- Spray Asbestos-Containing Material in Which the Asbestos Is Encapsulated With a Bituminous or Resinous Binder.
- Encapsulate Asbestos-Containing Materials by Spraying a Sealant Onto the Material.

TABLE A11 - 10

ESTIMATING ASBESTOS EMISSIONS AFTER IMPLEMENTATION OF MITIGATION MEASURES

(Based on the EPA Report, National Emission Standards For Asbestos -- Background Information For Proposed Standards, 1987)

M = E x [J/H]; If Wetting or Polyethylene Barriers Are Used
M = E x [(100 - F)/100]; If Control Device is Used

During Demolition, Renovation and Construction Activities

Where,

M = Mitigated Emissions (Tons Per Year)
E = Non-Mitigated Emissions from Table A9 -10 of Appendix 9; or,

E = Non-Mitigated Emissions; if Control Device is Used
= (G x H)/1 - I; If Control Device is Used;
(For Input Assumptions, Use Table 3-3 of Above-Mentioned Report.)
where,

G = Waste Collected in Control Device in Pounds/Year
H = Asbestos Content of G, i.e., Control Device Waste in Decimal Fraction (if 10%, use 0.10 rather than 10.0)
I = Control Device Efficiency (in Decimal Fraction) (if 15%, Use 0.15 rather than 15.0)

F = Time-Weighted-Average Efficiency by Gas Volumes in Percent. *(If 85%, use 85 rather than 0.85)*
J = New Fiber Count After Implementation of Mitigation Measure (*Use Table A11 - 10 - A*)
H = Original Fiber Count Before Implementation of Mitigation Measure (*Use Table A11 - 10 - A*)

TABLE A11 - 10 - A

INPUT ASSUMPTIONS FOR FIBER COUNTS
(Use the Following Information to Determine Percent Reduction of Impacts)

Source	Asbestos Handling Method	Fibers per Cubic Centimeters
8 x 12 Foot Ceiling	Dry Removal (H)	82.2
8 x 12 Foot Ceiling	Untreated Water (J)	23.1
8 x 12 Foot Ceiling	Treated Water (J)	8.1
Inner Room	Dry with Polyethylene Barriers (H or J)	74.4
Middle Room (Entry)	Dry with Polyethylene Barriers (H or J)	6.4
Outer Room (Staging)	Dry with Polyethylene Barriers (H or J)	2.0
Inner Room	Wet with Treated Water & Polyethylene Barriers (H or J)	8.2
Middle Room (Entry)	Wet with Treated Water & Polyethylene Barriers (H or J)	2.0
Outer Room (Staging)	Wet with Treated Water & Polyethylene Barriers (H or J)	0.0

TABLE A11 - 10 - B

ENVIRONMENTAL IMPACTS
NATIONWIDE ASBESTOS EMISSIONS FROM DEMOLITION AND RENOVATION
(Use the Following Information to Determine Percent Reduction of Impacts)
(Kilograms per Year)

Control Method	Asbestos Removal		Waste Disposal	
	Demolition	Renovation	Demolition	Renovation
No Regulation (1987 NESHAP)	1,713	13	509,800	1,400
Anticipated Reduction (Full Compliance with 1987 NESHAP)	700	9	380	2.0
Actual Reduction (Current Practices of Compliance)	1,300	13	226,000	1,000
Negative Pressure & High-Particulate Air (HEPA) With Freezing Weather	400	8	380	2.0
Negative Pressure & HEPA All Removals	0.2	0.003	380	2.0

TABLE A11 - 10 - C

ENVIRONMENTAL IMPACTS
NATIONWIDE ASBESTOS EMISSIONS FROM
MILLING MANUFACTURING AND FABRICATION
(Use the Following Information to Determine Percent Reduction of Impacts)
(Kilograms per Year)

Control Method	Emissions After Implementation of Controls in Year 1987		
	Current Regulation (1987 NESHAP) Best Estimates (Range)	HEPA Filter Best Estimates (Range)	Waste Disposal Estimates
Milling	2,390 (2,220 to 16,420)	0.7 (0.7 to 4.9)	160.0
Fabrication	7,410 (380 to 1,590)	2.2 (0.1 to 0.05)	3.0
	(Manufacturing)		
Friction	3,590 (3,390 to 19,280)	1.1 (0.2 to 5.0)	54.0
A/C Pipe	260 (240 to 1,790)	0.08 (0.07 to 0.5)	5.0
A/C Sheet	190 (190 to 1,130)	0.06 (0.06 to 0.3)	4.0
Paper	60 (60 to 620)	0.02 (0.02 to 0.2)	0.5
Coatings/Sealant	120 (120 to 170)	0.04 (0.04 to 0.05)	0.7
Plastics	250 (200 to 850)	0.07 (0.06 to 0.3)	3.0
Textiles	20 (20 to 480)	0.01 (0.01 to 0.1)	0.4
Packings, Gaskets	10 (10 to 290)	0.01 (0.01 to 0.1)	0.2
V/A Tile	60 (50 to 180)	0.02 (0.01 to 0.05)	0.5
Other Manufacturing			0.1

TABLES FOR ESTIMATING EMISSIONS FROM HOUSEHOLD ELECTRICITY CONSUMPTION AFTER IMPLEMENTATION OF MITIGATION MEASURES

Mitigation Measures
That Reduce Emissions Associated With Electricity Consumption

- Use Compact Fluorescent Lighting
- Use R-30 Ceiling and R-19 Walls with Central H/C Pump System
- Use Refrigerator with Vacuum Power Insulation
- Heat Water with Combined Space/Water Heater Unit
- Install High-Efficiency Air Conditioners
- Improve Evapotranspiration by Planting Three Trees to Provide Shade and Shadow on Building
  (*If Planting of Three Trees Does Not Provide Shade or Shadow on Building, this Mitigation Measure Does Not Apply. See Next Mitigation Measure*)
- Improve House Albedo by Choosing Light Colors for Exterior of Buildings
- Improve Overall Albedo Effect by:
  - Improving House Albedo or by Choosing Light Colors for Exterior of Buildings
  - Planting Trees to Provide Shade and Shadow on Buildings
  - Using Soil and Building Materials that Reduce the Roughness of Exterior of Buildings
  - Planting Trees in Surrounding Areas, and
  - Avoiding the Use of Dark-Colored Asphalt on Roofs or Surrounding Streets
- Install Fuel Cell For Residential Subdivisions or Office Buildings to Generate Electricity
- Recover Heat Produced in the Fuel Cell and Recycle it for Space Heating
- Recover and Condense the Steam Generated in the Fuel Cell and Recycle it as Hot Water
- Utilize Window Treatment (Reflective Window Film and High-Performance Glazing)

TABLE A11 - 11

ESTIMATING EMISSIONS AFTER IMPLEMENTATION OF MITIGATION MEASURES THAT REDUCE EMISSIONS FROM ELECTRICITY USAGE

(Note: Reduction efficiencies [in percents or in decimal fractions] are not needed for the formula to estimate remaining emissions from remaining Electricity consumption, but reduction efficiencies can be included in environmental documents for additional information)

(Pounds Per Day)

$M = \{[N] + [(O) \times (P)]\}$

(If Mitigation Measures Are Included In The Environmental Documents To Reduce Emissions From Only One Source Category)

$M = \{[N] + [(O_1) \times (P_1)] + [(O_2) \times (P_2)] + [(O_3) \times (P_3)] + \ldots\ldots\ldots\ldots + [(O_n) \times (P_n)]$

(If Mitigation Measures Are Included In The Environmental Documents To Reduce Emissions From Multiple Source Categories)

Where,

M = Total Mitigated Emissions from New Electricity Consumption After Implementation of Mitigation Measures and Non-Mitigated Portion of Original Electricity Consumption

N = Remaining Non-Mitigated Emissions from Original Electricity Consumption After the Removal of All Source Categories for Which Mitigation Measures Are Included in the Environmental Documents
(*From the Use of Table A9 - 11 - C in Appendix 9*)

O = Non-mitigated Emissions for Each Source Category From Table A9 - 11 - D in Appendix 9
(*Use non-mitigated emissions from Table A9 - 11 - D for each source category O_1, O_2, O_3, ...O_n for which mitigation measures included in the environmental documents*)

P = Combined Remaining Emissions Fraction or Remaining Electricity Consumption Fraction for That Source Category for which Mitigation Measure Are Included in the Environmental Document
(*Use remaining Electricity consumption fractions from Table A11 - 11 - A for each mitigation measure P_1, P_2, P_3, ...P_n*)
$= Q_1 \times Q_2 \times Q_3 \times \ldots\ldots \times Q_n$

Where,

Q_1 = Remaining Emission Fraction or Remaining Electricity Consumption Fraction for the First Mitigation Measure for That Source Category

Q_2 = Remaining Emission Fraction or Remaining Electricity Consumption Fraction for the Second Mitigation Measure for That Source Category

Q_n = Remaining Emission Fraction or Remaining Electricity Consumption Fraction for the Last Mitigation Measure for That Source Category

Example:

For Source Category, Space Cooling:	P_1 Remaining E.	O_1 # of Measures
Reorient Buildings Facing North (Q_1)	0.65	1
Double Paned Windows (Q_2)	x 0.90	1
Window Glazing Treatment (Q_3)	x 0.90	1
White-washing of Buildings (Q_4)	x 0.998	1
Total Remaining Emissions Fraction	0.525	4

Thus, for this example, since Value for P_1 = 0..525,

- o Combined **Remaining Emissions** would be 52.5 percent; and,
- o Combined **Emission Reduction Efficiency** from Implementation of 4 different mitigation measures would be
  {[100] - [52.5]} = 47.5 Percent (%).
  (*See note below the Table Title*)

Similarly, continue to determine value for P_1, P_2, P_3, ...P_n, for all source categories O_1, O_2, O_3, ...O_n for which mitigation measures are included in the environmental document.

TABLE A11 - 11 - A

REMAINING (NEW) ELECTRICITY CONSUMPTION IN RESIDENTIAL, COMMERCIAL AND INDUSTRIAL SECTORS

(Committee Draft Electricity Efficiency Report, 1990, California Energy Commission)

(Percent of the pre-mitigation Electricity use for that source category)

Note: The following percentages are provided to determine remaining emissions after the implementation of mitigation measures. These are not percent reductions

(One hundred minus the following values will provide percent reductions)

Source Category/ Mitigation Measures	Electricity Use (Percent)	Source Category/ Mitigation Measures	Electricity Use (Percent)
Space Cooling		**Space Heating**	
Face buildings to north	65.0	Face buildings to north	45.0
Insulation beyond Title 24	70.0	Insulation beyond Title 24	70.0
Double-paned windows	90.0	Double-paned windows	90.0
Fuel cell	93.0	Fuel cell	92.4
Window glazing treatment	90.0	**Water Heating**	
Efficient air-conditioners	94.0	Solar water heaters	50.0
Three trees per structure	95.0	Central & low-flow showerheads	58.4
White-washing of buildings	99.8	Fuel cell	96.8
Improved overall albedo	99.4	Light-colored roofs	97.0
Refrigeration		**Cooking**	
Efficient appliances	73.0	Efficient appliances	89.0
Fuel cell	79.6	Fuel cell	95.5
Freezing		**Clothes Dryer**	
Efficient appliances	84.0	Efficient appliances	89.0
Fuel cell	96.1	Fuel cell	93.2
Dishwashers w/Hot-Water Cycle		**Clothes Washer w/Hot-Water wash**	
Efficient appliances	89.0	Efficient appliances	89.0
Fuel cell	99.2	Fuel cell	98.7
Dishwasher Motor		**Clothes Washer Motor**	
Efficient appliances	89.0	Efficient appliances	89.0
Fuel cell	97.6	Fuel cell	99.1
Lighting		**Miscellaneous**	
Face buildings to north	69	Ventilation in parking lots	99.31 (R)
Lighting controls	96.0(R)	Fuel cell	86.3
Low-sodium parking lights	98.0 (R & C)	Ventilation in parking lots	99.5 (C)
Fuel cell	86.3	Ventilation in parking lots	99.5 (I)
Low-sodium lighting	87.5 (I)	**Lighting**	
Lighting controls	61.5 (I)	Lighting controls	50.0 (C)
	Use of Fuel cell		
For Swimming Pool Heating:		**For Solar Water Heating:**	
Solar	99.1	Water heating	99.8
Pump	96.6	Water heater's pump	99.96
Water Bed (fuel cell)	97.2	**Color TV**	95.2
Furnace Fan	98.4	**Other**	99.9
		Industrial	
Process Motors		**Process Heat**	
Modify processes	56.0	Use heat recovery systems	85.0

(R) = Residential (C) = Commercial (I) = Industrial

Bolded words describe source categories and remaining describe potential mitigation measures for those source categories. Impact should be analyzed for each source category separately. To determine remaining emissions from a source category, efficiencies of several mitigation measures for that source category can be combined.

TABLES FOR ESTIMATING EMISSIONS FROM HOUSEHOLD NATURAL GAS CONSUMPTION AFTER IMPLEMENTATION OF MITIGATION MEASURES

Mitigation Measures
That Reduce Emissions Associated With Natural Gas Consumption

- Use R-30 Ceiling and R-19 Walls with Central H/C Pump System
- Heat Water with Combined Space/Water Heater Unit
- Improve Evapotranspiration by Planting Three Trees to Provide Shade and Shadow on Building
  (If Planting of Three Trees Does Not Provide Shade or Shadow on Building, this Mitigation Measure Does Not Apply. See Next Mitigation Measure)
- Improve House Albedo by Choosing Light Colors for Exterior of Buildings
- Improve Overall Albedo Effect by:
  - Improving House Albedo or by Choosing Light Colors for Exterior of Buildings
  - Planting Trees to Provide Shade and Shadow on Buildings
  - Using Soil and Building Materials that Reduce the Roughness of Exterior of Buildings
  - Planting Trees in Surrounding Areas, and
  - Avoiding the Use of Dark-Colored Asphalt on Roofs or Surrounding Streets
- Recover Heat Produced in the Fuel Cell and Recycle it for Space Heating
- Recover and Condense the Steam Generated in the Fuel Cell and Recycle it as Hot Water
- Utilize Window Treatment (Reflective Window Film and High-Performance Glazing)

TABLE A11 - 12

ESTIMATING EMISSIONS AFTER IMPLEMENTATION OF MITIGATION MEASURES THAT REDUCE EMISSIONS FROM NATURAL GAS USAGE

(Reduction efficiencies either in percents or in decimal fractions are not needed for the formula to estimate remaining emissions from remaining Natural Gas consumption, but reduction efficiencies can be included in environmental documents for additional information)

(Pounds Per Day)

$M = \{[N] + [(O) \times (P)]\}$

(If Mitigation Measures Are Included In The Environmental Documents To Reduce Emissions From Only One Source Category)

$M = \{[N] + [(O_1) \times (P_1)] + [(O_2) \times (P_2)] + [(O_3) \times (P_3)] + \ldots\ldots\ldots\ldots + [(O_n) \times (P_n)]$

(If Mitigation Measures Are Included In The Environmental Documents To Reduce Emissions From Multiple Source Categories)

Where,

M = Total Mitigated Emissions from New Electricity Consumption After Implementation of Mitigation Measures and Non-Mitigated Portion of Original Electricity Consumption

N = Remaining Non-Mitigated Emissions from Original Electricity Consumption After the Removal of All Source Categories for Which Mitigation Measures Are Included in the Environmental Documents
(From the Use of Table A9 - 11 - C in Appendix 9)

O = Non-mitigated Emissions for Each Source Category From Table A9 - 11 - D in Appendix 9
(Use non-mitigated emissions from Table A9 - 11 - D for each source category O_1, O_2, O_3, ...O_n for which mitigation measures included in the environmental documents)

P = Combined Remaining Emissions Fraction or Remaining Electricity Consumption Fraction for That Source Category for which Mitigation Measure Are Included in the Environmental Document
(Use remaining Natural Gas consumption fractions from Table A11 - 11 - A for each mitigation measure P_1, P_2, P_3, ...P_n)
$= Q_1 \times Q_2 \times Q_3 \times \ldots\ldots \times Q_n$

Where,

Q_1 = Remaining Emission Fraction or Remaining Natural Gas Consumption Fraction for the First Mitigation Measure for That Source Category

Q_2 = Remaining Emission Fraction or Remaining Natural Gas Consumption Fraction for the Second Mitigation Measure for That Source Category

Q_n = Remaining Emission Fraction or Remaining Natural Gas Consumption Fraction for the Last Mitigation Measure for That Source Category

Example:

For Source Category, Space Cooling:	P_1 Remaining E.	O_1 # of Measures
Reorient Buildings Facing North (Q_1)	0.65	1
Double Paned Windows (Q_2)	x 0.90	1
Window Glazing Treatment (Q_3)	x 0.90	1
White-washing of Buildings (Q_4)	x 0.998	1
Total Remaining Emissions Fraction	0.525	4

Thus, for this example, since Value for P_1 = 0..525,

- o Combined **Remaining Emissions** would be 52.5 percent; and,
- o Combined **Emission Reduction Efficiency** from Implementation of 4 different mitigation measures would be
  {[100] - [52.5]} = 47.5 Percent (%).
  (See note provided under Table Title)

Similarly, continue to determine value for P_1, P_2, P_3, ...P_n, for all source categories O_1, O_2, O_3, ...O_n for which mitigation measures are included in the environmental document.

TABLE A11 - 12 - A

SOURCE CATEGORIES (P) OF POST-MITIGATION (NEW) NATURAL GAS USE IN RESIDENTIAL, COMMERCIAL AND INDUSTRIAL SECTORS

(Committee Draft Natural Gas Efficiency Report, 1990, California Energy Commission)

(Percent of the pre-mitigation Natural Gas use for that source category)

Note: The following percentages are provided to determine remaining emissions after the implementation of mitigation measures. These are not percent reductions
(*One hundred minus the following values will provide percent reductions*)

Source Category/ Mitigation Measures	Electricity Use (Percent)	Source Category/ Mitigation Measures	Electricity Use (Percent)
Space Cooling		**Space Heating**	
Face buildings to north	65.0	Face buildings to north	40.0
Insulation beyond Title 24	70.0	Insulation beyond Title 24	70.0
Double-paned windows	90.0	Double-paned windows	90.0
Window glazing treatment	90.0	**Water Heating**	
Efficient air-conditioners	94.0	Solar water heaters	50.0
Three trees per structure	95.0	Central & low-flow showerheads	58.4
White-washing of buildings	99.8	Light-colored roofs	97.0
Improved overall albedo	99.4		
Refrigeration		**Cooking**	
Efficient appliances	N/A	Efficient appliances	89.0
Freezing		**Clothes Dryer**	
Efficient appliances	N/A	Efficient appliances	89.0
Dishwashers w/Hot-Water Cycle		**Clothes Washer w/Hot Water Wash**	
Efficient appliances	89.0	Efficient appliances	89.0
Dishwasher Motor		**Clothes Washer Motor**	
Efficient appliances	89.0	Efficient appliances	89.0
Lighting		**Miscellaneous**	
Face buildings to north	69	Ventilation in parking lots	99.02 (R)
Lighting controls	N/A (R)	Ventilation in parking lots	N/A (C)
Low-sodium parking lights	N/A (R & C)	Ventilation in parking lots	N/A (I)
Low-sodium lighting	N/A (I)		
Lighting controls	N/A (I)	**Lighting**	
		Lighting controls	N/A (C)

(R) = Residential (C) = Commercial (I) = Industrial N/A Not Available

Bolded words describe source categories and remaining describe potential mitigation measures for those source categories. Impact should be analyzed for each source category separately. To determine remaining emissions from a source category, efficiencies of several mitigation measures for that source category can be combined.

TABLES FOR ESTIMATING EMISSIONS FROM COATINGS AND SPRAY EQUIPMENT AFTER IMPLEMENTATION OF MITIGATION MEASURES

Mitigation Measures
That Reduce Emissions Associated With Coatings and Spray Equipment

- Eliminate the Use of Paints and Solvents By Utilizing Precoated Building Materials
- Eliminate the Use of Paints and Solvents By Utilizing Naturally Colored Building Materials
- Use Water-Based or Low-VOC Coatings
- Use Coating Transfer or Spray Equipment with High Transfer Efficiency
- Employ Skilled Operators Who Are Well-Versed in Rule 1113 Requirement (Not Quantifiable, However, the Anticipated Emission Reductions Are from Improved Transfer Efficiency and from Less Paint and Solvent Spills)

TABLE A11 - 13

ESTIMATING EVAPORATIVE EMISSIONS FROM ARCHITECTURAL COATINGS AND BUILDING MATERIALS AFTER IMPLEMENTATION OF MITIGATION MEASURES THAT REDUCE EMISSIONS FROM COATINGS AND SPRAY EQUIPMENT

(These emissions occur during exterior finish and interior finish phases of project construction. If these phases overlap other phases of the construction, these emissions should be combined with ROC emissions from the other phases. These combined emissions should be used to determine project significance.)

(Pounds Per Day)

M1 = [E x {1 - (G + H + I + J)}] + [F x {(G x K) + (H x L) + (I x N) + (J x O)}]

(Use this formula if non-mitigated emissions are estimated first)

M2 = [(P x Q)/(1,000)] x [R]

(Use this formula if mitigated emissions are estimated without estimating non-mitigated emissions, or to estimate new coating and spray equipment-specific emissions. Convert these emissions per 1000 square foot with project-specific thickness in mils for value of K, L, N, and O for estimating M1 in above formula)

Where,

M1 = Mitigated Coatings Emissions After Implementation of Mitigation Measures

M2 = Mitigated emissions of Volatile Reactive Organic Compounds (ROC) from architectural coatings

E = Non-Mitigated Emissions Before Implementation of Mitigation Measure
(From Table A9 - 13)

F = Original <u>Total</u> Area (in Square Feet) To Be Coated with Original Coating Material <u>Per Project</u> Before the Implementation of that Mitigation Measure
(The area used for estimating non-mitigated emissions (E) in Table A9 - 13 of Appendix 9. If unknown, use Table A11 - 13 - E methodologies for estimating this area)

G = Decimal Fraction of Original Amount of Area Not Coated with Original Coating Material due to the Use of Pre-coated Building Materials or Natural-Colored Building Materials
(If the percent is expressed as 19.0, use 0.19 for G, and not 19.0. Natural-colored materials should not have additional emissions. Also, there is no need to add off-site emissions associated with the pre-coated building materials. However, vehicular emissions associated with hauling of these materials should be estimated using Table A9 - 5 of Appendix 9 and these vehicular emissions should be mitigated and mitigated emissions should be estimated using Table A11 - 5 of Appendix 11)

K = 0.0, natural-colored or pre-coated materials' emission rate

H = Decimal Fraction of Original Amount of Area Not Coated with Original Coating Material due to the Use of Water Based or Low VOC Coating Materials
(If the percent is expressed as 21.0, use 0.21 for H, and not 21.0)

L = Emission Rate of Water-Based or Low-VOC Coating Materials
(Use value of M2 converted into per 1000 square feet or see Table A9 - 13 - C, A11 - 13 - D, and A11 - 13 - E)

I = Decimal Fraction of Original Amount of Area Not Coated with Original Spraying Equipment due to the Use of High Transfer Efficiency Equipment
(If the Percent is Expressed as 21.0, Use 0.21 for I, and not 21.0)

N = Emission Rate of Original Coating with Greater or Improved-Transfer-Efficiency Spray Equipment
(Use value of M2 converted into per 1000 square feet or see Table A9 - 13 - C, A11 - 13 - D, and A11 - 13 - E)

TABLE A11 - 13 (Continued-)

J = Decimal Fraction of Original Amount of Area not Coated with Original Coating Materials and Spray Equipment due to the Use of Water-Based or Low-VOC Coating Materials Along With the Use of High Transfer Efficiency Equipment For the Same Area
(If the percent is expressed as 21.0, use 0.21 for J, and not 21.0)

O = Emission Rate of New Water-Based or Low-VOC Coating with Greater or Improved-Transfer-Efficiency Spray Equipment
(Use value of M2 converted into per 1000 square feet or see Table A9 - 13 - C, A11 - 13 - D, and A11 - 13 - E)

P = Pounds of ROC emissions
(If unknown, use Table A11 - 13 - C and Table A11 - 13 - D for this value. These values are expressed for 1 mil thick 1000 square feet area to be coated.)

Q = Total exterior and/or interior area to be coated
(If unknown, use Table A11 - 13 - F methodology to determine this value. Also, thickness should always be expressed in "mils" of thickness for this methodology to work. Also, see Table A11 - 13 - B for percent transfer efficiency default values.)

R = Required "mils" of coating thickness for the project
(If unknown, use 17.5 mils for exterior and interior walls, and 3 mils for wood and metal surfaces. Also, use Table A11 - 13 - A for mil thickness default values for coatings on various surfaces.)

TABLE A11 - 13 - A

Dry Film Thickness (R)
(Mils)

Surface Type	Thickness
Wood/Metal	1 < 4
Concrete/Masonry	5 < 30

TABLE A11 - 13 - B

Transfer Efficiency Fractions
(Percent)

Coating Equipment Type	Transfer Efficiency
Air Atomized Gun	25
HVLP	65
Brush/Roller	100

TABLE A11 - 13 - C

EMISSIONS OF VOLATILE REACTIVE ORGANIC COMPOUNDS (ROC) FROM ARCHITECTURAL COATINGS

(Value for "P" in Pounds for 65 % Transfer Efficiency For Spray Equipment Similar to HVLP.)

(This table provides VOC (ROC) emissions for 1 mil thick 1000 square feet area for all VOC limits included in Rule 1113. Rule 1113 should be consulted for corresponding coating types.)

(Pounds Per One Mil Thick 1000 Square foot Area) (P)

Rule 1113 Limits (Grams/Liter)	Rule 1113 Limits (Pounds/Gallon)	Coatings (Gallons/1000 SF)	Clean-Up Solvents Percent	ROCs Lbs/1,000 sq. ft.
Conventional Coatings				
*(Conventional coatings assumed to have 66.26 percent by weight solids, and 10.45 pounds per gallon density.)***				
780	6.49	7.92	10.0	57.21
730	6.07	5.28	10.0	35.92
680	5.66	4.13	10.0	26.42
650	5.41	3.65	10.0	22.46
600	4.99	2.97	10.0	17.00
580	4.83	2.79	10.0	15.55
550	4.58	2.50	10.0	13.29
500	4.16	2.21	10.0	10.82
420	3.49	6.38	15.0	8.39
400	3.33	5.97	15.0	7.95
High-Solid Coatings				
*(High-solid coatings assumed to have 77.35 percent by weight solids, and 11.33 pounds per gallon density.)***				
350	2.91	4.32	20.0	6.50
346	2.88	4.28	20.0	6.46
304	2.53	3.70	20.0	5.85
234	1.95	2.76	20.0	4.85
Water-Based Coatings				
*(Water-based coatings assumed to have 47.67 percent by weight solids, and 10.54 pounds per gallon density.)***				
310	2.58	7.73	5.0	8.84
262	2.18	6.34	5.0	7.41
258	2.15	6.25	5.0	7.32
253	2.10	6.10	5.0	7.17
250*	**2.08**	**6.05**	**5.0**	7.12
244	2.03	5.73	5.0	6.76
217	1.81	5.11	5.0	6.14
152	1.26	3.45	5.0	4.46
148	1.23	3.37	5.0	4.38
103	0.86	2.29	5.0	3.27
75	0.62	1.61	5.0	2.56

* If unknown use, 2.08 pounds/gallon VOC coatings for exterior walls.

** ARB's test results in 1988 report for Rule 1113 sales survey.

TABLE A11 - 13 - D

EMISSIONS OF VOLATILE REACTIVE ORGANIC COMPOUNDS (ROC) FROM ARCHITECTURAL COATINGS

(Value for "P" in Pounds for 100 % Transfer Efficiency for Brushes, Electrostatic Spray Guns)

(This table provides VOC (ROC) emissions for 1 mil thick 1000 square feet area for all VOC limits included in Rule 1113. Rule 1113 should be consulted for corresponding coating types.)

(Pounds Per One Mil Thick 1000 Square foot Area) (P)

Rule 1113 Limits (Grams/Liter)	Rule 1113 Limits (Pounds/Gallon)	Coatings (Gallons/1000 SF)	Clean-Up Solvents Percent	ROCs Lbs/1,000 sq. ft.
Conventional Coatings				
*(Conventional coatings assumed to have 66.26 percent by weight solids, and 10.45 pounds per gallon density.)***				
780	6.49	5.17	10.0	37.33
730	6.07	3.44	10.0	23.44
680	5.66	2.70	10.0	17.24
650	5.41	2.38	10.0	14.66
600	4.99	1.94	10.0	11.09
580	4.83	1.82	10.0	10.15
550	4.58	1.63	10.0	8.67
500	4.16	1.44	10.0	7.06
420	3.49	4.16	15.0	5.48
400	3.33	3.90	15.0	5.19
High Solid Coatings				
*(High solids coatings assumed to have 77.35 percent by weight solids, and 11.33 pounds per gallon density.)***				
350	2.91	2.82	20.0	4.25
346	2.88	2.79	20.0	4.22
304	2.53	2.41	20.0	3.82
234	1.95	1.80	20.0	3.17
Water Based Coatings				
*(Water-based coatings assumed to have 47.67 percent by weight solids, and 10.54 pounds per gallon density.)***				
310	2.58	5.03	5.0	5.74
262	2.18	4.12	5.0	4.81
258	2.15	4.06	5.0	4.76
253	2.10	3.97	5.0	4.66
250*	**2.08**	**3.93**	**5.0**	**4.62**
244	2.03	3.72	5.0	4.40
217	1.81	3.32	5.0	3.99
152	1.26	2.24	5.0	3.90
148	1.23	2.19	5.0	2.90
103	0.86	1.49	5.0	2.13
75	0.62	1.04	5.0	1.66

* If unknown use, 2.08 pounds/gallon VOC coatings for exterior walls.

** ARB's test results in 1988 report for Rule 1113 sales survey.

TABLE A11 - 13 - C and D (Continued-)

ASSUMPTIONS:

1. The use of solvents in the cleaning and painting of the structures will generate Volatile Organic Compound (VOC) or Reactive Organic Compound (ROC) emissions.
2. Non-mitigated VOCs are those which should not exceed Rule 1113 limits as coating is applied to the surface.
3. After removing % volume of VOC (non-exempt solvent), water and exempt solvents, what remains is the % volume of solids.
4. Non-exempt solvent density is 7.36 pounds per gallon of solvent.
5. Exempt solvent (1, 1, 1 -TCA) density is 11.06 pounds per gallon of solvent.
6. Water density is 8.337 pounds per gallon.
7. Water percent by weight is assumed to be 3.5 times higher than that of exempt solvent in the coating. (ARB's test results in 1988 report for Rule 1113 sales survey.)
8. For non-mitigated emissions, transfer efficiency is 25 % of solids applied to the surface.
9. Mathematical formulation indicates that 1 gallon of solids will cover 1 mil (0.001 inch) thick a 1604 square foot area. For the same amount of coating, if thickness is increased, the size of the area that can be coated with that amount of paint will be proportionally decreased. For the same size area if thickness is increased, the amount of coating will be proportionally increased.

TABLE A11 - 13 - E

ESTIMATING SURFACE AREA TO BE COATED (Q)

Estimate interior and exterior area to be covered by using the following methodologies:

Residential Structures:

Method 1.

It was estimated that every square foot of floor space would require the coating equivalent to that of 2.7 square feet of surface area. This may actually be an underestimate, but allows for non-coated surfaces such as windows, fireplaces, cabinets, overhead recessed ceiling lighting, etc.

For single family units consider 1/7 acre of floor surface or lot size per unit (ARB Report March 1990).

For multi-family units 1/20 acre lot size per unit (ARB Report March 1990).

Method 2.

Exterior Wall

1,280 square feet of exterior wall per single-family unit; or,
1,800 square feet of exterior wall on average for other than single-family units.
(Energy and Labor in the Construction Sector, Hannon, et.al).

Interior Wall

The exterior wall amount can be tripled to consider interior walls, ceiling coatings, trim, etc.

Non-residential Structures:

For nonresidential structures (schools, shopping malls, etc.) rooms will be larger in size, ceilings will be acoustic panels type. In this case, each of the floor area can be multiplied by 2.0 to obtain the total area to be coated.

Emissions from exterior and interior walls should be estimated and reported separately. These emissions should be combined with emissions from other construction activities.

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Control Technologies. Some projects that may be encountered by local planners may include point sources requiring permits from the District, as well as air pollution control equipment. A point source has one or more permitted pieces of equipment in a fixed identifiable location. Pursuant to the District's Regulation XIII, all major new or modified emission sources in the Basin must install best available control technology (BACT) to reduce emissions to the lowest achievable emission rate (LAER). BACT consists of a variety of air pollution control technologies, including process changes and substitution of high-polluting materials with low-polluting materials. BACT can also consist of air pollution control equipment that captures or oxidizes criteria pollutants to reduce air pollution emissions. The District periodically publishes a BACT Guideline document (available from the District's Public Information Center) for commonly encountered industrial processes or equipment categories. The purpose of the BACT Guideline is to provide the public with an up-to-date listing of current BACT requirements.

The District has determined that in some situations various air pollution control technologies may generate cross-media or indirect environmental impacts that may require analysis in a CEQA document to determine the significance of the impact and, if necessary, identify mitigation measures to minimize these cross-media impacts to the greatest extent feasible. For the purposes of this discussion, a cross-media impact is the removal of a contaminant or hazardous substance from one medium, e.g., air, and transferring it to another medium, e.g., water, which is typically released to a public sewer system. The purpose of this appendix, therefore, is to identify some common types of air pollution control equipment, or BACT equipment, and to summarize potential cross-media or other indirect adverse environmental impacts they may create, which may warrant a CEQA analysis.

A.13.1 Volatile Organic Compound (VOC) Control Technologies Add-On Control Technologies

For facilities unable to use reformulated materials or with operations that do not use coatings, two basic types of add-on control technologies are available, carbon adsorption and incineration. Many of the VOC control technologies can also be used to control air toxics. These technologies are briefly described in the following subsections.

Carbon Adsorption

Carbon adsorption is a control process typically used for organic contaminants (an organic compound is a chemical compound containing carbon and, typically, hydrogen). This control technology operates by collecting air containing VOCs and venting them to a carbon bed where the organic contaminants in the air stream are separated from the remaining effluent and adsorbed onto the surface of the carbon particles. Depending on the application, carbon adsorbers can achieve a removal efficiency of essentially 100% until breakthrough occurs (a situation where the carbon particles are completely saturated with organic contaminants and are no longer able to remove these contaminants from the exhaust air). Carbon adsorption is commercially available and is used in a wide variety of industrial applications. Although carbon adsorption devices for most applications have a similar design, two general categories of applications have been identified that differ significantly in their potential to create adverse environmental impacts. The two categories are:

(1) Vapor solvent recovery, and

(2) Liquid solvent recovery

Gaseous phase vapor recovery systems use a carbonized organic material (carbonized coconut shell, for example) as an activated carbon source to remove organic substances from gas streams. When the activated carbon of vapor solvent recovery becomes saturated with organic material, it is removed and regenerated (usually off-site) typically using a rotary kiln to oxidize (destroy by combustion) the organic material. Once the organic material is oxidized, the activated carbon can be reused. During the regeneration process, approximately five percent of the activated carbon is lost. This loss is replaced with new activated carbon and the entire amount is then reused. Vapor solvent recovery carbon can be continuously regenerated and replenished.

Liquid solvent recovery uses a moderately hard type of coal as a source of activated carbon to capture solvents. When carbon is saturated with solvent it is regenerated by heating the carbon and injecting either steam or hot gas into the carbon bed. The resulting hot solvent mixture is vented to a condenser, which cools the hot gases to a liquid/solvent mixture (known as regenerant). The solvent is then separated from the regenerant by gravity or distillation. The recovered solvent is then recycled or can be used in another application.

Carbon adsorption solvent recovery systems are most effective when only a single solvent is involved and the solvent does not break down during the heating process. For a system in which VOC compounds have a molecular weight less than or equal to eight carbon atoms, no polymer formers, or excessive particulates, a carbon life of 5-10 years is possible.

Depending on the type of carbon adsorption system used, several types of secondary impacts may occur. Carbon adsorption systems used for liquid solvent recovery have the potential to generate water quality impacts because water is often used to clean the spent carbon. Water contaminated with organic compounds could then be released to a public sewer system, not only affecting water quality, but water treatment utilities (often called Publicly Owned Treatment Works or POTWs).

Regenerating spent carbon for each type of carbon adsorption system has the potential to create air quality impacts because the regeneration process requires a combustion source which can generate criteria pollutant emissions or emissions of other products of incomplete combustion. For example, liquid and aqueous phase vapor recovery systems require a combustion source to heat water to steam which is then used to purge adsorbed organics from the carbon. Gaseous phase vapor recovery uses a combustion device to directly oxidize the organic compounds adsorbed to the carbon.

Liquid solvent carbon adsorption systems also have the potential to generate solid waste impacts because the coal eventually loses its effectiveness at capturing organic compounds and must then be disposed of. As previously indicated, carbon used in the liquid and aqueous phase can be regenerated and reused for approximately 5-10 years depending upon specific operating parameters, the components of the waste stream, control requirements, etc. Since spent carbon is typically considered a hazardous waste, it would most likely be disposed of in a Class 1 landfill. Therefore, hazardous waste disposal utilities could be adversely affected.

Solid waste impacts are, typically, not a problem with vapor recovery systems because the activated carbon can be used continuously until it is incinerated in the rotary kiln in the regeneration process.

Any incinerated carbon ash is generally produced in small quantities and, therefore, is typically not a significant solid waste impact.

Risks of upset impacts could occur during handling and transport of spent carbon because in many cases the organic compound may be flammable, thus creating risks of fire or explosion.

Incineration

Incineration is the most universally applied control method for organics because it is a "destructive" control technique in which the pollutants are destroyed, i.e., oxidized (burned) to carbon dioxide, water vapor and other products of combustion. Given the proper conditions, any organic compound will oxidize. Two of the most common types of incinerator technologies are identified here.

Thermal Incineration

Thermal incineration has a wide range of applications and is frequently used to oxidize organic compounds emitted from process industries. The organic compounds are collected and vented to a combustion chamber where the compound is oxidized. Supplemental fuel, generally natural gas, may be added to the combustion chamber to maintain the combustion process. The rate at which the compound is oxidized is greatly affected by the temperature within the combustion device. Thermal incineration destroys most organic compounds at temperatures between 1,100°F and 1,500°F. At these temperatures, efficiency levels of up to 99% are possible.

Catalytic Incineration

A catalytic incinerator is essentially identical to a thermal incinerator except that combustion of the exhaust gas takes place in the presence of a catalyst (a catalyst is a substance that promotes/accelerates a chemical reaction without being changed in the reaction itself). The presence of the catalyst allows the incinerator to operate at a lower temperature range (500°F-800°F compared to 1,100°F-1,500°F for thermal incinerators), consequently reducing supplemental fuel consumption and associated operating costs. Reduction efficiencies of up to 99% are also possible with catalytic incinerators.

Both types of incinerators have the potential to create air quality impacts because both generate criteria pollutant and reactive organic pollutant products. Because catalytic incinerators operate at lower combustion temperatures, they typically produce lower oxides of nitrogen emissions, which contribute to NO2 and ozone concentrations. Although newer incinerators burn natural gas very efficiently (thus producing fewer emissions) emissions should be calculated and compared with the District's emissions threshold of significance (Refer to Chapter 6 of this Handbook).

A drawback of catalytic incinerators is that the catalyst becomes less effective over time. Eventually the catalyst must be replaced and the spent catalyst must be disposed of, thus creating the potential for solid waste impacts.

Coating Solvent Reformulation

Methods of reducing VOC emissions from operations using coatings (paints) and cleaning solvents include reducing the VOC content and/or increasing the solids content of coating and cleanup solvent materials. Reformulating coatings or solvents with new or alternative compounds is another method that can be used to comply with District emission reduction requirements.

Product reformulation may result in adverse environmental impacts depending on the characteristics and chemical composition of the reformulated materials. For example, compounds such as 1,1,1-trichloroethane (TCA), methylene chloride (dichloromethane), and other chlorofluorocarbons (CFCs) could produce environmental impacts, including adverse human health effects. Worker safety and human health could be affected because some reformulated compounds may be toxic, carcinogenic, or have other adverse effects on human health. In addition, both TCA and CFCs are considered ozone depleting substances and CFCs contribute to global warming. Some reformulated compounds may be flammable, thus, increasing the risk of fire or explosions. Other risk of upset impacts could occur if any hazardous reformulated compounds are accidentally released during transport, which may also adversely affect public health.

A.13.2 NOx Control Technologies

NOx is formed by the oxidation of atmospheric nitrogen during combustion and from the oxidation of bound nitrogen in organic fuels. Thermal NOx formation is negligible below a peak flame temperature of approximately 2800°F, but rises exponentially above this temperature. Fuel NOx formation is typically a function of the type of fuel used for combustion.

Therefore, the actual amount of NOx formed depends, in part, upon the amount of available air supply, the type of fuel used, and the combustion temperature. Two major categories of NOx control options are currently available: (1) combustion modification and (2) flue gas treatment systems.

Combustion Modification

Combustion modification methods reduce NOx emissions, either by lowering the combustion temperature or by reducing the amount of oxygen available for combustion. The actual NOx reduction achieved is case-specific and depends upon the technology employed. In general, combustion modification reduces NOx emissions approximately 10-70% from baseline emission values. Combustion modification technologies have found widespread industrial applications. An overview of six widely used combustion modification technologies and one experimental technology is briefly described below.

Low Excess Air Burners

Low-excess air (LEA) burners require less oxygen for combustion because air and fuel are thoroughly mixed prior to combustion, thus requiring less excess air. Although fuel is more completely burned in this process, reducing excess oxygen tends to reduce combustion efficiency while increasing CO and particulate emissions. LEA burners have a maximum NOx emission reduction efficiency of approximately 25%.

Staged Air Burners

Staged air (SA) burners divide the combustion fuel mixture into two or more streams before combustion. The first stream flows into a fuel-rich zone where the fuel is partially burned. At this stage, thermal NOx formation is reduced because of the lack of excess oxygen. The remainder of the combustion air is mixed with the partially burned combustion air downstream of the fuel-rich zone where combustion is then completed. At this stage, NOx formation is reduced because of a lower flame temperature. SA burners have a maximum NOx reduction efficiency of about 30%.

Flue Gas Recirculation

Flue Gas Recirculation (also called exhaust gas recirculation when applied to internal combustion engines) is a control technique in which the flue gas is mixed with incoming combustion air. This process limits the oxygen level, resulting in a lower flame temperature and a lower peak combustion temperature, thus reducing thermal NOx formation. This method alone reduces NOx formation approximately 50% for gaseous fuel firing. In some circumstances, flue gas recirculation in conjunction with other control techniques, SA for example, can achieve a NOx reduction efficiency approaching 70%.

Water/Steam Injection

NOx formation rates can be lowered by the instantaneous cooling of the combustion temperatures. This cooling can be accomplished through the injection of water or steam into the combustion zone. The injected water acts as the inert mass and results in lower NOx production through lower peak combustion temperatures. Water injection, when used alone, can reduce NOx emissions 33-67%, but there is a slight increase in CO emissions due to the lowered combustion temperatures. Steam injection has an even higher NOx reduction efficiency. The primary impact associated with this type of control technology is increased water demand as substantial volumes of water may be necessary to achieve the desired NOx control efficiency. No other direct or indirect impacts are associated with this NOx control technology.

Stratified Combustion

Stratified combustion modification, used primarily for NOx control in internal combustion engines (ICEs), involves layering the fuel such that one layer is fuel-rich and the other layer is fuel-lean during and just after the combustion process. The fuel-rich layer is situated near the spark plug so that the elements burned as the flame moves out from the spark are subject to low-NOx formation rates because of the lower temperature and lack of oxygen. The stratified combustion process must be monitored frequently because improper stratification can actually cause NOx emissions to increase. No adverse environmental impacts, either direct or indirect, are associated with this type of control technology.

Lean Combustion

Air/fuel adjustments are applicable primarily to spark-ignited engines. Lean combustion requires increasing the air mass relative to the fuel concentration, thus creating a lean fuel mixture. One method of increasing the air/fuel ratio is through the application of turbocharging. Turbocharging involves recovering the energy of the exhaust gas stream by passing it through a turbine mechanically coupled to a compressor. The energy extracted from the exhaust is used to increase the pressure of the incoming air, increasing the quantity of air in the cylinder. Turbocharging is often used in conjunction with an intercooler to offset the temperature rise associated with increasing the compression. Turbocharging reduces NOx emissions by reducing the brake specific emission rate. As with stratified combustion, no direct or indirect adverse environmental impacts are associated with this type of control technology.

Low NOx Burners

Low NOx burners use a combination of fuel rich mixtures and staged combustion to control combustion and reduce NOx flue gas concentrations. This method reduces NOx formation approximately 50%. This technology can be used in conjunction with flue gas recirculation to achieve additional NOx reductions.

Oxygen Trim. Mechanical equipment can be used to reduce the excess oxygen by using oxygen trim. This method involves combustion at a low air to fuel ratio, still allowing for complete fuel combustion. Oxygen trim can increase boiler fuel combustion efficiency, which can result in a fuel savings of 1-2%. This method has a NOx emission reduction efficiency of 10-25%.

Staged Fuel Burners. Staged fuel (SF) burners divide the fuel into two or more streams. One fuel stream flows into, and is burned in a lean primary combustion zone. The remainder of the fuel is then mixed with the partially burned fuel downstream of the lean primary combustion zone. This process lowers the peak flame temperature, which reduces thermal NOx formation. SF burners have a maximum NOx emission reduction efficiency of approximately 55%.

Ceramic Fiber Burner. An emerging NOx control technology that requires additional retrofit demonstration on boiler equipment is a new ceramic fiber burner. Low NOx levels are achieved due to the slow kinetics of thermal NOx formation. The largest unit tested so far is a 10 million Btu burner. Test results indicate NOx emission levels of 50 ppm. Impacts. Few adverse environmental impacts have been identified for combustion modification technologies. The only exception is possibly for ceramic fiber burners. Ceramic fiber burners may pose worker health concerns because they contain ceramic fibers that could be released into the work place at a rate that may adversely affect worker health. Ceramic fibers are a health concern because of their structural similarity to asbestos, a carcinogen. However, there have been no human studies investigating the carcinogenicity of ceramic fibers. Furthermore, tests of ceramic fiber burners indicated that releases of ceramic fibers from radiant burners were typically 2-4 orders of magnitude less than the two fibers per cubic centimeter of air threshold limit value (TLV) established for ceramic fibers and recommended by the American Conference of Governmental Industrial Hygienists. This result should be periodically re-evaluated in case the conclusions regarding ceramic fibers are modified in the future.

Post-Combustion Flue Gas Treatment

Post-combustion flue gas treatment systems use a reducing agent, usually ammonia (NH3), to react with NOx, reducing it to molecular nitrogen (N2) and water (H2O). There are two basic types of post-combustion flue gas treatment technologies: selective catalytic reduction and selective noncatalytic reduction. Both technologies, discussed below, involve injecting a reducing agent, such as ammonia or urea, directly into the flue gas stream.

Selective Catalytic Reduction (SCR). This technology reduces NOx in the flue gas by using either anhydrous ammonia (a gaseous form free of water or moisture) or aqueous ammonia (a liquid mixture of ammonia and water) as a reducing agent. The reduction reaction occurs in the presence of a proprietary catalyst. In general, ammonia vapor, often diluted with air or steam, is injected into the flue gas in an approximately equimolar[1] ratio, depending upon the NOx removal requirements. To ensure maximum efficiency, the flue gas and ammonia should be thoroughly mixed to ensure uniform gas distribution prior to entering the catalyst grid system. For optimum results, this reaction must occur in a relatively narrow temperature window of between 200°C to 450°C. NOx emissions are reduced by the ammonia to molecular nitrogen (N2) and water vapor over the catalyst surface. NOx reduction efficiencies up to 95% have been obtained in some practical applications.

Impacts. Anhydrous ammonia is considered an acutely hazardous material according to state law. Therefore, technologies using this substance may have a number of adverse impacts associated with them. For example, an accidental release of ammonia during transport, storage, or handling may create significant risk of upset impacts because the released ammonia could form a dense gas that is passively transported close to the ground by wind. In addition, significant human health impacts could occur if anyone is exposed to released ammonia gas clouds. A site-specific analysis may be necessary to evaluate these potential impacts.

The catalyst of SCR systems typically contains small amounts of vanadium pentoxide, which is also classified as an acutely hazardous material. The District has assessed the possibility of risk of upset impacts and human health impacts from catalyst materials and has determined that they are not significant. However, the catalyst generally loses its effectiveness over time and must be replaced and properly disposed of, thus creating solid waste impacts. It may be necessary to determine the volume of spent catalyst generated each year to assess whether or not this exceeds any solid waste utility's significance threshold.

Selective Non-Catalytic Reduction - Ammonia Injection. Selective non-catalytic reduction (SNCR) reduces NOx emissions by injecting a reducing agent, such as ammonia, directly into the flue gas stream, usually at a temperature greater than 500°C. There is no catalyst, but the high temperature acts as a "catalyst" to reduce the NOx to molecular nitrogen and water. This technique is often used in situations where there are "dirty" flue gases which may plug or poison an SCR catalyst. NOx flue gas concentrations are reduced approximately 50% to possibly 80%.

Technologies that use ammonia as a NOx reducing agent may also create air quality impacts. For example, to ensure the efficiency of the NOx reduction reaction, small quantities of extra ammonia are injected into the exhaust gas. As a result, not all ammonia reacts with the NOx molecules and, therefore, is released into the atmosphere. This is known as an ammonia slip. Generally, the ammonia slip can be maintained at 5-10 ppm or slightly greater, which is not expected to adversely affect air quality. Ammonia slip, however, should be calculated for any project using ammonia.

High ammonia slip levels that could cause adversely affect human health or, at the very least, could create an odor nuisance. The District has determined that, because exhaust gases are typically very hot and buoyant, ground-level concentrations would not be expected to adversely affect human health or create an odor nuisance. Ground-level concentrations of ammonia from ammonia slip may need to be estimated to ensure that adverse impacts do not occur.

Selective Non-Catalytic Reduction - Urea Injection. Urea injection involves injecting a reducing agent, aqueous urea (an ammonia-based chemical compound) in this case, into the flue gas where it reacts with NOx, reducing it to molecular nitrogen, water, and carbon dioxide. The reduction reaction is maximized when the urea is thoroughly mixed in the flue gas and the temperature range is between 1,400°F-1,800°F. This process has a NOx reduction efficiency range of 50% to as high as 80% in some specific cases.

Urea itself is not considered to be a hazardous substance under state or federal law. In addition, it is typically transported in solid pellet form so, if an accidental release occurs, it is relatively easily cleaned up and does not pose a significant public health problem. One of the by-products of urea injection technologies, similar to SCR, is the production of ammonia slip. Typically, the amount of ammonia slip generated by urea injection is in the 10-20 ppm range and because of the buoyancy of the exhaust does not present an adverse air quality impact or a human health hazard at these low levels. However, a site-specific assessment may be necessary to ensure that ammonia slip levels do not pose a significant human health impact.

A.13.2 Particulate Control.

Filters, scrubbers, and mist eliminators are used primarily to reduce particulate emissions, as well as other criteria pollutant and toxic air contaminants. Particulate control devices can also be used to control air toxics. Each device is discussed briefly in the following paragraphs.

Baghouse Filters

Suspended dust and fumes may be removed from an air stream by a number of different devices. When high collection efficiency on small particles size is required, the most widely used method consists of separating the dust from the air by means of a fabric filter. Fibrous or fabric filter media formed into cylindrical sleeves or bags are the most widely used type of dry-particle collector for air cleaning. Baghouses (the structure supporting the filter) remove solid particulate contaminants from gas streams by filtering them through a fabric media which is generally a woven or felted material. Several different types of filters may be used within a baghouse depending on the particular source and composition of the particulates or gases to be controlled.

Baghouse filters collect dry particulates that must ultimately be disposed of as a solid waste. If care is not exercised during disposal of the waste particles, they could be blown from the trucks during transport to a waste disposal facility, creating secondary environmental impacts, e.g., re-entrainment to the atmosphere. In addition, depending upon the type of pollutant being collected, the resulting solid waste may be considered a hazardous waste, requiring disposal in a Class I landfill. If the amount of solid waste generated exceeds any threshold levels of significance established by any waste management agencies, solid waste impacts may be considered significant and, therefore, may warrant further investigation.

Scrubbers

Scrubbers have a number of advantages over other types of air pollution control devices: they do not create a secondary dust problem when disposing of the contaminant; they can handle high-temperature or moisture-laden air; and they can handle corrosive gases or aerosols. Scrubbers commonly used to control particulate emissions include spray towers, packed bed and venturi (high energy) scrubbers. These devices work by pumping a reagent such as sodium or calcium compounds into the device which condenses the air contaminant. Wet scrubbers use water "sprays" to collect and remove particulates. However, wet scrubbers are not well suited to control very fine particulates. Packed-bed scrubbers are generally used to remove pollutant gases. The packed-bed scrubber, or column, is generally a vertical column that has been filled with packing or materials with large surface areas. The gas stream that contains the pollutant moves upward through the packed bed against an absorbing or reacting liquid that is injected at the top of the packed column.

Installation of scrubbers as control equipment may require the use of caustic alkali solutions such as sodium hydroxide, calcium hydroxide, or magnesium hydroxide for removing dioxin compounds from incinerator exhausts. These alkali solutions are inorganic alkali compounds that are primary irritants to the skin. The alkali liquid can be recycled and reused until the pH exceeds a specified level or it becomes too concentrated. The liquid, called blowdown, is either shipped off-site as a hazardous waste or treated on-site to neutralize it, and is then reused in the system or released to a public sewage system. Disposal of the wastewater or its clarification for reuse may be difficult or expensive. Use of wet scrubbers may, therefore, pose a water quality impact, a solid waste impact, or a risk of upset impact if the alkali waste is accidentally released during transport to a disposal facility.

Mist Eliminators

Mist eliminators are "impaction" collectors that place barriers in the path of the mist particulates in the flowing gas. These barriers intercept the particulates and remove them from the gas stream. A de-mister is often used as part of a packed scrubbing device to increase its efficiency in removing fine particulate matter.

Impacts for mist eliminators will be similar to those described for scrubbers except that they do not use alkali materials.

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[1] In this case, equimolar means that the number of moles of ammonia needed is equal to the number of moles of NOx to be reduced. One mole of a substance contains 6.023×10^{23} molecules.

ACRONYMS
AS USED IN THE
CEQA AIR QUALITY HANDBOOK

AQMP	Air Quality Management Plan
AQTAN	(CalTrans) Air Quality Technical Analysis Notes
ARB	Air Resources Board
ASTM	American Society of Testing Methods
ATCM	Air Toxics Control Measure
AVO	average vehicle occupancy
AVR	average vehicle ridership
BACT	best available control technology
CAAA	Clean Air Act Amendments (federal law)
CCAA	California Clean Air Act (state law)
CAPCOA	California Air Pollution Control Officers Association
CEQA	California Environmental Quality Act
CFC	chlorofluorocarbon
CMP	Congestion Management Program
CNG	compressed natural gas
CO	carbon monoxide
CVAG	Coachella Valley Association of Governments
DU	dwelling unit
EPA	Environmental Protection Agency
ERC	emission reduction credits
GMP	Growth Management Plan
HOV	high-occupancy vehicle lane
ISR	indirect source rule
LAER	lowest achievable emission rate
LEV	low-emission vehicle

LOS	level of service
MAAQI	Mobile Assessment for Air Quality Impacts
MND	Mitigated Negative Declaration
MOU	Memorandum of Understanding
MPO	metropolitan planning organization
ND	Negative Declaration
NESHAP	National Emission Standards for Hazardous Air Pollutants
NMOG	non-methane organic gases
NPDES Permit	National Pollutant Discharge Elimination System
NOP	Notice of Preparation
NO_2	nitrogen dioxide
NOx	nitric oxide and nitrogen dioxide
OEHHA	Office of Environmental & Health Hazard Assessments
Pb	lead
POTW	publicly owned treatment works
PM10	Particulate matter less than 10 micrometers in diameter
PRC	Public Resource Code
PSI	Pollutant Standards Index
RECLAIM	Regional Clean Air Incentives Market
RMP	Regional Mobility Plan
RMPP	Risk Management and Prevention Program
ROC	reactive organic compounds
RU	residential unit
SCAB	South Coast Air Basin
SCAG	Southern California Association of Governments
SCAQMD	South Coast Air Quality Management District
SEDAB	Southeast Desert Air Basin

SO_2	sulfur dioxide
SOx	sulfur oxides
SRA	source receptor area
T-BACT	best available control technology for toxics
TCA	trichloroethane
TDM	transportation demand management
TIP	Transportation Improvement Program
TLEV	transitional low-emission vehicle
TLV	threshold limit value
ULEV	ultra-low-emission vehicle
VMT	vehicle miles traveled
VOC	volatile organic compounds
VT	vehicle trips
ZEV	zero-emission vehicle

GLOSSARY OF TERMS
AS USED IN THE
CEQA AIR QUALITY HANDBOOK

ADVISORY COUNCIL - A group of technical and scientific specialists who advise the District on long- and short-term matters affecting Clean Air programs.

AIR BASIN - An area designated by the Air Resources Board for air quality planning purposes.

AIR MONITORING - Sampling for and measuring of air pollutants present in the ambient air.

AIR POLLUTANT - A material in the ambient air that produces air pollution. Common air pollutants are ozone (O_3), nitrogen dioxide (NO_2), particulate matter (PM10), sulfur dioxide (SO_2), and carbon monoxide (CO). Air pollution is defined in the California Health and Safety Code as any discharge, release, or other propagation into the atmosphere, and includes, but is not limited to, smoke, charred paper, dust, soot, grime, carbon, fumes, gases, odors, particulate matter, acids or any combination thereof.

AIR QUALITY MANAGEMENT PLAN (AQMP) - A document describing how the SCAQMD plans to achieve federal and state air quality standards by the year 2010, as required by the CAAA and CCAA. The complete AQMP consists of more than 30 documents, including the plan itself, appendices and technical reports. Portions of the Plan are contributed by other agencies (e.g., SCAG produces the transportation and land use portions; ARB produces the mobile source regulations.) State law requires that the Plan be updated every three years.

AIR QUALITY STANDARD - The specified average concentration of an air pollutant in ambient air during a specified time period at or above which undesirable effects may be produced. The two sets of air quality standards with which the District is concerned are the National Ambient Air Quality Standards and the California State Air Quality Standards.

AIR RESOURCES BOARD (ARB) - Was subsumed into the California Environmental Protectiona Agency (Cal EPA) in 1991 and is responsible for setting state ambient air quality standards and allowable emission levels from new motor vehicles in California. The ARB is responsible for overseeing the efforts of local air pollution control districts and air quality management districts in regulating emissions from non-vehicular sources of air pollution. Also known as the California Air Resources Board (CARB), and State Air Resources Board (ARB), the Air Resources Board is the agency responsible for developing the State Implementation Plan and transmitting it to the federal Environmental Protection Agency for approval.

AMBIENT AIR - Any unconfined portion of the atmosphere; the outside air.

AREA-WIDE SOURCES - Those sources that individually emit relatively small quantities of air pollutants. This includes small items such as home heaters and consumer products.

AUXILIARY LANES - Traffic lanes that provide egress and ingress for vehicles entering or leaving a roadway.

AVERAGE VEHICLE RIDERSHIP - The number of employees who report to a worksite or another work-related activity divided by the number of vehicles driven by those employees, typically averaged over an established time period. This calculation typically includes crediting vehicle trip reductions from telecommuting, compressed work weeks, and non-motorized transportation.

AVERAGE VEHICLE OCCUPANCY - The average number of persons occupying a passenger vehicle along a roadway segment intersection, or area, as typically monitored during a specified time period. For the purpose of the California Clean Air Act, passenger vehicles includes autos, light duty trucks, passenger vans, buses, passenger rail vehicles, and motorcycles.

BASELINE INFORMATION - Information regarding the project's existing setting such as current air quality, transportation system serving the project, etc.

BEST AVAILABLE CONTROL TECHNOLOGY (BACT) - Under District rules, BACT is defined as the most stringent emissionscontrol which, for a given class of source, has been: 1) achieved in practice; 2) identified in a state implementation plan; or 3) found by the District to be technologically achievable and cost-effective. This definition is more closely aligned to the federal Lowest Achievable Emission Rate (LAER) definition and is far more stringent than the federal BACT definition.

BUILD-OUT YEAR - The year in which the project construction has been completed and the project is ready to be occupied.

CAL3QHC - An evolution of the CALINE 3 model enhanced by the EPA to incorporate vehicle traffic queuing emissions (at intersections) using recommended procedures as described in the Highway Capacity Manual.

CALIFORNIA CLEAN AIR ACT - A law setting forth a comprehensive program to assure that all areas within the State of California will attain federal and state ambient air quality standards by the earliest practicable date. Also known as the Sher Bill or AB-2595, the law mandates comprehensive planning and implementation efforts, and empowers local districts to adopt transportation control measures and indirect source control measures to achieve and maintain ambient air quality standards. The law provides annual emission reduction targets and regular review and evaluation of local programs by the Air Resources Board. The Act added and amended various sections in Division 26 of the Health and Safety Code.

CALINE MODEL - A model developed by Caltrans which calculates ambient concentrations of carbon monoxide from vehicular traffic on a roadway segment, intersection, or parking lot.

CARBON DIOXIDE - A colorless gas whose chemical formula is CO_2. It enters the atmosphere as the result of natural and artificial combustion processes and is also a normal part of the ambient air.

CARBON MONOXIDE - An invisible, odorless, tasteless, and toxic gas; its chemical formula is CO. It is primarily generated by motor vehicles but is found in trace quantities in the natural atmosphere.

CARCINOGENIC - Cancer producing.

CHLOROFLUOROCARBON (CFC) - A gas which when released into the troposphere, gradually migrates upward into the stratosphere. The CFCs participate and react with other complex chemicals (e.g., chlorinated compounds, nitrous oxide, etc.) and lead to the destruction of upper level ozone.

CLEAN AIR ACT - The federal statute which mandates a program to attain and maintain federal ambient air quality standards in all areas of the country. The Act establishes several programs. With respect to controlling emissions from non-vehicular sources, states are given primary authority to develop plans and regulations to attain federal ambient air quality standards by a specific date. These plans are called "state implementation plans" or "SIPs." With respect to emissions of motor vehicles, EPA sets emission standards for all states except California, which can adopt stricter standards. The Act also sets forth minimum standards for large new pollution sources by requiring EPA to adopt New Source Performance Standards or "NSPS." In addition, EPA is mandated to adopt regulations governing toxic air pollutants (National Emission Standards for Hazardous Air Pollutants, or NESHAPS). This Act is found beginning at 42 U.S.C. 7401.

CO HOT SPOTS - An area, usually an intersection or congested segment of a highway that exceeds the federal or state carbon monoxide standard.

CONFORMITY - A requirement in the federal Clean Air Act that no department, agency, or instrumentality of the federal government shall engage in, support in any way or provide financial assistance for, license or permit or approve any activity which does not conform with the State Implementation Plan (SIP) by causing or contributing to an increase in air pollutant emissions, or violation of an air pollutant standard, or frequency of violating that standard.

CONGESTION MANAGEMENT PROGRAM (CMP) - A state mandated program that requires each county to prepare a plan to relieve congestion and air pollution.

CONSISTENCY - A term used in CEQA to determine if a project is consistent by furthering the goals and objectives, and will not interfere with the implementation of, applicable regional plans.

CRITERIA POLLUTANTS -
Air pollutants for which the federal or state governments have established ambient air quality standards, or criteria, for outdoor concentration in order to protect public health.

DISAGGREGATE - Separate into component parts.

EMISSION STANDARD -
The maximum amount of an emittant legally permitted to be discharged from a single source.

EMISSION THRESHOLDS -
An amount of emissions established by the District, for use by local government planners, to compare with the emissions that could be emitted from a particular project to determine if that project could have a significant impact on air quality.

EMISSIONS - The mass of a specific material released to the atmosphere.

EMISSIONS INVENTORY -
A tabular listing, by source category, of all emissions within a specified political jurisdiction for an average annual day within a specified year.

ENVIRONMENTAL IMPACT REPORT (EIR) -
An EIR is prepared when the lead agency finds substantial evidence that the proposed project may have a significant effect on the environment.

ENVIRONMENTAL PROTECTION AGENCY (EPA) -
The federal agency responsible for coordinating pollution control activities at the federal level and for carrying out the terms of the federal Clean Air Act, Clean Water Act, and Superfund laws, among others. The EPA operates through regional offices located throughout the country. California is the responsibility of Region IX, which is headquartered in San Francisco.

EVAPORATIVE EMISSIONS -
Release of hydrocarbon (or reactive organic gas) emissions which occurs when fuel is exposed to the air, based on a variety of processes: when fuel entering a fuel tank displaces vapors into the air; when diurnal temperature variations on the fuel and fuel vapors in the fuel tank release hydrocarbons; or in the hot stabilized mode, after the engine and catalytic converter have warmed up to normal operating temperature (e.g., "blow-by" and crankcase emissions).

GLOBAL WARMING - The gradual buildup of "greenhouse" gases that absorb energy, and preventing it from passing into space. As a result, more solar energy is retained near the earth's surface than is lost into space, and there is a general warming of the earth's atmosphere.

GROWTH MANAGEMENT PLAN (GMP) - A plan developed by SCAG that contains demographic projections (i.e., housing units, employment, and population) through the year 2010 for a six county region (i.e., L.A. County, Orange County, Riverside County, San Bernardino County, Ventura County, and Imperial County). The plan also provides recommendations for local governments to better accommodate the growth projected to occur and reduce environmental impacts.

HALONS - A family of compounds containing bromine used in fire extinguishers; and are both ozone depleting and greenhouse gases.

HAZARDOUS AIR POLLUTANT - Defined by the Clear Air Act as an air pollutant to which no ambient air quality standard is applicable and which, in the judgement of the administrator of the Environmental Protections Agency, may result in an increased in mortality, serious irreversible illness, or incapacitating reversible illness.

HEAT ISLAND - An area, generally around a center of urban buildup, in which the average temperature is higher than that of the surrounding area.

HOT SPOT - A localized concentration of an air pollutant associated with restricted dispersion conditions, often occurring in such places as street canyons or close to sources of emissions.

INDIRECT SOURCE - Defined by the Clean Air Act as a facility, building, structure, installation, real property, road, or highway that attracts, or may attract, mobile sources of pollution. Examples of indirect sources are major highways and airports, large regional shopping center, major sports complexes and stadiums, large amusement and recreational facilities, and major parking facilities. Also known as a complex source.

INVERSION - A condition of the atmosphere in which the temperature increases with altitude.

INVERSION LAYER - A layer in the atmosphere through which the temperature remains constant or increases with altitude.

ITE TRIP GENERATION MANUAL - A document produced by the Institute Of Transportation Engineers (ITE) that provides trip generation numbers by land use based on trip generation studies conducted nationwide.

LEVEL OF SERVICE (LOS) - A scale that is used to rate the service (i.e., speed and maneuverability) on roadways. An LOS of "A" means that traffic is free flowing, while "F" refers to severely congested conditions.

LEWIS-PRESLEY AIR QUALITY MANAGEMENT ACT - The legislation which established the South Coast Air Quality Management District in 1977, and which sets forth those powers, authorities, and responsibilities of the District which may be different from those possessed by other air pollution control districts in California. It has been amended from time to time, most notably by legislation introduced by Senator Robert Priestly to expand the authorities of the District. The Act is found in Chapter 5.5 of Part 3 of Division 26 of the Health and Safety Code, beginning with Section 40400.

LOW-EMISSION VEHICLE (LEV) - Defined by ARB as a vehicle that meets a standard of 0.075 g/mi NMOG, 0.2 g/mi NO_x and 3.4 g/mi CO.

MITIGATE - Reduce the air quality impact on the environment through the application of programs and other mechanisms. Alleviate, ease, reduce, lighten, minimize.

MOBILE SOURCES - Those sources that emit pollution from vehicles. There are two types of mobile source emissions, those from on-road sources (e.g., passenger automobiles, trucks, busses, etc.) and off-road sources (e.g., airplanes, trains, construction equipment, etc.)

NEGATIVE DECLARATION (ND) - An ND is a written statement by the lead agency briefly describing the reasons a proposed project will not have a significant effect on the environment and, therefore, does not require the preparation of an EIR.

OZONE - A highly reactive, bluish-colored gas with a pungent odor. Its chemical formula is O_3. Ozone is a major constituent of photochemical oxidants. Ozone is formed in the atmosphere by a complex series of photo-chemical reactions involving oxides of nitrogen and reactive organic gases in the presence of sunlight. A National Ambient Air Quality Standard has been established for ozone.

OZONE-DEPLETING GASES - Gases released into the ambient air which are considered as global warming and stratospheric ozone-depleting. These gases include chlorofluorocarbon, halons, methyl chloroform, and carbon tetrachloride.

OZONE LAYER - Located in the stratosphere, approximately 10-30 miles above the earth's surface, is the ozone layer. This layer prevents most of the solar ultraviolet radiation (in the 290 to 320 nm wavelength range (UV-B)) from reaching the earth's surface. Increased exposure to UV-B could have serious public health and environmental effects.

PERMIT - Written authorization from the District for the construction or operation of equipment which controls or may cause regulated emissions.

PHOTOCHEMICAL OXIDANTS (OX) -
A collective term for a group of oxidizing gases produced by photochemical reactions involving reactive organic compounds and oxides of nitrogen; also referred to as an oxidant. Photochemical oxidants include ozone and other more complex compounds such as organic peroxides and peroxyacyl nitrates. A California State Air Quality Standard has been established for photochemical oxidants.

POINT SOURCE - A term used to designate a sizeable stationary emission source at a specific location.

POLLUTANT STANDARDS INDEX (PSI) -
A scale ranging between 0 and 500 that is used to indicate the air quality at a given time and location relative to National Ambient Air Quality Standards. A PSI of 100 for any air pollutant represents a concentration equal to its respective air quality standard.

QUANTIFIABLE - The expression of air emissions either generated or mitigated from a project in numerical terms.

REACTIVE ORGANIC COMPOUNDS (ROC) -
Species of organic compounds that undergo photochemical reactions.

REASONABLE FURTHER PROGRESS (RFP) -
Defined in the Clean Air Act as annual incremental reductions in emissions of an air pollutant that are sufficient to provide attainment of the applicable National Ambient Air Quality Standard by a specified date.

REGIONAL MOBILITY PLAN (RMP) -
A plan developed by SCAG that contains a listing of infrastructure improvements, travel forecasts, and other programs to regain mobility for a six county region (i.e., L.A. County, Orange County, Riverside County, San Bernardino County, Ventura County, and Imperial County).

SENSITIVE RECEPTORS -
Refers to sensitive populations such as children, athletes, elderly, and sick, that are more susceptible to the effects of air pollution than the population at large.

SMOG - A general term used to describe dense, visible air pollution. In the South Coast Air Basin, smog is formed when combustion products and gaseous emissions such as nitrogen oxides, sulphur oxides, and various hydrocarbons undergo photochemical reactions. Particles such as soil, dust, and various exhaust particles may mix with the ozone, carbon monoxide, and other compounds that are produced, creating a brownish, irritating haze. Smog poses health risks and damages crops, rubber, and other materials.

SMOG EPISODE LEVELS -
An occurrence of high concentration of air pollutants that could endanger or cause significant harm to the public. Alerts are classified by severity: Stage 1 is described a "Unhealthful," Stage 2 is "Very Unhealthful," and Stage 3 is classified as "Hazardous." Stationary Source Curtailment Plans and Traffic Abatement Plans are required to be implemented to reduce the severity of air pollution levels whenever episodes of high pollution are forecast.

SOIL STABLIZERS -

Chemical or other agents which are applied to soil surfaces to stabilize and mitigate PM10 fugitive dust emissions by creating a wind-resistant crust. Typically applied to disturbed surface areas next to roadways, bare ground areas, dirt parking lots and roadway shoulders, and exposed construction areas.

SOURCE - Any particular individual or group of organisms, mechanisms, devices, structures, installations, operations, facilities, or processes that emit air pollutants.

SOURCE CATEGORIES -

There are two primary source categories relating to projects; construction and operation. Refer to Figure 9-1 for an identification of source categories associated with construction and Figure 9-2 for source categories associated with operation.

SOUTH COAST AIR BASIN (SCAB) -

A geographic area defined by the San Jacinto Mountains to the east, the San Bernardino Mountains to the north, and the Pacific Ocean to the west and south. The entire SCAB is under the jurisdiction of the South Coast Air Quality Management District.

SOUTHEAST DESERT AIR BASIN (SEDAB) -

The air basin containing Imperial County and specific desert portions of Los Angeles, Kern, Riverside, and San Bernardino Counties. The full description is contained in the California Administrative Code.

SOUTHERN CALIFORNIA ASSOCIATION OF GOVERNMENTS (SCAG) -

The organization, known in federal law as a Council of Governments, representing Los Angeles, Ventura, San Bernardino, Riverside, Orange, and Imperial Counties and the cities of the six counties.

STATE IMPLEMENTATION PLAN (SIP) -

A state's plan to attain the federal air quality standards for all non-attainment areas within the state. The 1991 AQMP is integrated into the SIP once it is approved by the EPA and becomes the SIP for the South Coast Air Basin.

STATEMENT OF OVERRIDING CONSIDERATIONS -

Written statement by lead agency giving reasons for its approval of a project having environmental impacts which have not been mitigated to a level of insignificance.

STATIONARY SOURCES -

Those sources that emit pollution from equipment, or industrial or commercial processes. There are two types of stationary source emissions, those from area sources (e.g., water heaters, consumer products, architectural coatings, etc.) and point sources (e.g., boilers, refinery flairs, etc.)

SULFATES (SO_4) - The chemical designation for compounds containing sulfur and oxygen found in the atmosphere in the form of particulate matter. A California State Air Quality Standard has been established for sulfates. Sulfates are formed mainly by the oxidation of sulfur dioxide in the atmosphere.

SULFUR DIOXIDE - A colorless, extremely irritating gas or liquid; its chemical formula is SO_2. Sulfur dioxide enters the atmosphere as a pollutant mainly as a result of burning high sulfur-content fuel oils and coal and from chemical processes occurring at chemical plants and refineries. National Ambient Air Quality Standards and California State Air Quality Standards have been established for sulfur dioxide.

TELECOMMUTE - A work mode where individuals perform job requirements for part or all of the work week at off-site facilities, such as private residences or satellite centers (rather than commuting to the primary work site), thereby reducing vehicle trips or vehicle miles traveled, respectively.

TOXICS - Air pollutants that are carcinogens or produce acute effects. Toxic air pollutant thresholds are based on a quantative risk assessment rather than ambient air standards as with criteria pollutants.

TRANSITIONAL LOW-EMISSION VEHICLE -
Defined by ARB as a vehicle that meets a standard of 0.125 g/mi NMOG, 0.4 g/mi NO_x, and 3.4 g/mi CO.

TRANSPORTATION CONTROL MEASURES (TCM) -
Control measures in the AQMP that are directed at reducing emissions by reducing vehicle travel. Both the federal and state law specify requirements for TCMs.

ULTRA-LOW-EMISSION VEHICLE (ULEV) -
Defined by ARB as a vehicle that meets a standard of 0.04 g/mi NMOG, 0.2 g/mi NO_x, and 1.7 g/mi CO.

VISIBILITY - The distance that atmospheric conditions permit a person to see at a given time and location. The visibility reduction from air pollutions is due to the presence of sulfates, nitrates, and particulate matter in the atmosphere.

WIND ROSE - A graphic depiction of the direction and speed of wind in a given area. Wind roses are particularly important when assessing toxic emissions and odor problems.

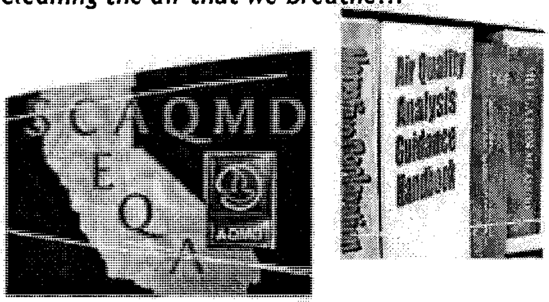
ZERO-EMISSION VEHICLE (ZEV) -
Defined by ARB as a vehicle that does not directly emit any regulated pollutants.

(GLOSS_2)

INDEX
FORTHCOMING

An index to the Handbook is being compiled as part of the ongoing update process.

Individuals who purchased this 1993 Handbook directly from the SCAQMD will automatically be sent the index as part of an update package later in 1993.



Air Quality Analysis Guidance Handbook

UPDATED 12-8-05

CONSTRUCTION

Public Notices
CEQA Documents
Air Quality Analysis Handbook
Permit Forms & Information
Air Quality Modeling
Commenting Agency Responsibility
Frequently Asked CEQA Questions
Links to Other Environ. Sources
CEQA Home

AQMD is in the process of developing an "Air Quality Analysis Guid Handbook" (Handbook) to replace the CEQA Air Quality Handbook approved by AQMD Governing Board in 1993. The 1993 CEQA Air Quality Handbook is available but not online. Therefore, it will be necessary to obtain a hardcopy of 1993 Handbook by contacting AQMD's Subscription Services at (909) 396-3720. addition, there are sections of the 1993 Handbook that are obsolete. A descrip of the obsolete sections can be obtained from CEQA Air Quality Handbook.

The titles of the chapters and appendices to be included in the new Air Qu Analysis Guidance Handbook are listed below. Please note the chapters below not equally correspond to the chapters found in the 1993 Handbook. Tl chapters/appendices that have been revised are highlighted and are accessible this webpage. As others are finalized they also will be accessible via this webpa

Chapters

- Chapter 1 - Introduction to the CEQA Air Quality Handbook
- Chapter 2 - Improving Air Quality and the AQMD's Role
- Chapter 3 - Basic Air Quality Information
- Chapter 4 - Early Consultation and Sensitive Receptor Siting Criteria
- Chapter 5 - Determining Air Quality Significance
  - SCAQMD Air Quality Significance Thresholds
- Chapter 6 - Developing Baseline Air Quality Information
- Chapter 7 - Emission Calculation Procedures
- Chapter 8 - Assessing Toxic Air Contaminants
- Chapter 9 - Mitigating Air Quality Impacts

Appendices

- Appendix A - Significance Threshold Look-Up Tables
- Appendix B - Description of Regional Climate and Its Effect on Air Quality
- Appendix C - Air Quality Analysis Examples
- Appendix D - Assessing Toxic Air Contaminants
- Appendix E - Mitigation Efficiency Calculation Methodology

In order to assist the CEQA practitioner in conducting an air quality analysis w the new Handbook is being prepared, the following supplemental informatio available:

- Localized Significance Thresholds
- Off-road Mobile Source Emission Factors
- EMFAC 2002 (v2.2) Emission Factors (On-Road)
- Mobile Source Toxics Analysis
- Carbon Monoxide (CO)Concentrations
- Guidance Document for Addressing Air Quality Issues in General Plans and Local Planning

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This page updated: September 02, 2005
URL: http://www.aqmd.gov/ceqa/hdbk.html

21865 Copley Dr, Diamond Bar, CA 91765 - (909) 396-2000 - (800) CUT-SMOG (288-7664)

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South Coast
Air Quality Management District
AQMD
21865 E. Copley Drive, Diamond Bar, CA 91765-4182
(909) 396-2000 • http://www.aqmd.gov

UPDATED
3-23-99
gcv

CEQA AIR QUALITY HANDBOOK

NOVEMBER 1993 UPDATE

The attached pages contain changes to the SCAQMD CEQA Air Quality Handbook.

THIS UPDATE PACKAGE IS NOT A COMPLETE HANDBOOK. IT CONTAINS ONLY CHANGED PAGES AND THEIR BACKING PAGES. Unchanged pages in this package (i.e. those missing the "Changed" notation in the lower left-hand corner) have been included because they back changed pages when printed two-sided.

When updating your copy, simply insert each change page in replacement of the same page number from the existing Handbook. (Note: Pages A9-68a and A9-93a are new pages.)

pw/ceqahdbk/novattc

CARLSBAD
FRESNO
IRVINE
LOS ANGELES
PALM SPRINGS
POINT RICHMOND
RIVERSIDE
ROSEVILLE
SAN LUIS OBISPO

MEMORANDUM

DATE: January 31, 2020

TO: Eric Lewis, City Traffic Engineer/Transportation Division Manager, Public Works, City of Moreno Valley

FROM: Ambarish Mukherjee, PE, AICP

SUBJECT: Kaiser Permanente Moreno Valley Medical Center Master Plan Project Traffic Impact Analysis – Evidence of Adjacent Development Limiting Mitigations Memorandum

LSA had prepared a traffic impact analysis (TIA) for the Kaiser Permanente Moreno Valley Medical Center Master Plan Project (project) to be located at 27300 Iris Avenue in the City of Moreno Valley (City). The existing project site includes a 130,000 square-foot (sf) 100-bed hospital, along with two medical office buildings and education trailers totaling approximately 85,000 sf. The project will be replacing and adding onto existing uses in three phases. Phase I consists of the demolition of the Iris Medical Office Building (MOB) 1 and Education Trailers medical office buildings (10,500 sf) and the construction of a 95,000 sf Diagnostics and Treatment (D&T) Expansion (hospital) and 22,000 sf Energy Center. Phase II consists of the construction of a 65,000 sf medical office building, 380,000 sf expansion of the D&T center, patient towers North and East, and 8,000 sf Energy Center. Phase III consists of the demolition of 130,000 sf of the existing hospital and construction of a 95,000 sf medical office building and a 375,000 sf expansion of the D&T center along with patient towers South and West.

Since the addition of project traffic will impact the surrounding roadway network, improvements to the roadway network may be necessary to offset the impacts. As described in the TIA, some study intersections are forecast to continue operating at an unsatisfactory level of service (LOS) with the recommended improvements. The improvements at these intersections do not constitute all of the improvements as per the City's General Plan designation. Based on comments provided on the TIA, further elaboration was requested on why these additional improvements are not feasible. These additional improvements are not feasible because the intersections are fully built out with adjacent developments (e.g. businesses and homes). The following lists intersections that fall under this category:

- Day Street/Alessandro Boulevard;
- Elsworth Street/Alessandro Boulevard;
- Perris Boulevard/Alessandro Boulevard; and

1500 Iowa Avenue, Suite 200, Riverside, California 92507 951.781.9310 www.lsa.net

- Moreno Beach Drive/Eucalyptus Avenue.

The evidence of the adjacent developments at each of these aforementioned intersections is illustrated in Figures 1 to 4 (attached with this memorandum).

Attachments:

Figure 1: Evidence of Adjacent Development – Day Street/Alessandro Boulevard
Figure 2: Evidence of Adjacent Development – Elsworth Street/Alessandro Boulevard
Figure 3: Evidence of Adjacent Development – Perris Boulevard/Alessandro Boulevard
Figure 4: Evidence of Adjacent Development – Moreno Beach Drive/Eucalyptus Avenue

LSA

FIGURE 1

NOT TO SCALE
SOURCE: Google Earth (2018)

Kaiser Permanente Moreno Valley Medical Center Master Plan Project
Traffic Impact Analysis - Evidence of Adjacent Development Limiting Mitigations

Evidence of Adjacent Development - Day Street/Alessandro Boulevard

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LSA

FIGURE 2

N

NOT TO SCALE
SOURCE: Google Earth (2018)
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Kaiser Permanente Moreno Valley Medical Center Master Plan Project
Traffic Impact Analysis - Evidence of Adjacent Development Limiting Mitigations

Evidence of Adjacent Development - Elsworth Street/Alessandro Boulevard

LSA

FIGURE 3

NOT TO SCALE

SOURCE: Google Earth (2018)

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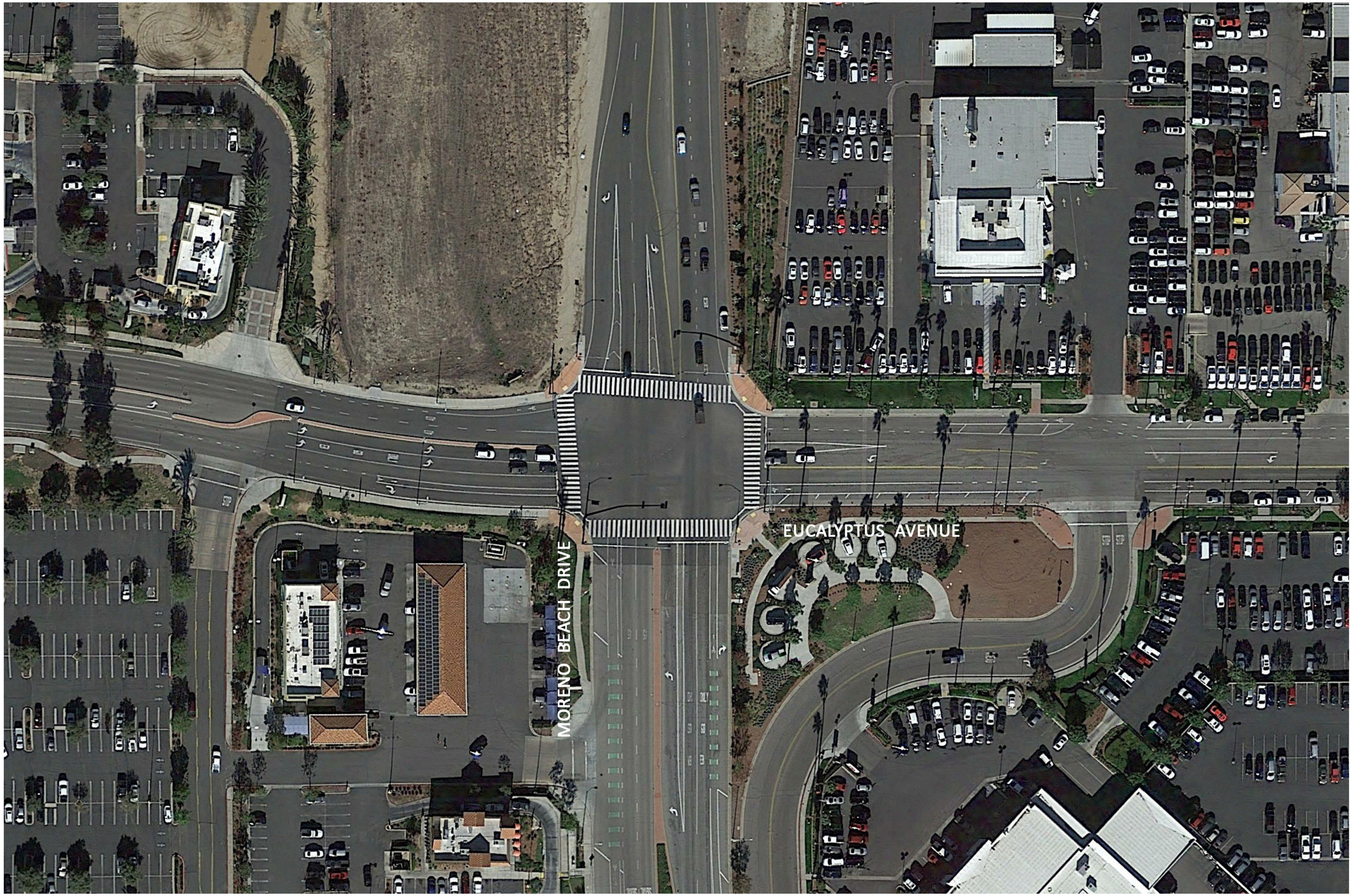
Kaiser Permanente Moreno Valley Medical Center Master Plan Project
Traffic Impact Analysis - Evidence of Adjacent Development Limiting Mitigations

Evidence of Adjacent Development - Perris Boulevard/Alessandro Boulevard



LSA

FIGURE 4

NOT TO SCALE

SOURCE: Google Earth (2018)

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Kaiser Permanente Moreno Valley Medical Center Master Plan Project

Traffic Impact Analysis - Evidence of Adjacent Development Limiting Mitigations

Evidence of Adjacent Development - Moreno Beach Drive/Eucalyptus Avenue

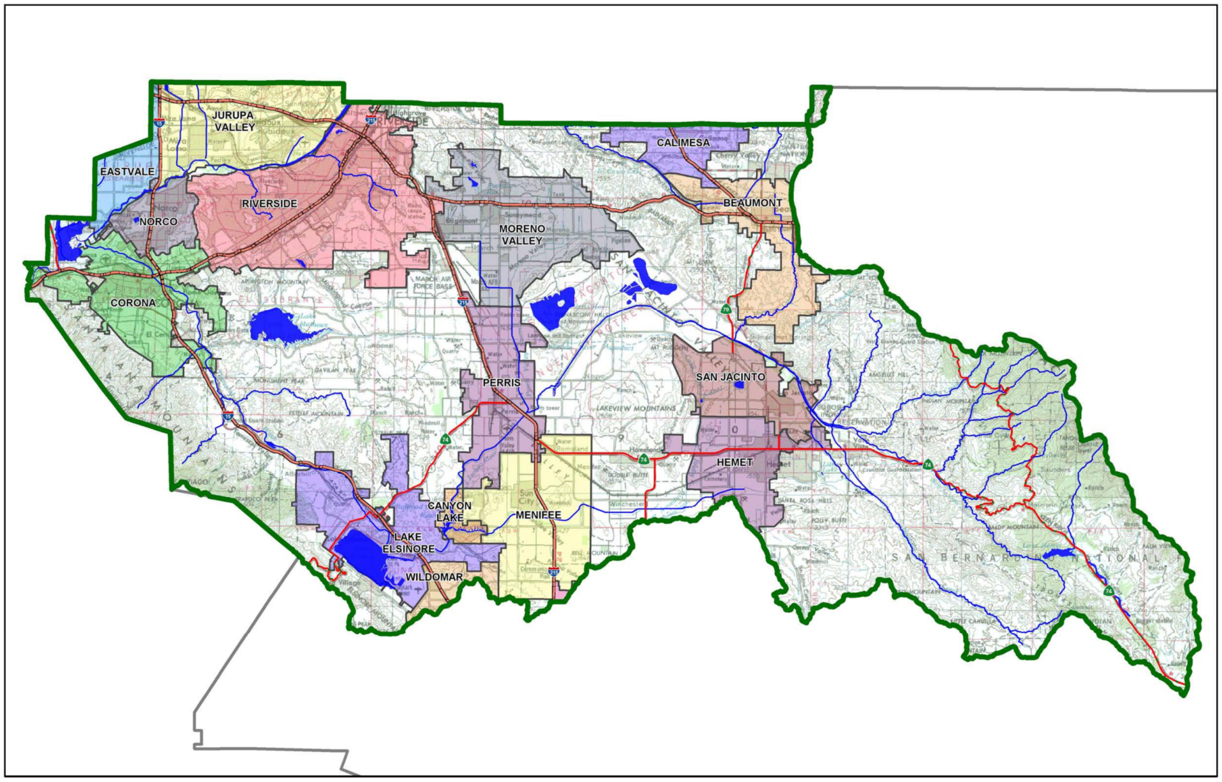
Project Specific Water Quality Management Plan

A Template for Projects located within the ***Santa Ana Watershed*** *Region of Riverside County*

Project Title: Kaiser Permanente Moreno Valley

Development No: PEN18-0228 thru 0230

Design Review/Case No: LWQ 18-0037



Contact Information:

Prepared for:
Kaiser Permanente
27300 Iris Avenue
Moreno Valley, CA 92555

Prepared by:
Scott Davis, Project Manager
9755 Clairemont Mesa Blvd, Suite 100
San Diego, CA 92124
Phone: (858) 614-5000

☒ **Preliminary**
☐ **Final**

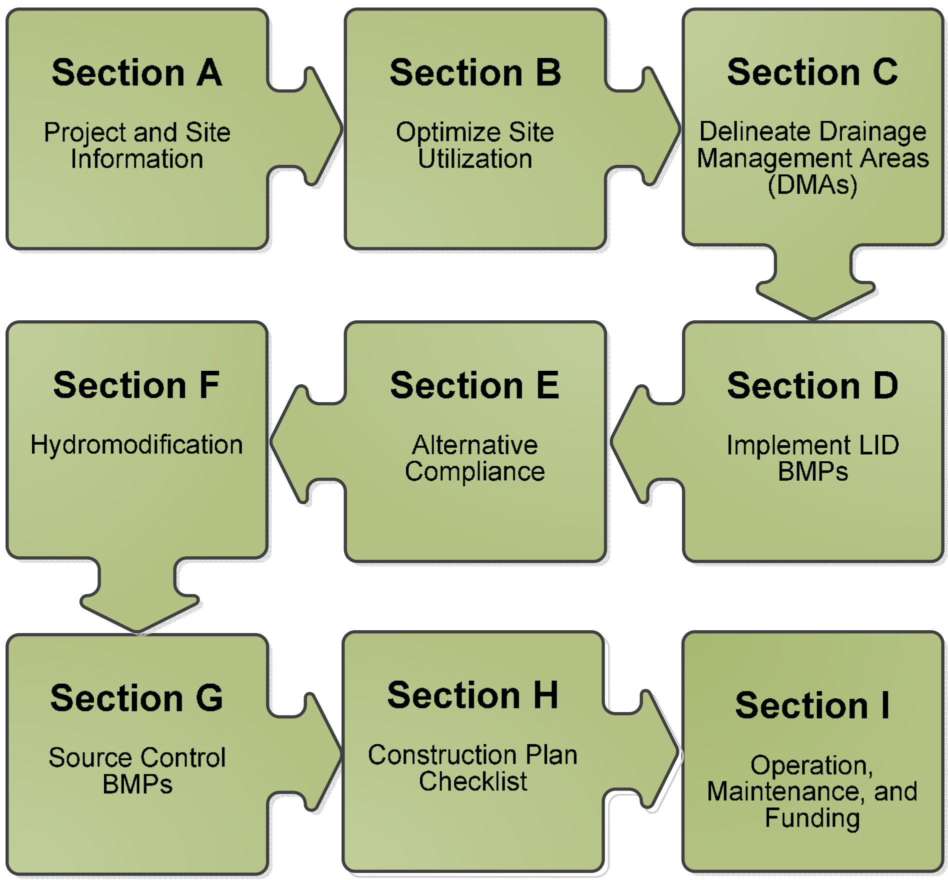
Original Date Prepared: November 2018

Revision Date(s): January 2019, June 2019, August 2019, September 2019

Prepared for Compliance with
Regional Board Order No. **R8-2010-0033**

A Brief Introduction

This Project-Specific WQMP Template for the **Santa Ana Region** has been prepared to help guide you in documenting compliance for your project. Because this document has been designed to specifically document compliance, you will need to utilize the WQMP Guidance Document as your "how-to" manual to help guide you through this process. Both the Template and Guidance Document go hand-in-hand, and will help facilitate a well prepared Project-Specific WQMP. Below is a flowchart for the layout of this Template that will provide the steps required to document compliance.



OWNER'S CERTIFICATION

This Project-Specific Water Quality Management Plan (WQMP) has been prepared for Kaiser Permanente by Michael Baker International Company for the Kaiser Permanente Moreno Valley Medical Center project.

This WQMP is intended to comply with the requirements of The City of Moreno Valley for Order No. R8-2010-0033 which includes the requirement for the preparation and implementation of a Project-Specific WQMP.

The undersigned, while owning the property/project described in the preceding paragraph, shall be responsible for the implementation and funding of this WQMP and will ensure that this WQMP is amended as appropriate to reflect up-to-date conditions on the site. In addition, the property owner accepts responsibility for interim operation and maintenance of Stormwater BMPs until such time as this responsibility is formally transferred to a subsequent owner. This WQMP will be reviewed with the facility operator, facility supervisors, employees, tenants, maintenance and service contractors, or any other party (or parties) having responsibility for implementing portions of this WQMP. At least one copy of this WQMP will be maintained at the project site or project office in perpetuity. The undersigned is authorized to certify and to approve implementation of this WQMP. The undersigned is aware that implementation of this WQMP is enforceable under The City of Moreno Valley Water Quality Ordinance (Municipal Code Section 8.21.170).

"I, the undersigned, certify under penalty of law that the provisions of this WQMP have been reviewed and accepted and that the WQMP will be transferred to future successors in interest."

____________________	____________________
Owner's Signature	Date
____________________	____________________
Owner's Printed Name	Owner's Title/Position

PREPARER'S CERTIFICATION

"The selection, sizing and design of stormwater treatment and other stormwater quality and quantity control measures in this plan meet the requirements of Regional Water Quality Control Board Order No. **R8-2010-0033** and any subsequent amendments thereto."

____________________	____________________
Preparer's Signature	Date
Scott Davis, PE	Project Manager
Preparer's Printed Name	Preparer's Title/Position

Preparer's Licensure: RCE 72281

Table of Contents

List of Tables

List of Appendices

Section A: Project and Site Information

PROJECT INFORMATION	
Type of Project:	Medical Center
Planning Area:	N/A
Community Name:	N/A
Development Name:	N/A
Project Description:	The Kaiser Permanente Moreno Valley Medical Center site is comprised of a 29.8-acre dual parcel (APN 486-310-033 and APN 486-310-034) that is currently developed with a hospital, patient tower, medical offices and onsite parking. The proposed project will be an expansion to the existing medical campus. This study addresses the total ultimate development which will include four (4) patient bed towers, a Diagnostics and Treatment Center (D&T), and an Emergency Department. The project will also include a Central Utility Plant (CUP) and two Parking Structures. LID BMPs will be implemented onsite to mitigate for water quality impacts. The subject study area encompasses a combined area of 29.5-acres. The project site is divided into two areas: west (DMA's A-C) and east (DMA's D-F). DMA's A-D drain to a proposed bioretention basin for treatment. Storage vaults/pipes are not provided for DMA's A-C due to post-development peak flows being lower than pre-development peak flows. DMA D's basin is designed with excess volume to attenuate post-development flows per drainage report. DMA's E-F drain to proposed modular wetland systems for treatment (E & F – two units in parallel) and bypass to proposed underground vaults/pipes for storage in peak storms, due to post-development flows being higher than pre-development flows. The treatment and storage systems are two separate systems to prevent comingling of treated and untreated flows. Both systems exit north of the site. The storage system design is outside the scope of this water quality study. Diversion manholes with an internal weir is provided upstream of the modular wetland systems for bypass for DMA's E-F. Modular wetland systems have been approved by City of Moreno Valley as biofiltration BMPs (biotreatment).

PROJECT LOCATION
Latitude & Longitude (DMS): N33° 53' 48" & W117° 11' 08"
Project Watershed and Sub-Watershed: Santa Ana River Watershed and San Jacinto Sub-Watershed
APN(s): 486-310-033 & 486-310-034
Map Book and Page No.: Book 486 Page 31

PROJECT CHARACTERISTICS	
Proposed or Potential Land Use(s)	Medical Center
Proposed or Potential SIC Code(s)	8011, 8050, 8051, 8071
Area of Impervious Project Footprint (SF)	623,435
Total Area of <u>proposed</u> Impervious Surfaces within the Project Limits (SF)/or Replacement	988,598
Does the project consist of offsite road improvements?	☐ Y ☒ N
Does the project propose to construct unpaved roads?	☐ Y ☒ N

Is the project part of a larger common plan of development (phased project)?	☒ Y ☐ N
EXISTING SITE CHARACTERISTICS	
Total area of existing Impervious Surfaces within the project limits (SF)	623,435
Is the project located within any MSHCP Criteria Cell?	☐ Y ☒ N
If so, identify the Cell number:	N/A
Are there any natural hydrologic features on the project site?	☐ Y ☒ N
Is a Geotechnical Report attached?	☒ Y ☐ N
If no Geotech. Report, list the NRCS soils type(s) present on the site (A, B, C and/or D)	See attached report
What is the Water Quality Design Storm Depth for the project?	0.66 inches

A.1 Maps and Site Plans

When completing your Project-Specific WQMP, include a map of the local vicinity and existing site. In addition, include all grading, drainage, landscape/plant palette and other pertinent construction plans in Appendix 2. At a **minimum**, your WQMP Site Plan should include the following:

- Drainage Management Areas
- Proposed Structural BMPs
- Drainage Path
- Drainage Infrastructure, Inlets, Overflows
- Source Control BMPs
- Buildings, Roof Lines, Downspouts
- Impervious Surfaces
- Standard Labeling

Use your discretion on whether or not you may need to create multiple sheets or can appropriately accommodate these features on one or two sheets. Keep in mind that the Co-Permittee plan reviewer must be able to easily analyze your project utilizing this template and its associated site plans and maps.

A.2 Identify Receiving Waters

Using Table A.1 below, list in order of upstream to downstream, the receiving waters that the project site is tributary to. Continue to fill each row with the Receiving Water's 303(d) listed impairments (if any), designated beneficial uses, and proximity, if any, to a RARE beneficial use. Include a map of the receiving waters in Appendix 1.

Table A.1 Identification of Receiving Waters

Receiving Waters	EPA Approved 303(d) List Impairments	Designated Beneficial Uses	Proximity to RARE Beneficial Use
Perris Valley Storm Drain	N/A	N/A	Not classified
San Jacinto River, Reach 3	N/A	AGR, GWR, REC1, REC2, WARM, WILD	Not classified
Railroad Canyon Reservoir - San Jacinto River, Reach 2	Nutrients (No TMDL date has been recorded by EPA for this waterbody)	N/A	Not classified
San Jacinto River, Reach 1	N/A	MUN, AGR, GWR, REC1, REC2, WARM, WILD	Not classified
Lake Elsinore	Nutrients (No TMDL date has been recorded by EPA for this waterbody), organic enrichment, DDT	COMM, WARM	Not classified
Lee Lake	N/A	MUN, AQUA, WARM, REC1, REC2, WILD, SHELL	Not classified
Temescal Creek, Reach 2	N/A	MUN, AQUA, WARM, REC1, REC2, WILD, SHELL	Not classified

Prado Flood Control Basin	pH	N/A	Not classified
Santa Ana River, Reach 2	N/A	MUN, AQUA, WARM, REC1, REC2, WILD, SHELL	Not classified
Santa Ana River, Reach 1	N/A	MUN, AQUA, WARM, REC1, REC2, WILD, SHELL	Not classified

A.3 Additional Permits/Approvals required for the Project:

Table A.2 Other Applicable Permits

Agency	Permit Required	
State Department of Fish and Game, 1602 Streambed Alteration Agreement	☐ Y	☒ N
State Water Resources Control Board, Clean Water Act (CWA) Section 401 Water Quality Cert.	☐ Y	☒ N
US Army Corps of Engineers, CWA Section 404 Permit	☐ Y	☒ N
US Fish and Wildlife, Endangered Species Act Section 7 Biological Opinion	☐ Y	☒ N
Statewide Construction General Permit Coverage	☒ Y	☐ N
Statewide Industrial General Permit Coverage	☐ Y	☒ N
Western Riverside MSHCP Consistency Approval (e.g., JPR, DBESP)	☐ Y	☒ N
Other *(please list in the space below as required)*	☐ Y	☒ N

If yes is answered to any of the questions above, the Co-Permittee may require proof of approval/coverage from those agencies as applicable including documentation of any associated requirements that may affect this Project-Specific WQMP.

Section B: Optimize Site Utilization (LID Principles)

Review of the information collected in Section 'A' will aid in identifying the principal constraints on site design and selection of LID BMPs as well as opportunities to reduce imperviousness and incorporate LID Principles into the site and landscape design. For example, **constraints** might include impermeable soils, high groundwater, groundwater pollution or contaminated soils, steep slopes, geotechnical instability, high-intensity land use, heavy pedestrian or vehicular traffic, utility locations or safety concerns. **Opportunities** might include existing natural areas, low areas, oddly configured or otherwise unbuildable parcels, easements and landscape amenities including open space and buffers (which can double as locations for bioretention BMPs), and differences in elevation (which can provide hydraulic head). Prepare a brief narrative for each of the site optimization strategies described below. This narrative will help you as you proceed with your LID design and explain your design decisions to others.

The 2010 Santa Ana MS4 Permit further requires that LID Retention BMPs (Infiltration Only or Harvest and Use) be used unless it can be shown that those BMPs are infeasible. Therefore, it is important that your narrative identify and justify if there are any constraints that would prevent the use of those categories of LID BMPs. Similarly, you should also note opportunities that exist which will be utilized during project design. Upon completion of identifying Constraints and Opportunities, include these on your WQMP Site plan in Appendix 1.

Site Optimization

The following questions are based upon Section 3.2 of the WQMP Guidance Document. Review of the WQMP Guidance Document will help you determine how best to optimize your site and subsequently identify opportunities and/or constraints, and document compliance.

Did you identify and preserve existing drainage patterns? If so, how? If not, why?

The proposed master grading preserves existing drainage patterns entirely. Under existing conditions, the site generally drains northwest towards Nason Street to an existing canal which conveys onsite flows southwest to San Jacinto River, Canyon Lake (Railroad Canyon Reservoir) and discharges to Lake Elsinore. The existing project site covers two parcels, each parcel is contained individually with a single stormwater outlet via concrete spillway. The master site plan will maintain the same two outlet locations and improved as deemed based on ultimate site design. There is offsite flow contribution from the eastern undeveloped parcel. These offsite flows were not accounted for in the sizing of onsite permanent BMPs. Offsite flows shall be evaluated during ultimate site design. Iris Avenue is a public paved road with curb, gutter and storm drain infrastructure conveying offsite flows from the south. There's an existing earthen berm along the western property line.

Did you identify and protect existing vegetation? If so, how? If not, why?

Minimal existing vegetation will remain undisturbed under ultimate buildout. New landscape will be provided wherever applicable and to the maximum extend feasible.

Did you identify and preserve natural infiltration capacity? If so, how? If not, why?

Michael Baker International (MBI) obtained available infiltration data from the existing Medical Office Building development at Kaiser Permanente Moreno Valley. Infiltration rates were documented in the geotechnical report titled: Geotechnical Investigation, Kaiser Permanente, Iris MOB 2 – Phase I, 27300 Iris Avenue, Moreno Valley, California, dated May 24, 2011. Two infiltration tests were performed for the MOB project revealing infiltration rates of 0.05 inches/hour in the northern portion of the eastern parcel. Soils *encountered during testing were Sandy Silt (ML). A second infiltration report was conducted to obtain infiltration rates on the southern portion of the eastern parcel and western portion of the western parcel. The report was titled: Moreno Valley Medical Center Infiltration Report, dated June 1, 2019. Infiltration rates varied from 0.48 to 1.07 in/hour. Based on the above infiltration rates, infiltration BMPs should not be used for the northern portion and should be used in the southern portions of the project.*

Did you identify and minimize impervious area? If so, how? If not, why?

Impervious areas have been minimized to the maximum extent practicable. However, due to the nature of the project (Medical Center), substitution of impervious areas for landscaping is not feasible. The runoff of impervious areas drains to proposed BMPs when possible. Each DMA's Design Flow Rate (Q_{BMP})/ Design Capture Volume (V_{BMP}) is handled by its respective BMPs.

Did you identify and disperse runoff to adjacent pervious areas? If so, how? If not, why?

Impervious area runoff drains to landscaped areas to the maximum extent possible. Due to low infiltration rates, drain inlets are provided for the majority of landscaped areas to capture and route runoff to Modular Wetland Systems/Bioretention Basins for treatment and underground storage vaults/pipes for peak storms.

Section C: Delineate Drainage Management Areas (DMAs)

Utilizing the procedure in Section 3.3 of the WQMP Guidance Document which discusses the methods of delineating and mapping your project site into individual DMAs, complete Table C.1 below to appropriately categorize the types of classification (e.g., Type A, Type B, etc.) per DMA for your project site. Upon completion of this table, this information will then be used to populate and tabulate the corresponding tables for their respective DMA classifications.

Table C.1 DMA Classifications

DMA Name or ID	Surface Type(s)[1]	Area (Sq. Ft.)	DMA Type
DMA A	Mix (Concrete, Asphalt, Roof, Landscape)	202,537	Type D
DMA B	Mix (Concrete, Asphalt, Roof, Landscape)	94,376	Type D
DMA C	Mix (Concrete, Asphalt, Roof, Landscape)	139,988	Type D
DMA D	Mix (Concrete, Asphalt, Roof, Landscape)	220,970	Type D
DMA E	Mix (Concrete, Asphalt, Roof, Landscape)	330,177	Type D
DMA F	Mix (Concrete, Asphalt, Roof, Landscape)	302,450	Type D

[1]*Reference Table 2-1 in the WQMP Guidance Document to populate this column*

Table C.2 Type 'A', Self-Treating Areas

DMA Name or ID	Area (Sq. Ft.)	Stabilization Type	Irrigation Type (if any)
N/A			

Table C.3 Type 'B', Self-Retaining Areas

Self-Retaining Area				Type 'C' DMAs that are draining to the Self-Retaining Area		
DMA Name/ ID	Post-project surface type	Area (square feet) [A]	Storm Depth (inches) [B]	DMA Name / ID	[C] from Table C.4 = [C]	Required Retention Depth (inches) [D]
N/A						

$$[D] = [B] + \frac{[B] \cdot [C]}{[A]}$$

Table C.4 Type 'C', Areas that Drain to Self-Retaining Areas

DMA					Receiving Self-Retaining DMA		
DMA Name/ ID	Area (square feet) [A]	Post-project surface type	Runoff factor [B]	Product [C] = [A] x [B]	DMA name /ID	Area (square feet) [D]	Ratio [C]/[D]
N/A							

Table C.5 Type 'D', Areas Draining to BMPs

DMA Name or ID	BMP Name or ID
DMA A	Bioretention Basin A (BRB A)
DMA B	Bioretention Basin B (BRB B)
DMA C	Bioretention Basin C (BRB C)
DMA D	Bioretention Basin C (BRB D)
DMA E	Modular Wetland System E (MWS E): Consists of (2) Modular Wetland System Units: MWS E1 & MWS E2
DMA F	Modular Wetland System F (MWS F): Consists of (2) Modular Wetland System Units: MWS F1 & MWS F2

<u>Note</u>: More than one drainage management area can drain to a single LID BMP, however, one drainage management area may not drain to more than one BMP.

Section D: Implement LID BMPs

D.1 Infiltration Applicability

Is there an approved downstream 'Highest and Best Use' for stormwater runoff (see discussion in Chapter 2.4.4 of the WQMP Guidance Document for further details)? ☐ Y ☒ N

If yes has been checked, Infiltration BMPs shall not be used for the site. If no, continue working through this section to implement your LID BMPs. It is recommended that you contact your Co-Permittee to verify whether or not your project discharges to an approved downstream 'Highest and Best Use' feature.

Geotechnical Report

A Geotechnical Report or Phase I Environmental Site Assessment may be required by the Copermittee to confirm present and past site characteristics that may affect the use of Infiltration BMPs. In addition, the Co-Permittee, at their discretion, may not require a geotechnical report for small projects as described in Chapter 2 of the WQMP Guidance Document. If a geotechnical report has been prepared, include it in Appendix 3. In addition, if a Phase I Environmental Site Assessment has been prepared, include it in Appendix 4.

Is this project classified as a small project consistent with the requirements of Chapter 2 of the WQMP Guidance Document? ☐ Y ☒ N

Infiltration Feasibility

Table D.1 below is meant to provide a simple means of assessing which DMAs on your site support Infiltration BMPs and is discussed in the WQMP Guidance Document in Chapter 2.4.5. Check the appropriate box for each question and then list affected DMAs as applicable. If additional space is needed, add a row below the corresponding answer.

Table D.1 Infiltration Feasibility

Does the project site…	YES	NO
…have any DMAs with a seasonal high groundwater mark shallower than 10 feet?		X
If Yes, list affected DMAs:		
…have any DMAs located within 100 feet of a water supply well?		X
If Yes, list affected DMAs:		
…have any areas identified by the geotechnical report as posing a public safety risk where infiltration of stormwater could have a negative impact?		X
If Yes, list affected DMAs:		
…have measured in-situ infiltration rates of less than 1.6 inches / hour?	X	
If Yes, list affected DMAs: Potentially all DMAs. The assumed infiltration rate is less than 1.6 inches/hour.		
…have significant cut and/or fill conditions that would preclude in-situ testing of infiltration rates at the final infiltration surface?		X
If Yes, list affected DMAs:		
…geotechnical report identify other site-specific factors that would preclude effective and safe infiltration?		X
Describe here:		

If you answered "Yes" to any of the questions above for any DMA, Infiltration BMPs should not be used for those DMAs and you should proceed to the assessment for Harvest and Use below.

D.2 Harvest and Use Assessment

Please check what applies*:*

☐ Reclaimed water will be used for the non-potable water demands for the project.

☐Downstream water rights may be impacted by Harvest and Use as approved by the Regional Board (verify with the Copermittee).

☐The Design Capture Volume will be addressed using Infiltration Only BMPs. In such a case, Harvest and Use BMPs are still encouraged, but it would not be required if the Design Capture Volume will be infiltrated or evapotranspired.

If any of the above boxes have been checked, Harvest and Use BMPs need not be assessed for the site. If neither of the above criteria applies, follow the steps below to assess the feasibility of irrigation use, toilet use and other non-potable uses (e.g., industrial use).

Irrigation Use Feasibility

Complete the following steps to determine the feasibility of harvesting stormwater runoff for Irrigation Use BMPs on your site:

Step 1: Identify the total area of irrigated landscape on the site, and the type of landscaping used.

Total Area of Irrigated Landscape: 6.8 acres

Type of Landscaping (Conservation Design or Active Turf): Conservative Design

Step 2: Identify the planned total of all impervious areas on the proposed project from which runoff might be feasibly captured and stored for irrigation use. Depending on the configuration of buildings and other impervious areas on the site, you may consider the site as a whole, or parts of the site, to evaluate reasonable scenarios for capturing and storing runoff and directing the stored runoff to the potential use(s) identified in Step 1 above.

Total Area of Impervious Surfaces: 22.6 acres

Step 3: Cross reference the Design Storm depth for the project site (see Exhibit A of the WQMP Guidance Document) with the left column of Table 2-3 in Chapter 2 to determine the minimum area of Effective Irrigated Area per Tributary Impervious Area (EIATIA).

Enter your EIATIA factor: 1.05

Step 4: Multiply the unit value obtained from Step 3 by the total of impervious areas from Step 2 to develop the minimum irrigated area that would be required.

Minimum required irrigated area: 23.7 acres

Step 5: Determine if harvesting stormwater runoff for irrigation use is feasible for the project by comparing the total area of irrigated landscape (Step 1) to the minimum required irrigated area (Step 4).

Minimum required irrigated area (Step 4)	**Available Irrigated Landscape (Step 1)**
23.7 acres	6.8 acres

Toilet Use Feasibility

Complete the following steps to determine the feasibility of harvesting stormwater runoff for toilet flushing uses on your site:

Step 1: Identify the projected total number of daily toilet users during the wet season, and account for any periodic shut downs or other lapses in occupancy:

Projected Number of Daily Toilet Users: TBD

Project Type: Commercial

Step 2: Identify the planned total of all impervious areas on the proposed project from which runoff might be feasibly captured and stored for toilet use. Depending on the configuration of buildings and other impervious areas on the site, you may consider the site as a whole, or parts of the site, to evaluate reasonable scenarios for capturing and storing runoff and directing the stored runoff to the potential use(s) identified in Step 1 above.

Total Area of Impervious Surfaces: 22.6 acres

Step 3: Enter the Design Storm depth for the project site (see Exhibit A) into the left column of Table 2-2 in Chapter 2 to determine the minimum number or toilet users per tributary impervious acre (TUTIA).

Enter your TUTIA factor: 141 tu/ac

Step 4: Multiply the unit value obtained from Step 3 by the total of impervious areas from Step 2 to develop the minimum number of toilet users that would be required.

Minimum number of toilet users: 3,187

Step 5: Determine if harvesting stormwater runoff for toilet flushing use is feasible for the project by comparing the Number of Daily Toilet Users (Step 1) to the minimum required number of toilet users (Step 4).

Minimum required Toilet Users (Step 4)	**Projected number of toilet users (Step 1)**
3,187	TBD

Other Non-Potable Use Feasibility

Are there other non-potable uses for stormwater runoff on the site (e.g. industrial use)? See Chapter 2 of the Guidance for further information. If yes, describe below. If no, write N/A.

N/A

Step 1: Identify the projected average daily non-potable demand, in gallons per day, during the wet season and accounting for any periodic shut downs or other lapses in occupancy or operation.

Average Daily Demand: N/A

Step 2: Identify the planned total of all impervious areas on the proposed project from which runoff might be feasibly captured and stored for the identified non-potable use. Depending on the configuration of buildings and other impervious areas on the site, you may consider the site as a whole, or parts of the site, to evaluate reasonable scenarios for capturing and storing runoff and directing the stored runoff to the potential use(s) identified in Step 1 above.

Total Area of Impervious Surfaces: 22.6 acres

Step 3: Enter the Design Storm depth for the project site (see Exhibit A) into the left column of Table 2-4 in Chapter 2 to determine the minimum demand for non-potable uses per tributary impervious acre.

Enter the factor from Table 2-3: 1,018 gpd/acre

Step 4: Multiply the unit value obtained from Step 4 by the total of impervious areas from Step 3 to develop the minimum number of gallons per day of non-potable use that would be required.

Minimum required use: 23,007 gpd

Step 5: Determine if harvesting stormwater runoff for other non-potable use is feasible for the project by comparing the Number of Daily Toilet Users (Step 1) to the minimum required number of toilet users (Step 4).

Minimum required non-potable use (Step 4)	**Projected average daily use (Step 1)**
23,007 gpd	N/A

If Irrigation, Toilet and Other Use feasibility anticipated demands are less than the applicable minimum values, Harvest and Use BMPs are not required and you should proceed to utilize LID Bioretention and Biotreatment, unless a site-specific analysis has been completed that demonstrates technical infeasibility as noted in D.3 below.

D.3 Bioretention and Biotreatment Assessment

Other LID Bioretention and Biotreatment BMPs as described in Chapter 2.4.7 of the WQMP Guidance Document are feasible on nearly all development sites with sufficient advance planning.

Select one of the following:

☒ LID Bioretention/Biotreatment BMPs will be used for some or all DMAs of the project as noted below in Section D.4 (note the requirements of Section 3.4.2 in the WQMP Guidance Document).

☐ A site-specific analysis demonstrating the technical infeasibility of all LID BMPs has been performed and is included in Appendix 5. If you plan to submit an analysis demonstrating the technical infeasibility of LID BMPs, request a pre-submittal meeting with the Copermittee to discuss this option. Proceed to Section E to document your alternative compliance measures.

D.4 Feasibility Assessment Summaries

From the Infiltration, Harvest and Use, Bioretention and Biotreatment Sections above, complete Table D.2 below to summarize which LID BMPs are technically feasible, and which are not, based upon the established hierarchy.

Table D.2 LID Prioritization Summary Matrix

DMA Name/ID	LID BMP Hierarchy				No LID (Alternative Compliance)
	1. Infiltration	2. Harvest and use	3. Bioretention	4. Biotreatment	
A	☐	☐	☒	☐	☐
B	☐	☐	☒	☐	☐
C	☐	☐	☒	☐	☐
D	☐	☐	☒	☐	☐
E	☐	☐	☐	☒	☐
F	☐	☐	☐	☒	☐

For those DMAs where LID BMPs are not feasible, provide a brief narrative below summarizing why they are not feasible, include your technical infeasibility criteria in Appendix 5, and proceed to Section E below to document Alternative Compliance measures for those DMAs. Recall that each proposed DMA must pass through the LID BMP hierarchy before alternative compliance measures may be considered.

Infiltration – Infiltration testing revealed rates of 0.05 inches/hour in the northern portion of the eastern parcel. Per WQMP guidelines, infiltration BMPs should not be used for the project if rates are less than 0.3 inches/hour.

Harvest and Use – The minimum required irrigated area is approximately 3.5 times larger compared to the available irrigated landscape under the ultimate phase.

Bioretention – Infiltration testing revealed rates of 0.05 inches/hour in DMA's D-E. Per WQMP guidelines, infiltration BMPs are not suggested for the project if rates are less than 0.3 inches/hour. Biotreatment was selected over bioretention to minimize conflicts with underground utilities in landscaped areas. DMA's A-C will use bioretention BMP's due to infiltration rates ranging from 0.48-1.07 inches/hour.

D.5 LID BMP Sizing

Each LID BMP must be designed to ensure that the Design Capture Volume will be addressed by the selected BMPs. First**,** calculate the Design Capture Volume for each LID BMP using the V_{BMP} worksheet in Appendix F of the LID BMP Design Handbook. Second**,** design the LID BMP to meet the required V_{BMP} using a method approved by the Copermittee. Utilize the worksheets found in the LID BMP Design Handbook or consult with your Copermittee to assist you in correctly sizing your LID BMPs. Complete Table D.3 below to document the Design Capture Volume and the Proposed Volume for each LID BMP. Provide the completed design procedure sheets for each LID BMP in Appendix 6. You may add additional rows to the table below as needed.

Table D.3 DCV Calculations for LID BMPs

DMA Type / ID	DMA Area (square feet) [A]	Post-Project Surface Type	Effective Impervious Fraction, I_f [B]	DMA Runoff Factor [C]	DMA Areas x Runoff Factor [A] x [C]	*Bioretention Basin A (BRB A)*		
A Imp	*174,794*	*Concrete/ Asphalt*	*1.0*	*0.89*	*155,917*			
A Perv	*27,743*	*Mixed Surface Types*	*0.15*	*0.141*	*3,924*			
						Design Storm Depth (in)	*Design Capture Volume,* **V_{BMP}** *(cubic feet)*	*Proposed Volume on Plans (cubic feet)*
A_T =	202,537			Σ=	159,841	0.66	**V_{BMP}** =8791	***V=9,306***

[B], [C] is obtained as described in Section 2.3.1 of the WQMP Guidance Document

[E] is obtained from Exhibit A in the WQMP Guidance Document

[G] is obtained from a design procedure sheet, such as in LID BMP Design Handbook and placed in Appendix 6

Table D.4 DCV Calculations for LID BMPs

DMA Type/ ID	DMA Area (square feet) [A]	Post-Project Surface Type	Effective Impervious Fraction, I_f [B]	DMA Runoff Factor [C]	DMA Areas x Runoff Factor [A] x [C]	*Bioretention Basin B (BRB B)*		
B Imp	*79,438*	*Concrete/ Asphalt*	*1.0*	*0.89*	*70,859*			
B Perv	*14,938*	*Mixed Surface Types*	*0.15*	*0.141*	*2,113*			
						Design Storm Depth (in)	*Design Capture Volume,* **V_{BMP}** *(cubic feet)*	*Proposed Volume on Plans (cubic feet)*
A_T =	94,377			*Σ=*	72,972	0.66	V_{BMP} =4,014	***V=5,865***

[B], [C] is obtained as described in Section 2.3.1 of the WQMP Guidance Document
[E] is obtained from Exhibit A in the WQMP Guidance Document
[G] is obtained from a design procedure sheet, such as in LID BMP Design Handbook and placed in Appendix 6

Table D.5 DCV Calculations for LID BMPs

DMA Type/ ID	DMA Area (square feet) [A]	Post-Project Surface Type	Effective Impervious Fraction, I_f [B]	DMA Runoff Factor [C]	DMA Areas x Runoff Factor [A] x [C]	*Bioretention Basin C (BRB C)*		
C Imp	*71,833*	*Concrete/ Asphalt*	*1.0*	*0.89*	*64,075*			
C Perv	*62,156*	*Mixed Surface Types*	*0.15*	*0.141*	*8,792*			
						Design Storm Depth (in)	*Design Capture Volume,* V_{BMP} *(cubic feet)*	*Proposed Volume on Plans (cubic feet)*
A_T =	133,989			*Σ=*	72,866	0.66	V_{BMP} =4,008	***V=4,046***

[B], [C] is obtained as described in Section 2.3.1 of the WQMP Guidance Document
[E] is obtained from Exhibit A in the WQMP Guidance Document
[G] is obtained from a design procedure sheet, such as in LID BMP Design Handbook and placed in Appendix 6

Table D.6 DCV Calculations for LID BMPs

DMA Type/ ID	DMA Area (square feet) [A]	Post-Project Surface Type	Effective Impervious Fraction, I_f [B]	DMA Runoff Factor [C]	DMA Areas x Runoff Factor [A] x [C]	*Bioretention Basin D (BRB D)*		
D Imp	*152,027*	*Concrete/ Asphalt*	*1.0*	*0.89*	*135,608*			
D Perv	*68,942*	*Mixed Surface Types*	*0.15*	*0.141*	*9,752*			
						Design Storm Depth (in)	*Design Capture Volume,* V_{BMP} *(cubic feet)*	*Proposed Volume on Plans (cubic feet)*
A_T =	220,969			*Σ=*	145,360	0.66	V_{BMP} =7995	***V=8,580***

[B], [C] is obtained as described in Section 2.3.1 of the WQMP Guidance Document
[E] is obtained from Exhibit A in the WQMP Guidance Document
[G] is obtained from a design procedure sheet, such as in LID BMP Design Handbook and placed in Appendix 6

Section E: Alternative Compliance (LID Waiver Program)

LID BMPs are expected to be feasible on virtually all projects. Where LID BMPs have been demonstrated to be infeasible as documented in Section D, other Treatment Control BMPs must be used (subject to LID waiver approval by the Copermittee). Check one of the following Boxes:

☒ LID Principles and LID BMPs have been incorporated into the site design to fully address all Drainage Management Areas. No alternative compliance measures are required for this project and thus this Section is not required to be completed.

- *Or* -

☐ The following Drainage Management Areas are unable to be addressed using LID BMPs. A site-specific analysis demonstrating technical infeasibility of LID BMPs has been approved by the Co-Permittee and included in Appendix 5. Additionally, no downstream regional and/or sub-regional LID BMPs exist or are available for use by the project. The following alternative compliance measures on the following pages are being implemented to ensure that any pollutant loads expected to be discharged by not incorporating LID BMPs, are fully mitigated.

E.1 Identify Pollutants of Concern

Utilizing Table A.1 from Section A above which noted your project's receiving waters and their associated EPA approved 303(d) listed impairments, cross reference this information with that of your selected Priority Development Project Category in Table E.1 below. If the identified General Pollutant Categories are the same as those listed for your receiving waters, then these will be your Pollutants of Concern and the appropriate box or boxes will be checked on the last row. The purpose of this is to document compliance and to help you appropriately plan for mitigating your Pollutants of Concern in lieu of implementing LID BMPs.

Table E.1 Potential Pollutants by Land Use Type

Priority Development Project Categories and/or Project Features (check those that apply)	**General Pollutant Categories**							
	Bacterial Indicators	**Metals**	**Nutrients**	**Pesticides**	**Toxic Organic Compounds**	**Sediments**	**Trash & Debris**	**Oil & Grease**
☐ Detached Residential Development	P	N	P	P	N	P	P	P
☐ Attached Residential Development	P	N	P	P	N	P	P	P(2)
☒ Commercial/Industrial Development	P(3)	P	P(1)	P(1)	P(5)	P(1)	P	P
☐ Automotive Repair Shops	N	P	N	N	P(4, 5)	N	P	P
☐ Restaurants (>5,000 ft^2)	P	N	N	N	N	N	P	P
☐ Hillside Development (>5,000 ft^2)	P	N	P	P	N	P	P	P
☒ Parking Lots (>5,000 ft^2)	P(6)	P	P(1)	P(1)	P(4)	P(1)	P	P
☐ Retail Gasoline Outlets	N	P	N	N	P	N	P	P
Project Priority Pollutant(s) of Concern	☐	☐	☒	☒	☒	☐	☐	☐

P = Potential
N = Not Potential
(1) *A potential Pollutant if non-native landscaping exists or is proposed onsite; otherwise not expected*
(2) *A potential Pollutant if the project includes uncovered parking areas; otherwise not expected*
(3) *A potential Pollutant is land use involving animal waste*
(4) *Specifically petroleum hydrocarbons*
(5) *Specifically solvents*
(6) *Bacterial indicators are routinely detected in pavement runoff*

E.2 Stormwater Credits

Projects that cannot implement LID BMPs but nevertheless implement smart growth principles are potentially eligible for Stormwater Credits. Utilize Table 3-8 within the WQMP Guidance Document to identify your Project Category and its associated Water Quality Credit. If not applicable, write N/A.

Table E.2 Water Quality Credits

Qualifying Project Categories	Credit Percentage[2]
N/A	
Total Credit Percentage[1]	

[1]Cannot Exceed 50%
[2]Obtain corresponding data from Table 3-8 in the WQMP Guidance Document

E.3 Sizing Criteria

After you appropriately considered Stormwater Credits for your project, utilize Table E.3 below to appropriately size them to the DCV, or Design Flow Rate, as applicable. Please reference Chapter 3.5.2 of the WQMP Guidance Document for further information.

Table E.3 Treatment Control BMP Sizing

DMA Type/ID	**DMA Area (square feet)** [A]	**Post-Project Surface Type**	**Effective Impervious Fraction, I_f** [B]	**DMA Runoff Factor** [C]	**DMA Area x Runoff Factor** [A] x [C]		***Modular Wetland System E (MWS E)*** ***(consists of (2) Modular Wetland System Units: MWS E1 & MWS E2)***		
E Imp	251,412	*Concrete/Asphalt*	1.0	0.89	224,260				
E Perv	78,765	*Mix Surface Types*	0.15	0.14	11,141				
						Design Storm Depth (in)	*Minimum Design Capture Volume or Design Flow Rate (cubic feet or cfs)*	*Total Storm Water Credit % Reduction*	*Proposed Volume or Flow on Plans (cubic feet or cfs)*
A_T =	330,177			Σ=	235,401	0.66	**Q_{BMP}** =1.1		***Q=****1.15*

[B], [C] is obtained as described in Section 2.3.1 from the WQMP Guidance Document
[E] is obtained from Exhibit A in the WQMP Guidance Document
[G] is for Flow-Based Treatment Control BMPs [G] = 43,560, for Volume-Based Control Treatment BMPs, [G] = 12
[H] is from the Total Credit Percentage as Calculated from Table E.2 above
[I] as obtained from a design procedure sheet from the BMP manufacturer and should be included in Appendix 6

Table E.4 Treatment Control BMP Sizing

DMA Type/ID	**DMA Area (square feet)** [A]	**Post-Project Surface Type**	**Effective Impervious Fraction, I_f** [B]	**DMA Runoff Factor** [C]	**DMA Area x Runoff Factor** [A] x [C]		***Modular Wetland System F (MWS F)*** ***(consists of (2) Modular Wetland System Units: MWS F1 & MWS F2)***		
F Imp	259,094	*Concrete /Asphalt*	1.0	0.89	231,112				
F Perv	43,356	*Mix Surface Types*	0.15	0.14	6,133				
						Design Storm Depth (in)	*Minimum Design Capture Volume or Design Flow Rate (cubic feet or cfs)*	*Total Storm Water Credit % Reduction*	*Proposed Volume or Flow on Plans (cubic feet or cfs)*
A_T =	302,450			Σ=	237,244	0.66	$\mathbf{Q_{BMP}}$ =1.1		***Q=**1.15*

[B], [C] is obtained as described in Section 2.3.1 from the WQMP Guidance Document
[E] is obtained from Exhibit A in the WQMP Guidance Document
[G] is for Flow-Based Treatment Control BMPs [G] = 43,560, for Volume-Based Control Treatment BMPs, [G] = 12
[H] is from the Total Credit Percentage as Calculated from Table E.2 above
[I] as obtained from a design procedure sheet from the BMP manufacturer and should be included in Appendix 6

E.4 Treatment Control BMP Selection

Treatment Control BMPs typically provide proprietary treatment mechanisms to treat potential pollutants in runoff, but do not sustain significant biological processes. Treatment Control BMPs must have a removal efficiency of a medium or high effectiveness as quantified below:

- **High**: equal to or greater than 80% removal efficiency
- **Medium**: between 40% and 80% removal efficiency

Such removal efficiency documentation (e.g., studies, reports, etc.) as further discussed in Chapter 3.5.2 of the WQMP Guidance Document, must be included in Appendix 6. In addition, ensure that proposed Treatment Control BMPs are properly identified on the WQMP Site Plan in Appendix 1.

Table E.5 Treatment Control BMP Selection

Selected Treatment Control BMP Name or ID[1]	Priority Pollutant(s) of Concern to Mitigate[2]	Removal Efficiency Percentage[3]
Bioretention Basin A	Nutrients, Pesticides, Toxic Organic Compounds	High (per Appendix E in LID BMP Design Handbook)
Bioretention Basin B	Nutrients, Pesticides, Toxic Organic Compounds	High (per Appendix E in LID BMP Design Handbook)
Bioretention Basin C	Nutrients, Pesticides, Toxic Organic Compounds	High (per Appendix E in LID BMP Design Handbook)
Bioretention Basin D	Nutrients, Pesticides, Toxic Organic Compounds	High (per Appendix E in LID BMP Design Handbook)
Modular Wetland System E	Nutrients, Pesticides, Toxic Organic Compounds	Medium (per appendix E in this report)
Modular Wetland System F	Nutrients, Pesticides, Toxic Organic Compounds	Medium (per appendix E in this report)

[1] Treatment Control BMPs must not be constructed within Receiving Waters. In addition, a proposed Treatment Control BMP may be listed more than once if they possess more than one qualifying pollutant removal efficiency.
[2] Cross Reference Table E.1 above to populate this column.
[3] As documented in a Co-Permittee Approved Study and provided in Appendix 6.

Section F: Hydromodification

F.1 Hydrologic Conditions of Concern (HCOC) Analysis

Once you have determined that the LID design is adequate to address water quality requirements, you will need to assess if the proposed LID Design may still create a HCOC. Review Chapters 2 and 3 (including Figure 3-7) of the WQMP Guidance Document to determine if your project must mitigate for Hydromodification impacts. If your project meets one of the following criteria which will be indicated by the check boxes below, you do not need to address Hydromodification at this time. However, if the project does not qualify for Exemptions 1, 2 or 3, then additional measures must be added to the design to comply with HCOC criteria. This is discussed in further detail below in Section F.2.

HCOC EXEMPTION 1: The Priority Development Project disturbs less than one acre. The Copermittee has the discretion to require a Project-Specific WQMP to address HCOCs on projects less than one acre on a case by case basis. The disturbed area calculation should include all disturbances associated with larger common plans of development.

Does the project qualify for this HCOC Exemption? ☐ Y ☒ N

If Yes, HCOC criteria do not apply.

HCOC EXEMPTION 2: The volume and time of concentration[1] of storm water runoff for the post-development condition is not significantly different from the pre-development condition for a 2-year return frequency storm (a difference of 5% or less is considered insignificant) using one of the following methods to calculate:

- Riverside County Hydrology Manual
- Technical Release 55 (TR-55): Urban Hydrology for Small Watersheds (NRCS 1986), or derivatives thereof, such as the Santa Barbara Urban Hydrograph Method
- Other methods acceptable to the Co-Permittee

Does the project qualify for this HCOC Exemption? ☐ Y ☒ N

If Yes, report results in Table F.1 below and provide your substantiated hydrologic analysis in Appendix 7.

Table F.1 Hydrologic Conditions of Concern Summary

	2 year – 24 hour		
	Pre-condition	**Post-condition**	**% Difference**
Time of Concentration	N/A	N/A	N/A
Volume (Cubic Feet)	N/A	N/A	N/A

[1] Time of concentration is defined as the time after the beginning of the rainfall when all portions of the drainage basin are contributing to flow at the outlet.

HCOC EXEMPTION 3: All downstream conveyance channels to an adequate sump (for example, Prado Dam, Lake Elsinore, Canyon Lake, Santa Ana River, or other lake, reservoir or naturally erosion resistant feature) that will receive runoff from the project are engineered and regularly maintained to ensure design flow capacity; no sensitive stream habitat areas will be adversely affected; or are not identified on the Co-Permittees Hydromodification Sensitivity Maps.

Does the project qualify for this HCOC Exemption? ☒ Y ☐ N

If Yes, HCOC criteria do not apply and note below which adequate sump applies to this HCOC qualifier:

The project location is in a HCOC exempt area. The site generally drains northwest towards Nason Street to an existing canal which conveys onsite flows southwest to San Jacinto River, Canyon Lake (Railroad Canyon Reservoir) and Lake Elsinore. Canyon Lake and Lake Elsinore are engineered and regularly maintained. No sensitive stream habitat areas will be adversely affected. Refer to Appendix 7 for HCOC Applicability Map.

F.2 HCOC Mitigation

If none of the above HCOC Exemption Criteria are applicable, HCOC criteria is considered mitigated if they meet one of the following conditions:

a. Additional LID BMPS are implemented onsite or offsite to mitigate potential erosion or habitat impacts as a result of HCOCs. This can be conducted by an evaluation of site-specific conditions utilizing accepted professional methodologies published by entities such as the California Stormwater Quality Association (CASQA), the Southern California Coastal Water Research Project (SCCRWP), or other Co-Permittee approved methodologies for site-specific HCOC analysis.

b. The project is developed consistent with an approved Watershed Action Plan that addresses HCOC in Receiving Waters.

c. Mimicking the pre-development hydrograph with the post-development hydrograph, for a 2-year return frequency storm. Generally, the hydrologic conditions of concern are not significant, if the post-development hydrograph is no more than 10% greater than pre-development hydrograph. In cases where excess volume cannot be infiltrated or captured and reused, discharge from the site must be limited to a flow rate no greater than 110% of the pre-development 2-year peak flow.

Be sure to include all pertinent documentation used in your analysis of the items a, b or c in Appendix 7.

Section G: Source Control BMPs

Source control BMPs include permanent, structural features that may be required in your project plans — such as roofs over and berms around trash and recycling areas — and Operational BMPs, such as regular sweeping and "housekeeping", that must be implemented by the site's occupant or user. The MEP standard typically requires both types of BMPs. In general, Operational BMPs cannot be substituted for a feasible and effective permanent BMP. Using the Pollutant Sources/Source Control Checklist in Appendix 8, review the following procedure to specify Source Control BMPs for your site:

1. ***Identify Pollutant Sources***: Review Column 1 in the Pollutant Sources/Source Control Checklist. Check off the potential sources of Pollutants that apply to your site.

2. ***Note Locations on Project-Specific WQMP Exhibit***: Note the corresponding requirements listed in Column 2 of the Pollutant Sources/Source Control Checklist. Show the location of each Pollutant source and each permanent Source Control BMP in your Project-Specific WQMP Exhibit located in Appendix 1.

3. ***Prepare a Table and Narrative***: Check off the corresponding requirements listed in Column 3 in the Pollutant Sources/Source Control Checklist. In the left column of Table G.1 below, list each potential source of runoff Pollutants on your site (from those that you checked in the Pollutant Sources/Source Control Checklist). In the middle column, list the corresponding permanent, Structural Source Control BMPs (from Columns 2 and 3 of the Pollutant Sources/Source Control Checklist) used to prevent Pollutants from entering runoff. **Add additional narrative** in this column that explains any special features, materials or methods of construction that will be used to implement these permanent, Structural Source Control BMPs.

4. ***Identify Operational Source Control BMPs:*** To complete your table, refer once again to the Pollutant Sources/Source Control Checklist. List in the right column of your table the Operational BMPs that should be implemented as long as the anticipated activities continue at the site. Copermittee stormwater ordinances require that applicable Source Control BMPs be implemented; the same BMPs may also be required as a condition of a use permit or other revocable Discretionary Approval for use of the site.

Table G.1 Permanent and Operational Source Control Measures

Potential Sources of Runoff pollutants	Permanent Structural Source Control BMPs	Operational Source Control BMPs
On-site storm drain inlets	Mark all inlets with the words "Only Rain Down the Storm Drain".	Maintain and repaint/replace inlet markings; provide stormwater pollution prevention information to site owners; see applicable operational BMPs in Fact Sheet SC-44 "Drainage System Maintenance" in CASQA Stormwater Quality Handbooks
Landscape/outdoor pesticide use	Design landscaping to minimize irrigation and runoff, to minimize use of fertilizers and pesticides; use pest-resistant plants	Maintain landscaping using minimum pesticides; see applicable operational BMPs in

	(especially adjacent to hardscape); select plants appropriate to site soils, slopes, climates, etc.	"What you should know for… Landscape and Gardening"
Fire sprinkler test water	Provide a means to drain fire sprinkler test water to sanitary sewer	See note in Fact Sheet SC-41 "Building and Grounds Maintenance" in CASQA Stormwater Quality Handbooks
Roofing, gutters, and trim	Avoid roofing, gutters, and trim made of copper or other unprotected metals that may leach into runoff	N/A
Plaza, sidewalks, and parking lots	N/A	Sweep plazas, sidewalks, and parking lots regularly to prevent accumulation of litter and debris
Condensate drain lines	Condensate drain lines may discharge to landscaped areas if the flow is small enough that runoff will not occur; condensate drain lines may not discharge to the storm drain system	N/A

Section H: Construction Plan Checklist

Populate Table H.1 below to assist the plan checker in an expeditious review of your project. The first two columns will contain information that was prepared in previous steps, while the last column will be populated with the corresponding plan sheets. This table is to be completed with the submittal of your final Project-Specific WQMP.

Table H.1 Construction Plan Cross-reference

BMP No. or ID	BMP Identifier and Description	Corresponding Plan Sheet(s)
BRB A	Bioretention basin A located northwest of western parking structure	WQMP Site Plan / Preliminary Drawings
BRB B	Bioretention Basin B located east of western parking structure	WQMP Site Plan / Preliminary Drawings
BRB C	Bioretention Basin C located southeast of western parking structure	WQMP Site Plan / Preliminary Drawings
BRB D	Bioretention Basin D located west of southeastern parking structure	WQMP Site Plan / Preliminary Drawings
MWS E	Modular Wetland System E located south of northwest parking structure (consists of (2) Modular Wetland System units in parallel under drive aisle)	WQMP Site Plan / Preliminary Drawings
MWS F	Modular Wetland System F located north of northwest parking structure (consists of (2) Modular Wetland System units in parallel in landscape area)	WQMP Site Plan / Preliminary Drawings

Note that the updated table — or Construction Plan WQMP Checklist — is **only a reference tool** to facilitate an easy comparison of the construction plans to your Project-Specific WQMP. Co-Permittee staff can advise you regarding the process required to propose changes to the approved Project-Specific WQMP.

Section I: Operation, Maintenance and Funding

The Copermittee will periodically verify that Stormwater BMPs on your site are maintained and continue to operate as designed. To make this possible, your Copermittee will require that you include in Appendix 9 of this Project-Specific WQMP:

1. A means to finance and implement facility maintenance in perpetuity, including replacement cost.
2. Acceptance of responsibility for maintenance from the time the BMPs are constructed until responsibility for operation and maintenance is legally transferred. A warranty covering a period following construction may also be required.
3. An outline of general maintenance requirements for the Stormwater BMPs you have selected.
4. Figures delineating and designating pervious and impervious areas, location, and type of Stormwater BMP, and tables of pervious and impervious areas served by each facility. Geo-locating the BMPs using a coordinate system of latitude and longitude is recommended to help facilitate a future statewide database system.
5. A separate list and location of self-retaining areas or areas addressed by LID Principles that do not require specialized O&M or inspections but will require typical landscape maintenance as noted in Chapter 5, pages 85-86, in the WQMP Guidance. Include a brief description of typical landscape maintenance for these areas.

Your local Co-Permittee will also require that you prepare and submit a detailed Stormwater BMP Operation and Maintenance Plan that sets forth a maintenance schedule for each of the Stormwater BMPs built on your site. An agreement assigning responsibility for maintenance and providing for inspections and certification may also be required.

Details of these requirements and instructions for preparing a Stormwater BMP Operation and Maintenance Plan are in Chapter 5 of the WQMP Guidance Document.

Maintenance Mechanism: Maintained by property owner

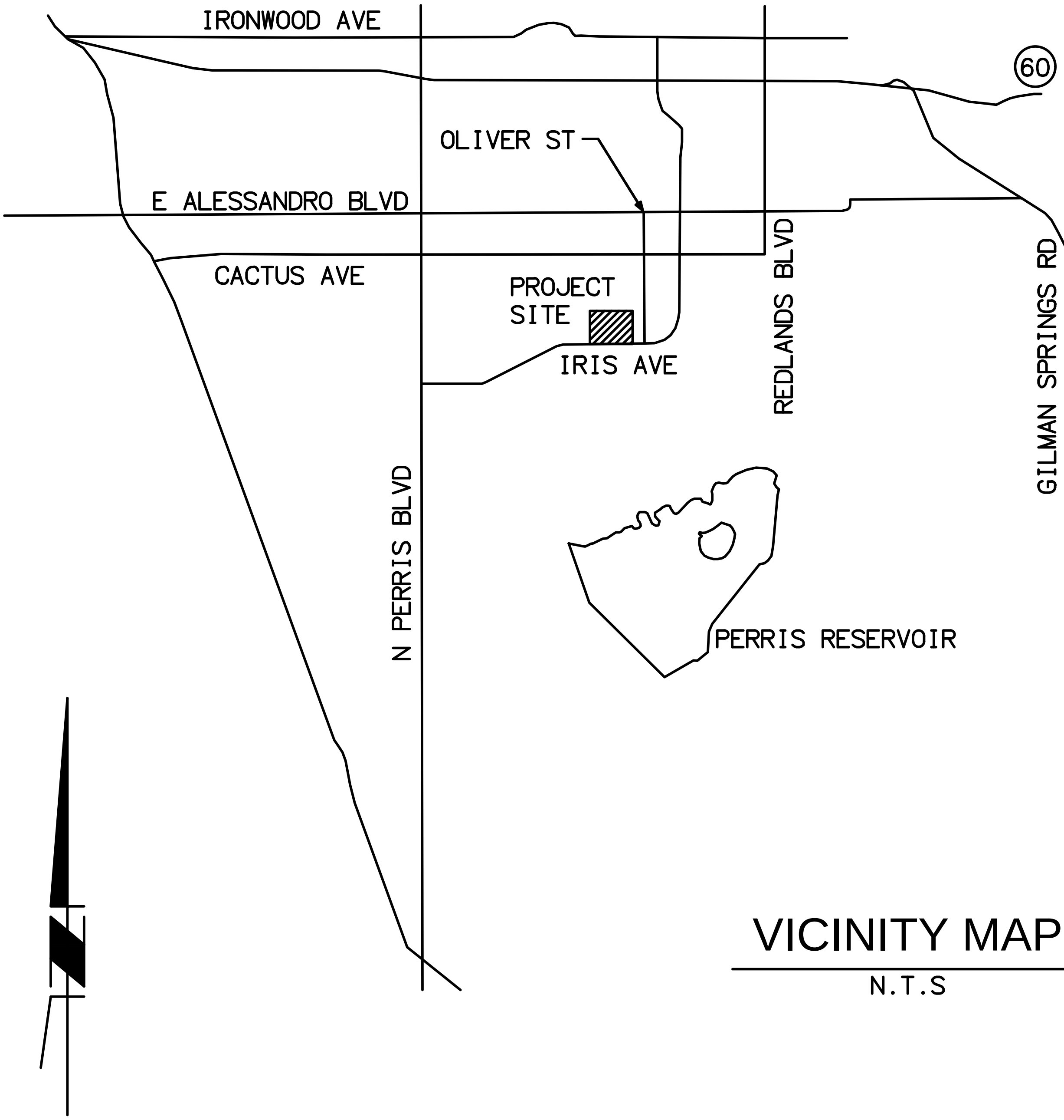
Will the proposed BMPs be maintained by a Home Owners' Association (HOA) or Property Owners Association (POA)?

☐ Y ☒ N

Include your Operation and Maintenance Plan and Maintenance Mechanism in Appendix 9. Additionally, include all pertinent forms of educational materials for those personnel that will be maintaining the proposed BMPs within this Project-Specific WQMP in Appendix 10.

Appendix 1: Maps and Site Plans

Location Map, WQMP Site Plan and Receiving Waters Map



VICINITY MAP

N.T.S

FIGURE 1

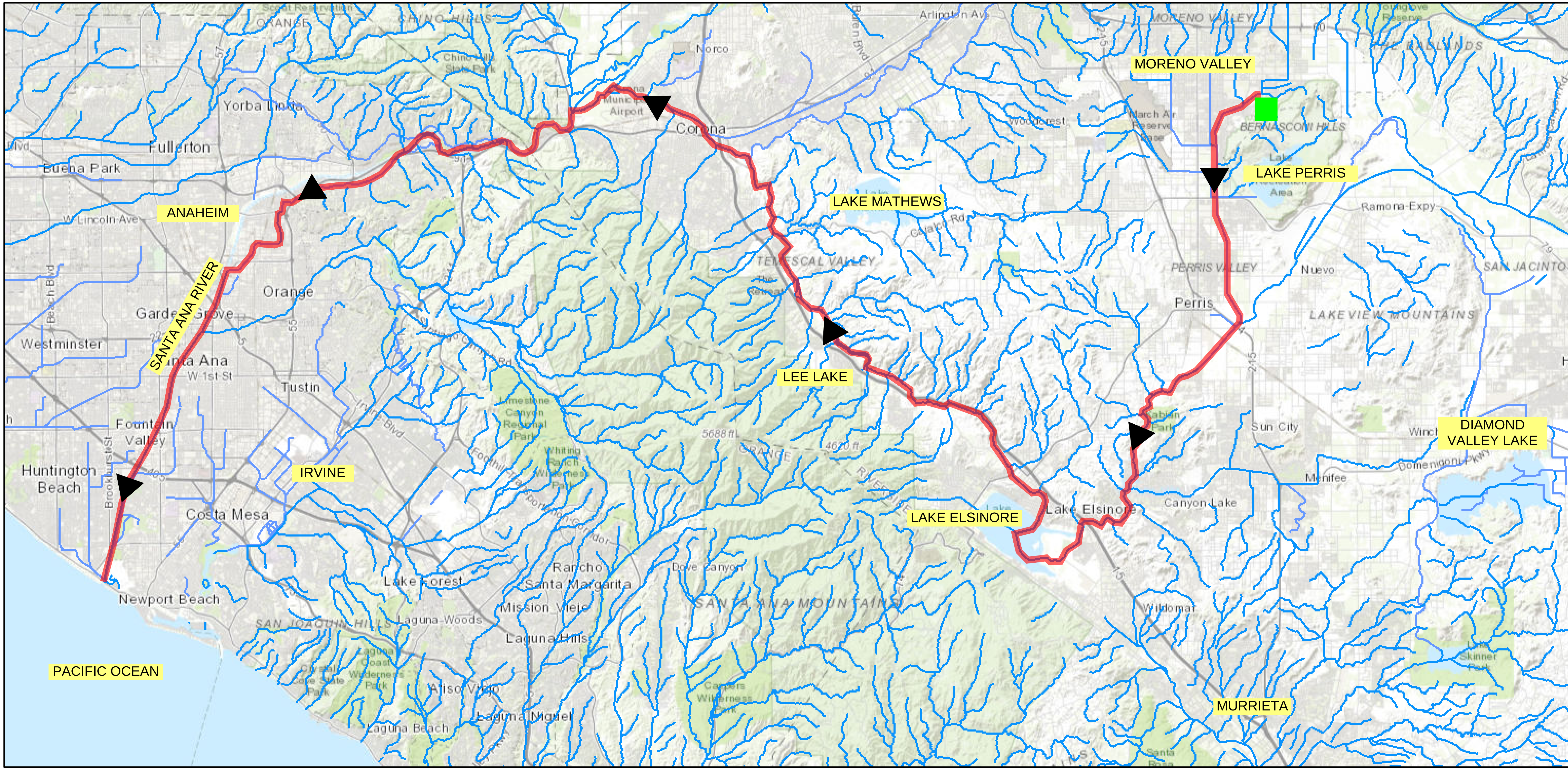
Michael Baker
INTERNATIONAL

9755 Clairemont Mesa Blvd., San Diego, CA 92124
Phone: (858) 614-5000 · MBAKERINTL.COM

KAISER PERMANENTE MORENO VALLEY AREAMASTER PLAN AND MEDICAL OFFICE BUILDING

VICINITY MAP

KAISER PERMANENTE MORENO VALLEY
RECEIVING WATERS MAP



CANALS/STREAMS

FLOW DIRECTION

PROJECT SITE LOCATION

1:288,895

0 2.75 5.5 11 mi

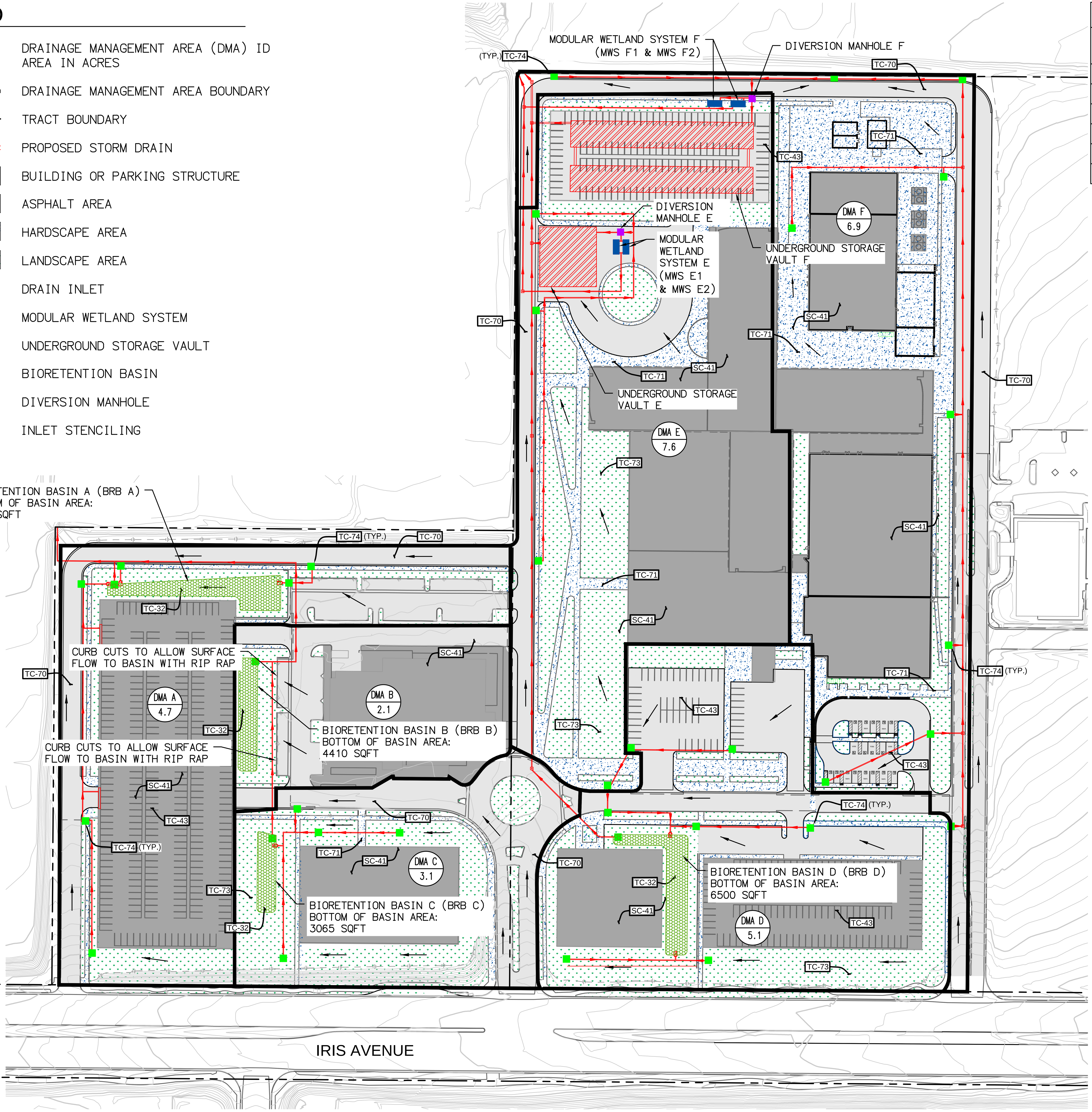
0 4.5 9 18 km

US EPA, Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, © OpenStreetMap contributors, and the

US Environment Protection Agency
US EPA | County of Riverside, Bureau of Land Management, Esri, HERE, Garmin, USGS, NGA, EPA, USDA, NPS |

LEGEND

DMA A / – (symbol)	DRAINAGE MANAGEMENT AREA (DMA) ID AREA IN ACRES
(thick line)	DRAINAGE MANAGEMENT AREA BOUNDARY
(dash line)	TRACT BOUNDARY
(red double line)	PROPOSED STORM DRAIN
(dark grey fill)	BUILDING OR PARKING STRUCTURE
(light grey fill)	ASPHALT AREA
(blue stipple)	HARDSCAPE AREA
(green stipple)	LANDSCAPE AREA
(green square)	DRAIN INLET
(blue rectangle)	MODULAR WETLAND SYSTEM
(red hatch)	UNDERGROUND STORAGE VAULT
(green hatch)	BIORETENTION BASIN
(magenta square)	DIVERSION MANHOLE
(stencil symbol)	INLET STENCILING



80 40 0 80 160 240

SCALE: 1"=80'

DRAINAGE MANAGEMENT AREAS

DMA AREA	IMPERVIOUS (SQ/FT)	PERVIOUS (SQ/FT)	BMP TYPE	PROPOSED BMP (SQFT/CFS)
A	174,794	27,743	BIORETENTION	7050 SQFT
B	79,439	14,938	BIORETENTION	4410 SQFT
C	71,833	62,156	BIORETENTION	3065 SQFT
D	152,027	68,942	BIORETENTION	6500 SQFT
E	251,412	78,765	BIOTREATMENT	1.15 CFS
F	259,094	43,356	BIOTREATMENT	1.15 CFS

NOTE: DMA'S E-F CONSISTS OF 2 MODULAR WETLAND SYTEMS EACH

SOURCE/TREATMENT CONTROL BMP'S

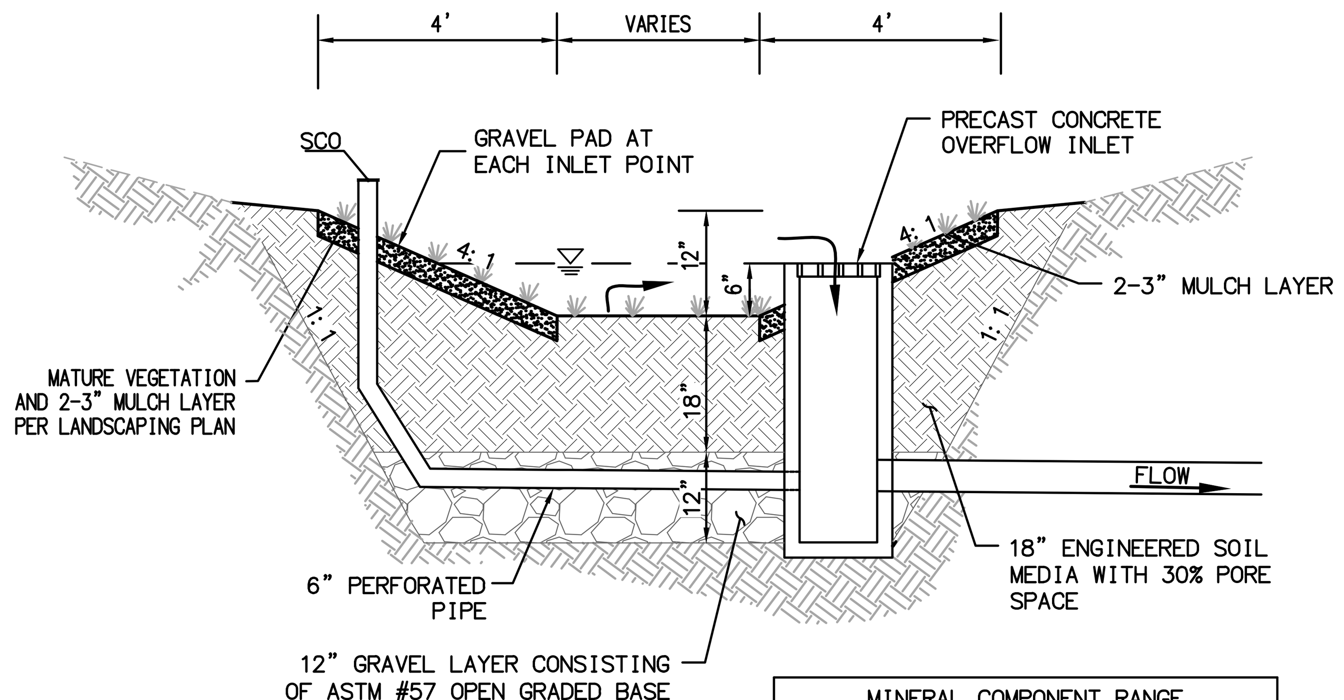
SC-41	BUILDING & GROUNDS MAINTENANCE
SC-43	PARKING MAINTENANCE
SC-60	HOUSEKEEPING PRACTICES
SC-70	ROAD AND STREET MAINTENANCE
SC-71	PLAZA AND SIDEWALK CLEANING
SC-73	LANDSCAPE MAINTENANCE
SC-74	DRAINAGE SYSTEM MAINTENANCE
TC-32	BIORETENTION

NOTE:
1. PROVIDE INLET STENCILING AT ALL ONSITE INLETS

Michael Baker
INTERNATIONAL
9755 Clairemont Mesa Blvd., San Diego, CA 92124
Phone: (858) 614-5000 · MBAKERINTL.COM

WQMP EXHIBIT
MASTER SITE PLAN

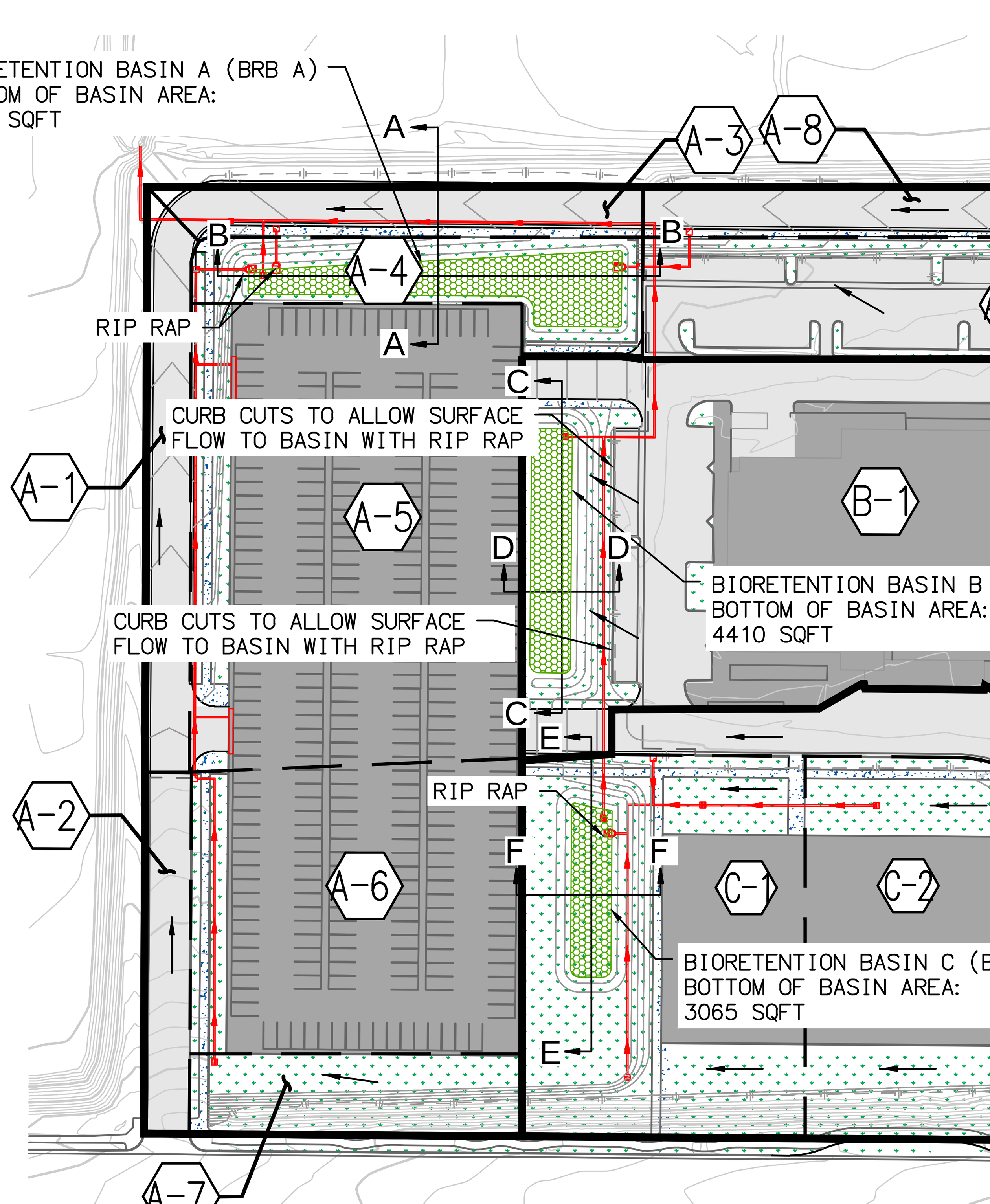
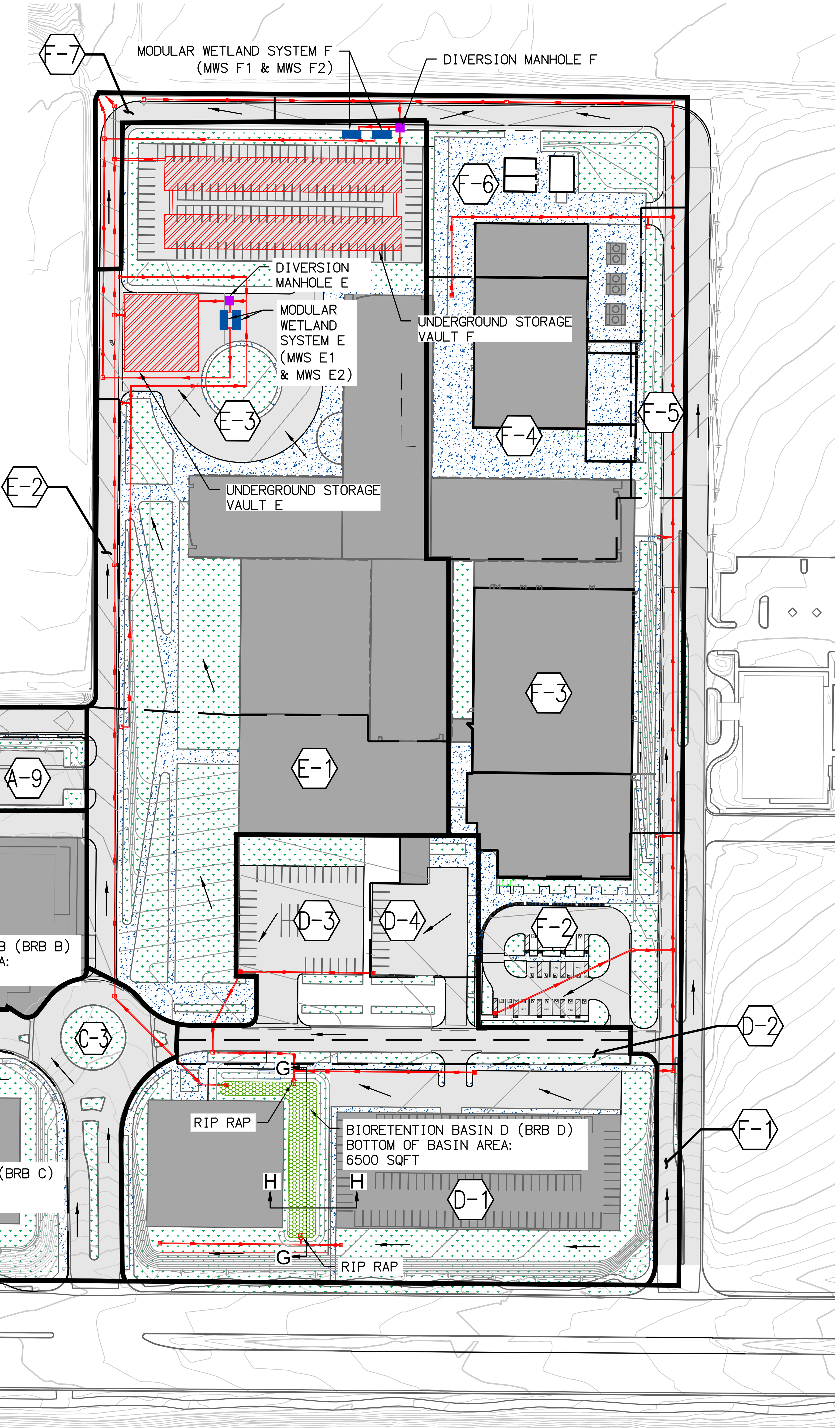
KAISER MEDICAL MORENO VALLEY



MINERAL COMPONENT RANGE REQUIREMENTS PER LID DESIGN MANUAL	
PERCENT RANGE	COMPONENT
70-80	SAND
15-20	SILT
5-10	CLAY

TYPICAL BIORETENTION BASIN SECTION

SCALE: NTS

80 40 0 80 160 240

SCALE: 1"=80'

LEGEND

(blue rectangle)	MODULAR WETLAND
(long-short dash line)	EXISTING RIGHT-OF-WAY
(solid line)	DMA BOUNDARY
(dashed line)	DMA SUB-AREA BOUNDARY
(red double line)	PROPOSED STORM DRAIN
(rip rap hatch)	5'x5' RIP RAP, 12" THICK, D50=6", UNDERLAY WITH FILTER FABRIC
(red hatch)	UNDERGROUND STORAGE VAULT
(magenta square)	DIVERSION MANHOLE
(A)	DMA NUMBER
(A-1)	DMA SUB-AREA NUMBER

NOTE:

BIORETENTION BASIN SECTIONS A-G SHOWN ON NEXT SHEET

DRAINAGE MANAGEMENT AREA - A

DMA SUB AREA	IMPERVIOUS (SQ/FT)	PERVIOUS (SQ/FT)
A-1	11,099.55	0
A-2	7,381.86	0
A-3	10,638.18	0
A-4	15,316.28	882.23
A-5	61,278.90	4,720.53
A-6	39377.84	3,399.92
A-7	405.16	11,650.67
A-8	10,668.91	0
A-9	18,627.58	7,089.86
TOTAL	174,794.26	27,743.21

DRAINAGE MANAGEMENT AREA - B

DMA SUB AREA	IMPERVIOUS (SQ/FT)	PERVIOUS (SQ/FT)
B-1	79,438.59	14,937.99

DRAINAGE MANAGEMENT AREA - C

DMA SUB AREA	IMPERVIOUS (SQ/FT)	PERVIOUS (SQ/FT)
C-1	16,556.09	31,582.35
C-2	22,034.62	24,152.67
C-3	33,241.85	6,421.19
TOTAL	71,832.56	62,156.21

DRAINAGE MANAGEMENT AREA - D

DMA SUB AREA	IMPERVIOUS (SQ/FT)	PERVIOUS (SQ/FT)
D-1	88,116.08	55,428.60
D-2	8,090	5,288.20
D-3	39,175.22	7,510.24
D-4	16,645.83	715.45
TOTAL	152,027.36	68,942.49

DRAINAGE MANAGEMENT AREA - E

DMA SUB AREA	IMPERVIOUS (SQ/FT)	PERVIOUS (SQ/FT)
E-1	53,279.49	32,593.43
E-2	8,842.15	0
E-3	189,289.96	46,171.70
TOTAL	251,411.60	78,765.13

DRAINAGE MANAGEMENT AREA - F

DMA SUB AREA	IMPERVIOUS (SQ/FT)	PERVIOUS (SQ/FT)
F-1	6,188.51	717.31
F-2	31,586.47	11,811.17
F-3	82,640.82	9,580.26
F-4	66,796.49	0
F-5	11,922.48	6,235.56
F-6	52,041.88	11,755.41
F-7	7,917.31	3,256.75
TOTAL	259,093.96	43,356.46
TOTAL SUMMATION	988,598.33	295,901.49

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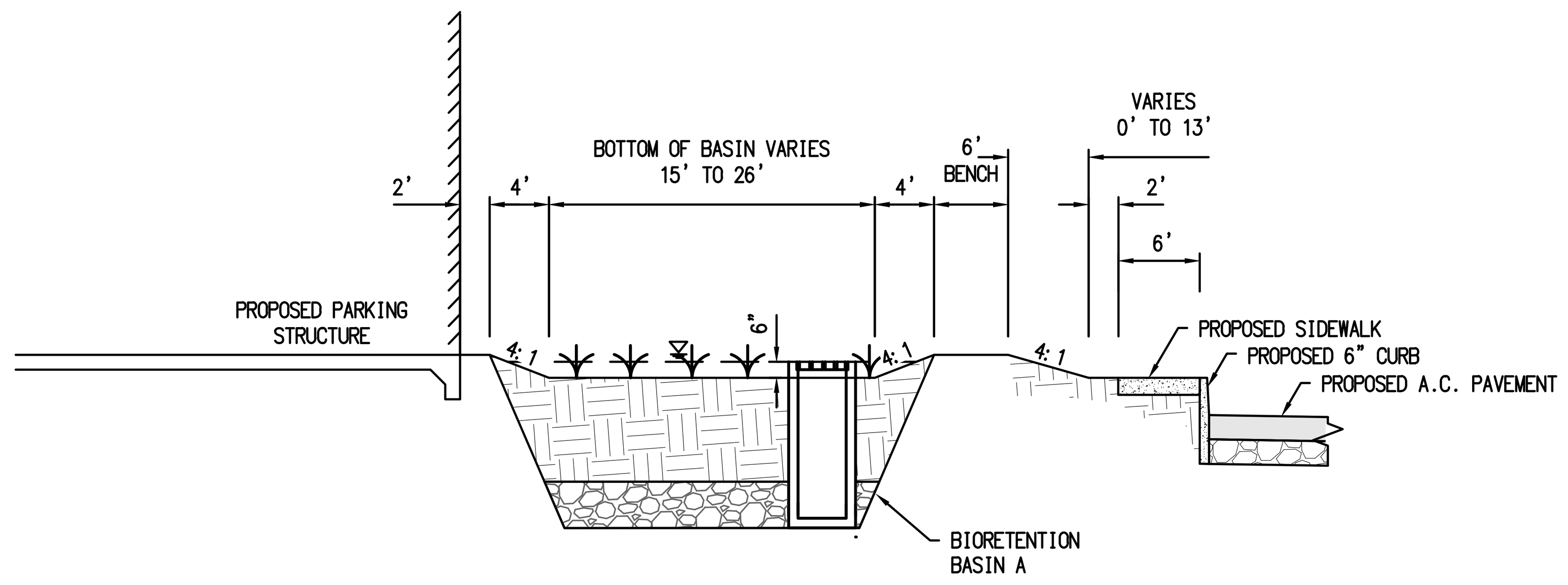
9755 Clairemont Mesa Blvd., San Diego, CA 92124
Phone: (858) 614-5000 · MBAKERINTL.COM

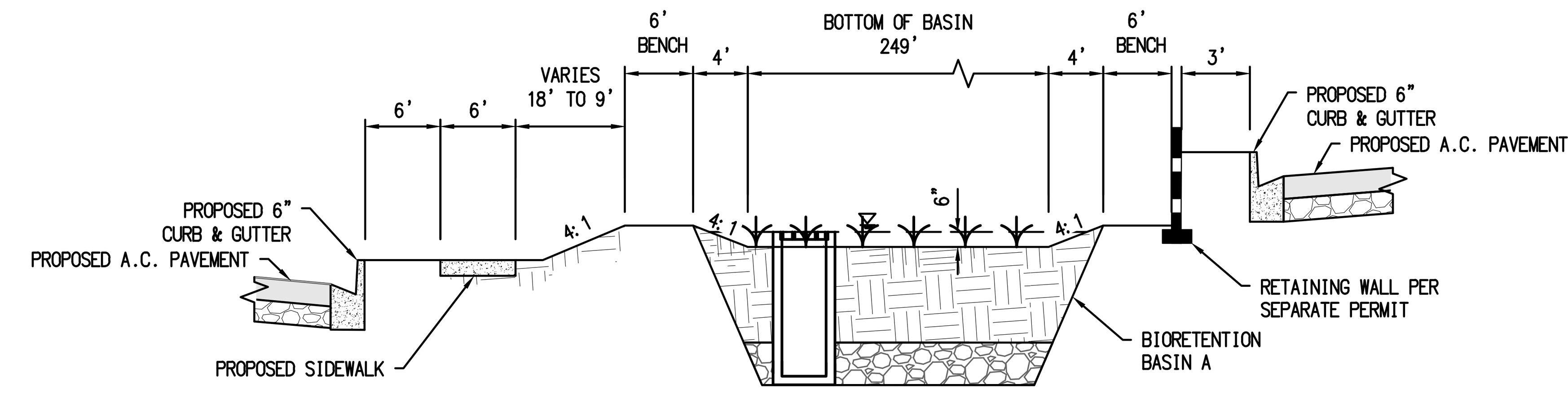
WQMP DMA EXHIBIT
MASTER SITE PLAN

KAISER MEDICAL MORENO VALLEY

H:\PDATA\169814\CADD\LAND\EXHIBITS\MASTER_WQMP-DMA EXHIBIT POST.DWG ABBOTT, FRANKIE 10/25/2019 9:00 AM



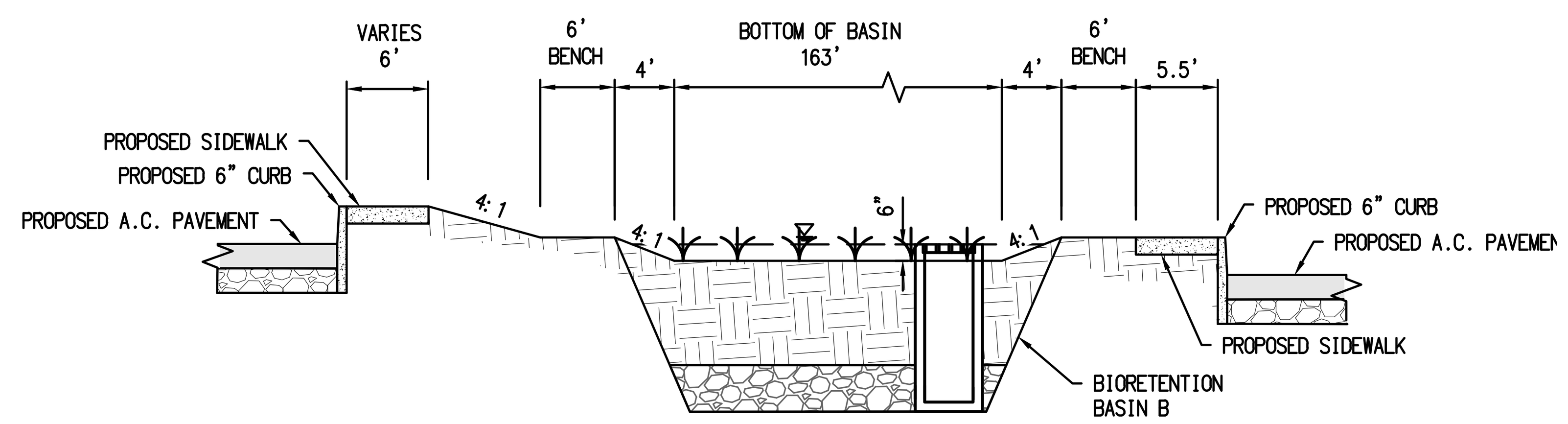
SECTION A-A



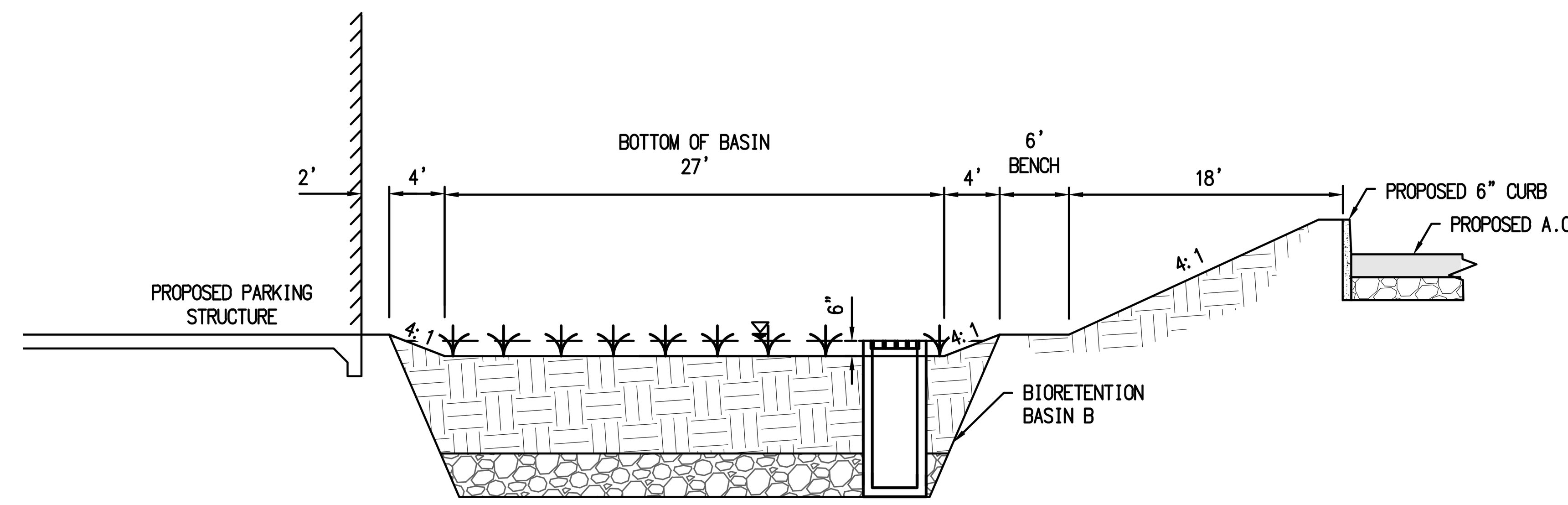
SECTION B-B

BIORETENTION BASIN A

SCALE: N.T.S



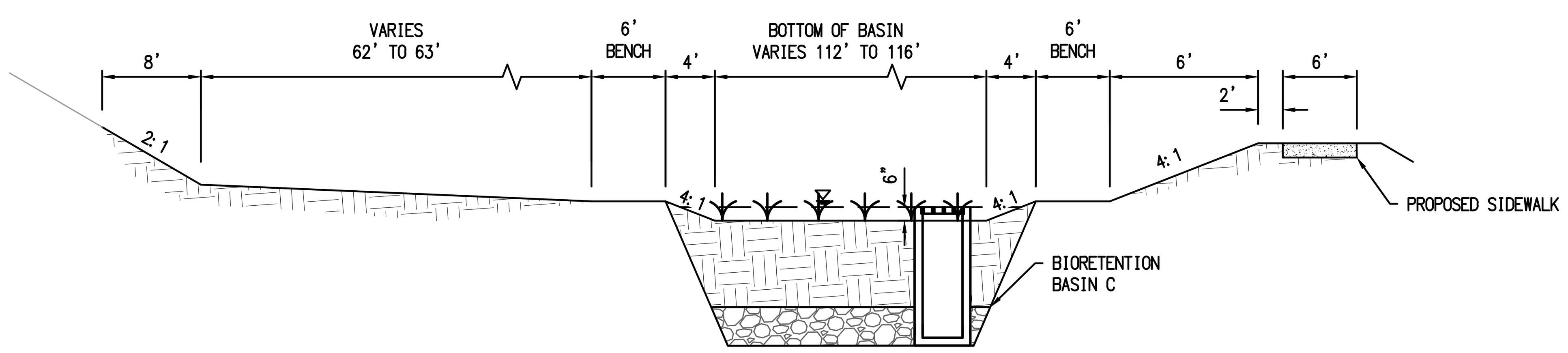
SECTION C-C



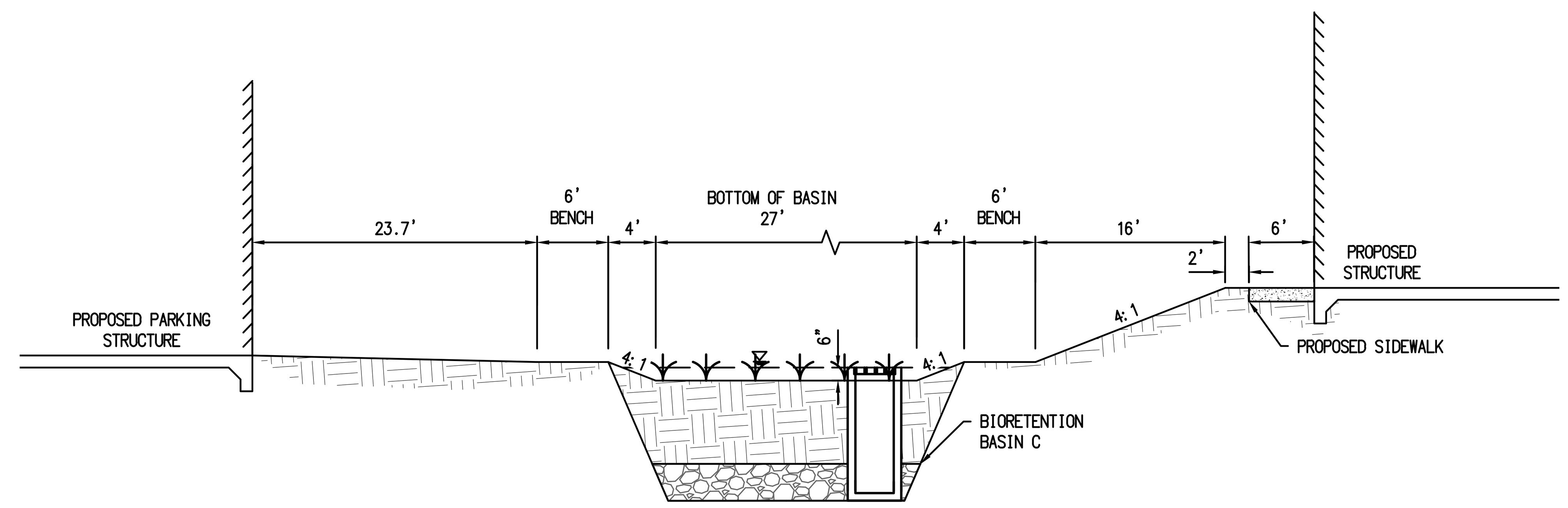
SECTION D-D

BIORETENTION BASIN B

SCALE: N.T.S



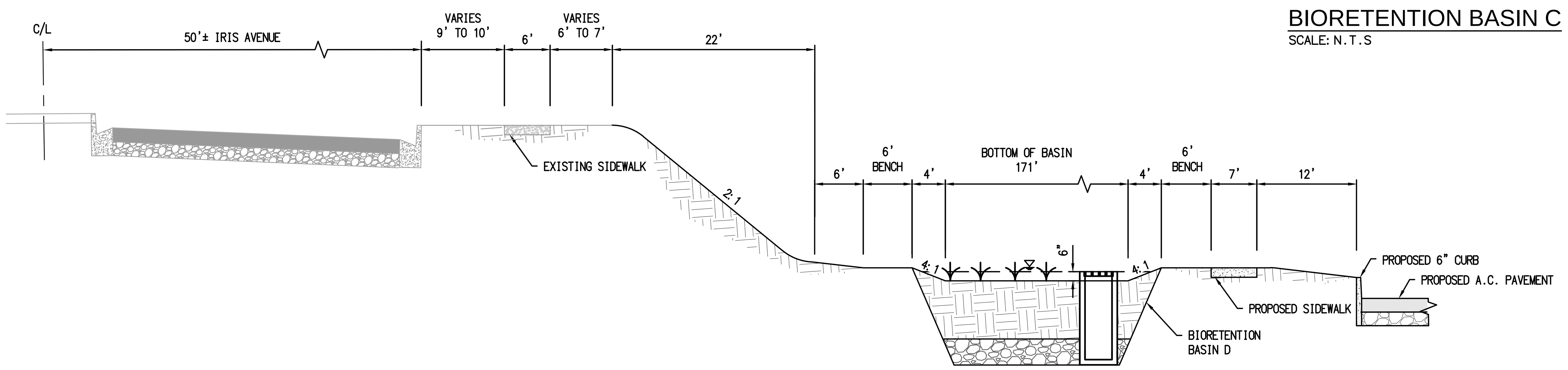
SECTION E-E



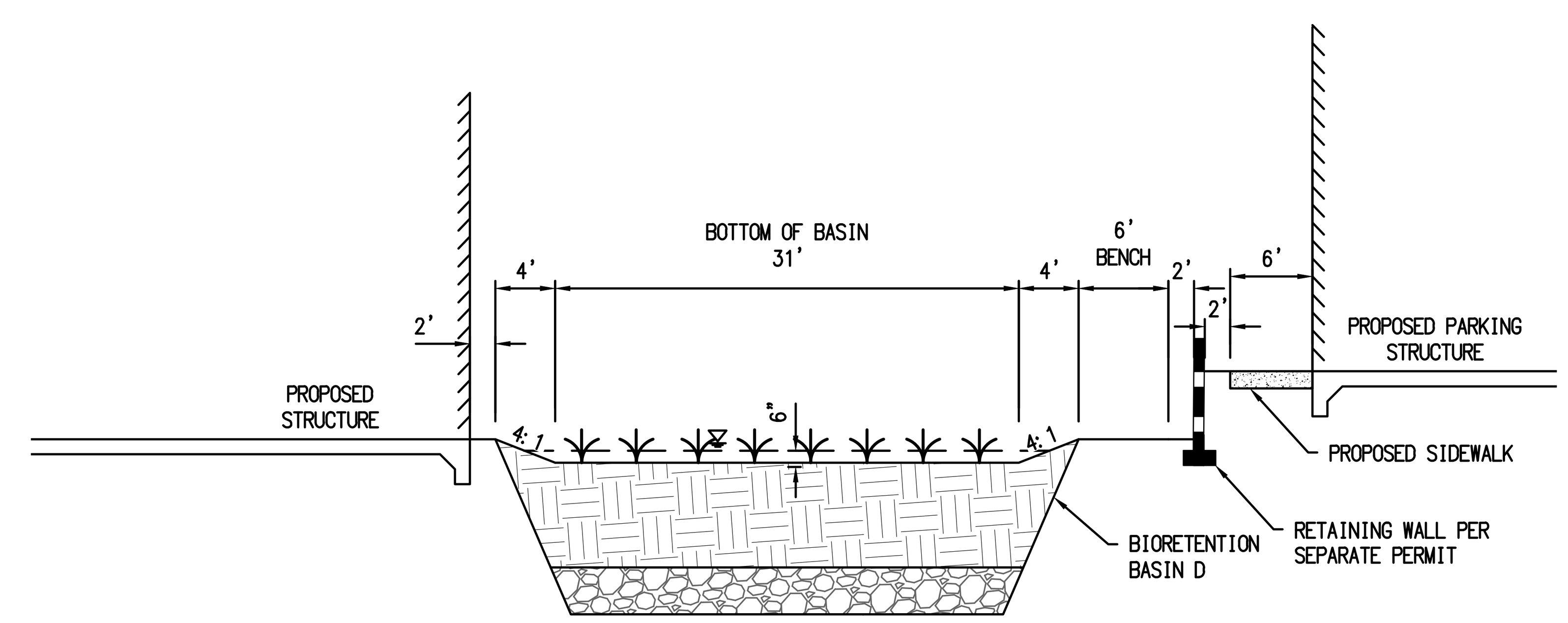
SECTION F-F

BIORETENTION BASIN C

SCALE: N.T.S



SECTION G-G



SECTION H-H

NOTE

FOR TYPICAL BIORETENTION BASIN CROSS SECTION, SEE PREVIOUS SHEET.

BIORETENTION BASIN D

SCALE: N.T.S

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INTERNATIONAL
9755 Clairemont Mesa Blvd., San Diego, CA 92124
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BIORETENTION BASIN SECTIONS

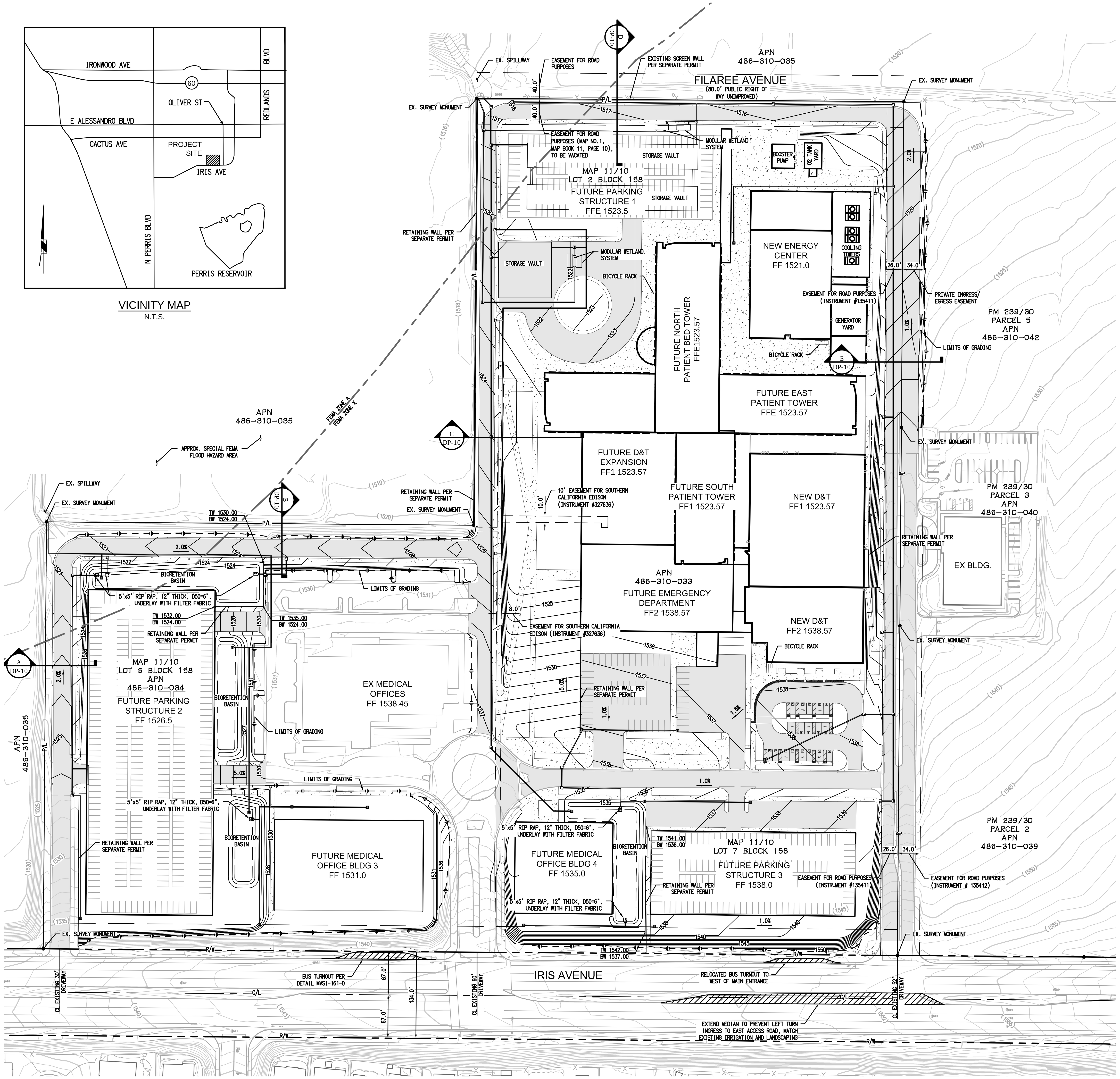
MASTER SITE PLAN

KAISER MEDICAL MORENO VALLEY

H:\PDATA\169814\CADD\LAND\EXHIBITS\MASTER_WQMP-SECTIONS.DWG ABBOTT, FRANKIE 10/15/2019 1:25 PM

Appendix 2: Construction Plans

Grading and Drainage Plans



LEGEND

- RIGHT-OF-WAY
- PROPERTY LINE
- EASEMENT
- MAJOR CONTOUR (420)
- MINOR CONTOUR (420)
- CURB
- CURB AND GUTTER
- RETAINING WALL
- AC PAVING
- CONCRETE PAVEMENT
- DIRECTION OF FLOW
- PRECAST CATCH BASIN
- CURB INLET
- STORM DRAIN/SEWER TYPE CLEANOUT
- STORM DRAIN LINE
- WING HEADWALL

OWNER/DEVELOPER

KAISER PERMANENTE
MORENO VALLEY MEDICAL CENTER
393 E. WALNUT STREET, 4TH FLOOR
CONTACT PERSON: SKYLER DENNISTON
PHONE NO. (626) 405-6333

ARCHITECT

CO ARCHITECTS
5055 WILSHIRE BOULEVARD, 9TH FLOOR
LOS ANGELES, CA 90036
PHONE NO. (323) 525-0500

CIVIL ENGINEER

MICHAEL BAKER INTERNATIONAL
9755 CLAIREMONT MESA BOULEVARD, SUITE 100
SAN DIEGO, CA 92124
PHONE NO. (858) 614-5000

EXISTING UTILITY NOTE

EXISTING UTILITIES HAVE BEEN SHOWN BASED ON THE BEST AVAILABLE INFORMATION. CONTRACTOR SHALL LOCATE AND MARK OUT ALL EXISTING UTILITIES PRIOR TO CONSTRUCTION. CONTRACTOR SHALL CONTACT THE ENGINEER IF ANY UTILITIES ARE LOCATED THAT ARE NOT IDENTIFIED ON THESE PLANS.

STORM WATER NOTE

A STORMWATER POLLUTION PREVENTION PLAN (SWPPP), WHICH INCLUDES BEST MANAGEMENT PRACTICES TO REDUCE POLLUTANTS REACHING DOWNSTREAM WATER BODIES, WILL BE PREPARED PRIOR TO ISSUANCE OF GRADING PERMIT AND A NOTICE OF INTENT SUBMITTED TO THE STATE REGIONAL WATER QUALITY CONTROL BOARD.

TOPOGRAPHY SOURCE

AEROTECH MAPPING, INC.
29970 TECHNOLOGY DRIVE, SUITE 220-C
MURRIETA, CA 92563
PHONE NO. (619) 606-5020
TOPO SOURCE: AERIAL TOPO
TOPO SOURCE DATE: JULY 21, 2017

LEGAL DESCRIPTION

APN 486-310-033
LOT/PARCEL: LOTS 2 AND 7 OF PARCEL 1

APN 486-310-034
LOT/PARCEL: LOT 6 OF PARCEL 1

SITE ADDRESS

D&T: 27300 IRIS AVENUE
MORENO VALLEY, CA 92555
ENERGY CENTER: 27370 IRIS AVENUE
MORENO VALLEY, CA 92555

PARCEL 1: LOTS 2,6 AND 7 IN BLOCK 158 OF MAP NO.1 BEAR VALLEY AND ALESSANDRO DEVELOPMENT COMPANY AS PER MAP RECORDED IN BOOK 11, PAGE 10 OF MAPS, RECORDS OF THE COUNTY OF SAN BERNARDINO, IN THE CITY OF MORENO VALLEY, COUNTY OF RIVERSIDE, STATE OF CALIFORNIA.
ABOVE LEGAL DESCRIPTION IS PURSUANT TO LOT LINE ADJUSTMENT NO. 1015/AND CERTIFICATE OF COMPLIANCE RECORDED JANUARY 19, 2012, AS INSTRUMENT NO. 2012-0023631 OF OFFICIAL RECORDS OF SAID COUNTY RECORDS.

EARTHWORK

CUT: 50,000 CY
FILL: 50,000 CY

LAND USE

EXISTING: COMMERCIAL AND OFFICE
PROPOSED: COMMERCIAL AND OFFICE

FEMA ZONE

FEMA ZONE X AND A. MAJORITY ZONE X

DISTURBED AREA

GROSS DISTURBED AREA: 22.0 ACRES

UTILITY COMPANIES

BOX SPRINGS MUTUAL WATER COMPANY	(951) 653-6419
CHARTER SPECTRUM	(877) 906-9121
EASTERN MUNICIPAL WATER DISTRICT	(951) 928-3777
EDGEMONT COMMUNITY SERVICE DISTRICT	(951) 784-2632
FRONTIER COMMUNICATION	(800) 921-8101
SOUTHERN CALIFORNIA EDISON COMPANY	(800) 655-4555
SOUTHERN CALIFORNIA GAS COMPANY	(800) 427-2200
SUNESYS	(951) 278-0400
RIVERSIDE TRANSIT AGENCY	(951) 565-5164
UNDERGROUND SERVICE ALERT	(800) 227-2600
MORENO VALLEY UTILITY ADMINISTRATION	(951) 413-3500
SPECIAL DISTRICTS ADMINISTRATION	(951) 413-3480
VERIZON WIRELESS	(800) 922-0204

GENERAL NOTES

PARKING LOTS SHALL BE DESIGNED CONSISTENT WITH THE CITY'S MUNICIPAL CODE (9.11 AND 9.17.050) REQUIREMENTS TO INCLUDE THE FOLLOWING:

1. PARKING LOT DESIGN SHALL INCLUDE OPENINGS IN CURBS TO CONVEY WATER RUNOFF INTO LANDSCAPE AREAS FOR WATER QUALITY, RETENTION AND ABSORPTION.
2. AUTO PARKING SPACES SHALL BE CLEARLY OUTLINED WITH WHITE DOUBLE LINES ON THE SURFACE OF THE PARKING FACILITY (THREE-INCH LINE - SIX INCH SPACE - THREE INCH LINE) FOR A TOTAL OF TWELVE (12) INCHES OR AS OTHERWISE SPECIFIED BY THE BUILDING OFFICIAL.
3. AUTO HEADLIGHTS IN PARKING AREAS SHALL BE SCREENED SO THAT THEY DO NOT SHINE INTO ADJACENT PROPERTIES OR THE PUBLIC RIGHT-OF-WAY. LOW HEDGE PLANTING OR WALL MAY BE REQUIRED.
4. FINGER PLANTERS SHALL HAVE A MINIMUM INTERIOR DIMENSION OF FIVE (5) FEET BY SIXTEEN (16) FEET, EXCLUSIVE OF CURBS, STEP-OUTS AND OTHER HARD SURFACES. A FINGER PLANTER WITH PARKING ON ONE SIDE HAS A MINIMUM CURB TO CURB FACE DIMENSION OF SEVEN FEET. A FINGER PLANTER WITH PARKING ON BOTH SIDES HAS A MINIMUM CURB-FACE-TO-CURB-FACE DIMENSION OF EIGHT (8) FEET.
5. DIAMOND PLANTERS ARE REQUIRED WHERE DOUBLE ROWS OF PARKING ARE PROVIDED.
6. DIAMOND PLANTERS HAVE A MINIMUM OF TWENTY-FIVE (25) SQUARE FOOT INTERIOR AREA (EXCLUSIVE OF PERIMETER CURBING) WITH MINIMUM INTERIOR DIMENSIONS OF FIVE FEET BY FIVE FEET.
7. END ISLANDS, OR FINGER PLANTERS ARE PROVIDED AT THE END OF EACH AISLE OF PARKING TO DEFINE PARKING LOT CIRCULATION, PROVIDE SIGHT DISTANCE AT THE INTERSECTION OF DRIVE AISLES AND PLACES FOR TREES.
8. END PLANTERS, FINGER PLANTERS, AND DIAMOND PLANTERS SHALL BE DESIGNED FOR LANDSCAPING PURPOSES ONLY AND SHALL NOT INCLUDE LIGHT POLES, FIRE HYDRANTS OR UTILITY CABINETS. DESIGN PLANTERS IN EXCESS OF REQUIRED DIMENSIONS IF THESE ITEMS WILL BE INCORPORATED INTO THE OVERALL DESIGN OF THE PROJECT.
9. PERVIOUS SURFACES ARE RECOMMENDED WHERE FEASIBLE AND REQUIRED FOR PARKING AREAS PROVIDED IN EXCESS OF CITY REQUIREMENTS.

80 40 0 80 160 240

SCALE: 1"=80'

CO ARCHITECTS

5055 Wilshire Boulevard, 9th Floor
Los Angeles, California 90036
323.525.0500 phone, 323.525.0955 fax

Michael Baker INTERNATIONAL
9755 Clairemont Mesa Blvd., San Diego, CA 92124
Phone: (858) 614-5000 · MBAKERINTL.COM

KAISER PERMANENTE

MORENO VALLEY MEDICAL CENTER
CAMPUS MASTER PLAN
PHASE 1 DIAGNOSTIC & TREATMENT EXPANSION AND ENERGY CENTER

OSHPD PROJECT #

N

MASTER PRELIMINARY GRADING & DRAINAGE PLAN

SCALE: AS INDICATED
DATE OF ISSUE: MARCH 12, 2019

CONDITIONAL USE PERMIT AND
PLANNED DEVELOPMENT PERMIT
CO - PROJECT NO.: 17009.000

DP-08

Appendix 3: Soils Information

Geotechnical Study and Other Infiltration Testing Data

June 1, 2019

RMA Job No.: 19-0918-0

National Facilities Services
Riverside Service Delivery Team
182 Granite Street, Suite 106
Corona, CA 92879

Attention: Scott L. Drane,
Senior Project Manager

Subject: Soil Infiltration Report
Moreno Valley Medical Center
27300 Iris Avenue
Moreno Valley, CA

Dear Mr. Drane:

In accordance with the District's request and authorization, a soil infiltration report has been prepared for Moreno Valley Medical Center in Moreno Valley, California.

Our scope of work included the following:

- Review regional geologic and groundwater data.
- Review an Infiltration Test Locations exhibit provided by Kaiser personnel.
- Review of a previous geotechnical investigation report prepared by Geobase in August 2017.
- Drilling of five exploratory boring.
- Drilling of ten infiltration test holes and performance of ten soil infiltration tests using the bore hole percolation test procedure.
- Backfilling of the boring and test holes.
- Analysis of the complied data and preparation of this report.

Proposed Construction

An exhibit provided by representatives from Kaiser (Figure 1) shows the proposed infiltration basins located in the northern portion of the site and two general infiltration areas on the south side of the site. They also provided the requested test depth of 5 feet.

The area of the proposed basins on the north side of the site is vacant land. The southern study areas are currently used as parking lots and landscape areas.

Geologic Setting

The site is located within a large geologic structural mass known as the Perris Block. This block is composed of granitic bedrock that in places is overlain by alluvium and thin sedimentary and volcanic units. The granitic bedrock was formed during Cretaceous time, some 90 to 100 million years ago, and is part of a much larger mass of plutonic rocks known as the Southern California Batholith. After formation of the granitic rocks, the Perris Block experienced vertical movements that produced several nearly flat erosional surfaces. Sediments emanating from the elevated portions of the Perris Block fill low lying areas in the region.

According to regional geologic mapping by Morton and Matti (2002), northern portion of the study area is underlain by Holocene to late Pleistocene age younger alluvium and the southern portion of the study area is underlain by late to middle Pleistocene age older alluvium. As discussed below, our boring encountered both younger and older alluvium.

Subsurface Conditions

During our subsurface investigation, we encountered older alluvium. The older alluvium encountered in the three basins on the north side of the site consisted of light brown to brown sandy silt. The locations on the south side of the site encountered brown silty sand. Logs of the borings are presented in Appendix A.

Groundwater was not encountered during our subsurface investigation for this study. According to the California Department of Water Resources (2006) depth to groundwater beneath the site is on the order of 60 feet.

Infiltration Test Procedure

Ten soil infiltration tests were performed using the bore hole percolation test procedure described in Appendix A of the Riverside County Low Impact Development BMP Design Handbook. An exploratory boring and test holes were drilled with a truck mounted CME-75 drill rig equipped with 8-inch diameter hollow stem augers. The exploratory boring was drilled to a depth of 15 feet. Test holes were extended to a depth of approximately 5 feet below the existing ground surface, the approximate depths of the proposed subsurface infiltration basins. A three inch diameter perforated pipe wrapped in a filter sock was placed through the augers prior into each test hole prior to removal of the augers. Each hole was presoaked by filling the holes with approximately 5 gallons water as per the Riverside County guidelines.

The percolation rate in each test hole was measured for two 25 minute periods to determine if the soil met the sandy soils criteria. Three tests exhibited more than 6 inches of water seeped away during two consecutive measurements at each location, consequently the sandy soils criteria was used during testing. The remaining seven tests, did not pass the sandy soil criteria, and hence utilized a 30 minute time interval. Water levels in the test holes were maintained approximately 5 times the hole radius or slightly higher. Water levels were measured to the nearest hundredth of a foot using a well sounder. A total of 7 to 13 measurements, dependant on the sandy soil criteria, were made following completion of presoaking, after which time testing was stopped. The pipes were pulled from the test holes after completion of testing. The holes were then backfilled and capped with asphaltic cold patch.

Infiltration Test Results

The percolation rates obtained from the bore hole percolation test method are not equivalent to infiltration rates obtained from single or double ring infiltrometer tests. This is because both downward and horizontal fluxes of water occur during bore hole percolation tests, whereas infiltration refers to only the downward flux of water. For our study, we used the Porchet Method to convert percolation rates to infiltration rates.

Test Location	Infiltration Rate
P-1	0.51 in/hr
P-2	0.10 in/hr
P-3	0.13 in/hr
P-4	0.21 in/hr
P-5	0.60 in/hr
P-6	0.26 in/hr
P-7	1.07 in/hr
P-8	0.68 in/hr
P-9	0.84 in/hr
P-10	0.48 in/hr

Soil percolation test sheets are presented in Appendix A.

Discussion and Recommendations

Per the Santa Ana Regional Water Quality Control Board Water Quality Management Plan Guidance Document for Riverside County (Page 33), pre-development "in-situ" tested infiltration rates of soil must be greater than 1.6 in/hr to be considered acceptable for storm water infiltration.

Because the calculated infiltration rates for this study are less than 1.6 inches per hour, we conclude that infiltration of stormwater into soils at the site is not feasible. Since the tested soils extend to ground surface, we also conclude that infiltration of stormwater into soils above the depths tested and in the tested area are not feasible.

Since some of our testing indicates that the tested infiltration rates on the south side of the site are greater than 0.3 inches per hour, but less than 1.6 in/hr, use of bioretention BMPs are feasible according to the LID BMP Feasibility Flow Chart in the Santa Ana Regional Water Quality Control Board Water Quality Management Plan Guidance Document for Riverside County (Figure 3-6, page 58). For areas where the lowest tested infiltration rate is less than 0.3 inches per hour, at the test locations on the north side of the site, biotreatment BMPs may be used. This would include the areas tested on the north side of the site. Information on types of bioretention and biotreatment BMPs can be found in the LID BMP Feasibility Flow Chart in the Santa Ana Regional Water Quality Control Board Water Quality Management Plan Guidance Document for Riverside County

We trust this letter will serve your needs at this time. In you have any questions or require further assistance, please do not hesitate to contact us.

Respectfully,

RMA Group

Kenneth Dowell, CEG, PG
Project Geologist
CEG 2470

Attachments: Figure 1: Test Location Map
Figure 2: Regional Geologic Map
Appendix A: Boring/Test Hole Logs and Percolation Test Data Sheets
Appendix B: References

FIGURES

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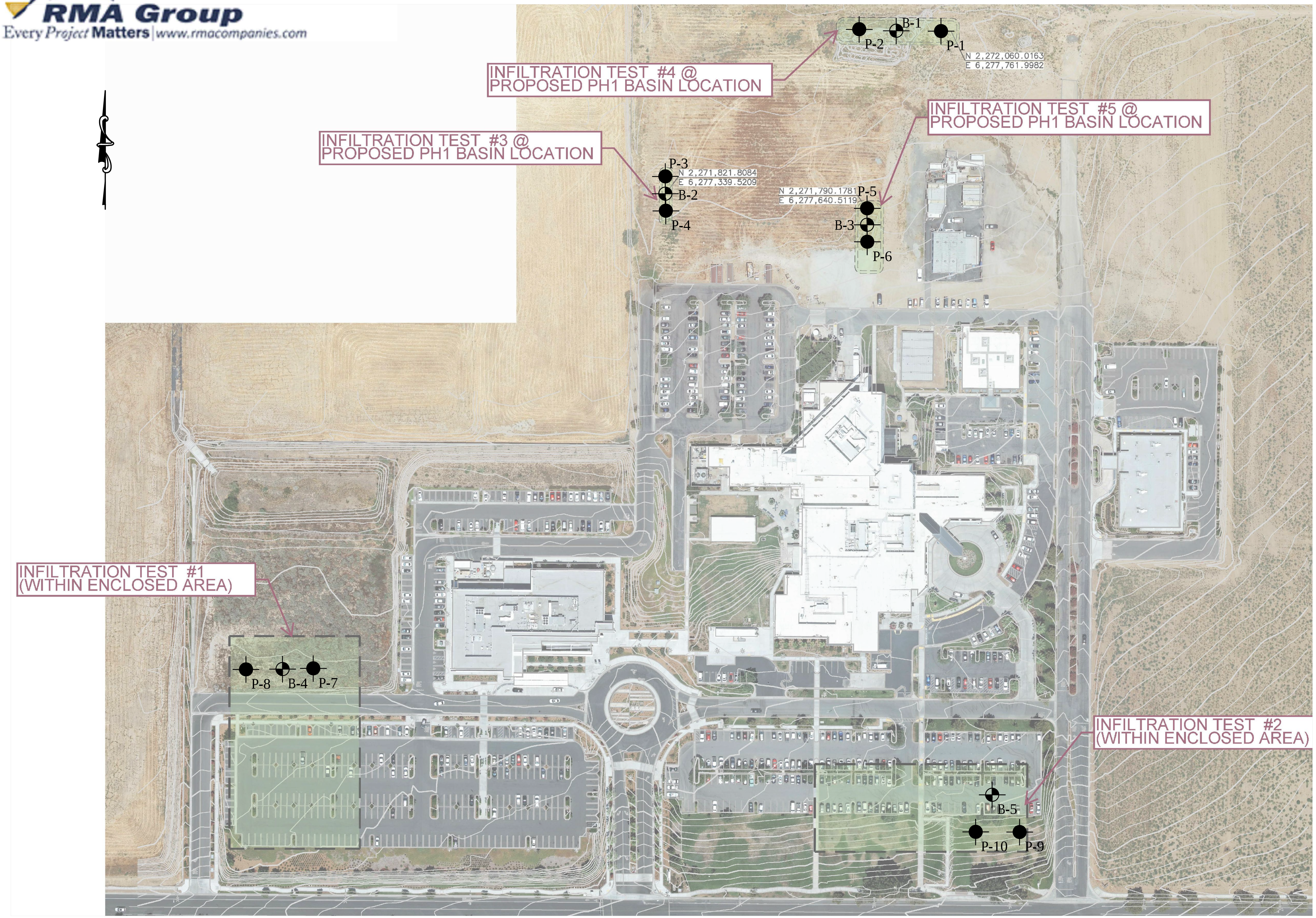


BORING AND INFILTRATION TEST LOCATION MAP
Not to Scale

Legend

B-5 - Approximate location of exploratory boring

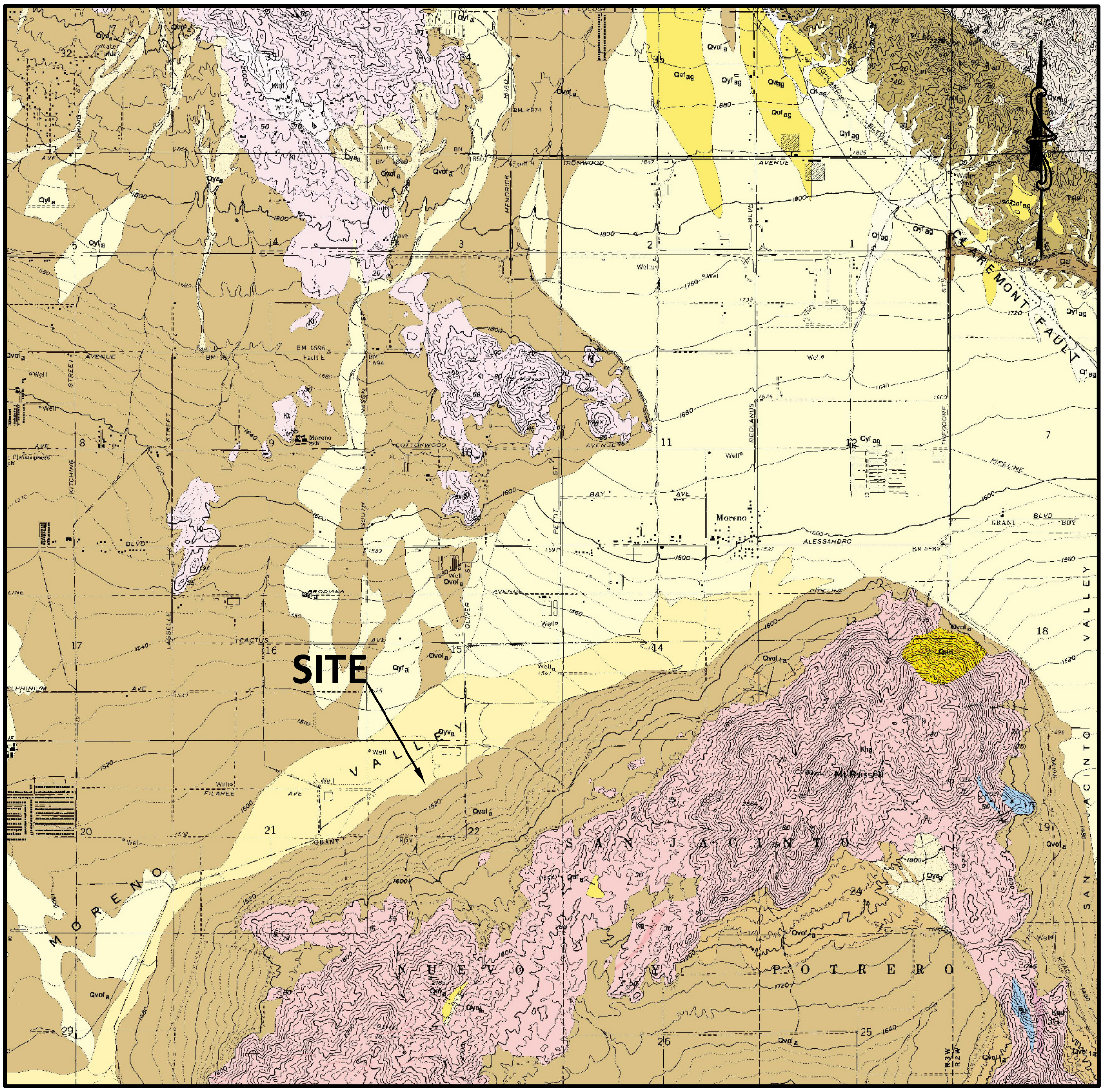
P-10 - Approximate location of infiltration test

Base map provided by Kaiser Permanente

Kaiser Permanente Health Plan, Inc.
Moreno Valley Medical Center
Moreno Valley, CA

RMA Job No.: 19-0918-0
Figure 1

GEOTECHNICAL CONSULTANTS



REGIONAL GEOLOGIC MAP

Scale: 1" ≈ 2,000'

Partial Legend

Qyv - Young Alluvial Valley Deposits
Qvof - Very old alluvial fan deposits
Khg - Granitic rock

Source: Morton, M.M. and Matti J.C., Geologic Map of the Sunnymead 7.5-Minute Quadrangle, California, 2001.

APPENDIX A

BORING/TEST HOLE LOGS
AND
PERCOLATION TEST DATA SHEETS

APPENDIX A

FIELD INVESTIGATION

A-1.00 FIELD EXPLORATION

A-1.01 Number of Borings and Test Holes

Our current subsurface exploration consisted of 5 boring and 10 test holes. The borings and test holes were drilled with a CME-75 drill rig equipped with 8-inch hollow stem augers.

A-1.02 Location of Boring and Test Holes

A map showing the approximate locations of boring and test holes is presented as Figure 1.

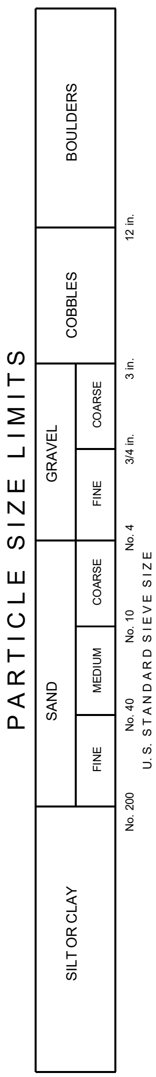
A-1.03 Boring Logging

A log of the boring was prepared by one of our staff and is attached in this appendix. The log contains factual information and interpretation of subsurface conditions between samples. The strata indicated on the log represent the approximate boundary between earth units and the transition may be gradual. The logs show subsurface conditions at the dates and locations indicated, and may not be representative of subsurface conditions at other locations and times.

Identification of the soils encountered during the subsurface exploration was made using the field identification procedure of the Unified Soils Classification System (ASTM D2488). A legend indicating the symbols and definitions used in this classification system and a legend defining the terms used in describing the relative compaction, consistency or firmness of the soil are attached in this appendix.

A-1.04 Soil Infiltration Testing

Three soil infiltration tests were performed using the bore hole percolation test procedure described in the Riverside County Flood Control District Design Handbook for Low Impact Development Best Management Practices. Locations of the tests are shown on Figure 1.



MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES
COARSE GRAINED SOILS (More than 50% of material is LARGER than No. 200 sieve size)	GRAVELS (More than 50% of coarse fraction is LARGER than the No. 4 sieve size.	CLEAN GRAVELS (Little or no fines)	GW	Well graded gravel, gravel-sand mixtures. little or no fines.
			GP	Poorly graded gravel or gravel-sand mixtures, little or no fines.
		GRAVELS WITH FINES (Appreciable amt. of fines)	GM	Silty gravels, gravel-sand-silt mixtures.
			GC	Clayey gravels, gravel-sand-clay mixtures.
	SANDS (More than 50% of coarse fraction is SMALLER than the No. 4 sieve size)	CLEAN SANDS (Little or no fines)	SW	Well graded sands, gravelly sands, little or no fines.
			SP	Poorly graded sands or gravelly sands, little or no fines.
		SANDS WITH FINES (Appreciable amount of fines)	SM	Silty sands, sand-silt mixtures.
			SC	Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS (More than 50% of material is SMALLER than No. 200 sieve size)	SILTS AND CLAYS (Liquid limit LESS than 50)		ML	Inorganic silts and very fine sands, rock flour silty or clayey fine sands or clayey silts with slight plasticity
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
			OL	Organic silts and organic silty clays of low plasticity.
	SILTS AND CLAYS (Liquid limit GREATER than 50)		MH	Inorganic silts, micaceous or diatamaceous fine sandy or silty soils, elastic silts.
			CH	Inorganic clays of high plasticity, fat clays.
			OH	Organic clays of medium to high plasticity, organic silts.
HIGHLY ORGANIC SOILS			Pt	Peat and other highly organic soils.

BOUNDARY CLASSIFICATIONS: Soils possessing characteristics of two groups are designated by combinations of group symbols.

UNIFIED SOIL CLASSIFICATION SYSTEM

I. SOIL STRENGTH/DENSITY

BASED ON STANDARD PENETRATION TESTS

Compactness of sand		Consistency of clay	
Penetration Resistance N (blows/Ft)	Compactness	Penetration Resistance N (blows/ft)	Consistency
0-4	Very Loose	<2	Very Soft
4-10	Loose	2-4	Soft
10-30	Medium Dense	4-8	Medium Stiff
30-50	Dense	8-15	Stiff
>50	Very Dense	15-30	Very Stiff
		>30	Hard

N = Number of blows of 140 lb. weight falling 30 in. to drive 2-in OD sampler 1 ft.

BASED ON RELATIVE COMPACTION

Compactness of sand		Consistency of clay	
% Compaction	Compactness	% Compaction	Consistency
<75	Loose	<80	Soft
75-83	Medium Dense	80-85	Medium Stiff
83-90	Dense	85-90	Stiff
>90	Very Dense	>90	Very Stiff

II. SOIL MOISTURE

Moisture of sands		Moisture of clays	
% Moisture	Description	% Moisture	Description
<5%	Dry	<12%	Dry
5-12%	Moist	12-20%	Moist
>12%	Very Moist	>20%	Very Moist, wet

SOIL DESCRIPTION LEGEND

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Exploratory Boring Log

Boring No. B-1

Date Drilled: 05-06-19
Logged By: KRD
Location: See Boring Location Map

Drilling Equipment: CME-75
Boring Hole Diameter: 8"
Drive Weights: 140 lbs.
Drop: 30"

Depth (ft)	Samples: Sample Type	Samples: Blows (blows/ft)	Samples: Bulk Sample	Moisture Content (%)	Dry Density (pcf)	USCS	Graphic Symbol	Material Description
								This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
0						ML		Older Alluvium: Light brown sandy silt, trace carbonate stringers, slightly moist, medium stiff to stiff with depth.
5	S	13						
10	S	55						Becomes light brown to light reddish brown, dry, hard.
15	S	28						Becomes very stiff.
16.5							End of Boring	Total depth 16.5' No groundwater encountered. Hole backfilled the same day with soil cuttings.
20								
25								

Sample Types:
- R - Ring Sample
- Bulk Sample
- Groundwater
- T - Tube Sample
- S - SPT Sample
- End of Boring

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Exploratory Boring Log

Boring No. B-2
Sheet 1 of 1

Date Drilled:	05-06-19	Drilling Equipment:	CME-75
Logged By:	KRD	Boring Hole Diameter:	8"
Location:	See Boring Location Map	Drive Weights:	140 lbs.
		Drop:	30"

Depth (ft)	Samples: Sample Type	Samples: Blows (blows/ft)	Samples: Bulk Sample	Moisture Content (%)	Dry Density (pcf)	USCS	Graphic Symbol	Material Description
0						ML		Older Alluvium: Brown sandy silt, slightly moist, upper 1' soft (plowed zone) to medium stiff to stiff with depth.
5	S	12						Gray brown sandy silt, moist, non-porous, stiff.
10	S	24						Brown sandy silt, fine sand with trace coarse sand, slightly moist, stiff to very stiff.
15	S	25						
16.5							End of Boring	Total depth 16.5' No groundwater encountered. Hole backfilled the same day with soil cuttings.
20								
25								

Material Description: This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.

Sample Types:
- R - Ring Sample
- Bulk Sample
- Groundwater
- T - Tube Sample
- S - SPT Sample
- End of Boring

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Exploratory Boring Log

Boring No. B-3

Sheet 1 of 1

Date Drilled:	05-06-19	Drilling Equipment:	Geoprobe 7822DT
Logged By:	KRD	Boring Hole Diameter:	8"
Location:	See Boring Location Map	Drive Weights:	140 lbs.
		Drop:	30"

This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.

Depth (ft)	Samples: Sample Type	Samples: Blows (blows/ft)	Samples: Bulk Sample	Moisture Content (%)	Dry Density (pcf)	USCS	Graphic Symbol	Material Description
0						ML		Older Alluvium: Brown sandy silt, fine to medium sand with minor coarse sand, slightly moist, upper 1' soft (plowed zone) to medium stiff to stiff with depth. @2', Becomes dry.
5	S	62						Becomes hard.
10	S	51						
15	S	49						
16.5							End of Boring	Total depth 16.5' No groundwater encountered. Hole backfilled the same day with soil cuttings.
20								
25								

Sample Types:

R - Ring Sample; Bulk Sample; Groundwater

T - Tube Sample; S - SPT Sample; End of Boring

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Exploratory Boring Log

Boring No. B-4
Sheet 1 of 1

Date Drilled:	05-07-19	Drilling Equipment:	CME-75
Logged By:	KRD	Boring Hole Diameter:	8"
Location:	See Boring Location Map	Drive Weights:	140 lbs.
		Drop:	30"

Depth (ft)	Samples: Sample Type	Samples: Blows (blows/ft)	Samples: Bulk Sample	Moisture Content (%)	Dry Density (pcf)	USCS	Graphic Symbol	Material Description
								This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
0						SM		Older Alluvium: Brown sandy silt, fine to coarse sand, slightly moist, medium dense.
5	S	20						
10	S	17						
15	S	22						
16.5								Total depth 16.5' No groundwater encountered. Hole backfilled the same day with soil cuttings.
20								
25								

Sample Types:

- R - Ring Sample
- Bulk Sample
- Groundwater
- T - Tube Sample
- S - SPT Sample
- End of Boring

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Exploratory Boring Log

Boring No. B-5
Sheet 1 of 1

Date Drilled:	05-07-19	Drilling Equipment:	CME-75
Logged By:	KRD	Boring Hole Diameter:	8"
Location:	See Boring Location Map	Drive Weights:	140 lbs.
		Drop:	30"

Depth (ft)	Sample Type	Blows (blows/ft)	Bulk Sample	Moisture Content (%)	Dry Density (pcf)	USCS	Graphic Symbol	Material Description
								This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log show subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.
0						SM		6" Asphaltic Concrete, 4" Base Older Alluvium: Brown sandy silt to silty sand, fine to medium sand, slightly cohesive, moist, loose.
5	S	7						
10	S	13						Becomes brown to reddish brown, occasional coarse sand.
15	S	51						Becomes reddish brown, fine to coarse sand, moist, very dense.
16.5								Total depth 16.5' No groundwater encountered. Hole backfilled the same day with soil cuttings.
20								
25								

Sample Types:
- R - Ring Sample
- Bulk Sample
- Groundwater
- T - Tube Sample
- S - SPT Sample
- End of Boring

Percolation Test Data Sheet

Project:	Kaiser Moreno Valley		Project No.:	19-0918-0		Date:	5/7/2019
Test Hole No.:		P-1	Tested By:	520STA			
Test Hole Depth (In.) , D_T:		60	USCS Soil Classification:		SM		
Test Hole Dimensions (inches)					Length	Width	
Diameter In.) if round=		8	Sides (if rectangular)=		n/a	n/a	
Sandy Soil Criteria*							

Trial No.	Start Time	Stop Time	Time Interval (min.)	Initial Depth to Water (in.)	Final Depth to Water (in.)	Change in Water Level (in.)	Greater than or equal to 6"? (y/n)
1	7:23 AM	7:48 AM	25	38.6	44.4	5.76	No
2	7:53 AM	8:18 AM	25	44.4	46.8	2.40	No

*If two consecutive measurements show that six inches of water seeps away in less than 25 minutes, the test shall be run for an additional hour with measurements taken every 10 minutes. Otherwise, pre-soak (fill) overnight. Obtain at least twelve measurements per hole over at least six hours (approximate 30 minute intervals) with a precision of at least 0.25".

Trial No.	Start Time	Stop Time	Δt Time Interval (min.)	D_o Initial Depth to Water (In.)	D_f Final Depth to Water (In.)	ΔD Change in Water Level (In.)	Percolation Rate (min./in.)
1	7:21 AM	7:51 AM	30	35.6	41.4	5.8	5.2
2	7:52 AM	8:22 AM	30	35.0	39.1	4.1	7.4
3	8:23 AM	8:53 AM	30	35.8	39.6	3.8	7.8
4	8:54 AM	9:24 AM	30	35.4	38.9	3.5	8.6
5	9:24 AM	9:54 AM	30	36.0	39.2	3.2	9.3
6	9:55 AM	10:25 AM	30	36.5	39.5	3.0	10.0
7	10:26 AM	10:56 AM	30	35.9	39.0	3.1	9.6
8	10:57 AM	11:27 AM	30	35.8	38.8	3.0	10.0
9	11:28 AM	11:58 AM	30	36.0	39.0	3.0	10.0
10	11:59 AM	12:30 PM	31	35.4	38.5	3.1	9.9
11	12:31 PM	1:01 PM	30	36.0	39.0	3.0	10.0
12	1:02 PM	1:32 PM	30	35.2	38.4	3.2	9.3

COMMENTS: Sunny, low 60s, dry

Infiltration Rate (in/hr) = $(\Delta H*60min/hr*r)/\Delta t\ (r+2Havg)$

H avg = $(H_o - Hf)/2$

Infiltration Rate (in/hr): 0.51

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Percolation Test Data Sheet

Project:	Kaiser Moreno Valley		Project No.:	19-0918-0	Date:	5/7/2019
Test Hole No.:		P-2	Tested By:	520STA		
Test Hole Depth (In.) , D_T:		60	USCS Soil Classification:	SM		
Test Hole Dimensions (inches)				Length	Width	
Diameter In.) if round=		8	Sides (if rectangular)=	n/a	n/a	

Sandy Soil Criteria*

Trial No.	Start Time	Stop Time	Time Interval (min.)	Initial Depth to Water (in.)	Final Depth to Water (in.)	Change in Water Level (in.)	Greater than or equal to 6"? (y/n)
1	7:55 AM	8:20 AM	25	33.8	34.8	1.00	No
2	8:20 AM	8:45 AM	25	34.8	35.5	0.70	No

*If two consecutive measurements show that six inches of water seeps away in less than 25 minutes, the test shall be run for an additional hour with measurements taken every 10 minutes. Otherwise, pre-soak (fill) overnight. Obtain at least twelve measurements per hole over at least six hours (approximate 30 minute intervals) with a precision of at least 0.25".

Trial No.	Start Time	Stop Time	Δt Time Interval (min.)	D_o Initial Depth to Water (In.)	D_f Final Depth to Water (In.)	ΔD Change in Water Level (In.)	Percolation Rate (min./in.)
1	7:21 AM	7:51 AM	30	31.8	33.0	1.2	25.0
2	7:52 AM	8:22 AM	30	33.0	33.7	0.7	41.7
3	8:23 AM	8:53 AM	30	33.7	34.6	0.8	35.7
4	8:54 AM	9:24 AM	30	34.6	35.8	1.2	25.0
5	9:24 AM	9:54 AM	30	35.8	35.9	0.1	250.0
6	9:55 AM	10:25 AM	30	35.9	36.4	0.5	62.5
7	10:26 AM	10:56 AM	30	35.4	36.0	0.6	50.0
8	10:57 AM	11:27 AM	30	36.0	36.6	0.6	50.0
9	11:28 AM	11:58 AM	30	36.6	37.2	0.6	50.0
10	11:59 AM	12:30 PM	33	37.2	37.8	0.6	55.0
11	12:31 PM	1:01 PM	30	36.2	36.8	0.6	50.0
12	1:02 PM	1:32 PM	30	36.8	37.4	0.6	50.0

COMMENTS: Sunny, low 60s, dry

Infiltration Rate (in/hr) = $(\Delta H*60min/hr*r)/\Delta t\ (r+2Havg)$

H avg = $(H_o - Hf)/2$

Infiltration Rate (in/hr): 0.10

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Percolation Test Data Sheet

Project:	Kaiser Moreno Valley		Project No.:	19-0918-0		Date:	5/7/2019
Test Hole No.:		P-3	Tested By:	520STA			
Test Hole Depth (In.) , D_T:		60	USCS Soil Classification:		SM		
Test Hole Dimensions (inches)					Length	Width	
Diameter In.) if round=		8	Sides (if rectangular)=		n/a	n/a	
Sandy Soil Criteria*							
Trial No.	Start Time	Stop Time	Time Interval (min.)	Initial Depth to Water (in.)	Final Depth to Water (in.)	Change in Water Level (in.)	Greater than or equal to 6"? (y/n)
1	8:04 AM	8:29 AM	25	43.6	43.8	0.20	No
2	8:29 AM	8:54 AM	25	43.8	44.2	0.40	No

*If two consecutive measurements show that six inches of water seeps away in less than 25 minutes, the test shall be run for an additional hour with measurements taken every 10 minutes. Otherwise, pre-soak (fill) overnight. Obtain at least twelve measurements per hole over at least six hours (approximate 30 minute intervals) with a precision of at least 0.25".

Trial No.	Start Time	Stop Time	Δt Time Interval (min.)	D_o Initial Depth to Water (In.)	D_f Final Depth to Water (In.)	ΔD Change in Water Level (In.)	Percolation Rate (min./in.)
1	7:43 AM	8:13 AM	30	36.0	42.4	6.4	4.7
2	8:14 AM	8:44 AM	30	36.0	39.5	3.5	8.6
3	8:45 AM	9:15 AM	30	35.4	38.2	2.8	10.9
4	9:16 AM	9:46 AM	30	35.6	37.7	2.0	14.7
5	9:47 AM	10:17 AM	30	35.4	37.4	2.0	14.7
6	10:18 AM	10:48 AM	30	35.4	37.3	1.9	15.6
7	10:49 AM	11:19 AM	30	35.4	37.0	1.6	19.2
8	1:20 AM	11:50 AM	30	36.0	37.2	1.2	25.0
9	11:51 AM	12:21 PM	30	36.0	37.0	1.0	31.3
10	12:22 PM	12:52 PM	30	36.0	37.0	1.0	31.3
11	12:53 PM	1:23 PM	30	36.1	37.0	0.8	35.7
12	1:24 PM	1:54 PM	30	36.2	37.1	0.8	35.7

COMMENTS: Sunny, low 60s, dry

Infiltration Rate (in/hr) = $(\Delta H*60min/hr*r)/\Delta t\ (r+2Havg)$

H avg = $(H_o - Hf)/2$

Infiltration Rate (in/hr): 0.13

Percolation Test Data Sheet

Project:	Kaiser Moreno Valley		Project No.:	19-0918-0		Date:	5/7/2019
Test Hole No.:		P-4	Tested By:	520STA			
Test Hole Depth (In.) , D_T:		60	USCS Soil Classification:		SM		
Test Hole Dimensions (inches)					Length	Width	
Diameter In.) if round=		8	Sides (if rectangular)=		n/a	n/a	
Sandy Soil Criteria*							
Trial No.	Start Time	Stop Time	Time Interval (min.)	Initial Depth to Water (in.)	Final Depth to Water (in.)	Change in Water Level (in.)	Greater than or equal to 6"? (y/n)
1	8:35 AM	8:59 AM	25	38.4	41.3	2.90	No
2	8:59 AM	9:24 AM	25	41.3	44.4	3.10	No

*If two consecutive measurements show that six inches of water seeps away in less than 25 minutes, the test shall be run for an additional hour with measurements taken every 10 minutes. Otherwise, pre-soak (fill) overnight. Obtain at least twelve measurements per hole over at least six hours (approximate 30 minute intervals) with a precision of at least 0.25".

Trial No.	Start Time	Stop Time	Δt Time Interval (min.)	D_o Initial Depth to Water (In.)	D_f Final Depth to Water (In.)	ΔD Change in Water Level (In.)	Percolation Rate (min./in.)
1	7:41 AM	8:11 AM	30	35.2	43.9	8.8	3.4
2	8:12 AM	8:42 AM	30	36.5	43.7	7.2	4.2
3	8:43 AM	9:13 AM	30	35.6	42.0	6.4	4.7
4	9:14 AM	9:44 AM	30	35.3	40.7	5.4	5.6
5	9:45 AM	10:15 AM	30	35.9	40.9	5.0	6.0
6	10:16 AM	10:46 AM	30	36.2	40.8	4.6	6.6
7	10:47 AM	11:17 AM	30	35.2	37.9	2.8	10.9
8	11:18 AM	11:48 AM	30	35.4	36.8	1.4	20.8
9	11:49 AM	12:20 PM	30	35.4	36.6	1.2	25.0
10	12:21 PM	12:51 PM	30	35.8	37.2	1.4	20.8
11	12:52 PM	1:22 PM	30	36.1	37.9	1.8	16.7
12	1:23 PM	1:53 PM	30	36.1	37.4	1.3	22.7
13	1:54 PM	2:24 PM	30	36.1	37.4	1.3	22.7

COMMENTS: Sunny, low 60s, dry

Infiltration Rate (in/hr) = $(\Delta H*60min/hr*r)/\Delta t\ (r+2Havg)$

H avg = $(H_o - Hf)/2$

Infiltration Rate (in/hr): 0.21

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Percolation Test Data Sheet

Project:	Kaiser Moreno Valley		Project No.:	19-0918-0		Date:	5/7/2019
Test Hole No.:		P-5	Tested By:	520STA			
Test Hole Depth (In.) , D_T:		60	USCS Soil Classification:		SM		
Test Hole Dimensions (inches)					Length	Width	
Diameter In.) if round=		8	Sides (if rectangular)=		n/a	n/a	
Sandy Soil Criteria*							
Trial No.	Start Time	Stop Time	Time Interval (min.)	Initial Depth to Water (in.)	Final Depth to Water (in.)	Change in Water Level (in.)	Greater than or equal to 6"? (y/n)
1	9:36 AM	10:01 AM	25	34.8	42.6	7.80	Yes
2	10:07 AM	10:32 AM	25	42.6	47.0	4.40	No

*If two consecutive measurements show that six inches of water seeps away in less than 25 minutes, the test shall be run for an additional hour with measurements taken every 10 minutes. Otherwise, pre-soak (fill) overnight. Obtain at least twelve measurements per hole over at least six hours (approximate 30 minute intervals) with a precision of at least 0.25".

Trial No.	Start Time	Stop Time	Δt Time Interval (min.)	D_o Initial Depth to Water (In.)	D_f Final Depth to Water (In.)	ΔD Change in Water Level (In.)	Percolation Rate (min./in.)
1	7:32 AM	8:02 AM	30	36.0	41.6	5.6	5.3
2	8:03 AM	8:33 AM	30	36.0	40.6	4.6	6.6
3	8:34 AM	9:04 AM	30	36.6	40.7	4.1	7.4
4	9:05 AM	9:35 AM	30	36.4	40.3	4.0	7.6
5	9:36 AM	10:06 AM	30	35.3	39.4	4.1	7.4
6	10:07 AM	10:37 AM	30	36.4	40.1	3.7	8.1
7	10:38 AM	11:09 AM	31	34.4	38.8	4.3	7.2
8	11:10 AM	11:40 AM	30	34.6	38.6	4.1	7.4
9	11:41 AM	12:11 PM	30	35.6	39.2	3.6	8.3
10	12:12 PM	12:42 PM	30	35.8	39.4	3.6	8.3
11	12:43 PM	1:13 PM	30	36.2	39.8	3.6	8.3
12	1:14 PM	1:44 PM	30	36.0	39.6	3.6	8.3

COMMENTS: Sunny, low 60s, dry

Infiltration Rate (in/hr) = $(\Delta H*60min/hr*r)/\Delta t\ (r+2Havg)$

H avg = $(H_o - Hf)/2$

Infiltration Rate (in/hr): 0.60

Percolation Test Data Sheet

Project:	Kaiser Moreno Valley		Project No.:	19-0918-0		Date:	5/7/2019
Test Hole No.:		P-6	Tested By:	520STA			
Test Hole Depth (In.) , D_T:		60	USCS Soil Classification:		SM		
Test Hole Dimensions (inches)					Length	Width	
Diameter In.) if round=		8	Sides (if rectangular)=		n/a	n/a	
Sandy Soil Criteria*							
Trial No.	Start Time	Stop Time	Time Interval (min.)	Initial Depth to Water (in.)	Final Depth to Water (in.)	Change in Water Level (in.)	Greater than or equal to 6"? (y/n)
1	9:39 AM	10:04 AM	25	26.2	30.5	4.30	No
2	10:07 AM	10:32 AM	25	30.5	34.2	3.70	No

*If two consecutive measurements show that six inches of water seeps away in less than 25 minutes, the test shall be run for an additional hour with measurements taken every 10 minutes. Otherwise, pre-soak (fill) overnight. Obtain at least twelve measurements per hole over at least six hours (approximate 30 minute intervals) with a precision of at least 0.25".

Trial No.	Start Time	Stop Time	Δt Time Interval (min.)	D_o Initial Depth to Water (In.)	D_f Final Depth to Water (In.)	ΔD Change in Water Level (In.)	Percolation Rate (min./in.)
1	7:35 AM	8:05 AM	30	36.0	38.5	2.5	11.9
2	8:06 AM	8:36 AM	30	34.9	37.2	2.3	13.2
3	8:37 AM	9:07 AM	30	35.6	37.7	2.0	14.7
4	9:08 AM	9:38 AM	30	35.9	37.6	1.7	17.9
5	9:39 AM	10:09 AM	30	35.5	37.3	1.8	16.7
6	10:10 AM	10:40 AM	30	35.5	37.2	1.7	17.9
7	10:41 AM	11:11 AM	30	35.2	37.1	1.9	15.6
8	11:12 AM	11:42 AM	30	34.4	36.2	1.8	16.7
9	11:43 AM	12:13 PM	30	35.3	37.0	1.7	17.9
10	12:14 PM	12:44 PM	30	36.1	37.8	1.7	17.9
11	12:45 PM	1:15 PM	30	36.5	38.2	1.7	17.9
12	1:16 PM	1:46 PM	30	35.5	37.2	1.7	17.9

COMMENTS: Sunny, low 60s, dry

Infiltration Rate (in/hr) = $(\Delta H*60min/hr*r)/\Delta t\ (r+2Havg)$

H avg = $(H_o - Hf)/2$

Infiltration Rate (in/hr): 0.26

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Percolation Test Data Sheet

Project:	Kaiser Moreno Valley		Project No.:	19-0918-0		Date:	5/8/2019
Test Hole No.:		P-7	Tested By:	520STA			
Test Hole Depth (In.) , D_T:		60	USCS Soil Classification:		SM		
Test Hole Dimensions (inches)					Length	Width	
Diameter In.) if round=		8	Sides (if rectangular)=		n/a	n/a	

Sandy Soil Criteria*

Trial No.	Start Time	Stop Time	Time Interval (min.)	Initial Depth to Water (in.)	Final Depth to Water (in.)	Change in Water Level (in.)	Greater than or equal to 6"? (y/n)
1	8:12 AM	8:37 AM	25	26.0	40.0	14.00	Yes
2	10:00 AM	10:25 AM	25	24.0	33.0	9.00	Yes

*If two consecutive measurements show that six inches of water seeps away in less than 25 minutes, the test shall be run for an additional hour with measurements taken every 10 minutes. Otherwise, pre-soak (fill) overnight. Obtain at least twelve measurements per hole over at least six hours (approximate 30 minute intervals) with a precision of at least 0.25".

Trial No.	Start Time	Stop Time	Δt Time Interval (min.)	D_o Initial Depth to Water (In.)	D_f Final Depth to Water (In.)	ΔD Change in Water Level (In.)	Percolation Rate (min./in.)
1	8:21 AM	8:31 AM	10	47.3	50.3	3.0	3.3
2	8:32 AM	8:42 AM	10	48.0	50.2	2.2	4.6
3	8:43 AM	8:53 AM	10	47.9	49.7	1.8	5.6
4	8:54 AM	9:04 AM	10	48.0	49.8	1.8	5.6
5	9:05 AM	9:15 AM	10	48.0	49.6	1.6	6.4
6	9:16 AM	9:26 AM	10	48.0	49.1	1.1	9.3
7	9:27 AM	9:37 AM	10	47.9	49.1	1.2	8.3
8	9:38 AM	9:48 AM	10	47.9	49.1	1.2	8.3
9							
10							
11							
12							

COMMENTS: Sunny, low 60s, dry

Infiltration Rate (in/hr) = $(\Delta H*60min/hr*r)/\Delta t\ (r+2Havg)$

H avg = $(H_o - Hf)/2$

Infiltration Rate (in/hr): 1.07

Percolation Test Data Sheet

Project:	Kaiser Moreno Valley		Project No.:	19-0918-0		Date:	5/8/2019
Test Hole No.:		P-8	Tested By:	520STA			
Test Hole Depth (In.) , D_T:		60	USCS Soil Classification:		SM		
Test Hole Dimensions (inches)					Length	Width	
Diameter In.) if round=		8	Sides (if rectangular)=		n/a	n/a	
Sandy Soil Criteria*							
Trial No.	Start Time	Stop Time	Time Interval (min.)	Initial Depth to Water (in.)	Final Depth to Water (in.)	Change in Water Level (in.)	Greater than or equal to 6"? (y/n)
1	8:10 AM	8:35 AM	25	29.0	42.0	13.00	Yes
2	9:57 AM	10:22 AM	25	26.5	36.0	9.50	Yes

*If two consecutive measurements show that six inches of water seeps away in less than 25 minutes, the test shall be run for an additional hour with measurements taken every 10 minutes. Otherwise, pre-soak (fill) overnight. Obtain at least twelve measurements per hole over at least six hours (approximate 30 minute intervals) with a precision of at least 0.25".

Trial No.	Start Time	Stop Time	Δt Time Interval (min.)	D_o Initial Depth to Water (In.)	D_f Final Depth to Water (In.)	ΔD Change in Water Level (In.)	Percolation Rate (min./in.)
1	8:23 AM	8:33 AM	10	39.6	41.6	2.0	4.9
2	8:34 AM	8:44 AM	10	39.0	40.7	1.7	6.0
3	8:45 AM	8:55 AM	10	37.9	39.7	1.8	5.6
4	8:56 AM	9:06 AM	10	37.7	39.2	1.6	6.4
5	9:07 AM	9:17 AM	10	38.2	39.6	1.4	6.9
6	9:18 AM	9:28 AM	10	38.2	39.6	1.4	6.9
7	9:29 AM	9:39 AM	10	37.9	39.2	1.3	7.6
8							
9							
10							
11							
12							

COMMENTS: Sunny, low 60s, dry

Infiltration Rate (in/hr) = $(\Delta H*60min/hr*r)/\Delta t\ (r+2Havg)$

H avg = $(H_o - Hf)/2$

Infiltration Rate (in/hr): 0.68

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Percolation Test Data Sheet

Project:	Kaiser Moreno Valley		Project No.:	19-0918-0		Date:	5/8/2019
Test Hole No.:		P-9	Tested By:	520STA			
Test Hole Depth (In.) , D_T:		60	USCS Soil Classification:		SM		
Test Hole Dimensions (inches)					Length	Width	
Diameter In.) if round=		8	Sides (if rectangular)=		n/a	n/a	
Sandy Soil Criteria*							

Trial No.	Start Time	Stop Time	Time Interval (min.)	Initial Depth to Water (in.)	Final Depth to Water (in.)	Change in Water Level (in.)	Greater than or equal to 6"? (y/n)
1	9:23 AM	9:48 AM	25	15.0	29.0	14.00	Yes
2	9:48 AM	10:13 AM	25	13.0	24.0	11.00	Yes

*If two consecutive measurements show that six inches of water seeps away in less than 25 minutes, the test shall be run for an additional hour with measurements taken every 10 minutes. Otherwise, pre-soak (fill) overnight. Obtain at least twelve measurements per hole over at least six hours (approximate 30 minute intervals) with a precision of at least 0.25".

Trial No.	Start Time	Stop Time	Δt Time Interval (min.)	D_o Initial Depth to Water (In.)	D_f Final Depth to Water (In.)	ΔD Change in Water Level (In.)	Percolation Rate (min./in.)
1	10:14 AM	10:24 AM	10	35.4	37.7	2.3	4.4
2	10:25 AM	10:35 AM	10	36.0	37.8	1.8	5.6
3	10:36 AM	10:46 AM	10	35.8	37.7	1.9	5.2
4	10:47 AM	10:57 AM	10	35.4	37.2	1.8	5.6
5	10:58 AM	11:08 AM	10	35.4	37.2	1.8	5.6
6	11:09 AM	11:19 AM	10	35.5	37.3	1.8	5.6
7	11:20 AM	11:30 AM	10	35.4	37.2	1.8	5.6
8							
9							
10							
11							
12							

COMMENTS: Sunny, low 60s, dry

Infiltration Rate (in/hr) = $(\Delta H*60min/hr*r)/\Delta t\ (r+2Havg)$

H avg = $(H_o - Hf)/2$

Infiltration Rate (in/hr): 0.84

GEOTECHNICAL CONSULTANTS

Percolation Test Data Sheet

Project:	Kaiser Moreno Valley		Project No.:	19-0918-0		Date:	5/8/2019
Test Hole No.:		P-10	Tested By:	520STA			
Test Hole Depth (In.) , D_T:		60	USCS Soil Classification:		SM		
Test Hole Dimensions (inches)					Length	Width	
Diameter In.) if round=		8	Sides (if rectangular)=		n/a	n/a	

Sandy Soil Criteria*

Trial No.	Start Time	Stop Time	Time Interval (min.)	Initial Depth to Water (in.)	Final Depth to Water (in.)	Change in Water Level (in.)	Greater than or equal to 6"? (y/n)
1	9:26 AM	9:51 AM	25	16.0	24.0	8.00	Yes
2	9:51 AM	10:16 AM	25	9.0	13.0	4.00	No

*If two consecutive measurements show that six inches of water seeps away in less than 25 minutes, the test shall be run for an additional hour with measurements taken every 10 minutes. Otherwise, pre-soak (fill) overnight. Obtain at least twelve measurements per hole over at least six hours (approximate 30 minute intervals) with a precision of at least 0.25".

Trial No.	Start Time	Stop Time	Δt Time Interval (min.)	D_o Initial Depth to Water (In.)	D_f Final Depth to Water (In.)	ΔD Change in Water Level (In.)	Percolation Rate (min./in.)
1	10:12 AM	10:42 AM	30	35.0	39.0	4.0	7.6
2	10:43 AM	11:13 AM	30	35.4	39.0	3.6	8.3
3	11:14 AM	11:44 AM	30	35.6	39.0	3.4	8.9
4	11:45 AM	12:15 PM	30	35.5	39.0	3.5	8.6
5	12:16 PM	12:46 PM	30	35.5	38.8	3.2	9.3
6	12:47 PM	1:17 PM	30	35.6	38.8	3.1	9.6
7	1:18 PM	1:48 PM	30	35.4	38.5	3.1	9.6
8	1:49 PM	2:19 PM	30	35.8	38.8	3.0	10.0
9	2:20 PM	2:50 PM	30	35.5	38.8	3.2	9.3
10	2:51 PM	3:21 PM	30	35.8	38.8	3.0	10.0
11	3:22 PM	3:52 PM	30	35.4	38.4	3.0	10.0
12	3:53 PM	4:23 PM	30	35.5	38.5	3.0	10.0

COMMENTS: Sunny, low 60s, dry

Infiltration Rate (in/hr) = $(\Delta H*60min/hr*r)/\Delta t\ (r+2Havg)$

H avg = $(H_o - Hf)/2$

Infiltration Rate (in/hr): 0.48

APPENDIX B

REFERENCES

APPENDIX B

REFERENCES

1. Morton M.M., Matti, J.C., 2001, Geologic Map of the Sunnymead 7.5' Quadrangles, Riverside County, California: Open-File Report 01-450.

2. GeoBase, Inc., 2017, Geotechnical Report, Kaiser Permanente, Moreno Valley Medical Center, Diagnostic and Treatment (D&T) Building, 27300 Iris Avenue, Moreno Valley, California, prepared for Kaiser Foundation Health Plan, Inc., dated August 2017.

3. Riverside County – Low Impact Development BMP Design Handbook, 2011, Appendix A – Infiltration Testing

4. Santa Ana Regional Water Quality Control Board, 2012, Water Quality Management Plan: A Guidance Document for the Santa Ana Region of Riverside County prepared with assistance from Brown and Caldwell, and Dan Cloak Environmental Consulting.

GEOTECHNICAL REPORT

KAISER PERMANENTE

MORENO VALLEY MEDICAL CENTER
CENTRAL UTILITY PLANT (CUP)
27300 IRIS AVENUE
MORENO VALLEY, CALIFORNIA

GEOBASE, INC.

GEOTECHNICAL REPORT

KAISER PERMANENTE

MORENO VALLEY MEDICAL CENTER
CENTRAL UTILITY PLANT (CUP)
27300 IRIS AVENUE
MORENO VALLEY, CALIFORNIA

Prepared for:

Kaiser Foundation Health Plan, Inc.
Moreno Valley, California

By:
GEOBASE, INC.
23362 Peralta Drive, Unit 4
Laguna Hills, California 92653
(949) 588-3744

August 2017
Project No. C.314.82.00

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I. INTRODUCTION

1.1 General

Kaiser Foundation Health Plan, Inc. is planning the construction of a new Central Utility Plant (CUP) on the Moreno Valley Medical Center (MVMC) campus, located at 27300 Iris Avenue, in the City of Moreno Valley, California. The MVMC campus location is shown on Figure A-1, Appendix A and the proposed new CUP location is shown on Figure A-2, Appendix A. GEOBASE, INC. (GEOBASE) was retained by Kaiser Foundation Health Plan, Inc. to complete a geotechnical investigation for the proposed new CUP.

For this geotechnical investigation we were provided with:

- A site plan, prepared by CO Architects, showing the existing Hospital and existing CUP, and proposed new CUP. This plan is reproduced herein as Figure A-2, Appendix A, Site, Boring and CPT Locations Plan.
- Topographic Survey Plan prepared by SB&O Inc. dated October 27, 2009 showing the layout of the existing buildings and site features. The location of the proposed New CUP, borings, CPT's and geophysical survey lines have been added to this plan which is presented herein as Figure A-3, Appendix A, Site Topographic Survey Plan.
- Geotechnical reports pertinent to the site (see references).

This geotechnical report incorporates results of the field and laboratory testing, and the geologic-seismic study, as required by the guidelines prepared by the Department of Conservation, California Geological Survey (CGS) and the California Office of Statewide Health and Planning Department (OSHPD). Both general and specific recommendations pertinent to suitable site development and foundation design, respectively, are provided. Construction guidelines related to the geotechnical aspects of the project are also addressed.

1.2 Objectives of the Geotechnical Investigation

The objectives of the geotechnical investigation are to obtain soil parameters and an understanding of site geologic conditions in order to provide recommendations pertinent to suitable site development and foundation design. These recommendations will assist with final design and construction of the project as planned.

1.3 Scope of Services

To achieve the objectives of the geotechnical investigation, stated above, the services provided during the course of this investigation included:

- a review of available published and unpublished geotechnical, geological and seismological reports, and maps pertinent to the site.
- Field exploration program consisting of advancing eleven (11) borings, fourteen (14) Cone Penetration Tests (CPT) and one (1) test pit;
- Logging the borings and test pit, and selection of samples representative of the materials encountered for laboratory testing;
- Field testing consisting of the Standard Penetration Test (SPT) and CPT, including shear wave velocity measurements;
- Field testing consisting of two (2) geophysical survey lines, utilizing multi–channel array surface wave (MASW) methods.
- Selection of appropriate laboratory tests and laboratory testing;
- Evaluation of data obtained from the above, and engineering analyses; and,
- Preparation of this report describing the field investigation, summarizing the results of field testing, laboratory testing and engineering analyses, and providing appropriate recommendations for site development and foundation design.

II. PREVIOUS RELEVANT REPORT

GEOBASE has completed a geotechnical investigation of the existing hospital addition and existing CUP for Kaiser Foundation Health Plan, Inc. The results of this investigation were presented in a report titled "Geotechnical Investigation, Kaiser Permanente MVCH, Hospital Addition and CUP, 27300 Iris Avenue, Moreno Valley, California" (GEOBASE, 2010). This report was approved by the regulating agencies and the Emergency Room Expansion was built. Relevant field boring logs, CPT's and laboratory test results of the aforementioned geotechnical investigation have been evaluated and are incorporated in this investigation as supplemental data.

The locations of the pertinent borings and CPT's are shown on Figures A-2 and A-3, Appendix A. Relevant laboratory test data are presented in Appendices B and C.

III. SITE AND PROJECT DESCRIPTIONS

3.1 Site Description

The Kaiser Permanente - Moreno Valley Medical Center (MVMC) site is located on an approximately twenty (20) acre site at 27300 Iris Avenue, in the City of Moreno Valley, California. The MVMC site is bounded by medical office buildings to the east and west, Iris Avenue to the south, and an empty/vacant lot to the north. The site is gently sloping to the north and is occupied by the Hospital, the CUP, a medical office building (MOB), and at-grade parking and driveways.

3.2 Project Description

The proposed new CUP is located at the northeast corner of the MVMC site, as shown on the Site, Boring and CPT Locations Plan, Figure A-2, Appendix A.

The new CUP project area consists of vacant land and slopes gently to the northwest, approximately two (2) percent. Proposed construction is anticipated to consist of a three (3) storey at-grade structure. Column loads were not available at the time of writing this report.

IV. SITE INVESTIGATION

4.1 Field Program

The field investigation for the proposed MVMC site was carried out on June 07, 08, 09 and 22, 2017 by advancing eleven (11) borings using a truck-mounted CME-75 drill rig fitted with hollow-stem augers, fourteen (14) CPT's and one (1) test pit. The borings, CPT's and test pit were located in the field by utilizing a Trumeter 550SE (roll-a-tape) and elevations were estimated from Site, Boring, CPT Locations Plan and Site Topographic Survey Plan (Figures A-2 and A-3, respectively, Appendix A). Therefore, the locations and elevations should be considered accurate only to the degree implied by the methods used.

Geophysical survey lines, utilizing multi-channel array surface wave (MASW) methods, were conducted by GeoVision Geophysical Services, Inc. on July 10, 2017.

Three (3) borings (B-9 thru B-11, inclusive) and four (4) CPT's (CPT-6 and CPT-12 thru CPT-14, inclusive) advanced during this investigation are considered relevant to the proposed new CUP. All borings and CPT's at the MVMC site were advanced to maximum penetration depths of seventy-one and one-half (71.5) feet and seventy-five (75) feet, respectively, except for CPT-2 and CPT-5 locations where refusal was obtained at shallow depths. In this respect, the test pit was excavated at CPT-5 location and advanced to eighteen (18) feet depth, beyond the depth at which refusal was obtained, to confirm that refusal was due to a hard soil layer. Two (2) seismic CPT's (SCPT-4 and SCPT-12) were advanced to a depth of 100 feet to determine shear wave velocities of the subsoils. All borings were hand-augered in the upper five (5) feet.

The Log of Borings, together with the Explanation of Terms and Symbols used are shown on Figures B-1 thru B-12, inclusive, CPT plots are presented on Figures B-13 thru B-26, inclusive, and the Log of Test Pit on Figure B-27, Appendix B. Relevant borings and CPT's from a previous investigation (GEOBASE, 2010) are presented herein as Figures B-28 thru B-31, inclusive, Appendix B.

Field testing consisted of: Standard Penetration Test (SPT); Cone Penetration Tests (CPT's), including Seismic Cone Penetration Testing at two (2) CPT locations (SCPT-4 and SCPT-12) to determine the shear wave velocities of the subsoils; and, geophysical survey lines to determine shear wave velocities of the subsoils.

- The SPT test (ASTM D 1586) involves failure of the soil around the tip of a split spoon sampler for a condition of constant energy transmittal. The split spoon, two (2) inches outside diameter and one and three-eights (1-3/8) inches inside diameter, is driven eighteen (18) inches and the number of blows required to drive the sampler the last foot is recorded as the "N" value, or SPT blow count. The driving energy is provided by a 140-pound weight dropping thirty (30) inches.

- The Cone Penetration Tests (CPT's) were performed in accordance with ASTM D 3441. The CPT equipment consists of a cone assembly mounted at the end of a series of hollow sounding rods. A set of hydraulic rams is used to push the cone and rods into the soil, and a continuous record of cone tip resistance, friction resistance and pore water pressures versus depth is obtained in digital form at the ground surface. A specially designed truck is used to transport and house the test equipment and to provide a ten (10) ton reaction to the thrust of the hydraulic rams. Near-continuous CPT records provide: approximate correlations with soil classification; relatively accurate definition of the thickness of various soil layers; subsoils data for liquefaction and seismic settlement analyses; and, engineering properties of the subsoils for static settlement analyses.

- Shear wave velocity measurements were carried out at five (5) foot intervals at two (2) CPT locations, SCPT-4 and SCPT-12.
- Two (2) geophysical survey lines utilizing multi-channel array surface wave (MASW) methods were completed to obtain the shear wave velocity profile of the subsoils. A discussion of field procedures, geophysical techniques, data processing and interpretation, and the results of the geophysical survey are given in Appendix B.

Sampling consisted of:

- Collection of bulk samples at selected locations retrieved from the auger;
- Collection of samples retrieved from the Standard Penetration Test (SPT) split spoon sampler; and,
- Collection of soil samples at selected locations using a Modified California Sampler. The soil samples were retained in a series of brass rings, each having an inside diameter of 2.41 inches and a height of one (1) inch. These ring samples were placed in close- fitting, moisture-tight containers for shipment to the laboratory.

4.2 <u>Laboratory Testing</u>

The samples obtained during the field program were returned to the laboratory for visual examination and testing. The soils were classified in accordance with ASTM D 2487 and D 2488.

The laboratory testing program consisted of the following:

- Laboratory determination of water (moisture) content of soils, rock, and soil-aggregate mixtures (ASTM D 2216), and dry density (ASTM D 2937);

- Particle size analysis of soils (ASTM D 422);
- Standard test methods for amount of material in soils finer than the No. 200 Sieve (ASTM D1140); and,
- Atterberg Limits (ASTM D 4318);
- Direct shear test of soils (ASTM D 3080);
- Consolidation tests (ASTM D 2435);
- Maximum dry density and optimum moisture content (ASTM D 1557);
- Expansion potential of soils (ASTM D 4829);
- Resistance R-Value (CT 301); and,
- Water soluble sulfate content of soils (CT 417); pH and electrical resistivity (CT 643); and water soluble chlorides (CT 422).

The laboratory test results from this investigation and previous investigation (GEOBASE, 2010) are presented on the Log of Borings, Figures B-2 thru B-12, inclusive, and B-28 and B-29, Appendix B, where applicable and in Appendix C.

V. GEOLOGIC SETTING

5.1 Regional Geology

The MVMC site is located in the Northern portion of the Peninsular Ranges Physiographic Province of California on a structural unit known as the Perris Block (CGS, 2002). The Perris Block is bounded on the northeast by the San Jacinto Fault Zone, on the southwest by the Elsinore Fault Zone, and on the north by the Cucamonga Fault Zone. The southern boundary of the Perris Block is not as distinct, but is believed to coincide with a complex group of faults trending southeast from the Murrieta, California area (Kennedy, 1977 and Mann, 1955). The Peninsular Ranges are characterized by northwest trending elongated alluvial valleys and by elevated Mesozoic age intrusive rock masses of the California batholith, flanked by metavolcanic and metasedimentary rocks that form the mountainous portions of the province. Various thicknesses of alluvial sediments derived from the erosion of the elevated portions of the region fill the low-lying areas such as the Moreno Valley where the site is located. According to Morton and Matti (2001), the sediments that infill the Moreno Valley have been differentiated into Holocene and late Pleistocene age young alluvial fan and alluvial valley deposits and into very old alluvial fan deposits of early Pleistocene age. Maximum depths of valley fill in the area are reported to reach approximately 900 feet in the western and northern portions of the San Jacinto Groundwater Basin, where the site is located, but may exceed 5,000 feet in the eastern part of the same basin between the Casa Loma and Claremont faults (CDWR, 2006). Morton and Matti (2001) indicate that the young alluvial fan and valley deposits consist predominantly of sandy materials with silty, gravelly and cobbly interbeds. The very old alluvial fan deposits are reported to consist of mostly well-dissected, well-indurated sand deposits that typically flank the bedrock outcrops in the immediate vicinity. Very old alluvium underlies the subject site whereas Cretaceous age quartz diorite constitutes the hilly areas of the Perris State Recreational area to the south. The alluvial sequence at the site is inferred to rest unconformably on Cretaceous age crystalline bedrock. Figure A-4, Appendix A, presents the Regional Geology Map.

5.2 Site Geology

The MVMC is located near the foothills of the mountains that constitute the Perris State Recreational area to the south. The site is located at an approximate elevation of 1,530 feet above mean sea level (amsl) on a gently northwest sloping surface that grades down towards the Moreno Valley (Figures A-1 and A-4, Appendix A). Drainage at the site area is presently controlled by storm run-off sewers, street and/or natural drainages.

GEOBASE advanced four (4) exploratory soil borings and three (3) cone penetration tests (CPT's) at the site in 2010, and an additional eleven (11) borings, fourteen (14) CPT's and one (1) test pit in June 2017 (Figure A-2, Appendix A, Site, Boring and CPT Locations Plan). Soil borings were drilled to a maximum depth of seventy-one and one-half (71.5) feet, whereas the CPT's had a maximum depth that ranged up to 100 feet.

All the soil borings and CPT's advanced by GEOBASE to a maximum depth of seventy-one and one-half (71.5) and 100 feet below ground surface (bgs), respectively, confirm that the MVMC site is underlain by unconsolidated Quaternary alluvial fan deposits covered by a thin mantle of man-made fill (Figures B-2 thru B-31, inclusive, Appendix B). The man-made fill materials consist of approximately up to eight (8.0) feet of predominantly brown, silty sands (SM) at the boring locations. The unconsolidated alluvium consists predominantly of medium-grained brown silty sands with a five (5.0) to ten (10.0) foot thick orange to brown, silt (ML) interbed in the upper twenty-five (25) feet. This silt (ML) interbed was not encountered at soil boring location B-4. A five (5) foot thick silty layer was also encountered at fifty (50) to fifty-five (55) and fifty-five (55) to sixty (60) feet bgs at boring locations B-6 and B-3, respectively. The density of the alluvial materials at the site generally increases with depth. Unconsolidated alluvial materials were encountered to the total depth of penetration of all the soil borings that have been advanced at the site.

Our interpreted surface distribution of geologic materials encountered during the site investigations is illustrated in Figure A-2, Appendix A. Geologic Sections A-A' and B-B' across the new CUP site are given on Figures A-5 and A-6, Appendix A, respectively.

VI. SUBSURFACE CONDITIONS

6.1 Subsoil Conditions

At the boring and CPT locations within paved areas, the pavement section consisted of approximately four (4) to six (6) inches of asphaltic concrete overlying approximately four (4) to five (5) inches of aggregate base.

The generalized stratigraphic profile, at the boring locations relevant to the new CUP, consisted of up to five (5) feet of fill soils overlying native silty sands and sands with traces of gravel to the maximum depth of exploration, sixty-one and one-half (61.5) feet. The fill soils may be thicker at other locations. Unless a compaction report is made available, these fills are considered "undocumented fills".

The SPT test results and CPT data indicate that the native silts and silty sands can be generally inferred to be in a "stiff" to "hard" and "medium dense" to "very dense" state, respectively; however, very loose silts and silty sands were encountered at shallow depths.

The silty samples tested showed non-plastic behavior, and the soil natural moisture contents ranged from four (4) to thirteen (13) percent, with the higher values measured in the siltier samples. Expansion potential of the samples tested showed "very low" potential for expansion(Expansion Indices = 4 at the new CUP location; and, 0 to 12 at the MVMC site).

6.2 Regional Groundwater Conditions

The MVMC site is located in the western portion of the San Jacinto Groundwater Basin. The San Jacinto Groundwater Basin underlies San Jacinto, Perris, Moreno, and Menifee Valleys in western Riverside County. This basin is bounded by the San Jacinto Mountains on the east, the San Timoteo Badlands on the northeast, the Box Mountains on the north, the Santa Rosa Hills and Bell Mountain on the south, and unnamed hills on the west. The valleys are drained by the San Jacinto River and its tributaries.

According to the CDWR (2006), groundwater in the western portion of the San Jacinto Basin occurs under confined conditions. The primarily source of recharge for the confined aquifers is found where the San Jacinto River and the Baustita Creek enter the San Jacinto Valley CDWR (2006). Percolation of water stored in Lake Perris has been an additional source of recharge along with reclaimed water percolation by means of storage ponds administered by Eastern Municipal Water District.

6.3 Site Groundwater Conditions

During our exploratory investigations, groundwater was not encountered to the maximum depth of boring penetration, seventy-one and one-half (71.5) feet. The exploratory soil borings drilled by GEOBASE at the MVMC site did not encounter groundwater; that is in general agreement with the conditions reported by the CDWR (2017).

6.4 Historic High Groundwater Level

Historical groundwater level data was obtained online from the Water Data Library operated by the CDWR (2017). There are five (5) monitoring wells within a two (2) kilometer radius of the site. Monitoring well locations are shown on Figure A-4, Appendix A, and pertinent data is summarized in Table I.

TABLE I
HIGHEST GROUNDWATER LEVEL OBSERVED AT MONITORING WELLS

Point	Well No.	Period of Measurements	Date of Highest Recorded Groundwater (mm/dd/yr)	Highest Recorded Groundwater Below Existing Grade (ft.)	Ground Elevation* (ft.)	Groundwater Elevation Above Mean Sea Level (ft)
1	EMWD12077	10/04/2011 to 04/11/2017	04/11/2017	34.9	1507.4	1472.5
2	EMWD25696	11/07/2011 to 04/11/2017	04/11/2017	41.0	1506.2	1465.2
3	EMWD25695	11/07/2011 to 04/11/2017	04/11/2017	44.5	1507.4	1462.9
4	EMWD10141	11/03/2011 to 04/11/2017	04/07/2017	59.8	1545.8	1486.0
5	03S03W15F001S	05/29/1951 to 09/15/1986	04/01/1952	99.8	1539.0	1439.2

* Existing Ground Surface Elevation at the Well Location

Reference : California Department of Water Resources (CDWR); http://www.well.water.ca.gov/cgi-shl/gwater.

Groundwater level reading for water well number EMWD12077 are available for the time period of 2011 to 2017. Ground surface elevation for this well is reported to be 1,507.4 feet above mean sea level (amsl), whereas the approximate elevation for the new CUP site was estimated at approximately 1,525 feet amsl (an approximate difference in elevation of 18 feet). The shallowest ground water level condition of 1,472.5 feet amsl (depth of 34.9 below ground surface [bgs]) at this well occurred on April 11, 2017. Therefore, it can be concluded that the MVMC site is located on a confined aquifer that appears to have been recharged since 2014. No historical groundwater data is available prior to 2011. Well number 03S03W115F001S has historical data dating back to 1951. Unfortunately, the data ends in 1986.

Projecting the higher groundwater elevation noted above across the MVMC site, the highest groundwater elevation is obtained to be at approximately fifty-three (53) feet bgs based on current well data. For design purposes, historic highest groundwater level in excess of fifty (50) feet bgs shall be considered for the site.

VII. SEISMOLOGY

7.1 Regional Faulting

The two principal seismic considerations for most properties in Southern California are ground surface rupture along fault traces and damage to structures due to seismically induced ground shaking. The fault classification system adopted by the California Geological Survey (CGS), relative to the State legislation, delineates Earthquake Fault Zones along active or potentially active faults (Alquist-Priolo Act). Such Earthquake Fault Zones are in turn used to establish setbacks of structures from active fault zones. An active fault is defined by the CGS as a "sufficiently active and well defined fault" that has exhibited surface displacement within Holocene time (approximately the last 11,000 years). A potentially active fault is defined by the State as a fault with a history of movement within Pleistocene time (between 11,000 and 1.6 million years ago). Any fault proven not to have moved within the last 1.6 million years is considered inactive.

The closest known active faults to the site are the San Jacinto, San Andreas and Elsinore faults. A California Fault Map, showing the geographic relationship of these faults to the site is presented as Figures A-7 and A-8, Appendix A. A brief description of these faults is provided below.

7.1.1 *San Jacinto Fault – San Jacinto Valley Segment*

The San Jacinto Fault is one of the most active faults in California, having been an important source of moderate- to large-magnitude earthquakes during this century. What makes the San Jacinto Fault of extreme interest to scientists and state building engineers is that the fault is remarkably long and has a potential of hundreds of kilometers of rupture length, thus creating larger magnitude earthquakes and potentially affecting larger areas. This fault, over approximately 210 kilometers in total length, extends to the southern border of California and joins the San Andreas Fault west of the city of San Bernardino. The sense of movement is right-lateral strike-slip. According to the Southern California Earthquake Center (SCEC,1995), slip is regularly released on this fault in the form of small earthquakes (M_L 3 and 4). Historically, this fault has experienced numerous medium sized earthquakes (M_L of upper 4's and 5's) and several large earthquakes (larger than M_L 6). In the early 1900s large earthquakes in the Hemet and San Jacinto areas produced surface rupture. Using information on fault geometry, historical seismicity, and slip-rate data, Petersen et al (1996) divided this fault into eight segments. These segments, from north to south are: San Bernardino Valley, San Jacinto Valley, Anza, Coyote Creek, Borrego

Mountain, Superstition Hills, Superstition Mountains, and Imperial.

The closest active fault segment of the San Jacinto Fault to the MVMC site is the northwest-trending, right-lateral strike-slip San Jacinto Valley fault segment, located approximately 4.8 kilometers (km) to the northeast of the site. The San Jacinto Valley fault segment extends approximately 43.0 km from the northern end of the San Jacinto Valley to the junction of the Claremont and Casa Loma faults to the south.

The San Jacinto Valley segment may have been the source of the December 25, 1899 and April 21, 1918 earthquakes with magnitudes of 6.4 and 6.8 that occurred on the Casa Loma and Claremont faults, respectively (SCEC, 1995 and Treiman and Lundbergh, 1999). Petersen et al (1996) and SCEC (1995) assigned a slip-rate of 12+/- 6 millimeters/year (mm/yr), a M_W 6.9 and a recurrence interval of sixty-five (65) to ninety-eight (98) years. Similarly, the estimate of characteristics displacement was assigned at 1.0 +/- 0.2 meters (m).

7.1.2 *San Andreas Fault – San Bernardino Mountains Segment*

The San Andreas Fault extends for several hundred miles from the Gulf of California in the south to Cape Mendocino in northern California and it is the main element of the boundary between the Pacific and North American tectonic plates. The San Andreas Fault extends as a continuous trace from Cape Mendocino to San Bernardino, bends eastward, and continues southeast near Indio. The central and southern San Andreas Fault was divided by SCEC (1995) and Petersen et al (1996) into the following five (5) fault segments: Cholame, Carrizo, Mojave, San Bernardino Mountains, and Coachella Valley. It is important to emphasize that although these segments are treated as independent sources of earthquakes, historical and paleoseismological observations show that ruptures may overlap and that some segments may both produce their own earthquakes and fail when large ruptures nucleate in an adjacent segment and propagate into them. The fault segments are composed of numerous subparallel right-lateral, strike-slip faults that range from 0.5 to 11 km in length. The Fort Tejon earthquake of approximately Mw 8, one of the greatest earthquakes ever recorded in the United States, occurred along the San Andreas Fault in January 9, 1857 and produced a surface rupture of approximately 350 km in length from Cholame on the north to the Cajon Pass on the south.

The closest significant San Andreas Fault segment to the MVMC site is the northwest-trending, right-lateral strike-slip San Bernardino Mountains segment, located approximately 23.7 km to the northeast of the site. The San Bernardino Mountains segment is approximately 103 km long and extends from a few kilometers northwest of Cajon Creek southeast to the area between Thousand Palms and Myoma. The San Bernardino Mountains segment is characterized by a large left-restraining step between the Mojave segment to the northwest and the Coachella segment to the southeast. The San Andreas Fault Zone is very complex in this restraining step, consisting of dextral strike-slip, thrust, and oblique slip faults (Bryant and Lundbergh, 2002). According to the SCEC (1995), the past five ground surface rupture events at Wrightwood occurred approximately in 1812, 1693, 1587, 1452, and 1192 of the current era. In addition, displacements of 4 m during the 1812 event, and a cumulative offset of 7 to 8 m of right slip for the 1812 and 1693 earthquakes, have been measured in the Cajon Pass area. Therefore, based on paleoseismic studies, the San Bernardino Mountains segment is believed to have last ruptured in 1812. The Wrightwood site has averaged one surface-rupturing earthquake every 124 years since 1192. The most recent three events have been closer together, averaging 112 years between events.

Petersen et al (1996) and the SCEC (1995) assigned a slip rate of 24+/- 6 mm/yr, a M_w 7.5, and a recurrence interval of 14 (+91, -60) years to this segment.

7.1.3 *Elsinore Fault – Glen Ivy and Temecula Segments*

The Elsinore fault zone forms the northeast boundary of the Santa Ana Mountains and extends nearly 200 km from Whittier to the Mexican border. Individual segments within the Los Angeles region are three (3) to forty (40) km long and display reverse right oblique, right-lateral strike-slip, and normal-right-oblique-slip late Quaternary or Holocene offsets. Petersen et al (1996) divided this fault into six segments which from north to south are: Whittier, Glen Ivy, Temecula, Julian, Coyote Mountain, and Laguna Salada. In addition, several of the fault segments possess locally their own names. For example, the Glen Ivy North and Glen Ivy South branches are located Northwest of Lake Elsinore. Heading southeast from Lake Elsinore, the two parallel fault strands are denominated Wildomar Fault (the more easterly) and Willard Fault. At its northern end, the Glen Ivy segment splays into two (2) fault segments, the Chino – Central Avenue and the Whittier faults.

The closest significant Elsinore Fault segments to the MVMC site are the northwest-trending, right-lateral strike-slip Glen Ivy and Temecula segments, located approximately 32.1 km to the southwest of the site.

The Glen Ivy fault segment extends for approximately 38 km. According to the SCEC (1995), this segment at Glen Ivy marsh shows that five (5) and probably six (6) earthquakes have disrupted the sediments there since approximately 1060, yielding an average recurrence interval of 150 to 200 years. These events occurred in 1910, post-1660, 1360 to 1660, about 1300, 1260, and about 1060. The most recent surface rupture is associated with the 1910 Temescal Valley earthquake with an estimated magnitude MW6.0 (Ziony and Jones, 1989). The surface displacement in this event was approximately 250 to 300 millimeters (mm). This fault segment has been assigned a probable MW6.8 with a slip rate of 5 mm/yr and a recurrence interval of 340 years (Petersen et al, 1996).

The Temecula Fault segment extends for approximately 62 km. Trenching across the Wildomar Fault in the Temecula segment has yielded a late Holocene slip rate for the principal strand. A fluvial channel, dated by C-14 at about 2000 to 2400 years, is laterally displaced approximately 10+/- 1 m and yields a slip rate of about 4.2 mm/yr (SCEC, 1995). This rate is considered as minimum since several minor strands of the fault also have a geomorphic expression. Nevertheless, it is similar to the rates determined at other locations along the Elsinore Fault. SCEC (1995) concluded a maximum average recurrence interval of between 250 and 600 years and a slip rate of 5.0+/- 2.0 mm/yr for this segment. Because no measurements of characteristic displacements are available, SCEC (1995) calculated a value of 1.2+/- 0.3 m using the segment length and empirical relations postulated by Wells and Coppersmith in 1994. According to SCEC (1995), this yields an average recurrence interval of 240 (+260, -111) years.

7.2 Historic Earthquakes

A map of recorded earthquake epicenters is provided as Figure A-9, Appendix A. This map can be accessed online by the Southern California Earthquake Data Center at Cal Tech. The Southern California Earthquake Data Center identifies three major earthquakes magnitude 6.0 or greater that have occurred on the San Jacinto fault since 1899, within a fifty (50) mile radius of the subject site: North San Jacinto Fault Earthquake near Loma Linda occurred July 22, 1923 with a magnitude of 6.3; the San Jacinto Earthquake just east of Hemet occurred April 21, 1918 with a magnitude of 6.8; and, the San Jacinto Fault (Terwilliger Valley) Earthquake also known as the Borrego Springs Fault, occurred in 1937 with a magnitude of 6.0.

The only large historical earthquake that can be attributed to the Elsinore Fault is a magnitude 6.0 that occurred in 1910 in the Temescal Valley area.

Four (4) other earthquakes of magnitude 4.0 or greater are identified within this fifty (50) mile radius: the Anza Gap Earthquake M 4.8; the White Wash Earthquake east of Anza occurred on February 25, 1980, M 5.5; the Chino Hills Earthquake in 2008, M 5.4; and, the Upland Earthquake of 1990, M 5.4.

7.3 Site Accelerations

7.3.1 *Site Coordinates*

The site latitude and longitude are 33.898 degrees north and 117.186 degrees west, respectively.

7.3.2 *Site Classification*

The site classification procedure recommended by CBC 2016, subsection 1613A.3.2, which references ASCE 7-10, Chapter 20, was adhered to.

The Cone Penetration Tests (CPT's) and geophysical surveys results provided measured average shear wave velocities at a minimum 402 m/s within the top 100 feet. The shear wave velocity profiles of the CPT's and geophysical surveys presented on Figure A-10, Appendix A, show good correlation. Based on the aforementioned measured shear wave velocities, to develop seismic design criteria, the site subsoils within the top 100 feet are judged to be Site Class C.

7.3.3 *Seismic Design Criteria*

Based on CBC 2016, subsection 1616A.1.3, which references and modifies ASCE 7-10, subsection 11.4.7, since the structure is assigned to Seismic Design Category D and S_1 is less than 0.75g (see subsection 7.3.3.2), a site-specific GMHA was not completed. The following subsections present the seismic design parameters based on mapped parameters.

7.3.3.1 Mapped Accelerations Response Spectra

Mapped, risk-targeted maximum considered earthquake, MCE_R, spectral response accelerations for 0.2 and 1.0 second periods are provided in maps published in the ASCE 7-10, which is the reference used in the CBC 2016. These maps are prepared by the USGS and the California portion of the map was prepared jointly with the CGS. These maps use results of seismic hazard analyses from both probabilistic and deterministic procedures, and are applicable to Site Class

B and five (5) percent of critical damping. The mapped site accelerations are adjusted for site class effects using parameters Fa and Fv, which are functions of site class and mapped site spectral accelerations.

The mapped design horizontal spectral accelerations were evaluated in accordance with ASCE 7-10, using the US Seismic Design Maps Application (USGS, 2017) available at the USGS website: http://geohazards.gov/designmaps/us/application.php. This web application requires the inputs of site location (coordinates) and site soil classification.

The project site is Site Class C and coefficient values Fa and Fv of 1.0 and 1.3, respectively, are obtained for the site. Mapped MCE_R accelerations obtained for the project site are summarized in Table II, below.

TABLE II

MCE_R MAPPED ACCELERATIONS

PERIOD (SECONDS)	MAPPED ACCELERATION PARAMETERS (g)	Site Class C MCE_R ACCELERATIONS ADJUSTED FOR SITE CLASS EFFECTS (g)	Site Class C RISK COEFFICIENTS
0.2	S_s: 1.673	1.673	C_{RS} = 1.008
1.0	S_1: 0.729	0.948	C_{R1} = 0.976

Based on Table II, the mapped spectral response accelerations, adjusted for Site Class C, S_{MS} and S_{M1} are 1.673g and 0.948g, respectively.

7.3.3.2 Seismic Design Category

The mapped spectral response acceleration parameter at one (1) second period (S_1) is 0.729g which is less than 0.75g. The design spectral response acceleration coefficients S_{DS} and S_{D1} are 1.115 and 0.632g, respectively. Therefore, a Seismic Design Category D should be used for the design of the proposed structure per Section 1613A.3.5 of CBC 2016.

7.3.3.3 Design Spectra Based on Mapped Parameters

Section 11.4.5 of ASCE 7-10 describes a procedure to obtain a design response spectra curve for use in cases where a design response spectrum is required by the ASCE 7-10 standard, and site-specific ground motion procedures are not used. This procedure is based on the use of the mapped spectral response accelerations adjusted for site class effects in the determination of the design response spectra curve. Using this procedure, numerical values of the design spectral response accelerations based on the mapped parameters for the project site are provided in Table III, below.

TABLE III

MAPPED DESIGN RESPONSE SPECTRUM

Period (Seconds)	Mapped Design Spectral Response Acceleration (g)
0.00	0.446
0.113	1.115
0.20 (S_{DS})	1.115
0.500	1.115
0.566	1.115
0.700	0.903
0.800	0.790
0.900	0.702
1.00 (S_{D1})	0.632
2.00	0.316
3.00	0.211
4.00	0.158
5.00	0.126

7.3.3.4 Maximum Considered Earthquake Geometric Mean (MCE_G) Peak Ground Accelerations

From Figure 22-7 of ASCE 7-10, PGA = 0.657g is multiplied by the site coefficient F_{PGA} = 1.0 (Table 11.8-1) to obtain the mapped MCE Geometric Mean Peak Ground Acceleration (PGA_M). For Site Class C, $PGA_M = F_{PGA} \times PGA$. Therefore, PGA_M = 0.657 may be used for evaluation of liquefaction, lateral spreading, seismic settlement and soil-related issues.

7.3.3.5 Seismic Hazard Deaggregation

Relative contributions of various combinations of earthquake magnitudes and distances to a particular seismic hazard at a site are determined using deaggregation of the seismic hazards. Magnitude-distance deaggregation, obtained from the Unified Hazard Tool "Dynamic: Conterminous US 2008 (V.3.3.1)" edition that is available on the USGS website, indicates that the deaggregated mode magnitude and distance for the peak ground acceleration at the project site are M7.5 and 7.0 kilometers, respectively.

7.4 Earthquake Effects

7.4.1 *Liquefaction*

Liquefaction occurs when the pore pressures generated within a soil mass equals the overburden pressure. This results in a loss of strength and the soil then possesses a certain degree of mobility.

Factors considered to evaluate liquefaction potential include groundwater conditions, soil type, particle size distribution, earthquake magnitude and acceleration, and soil density obtained through the Standard Penetration Test (SPT) or Cone Penetration Test (CPT). Soils subject to liquefaction comprise saturated fine-grained sands to low-plasticity silts and clays. Coarser-grained soils are considered free-draining and therefore dissipate excess pore pressures, while fine-grained soils possess undrained shear strength and are therefore less subject to liquefaction.

The liquefaction susceptibility map, Figure A-11, Appendix A, of the County of Riverside General Plan, indicates that the project site is located in an area that is subject to "low" liquefaction potential. Furthermore, the subsoils are considered "dense" to "very dense" or "stiff" to "hard" with a historic highest groundwater table at a depth greater than fifty (50) feet; therefore, the site is considered to possess a "very low" potential for liquefaction.

7.4.2 *Seismically Induced Settlements*

Based on an examination of the subsoils conditions, seismic settlement analyses were conducted at CPT-12 and CPT-13 locations. For these analyses, a PGA_M of 0.657g and an earthquake magnitude of 7.5 based on the deaggregation results, described in subsection 7.3.3.5, were used. Seismic settlements for the unsaturated cohesionless soils were estimated using the Tokimatsu and Seed (1987) Method. The results of the seismic settlement analyses are provided in Appendix D.

Based on our evaluation of the analyses results at the CPT locations, seismically induced settlements at the site are not anticipated to exceed one-half (0.5) inch for the New CUP.

7.4.3 *Seismically Induced Landsliding*

Due to the relatively flat existing topographic conditions, the MVMC site is not located within a designated area where previous occurrence of landslide movement, or local topographic, geological, geotechnical and subsurface water conditions indicate a potential for permanent ground displacement such that mitigation would be required (RCIT, 2017). In addition, based on our field reconnaissance and field investigations, there are no known landslides near or at the MVMC site, nor is the site on the path of any known or potential landslides.

7.4.4 *Ground Surface Rupture*

Ground surface displacement along a fault, although more limited in area than the ground shaking associated with it, can have disastrous consequences when structures are located straddling the fault or near the fault zone. Fault displacement involves forces so great that in most cases it is not practically feasible (structurally or economically) to design and build structures to accommodate rapid displacement and remain intact. Amounts of movement during a single earthquake can range from several inches to tens of feet. Another aspect of fault displacement comes not from the violent movement associated with earthquakes, but the barely perceptible movement along a fault called "fault creep". Damage by fault creep is usually expressed by the rupture or bending of buildings, fences, railroad tracks, streets, pipelines, curbs, and other linear features.

No faulting was observed during our field reconnaissance. In addition, active, potentially active, and other major inactive faults noted on regional geologic and fault maps do not cross nor project toward the site. Furthermore, the site is not located within any APEQFZ Map as designated by the CGS (Bryant and Hart, 2007; CDMG, 2000 and CGS, 2017). The County of Riverside (RCIT, 2017) and the USGS (2017) indicate that the closest active fault to the site is the San Jacinto Fault Zone located approximately 4.8 km to the northeast. Cracking due to shaking from distant events is not considered a significant hazard, although it is a possibility at any site.

7.4.5 *Lateral Spreading*

Seismically induced lateral spreading involves primarily movement of earth materials due to ground shaking. Lateral spreading is demonstrated by near-vertical cracks with predominantly horizontal movement of the soil mass involved. Such spreads can occur on gently sloping ground or where nearby drainage or stream channels can lead to static shear stress biases on essentially horizontal ground. The potential for liquefaction at the site is considered very low. Therefore, the potential for lateral spreading of the subject site is very low.

7.4.6 *Subsidence*

Subsidence refers to the sudden sinking or gradual downward settling and compaction of soil and other surface material with little or no horizontal motion. It may be caused by a variety of human and natural activities, including changes in groundwater level, soil moisture and earthquakes. Alluvial valley regions are especially susceptible and according to RCIT (2017), the site is located within an area that is susceptible to subsidence (Figure A-12, Appendix A) .

7.4.7 *Tsunamis*

A tsunami is a sea wave generated by a submarine earthquake, landslide, or volcanic event. The MVMC site is not located within a coastal area; instead, it is located several tens of miles inland from the Pacific Ocean at an approximate elevation of 1525 feet amsl (GoogleEarth, 2017). Therefore, a tsunami hazard at the property is considered negligible.

7.4.8 *Seiches*

A seiche is an earthquake-induced wave in a confined body of water, such as a lake, reservoir, or bay. Resulting oscillations could cause waves up to tens of feet high, which in turn could cause extensive damage along the shoreline. The most serious consequence of a seiche would be the overtopping and failure of a dam. Based on Figure 5.5-2, Floodplains and High Fire Hazard Areas, included in the Moreno Valley General Plan (2006), the site is not located downstream of any large bodies of water that could adversely affect the site in the event of earthquake-induced failures or seiches.

7.4.9 *Flooding*

According to the Federal Emergency Management Agency (FEMA, 2017) flood map 06065C0770G, Figure A-13, Appendix A, the City of Moreno Valley (2006a) and RCIT (2017), the MVMC is located within a "Zone X", which corresponds to an area determined to be outside of a

0.2 percent annual chance of floodplain (FEMA, 2017).

It should be noted that the northwestern corner of the property is located within "Zone A", which corresponds to a 1.0 percent annual chance of flood hazard (FEMA, 2017), areas of flooding sensitivity (RCIT, 2017) and a 100-year flood plain (City of Moreno Valley, 2006a). The extent of the affected area varies according to the different agencies.

VIII. SITE DEVELOPMENT RECOMMENDATIONS

8.1 General

The proposed development, described in subsection 3.2, is feasible from a geotechnical engineering standpoint. Project plans and specifications should take into account the appropriate geotechnical features of the site and conform to the geotechnical recommendations.

8.2 Clearing

All surface vegetation, asphaltic concrete, trash, debris, underground pipes, and concrete pieces after demolishing the existing structures should be cleared and removed from the proposed site. Topsoil and soils with organic inclusions are ***not*** considered suitable for reuse as structural fill, but may be stockpiled for future use in landscape areas.

Underground facilities such as utilities, pipes or underground storage tanks may exist at the site. Removal of underground tanks is subject to state law as regulated by County or City Health and/or Fire Department agencies. If storage tanks containing hazardous or unknown substances are encountered, the proper authorities must be notified prior to any attempts at removing such objects.

Septic tanks should be removed in their entirety. Cesspools or seepage pits should be pumped of their contents and backfilled with a minimum two-sack sand-cement slurry. Any water wells, if encountered during construction, should be exposed and capped in accordance with the requirements of the regulating agencies.

Depressions resulting from the removal of buried obstructions, existing building foundations, tunnels and pipes should be backfilled with properly compacted material.

8.3 Subgrade Preparation

8.3.1 *Building Pad*

In the new CUP area, undocumented fills and "very loose" to "medium dense" silty sands to sandy silts layers were observed at the boring locations and can be observed on the data from relevant CPT's as well. These materials are not suitable for structural support and they extend to approximate elevation 1510 amsl, as shown on Figures A-5 and A-6, Appendix A. These materials may also extend deeper at other locations and, where encountered, should be removed and replaced as properly compacted fill. Notwithstanding the aforementioned, a compacted fill blanket, a minimum of five (5) feet in thickness, should be constructed below the footing bottoms. The lateral extent of overexcavation beyond the footing limits should be at least equal to the depth of fill.

Exposed bottoms of overexcavation should be observed by GEOBASE to verify the removal of all unsuitable materials.

8.3.2 *Minor Structures, Walkways, Flatwork and Pavement Areas*

In order to minimize the potential for excessive settlement of minor structures which are structurally separated from the new CUP, the footing subgrade areas should be over excavated to provide a uniform compacted fill blanket a minimum three (3) feet in thickness below adjacent grade, or at least two (2) feet below footing bottoms, whichever is greater. The lateral extent of removal beyond the footing limits should be equal to at least the depth of overexcavation. The fill should be compacted to a minimum of ninety (90) percent relative compaction (ASTM D 1557).

The subsoils within the concrete walkways, flatwork and parking areas, and within two (2) feet of their proposed limits, should be over excavated at least two (2) feet and replaced as properly compacted fills.

The above subgrade preparation recommendations may only be considered if future maintenance as a result of settlement of underlying undocumented fills can be tolerated. Alternatively, all undocumented fills should be removed and replaced as properly compacted fills.

8.4 Fill Placement

8.4.1 *Preparation of Bottom of Excavations*

Prior to placing any fill, the exposed soils at the bottom of excavations should be scarified to a minimum depth of six (6) to eight (8) inches, moisture conditioned (wetted or dried) to at least optimum moisture content and compacted to a minimum of ninety (90) percent relative compaction, based on ASTM D1557.

8.4.2 *Compaction*

Cohesive soils should be placed in loose lifts not exceeding six (6) inches, moisture-conditioned to approximately two (2) to four (4) percentage points above optimum, and compacted to the minimum relative compaction listed in Table IV below.

Granular fill materials should be placed in loose lifts of six (6) to eight (8) inches, moisture-conditioned to near optimum, and compacted to the minimum relative compaction listed in Table IV.

TABLE IV

COMPACTION REQUIREMENTS

Type of Fill/Area	Relative Compaction (ASTM D1557) Minimum Percent
Fills within building pad area	95
All other structural fill	90

8.4.3 *Fill Material*

The upper ten (10) feet of on-site soils are predominantly "very low" expansive soils (EI = 0-12). These soils may be reused as compacted fill provided they are free of organics, deleterious materials, debris and particles over six (6) inches in largest dimension.

Any soils imported to the site for use as fill for subgrade materials should be predominantly granular and "very low" expansive (Expansion Index less than twenty [20])and should contain sufficient fines (approximately twenty [20] percent passing the No. 200 sieve) so as to be relatively impermeable when compacted. The imported soils should be approved by GEOBASE prior to importing.

8.5 Drainage

To enhance future site performance, it is recommended that all pad drainage be collected and directed away from proposed structures and slopes to disposal areas off site. For soil areas, we recommend that a minimum of five (5) percent gradient away from foundation elements be maintained. It is important that drainage be directed away from foundations and that proper drainage patterns be established at the time of construction and maintained through the life of the structures. Roof gutter discharge should be directed away from the building to suitable discharge points.

All slopes should be properly drained and maintained to help control erosion. Care should be exercised in controlling surface runoff onto temporary slopes. The area back of the slope crest should be graded such that water will not be allowed to flow freely onto the slope face. If excavations of temporary slopes are carried out in the rainy season, appropriate erosion protection measures may be required to minimize erosion of the slope cuts.

8.6 Temporary Excavations

Temporary construction excavations are anticipated for construction of utility trenches, footings and overexcavation.

Temporary construction excavations to depths of approximately four (4) feet below grade may be cut vertically without shoring. Where the necessary space is available, temporary unsurcharged excavations up to fifteen (15) feet high in level ground surface may be sloped back at 1H:1V (Horizontal:Vertical) or flatter in native soils. No surcharge loads should be permitted within a horizontal distance equal to the height of cut from crest of the excavation unless the cut is properly shored. Excavations that extend below a plane drawn at 1H:1V (Horizontal:Vertical) downward from the the edge of foundations of existing buildings and underground pipelines should be properly shored to maintain foundation support of adjacent structures and utilities.

The exposed slope face should be kept moist (but not saturated) during construction to reduce local sloughing.

All excavations and shoring systems should meet, as a minimum, the requirements given in the State of California Occupational Safety and Health Administration (OSHA) and Trench Safety

Standards. Stability of temporary slopes is the responsibility of the contractor.

8.7 Trench Backfill

Underground utility trenches could be backfilled and properly compacted by mechanical means. Pipe bedding, shading, and trench backfill should conform to the requirements of appropriate utility authorities.

If utility contractors indicate that it is undesirable to use compaction equipment in close proximity to a buried conduit, other methods of utility trench compaction may also be appropriate as approved by GEOBASE at the time of construction. Jetting or flooding of backfill material is not recommended.

IX. FOUNDATION RECOMMENDATIONS

9.1 General

The following recommendations have been formulated from visual, physical and analytical considerations of the existing site conditions and are believed to be applicable for the proposed development.

The on-site soils have a "very low" expansion potential. The recommendations presented in the following subsections are based on a "very low" expansion potential for the subgrade soils. Foundations and slab reinforcement configurations should meet, as a minimum, the requirements of the regulating agencies and the 2016 CBC.

9.2 Footings

Spread or continuous footings may be used for support of the proposed new CUP. Footings should be based a minimum of three (3) feet below the lowest adjoining grade.

9.2.1 *Soil Bearing Pressures*

Footings with a minimum width of two (2) feet and maximum width of twelve (12) feet, founded on a minimum of five (5) feet of compacted fill (subsection 8.3.1), may be designed for an allowable bearing pressure of 4,000 psf. The maximum edge pressures induced by eccentric loading or overturning moments should not be allowed to exceed the aforementioned allowable bearing value.

Footings placed closer than one (1) width apart should be structurally tied.

9.2.2 *Footings Adjacent to Trenches or Existing Footings*

Where footings are located adjacent to utility trenches, they should extend below a one-to-one plane projected upward from the inside bottom corner of the trench. Footing excavations adjacent to the footings of existing buildings should be carried out such that the existing footings are not undermined.

9.2.3 *Settlement*

For allowable dead-plus-live load bearing pressures of 4,000 psf, the total and differential settlements of the footings are not anticipated to exceed one (1.0) inch and one-half (0.5) inch, respectively. Total seismic settlements are anticipated not to exceed one-half (0.5) inch and differential seismic settlements are estimated at three-tenths (0.3) of an inch over a distance of thirty (30.0) feet.

Notwithstanding the preceding, the static settlement of the footings foundation system should be reviewed by GEOBASE once the configuration of the footings is finalized.

9.2.4 *Lateral Load Resistance*

Lateral loads (wind or seismic) against structures may be resisted by friction between the bottom of foundations and the supporting soils. An allowable friction coefficient of 0.35 between spread footing and the underlying compacted soil is recommended. An allowable lateral bearing pressure equal to an equivalent fluid weight of 200 pounds per cubic foot to a maximum of 3,000 pounds per square foot acting against the foundations may also be used, provided the foundations are poured tight against compacted fill.

9.2.5 *Footing Observations*

All foundation excavations should be observed by GEOBASE prior to the placement of forms, reinforcement, or concrete, for verification of conformance with the intent of these recommendations and confirmation of the bearing capacities. All loose or unsuitable materials should be removed prior to the placement of concrete. Materials from footing excavations should not be spread in slab-on-grade areas unless compacted.

9.3 Minor Structures

Minor structures may be designed using the presumptive load-bearing values outlined in CBC 2016, provided that the risk of future settlements and associated maintenance can be tolerated.

9.4 Ultimate Values

The recommended design values presented in this report are for use with loading determined by a conventional working stress design. When considering an ultimate design approach, the recommended design values may be multiplied by the factors given in Table V.

TABLE V
LOAD FACTORS FOR ULTIMATE DESIGN

Foundation Loading	Ultimate Design Loading
Bearing Value	3.0
Passive Pressure	1.33
Coefficient of Friction	1.25

In no event, however, should the footing sizes be reduced from those required for support of dead-plus-live loads when using the working stress values.

9.5 Floor Slabs

Concrete slab-on-grade may be used for the proposed new CUP. The subgrade of the slab-on-grade should be prepared in accordance with the recommendations provided in subsections 8.3 and 8.4.

In moisture sensitive areas, as a minimum, the floor slabs should be dampproofed per CBC 2016, subsection 1805A.2; specific recommendations can be provided by a Waterproofing Consultant.

A subgrade modulus of 150 pounds per cubic inch may be used for slab design. The slab should be designed by the Structural Engineer using applicable CBC requirements, and the various anticipated loading conditions including shrinkage, temperature stresses, construction and operation conditions.

X. SOIL CORROSIVITY -- IMPLICATIONS

Electrical conductivity, pH, chloride and water soluble sulfate tests were conducted on representative samples by Anaheim Test Labs, and the results are provided in Appendix C. The tests results indicate that the subsoils at the site have a "low" corrosive potential with respect to concrete and "corrosive" potential with respect to steel and other metals. Therefore, Type II Portland Cement may be used for construction of concrete structures in contact with subgrade soils.

XI. PAVEMENT RECOMMENDATIONS

11.1 Asphaltic Concrete Pavement

Based on an R-value of fifty (50), the following alternative preliminary minimum pavement sections may be used. The traffic index assumed in Table VI, below, **should be confirmed by the Civil Engineer** and R-value tests should be performed during grading, prior to finalizing the pavement sections.

TABLE VI

ASPHALTIC CONCRETE PAVEMENT SECTIONS

PAVEMENT UTILIZATION	TRAFFIC INDEX	ASPHALTIC CONCRETE (INCHES)	CLASS II BASE (INCHES)
Automobile parking areas	5	3	3
Truck and bus loading/unloading areas and driveways	6	4	3

The upper twelve (12) inches of subgrade soils, below the aggregate base, should be scarified, moisture conditioned and recompacted to a minimum of ninety-five (95) percent relative compaction, at to slightly above optimum moisture content, based on ASTM D 1557.

The aggregate base must meet CALTRANS "Class 2 Base" specifications and should be compacted to at least ninety-five (95) percent relative compaction based on ASTM D 1557. Asphaltic concrete should be compacted to at least ninety five (95) percent of the density obtained with the California Kneading Compactor (CAL 304).

11.2 Rigid Pavement

A Portland Cement concrete (PCC) pavement may also be used. In the design of the PCC pavement section shown in Table VII, below, the following design parameters were used:

- Modulus of subgrade reaction of the soil, k -- 240 pci
- Modulus of rupture of concrete, MR -- 500 psi
- Traffic Category, TC -- C
- Average daily truck traffic, ADTT -- 100

TABLE VII
PCC PAVEMENT SECTION

PAVEMENT UTILIZATION	PCC Minimum Thickness (inches)
Truck loading/unloading areas (TC = C)	6

The traffic category and average daily truck traffic should be confirmed by the civil engineer and R-value tests should be performed during grading, prior to finalizing PCC thickness.

Based on the design parameters presented above, the following rigid pavement section, calculated in general conformance with the procedure recommended by ACI 330R-01, may be used.

The upper twelve (12) inches of subgrade soils below the PCC should be scarified, moisture conditioned and recompacted to a minimum of ninety-five (95) percent relative compaction, at to slightly above optimum moisture content, based on ASTM D 1557.

The PCC pavement reinforcement should be designed by the structural engineer for shrinkage, temperature stresses and loading conditions including vehicular traffic. A thickened edge should be constructed on the outside of concrete pavements subject to wheel loads. Control joints should be included in the design of the PCC by the structural engineer at a maximum spacing of fifteen (15) feet each way.

XII. PLAN REVIEW, OBSERVATIONS AND TESTING

Post-investigation services are an important and integrated part of this investigation and should be carried out by GEOBASE. The project foundation and grading plans, and specifications should be forwarded to GEOBASE for review for conformance with the intent of the soils recommendations.

Geotechnical observations of excavation bases should be carried out prior to fill placement. Observations and testing of all fill placement should be carried out on a continuous basis to verify the design assumptions and conformance with the intent of the recommendations. Observations of footings bases should be carried out prior to concrete pour.

XIII. LIMITATIONS

This investigation was performed in accordance with generally accepted geotechnical engineering principles and practices. No warranty, expressed or implied, is made as to the conclusions and professional advice included in this report.

This report is intended for use by the client and its representatives, and with regard to the specific project discussed herein. Any changes in the design or location of the proposed new structure, however slight, should be brought to our attention so that we may determine how they may affect our conclusions. The conclusions and recommendations contained in this report are based on the data relating only to the specific project and location discussed herein. This report does not relate any conclusions or recommendations about the potential for hazardous and/or contaminated materials existing at the site.

The analyses and recommendations submitted in this report are based upon the observations noted during drilling of the borings, interpretation of laboratory test results, and geological evidence. This report does not reflect any variations which may occur away from the borings and which may be encountered during construction. If conditions observed during construction are at variance with the preliminary findings, we should be notified so that we may modify our conclusions and recommendations, or provide alternate recommendations, if necessary.

The recommendations presented herein assume that the plan review, observations and testing services, outlined in Section XII of the report, will be provided by GEOBASE. During execution of the aforementioned services, GEOBASE can finalize the report recommendations based on observations of actual subsurface conditions evident during construction. GEOBASE cannot assume liability for the adequacy of the recommendations if another party is retained to observe construction.

This report is issued with the understanding that it is the responsibility of the owner, or of his representative, to ensure that the information and recommendations contained herein are brought to the attention of the architect and engineer for the project, and incorporated into the plans and specifications. In this respect, it is recommended that we be allowed the opportunity to review the project plans and the specifications for conformance with the geotechnical recommendations.

This office does not practice or consult in the field of safety engineering. We do not direct the contractor's operations, and we cannot be responsible for other than our own personnel on the site. Therefore, the safety of others is the responsibility of the contractor. The contractor should notify the owner if he considers any of the recommended actions presented herein to be unsafe.

This report is subject to review by the appropriate regulating agencies.

Respectfully submitted
GEOBASE, INC.

H. D. Nguyen, P.E.
R.C.E. 82460
Associate Engineer

J-M. Chevallier, P.E., G.E.
R.C.E. 39198; G.E. 2056
Managing Principal

S. Gutierrez
P.G. 8835, C.E.G. 2652
Associate Geologist

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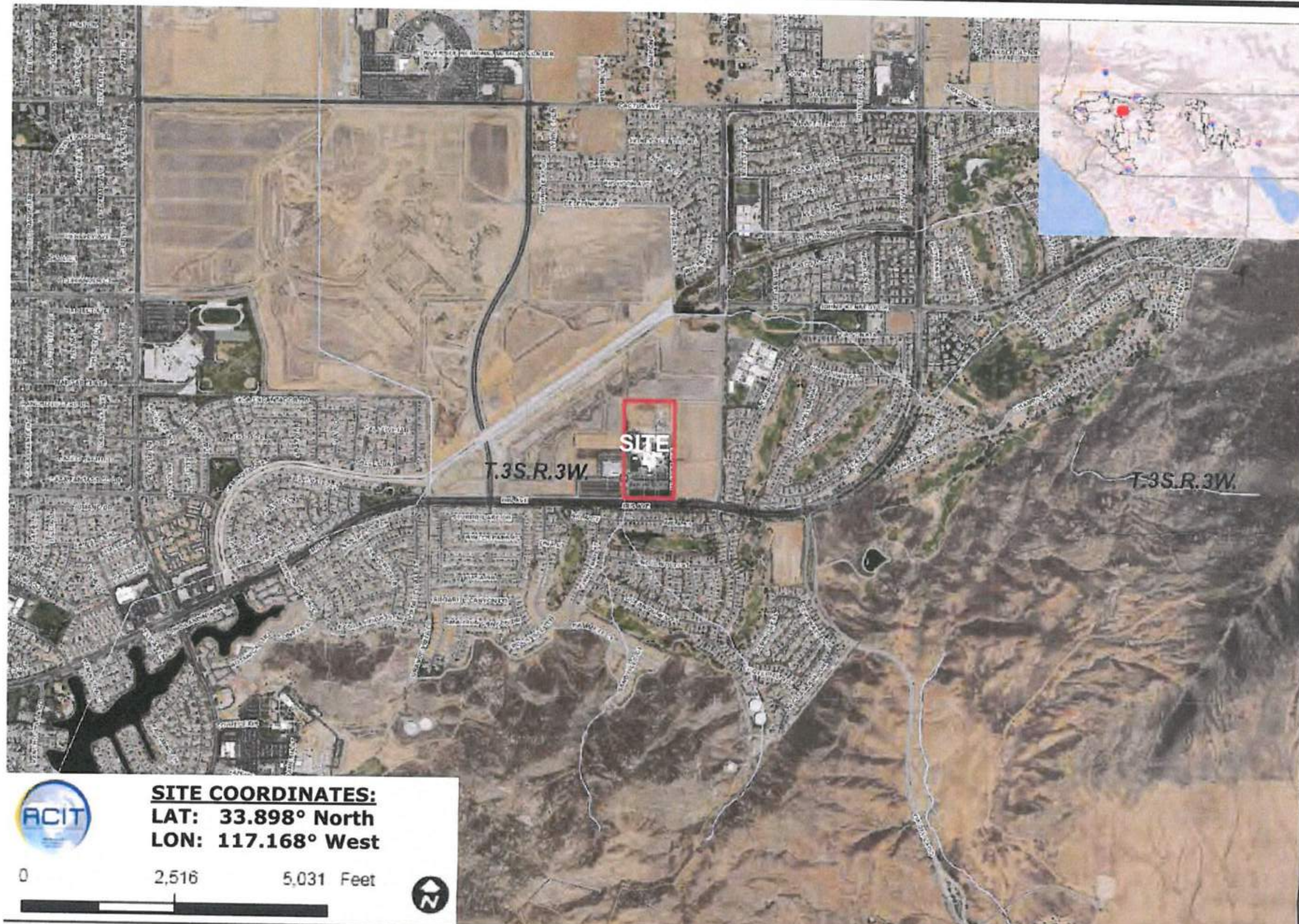
APPENDIX A

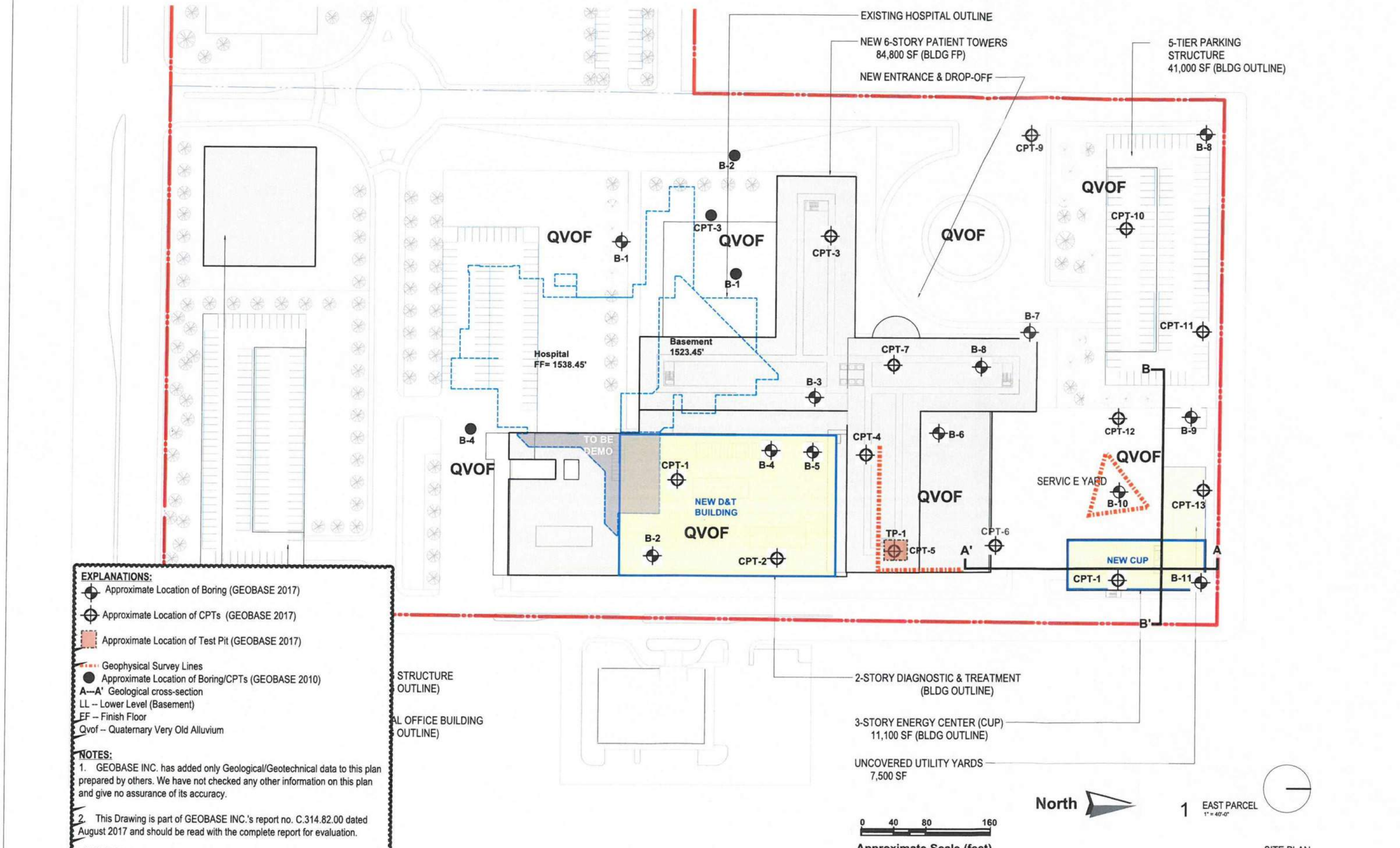


GEOBASE

SITE LOCATION MAP
Kaiser Permanente MVMC – CUP
27300 Iris Avenue
Moreno Valley, California

C.314.82.00

FIGURE A-1



CO ARCHITECTS

C.314.82.00

KAISER PERMANENTE

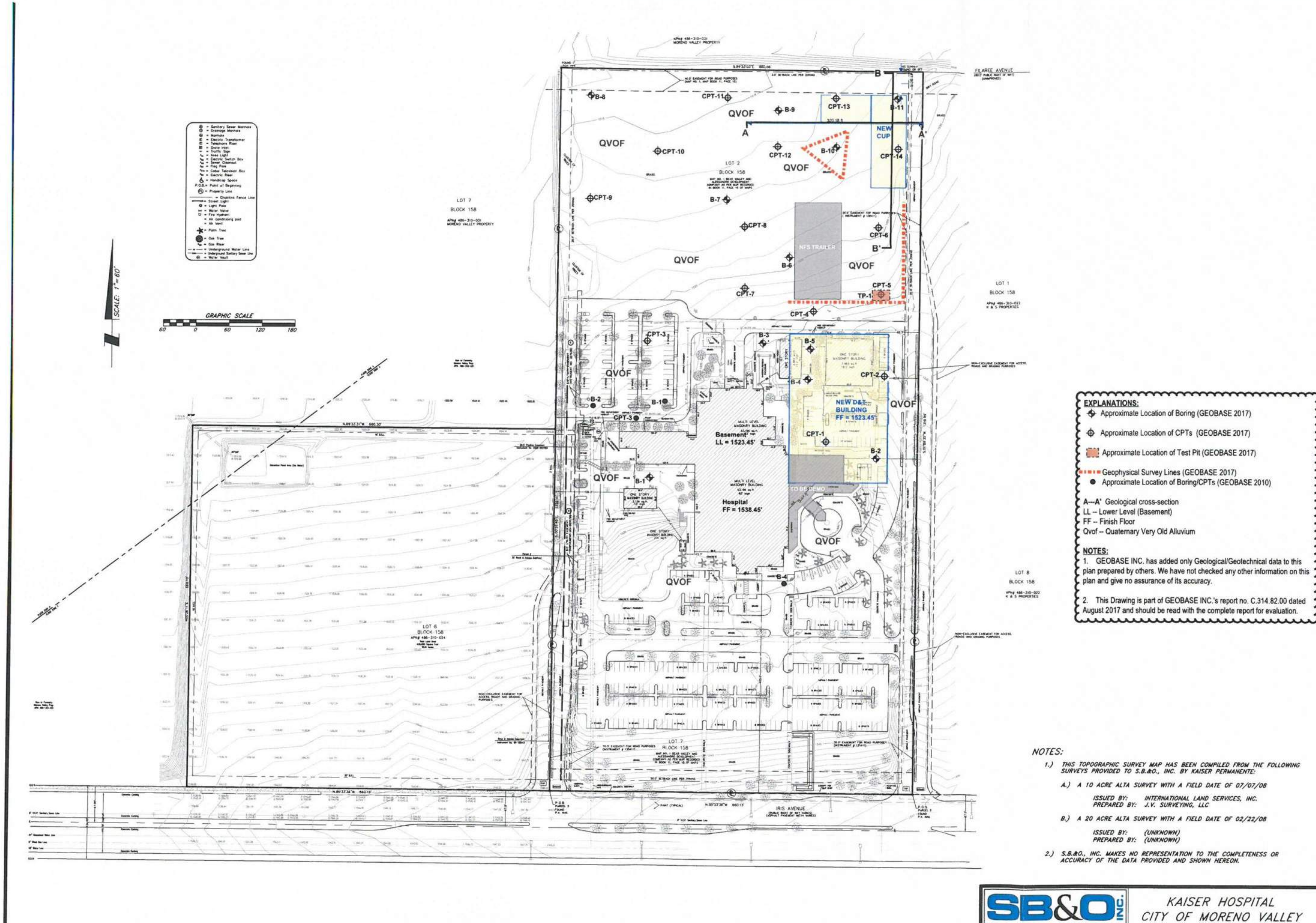
Site, Boring and CPT Locations Plan

MORENO VALLEY MEDICAL CENTER

SITE PLAN
07/05/17

Figure A-2

SD-10



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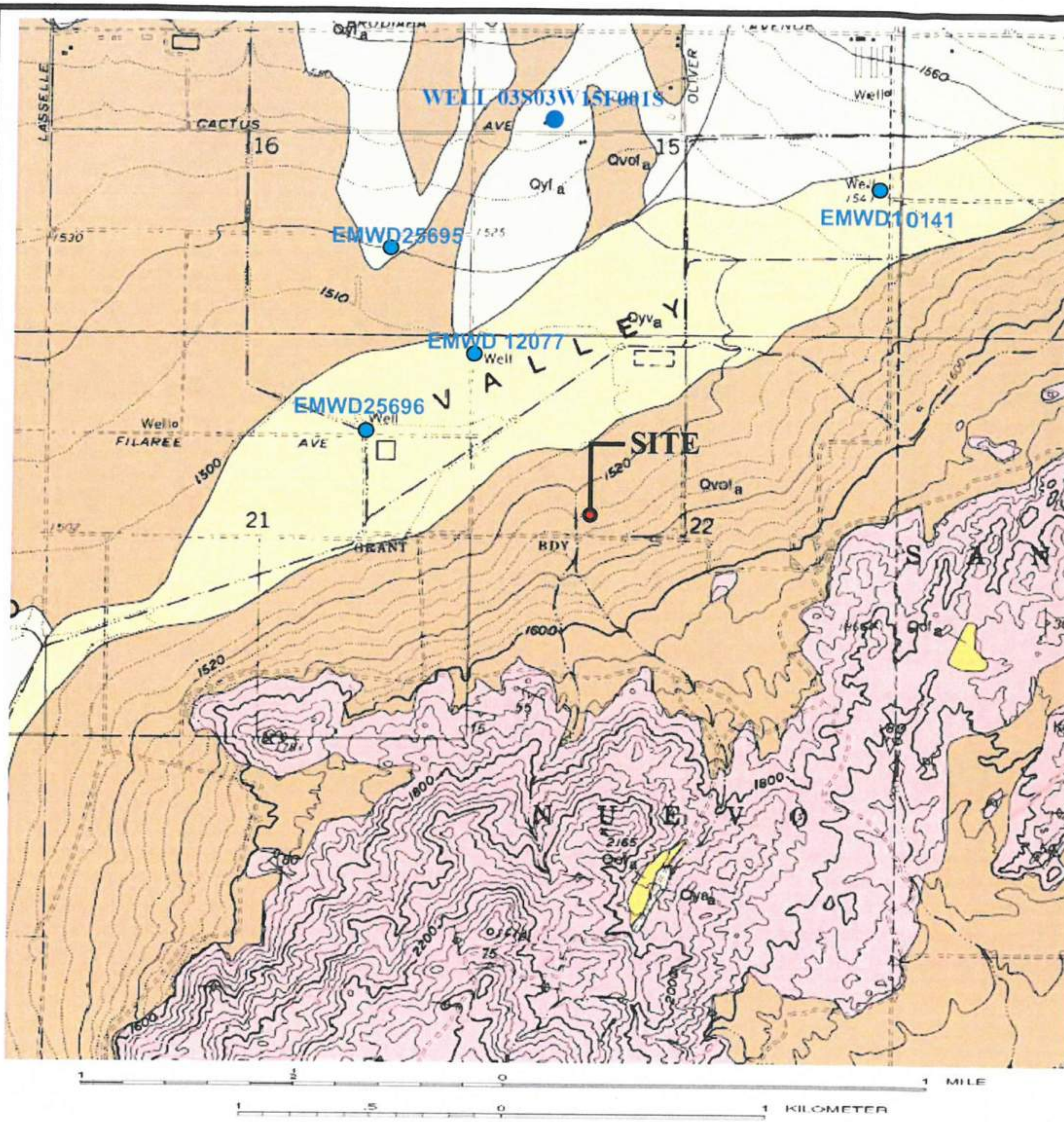
SITE TOPOGRAPHIC SURVEY PLAN

FIGURE A-3



EXPLANATION

Qyf	Qyf - Quaternary Young Alluvial Fan Deposits (Holocene and late Pleistocene)
Qyv	Qyv - Quaternary Young Alluvial Valley Deposits (Holocene and late Pleistocene)
Qvof	Qvof - Quaternary Very Old Alluvial Fan Deposits (early Pleistocene)
Kqd	Kgd - Quatz Diorite, Undifferentiated (Cretaceous)

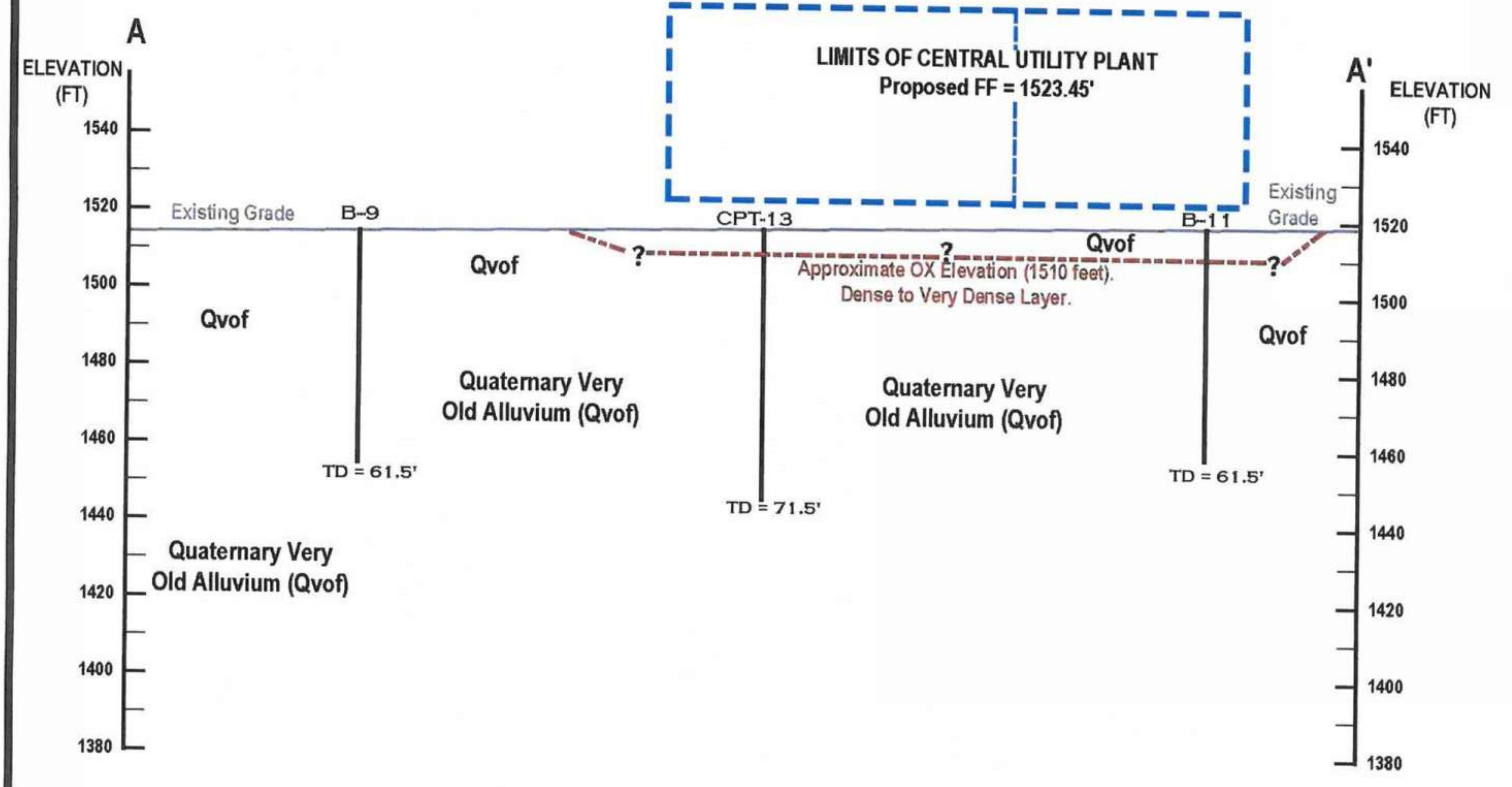
Source: Morton, D. M., and Matti, J. C., 2001, Geologic Map of the Sunnymead Quadrangle, Riverside County, California: Version 1.0, Scale 1:24,000, Open File Report 01-450, Published by the United States Geological Survey in Cooperation with the California Geological Survey and the United States Air Force.

GEOBASE

REGIONAL GEOLOGIC MAP
Kaiser Permanente MVMC – CUP
27300 Iris Avenue
Moreno Valley, California

C.314.82.00

FIGURE A-4



EXPLANATIONS:

Qvof -- Quaternary Very Old Alluvium

TD -- Total depth of borehole

dense to very dense layer, overexcavation bottom

NOTES:

1. Locations of the cross section are shown on Figures A-2 & A-3
2. Soil profiles are known with accuracy only at the locations observed.

The subsoil condition between borehole locations has been inferred from geological or geotechnical evidence and may vary from that shown.

SCALE AS SHOWN:

HORIZONTAL 1 IN. = 40 Feet

VERTICAL 1 IN. = 40 Feet

NORTH

GEOBASE

GEOLOGIC CROSS-SECTION A-A'

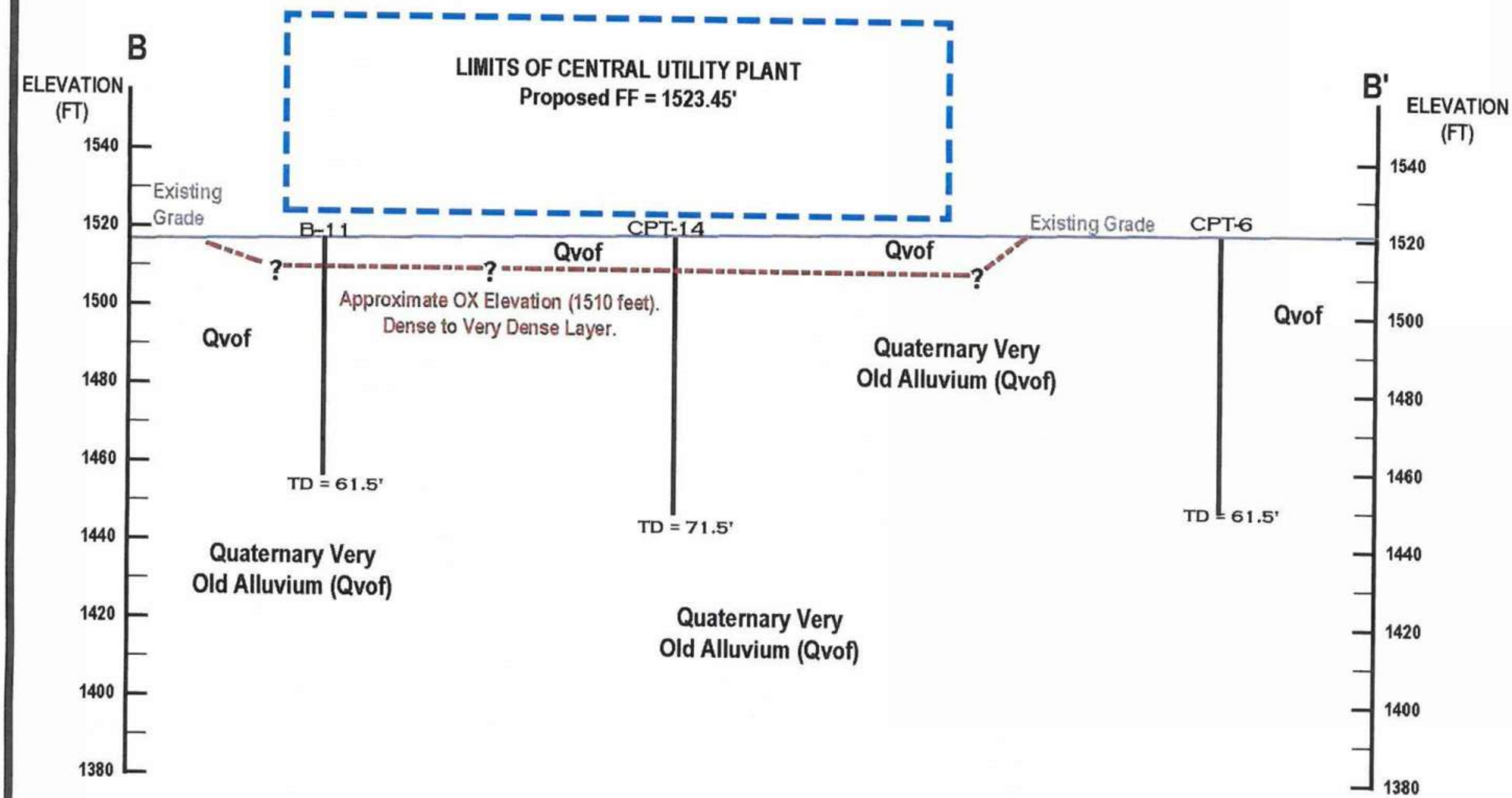
Kaiser Permanente MVMC -- CUP

27300 Iris Avenue

Moreno Valley, California

C.314.82.00

FIGURE A-5



EXPLANATIONS:

Qvof -- Quaternary Very Old Alluvium

TD -- Total depth of borehole

dense to very dense layer, overexcavation bottom

NOTES:

1. Locations of the cross section are shown on Figures A-2 & A-3
2. Soil profiles are known with accuracy only at the locations observed. The subsoil condition between borehole locations has been inferred from geological or geotechnical evidence and may vary from that shown.

SCALE AS SHOWN:
HORIZONTAL 1 IN. = 40 Feet
VERTICAL 1 IN. = 40 Feet

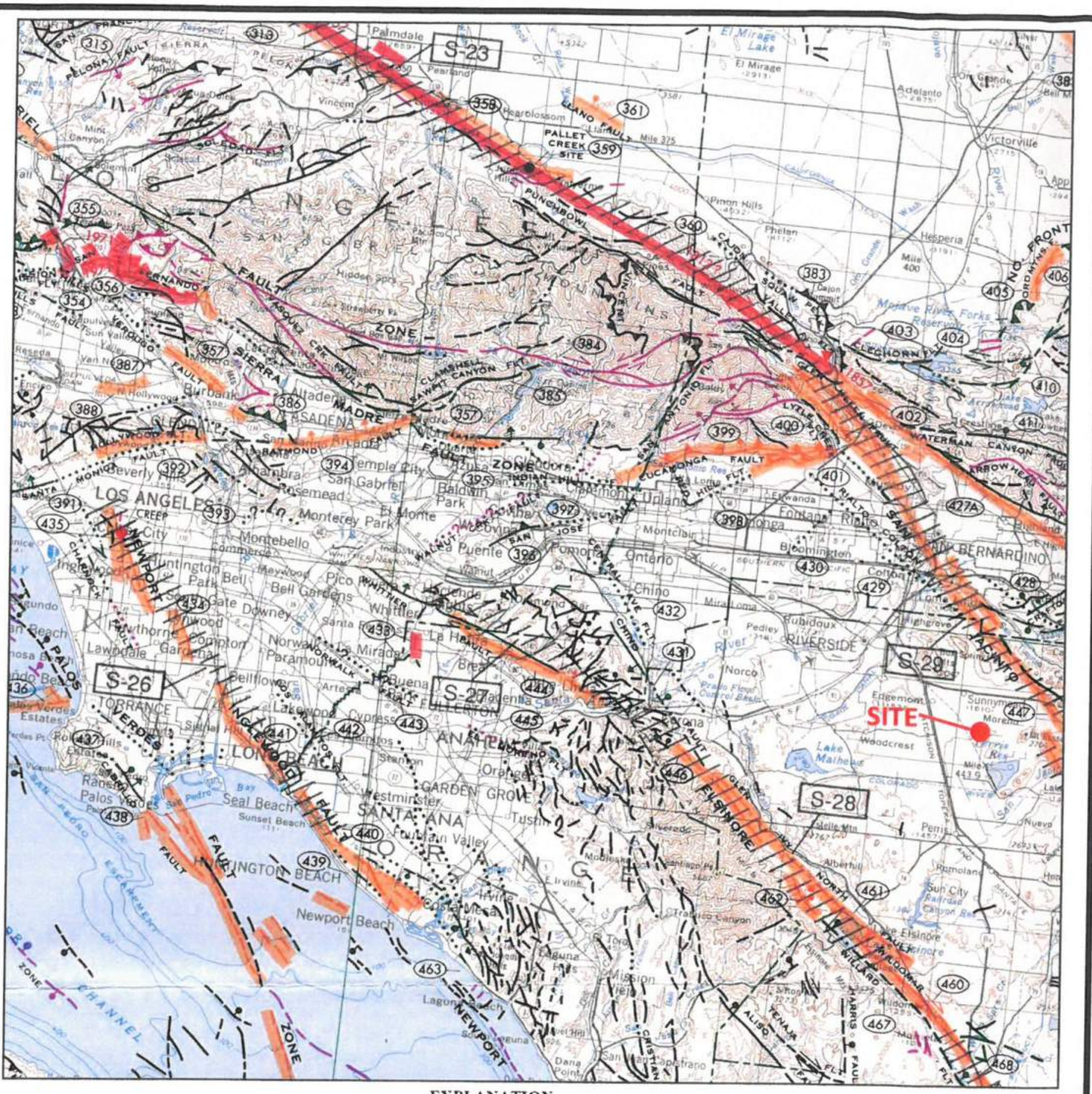
NORTH

GEOBASE

GEOLOGIC CROSS-SECTION B-B'
Kaiser Permanente MVMC -- CUP
27300 Iris Avenue
Moreno Valley, California

C.314.82.00

FIGURE A-6



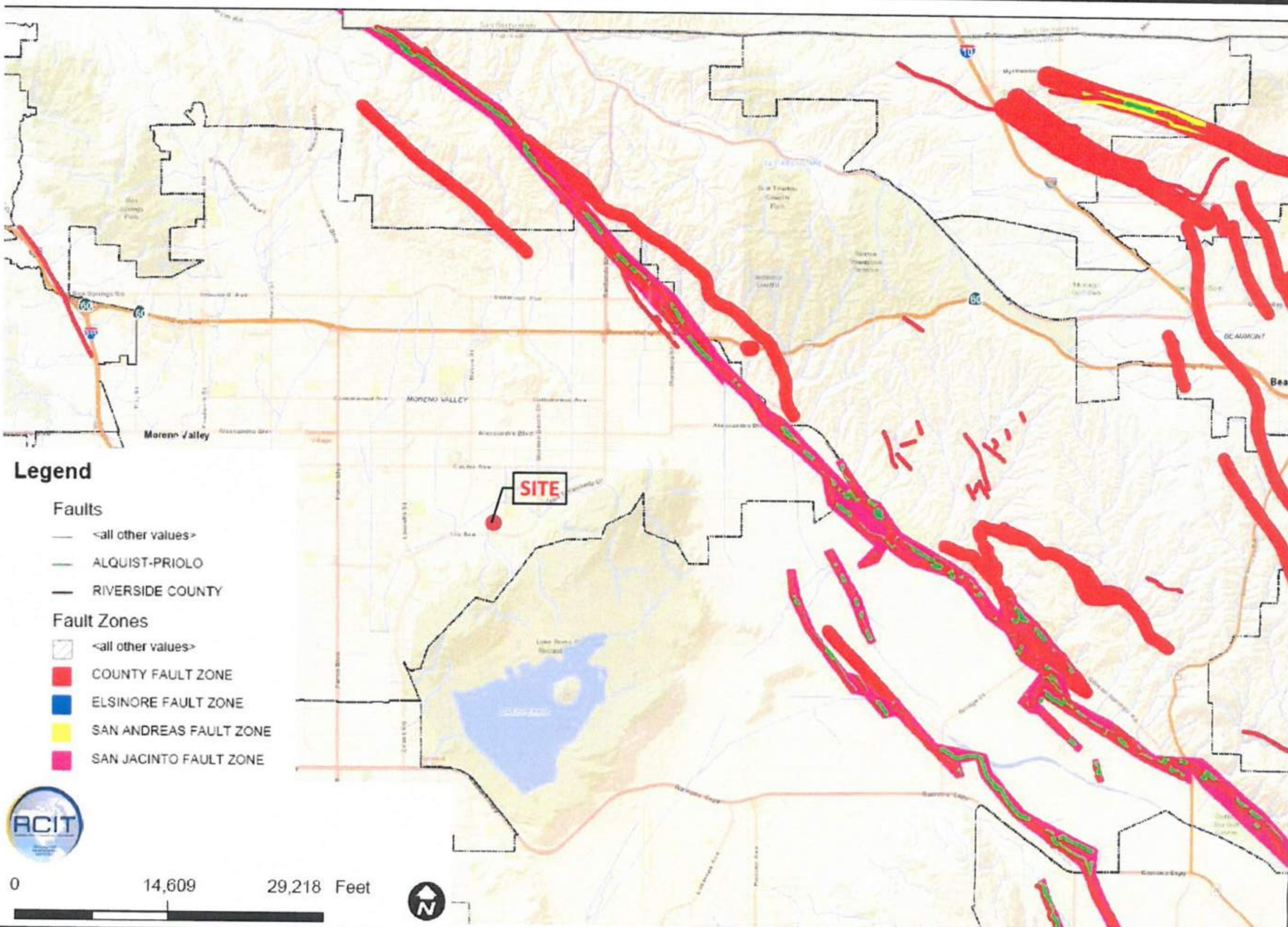
EXPLANATION

- Fault along which historic (last 200 years) displacement has occurred.
- Holocene fault displacement (during past 10,000 years).
- Late Quaternary fault displacement (during past 700,000 years).
- Quaternary fault (age undifferentiated).
- Late Cenozoic faults within the Sierra Nevada.
- Pre-Quaternary fault (older than 1.6 million years) or fault without recognized Quaternary displacement.
- Pink band added to emphasize location of historic fault displacement.

Approximate Scale 1 Inch Equals 10.89 Miles

Source: Jennings, C.W., 1994. Fault Activity map of California and Adjacent Areas with Location and Ages of Recent Volcanic Eruptions: California Division of Mines and Geology, Geologic Data Map Series, Map No. 6, Scale 1 : 750,000.

GEOBASE	C.314.82.00	**REGIONAL FAULT MAP** **Kaiser Permanente MVMC – CUP** **27300 Iris Avenue** **Moreno Valley, California** **FIGURE A-7**



GEOBASE

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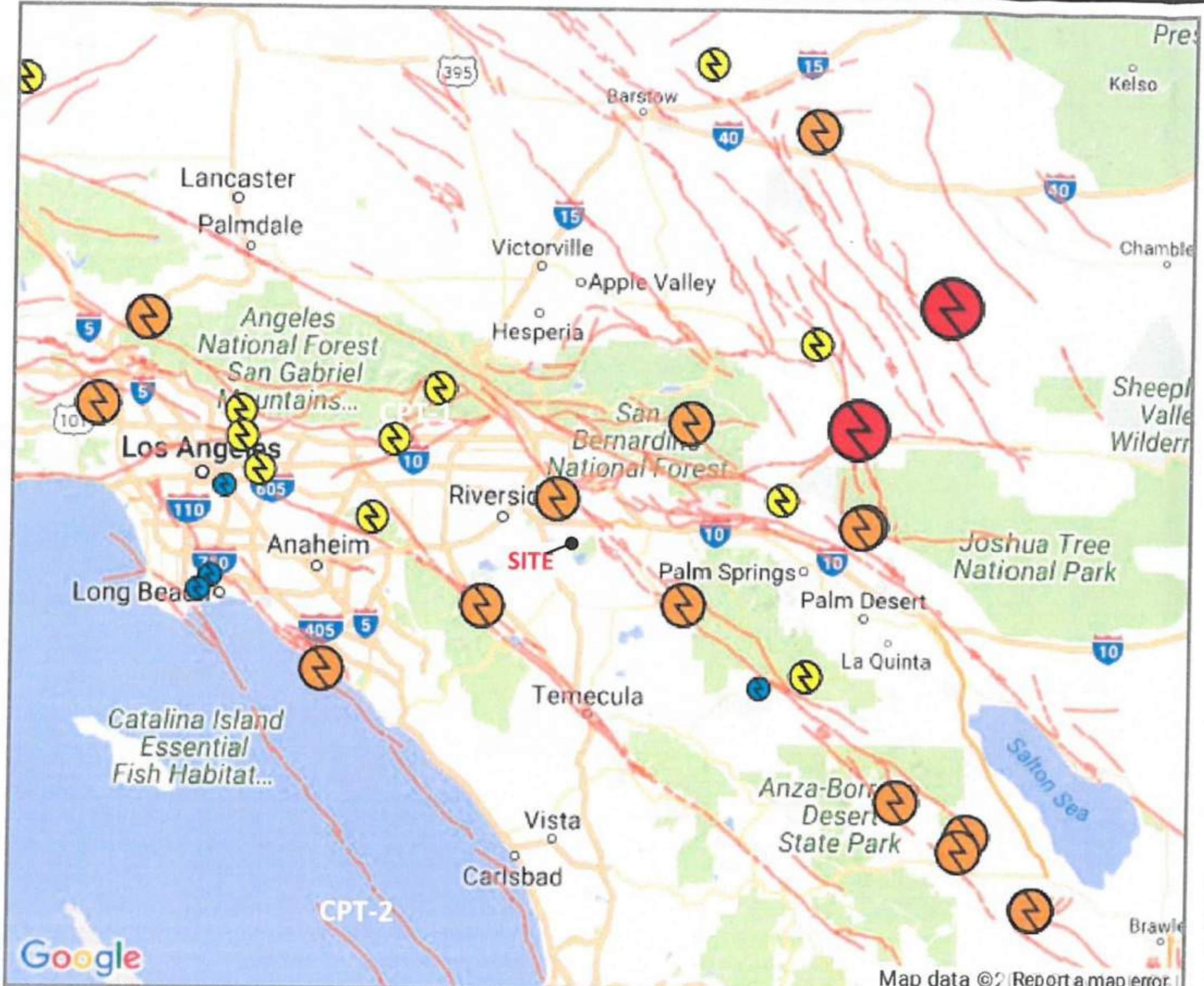
VICINITY FAULT MAP
Kaiser Permanente MVMC – CUP
27300 Iris Avenue
Moreno Valley, California

FIGURE A-8



Sources: Southern CA Earthquake Center, Division of Geological and Planetary Sciences | California Institute of Technology.

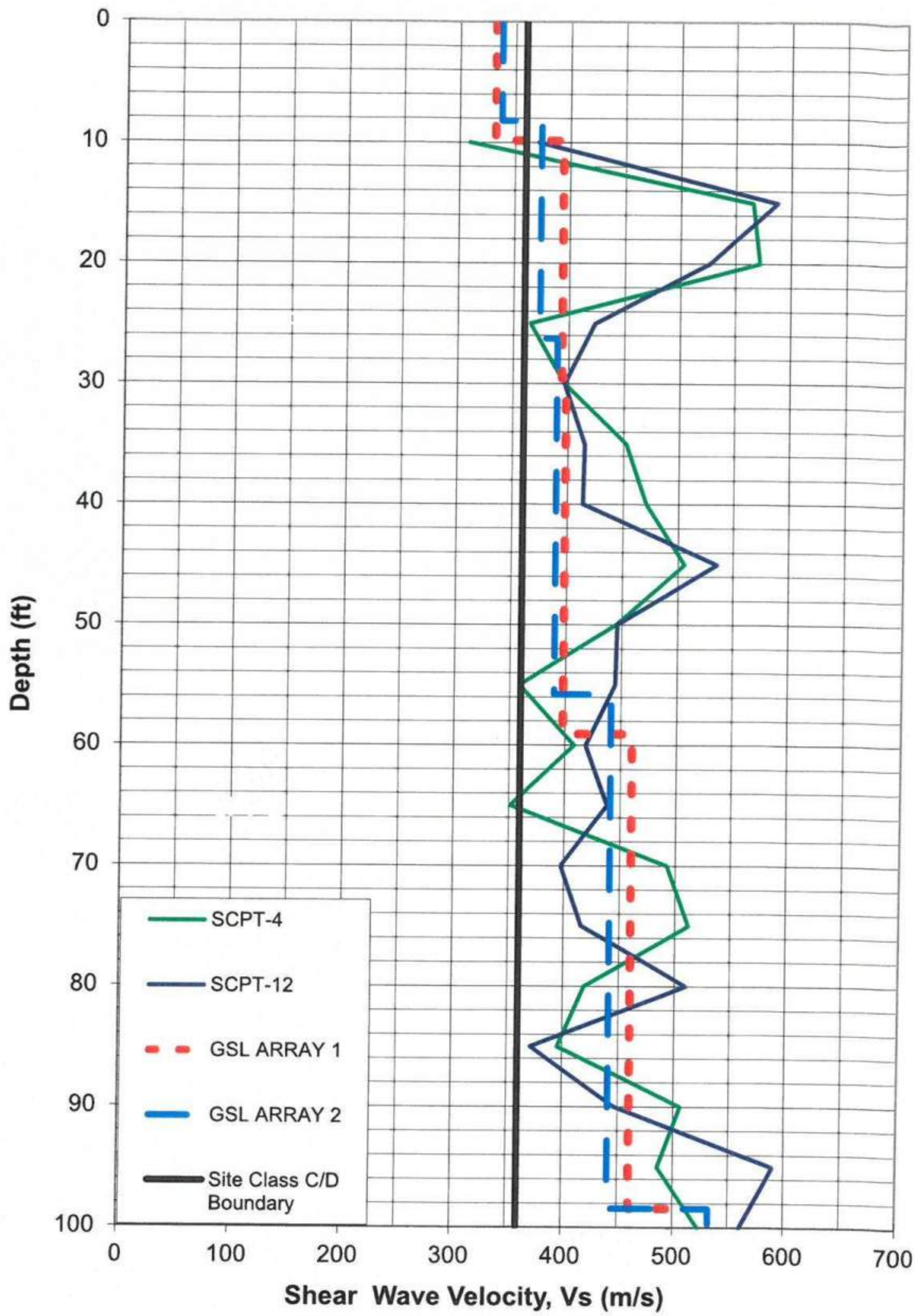
Note: Fault traces are in red as shown.

GEOBASE

C.314.82.00

HISTORICAL EARTHQUAKES MAP
Kaiser Permanente MVMC – CUP
27300 Iris Avenue
Moreno Valley, California

FIGURE A-9

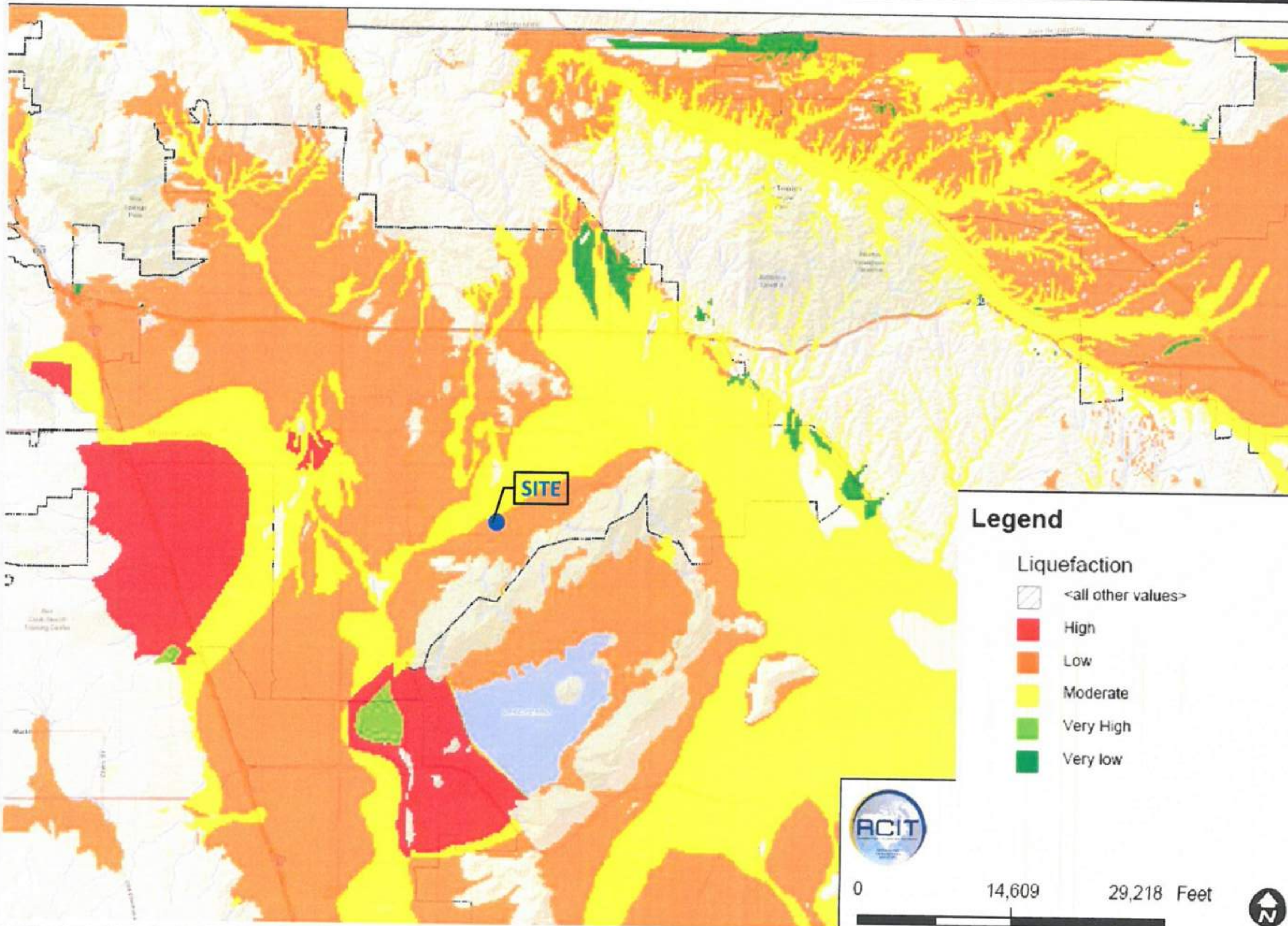


GEOBASE

SHEAR WAVE VELOCITY PROFILES
Kaiser Permanente MVMC – CUP
27300 Iris Avenue
Moreno Valley, California

C.314.82.00

FIGURE A-10

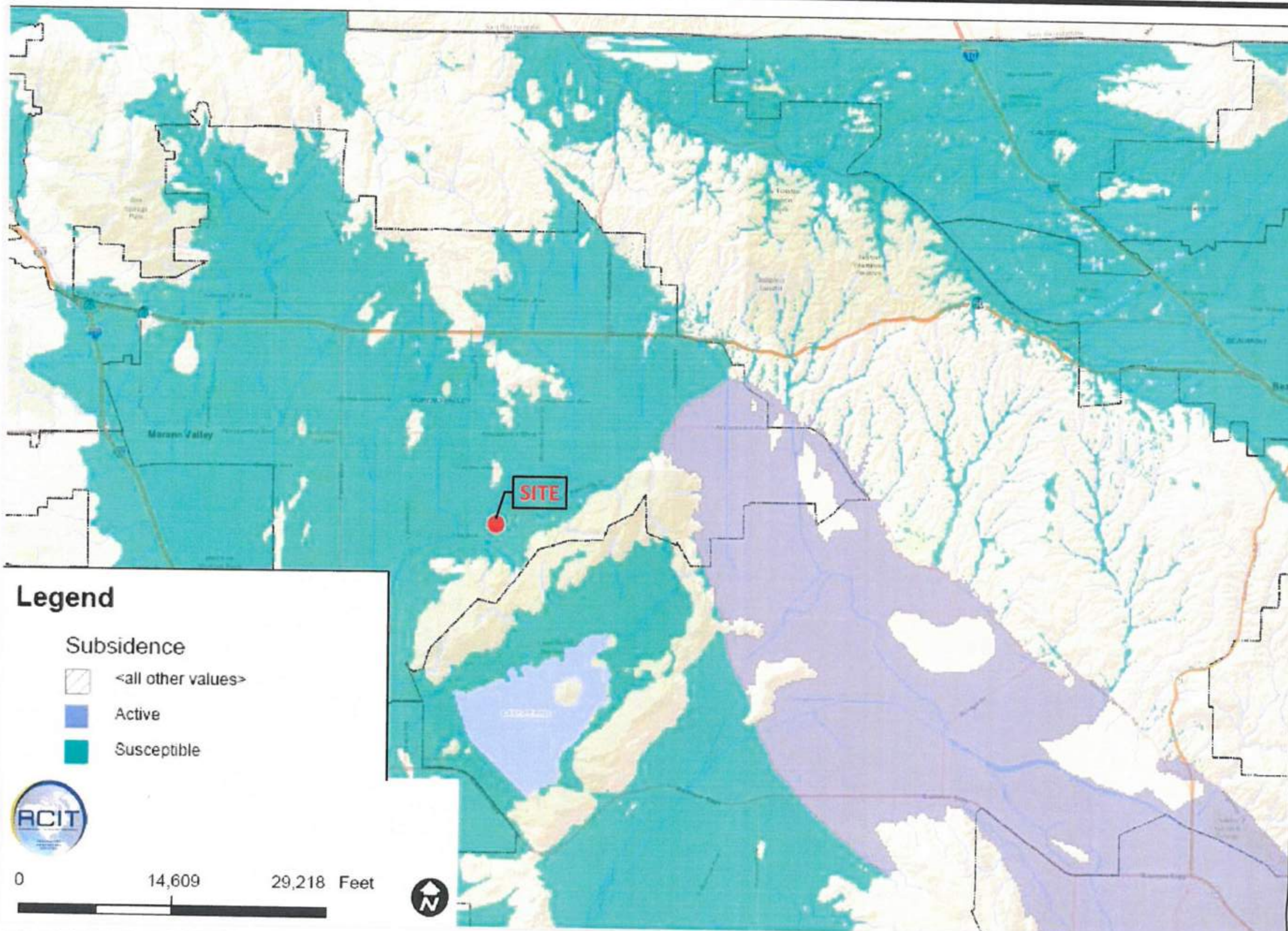


GEOBASE

C.314.82.00

LIQUEFACTION SUSCEPTIBILTY MAP
Kaiser Permanente MVMC – CUP
27300 Iris Avenue
Moreno Valley, California

FIGURE A-11



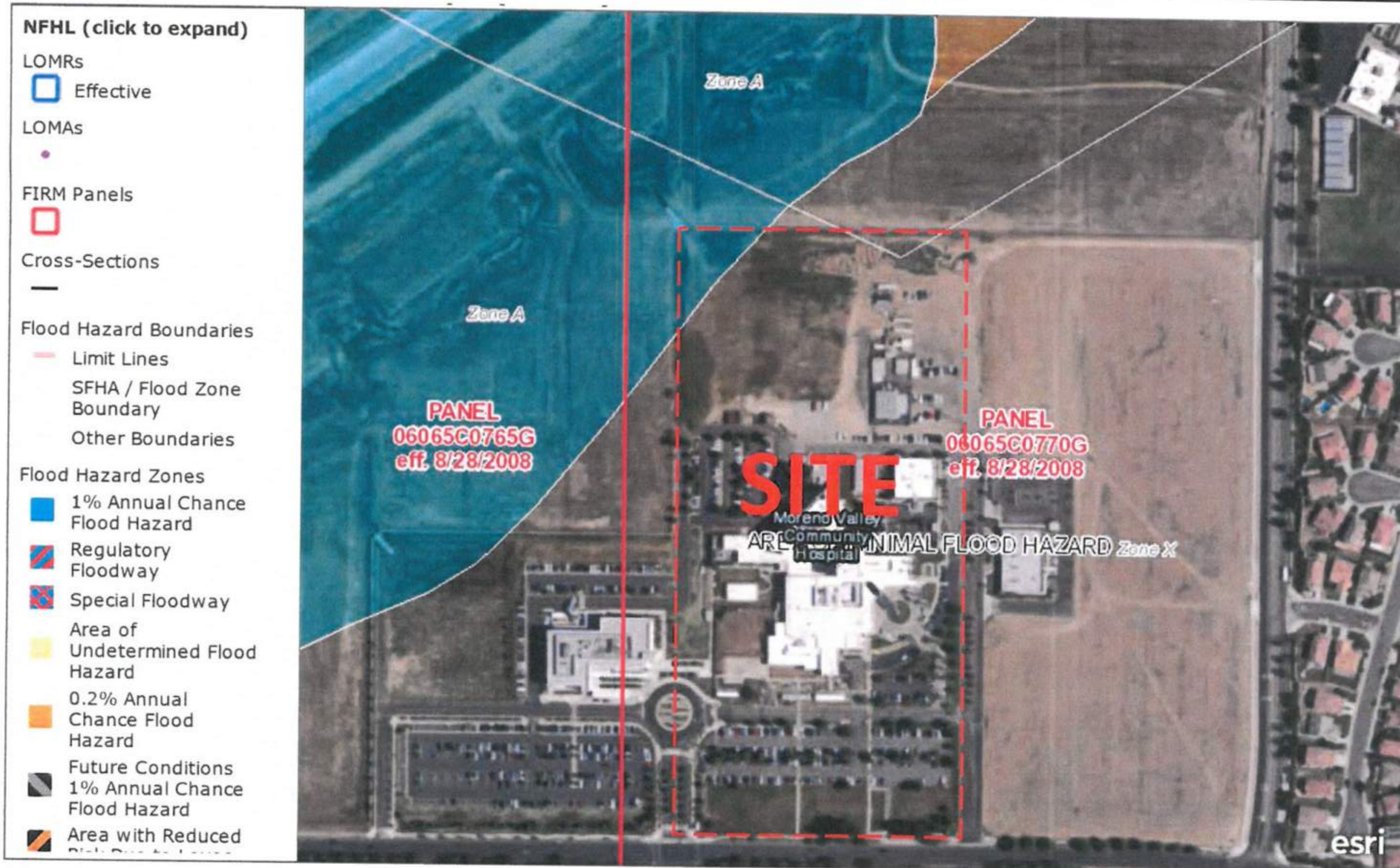
GEOBASE

SUBSIDENCE SUSCEPTIBILTY MAP

Kaiser Permanente MVMC – CUP
27300 Iris Avenue
Moreno Valley, California

C.314.82.00

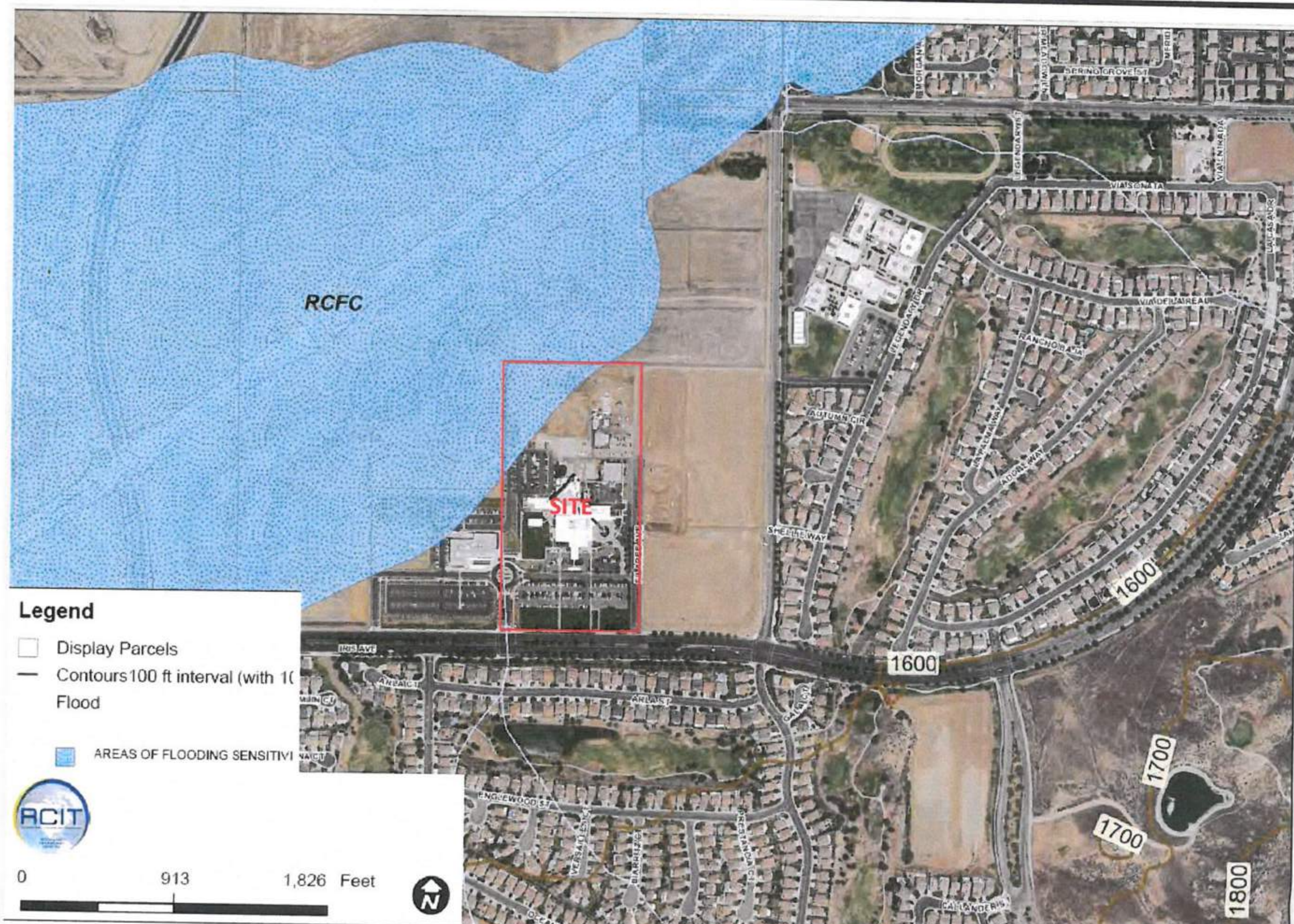
FIGURE A-12



Data from Flood Insurance Rate Maps (FIRMs) where available digitally. New NFHL FIRMette Print app available:

The **SITE** is in Zone X – Area determined to be outside of 0.2% annual chance of floodplain.
Zone A – 1% Annual Chance Flood Hazard

GEOBASE	C.314.82.00	**FEMA FLOOD MAP** **Kaiser Permanente MVMC – CUP** **27300 Iris Avenue** **Moreno Valley, California**
		FIGURE A-13 **Page 1 of 2**



GEOBASE

RCIT FLOOD MAP
Kaiser Permanente MVMC – CUP
27300 Iris Avenue
Moreno Valley, California

C.314.82.00

FIGURE A-13
Page 2 of 2

APPENDIX B

GEOBASE INC (June 2010)

GeoVision Geophysical Services, Inc. (July 21, 2017)

The terms and symbols used on the Log of Borings to summarize the results of the field investigation and subsequent laboratory testing are described in the following:

It should be noted that materials, boundaries, and conditions have been established only at the boring locations, and are not necessarily representative of subsurface conditions elsewhere across the site.

A. PARTICLE SIZE DEFINITION (ASTM D2487 AND D422)

Boulder	-- larger than 12-inches	Sand, medium	-- No.40 to No. 10 sieves
Cobble	-- 3-inches to 12-inches	Sand, fine	-- No.200 to No. 40 sieves
Gravel, coarse	-- 3/4-inch to 3-inches	Silt	-- 5μm to No. 200 sieves
Gravel, fine	-- No.4 sieve to 3/4 -inch	Clay	-- smaller than 5 μm
Sand, coarse	-- No.10 to No.4 sieve		

B. SOIL CLASSIFICATION

Soils and bedrock are classified and described according to their engineering properties and behavioral characteristics. The soil of each stratum is described using ASTM D2487 and D2488.

The following adjectives may be employed to define percentage ranges by weight of minor components:

trace	--	1-10%	some	--	20-35%
little	--	10-20%	"and" or "y"	--	35-50%

The following descriptive terms may be used for stratified soils:

parting	--	0 to 1/16-in. thickness;	layer	--	½-in. to 12-in. thickness;
seam	--	1/16 to ½-in. thickness;	stratum	--	greater than 12-in. thickness.

C. SOIL DENSITY AND CONSISTENCY

The density of coarse grained soils and the consistency of fine grained soils are described on the basis of the Standard Penetration Test:

COARSE GRAINED SOILS		FINE GRAINED SOILS		
Density	SPT Blows per Foot	Estimated Consistency	SPT Blows per Foot	Estimated Range of Unconfined Compressive Strength (TSF)
very loose	less than 4	very soft	less than 2	less than 0.25
loose	5 to 10	soft	2 to 4	0.25 to 0.50
medium	11 to 30	firm (medium)	5 to 8	0.50 to 1.0
dense	31 to 50	stiff	9 to 15	1.0 to 2.0
very dense	over 50	very stiff	16 to 30	2.0 to 4.0
		hard	over 30	over 4.0

D. STANDARD PENETRATION TEST (SPT) -- D1586

The SPT test involves failure of the soil around the tip of a split spoon sampler for a condition of constant energy transmittal. The split spoon, 2-inches outside diameter and 1 3/8-inches inside diameter, is driven eighteen (18) inches. The sampler is seated in the first six (6) inches and the number of blows required to drive the sampler the last foot is recorded as the "N" value or SPT blow count. The driving energy is provided by a 140 pound weight dropping thirty (30) inches.

E. ABBREVIATION OF LABORATORY TEST DESIGNATIONS

C	Consolidation
CBR	California Bearing Ratio
Ch	Water Soluble Chlorides
DS	Direct Shear
EI	Expansion Index
ER	Electrical Resistivity
k	Permeability
MD	Moisture
MP	Modified Proctor Compaction Test
O	Organic Content
pH	pH
pp	Pocket Penetrometer
PS	Particle Size
RV	R-Value
SE	Sand Equivalent
SG	Specific Gravity
SO_4	Water Soluble Sulfates
TX	Triaxial Compression
TV	Torvane Shear
U	Unconfined Compression

F. STRATIFICATION LINES

The stratification lines indicated on the boring logs and profiles represent the ***approximate*** boundary between material types and the transition may be gradual.

SOIL CLASSIFICATION SYSTEM (ASTM D 2487)

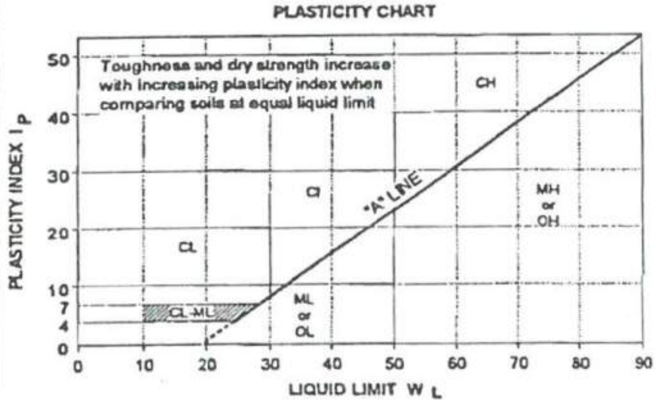
MAJOR DIVISION			GROUP SYMBOL	GRAPHIC SYMBOL	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA
HIGHLY ORGANIC SOILS			Pt		Peat and other highly organic soils	Strong color or odor and often fibrous texture
COARSE-GRAINED SOILS (More than half by weight larger than No. 200 sieve size)	GRAVELS (More than half coarse fraction larger than No. 4 sieve size)	CLEAN GRAVELS	GW		Well-graded Gravels, Gravel-Sand mixtures (<5% fines)	$C_u = \frac{D_{60}}{D_{10}} > 4$ $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1$ to 3
			GP		Poorly-graded Gravels and Gravel-Sand mixtures (<5% fines)	Not meeting all above requirements
		DIRTY GRAVELS	GM		Silty Gravels, Gravel-Sand-Silt mixtures (>12% fines)	Atterberg limits below "A" line or $I_p < 4$
			GC		Clayey Gravels, Gravel-Sand-Clay mixtures (>12% fines)	Atterberg limits above "A" line or $I_p > 7$
	SANDS (More than half coarse fraction smaller than No. 4 sieve size)	CLEAN SANDS	SW		Well-graded Sands, Gravelly Sands (<5% fines)	$C_u = \frac{D_{60}}{D_{10}} > 6$ $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}} > 1$ to 3
			SP		Poorly-graded Sands or Gravelly Sands (<5% fines)	Not meeting all above requirements
		DIRTY SANDS	SM		Silty Sands, Sand-Silt mixtures (>12% fines)	Atterberg limits below "A" line or $I_p < 4$
			SC		Clayey Sands, Sand-Clay mixtures (>12% fines)	Atterberg limits above "A" line or $I_p > 7$
FINE-GRAINED SOILS (More than half by weight passes No. 200 sieve size)	SILTS Below "A" line on plasticity chart: negligible organic content		ML		Inorganic Silts and very fine Sands, Rock Flour, Silty Sands of slight plasticity	$W_L < 50$
			MH		Inorganic Silts micaceous or diatomaceous, fine Sandy or Silty soils	$W_L > 50$
	CLAYS Above "A" line on plasticity chart: negligible organic content		CL		Inorganic Clays of low plasticity, Gravelly, Sandy, or Silty Clays, lean Clays	$W_L < 30$
			CI		Inorganic Clays of medium plasticity, Silty Clays	$W_L > 30, < 50$ — See chart below
			CH		Inorganic Clays of high plasticity, fat Clays	$W_L > 50$
	ORGANIC SILTS & ORGANIC CLAYS Below "A" line on plasticity chart		OL		Organic Silts and organic Silty Clays of low plasticity	$W_L < 50$
			OH		Organic Clays of high plasticity	$W_L > 50$

The soil of each stratum is described using ASTM D2487 and D2488 modified slightly so that an inorganic clay of "medium plasticity" is recognized.

ADDITIONAL SOIL CLASSIFICATION

- Fill Soil
- Ss Sandstone
- Cs Claystone
- Ms Siltstone

PLASTICITY CHART



GEOBASE

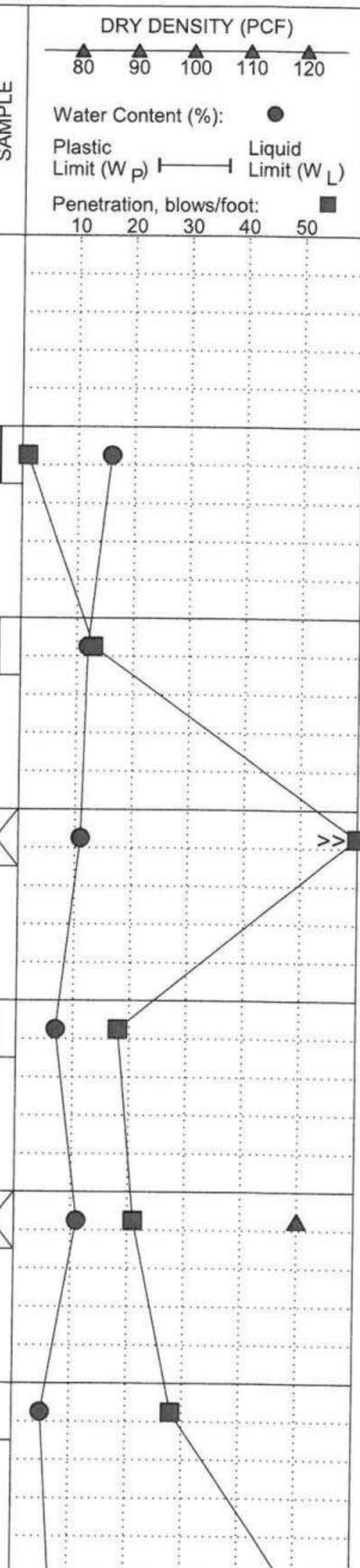
EXPLANATION OF TERMS AND SYMBOLS USED

Figure B-1

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

DEPTH (feet)	GRAPHIC LOG	SOIL DESCRIPTION	SOIL CLASSIFICATION	SAMPLE	REMARKS/ OTHER TESTS
		GRASS AND ROOTS, GRASS			
		SAND (FILL), brown, clayey, very loose.			
5		SILT, brown, fined-sands, little clay, very soft.	ML		N = PUSH 200 Wash
10		...stiff			
		SAND, brown, fine- to medium-grained, some silt.	SM		
15		...coarse-grained, little gravels, very dense			Blowcount = 94/12 in.
20		...medium- to coarse-grained, silty, medium dense			
25		...trace of gravels, medium dense			Blowcount = 32/12 in.
30		...poorly graded, trace to little silt, little gravels, medium dense			
35					



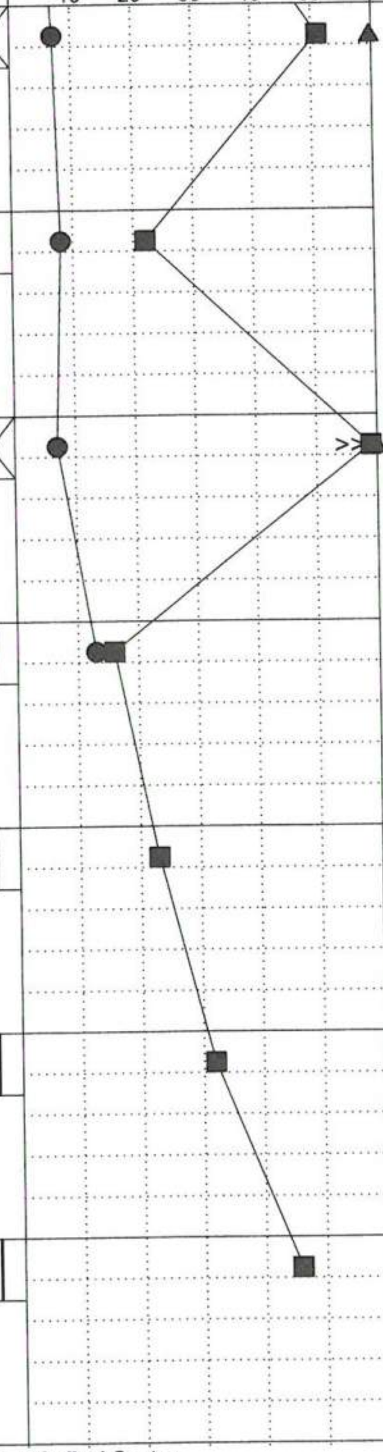
GEOBASE, INC.	PROJECT	KP Moreno Valley Medical Center 27300 Iris Avenue, Moreno Valley, CA		BORING NO. **B-1**
	DEPTH TO WATER feet	SURFACE ELEV. **1526 feet**	LOGGED BY **HDN**	PROJECT NO. **C.314.81.00**
	DEPTH TO SLOUGH	DRILL RIG **CME-75 HT** DRILLER **Martini Drilling**	DATE LOGGED **06/07/2017**	FIGURE NO. B- **2**

Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

DEPTH (feet)	GRAPHIC LOG	SOIL DESCRIPTION	SOIL CLASSIFICATION	SAMPLE	DRY DENSITY (PCF) 80 90 100 110 120; Water Content (%): ●; Plastic Limit (W_P) – Liquid Limit (W_L); Penetration, blows/foot: ■ 10 20 30 40 50	REMARKS/ OTHER TESTS
		SAND, light brown, medium- to coarse-grained, trace to little silt, little gravels, very dense.	SM	California Modified		Blowcount = 78/12 in. 200 Wash
40		...silty, medium dense		SPT		200 Wash
45		...coarse-grained, some silt and fine-gravels, very dense		California Modified	>>	Blowcount = 90/12 in. 200 Wash
50		SAND, brown, little silt, trace of gravel, medium dense.	SM	SPT		
		SAND, light brown, medium- to coarse-grained, little pea gravels, trace of silt, medium dense.	SP			
55		...minor seepage at 56.5 ft		SPT		
		SAND, light brown, medium- to coarse grained, some gravels, dense	SM			
60				SPT		PS
65		...little silt, trace of gravels, dense		SPT		PS
70		End of Boring at 66.5 feet. Boring dry at completion of drilling.. Backfilled with soil cuttings.				



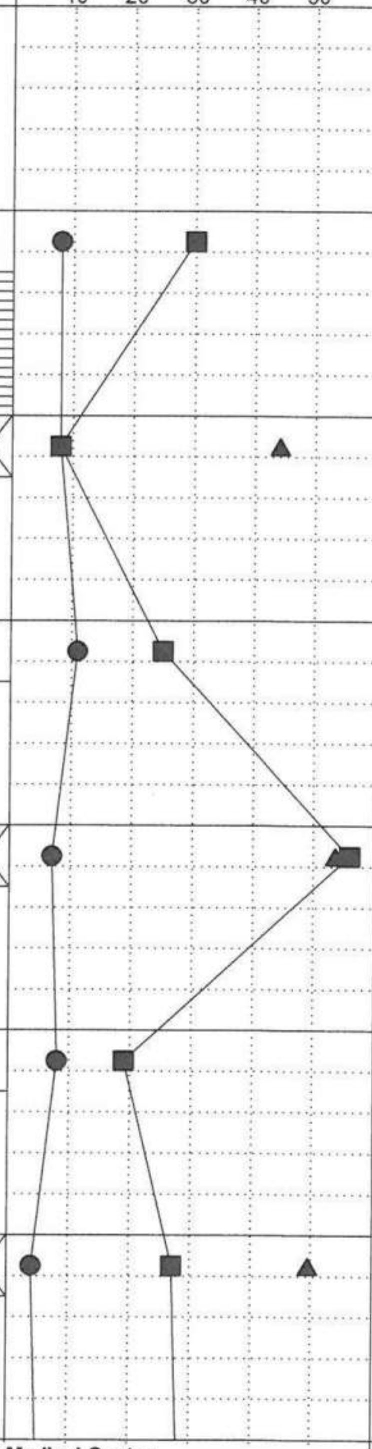
GEOBASE, INC.	PROJECT	KP Moreno Valley Medical Center 27300 Iris Avenue, Moreno Valley, CA		BORING NO. B-1
	DEPTH TO WATER feet	SURFACE ELEV. 1526 feet	LOGGED BY HDN	PROJECT NO. C.314.81.00
	DEPTH TO SLOUGH	DRILL RIG CME-75 HT DRILLER Martini Drilling	DATE LOGGED 06/07/2017	FIGURE NO. B-2

Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

DEPTH (feet)	GRAPHIC LOG	SOIL DESCRIPTION	SOIL CLASSIFICATION	SAMPLE	DRY DENSITY (PCF) 80 90 100 110 120; Water Content (%): ●; Plastic Limit (W_P) ├──┤ Liquid Limit (W_L); Penetration, blows/foot: ■ 10 20 30 40 50	REMARKS/ OTHER TESTS
		GRASS AND ROOTS, GRASS				
		SILT (FILL), brown, little sand and clay, soft.				
5		...some sands, very stiff		SPT		
		SAND, brown, fine- to medium-grained, sandy SILT with little clay.	SM-ML	Disturbed		Bulk Sample 5-10 ft. EI, MP, 95 RC, Ch, ER, pH, SO_4
10		...firm, some clay		California		Blowcount = 11/12 in. C, DS
15		...coarse-grained, little gravels, medium dense.		SPT		
		SAND, brown,.medium- to coarse-grained, silty, cementation, very dense	SM			
20				California		Blowcount = 86/12 in. C, DS
25		...trace of gravels, medium dense		SPT		
30		...poorly graded, trace to little silt, little gravels, medium dense		California		Blowcount = 41/12 in. C, DS
35						



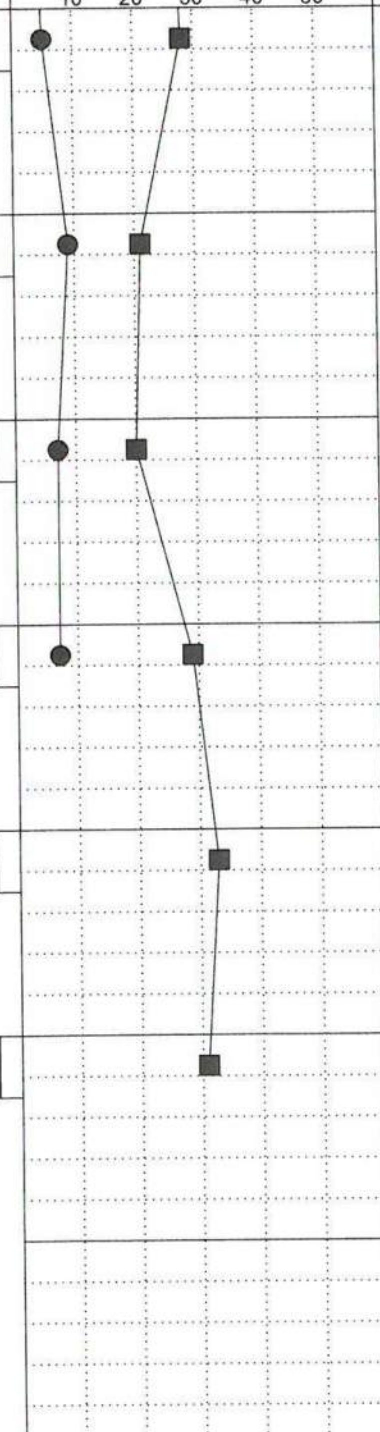
GEOBASE, INC.	PROJECT	**KP Moreno Valley Medical Center** **27300 Iris Avenue, Moreno Valley, CA**		**BORING NO. B-2**
	DEPTH TO WATER feet	SURFACE ELEV. **1535 feet**	LOGGED BY **HDN**	PROJECT NO. **C.314.81.00**
	DEPTH TO SLOUGH	DRILL RIG **CME-75 HT** DRILLER **Martini Drilling**	DATE LOGGED **06/07/2017**	FIGURE NO. B- **3**

Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

DEPTH (feet)	GRAPHIC LOG	SOIL DESCRIPTION	SOIL CLASSIFICATION	SAMPLE	DRY DENSITY (PCF) 80 90 100 110 120; Water Content (%): ●; Plastic Limit (W_P) ├──┤ Liquid Limit (W_L); Penetration, blows/foot: ■ 10 20 30 40 50	REMARKS/ OTHER TESTS
		SAND, light brown, medium- to coarse-grained, trace to little silt, little gravels, medium dense.	SP-SM			
40		...silty, white streak rock				
45		...silty				200 Wash
50		...fine-grained, silty				
55		...dense, minor seepage at 56 ft				
60		SAND, light brown, coasrse-grained, trace of silt, little gravel, dense.	SP			
65		End of Boring at 66.5 feet. Boring dry at completion of drilling. Backfilled with soil cuttings.				
70						



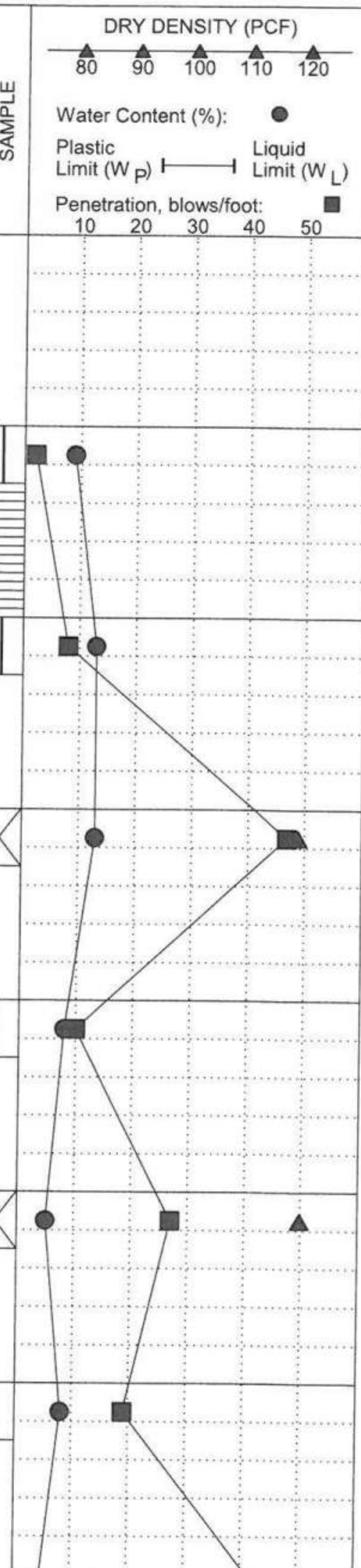
GEOBASE, INC.	PROJECT	KP Moreno Valley Medical Center 27300 Iris Avenue, Moreno Valley, CA		BORING NO. B-2
	DEPTH TO WATER feet	SURFACE ELEV. 1535 feet	LOGGED BY HDN	PROJECT NO. C.314.81.00
	DEPTH TO SLOUGH	DRILL RIG CME-75 HT DRILLER Martini Drilling	DATE LOGGED 06/07/2017	FIGURE NO. B-3

Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

DEPTH (feet)	SOIL DESCRIPTION	SOIL CLASSIFICATION	REMARKS/ OTHER TESTS
0	GRASS AND ROOTS, GRASS		
	SAND (FILL), brown, silty, very loose.		
5	SILT, brown, some fine-grained sand, soft.	ML	Bulk Sample 5-10 ft. EI, MP, 95 RC Ch, ER, pH, SO_4
10	SAND, brown, fine-grained, silty, loose.	SM	
	SILT, brown, little fine-grained sand, cementation, hard.	ML	
15			Blowcount = 72/12 in. DS, 200 Wash
	SAND, ...medium- to coarse-grained, silty.	SM	
20	...some silt, loose		
25	...trace of gravels, medium dense		Blowcount = 42/12 in.
30	...micaceous, fine- to medium-grained, silty and little gravels		
35			



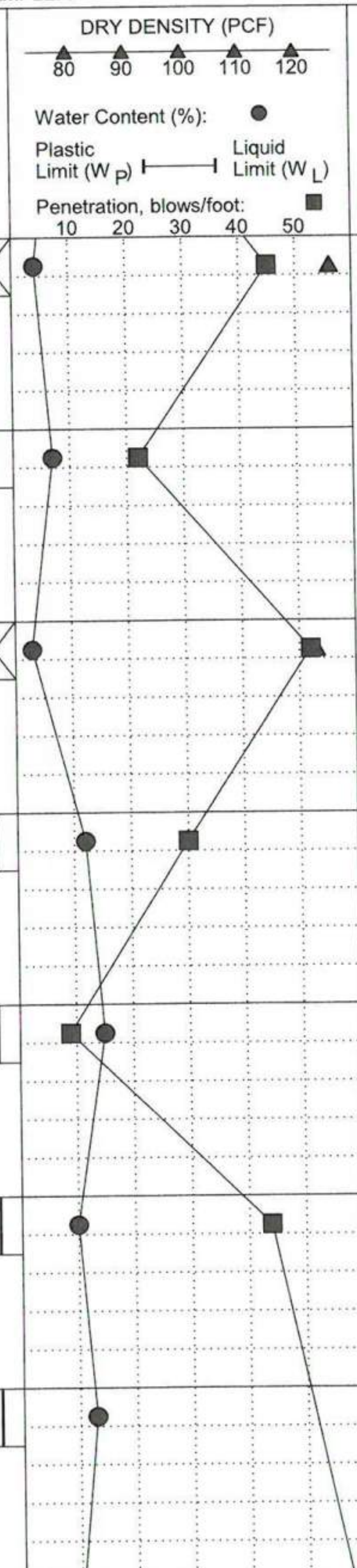
GEOBASE, INC.	PROJECT	KP Moreno Valley Medical Center 27300 Iris Avenue, Moreno Valley, CA		BORING NO. B-3
	DEPTH TO WATER feet	SURFACE ELEV. 1525 feet	LOGGED BY HDN	PROJECT NO. C.314.81.00
	DEPTH TO SLOUGH	DRILL RIG CME-75 HT DRILLER Martini Drilling	DATE LOGGED 06/07/2017	FIGURE NO. B-4

Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

DEPTH (feet)	GRAPHIC LOG	SOIL DESCRIPTION	SOIL CLASSIFICATION	SAMPLE	DRY DENSITY (PCF) / Water Content (%) / Plastic Limit (W_P) – Liquid Limit (W_L) / Penetration, blows/foot	REMARKS/ OTHER TESTS
		SAND, light brown, medium- to coarse-grained, siltyt, trace of gravels, dense.	SM	California Modified		Blowcount = 69/12 in. DS, 200 Wash
40		...medium dense		SPT		
45		SAND, light brown, trace of silt and gravel, dense to very dense.	SP	California Modified		Blowcount = 80/12 in.
50		...coasrse-grained, little gravels, dense ...minor seepage at 51 ft		SPT		
55		SILT, brown, little sands, stiff.	ML	SPT		
60		SAND, brown, medium-grained, little silt and trace of gravel, dense.	SM	SPT		
65		SAND, brown, coarse-grained, little gravel, trace of silt, medium dense.	SP	SPT		
70						



GEOBASE, INC.	PROJECT	**KP Moreno Valley Medical Center** **27300 Iris Avenue, Moreno Valley, CA**	BORING NO. **B-3**
	DEPTH TO WATER feet	SURFACE ELEV. **1525 feet** / LOGGED BY **HDN**	PROJECT NO. **C.314.81.00**
	DEPTH TO SLOUGH	DRILL RIG **CME-75 HT** / DRILLER **Martini Drilling** / DATE LOGGED **06/07/2017**	FIGURE NO. B-**4**

Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

DEPTH (feet)	GRAPHIC LOG	SOIL DESCRIPTION	SOIL CLASSIFICATION	SAMPLE	DRY DENSITY (PCF) 80 90 100 110 120 / Water Content (%): ● / Plastic Limit (W_P) ├──┤ Liquid Limit (W_L) / Penetration, blows/foot: ■ 10 20 30 40 50	REMARKS/ OTHER TESTS
		SAND, brown, trace of silt, some gravels, very dense.	SP			
75		End of Boring at 71.5 feet. Boring dry at completion of drilling. Backfilled with soil cuttings.				
80						
85						
90						
95						
100						
105						

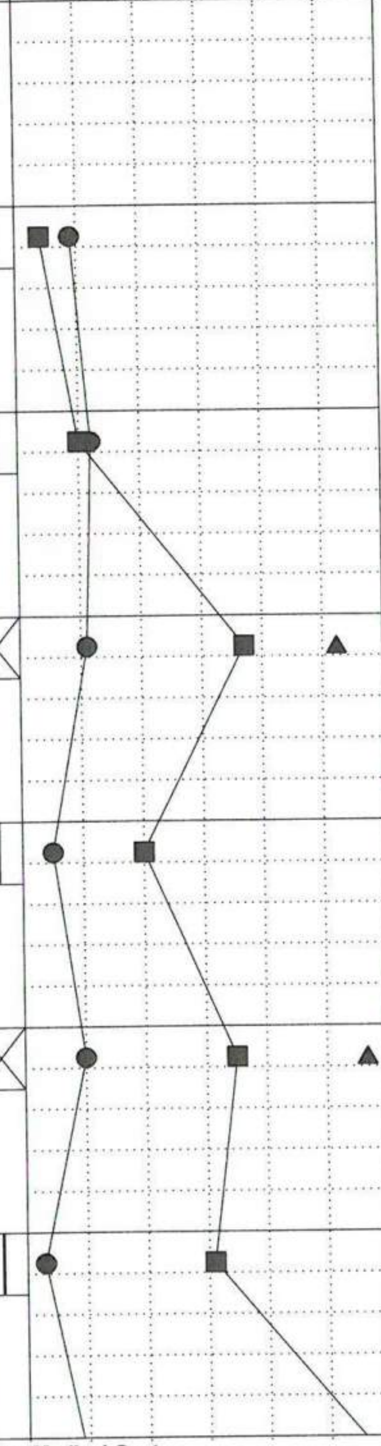
GEOBASE, INC.	PROJECT	KP Moreno Valley Medical Center 27300 Iris Avenue, Moreno Valley, CA		BORING NO. B-3
	DEPTH TO WATER feet	SURFACE ELEV. 1525 feet	LOGGED BY HDN	PROJECT NO. C.314.81.00
	DEPTH TO SLOUGH	DRILL RIG CME-75 HT DRILLER Martini Drilling	DATE LOGGED 06/07/2017	FIGURE NO. B-4

Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

DEPTH (feet)	GRAPHIC LOG	SOIL DESCRIPTION	SOIL CLASSIFICATION	SAMPLE	DRY DENSITY (PCF) 80 90 100 110 120; Water Content (%): ●; Plastic Limit (W_P) — Liquid Limit (W_L); Penetration, blows/foot: ■ 10 20 30 40 50	REMARKS/ OTHER TESTS
		SAND (FILL), brown, silty, very loose.	SM			
5		SILT, brown, little fine- to coarse-grained sand, soft.	ML	SPT		
10		...stiff		SPT		
		SAND, brown, silty, medium- to coarse grained, micaceous.	SM			
15		...dense		California		Blowcount = 37/12 in. C, DS, 200 Wash
20		...fine- to medium grained, little silt, medium dense		SPT		200 Wash
25		...silty, dense		California		Blowcount = 54/12 in.
30		SAND, light brown, fine- to medium grained, little silt, micaceous, dense.	SP	SPT		
35						



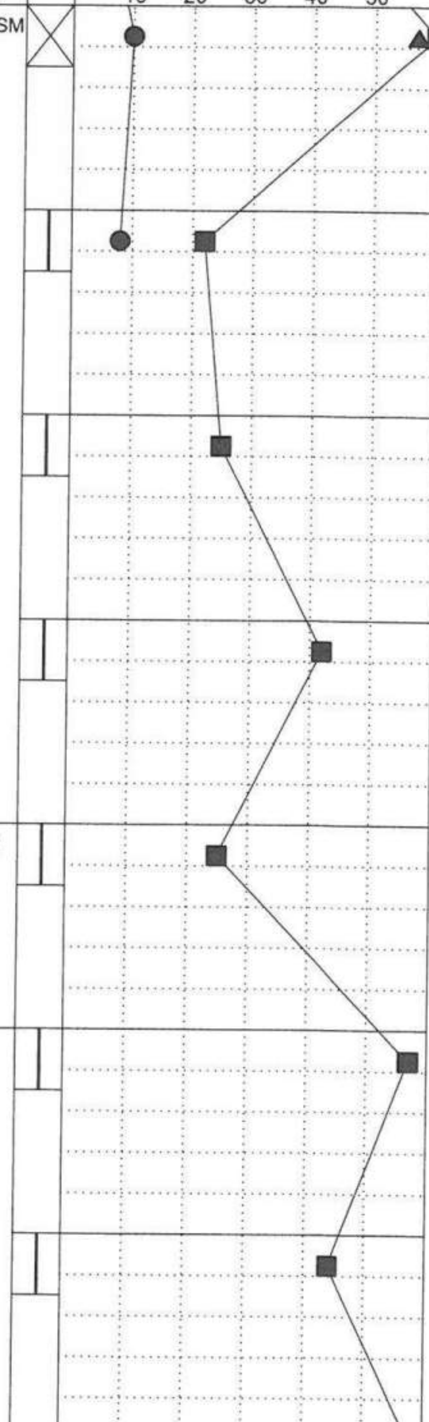
GEOBASE, INC.	PROJECT	KP Moreno Valley Medical Center 27300 Iris Avenue, Moreno Valley, CA	BORING NO. B-4
	DEPTH TO WATER feet	SURFACE ELEV. 1526 feet; LOGGED BY HDN	PROJECT NO. C.314.81.00
	DEPTH TO SLOUGH	DRILL RIG CME-75 HT; DRILLER Martini Drilling; DATE LOGGED 06/08/2017	FIGURE NO. B- 5

Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

DEPTH (feet)	GRAPHIC LOG	SOIL DESCRIPTION	SOIL CLASSIFICATION	SAMPLE	DRY DENSITY (PCF) 80 90 100 110 120; Water Content (%): ●; Plastic Limit (W_P) ├──┤ Liquid Limit (W_L); Penetration, blows/foot: ■ 10 20 30 40 50	REMARKS/ OTHER TESTS
		SAND, brown, medium- to coarse-grained, little silt, very dense.	SP-SM			Blowcount = 91/10 in.
40		...silty medium dense				
45		...fine-grained, silty, medium dense				
50		...little silt, trace of gravel, dense				PS
55		SAND, brown, silty, fine-grained, medium dense. ...minor seepage at 56 ft	SM			
60		SAND, light brown, coarse-grained, trace of silt, very dense.	SP			
65		...fine- to medium-grained, dense				
70						



GEOBASE, INC.	PROJECT	KP Moreno Valley Medical Center 27300 Iris Avenue, Moreno Valley, CA		BORING NO. B-4
	DEPTH TO WATER feet	SURFACE ELEV. 1526 feet	LOGGED BY HDN	PROJECT NO. C.314.81.00
	DEPTH TO SLOUGH	DRILL RIG CME-75 HT DRILLER Martini Drilling	DATE LOGGED 06/08/2017	FIGURE NO. B-5

Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

DEPTH (feet)	GRAPHIC LOG	SOIL DESCRIPTION	SOIL CLASSIFICATION	SAMPLE	DRY DENSITY (PCF) 80 90 100 110 120; Water Content (%); Plastic Limit (W_P) – Liquid Limit (W_L); Penetration, blows/foot: 10 20 30 40 50	REMARKS/ OTHER TESTS
		SAND, brown, coarse grained, little silt, trace of fined-gravels, very dense.	SM			N = 79, PS
75		End of Boring at 71.5 feet. Boring dry at completion of drilling. Backfilled with soil cuttings.				
80						
85						
90						
95						
100						
105						

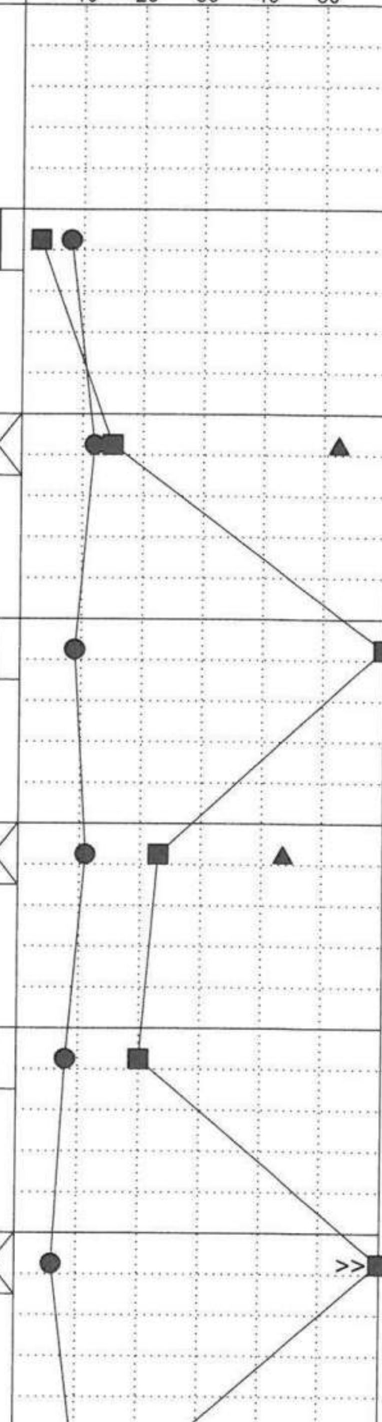
GEOBASE, INC.	PROJECT	KP Moreno Valley Medical Center 27300 Iris Avenue, Moreno Valley, CA		BORING NO. B-4
	DEPTH TO WATER feet	SURFACE ELEV. 1526 feet	LOGGED BY HDN	PROJECT NO. C.314.81.00
	DEPTH TO SLOUGH	DRILL RIG CME-75 HT DRILLER Martini Drilling	DATE LOGGED 06/08/2017	FIGURE NO. B-5

Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

DEPTH (feet)	GRAPHIC LOG	SOIL DESCRIPTION	SOIL CLASSIFICATION	SAMPLE	DRY DENSITY (PCF) 80 90 100 110 120 / Water Content (%) / Plastic Limit (W_P) – Liquid Limit (W_L) / Penetration, blows/foot: 10 20 30 40 50	REMARKS/ OTHER TESTS
0		SAND (FILL), brown, silty, very loose.	SM			
5		SILT, brown, fine-grained sands, soff	ML	SPT		
10		...sandy, stiff		California		Blowcount = 23/12 in.
		SAND, brown, silty, cementation, micaceous, trace of gravels.	SM			
15		...white streak, very dense		SPT		N = 83
		SILT, ...some sands, very stiff.	ML			
20				California		Blowcount = 35/12 in.
		SAND, brown, silty, fine-grained, medium dense.	SM			
25				SPT		200 Wash
30		...light brown, silty, very dense.		California	>>	Blowcount = 98/11 in. 200 Wash
35						



GEOBASE, INC.	PROJECT	KP Moreno Valley Medical Center 27300 Iris Avenue, Moreno Valley, CA		BORING NO. B-5
	DEPTH TO WATER feet	SURFACE ELEV. 1527 feet	LOGGED BY HDN	PROJECT NO. C.314.81.00
	DEPTH TO SLOUGH	DRILL RIG CME-75 HT DRILLER Martini Drilling	DATE LOGGED 06/08/2017	FIGURE NO. B-6

Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

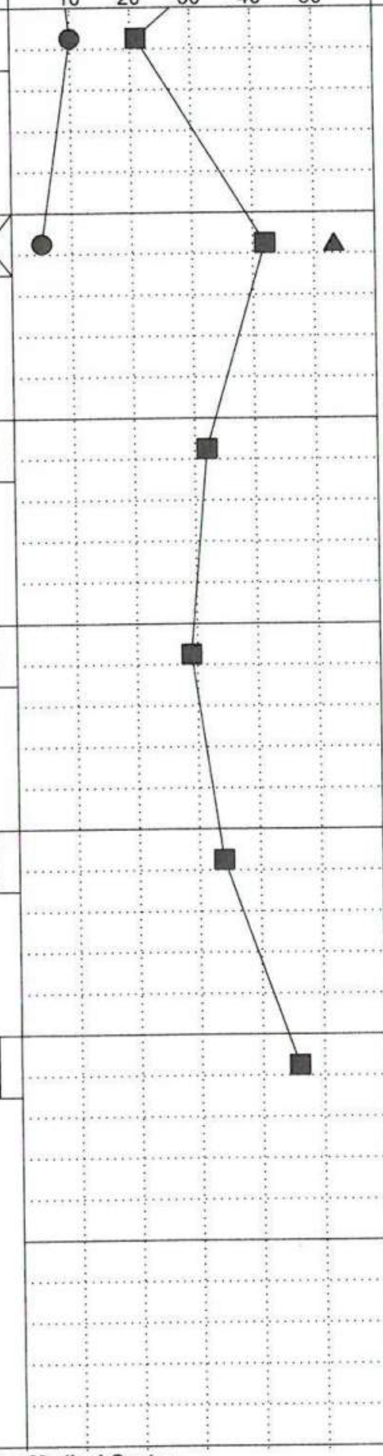
DEPTH (feet)	GRAPHIC LOG	SOIL DESCRIPTION	SOIL CLASSIFICATION	SAMPLE	REMARKS/ OTHER TESTS
		SAND, brown, medium- to coarse-grained, silty, medium dense.	SM		
40		...dense			Blowcount = 65/12 in.
45		...fine-grained, little gravels, dense			
50		SAND, light brown, fine- to medium-grained, little fine-gravels, medium dense.	SP		
55		...silty, dense ...minor seepage at 56 ft			
60		SAND, light brown, coarse-grained, little fine-gravel, dense.	SP		
65		End of Boring at 61.5 feet. Boring dry at completion of drilling. Backfilled with soil cuttings.			
70					

DRY DENSITY (PCF): 80 90 100 110 120

Water Content (%): ●

Plastic Limit (W_P) ├──┤ Liquid Limit (W_L)

Penetration, blows/foot: ■ 10 20 30 40 50



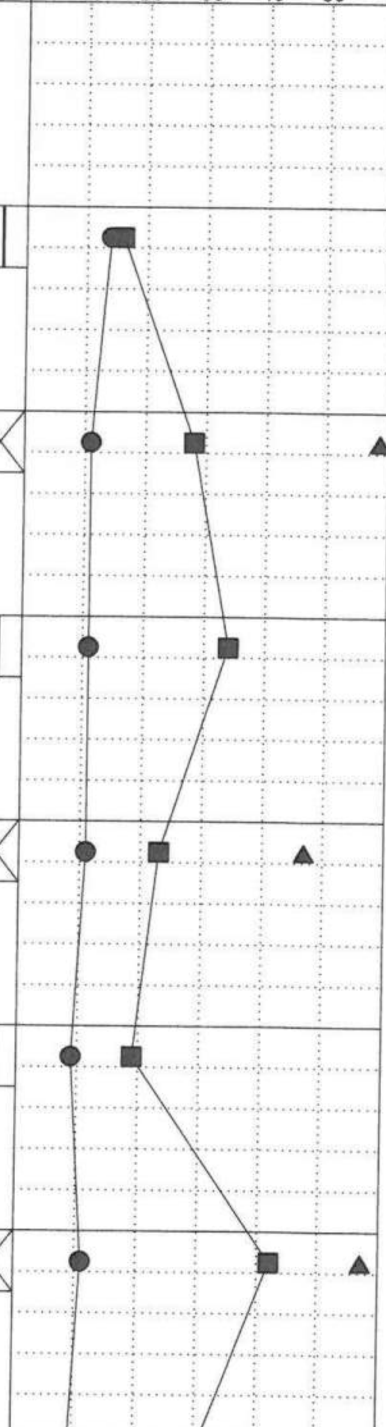
GEOBASE, INC.	PROJECT	KP Moreno Valley Medical Center 27300 Iris Avenue, Moreno Valley, CA		BORING NO. B-5
	DEPTH TO WATER feet	SURFACE ELEV. 1527 feet	LOGGED BY HDN	PROJECT NO. C.314.81.00
	DEPTH TO SLOUGH	DRILL RIG CME-75 HT DRILLER Martini Drilling	DATE LOGGED 06/08/2017	FIGURE NO. B-6

Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

DEPTH (feet)	GRAPHIC LOG	SOIL DESCRIPTION	SOIL CLASSIFICATION	SAMPLE	DRY DENSITY (PCF) 80 90 100 110 120; Water Content (%): ●; Plastic Limit (W_P) – Liquid Limit (W_L); Penetration, blows/foot: ■ 10 20 30 40 50	REMARKS/ OTHER TESTS
0		SAND (FILL), brown, silty, very loose.	SM			
5		SILT, brown, fine-grained sands, stiff.	ML			
10		...some sands, very stiff				Blowcount = 43/12 in.
15		...little micaceous sands, white streak, cementation,, hard.				
20		...some sands, very stiff.				Blowcount = 35/12 in.
		SAND, brown, silty, fine-grained, medium dense.	SM			
25						
30		...little fine-gravel, dense				Blowcount = 64/12 in.
35						



GEOBASE, INC.	PROJECT	KP Moreno Valley Medical Center 27300 Iris Avenue, Moreno Valley, CA		BORING NO. B-6
	DEPTH TO WATER feet	SURFACE ELEV. 1520 feet	LOGGED BY HDN	PROJECT NO. C.314.81.00
	DEPTH TO SLOUGH	DRILL RIG CME-75 HT DRILLER Martini Drilling	DATE LOGGED 06/08/2017	FIGURE NO. B-7

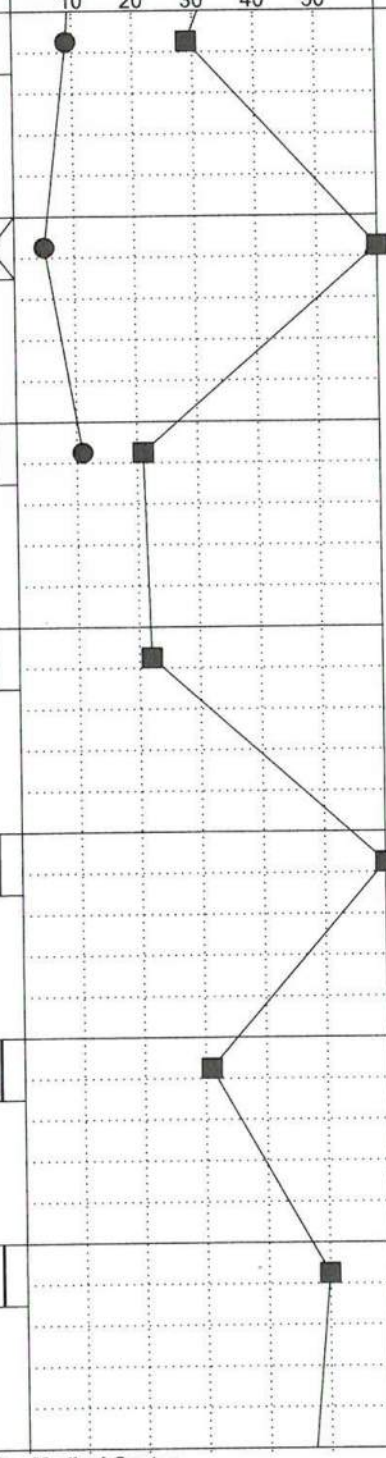
Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE; SPT SPLIT SPOON; CALIFORNIA MODIFIED SAMPLER; DISTURBED; NO RECOVERY; CORE

DRY DENSITY (PCF): 80, 90, 100, 110, 120
Water Content (%): ●
Plastic Limit (W_P) ├──┤ Liquid Limit (W_L)
Penetration, blows/foot: ■ 10, 20, 30, 40, 50

DEPTH (feet)	SOIL DESCRIPTION	SOIL CLASSIFICATION	REMARKS/ OTHER TESTS
	SAND, brown, medium- to coarse-grained, little silt and gravels, medium dense.	SM	
40	...well-graded, trace of silt, some fine-gravels, very dense		Blowcount = 85/11 in.
45	...fine-grained, little gravels, medium dense		
50	SILT, brown, some sands, very stiff. ...minor seepage at 51.5 ft	ML	
55	SAND, light brown, coarse-grained, micaceous, fined-gravels, very dense.	SW	N = 66 PS
60	SAND, brown, coarse-grained, little fine-gravel and silt, dense.	SM	
65	SAND, light brown, coarse-grained, trace of silt and gravels, very dense.	SP	PS
70			



GEOBASE, INC.	PROJECT: KP Moreno Valley Medical Center, 27300 Iris Avenue, Moreno Valley, CA		BORING NO. B-6
	DEPTH TO WATER feet	SURFACE ELEV. 1520 feet / LOGGED BY HDN	PROJECT NO. C.314.81.00
	DEPTH TO SLOUGH	DRILL RIG CME-75 HT / DRILLER Martini Drilling / DATE LOGGED 06/08/2017	FIGURE NO. B-7

Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

DEPTH (feet)	GRAPHIC LOG	SOIL DESCRIPTION	SOIL CLASSIFICATION	SAMPLE	DRY DENSITY (PCF) 80 90 100 110 120; Water Content (%): ●; Plastic Limit (W_P) ├──┤ Liquid Limit (W_L); Penetration, blows/foot: ■ 10 20 30 40 50	REMARKS/ OTHER TESTS
		SAND, brown, silty, trace of gravels, dense.	SM		■ (~50)	
75		End of Boring at 71.5 feet. Boring dry at completion of drilling. Backfilled with soil cuttings.				
80						
85						
90						
95						
100						
105						

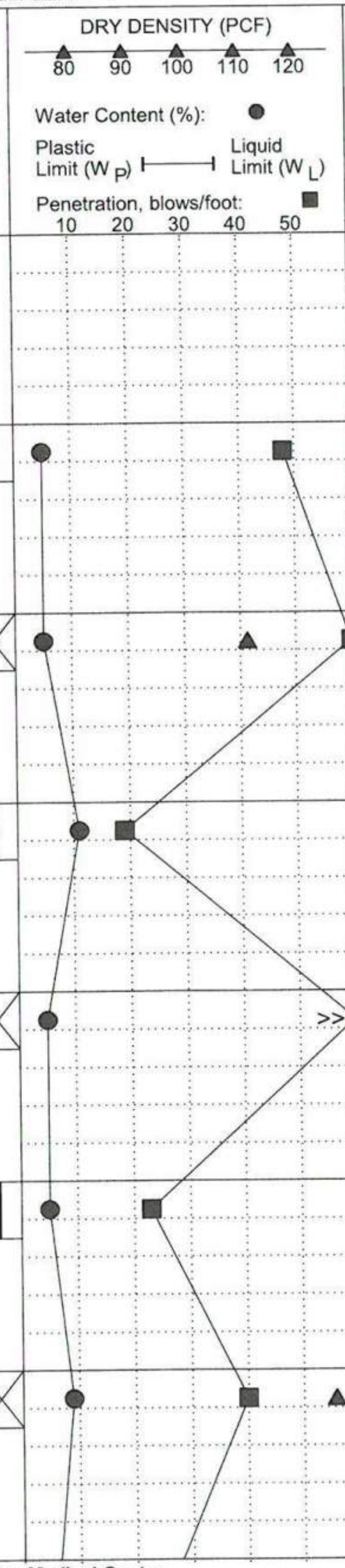
GEOBASE, INC.			
PROJECT	KP Moreno Valley Medical Center 27300 Iris Avenue, Moreno Valley, CA		BORING NO. B-6
DEPTH TO WATER feet	SURFACE ELEV. 1520 feet	LOGGED BY HDN	PROJECT NO. C.314.81.00
DEPTH TO SLOUGH	DRILL RIG CME-75 HT DRILLER Martini Drilling	DATE LOGGED 06/08/2017	FIGURE NO. B-7

Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

DEPTH (feet)	GRAPHIC LOG	SOIL DESCRIPTION	SOIL CLASSIFICATION	SAMPLE	DRY DENSITY (PCF) / Water Content (%) / Plastic Limit (W_P) – Liquid Limit (W_L) / Penetration, blows/foot	REMARKS/ OTHER TESTS
		GRASS AND ROOTS,				
		SAND, brown, silty, very loose.	SM			
5		SILT, brown, little fine-grained sands, hard.	ML	SPT		
10		...cementation, sandy, hard		California		Blowcount = 50/5 in. C, DS
15		...trace of sands, stiff		SPT		
20		SAND, brown, silty, fine-grained, very dense.	SM	California	>>	Blowcount = 85/11 in.
25		...micaceous, some silt, medium dense		SPT		
30		...silty, dense		California		Blowcount = 60/12 in.
35						



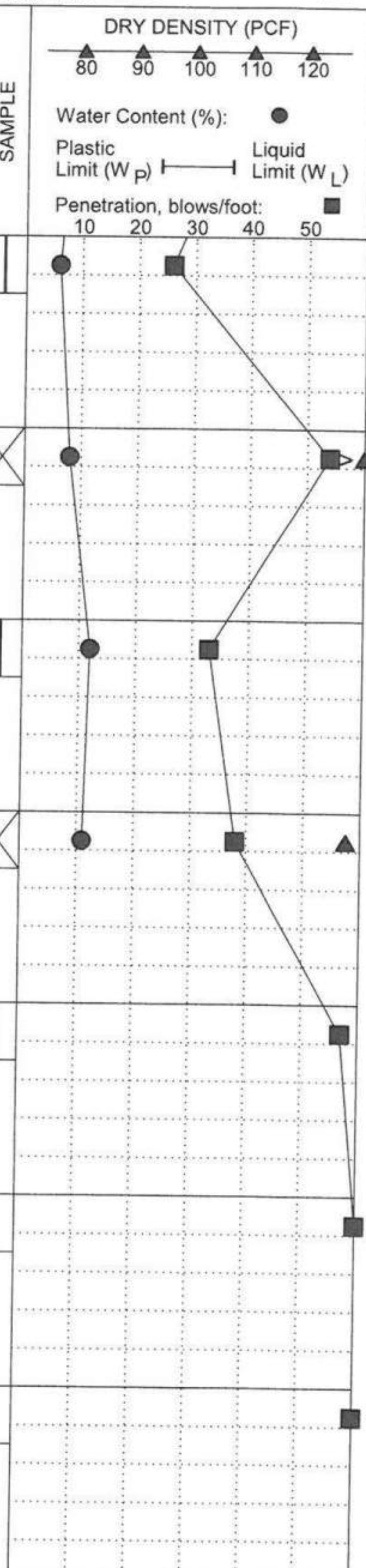
GEOBASE, INC.	PROJECT	KP Moreno Valley Medical Center 27300 Iris Avenue, Moreno Valley, CA		BORING NO. B-7
	DEPTH TO WATER feet	SURFACE ELEV. 1517 feet	LOGGED BY HDN	PROJECT NO. C.314.81.00
	DEPTH TO SLOUGH	DRILL RIG CME-75 HT DRILLER Martini Drilling	DATE LOGGED 06/08/2017	FIGURE NO. B-8

Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

DEPTH (feet)	SOIL DESCRIPTION	SOIL CLASSIFICATION	SAMPLE	REMARKS/ OTHER TESTS
	SAND, brown, medium- to coarse-grained, little silt and gravels, medium dense.	SM	SPT	PS
40	...little silt, trace of fine-gravels, very dense		California	Blowcount = 83/12 in.
45	SAND, light, brown, little fine-gravels, trace of silt, dense.	SP	SPT	
50	SAND, brown, some silt, little gravels, dense.	SM	California	Blowcount = 54/12 in.
	...minor seepage at 51.5 ft			
55	SAND, light brown, micaceous, litte silt and fine-gravels, very dense.	SP-SM	SPT	
60	...silty, little gravels, very dense		SPT	
65	...coarse-grained to fine-gravels		SPT	N = 79
70				



GEOBASE, INC.	PROJECT: **KP Moreno Valley Medical Center, 27300 Iris Avenue, Moreno Valley, CA**		BORING NO. **B-7**
	DEPTH TO WATER feet	SURFACE ELEV. **1517 feet** / LOGGED BY **HDN**	PROJECT NO. **C.314.81.00**
	DEPTH TO SLOUGH	DRILL RIG **CME-75 HT** / DRILLER **Martini Drilling** / DATE LOGGED **06/08/2017**	FIGURE NO. B-**8**

Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

DEPTH (feet)	GRAPHIC LOG	SOIL DESCRIPTION	SOIL CLASSIFICATION	SAMPLE	DRY DENSITY (PCF) 80 90 100 110 120; Water Content (%); Plastic Limit (W_P) / Liquid Limit (W_L); Penetration, blows/foot: 10 20 30 40 50	REMARKS/ OTHER TESTS
		SAND, brown, little silt, some fine-gravels, very dense.	SP			N = 74
75		End of Boring at 71.5 feet. Boring dry at completion of drilling. Backfilled with soil cuttings.				
80						
85						
90						
95						
100						
105						

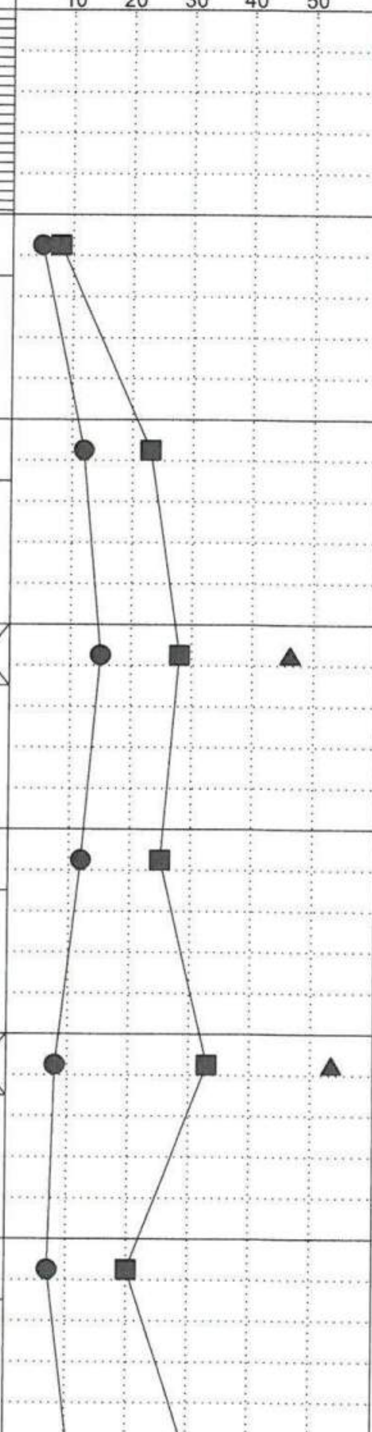
GEOBASE, INC.				
PROJECT	KP Moreno Valley Medical Center 27300 Iris Avenue, Moreno Valley, CA			BORING NO. B-7
DEPTH TO WATER feet	SURFACE ELEV. 1517 feet	LOGGED BY HDN		PROJECT NO. C.314.81.00
DEPTH TO SLOUGH	DRILL RIG CME-75 HT DRILLER Martini Drilling	DATE LOGGED 06/08/2017		FIGURE NO. B-8

Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

DEPTH (feet)	GRAPHIC LOG	SOIL DESCRIPTION	SOIL CLASSIFICATION	SAMPLE	DRY DENSITY (PCF) 80 90 100 110 120; Water Content (%): ●; Plastic Limit (W_P) — Liquid Limit (W_L); Penetration, blows/foot: ■ 10 20 30 40 50	REMARKS/ OTHER TESTS
0		GRASS AND ROOTS,		Disturbed		
		SAND, brown, silty, very loose.	SM	Disturbed		Bulk Sample 0-5 ft. EI, MP, RV, 200 Wash, 95 RC, Ch, ER, pH, SO_4
5		SILT, brown, some fine-grained sands, firm.	ML	SPT		
10		...little sands, very stiff		SPT		
15		...trace of sand		California		Blowcount = 43/12 in.
20		...little sands		SPT		
25		SAND, brown, fine-grained, silty, dense.	SM	California		Blowcount = 50/12 in.
30		...fine-grained, medium dense		SPT		
35						



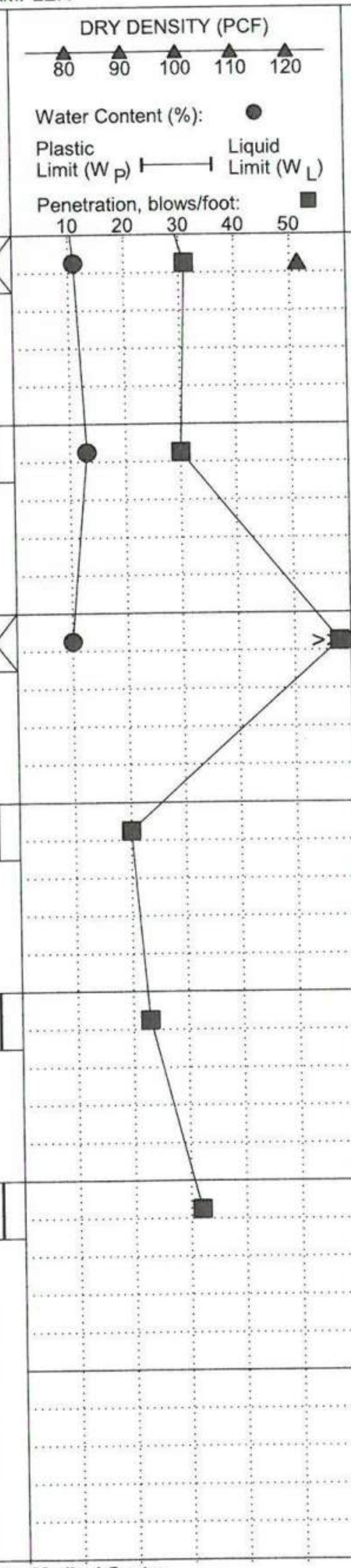
GEOBASE, INC.	PROJECT	KP Moreno Valley Medical Center 27300 Iris Avenue, Moreno Valley, CA		BORING NO. B-8
	DEPTH TO WATER feet	SURFACE ELEV. 1514 feet	LOGGED BY HDN	PROJECT NO. C.314.81.00
	DEPTH TO SLOUGH	DRILL RIG CME-75 HT DRILLER Martini Drilling	DATE LOGGED 06/09/2017	FIGURE NO. B-9

Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

DEPTH (feet)	GRAPHIC LOG	SOIL DESCRIPTION	SOIL CLASSIFICATION	SAMPLE	REMARKS/ OTHER TESTS
		SAND, brown, medium- to coarse-grained, little silt and gravels, dense.	SM	California Modified Sampler	Blowcount = 48/12 in.
40		...light gray, fine- to medium-grained		SPT	
45		... little fine-gravels and silt, very dense.		California Modified Sampler	Blowcount = 89/12 in. PS
50		brown, some silt, trace of gravels, medium dense.		SPT	
55		...silty ...minor seepage at 56 ft		SPT	
60		...silty, fine- to medium-grained, dense		SPT	
65		End of Boring at 61.5 feet. Boring dry at completion of drilling. Backfilled with soil cuttings.			
70					



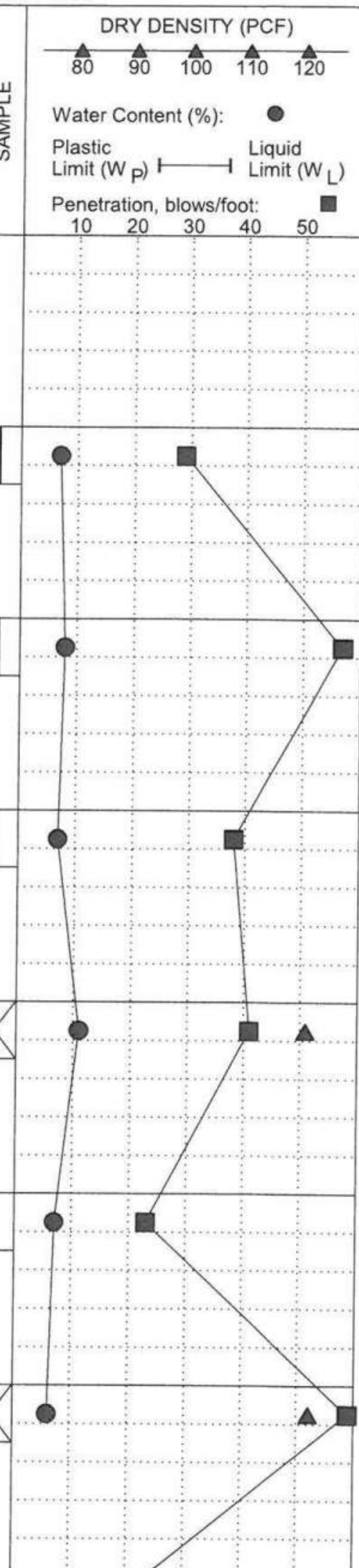
GEOBASE, INC.	PROJECT	**KP Moreno Valley Medical Center** **27300 Iris Avenue, Moreno Valley, CA**	BORING NO. **B-8**
	DEPTH TO WATER feet	SURFACE ELEV. **1514 feet** / LOGGED BY **HDN**	PROJECT NO. **C.314.81.00**
	DEPTH TO SLOUGH	DRILL RIG **CME-75 HT** DRILLER **Martini Drilling** / DATE LOGGED **06/09/2017**	FIGURE NO. B- **9**

Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

DEPTH (feet)	GRAPHIC LOG	SOIL DESCRIPTION	SOIL CLASSIFICATION	SAMPLE	REMARKS/ OTHER TESTS
0		GRASS AND ROOTS,			
		SAND (FILL), brown, silty, very loose.	SM		
		SILT, brown, little fine-grained sands.	ML		
5		...very stiff		SPT	
10		...some sands, cementation, hard		SPT	
15		...hard		SPT	
20		SAND, brown, silty, fine-grained, dense.	SM	California	Blowcount = 63/12 in. C, DS
25		...silty, trace of gravels, medium dense		SPT	200 Wash
30		...little fine-gravels, very dense.		California	Blowcount = 80/11 in.
35					



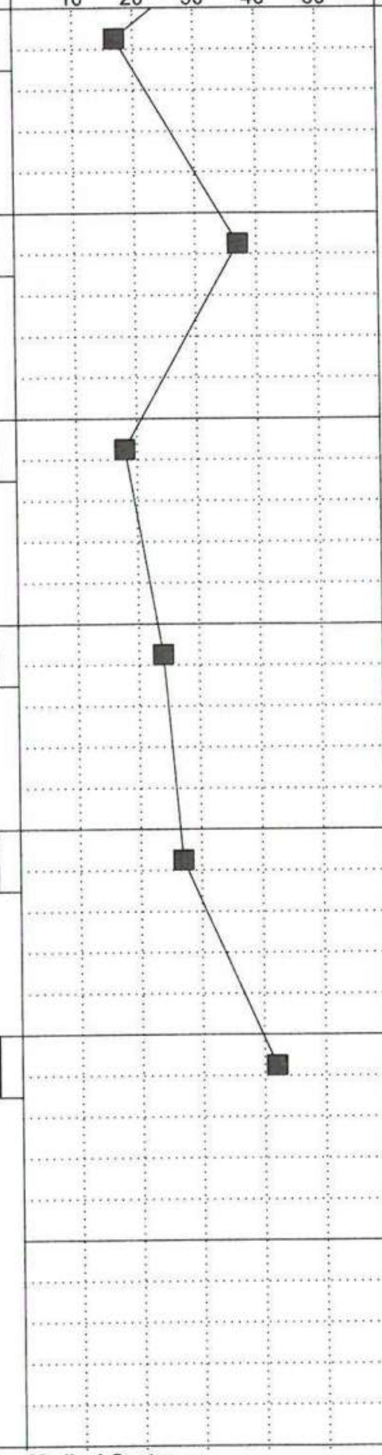
GEOBASE, INC.	PROJECT	KP Moreno Valley Medical Center 27300 Iris Avenue, Moreno Valley, CA		BORING NO. B-9
	DEPTH TO WATER feet	SURFACE ELEV. 1516 feet	LOGGED BY HDN	PROJECT NO. C.314.81.00
	DEPTH TO SLOUGH	DRILL RIG CME-75 HT DRILLER Martini Drilling	DATE LOGGED 06/09/2017	FIGURE NO. B-10

Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

LOG OF BORING

SAMPLE TYPE: ■ THIN WALLED TUBE · SPT SPLIT SPOON · CALIFORNIA MODIFIED SAMPLER · DISTURBED · NO RECOVERY · CORE

DEPTH (feet)	GRAPHIC LOG	SOIL DESCRIPTION	SOIL CLASSIFICATION	SAMPLE	DRY DENSITY (PCF) 80 90 100 110 120; Water Content (%); Plastic Limit (W_P) – Liquid Limit (W_L); Penetration, blows/foot: 10 20 30 40 50	REMARKS/ OTHER TESTS
		SAND, brown, some gravels, little silt, medium dense	SM			
40		SAND, light brown, fine-grained, trace of silt, dense.	SP			
45		SAND, brown, little to some silt, medium dense.	SM			
50		...silty,				
		...seepage at 51.5 ft				
55		...medium-grained				
60		SAND, light brown, coarse-grained, some gravels, trace of silt, dense.	SW			PS
65		End of Boring at 61.5 feet. Boring dry at completion of drilling. Backfilled with soil cuttings.				
70						



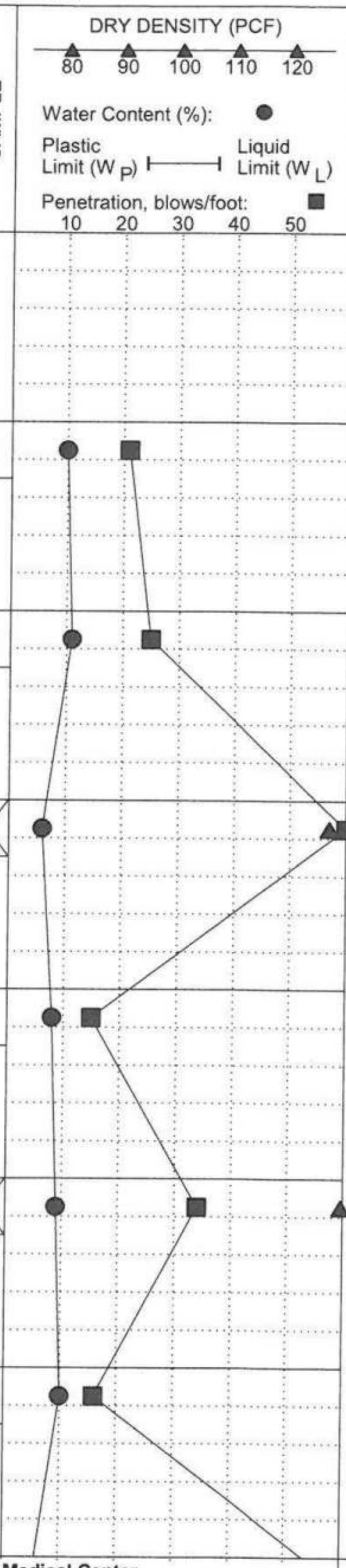
GEOBASE, INC.	PROJECT	**KP Moreno Valley Medical Center 27300 Iris Avenue, Moreno Valley, CA**	BORING NO. **B-9**
	DEPTH TO WATER feet	SURFACE ELEV. **1516 feet** / LOGGED BY **HDN**	PROJECT NO. **C.314.81.00**
	DEPTH TO SLOUGH	DRILL RIG **CME-75 HT** DRILLER **Martini Drilling** / DATE LOGGED **06/09/2017**	FIGURE NO. B- **10**

Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

DEPTH (feet)	SOIL DESCRIPTION	SOIL CLASSIFICATION	REMARKS/ OTHER TESTS
0	SAND (FILL), brown, silty, medium dense	SM	Bulk Sample 0-5 ft. EI, RV, 200 Wash, Ch, ER, pH, SO_4
5	SILT, brown, little fine-grained sands, very stiff.	ML	200 Wash
10	...very stiff		200 Wash
13	SAND, brown, silty interlayers, fine- to medium-grained, cementation.	SM	
15	...very dense layer.		Blowcount = 100/11 in. 200 Wash, C, DS
20	...fine-grained, medium dense		
25	...medium-grained, dense		Blowcount = 52/12 in. C, DS
30	...silty, little fine-gravels, medium dense.		200 Wash



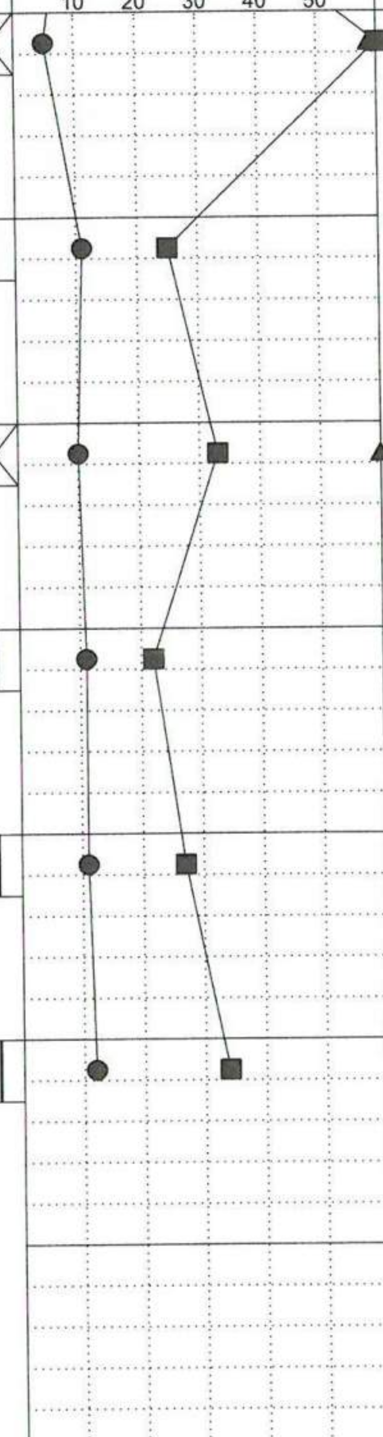
GEOBASE, INC.			
PROJECT	KP Moreno Valley Medical Center 27300 Iris Avenue, Moreno Valley, CA		BORING NO. B-10
DEPTH TO WATER feet	SURFACE ELEV. 1517 feet	LOGGED BY HDN	PROJECT NO. C.314.81.00
DEPTH TO SLOUGH	DRILL RIG CME-75 HT DRILLER Martini Drilling	DATE LOGGED 06/09/2017	FIGURE NO. B-11

Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

DEPTH (feet)	GRAPHIC LOG	SOIL DESCRIPTION	SOIL CLASSIFICATION	SAMPLE	DRY DENSITY (PCF) 80 90 100 110 120 / Water Content (%) / Plastic Limit (W_P) / Liquid Limit (W_L) / Penetration, blows/foot: 10 20 30 40 50	REMARKS/ OTHER TESTS
		SAND, light brown, silty interlayer, coarse-grained, trace of fine-gravels, very dense.	SM	California Modified		Blowcount = 85/11 in. PS
40		...some silt, some fine-gravels up to 1/2 in fragments, medium dense.		SPT		PS
45		...silty, little gravels, dense		California Modified		Blowcount = 51/12 in.
50		...coarse-grained, some fine-gravels , medium dense. ...seepage at 51.5 ft		SPT		PS
55		...fine-grained, little silt, medium dense.		SPT		PS
60		...silty, fine- to medium-grained, dense.		SPT		
65		End of Boring at 61.5 feet. Boring dry at completion of drilling.. Backfilled with soil cuttings.				
70						



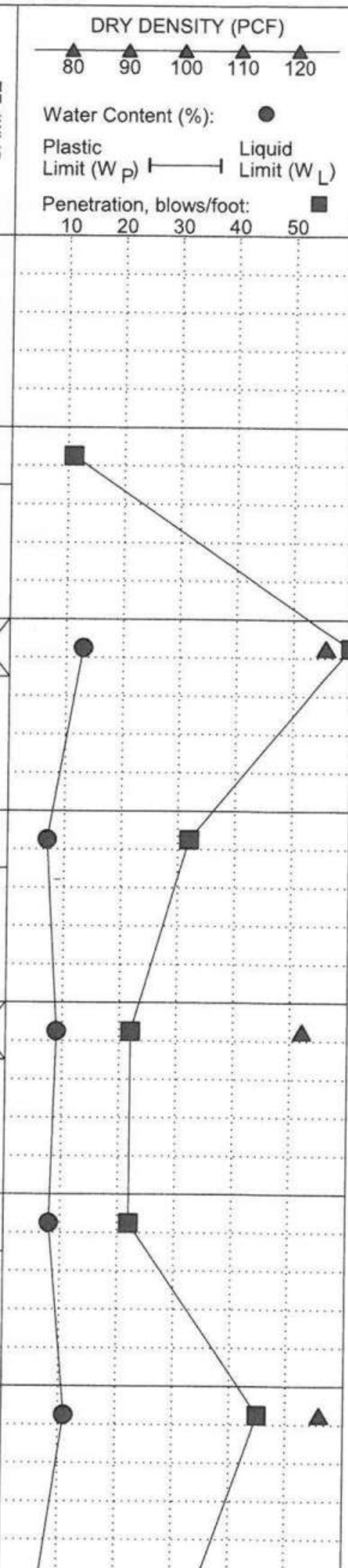
GEOBASE, INC.	PROJECT	**KP Moreno Valley Medical Center** **27300 Iris Avenue, Moreno Valley, CA**		**BORING NO. B-10**
	DEPTH TO WATER feet	SURFACE ELEV. **1517 feet**	LOGGED BY **HDN**	PROJECT NO. **C.314.81.00**
	DEPTH TO SLOUGH	DRILL RIG **CME-75 HT** DRILLER **Martini Drilling**	DATE LOGGED **06/09/2017**	FIGURE NO. B- **11**

Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

DEPTH (feet)	GRAPHIC LOG	SOIL DESCRIPTION	SOIL CLASSIFICATION	SAMPLE	REMARKS/ OTHER TESTS
0		SAND (FILL), brown, silty, medium dense	SM		
5		SILT, brown, little fine-grained sands, stiff.	ML	SPT	
10		...hard		California	Blowcount = 50/6 in.
15		SAND, brown, silt interlayer, coarse-grained, some gravels, dense.	SM	SPT	200 Wash
20		...fine-grained sands, medium dense		California	Blowcount = 33/12 in. 200 Wash
25		...silty, medium dense.		SPT	
30		...silty, dense		California	Blowcount = 69/12 in.200 Wash
35					



GEOBASE, INC.

PROJECT	KP Moreno Valley Medical Center 27300 Iris Avenue, Moreno Valley, CA		BORING NO. **B-11**
DEPTH TO WATER feet	SURFACE ELEV. **1517 feet**	LOGGED BY **HDN**	PROJECT NO. **C.314.81.00**
DEPTH TO SLOUGH	DRILL RIG **CME-75 HT** DRILLER **Martini Drilling**	DATE LOGGED **06/09/2017**	FIGURE NO. B- **12**

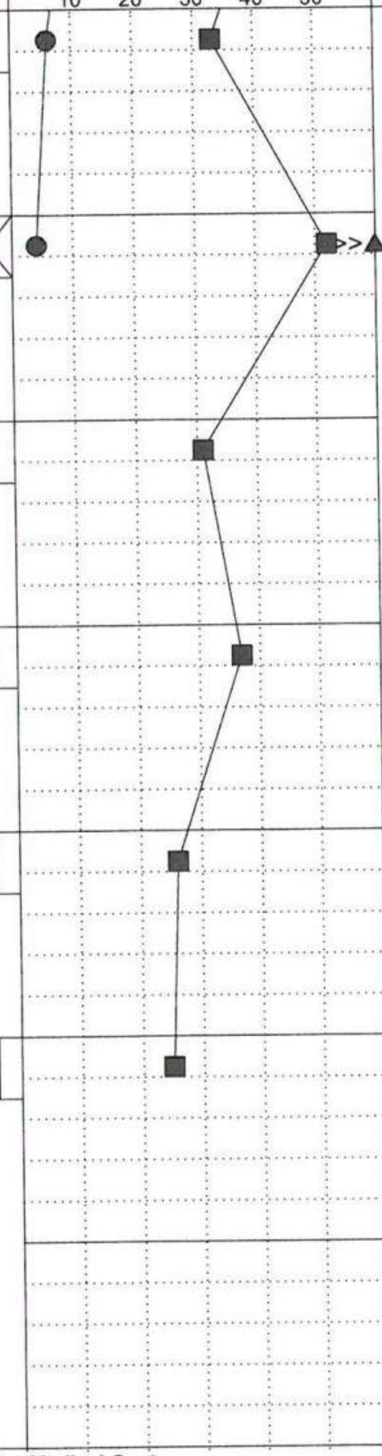
Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

DRY DENSITY (PCF): 80 90 100 110 120 — Water Content (%): ● — Plastic Limit (W_P) ├──┤ Liquid Limit (W_L) — Penetration, blows/foot: ■ 10 20 30 40 50

DEPTH (feet)	SOIL DESCRIPTION	SOIL CLASSIFICATION	REMARKS/ OTHER TESTS
	SAND, brown, fine- to medium-grained, trace of silt, dense.	SM	200 Wash
40	SAND, light brown, coarse-grained, little silt, some fine-gravels, very dense.	SP	Blowcount = 80/12 in. PS
45	...fine-to medium-grained, silty, dense		
50	SAND, brown, silty, fine-to medium grained, trace of gravel, dense.	SM	PS
55	...medium dense ...seepage at 56 ft		
60	...trace of gravels, medium dense		
65	End of Boring at 61.5 feet. Boring dry at completion of drilling. Backfilled with soil cuttings.		
70			



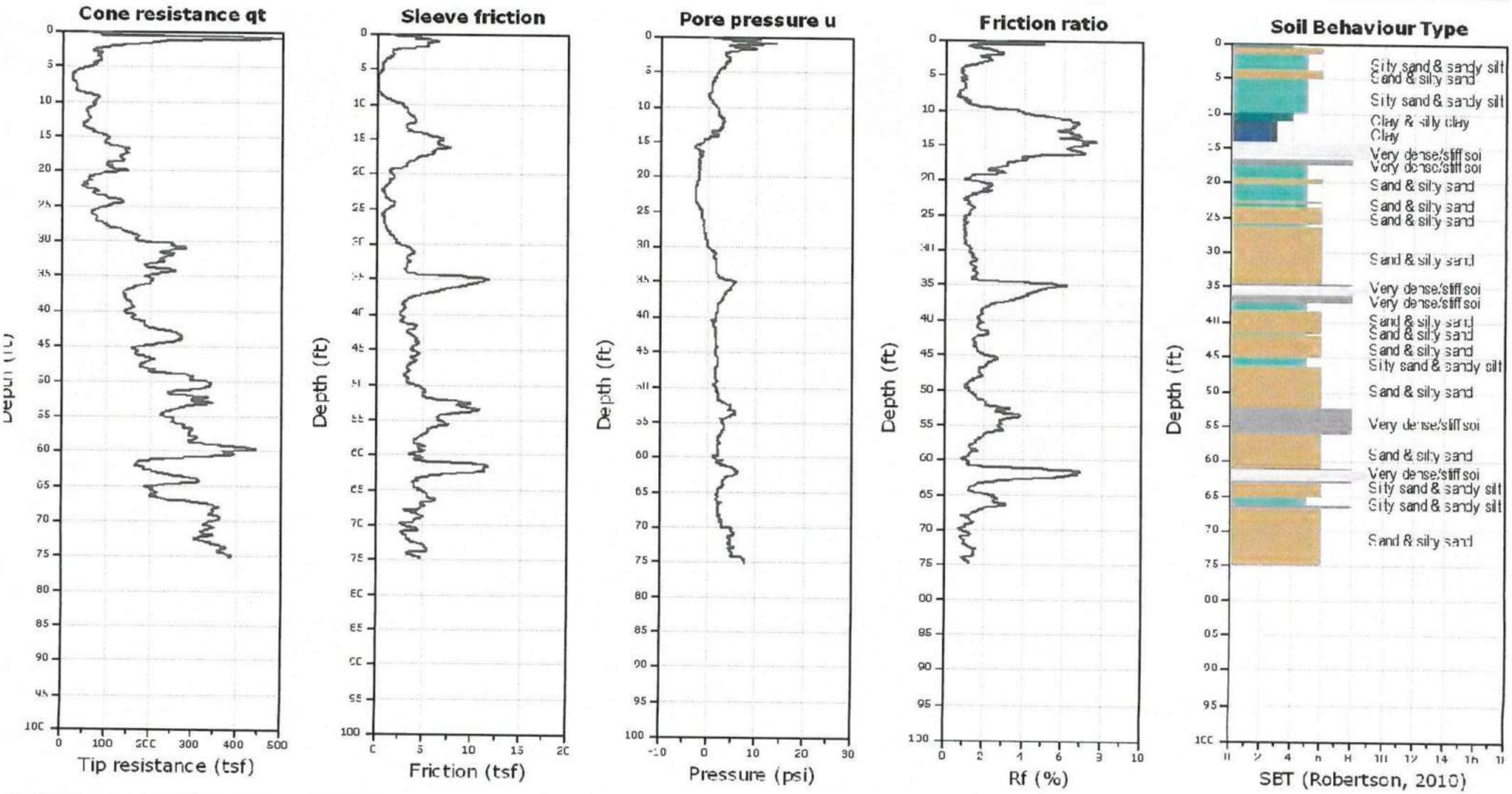
GEOBASE, INC.	PROJECT: KP Moreno Valley Medical Center, 27300 Iris Avenue, Moreno Valley, CA		BORING NO. B-11
	DEPTH TO WATER feet	SURFACE ELEV. 1517 feet; LOGGED BY HDN	PROJECT NO. C.314.81.00
	DEPTH TO SLOUGH	DRILL RIG CME-75 HT; DRILLER Martini Drilling; DATE LOGGED 06/09/2017	FIGURE NO. B-12

Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

Kehoe Testing and Engineering
714-901-7270
rich@kehoetesting.com
www.kehoetesting.com

Project: GEOBASE, Inc.
Location: 27300 Iris Ave Moreno Valley, CA

CPT-1
Total depth: 75.14 ft, Date: 6/8/2017
Cone Type: Vertek



CPeT-IT v.2.0.1.55 - CPTU data presentation & interpretation software - Report created on: 6/12/2017, 3:32:59 PM
Project file: C:\GeobaseMorenoValley6-17\Plot Data\Plots.cpt

C.314.81.00

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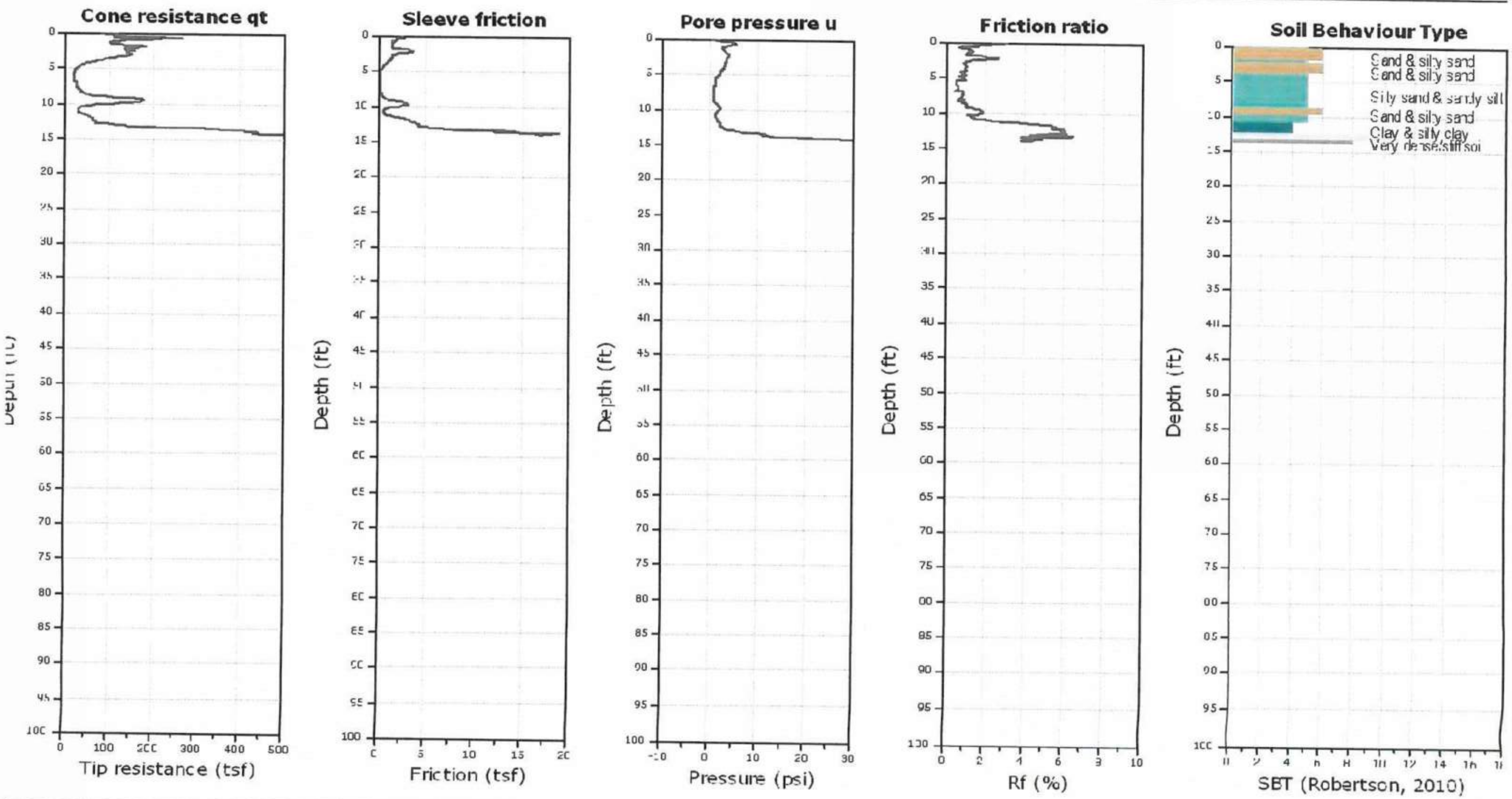
Figure B-13

Kehoe Testing and Engineering
714-901-7270
rich@kehoetesting.com
www.kehoetesting.com

Project: GEOBASE, Inc.
Location: 27300 Iris Ave Moreno Valley, CA

CPT-2
Total depth: 14.30 ft, Date: 6/8/2017
Cone Type: Vertek



CPeT-IT v.2.0.1.55 - CPTU data presentation & interpretation software - Report created on: 6/12/2017, 3:33:28 PM
Project file: C:\GeobaseMorenoValley6-17\Plot Data\Plots.cpt

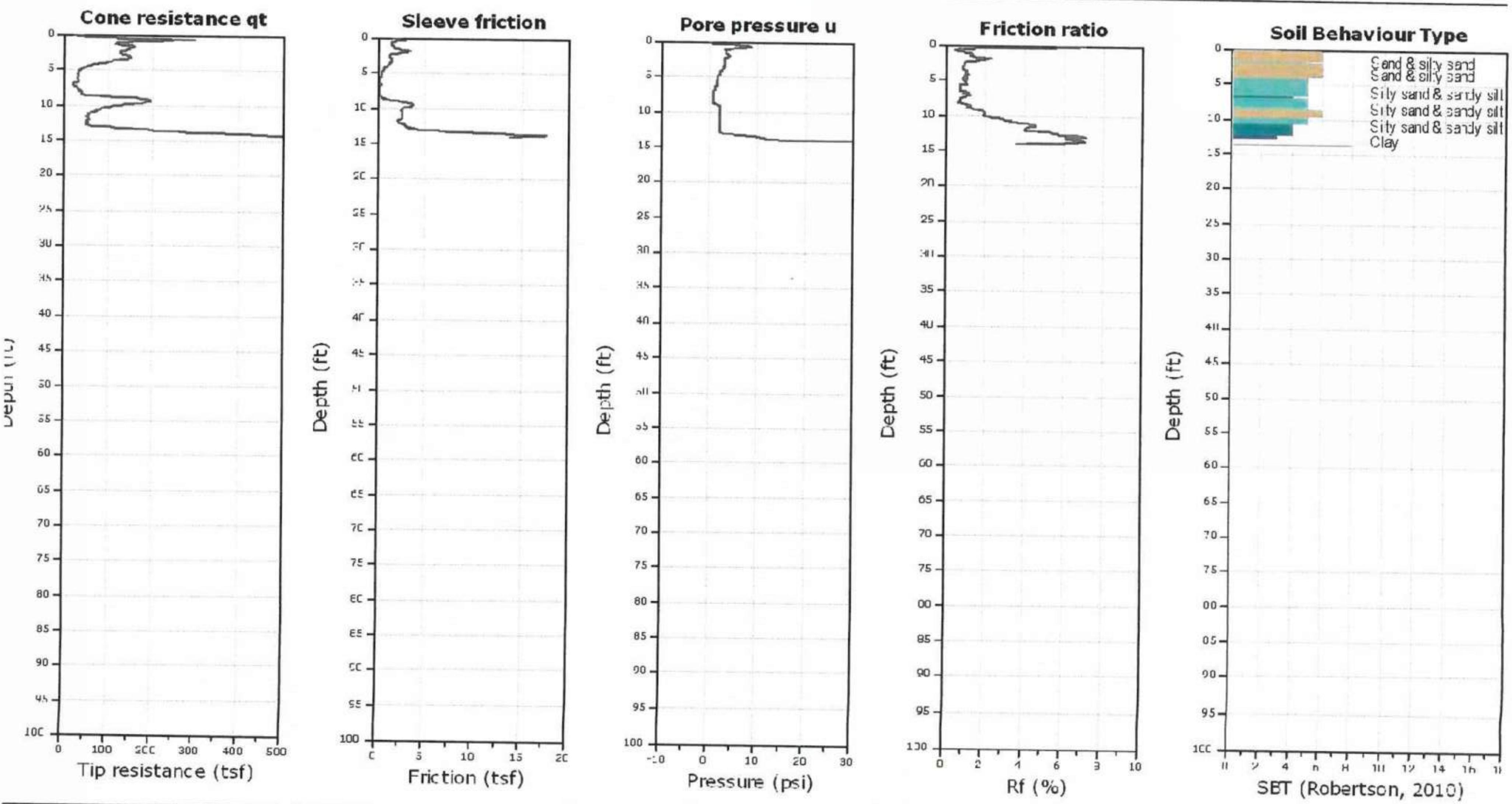
C.314.81.00

Figure B-14, page 1 of 2

Kehoe Testing and Engineering
714-901-7270
rich@kehoetesting.com
www.kehoetesting.com

Project: GEOBASE, Inc.
Location: 27300 Iris Ave Moreno Valley, CA

CPT-2A
Total depth: 14.33 ft, Date: 6/8/2017
Cone Type: Vertek



CPeT-IT v.2.0.1.55 - CPTU data presentation & interpretation software - Report created on: 6/12/2017, 3:33:53 PM
Project file: C:\GeobaseMorenoValley6-17\Plot Data\Plots.cpt

C.314.81.00

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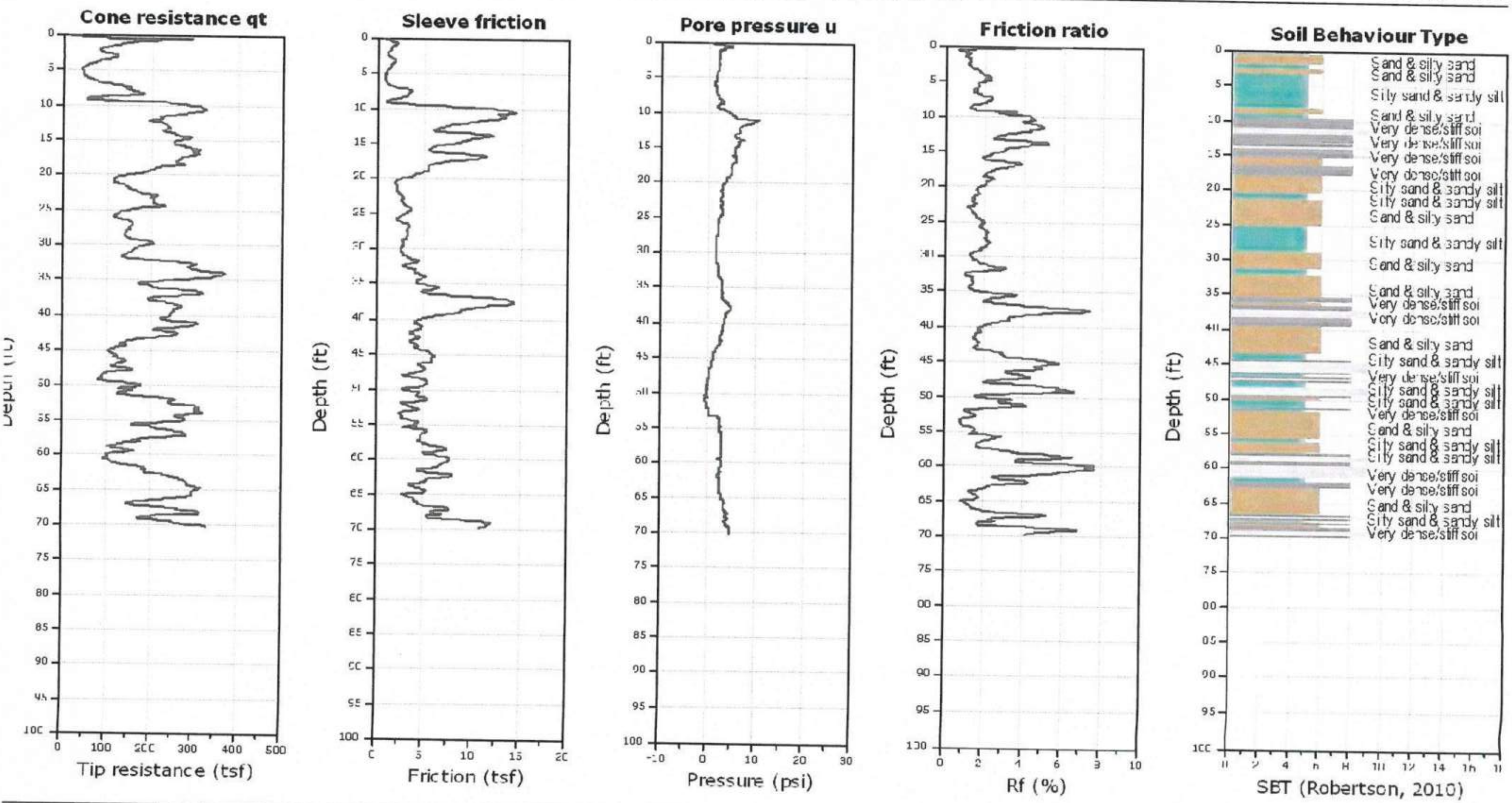
Figure B-14, page 2 of 2

Kehoe Testing and Engineering
714-901-7270
rich@kehoetesting.com
www.kehoetesting.com

Project: GEOBASE, Inc.
Location: 27300 Iris Ave Moreno Valley, CA

CPT-3
Total depth: 70.16 ft, Date: 6/8/2017
Cone Type: Vertek



CPeT-IT v.2.0.1.55 - CPTU data presentation & interpretation software - Report created on: 6/12/2017, 3:34:32 PM
Project file: C:\GeobaseMorenoValley6-17\Plot Data\Plots.cpt

C.314.81.00

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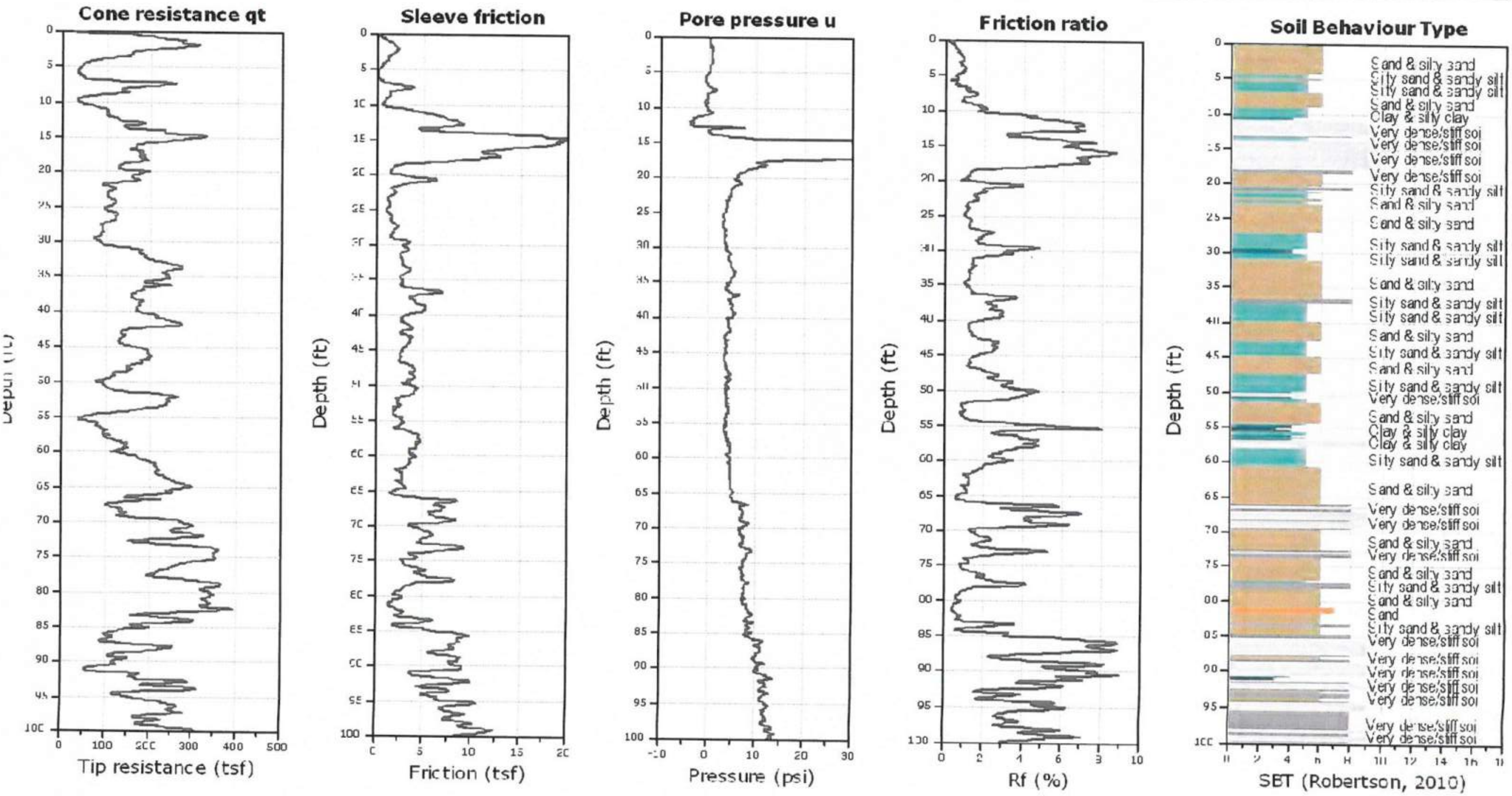
Figure B-15

Kehoe Testing and Engineering
714-901-7270
rich@kehoetesting.com
www.kehoetesting.com

Project: GEOBASE, Inc.
Location: 27300 Iris Ave Moreno Valley, CA

SCPT-4
Total depth: 100.15 ft, Date: 6/8/2017
Cone Type: Vertek



CPeT-IT v.2.0.1.55 - CPTU data presentation & interpretation software - Report created on: 6/12/2017, 3:37:36 PM
Project file: C:\GeobaseMorenoValley6-17\Plot Data\Plots.cpt

C.314.81.00

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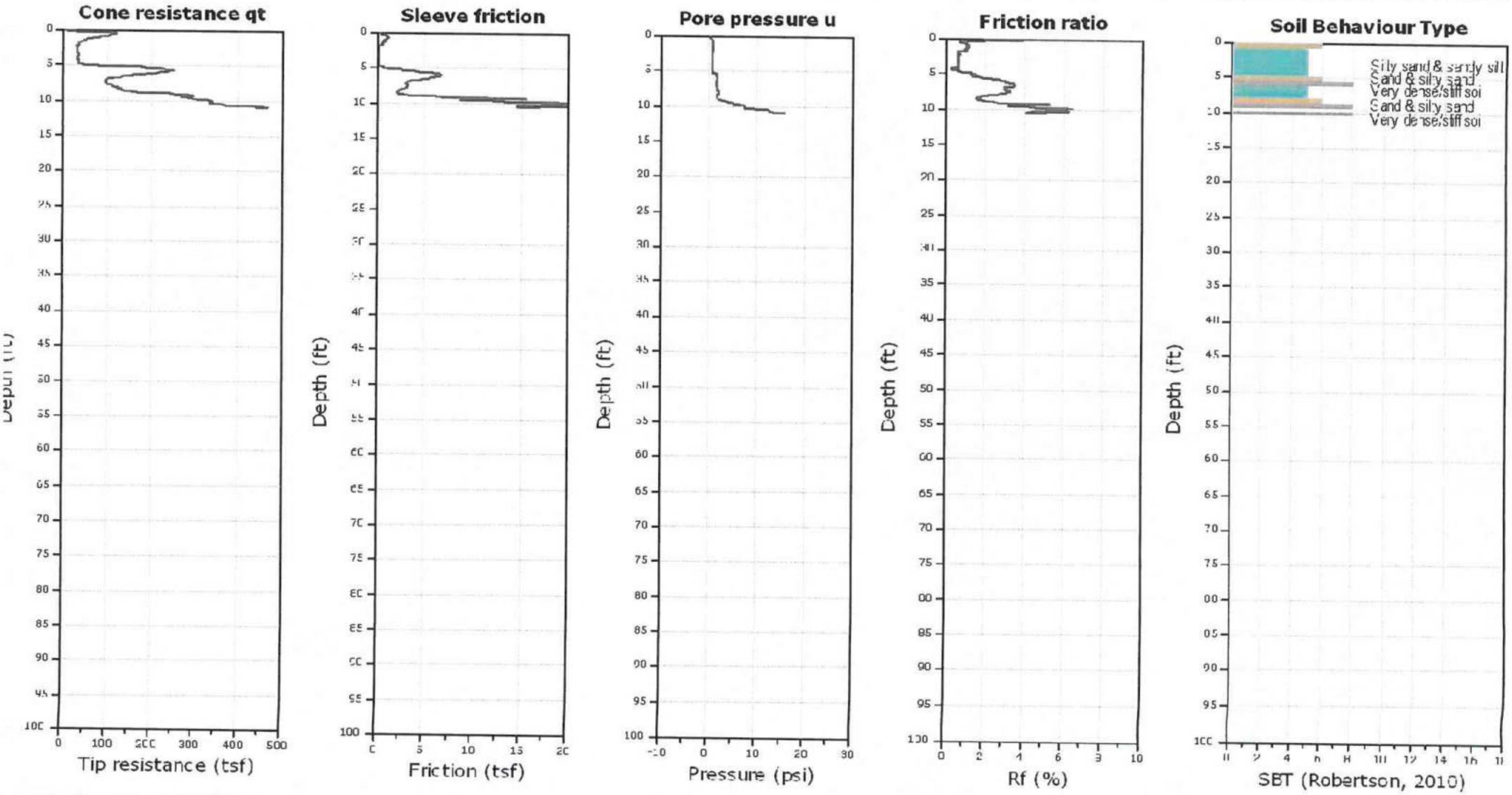
Figure B-16

Kehoe Testing and Engineering
714-901-7270
rich@kehoetesting.com
www.kehoetesting.com

Project: GEOBASE, Inc.
Location: 27300 Iris Ave Moreno Valley, CA

CPT-5
Total depth: 10.90 ft, Date: 6/8/2017
Cone Type: Vertek



CPeT-IT v.2.0.1.55 - CPTU data presentation & interpretation software - Report created on: 6/12/2017, 3:34:54 PM
Project file: C:\GeobaseMorenoValley6-17\Plot Data\Plots.cpt

C.314.81.00

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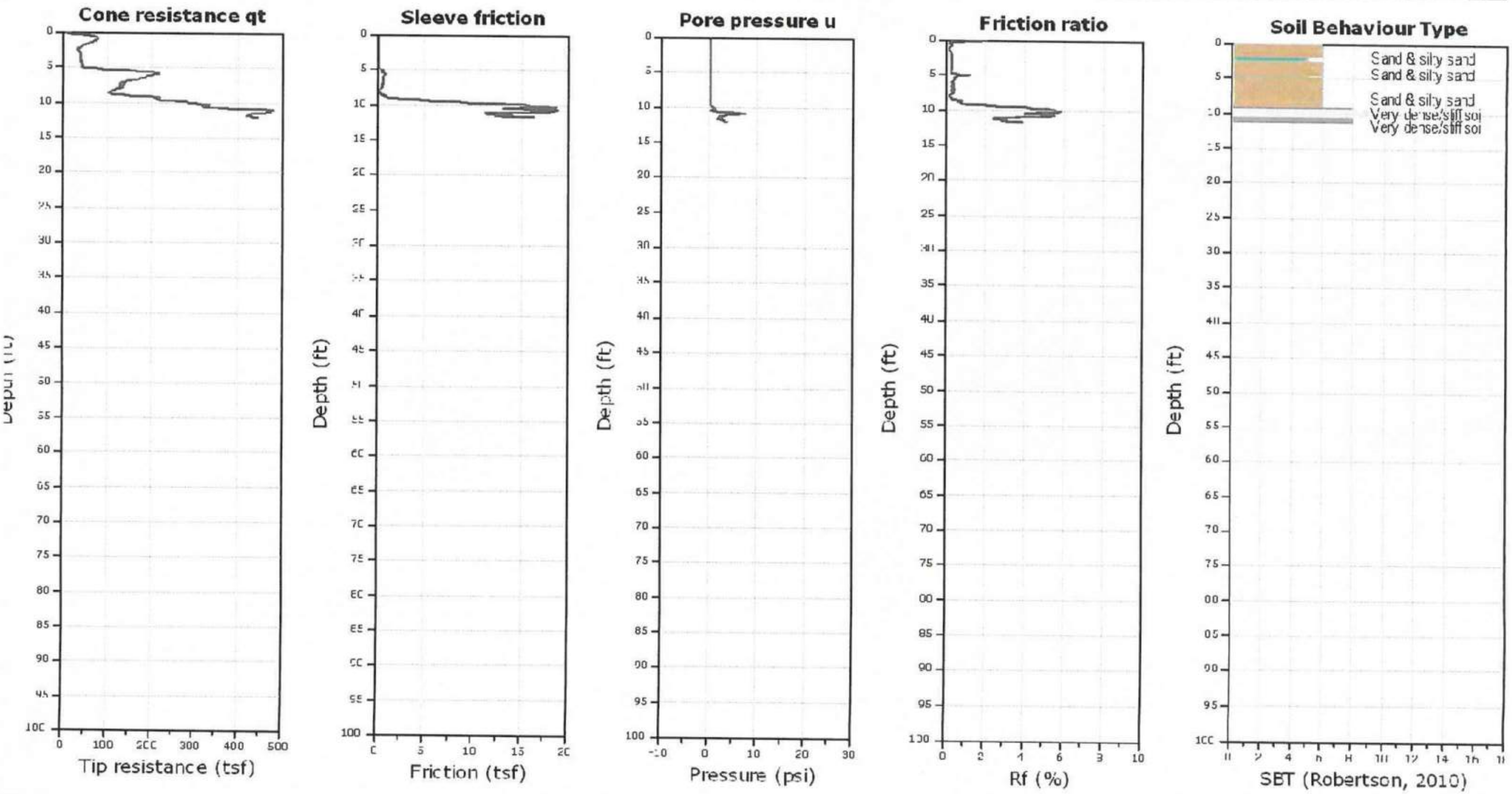
Figure B-17, page 1 of 2

Kehoe Testing and Engineering
714-901-7270
rich@kehoetesting.com
www.kehoetesting.com

Project: GEOBASE, Inc.
Location: 27300 Iris Ave Moreno Valley, CA

CPT-5A
Total depth: 12.01 ft, Date: 6/8/2017
Cone Type: Vertek



CPeT-IT v.2.0.1.55 - CPTU data presentation & interpretation software - Report created on: 6/12/2017, 3:35:12 PM
Project file: C:\GeobaseMorenoValley6-17\Plot Data\Plots.cpt

C.314.81.00

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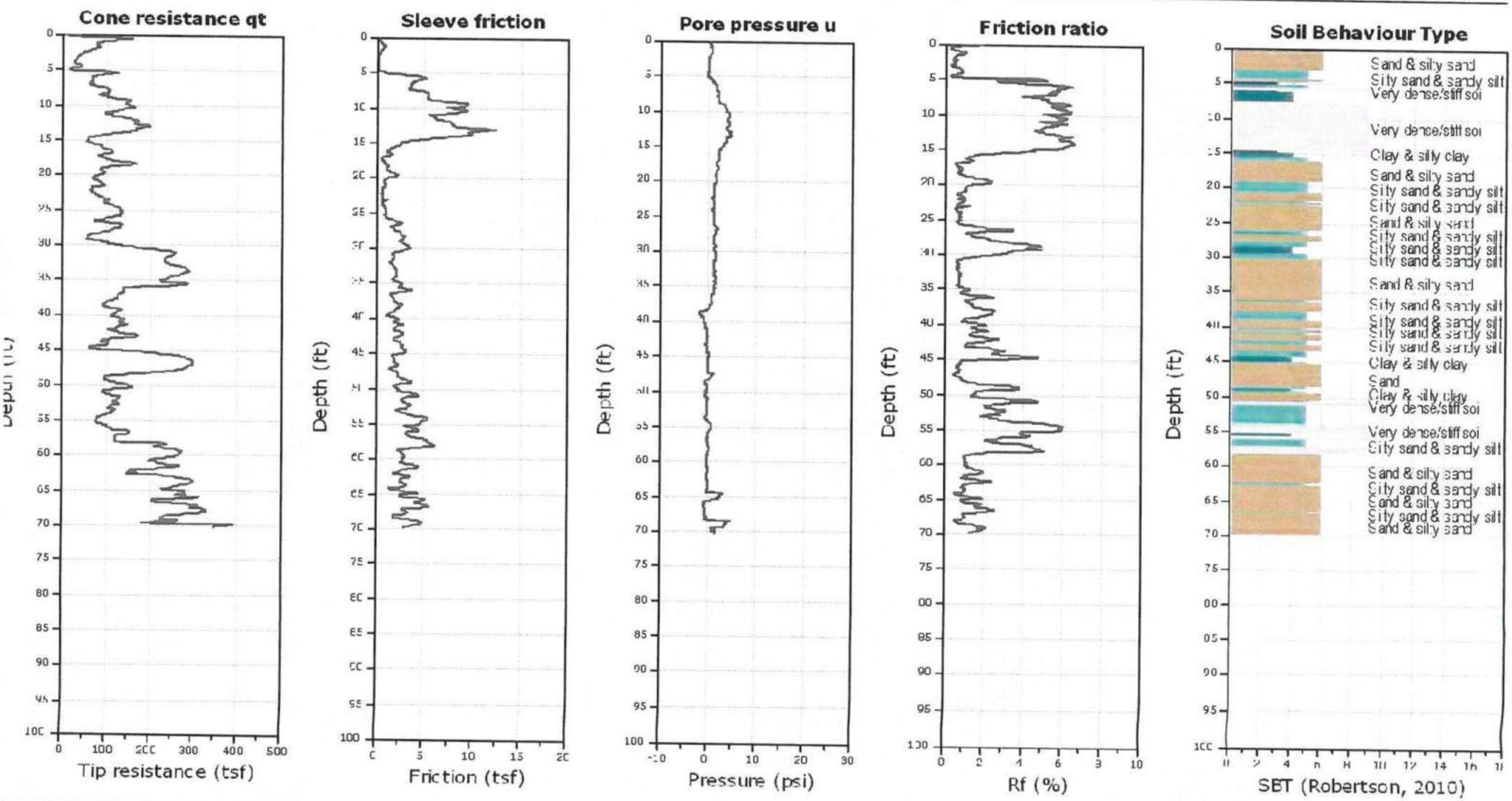
Figure B-17, page 2 of 2

Kehoe Testing and Engineering
714-901-7270
rich@kehoetesting.com
www.kehoetesting.com

Project: GEOBASE, Inc.
Location: 27300 Iris Ave Moreno Valley, CA

CPT-6
Total depth: 70.15 ft, Date: 6/8/2017
Cone Type: Vertek



CPeT-IT v.2.0.1.55 - CPTU data presentation & interpretation software - Report created on: 6/12/2017, 3:35:28 PM
Project file: C:\GeobaseMorenoValley6-17\Plot Data\Plots.cpt

C.314.81.00

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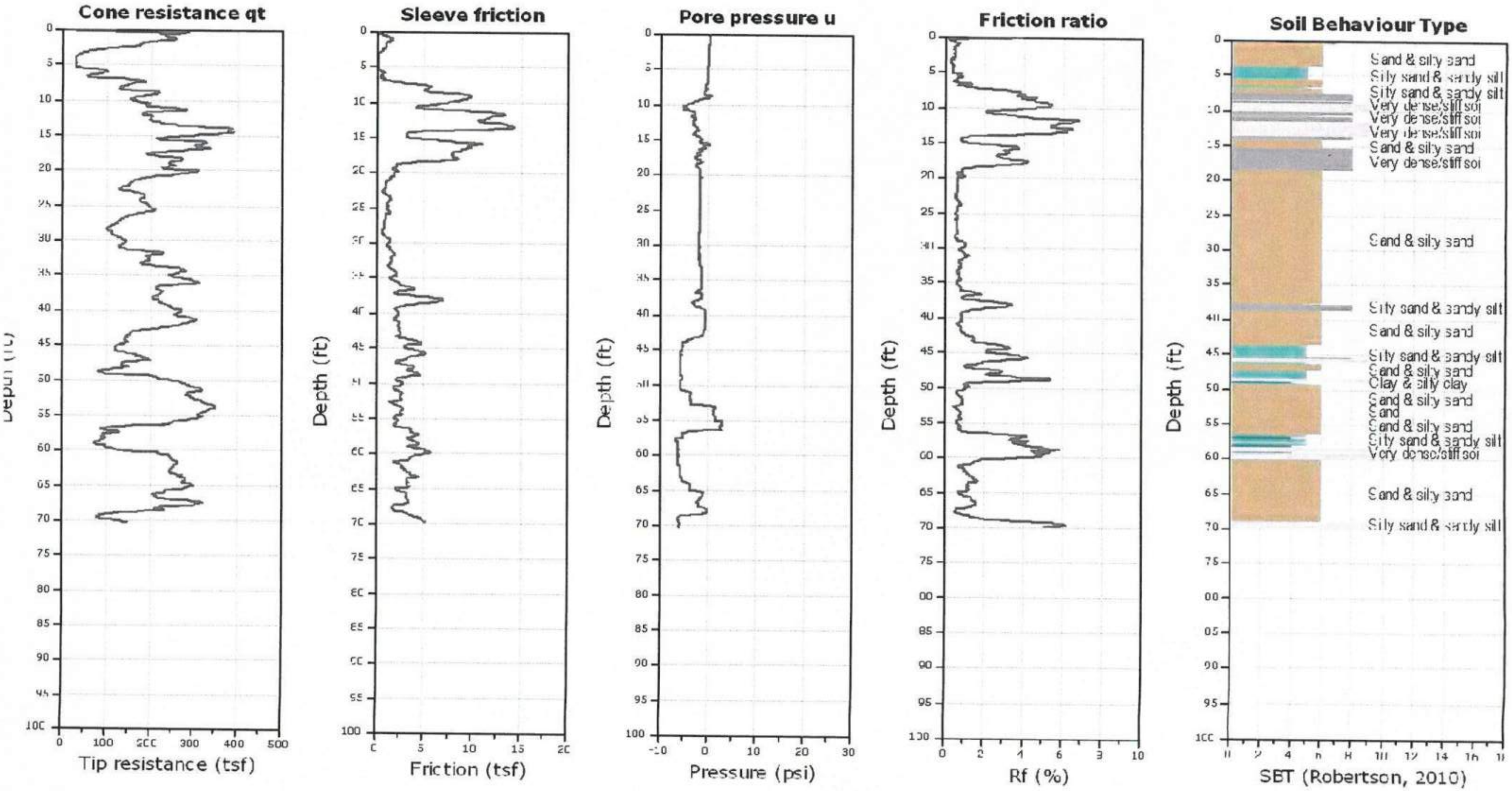
Figure B-18

Kehoe Testing and Engineering
714-901-7270
rich@kehoetesting.com
www.kehoetesting.com

Project: GEOBASE, Inc.
Location: 27300 Iris Ave Moreno Valley, CA

CPT-7
Total depth: 70.22 ft, Date: 6/8/2017
Cone Type: Vertek



CPeT-IT v.2.0.1.55 - CPTU data presentation & interpretation software - Report created on: 6/12/2017, 3:35:47 PM
Project file: C:\GeobaseMorenoValley6-17\Plot Data\Plots.cpt

C.314.81.00

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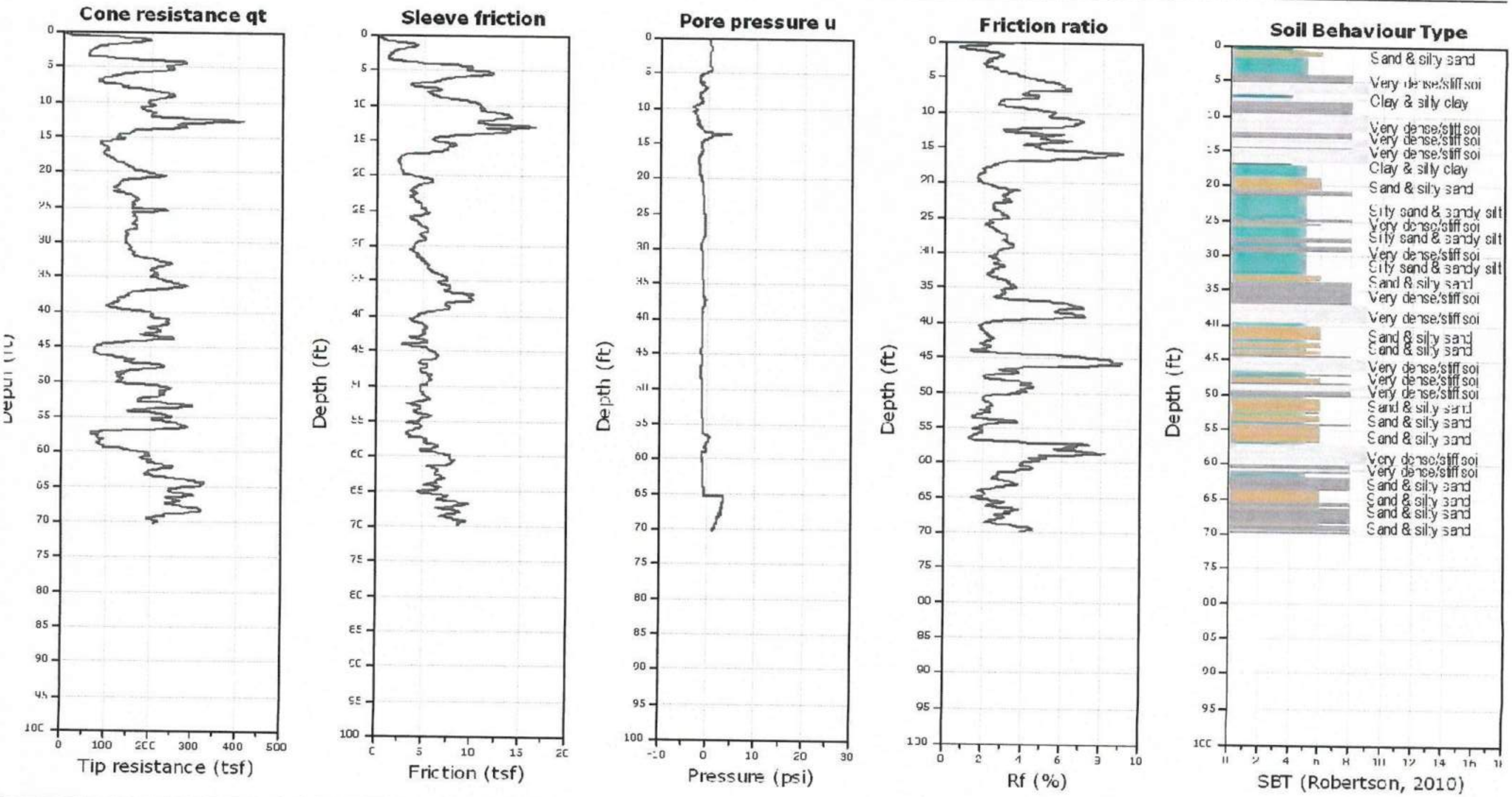
Figure B-19

Kehoe Testing and Engineering
714-901-7270
rich@kehoetesting.com
www.kehoetesting.com

Project: GEOBASE, Inc.
Location: 27300 Iris Ave Moreno Valley, CA

CPT-8
Total depth: 70.15 ft, Date: 6/9/2017
Cone Type: Vertek



CPeT-IT v.2.0.1.55 - CPTU data presentation & interpretation software - Report created on: 6/12/2017, 3:36:02 PM
Project file: C:\GeobaseMorenoValley6-17\Plot Data\Plots.cpt

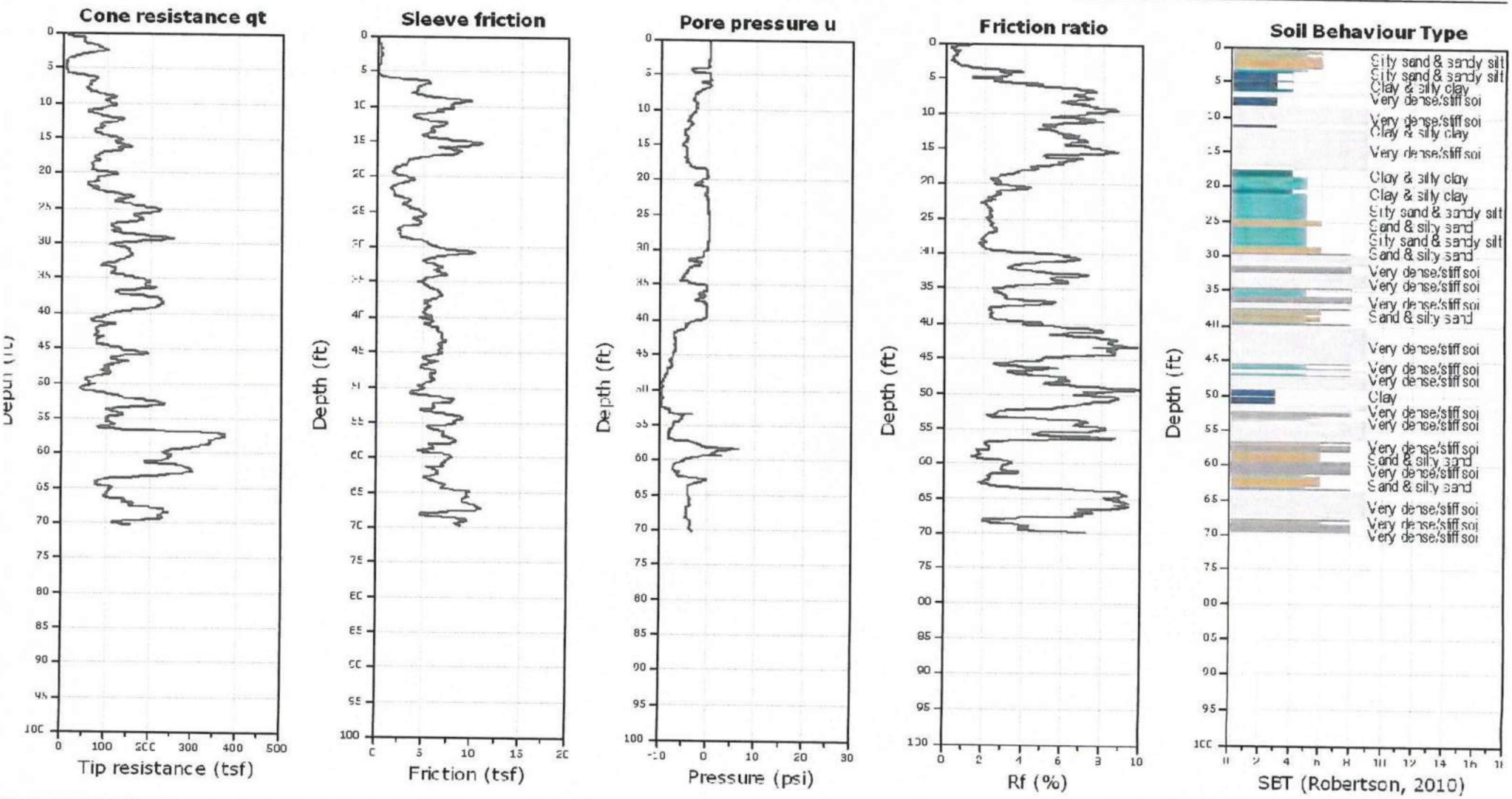
C.314.81.00

Figure B-20

Kehoe Testing and Engineering
714-901-7270
rich@kehoetesting.com
www.kehoetesting.com

Project: GEOBASE, Inc.
Location: 27300 Iris Ave Moreno Valley, CA

CPT-9
Total depth: 70.24 ft, Date: 6/9/2017
Cone Type: Vertek



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Project file: C:\GeobaseMorenoValley6-17\Plot Data\Plots.cpt
C.314.81.00

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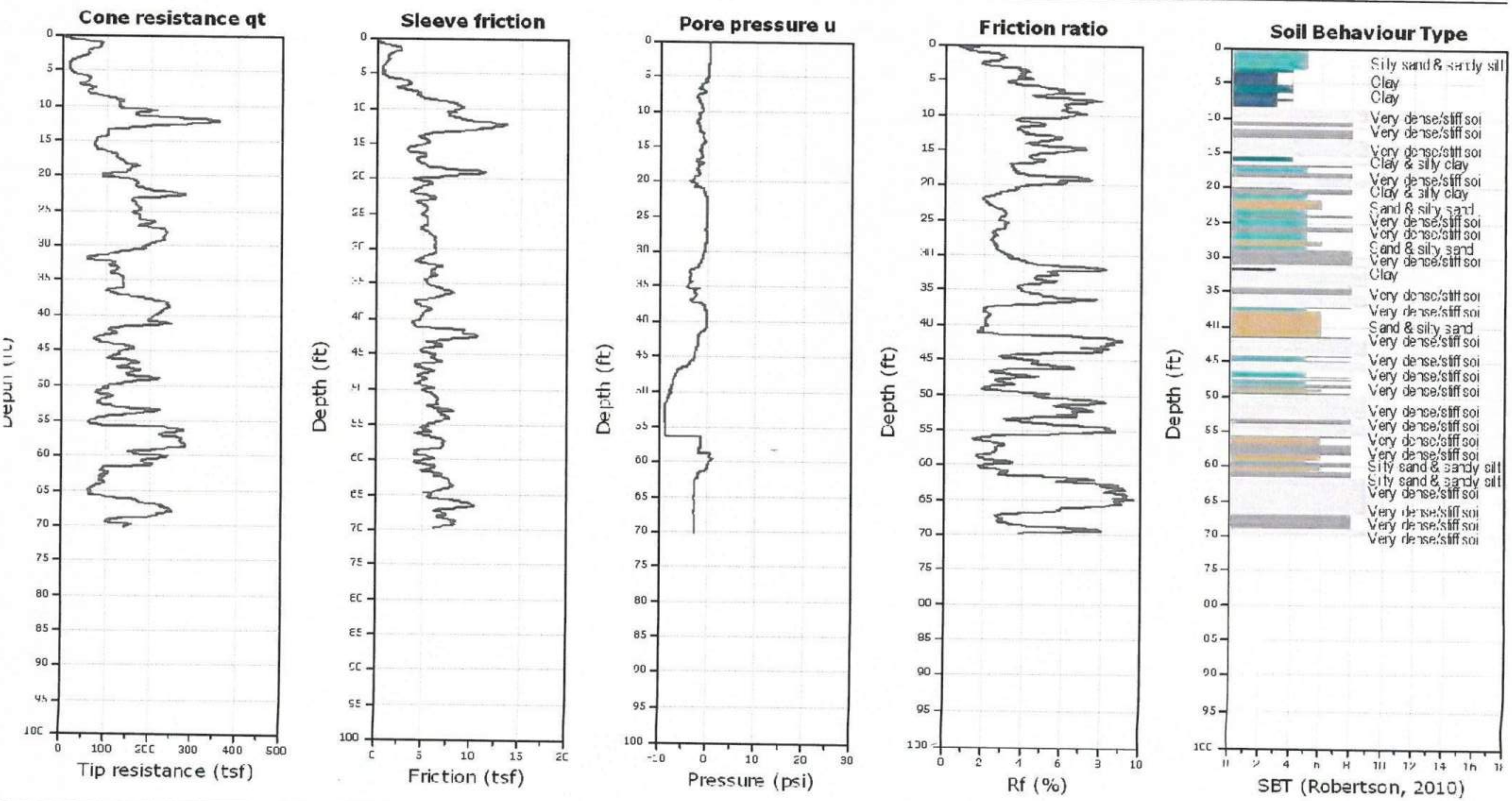
Figure B-21

Kehoe Testing and Engineering
714-901-7270
rich@kehoetesting.com
www.kehoetesting.com

Project: GEOBASE, Inc.
Location: 27300 Iris Ave Moreno Valley, CA

CPT-10
Total depth: 70.15 ft, Date: 6/9/2017
Cone Type: Vertek



CPeT-IT v.2.0.1.55 - CPTU data presentation & interpretation software - Report created on: 6/12/2017, 3:36:33 PM
Project file: C:\GeobaseMorenoValley6-17\Plot Data\Plots.cpt

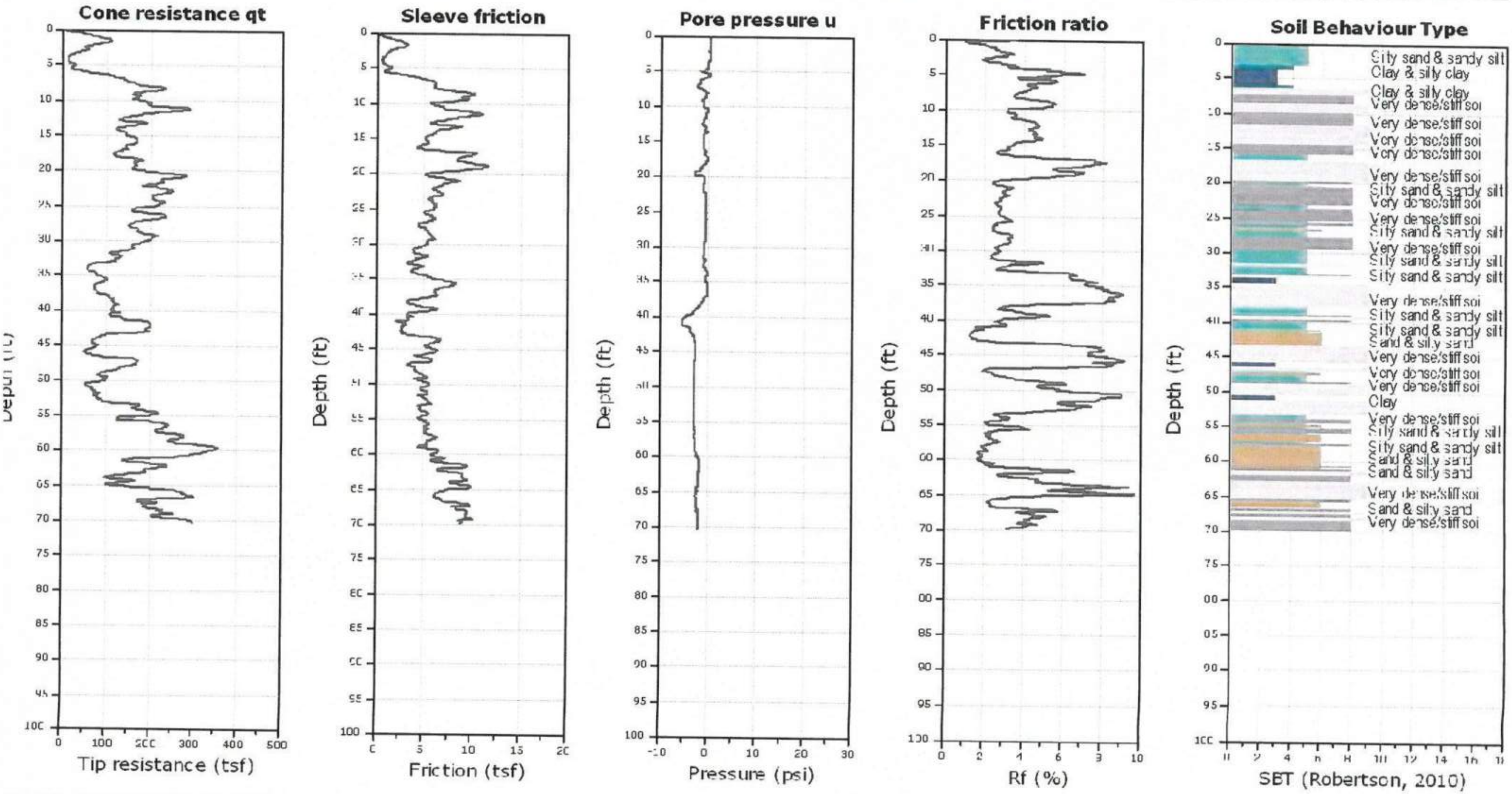
C.314.81.00

Figure B-22

Kehoe Testing and Engineering
714-901-7270
rich@kehoetesting.com
www.kehoetesting.com

Project: GEOBASE, Inc.
Location: 27300 Iris Ave Moreno Valley, CA

CPT-11
Total depth: 70.22 ft, Date: 6/9/2017
Cone Type: Vertek



CPeT-IT v.2.0.1.55 - CPTU data presentation & interpretation software - Report created on: 6/12/2017, 3:36:47 PM
Project file: C:\GeobaseMorenoValley6-17\Plot Data\Plots.cpt

0

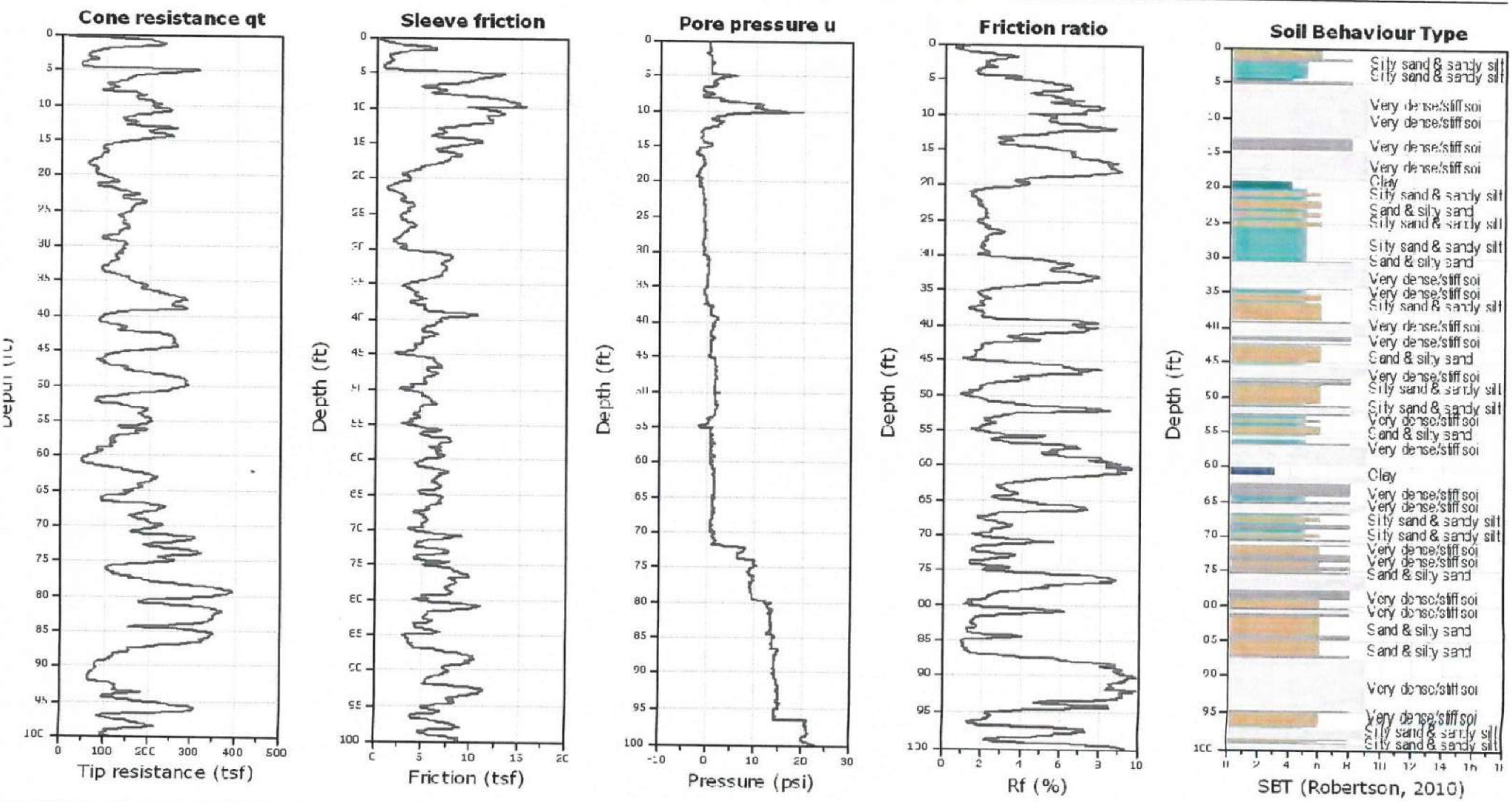
C.314.81.00

Figure B-23

Kehoe Testing and Engineering
714-901-7270
rich@kehoetesting.com
www.kehoetesting.com

Project: GEOBASE, Inc.
Location: 27300 Iris Ave Moreno Valley, CA

SCPT-12
Total depth: 100.13 ft, Date: 6/9/2017
Cone Type: Vertek



CPeT-IT v.2.0.1.55 - CPTU data presentation & interpretation software - Report created on: 6/12/2017, 3:38:00 PM
Project file: C:\GeobaseMorenoValley6-17\Plot Data\Plots.cpt

C.314.81.00

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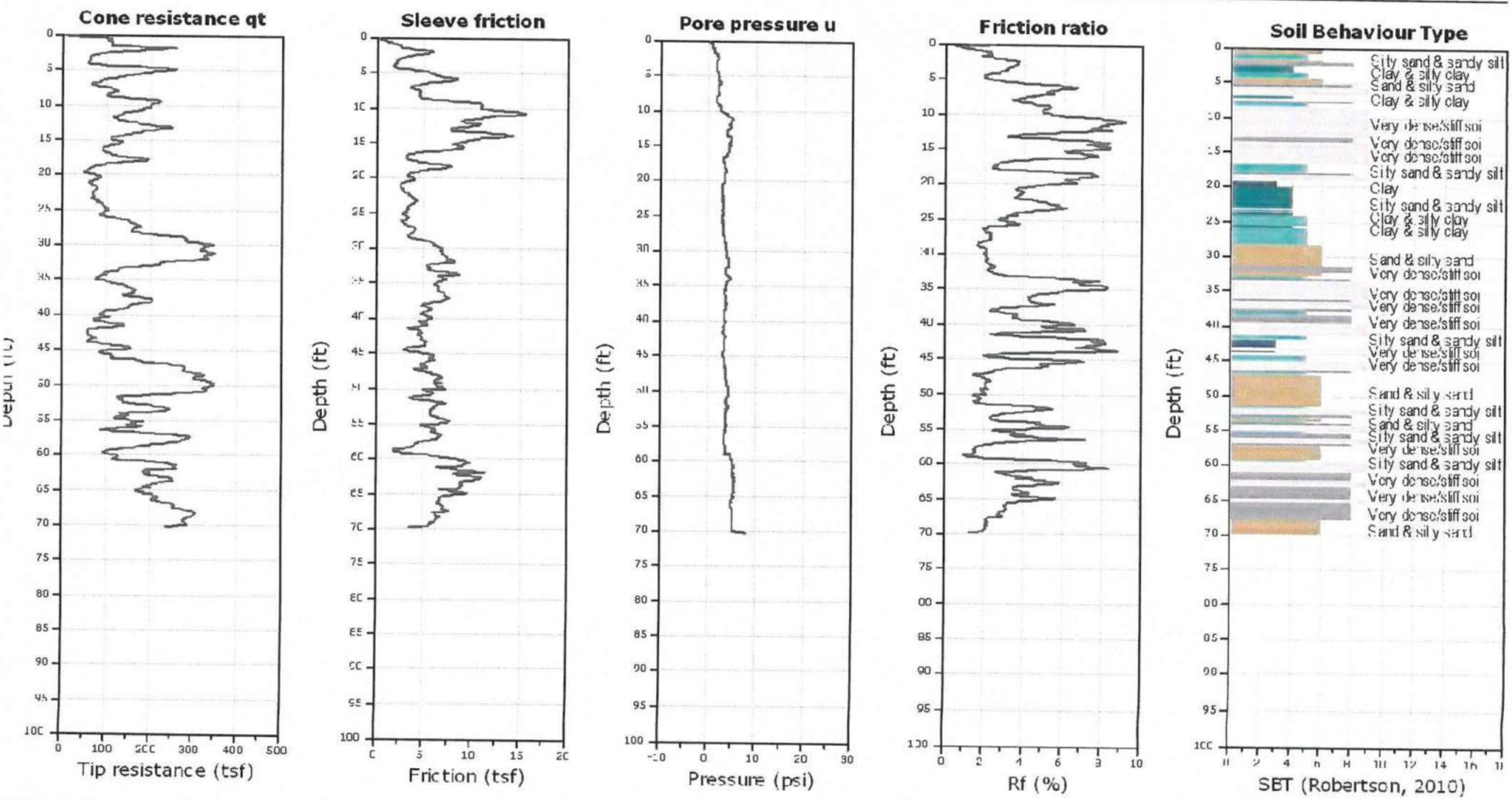
Figure B-24

Kehoe Testing and Engineering
714-901-7270
rich@kehoetesting.com
www.kehoetesting.com

Project: GEOBASE, Inc.
Location: 27300 Iris Ave Moreno Valley, CA

CPT-13
Total depth: 70.22 ft, Date: 6/9/2017
Cone Type: Vertek



CPeT-IT v.2.0.1.55 - CPTU data presentation & interpretation software - Report created on: 6/12/2017, 3:37:02 PM
Project file: C:\GeobaseMorenoValley6-17\Plot Data\Plots.cpt

C.314.81.00

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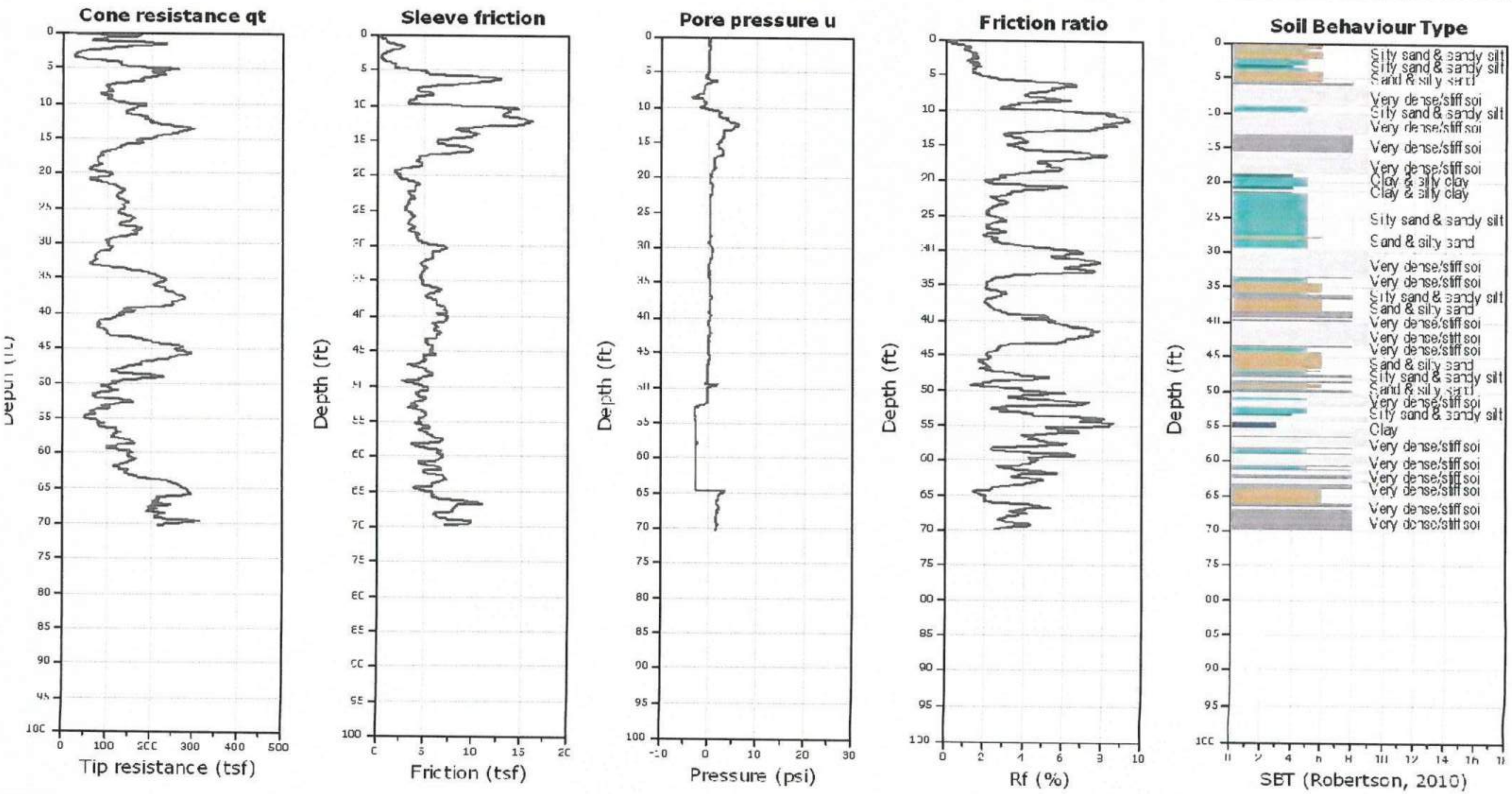
Figure B-25

Kehoe Testing and Engineering
714-901-7270
rich@kehoetesting.com
www.kehoetesting.com

Project: GEOBASE, Inc.
Location: 27300 Iris Ave Moreno Valley, CA

CPT-14
Total depth: 70.21 ft, Date: 6/9/2017
Cone Type: Vertek



CPeT-IT v.2.0.1.55 - CPTU data presentation & interpretation software - Report created on: 6/12/2017, 3:37:18 PM
Project file: C:\GeobaseMorenoValley6-17\Plot Data\Plots.cpt

0

C.314.81.00

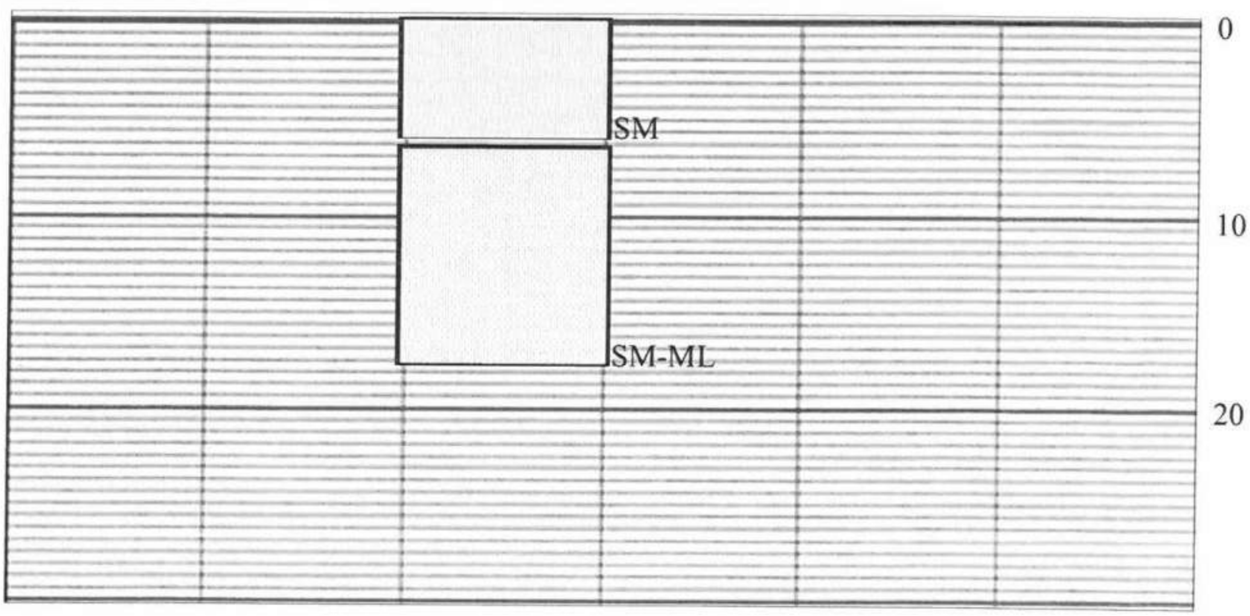
Figure B-26

LOG OF TEST PIT: TP - 1

Soil Interval	Soil Interval Depth (Feet bgs)	Soil Sample Depth (Feet bgs)	SOIL DESCRIPTION
A	0.0 – 1.0		FILL- Aggregate Bases
B	1.0 - 5.0		SAND (SM), light brown, fine- to medium grained, little to some silt, trace of gravels, moist, loose to medium dense.
C	5.0-14.0		SAND TO SILT (SM-ML), brown, fine-grained, white streak and concretion, cementation, medium dense to very stiff.
D	14.0-18.0		SAND TO SILT (SM-ML), brown, very distinct white streak, concretion, cementation, stratified, very dense. Difficult to excavate.

GRAPHIC REPRESENTATION

SCALE: 1 inch = 10 Feet **BEARING**: N **WALL**: FRONT (North)



Project Number: **C.314.81.00** Date: 5/7/2015

GEOBASE INC.

Location: Figures A-2 & A-3, Appendix A Equipment: JD410

Approx. Elevation: 1525 feet AMSL (Top) Logged By: HDN

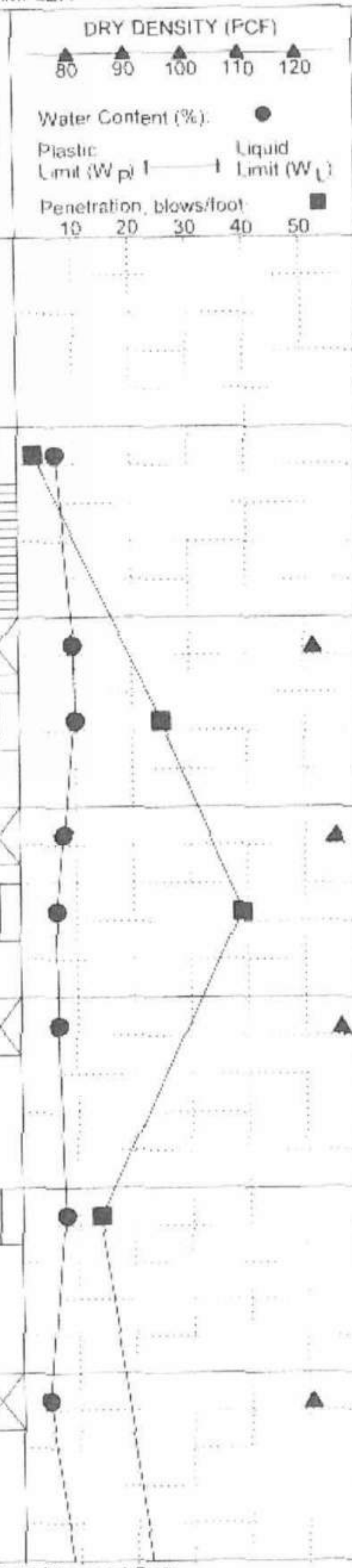
Project: KP Moreno Valley Medical Center

FIGURE B-27

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

DEPTH (feet)	SOIL DESCRIPTION	SOIL CLASSIFICATION	REMARKS/ OTHER TESTS
	PAVEMENT, AC = 5 in. and AB = 5 in.		
	SAND (FILL), brown, silty, moist	SM	
5	SILT, brown, sandy, trace of gravels, very loose, damp.	ML	PS
			Bulk Sample 5-10 FT. EI Ch, ER, pH, SO_4
10	*dense, moist*		C*, DS
	SAND, brown, silty, trace of gravels, medium dense, *moist*	SM	
15	...orange to brown, damp		PS
	dense		
20	...sandy, trace of gravels		PS
25	...orange to brown, silty, medium dense		
30	some gravels, damp		
35			



GEOBASE, INC.	PROJECT: MVCH – Hospital Addition and CUP, 2300 IRIS AVENUE, Moreno Valley, California		BORING NO. B-1
	DEPTH TO WATER feet	SURFACE ELEV. 1524.5 feet / LOGGED BY HDN	PROJECT NO. C.314.39.00
	DEPTH TO SLOUGH	DRILL RIG CME-75 HT / DRILLER MARTINI / DATE LOGGED 03/30/2010	FIGURE NO. B-2

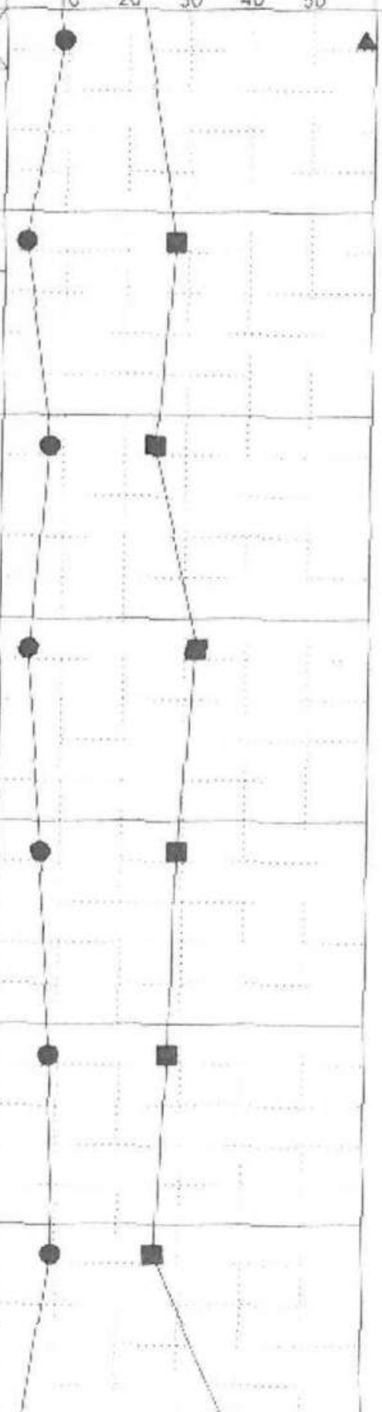
Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

page 1 of 3

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

DEPTH (feet)	GRAPHIC LOG	SOIL DESCRIPTION	SOIL CLASSIFICATION	SAMPLE	DRY DENSITY (PCF) 80 90 100 110 120 / Water Content (%) ● / Plastic Limit (W_p) — Liquid Limit (W_L) / Penetration blows/foot ■ 10 20 30 40 50	REMARKS/ OTHER TESTS
		SAND, brown, silty, little gravels, moist.	SM			
40		SAND, brown, white streak, trace of silt, medium dense damp	SP			
45		SAND, tan brown, silty, little gravels, medium dense, damp.	SM			
50		SAND, brown, white streak, trace of silt, dense, moist	SP			
55		SAND, brown, some silt, medium dense, damp	SM			
60		...silty, greyish brown, slightly moist				
65		brown, little silt, moist				
70						



GEOBASE, INC.	PROJECT	MVCH -- Hospital Addition and CUP 2300 IRIS AVENUE, Moreno Valley, California		BORING NO. B-1
	DEPTH TO WATER feet	SURFACE ELEV 1524.5 feet	LOGGED BY HDN	PROJECT NO. C.314.39.00
	DEPTH TO SLOUGH	DRILL RIG CME-75 HT DRILLER MARTINI	DATE LOGGED 03/30/2010	FIGURE NO. B-2

Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

DEPTH (feet)	GRAPHIC LOG	SOIL DESCRIPTION	SOIL CLASSIFICATION	SAMPLE	DRY DENSITY (PCF) 80 90 100 110 120; Water Content (%) ●; Plastic Limit (W_P) – Liquid Limit (W_L); Penetration, blows/foot ■ 10 20 30 40 50	REMARKS/ OTHER TESTS
		SAND, gray to brown, little of silt, dense, moist	SM			
75		* End of Boring at 71.5 feet. * Boring dry at completion of drilling.				
80						
85						
90						
95						
100						
105						

GEOBASE, INC.	PROJECT	MVCH -- Hospital Addition and CUP 2300 IRIS AVENUE, Moreno Valley, California		BORING NO. B-1
	DEPTH TO WATER feet	SURFACE ELEV. 1524.5 feet	LOGGED BY HDN	PROJECT NO. C.314.39.00
	DEPTH TO SLOUGH	DRILL RIG CME-75 HT DRILLER MARTINI	DATE LOGGED 03/30/2010	FIGURE NO. B-2

Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

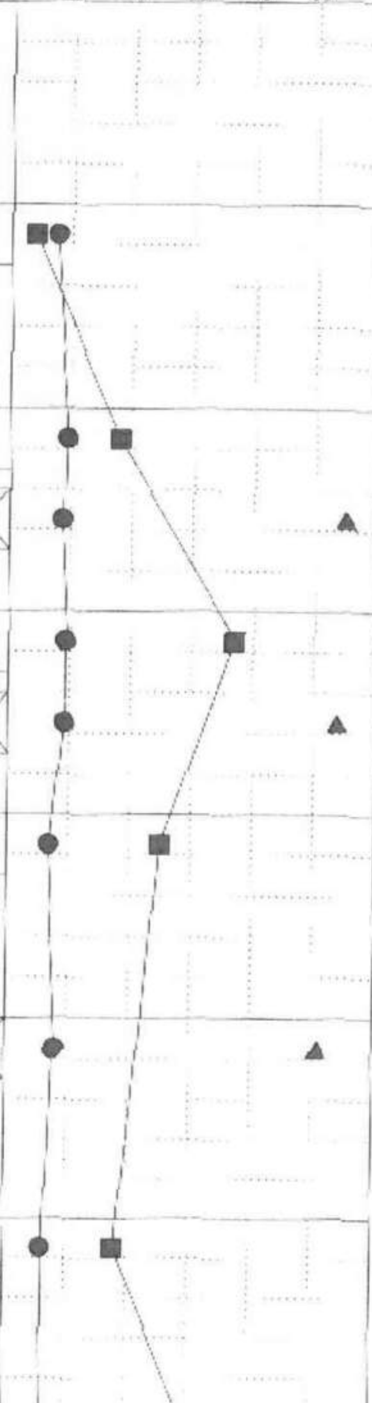
page 3 of 3

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

DRY DENSITY (PCF): 80 90 100 110 120
Water Content (%) ●
Plastic Limit (W_P) ├──┤ Liquid Limit (W_L)
Penetration blows/foot ■: 10 20 30 40 50

DEPTH (feet)	SOIL DESCRIPTION	SOIL CLASSIFICATION	REMARKS/ OTHER TESTS
0	PAVEMENT, AC = 4.5 in. and AB = 5 in		
	SAND (FILL), brown, silty, moist.	SM	
5	SILT, brown, sandy, trace of gravels, very soft, moist.	ML	200 Wash
10	...very stiff		PS
	...hard		PS, C*
15	SAND, olive to brown, white streak, silty, trace of gravels, dense	SM	PS
	brown, some silt, slightly moist.		PS
20	...orange brown, silty, medium dense.		PS
25			PS
30	...light brown, some silt		200 Wash
35			

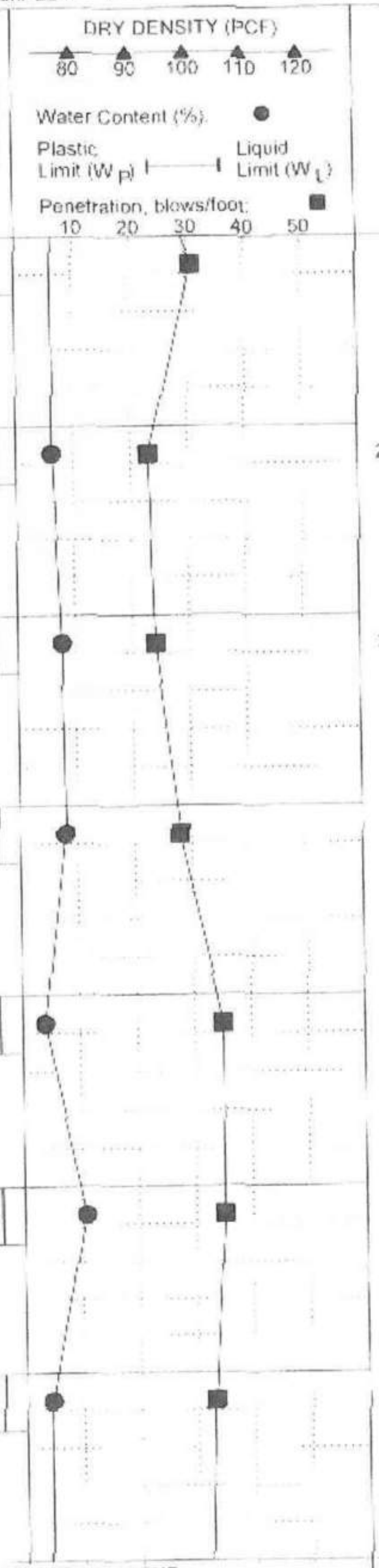


GEOBASE, INC.	PROJECT	MVCH -- Hospital Addition and CUP 2300 IRIS AVENUE, Moreno Valley, California	BORING NO. B-2
	DEPTH TO WATER feet	SURFACE ELEV 1523 feet / LOGGED BY HDN	PROJECT NO. C.314.39.00
	DEPTH TO SLOUGH	DRILL RIG CME-75 HT / DRILLER MARTINI / DATE LOGGED 03/31/2010	FIGURE NO. B-3

Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring *represents conditions observed at the specific boring location and at the date indicated.*

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE



DEPTH (feet)	SOIL DESCRIPTION	SOIL CLASSIFICATION	REMARKS/ OTHER TESTS
	SAND light brown, little silt dense, damp	SM	
40	...medium dense		200 Wash
45	greyish-brown, silty, medium dense, moist.		200 Wash
50	...light brown		200 Wash
55	...medium-grained		200 Wash
60	tan brown, silty		200 Wash
65	...fined grained, little silt.		200 Wash
70			

GEOBASE, INC.	PROJECT: MVCH -- Hospital Addition and CUP, 2300 IRIS AVENUE, Moreno Valley, California		BORING NO. B-2
	DEPTH TO WATER feet	SURFACE ELEV. 1523 feet / LOGGED BY HDN	PROJECT NO. C.314.39.00
	DEPTH TO SLOUGH	DRILL RIG CME-75 HT / DRILLER MARTINI / DATE LOGGED 03/31/2010	FIGURE NO. B-3

Note. This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SP1 SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

DEPTH (feet)	GRAPHIC LOG	SOIL DESCRIPTION	SOIL CLASSIFICATION	SAMPLE	DRY DENSITY (PCF) 80 90 100 110 120 / Water Content (%) / Plastic Limit (W_p) — Liquid Limit (W_L) / Penetration, blows/foot 10 20 30 40 50	REMARKS/ OTHER TESTS
		SAND, light brown, trace of silt, medium dense, moist.	SP			200 Wash
75		* End of Boring at 71.5 feet. * Boring dry at completion of drilling				
80						
85						
90						
95						
100						
105						

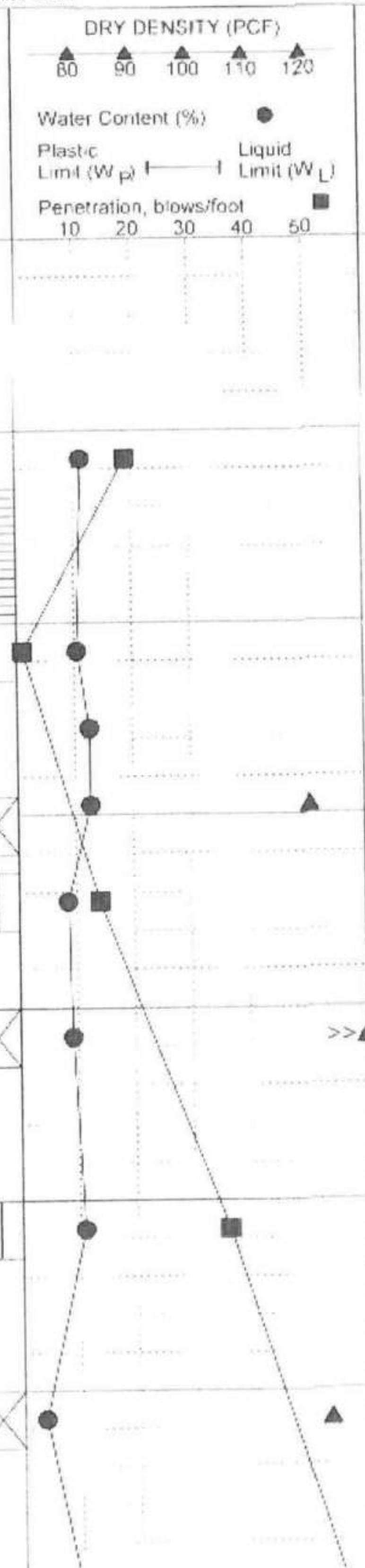
GEOBASE, INC.	PROJECT	MVCH -- Hospital Addition and CUP 2300 IRIS AVENUE, Moreno Valley, California		BORING NO. B-2
	DEPTH TO WATER feet	SURFACE ELEV. 1523 feet	LOGGED BY HDN	PROJECT NO. C.314.39.00
	DEPTH TO SLOUGH	DRILL RIG CME-75 HT DRILLER MARTINI	DATE LOGGED 03/31/2010	FIGURE NO. B-3

Note. This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

page 3 of 3

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE



DEPTH (feet)	SOIL DESCRIPTION	SOIL CLASSIFICATION	REMARKS/ OTHER TESTS
	PAVEMENT, AC = 6 in and AB = 4 in.		
	SAND (FILL), brown, silty, moist	SM	
5	SAND, light brown, little silt, medium dense	SM	200 Wash
	SILT, reddish brown, sandy, little gravels, very moist.	ML	Bulk Sample 5-10 FT 200 Wash, Ch, ER, pH, SO_4
10	... very loose		200 Wash
15	... little clay, sandy, moist		200 Wash, C*
	SAND, light brown, some silt, little gravels, medium dense, moist	SM	200 Wash
20	... reddish brown, trace of gravels		200 Wash, C*, DS
25	SILT, brown, sandy, hard, moist	ML	200 Wash
30	SAND, light brown, coarse grained, trace of silt and gravels.	SP	200 Wash
35			

GEOBASE, INC.	PROJECT: MVCH -- Hospital Addition and CUP, 2300 IRIS AVENUE, Moreno Valley, California		BORING NO. B-4
	DEPTH TO WATER feet	SURFACE ELEV 1540 feet	LOGGED BY HDN	PROJECT NO. C.314.39.00
	DEPTH TO SLOUGH	DRILL RIG CME-75 HT, DRILLER MARTINI	DATE LOGGED 03/30/2010	FIGURE NO. B-5

Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

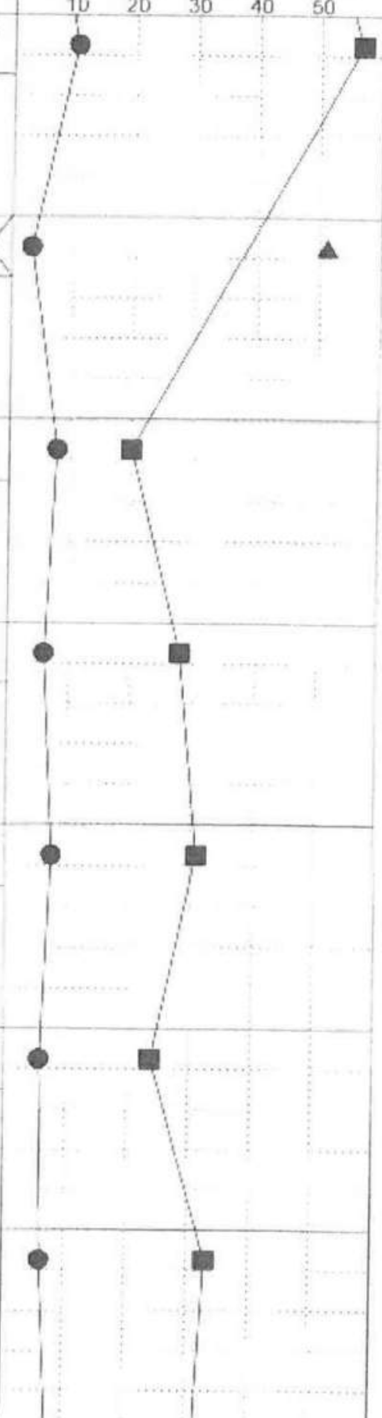
page 1 of 3

LOG OF BORING

SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

DRY DENSITY (PCF): 80 90 100 110 120
Water Content (%) ●
Plastic Limit (W_p) |——| Liquid Limit (W_L)
Penetration, blows/foot ■: 10 20 30 40 50

DEPTH (feet)	SOIL DESCRIPTION	SOIL CLASSIFICATION	REMARKS/ OTHER TESTS
	SAND, light brown, little silt and gravels, very dense moist	SM	200 Wash
40	SAND, brown, coarsed grained, trace of silt, damp.	SP	200 Wash
45	SAND, light brown, some silt, trace of gravels, medium dense, damp	SM	200 Wash
50			200 Wash
55	...tan, little silt, dense, moist		200 Wash
60	...little silt.		200 Wash
65	...moist.		200 Wash
70			



GEOBASE, INC.	PROJECT: MVCH – Hospital Addition and CUP, 2300 IRIS AVENUE, Moreno Valley, California		BORING NO. B-4
	DEPTH TO WATER feet	SURFACE ELEV. 1540 feet / LOGGED BY HDN	PROJECT NO. C.314.39.00
	DEPTH TO SLOUGH	DRILL RIG CME-75 HT, DRILLER MARTINI / DATE LOGGED 03/30/2010	FIGURE NO. B-5

Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.

LOG OF BORING

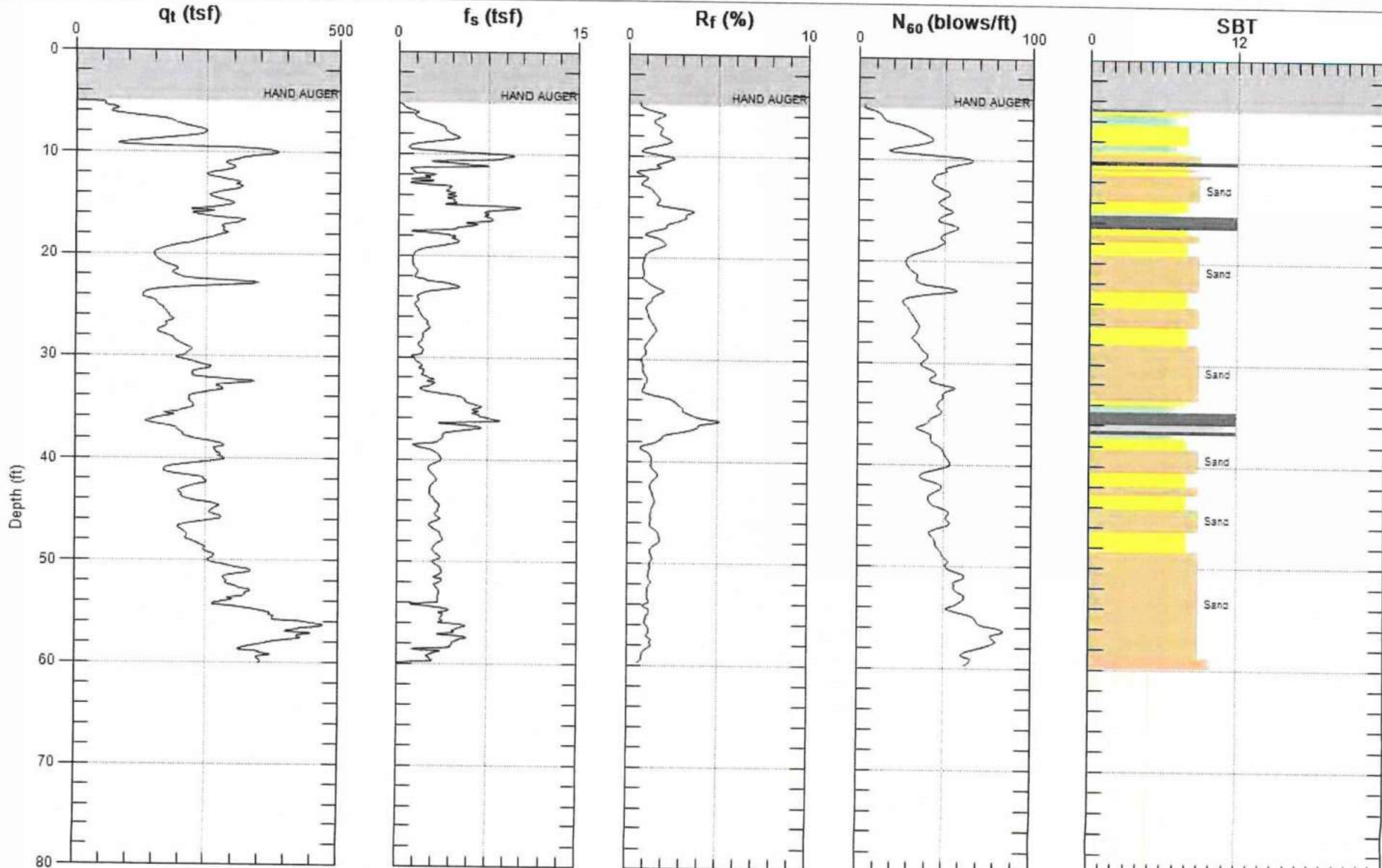
SAMPLE TYPE: THIN WALLED TUBE | SPT SPLIT SPOON | CALIFORNIA MODIFIED SAMPLER | DISTURBED | NO RECOVERY | CORE

DEPTH (feet)	GRAPHIC LOG	SOIL DESCRIPTION	SOIL CLASSIFICATION	SAMPLE	DRY DENSITY (PCF) 80 90 100 110 120 / Water Content (%) ● / Plastic Limit (W_P) — Liquid Limit (W_L) / Penetration, blows/foot ■ 10 20 30 40 50	REMARKS/ OTHER TESTS
		SAND, brown, some silt, trace of gravels, dense, moist.	SM			200 Wash
75		* End of Boring at 71.5 feet * Boring dry at completion of drilling				
80						
85						
90						
95						
100						
105						

GEOBASE, INC.				
PROJECT	MVCH -- Hospital Addition and CUP 2300 IRIS AVENUE, Moreno Valley, California			BORING NO. B-4
DEPTH TO WATER feet	SURFACE ELEV. 1540 feet	LOGGED BY HDN		PROJECT NO. C.314.39.00
DEPTH TO SLOUGH	DRILL RIG CME-75 HT DRILLER MARTINI	DATE LOGGED 03/30/2010		FIGURE NO. B-5
Note: This log of boring should be evaluated in conjunction with the complete geotechnical report. This log of boring represents conditions observed at the specific boring location and at the date indicated.				page 3 of 3

GREGG GEOBASE

Site: KAISER MORENO VALLEY Engineer: H.NGUYEN
Sounding: CPT-3 Date: 2010-03-31 10:36



Max. Depth: 60.039 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

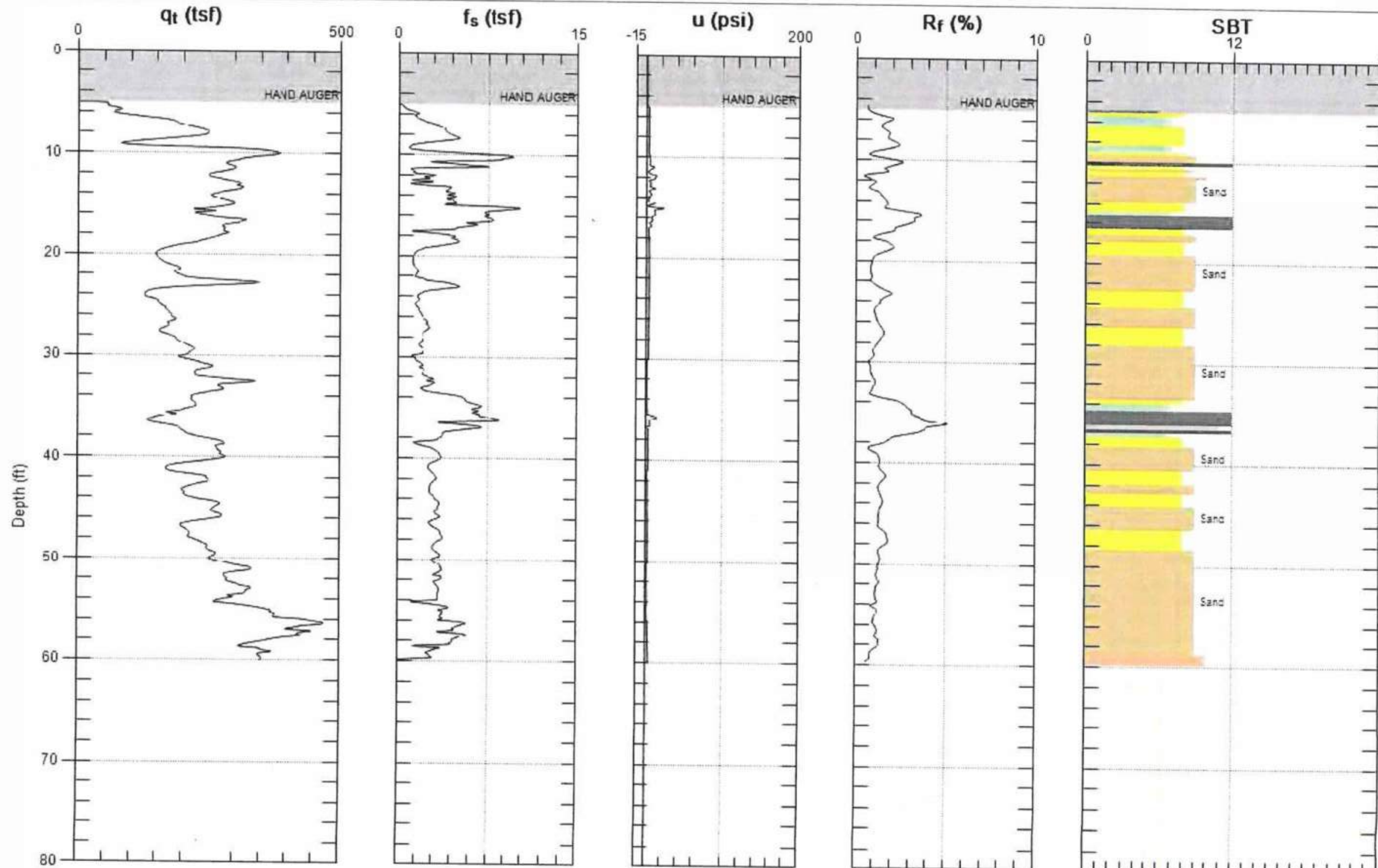
C.314.81.00

Figure B-31, page 1 of 2

GREGG GEOBASE

Site: KAISER MORENO VALLEY Engineer: H.NGUYEN

Sounding: CPT-3 Date: 2010-03-31 10:36



Max. Depth: 60.039 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Appendix 4: Historical Site Conditions

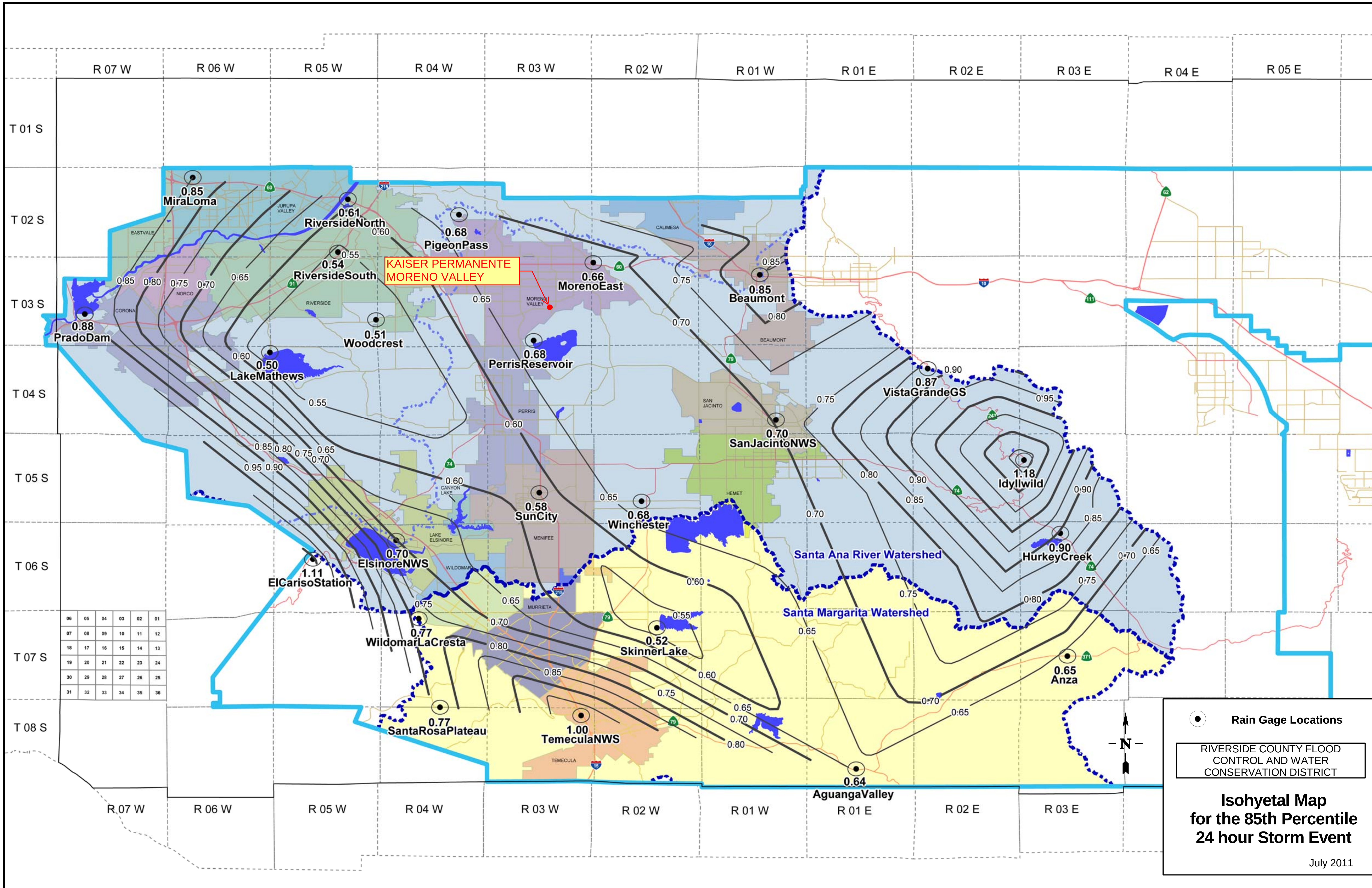
Phase I Environmental Site Assessment or Other Information on Past Site Use

Appendix 5: LID Infeasibility

LID Technical Infeasibility Analysis

Appendix 6: BMP Design Details

BMP Sizing, Design Details and other Supporting Documentation



KAISER PERMANENTE
MORENO VALLEY
0.85 MiraLoma
0.61 RiversideNorth
0.68 PigeonPass
0.54 RiversideSouth
0.66 MorenoEast
0.85 Beaumont
0.88 PradoDam
0.51 Woodcrest
0.68 PerrisReservoir
0.50 LakeMathews
0.87 VistaGrandeGS
0.70 SanJacintoNWS
1.18 Idyllwild
0.58 SunCity
0.68 Winchester
0.90 HurkeyCreek
0.70 ElsinoreNWS
1.11 ElCarisoStation
0.77 WildomarLaCresta
0.52 SkinnerLake
0.65 Anza
0.77 SantaRosaPlateau
1.00 TemeculaNWS
0.64 AguangaValley
Santa Ana River Watershed
Santa Margarita Watershed
R 07 W
R 06 W
R 05 W
R 04 W
R 03 W
R 02 W
R 01 W
R 01 E
R 02 E
R 03 E
R 04 E
R 05 E
T 01 S
T 02 S
T 03 S
T 04 S
T 05 S
T 06 S
T 07 S
T 08 S
N
Rain Gage Locations
RIVERSIDE COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT
Isohyetal Map for the 85th Percentile 24 hour Storm Event
July 2011

Effective Impervious Fraction

Developed Cover Types	Effective Impervious Fraction
Roofs	1.00
Concrete or Asphalt	1.00
Grouted or Gapless Paving Blocks	1.00
Compacted Soil (e.g. unpaved parking)	0.40
Decomposed Granite	0.40
Permeable Paving Blocks w/ Sand Filled Gap	0.25
Class 2 Base	0.30
Gravel or Class 2 Permeable Base	0.10
Pervious Concrete / Porous Asphalt	0.10
Open and Porous Pavers	0.10
Turf block	0.10
Ornamental Landscaping	0.10
Natural (A Soil)	0.03
Natural (B Soil)	0.15
Natural (C Soil)	0.30
Natural (D Soil)	0.40

Mixed Surface Types

Santa Ana Watershed - BMP Design Volume, V_{BMP}	Legend:	Required Entries
		Calculated Cells

*(Note this worksheet shall **only** be used in conjunction with BMP designs from the **LID BMP Design Handbook**)*

Company Name: Michael Baker International — Date: 9/25/2019
Designed by: Frankie Abbott — Case No: .
Company Project Number/Name: Kaiser Permanente Moreno Valley Medical Center

BMP Identification

BMP NAME / ID: Bioretention Basin A (BRB A)

Must match Name/ID used on BMP Design Calculation Sheet

Design Rainfall Depth

85th Percentile, 24-hour Rainfall Depth, from the Isohyetal Map in Handbook Appendix E — D_{85}= 0.66 inches

Drainage Management Area Tabulation

Insert additional rows if needed to accommodate all DMAs draining to the BMP

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Imperivous Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Design Storm Depth (in)*	*Design Capture Volume, V_{BMP} (cubic feet)*	*Proposed Volume on Plans (cubic feet)*
A Imp	*174794.26*	*Concrete or Asphalt*	*1*	*0.89*	*155916.5*			
A Per	*27743.21*	*Mixed Surface Types*	*0.15*	*0.141446*	*3924.2*			
	202537.47	***Total***			**159840.7**	**0.66**	**8791.2**	**9,306**

Notes:

Proposed Volume = Proposed Area X Effective Depth
= 7,050 SQFT X 1.32 FT = 9,306

Bioretention Facility - Design Procedure	BMP ID	Legend:	Required Entries
	BRB A		Calculated Cells

Company Name: Michael Baker International   Date: 9/25/2019

Designed by: Frankie Abbott   County/City Case No.:

Design Volume

Enter the area tributary to this feature A_T= 4.6 acres

Enter V_{BMP} determined from Section 2.1 of this Handbook V_{BMP}= 8,791 ft^3

Type of Bioretention Facility Design

- (●) Side slopes required (parallel to parking spaces or adjacent to walkways)
- ( ) No side slopes required (perpendicular to parking space or Planter Boxes)

Bioretention Facility Surface Area

Depth of Soil Filter Media Layer d_S = 1.5 ft

Top Width of Bioretention Facility, excluding curb w_T = 25.0 ft

Total Effective Depth, d_E

$d_E = (0.3) \times d_S + (0.4) \times 1 - (0.7/w_T) + 0.5$ d_E = 1.32 ft

Minimum Surface Area, A_m

$$A_M\,(ft^2) = \frac{V_{BMP}\,(ft^3)}{d_E\,(ft)}$$

A_M = 6,650 ft^2

Proposed Surface Area   A= 7,050 ft^2

Bioretention Facility Properties

Side Slopes in Bioretention Facility   z = 4 :1

Diameter of Underdrain   6 inches

Longitudinal Slope of Site (3% maximum)   2.5 %

6" Check Dam Spacing   10 feet

Describe Vegetation: Shrubs

Notes:

Santa Ana Watershed - BMP Design Volume, V_{BMP}

Legend: Required Entries / Calculated Cells

*(Note this worksheet shall **only** be used in conjunction with BMP designs from the **LID BMP Design Handbook**)*

Company Name: Michael Baker International — Date: 9/25/2019
Designed by: Frankie Abbott — Case No:
Company Project Number/Name: Kaiser Permanente Moreno Valley Medical Center

BMP Identification

BMP NAME / ID: Bioretention Basin B (BRB B)

Must match Name/ID used on BMP Design Calculation Sheet

Design Rainfall Depth

85th Percentile, 24-hour Rainfall Depth,
from the Isohyetal Map in Handbook Appendix E — D_{85}= 0.66 inches

Drainage Management Area Tabulation

Insert additional rows if needed to accommodate all DMAs draining to the BMP

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Impervious Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Design Storm Depth (in)*	*Design Capture Volume, V_{BMP} (cubic feet)*	*Proposed Volume on Plans (cubic feet)*
B Imp	*79438.59*	*Concrete or Asphalt*	*1*	*0.89*	*70859.2*			
B Per	*14937.99*	*Mixed Surface Types*	*0.15*	*0.141446*	*2112.9*			
	94376.58	***Total***			*72972.1*	**0.66**	**4013.5**	**5,865**

Notes:

Proposed Volume = Proposed Area X Effective Depth
= 4,410 SQFT X 1.33 FT = 5,865 CF

Bioretention Facility - Design Procedure	BMP ID	Legend:	Required Entries
	BRB B		Calculated Cells

Company Name:	Michael Baker International	Date:	9/16/2019
Designed by:	Frankie Abbott	County/City Case No.:	

Design Volume

Enter the area tributary to this feature — A_T= 2.1 acres

Enter V_{BMP} determined from Section 2.1 of this Handbook — V_{BMP}= 4,014 ft^3

Type of Bioretention Facility Design

- (●) Side slopes required (parallel to parking spaces or adjacent to walkways)
- ( ) No side slopes required (perpendicular to parking space or Planter Boxes)

Bioretention Facility Surface Area

Depth of Soil Filter Media Layer — d_S = 1.5 ft

Top Width of Bioretention Facility, excluding curb — w_T = 35.0 ft

Total Effective Depth, d_E

$d_E = (0.3) \times d_S + (0.4) \times 1 - (0.7/w_T) + 0.5$ — d_E = 1.33 ft

Minimum Surface Area, A_m

$$A_M\,(ft^2) = \frac{V_{BMP}\,(ft^3)}{d_E\,(ft)}$$

A_M = 3,018 ft^2

Proposed Surface Area — A= 4,410 ft^2

Bioretention Facility Properties

Side Slopes in Bioretention Facility — z = 4 :1

Diameter of Underdrain — 6 inches

Longitudinal Slope of Site (3% maximum) — 2.5 %

6" Check Dam Spacing — 10 feet

Describe Vegetation: Shrubs

Notes:

Santa Ana Watershed - BMP Design Volume, V_{BMP}

Legend: Required Entries / Calculated Cells

(Note this worksheet shall ***only*** *be used in conjunction with BMP designs from the* ***LID BMP Design Handbook****)*

Company Name: Michael Baker International — Date: 9/25/2019
Designed by: Frankie Abbott — Case No:
Company Project Number/Name: Kaiser Permanente Moreno Valley Medical Center

BMP Identification

BMP NAME / ID: Bioretention Basin C (BRB C)

Must match Name/ID used on BMP Design Calculation Sheet

Design Rainfall Depth

85th Percentile, 24-hour Rainfall Depth, from the Isohyetal Map in Handbook Appendix E — D_{85}= 0.66 inches

Drainage Management Area Tabulation

Insert additional rows if needed to accommodate all DMAs draining to the BMP

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Imperivous Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Design Storm Depth (in)*	*Design Capture Volume, V_{BMP} (cubic feet)*	*Proposed Volume on Plans (cubic feet)*
C Imp	*71832.56*	*Concrete or Asphalt*	*1*	*0.89*	*64074.6*			
C Per	*62156.21*	*Mixed Surface Types*	*0.15*	*0.141446*	*8791.7*			
	133988.77	***Total***			**72866.3**	**0.66**	***4007.6***	***4,046***

Notes:

Proposed Volume = Proposed Area X Effective Depth
= 3,065 SQFT X 1.32 FT = 4,046 CF

Bioretention Facility - Design Procedure	BMP ID	Legend:	Required Entries
	BRB D		Calculated Cells

Company Name: Michael Baker International — Date: 9/25/2019

Designed by: Frankie Abbott — County/City Case No.:

Design Volume

Enter the area tributary to this feature	A_T=	5.07	acres
Enter V_{BMP} determined from Section 2.1 of this Handbook	V_{BMP}=	7,995	ft^3

Type of Bioretention Facility Design

- (●) Side slopes required (parallel to parking spaces or adjacent to walkways)
- ( ) No side slopes required (perpendicular to parking space or Planter Boxes)

Bioretention Facility Surface Area

Depth of Soil Filter Media Layer	d_S =	1.5	ft
Top Width of Bioretention Facility, excluding curb	w_T =	20.0	ft
Total Effective Depth, d_E $d_E = (0.3) \times d_S + (0.4) \times 1 - (0.7/w_T) + 0.5$	d_E =	1.32	ft
Minimum Surface Area, A_m $A_M\ (ft^2) = \frac{V_{BMP}\ (ft^3)}{d_E\ (ft)}$	A_M =	6,080	ft^2
Proposed Surface Area	A=	6,600	ft^2

Bioretention Facility Properties

Side Slopes in Bioretention Facility	z =	4	:1
Diameter of Underdrain		6	inches
Longitudinal Slope of Site (3% maximum)		2.5	%
6" Check Dam Spacing		10	feet

Describe Vegetation: Shrubs

Notes:

Santa Ana Watershed - BMP Design Volume, V_{BMP}

Legend: Required Entries / Calculated Cells

*(Note this worksheet shall **only** be used in conjunction with BMP designs from the **LID BMP Design Handbook**)*

Company Name: Michael Baker International — Date: 9/25/2019
Designed by: Frankie Abbott — Case No:
Company Project Number/Name: Kaiser Permanente Moreno Valley Medical Center

BMP Identification

BMP NAME / ID: Bioretention Basin D (BRB D)

Must match Name/ID used on BMP Design Calculation Sheet

Design Rainfall Depth

85th Percentile, 24-hour Rainfall Depth,
from the Isohyetal Map in Handbook Appendix E

D_{85}= 0.66 inches

Drainage Management Area Tabulation

Insert additional rows if needed to accommodate all DMAs draining to the BMP

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Imperivous Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Design Storm Depth (in)*	*Design Capture Volume, V_{BMP} (cubic feet)*	*Proposed Volume on Plans (cubic feet)*
C Imp	*152027.36*	*Concrete or Asphalt*	*1*	*0.89*	*135608.4*			
C Per	*68942.49*	*Mixed Surface Types*	*0.15*	*0.141446*	*9751.6*			
	220969.85	***Total***			145360	0.66	*7994.8*	*8,580*

Notes:

Proposed Volume = Proposed Area x Effective Depth
= 6,500 SQFT x 1.32 FT = 8,580 CF

Bioretention Facility - Design Procedure	BMP ID	Legend:	Required Entries
	BRB D		Calculated Cells

Company Name: Michael Baker International — Date: 9/25/2019

Designed by: Frankie Abbott — County/City Case No.:

Design Volume

Enter the area tributary to this feature A_T= 5.07 acres

Enter V_{BMP} determined from Section 2.1 of this Handbook V_{BMP}= 7,995 ft^3

Type of Bioretention Facility Design

◉ Side slopes required (parallel to parking spaces or adjacent to walkways)

○ No side slopes required (perpendicular to parking space or Planter Boxes)

Bioretention Facility Surface Area

Depth of Soil Filter Media Layer d_S = 1.5 ft

Top Width of Bioretention Facility, excluding curb w_T = 20.0 ft

Total Effective Depth, d_E

$d_E = (0.3) \times d_S + (0.4) \times 1 - (0.7/w_T) + 0.5$ d_E = 1.32 ft

Minimum Surface Area, A_m

$$A_M\,(ft^2) = \frac{V_{BMP}\,(ft^3)}{d_E\,(ft)}$$

A_M = 6,080 ft^2

Proposed Surface Area A= 6,500 ft^2

Bioretention Facility Properties

Side Slopes in Bioretention Facility z = 4 :1

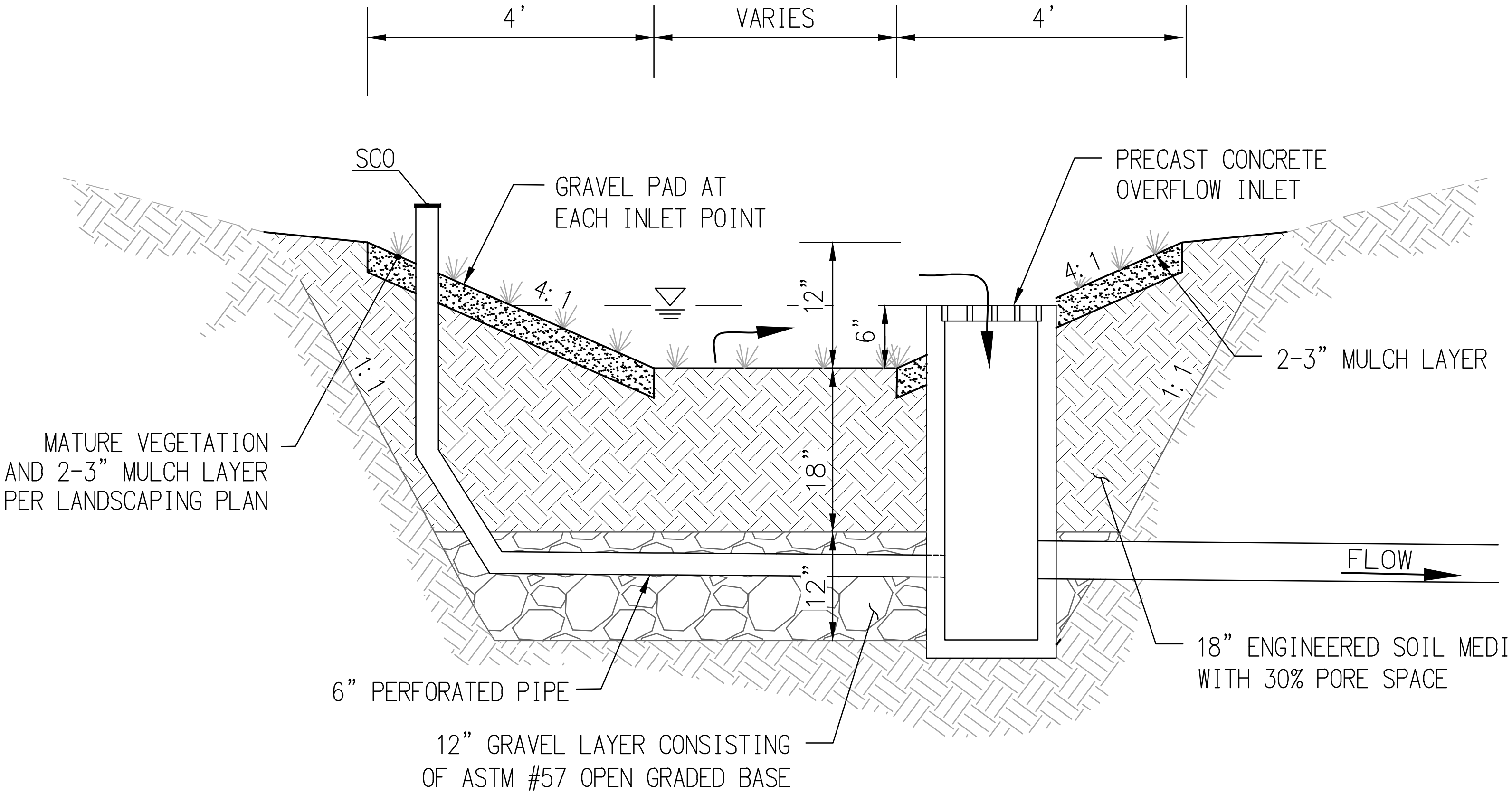
Diameter of Underdrain 6 inches

Longitudinal Slope of Site (3% maximum) 2.5 %

6" Check Dam Spacing 10 feet

Describe Vegetation: Shrubs

Notes:



MINERAL COMPONENT RANGE REQUIREMENTS PER LID DESIGN MANUAL	
PERCENT RANGE	COMPONENT
70-80	SAND
15-20	SILT
5-10	CLAY

BIORETENTION BASIN CROSS SECTION

SCALE: NTS

Michael Baker INTERNATIONAL

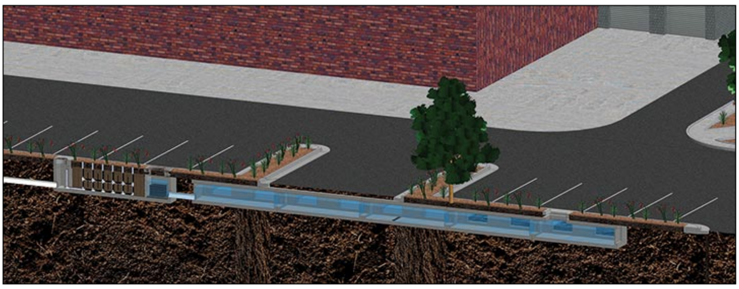
9755 Clairemont Mesa Blvd., San Diego, CA 92124

Phone: (858) 614-5000 · MBAKERINTL.COM

Flow Based Sizing

The MWS Linear can be used in stand alone applications to meet treatment flow requirements. Since the MWS Linear is the only biofiltration system that can accept inflow pipes several feet below the surface it can be used not only in decentralized design applications but also as a large central end-of-the-line application for maximum feasibility.

Model #	Dimensions	WetlandMEDIA Surface Area	Treatment Flow Rate (cfs)
MWS-L-4-4	4′ x 4′	23 sq. ft.	0.052
MWS-L-4-6	4′ x 6′	32 sq. ft.	0.073
MWS-L-4-8	4′ x 8′	50 sq. ft.	0.115
MWS-L-4-13	4′ x 13′	63 sq. ft.	0.144
MWS-L-4-15	4′ x 15′	76 sq. ft.	0.175
MWS-L-4-17	4′ x 17′	90 sq. ft.	0.206
MWS-L-4-19	4′ x 19′	103 sq. ft.	0.237
MWS-L-4-21	4′ x 21′	117 sq. ft.	0.268
MWS-L-6-8	7′ x 9′	64 sq. ft.	0.147
MWS-L-8-8	8′ x 8′	100 sq. ft.	0.230
MWS-L-8-12	8′ x 12′	151 sq. ft.	0.346
MWS-L-8-16	8′ x 16′	201 sq. ft.	0.462
MWS-L-8-20	9′ x 21′	252 sq. ft.	0.577
MWS-L-8-24	9′ x 25′	302 sq. ft.	0.693



Volume Based Sizing

Many states require treatment of a water quality volume and do not offer the option of flow based design. The MWS Linear and its unique horizontal flow makes it the only biofilter that can be used in volume based design installed downstream of ponds, detention basins, and underground storage systems.

Model #	Treatment Capacity (cu. ft.) @ 24-Hour Drain Down	Treatment Capacity (cu. ft.) @ 48-Hour Drain Down
MWS-L-4-4	1140	2280
MWS-L-4-6	1600	3200
MWS-L-4-8	2518	5036
MWS-L-4-13	3131	6261
MWS-L-4-15	3811	7623
MWS-L-4-17	4492	8984
MWS-L-4-19	5172	10345
MWS-L-4-21	5853	11706
MWS-L-6-8	3191	6382
MWS-L-8-8	5036	10072
MWS-L-8-12	7554	15109
MWS-L-8-16	10073	20145
MWS-L-8-20	12560	25120
MWS-L-8-24	15108	30216

Santa Ana Watershed - BMP Design Flow Rate, Q_{BMP}

Legend: Required Entries / Calculated Cells

*(Note this worksheet shall **only** be used in conjunction with BMP designs from the **LID BMP Design Handbook**)*

Company Name: Michael Baker International — Date: 7/18/2019
Designed by: Charisse Garrido — Case No:
Company Project Number/Name: Kaiser Permanente Moreno Valley Medical Center

BMP Identification

BMP NAME / ID: Modular Wetland System (MWS E)

Must match Name/ID used on BMP Design Calculation Sheet

Design Rainfall Depth

Design Rainfall Intensity I = 0.20 in/hr

Drainage Management Area Tabulation

Insert additional rows if needed to accommodate all DMAs draining to the BMP

	DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type (use pull-down menu)	Effective Imperivous Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Design Rainfall Intensity (in/hr)*	*Design Flow Rate (cfs)*	*Proposed Flow Rate (cfs)*
DMAs	*D Imp*	*251412*	*Concrete or Asphalt*	*1*	*0.89*	*224259.5*			
	D Per	*78765*	*Mixed Surface Types*	*0.15*	*0.14145*	*11141*			
		330177	***Total***			**235400.5**	**0.20**	***1.1***	***1.15***

Notes:

SITE SPECIFIC DATA

PROJECT NUMBER	9338		
ORDER NUMBER	----		
PROJECT NAME	KAISER MEDICAL MORENO VALLEY		
PROJECT LOCATION	MORENO VALLEY, CA		
STRUCTURE ID	MWS E1		
TREATMENT REQUIRED			
VOLUME BASED (CF)	FLOW BASED (CFS)		
N/A	0.55		
TREATMENT HGL AVAILABLE (FT)			N/K
PEAK BYPASS REQUIRED (CFS) – IF APPLICABLE			BYPASS
PIPE DATA	I.E.	MATERIAL	DIAMETER
INLET PIPE 1	1.33	HDPE	8"
INLET PIPE 2	N/A	N/A	N/A
OUTLET PIPE	0.00	HDPE	8"
	PRETREATMENT	BIOFILTRATION	DISCHARGE
RIM ELEVATION	5.50	5.50	5.50
SURFACE LOAD	PEDESTRIAN	PEDESTRIAN	PEDESTRIAN
FRAME & COVER	3EA ø30"	36X36", (2)30X48"	ø24"
WETLANDMEDIA VOLUME (CY)			12.67
ORIFICE SIZE (DIA. INCHES)			ø2.43" EA

NOTES: PRELIMINARY NOT FOR CONSTRUCTION. STORAGE HGL MUST BE LOWER THAN MWS OUTLET, EOR TO VERIFY. TWO IDENTICAL MWS SET IN PARALLEL TO SPLIT 1.1 CFS. ACCORDING TO SOILS REPORT, "TYPE II PORTLAND CEMENT MAY BE USED FOR CONSTRUCTION OF CONCRETE STRUCTURES..."

INSTALLATION NOTES

1. CONTRACTOR TO PROVIDE ALL LABOR, EQUIPMENT, MATERIALS AND INCIDENTALS REQUIRED TO OFFLOAD AND INSTALL THE SYSTEM AND APPURTENANCES IN ACCORDANCE WITH THIS DRAWING AND THE MANUFACTURERS SPECIFICATIONS, UNLESS OTHERWISE STATED IN MANUFACTURERS CONTRACT.
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GENERAL NOTES

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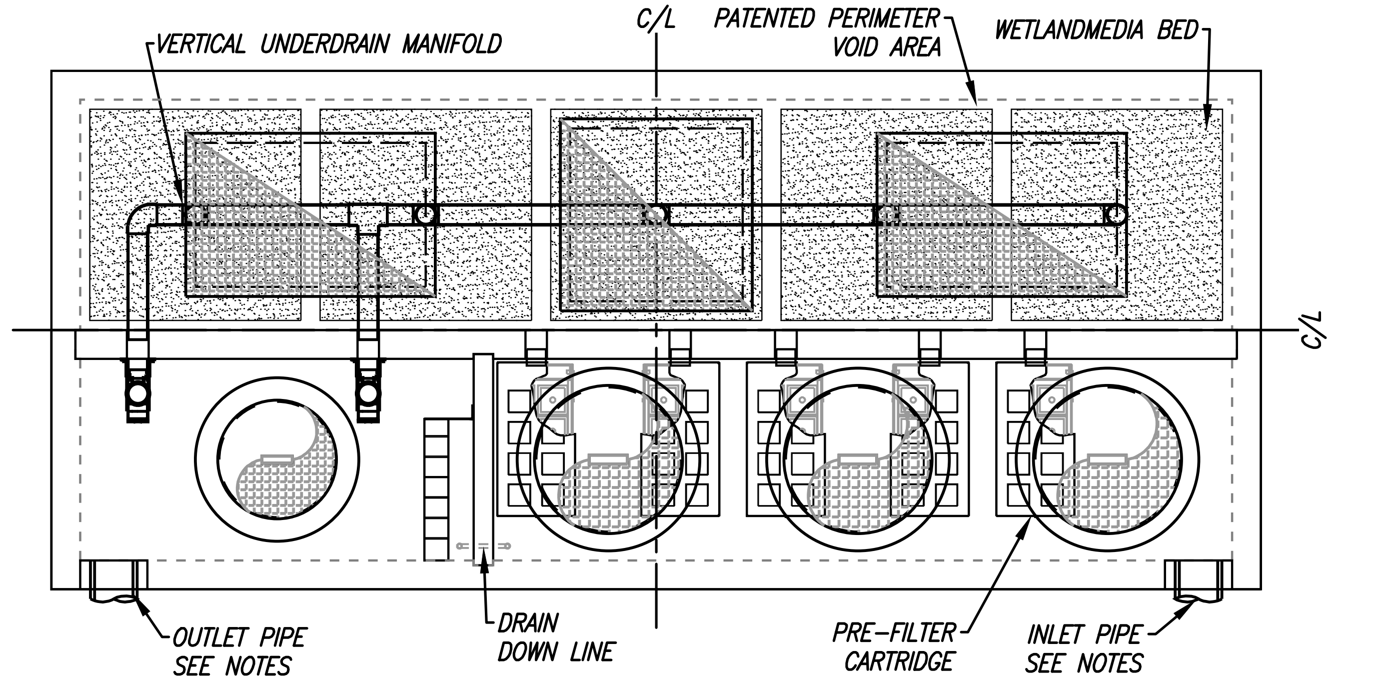
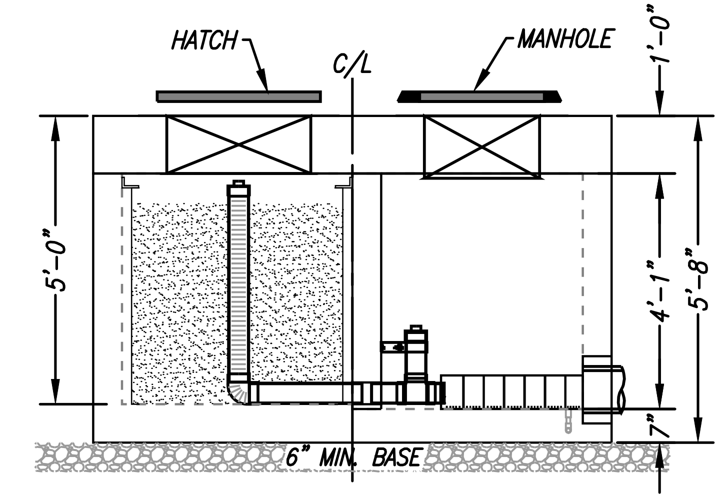
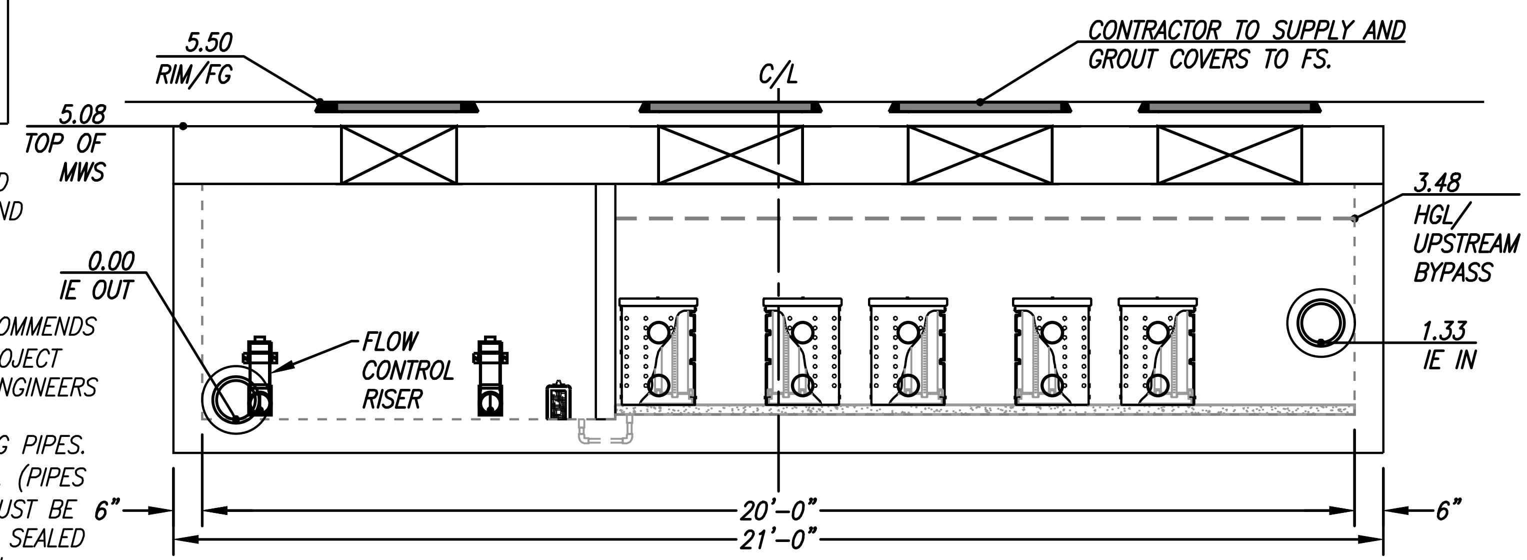


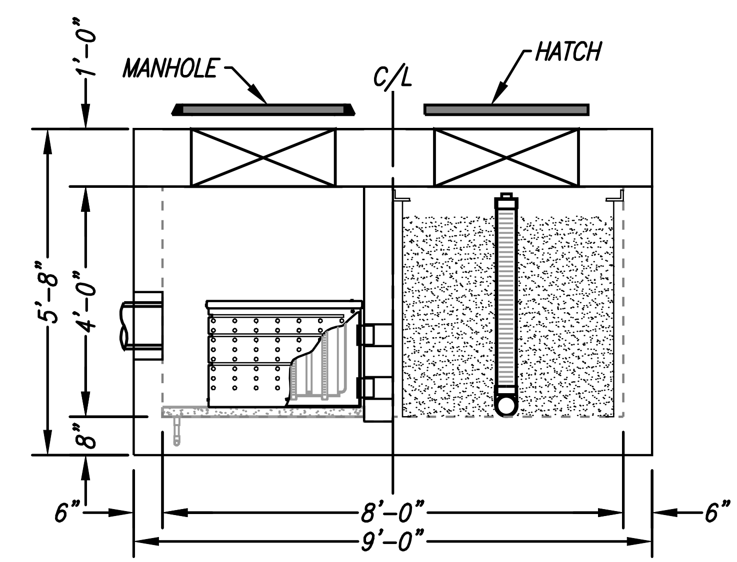
PLAN VIEW



LEFT END VIEW



ELEVATION VIEW



RIGHT END VIEW

TREATMENT FLOW (CFS)	0.577
OPERATING HEAD (FT)	3.4
PRETREATMENT LOADING RATE (GPM/SF)	2.0
WETLAND MEDIA LOADING RATE (GPM/SF)	1.0

MODULAR WETLANDS

THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING US PATENTS: 7,425,262; 7,470,362; 7,674,378; 8,303,816; RELATED FOREIGN PATENTS OR OTHER PATENTS PENDING

Bio Clean
A Forterra Company

MWS-L-8-20-5'-0"-V-UG
STORMWATER BIOFILTRATION SYSTEM
STANDARD DETAIL

7/30/19CTORRES

SITE SPECIFIC DATA			
PROJECT NUMBER	9338		
ORDER NUMBER	----		
PROJECT NAME	KAISER MEDICAL MORENO VALLEY		
PROJECT LOCATION	MORENO VALLEY, CA		
STRUCTURE ID	MWS E2		
TREATMENT REQUIRED			
VOLUME BASED (CF)		FLOW BASED (CFS)	
N/A		0.55	
TREATMENT HGL AVAILABLE (FT)			N/K
PEAK BYPASS REQUIRED (CFS) – IF APPLICABLE			BYPASS
PIPE DATA	I.E.	MATERIAL	DIAMETER
INLET PIPE 1	1.33	HDPE	8"
INLET PIPE 2	N/A	N/A	N/A
OUTLET PIPE	0.00	HDPE	8"
	PRETREATMENT	BIOFILTRATION	DISCHARGE
RIM ELEVATION	5.50	5.50	5.50
SURFACE LOAD	PEDESTRIAN	PEDESTRIAN	PEDESTRIAN
FRAME & COVER	3EA ø30"	30X30", (2) 30X48"	ø24"
WETLANDMEDIA VOLUME (CY)			12.67
ORIFICE SIZE (DIA. INCHES)			ø2.43" EA

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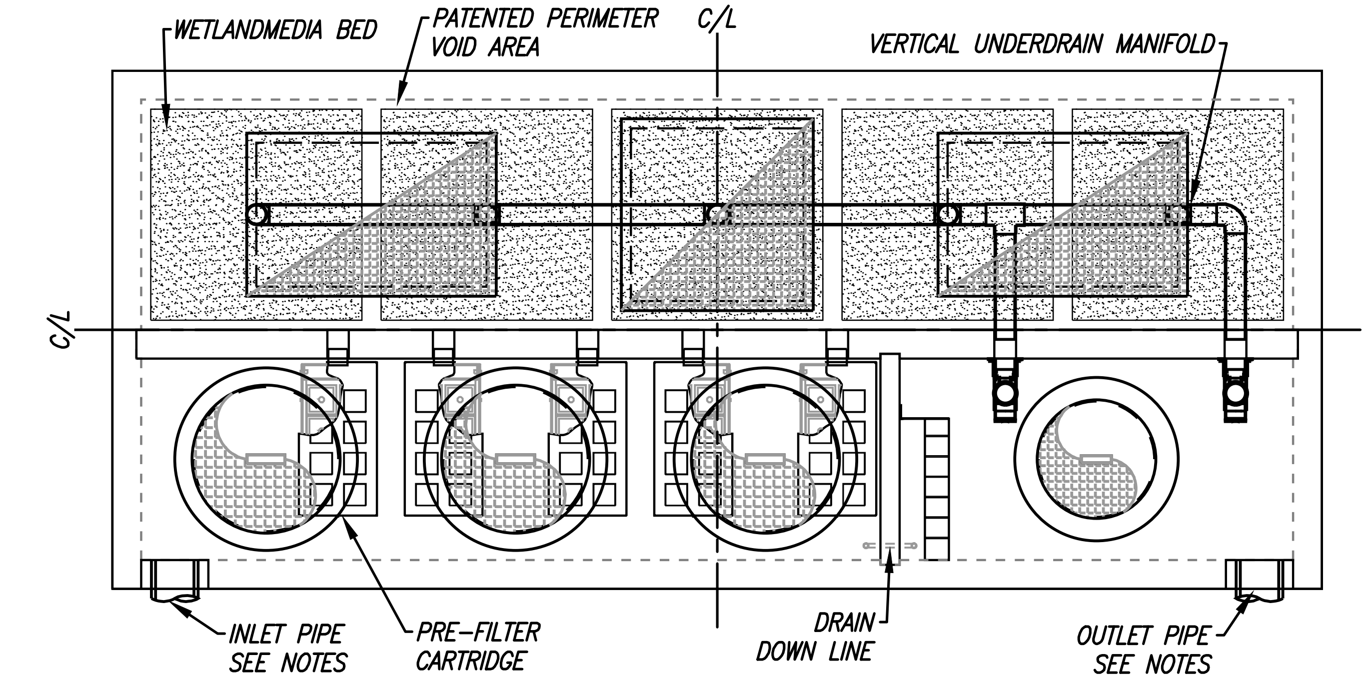
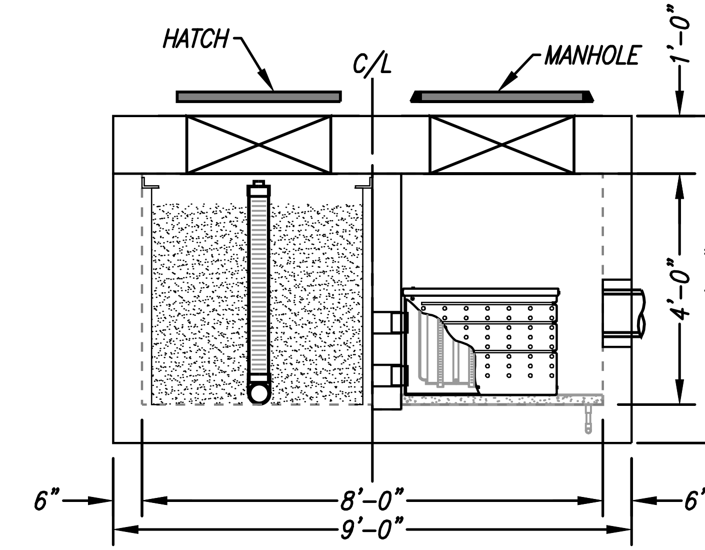
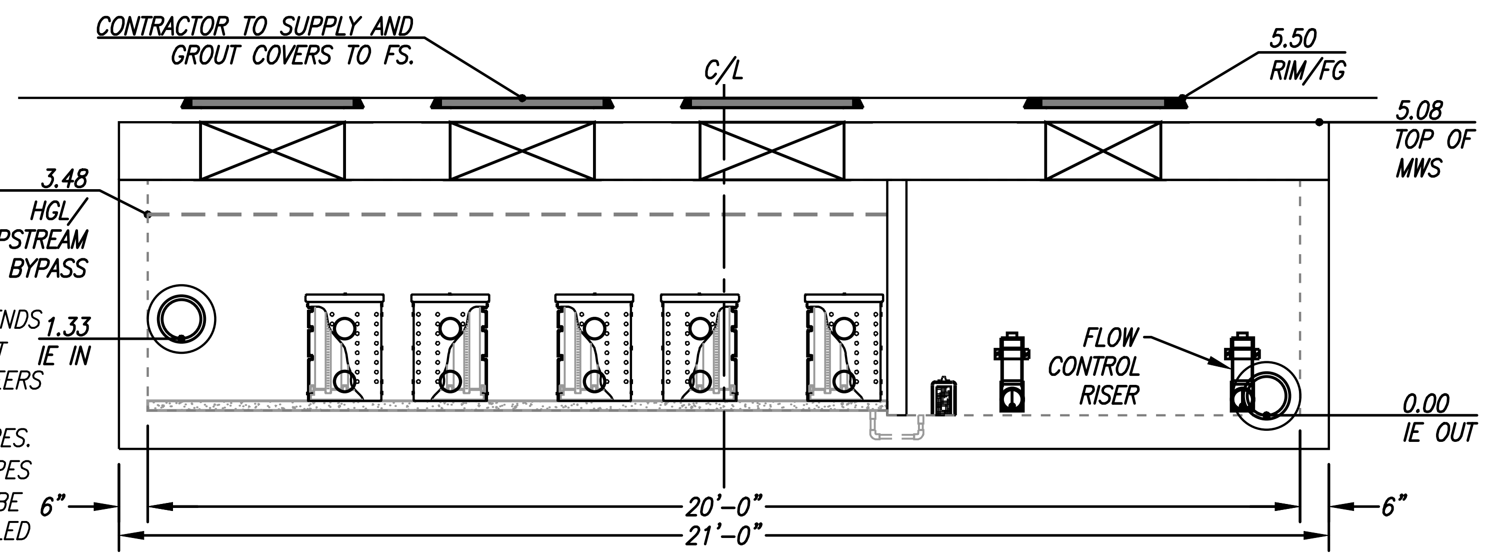


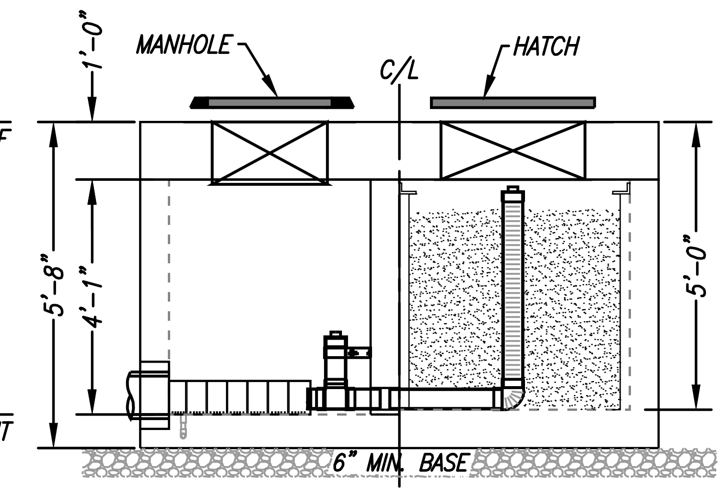
PLAN VIEW



LEFT END VIEW



ELEVATION VIEW



RIGHT END VIEW

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TREATMENT FLOW (CFS)	0.577
OPERATING HEAD (FT)	3.4
PRETREATMENT LOADING RATE (GPM/SF)	2.0
WETLAND MEDIA LOADING RATE (GPM/SF)	1.0

MODULAR WETLANDS

Bio Clean
A Forterra Company

MWS-L-8-20-5'-0"-V-UG
STORMWATER BIOFILTRATION SYSTEM
STANDARD DETAIL

7/30/19CTORRES

Santa Ana Watershed - BMP Design Flow Rate, Q_{BMP}

Legend: Required Entries / Calculated Cells

*(Note this worksheet shall **only** be used in conjunction with BMP designs from the **LID BMP Design Handbook**)*

Company Name: Michael Baker International
Date: 7/18/2019
Designed by: Charisse Garrido
Case No:
Company Project Number/Name: Kaiser Permanente Moreno Valley Medical Center

BMP Identification

BMP NAME / ID: Modular Wetland System (MWS F)

Must match Name/ID used on BMP Design Calculation Sheet

Design Rainfall Depth

Design Rainfall Intensity I = 0.20 in/hr

Drainage Management Area Tabulation

Insert additional rows if needed to accommodate all DMAs draining to the BMP

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type (use pull-down menu)	Effective Imperivous Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Design Rainfall Intensity (in/hr)*	*Design Flow Rate (cfs)*	*Proposed Flow Rate (cfs)*
E Imp	*259094*	*Concrete or Asphalt*	*1*	*0.89*	*231111.8*			
E Per	*43356*	*Mixed Surface Types*	*0.15*	*0.14145*	*6132.5*			
	302450	***Total***			**237244.3**	**0.20**	***1.1***	***1.15***

DMAs

Notes:

SITE SPECIFIC DATA

PROJECT NUMBER	9338		
ORDER NUMBER	----		
PROJECT NAME	KAISER MEDICAL MORENO VALLEY		
PROJECT LOCATION	MORENO VALLEY, CA		
STRUCTURE ID	MWS F1		
TREATMENT REQUIRED			
VOLUME BASED (CF)	FLOW BASED (CFS)		
N/A	0.55		
TREATMENT HGL AVAILABLE (FT)			N/K
PEAK BYPASS REQUIRED (CFS) – IF APPLICABLE			BYPASS
PIPE DATA	I.E.	MATERIAL	DIAMETER
INLET PIPE 1	1.33	HDPE	8"
INLET PIPE 2	N/A	N/A	N/A
OUTLET PIPE	0.00	HDPE	8"
	PRETREATMENT	BIOFILTRATION	DISCHARGE
RIM ELEVATION	5.08	5.08	5.08
SURFACE LOAD	PEDESTRIAN	OPEN PLANTER	PEDESTRIAN
FRAME & COVER	3EA ø30"	OPEN PLANTER	ø24"
WETLANDMEDIA VOLUME (CY)			12.67
ORIFICE SIZE (DIA. INCHES)			ø2.43" EA

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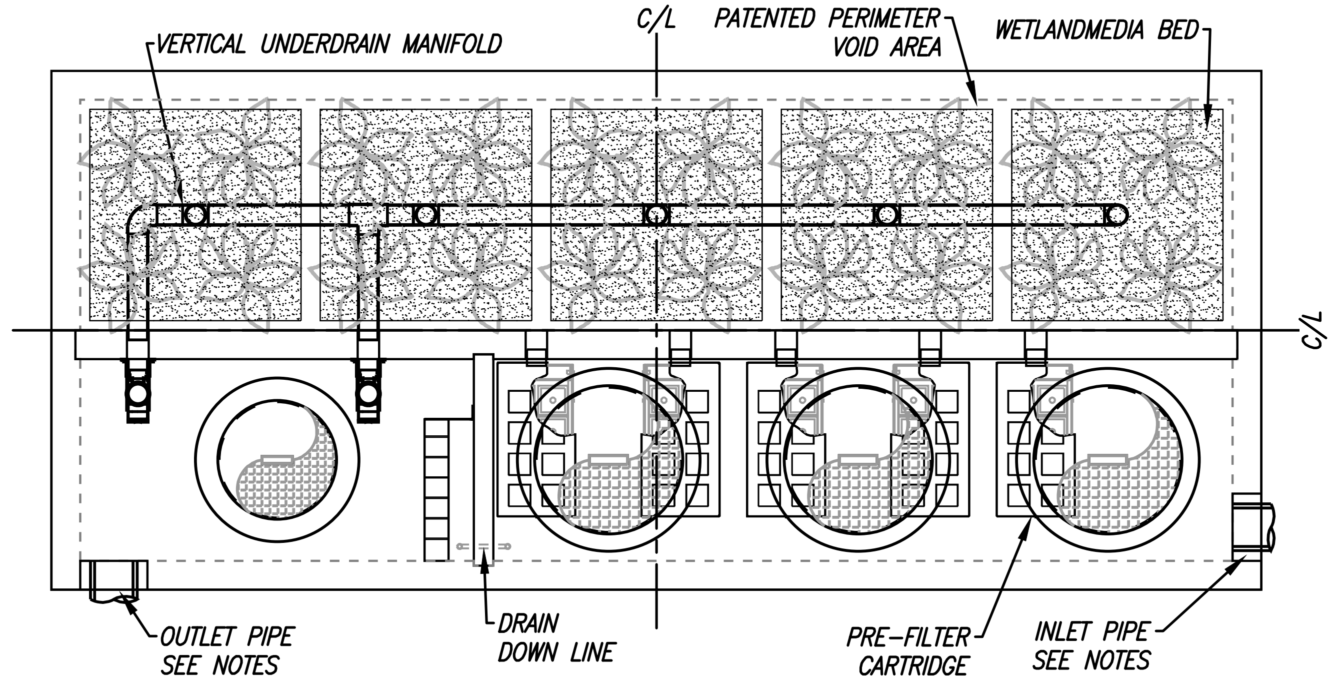
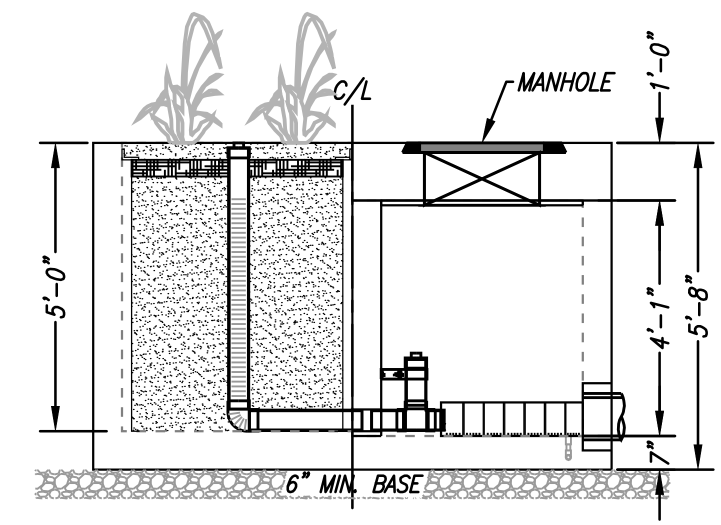
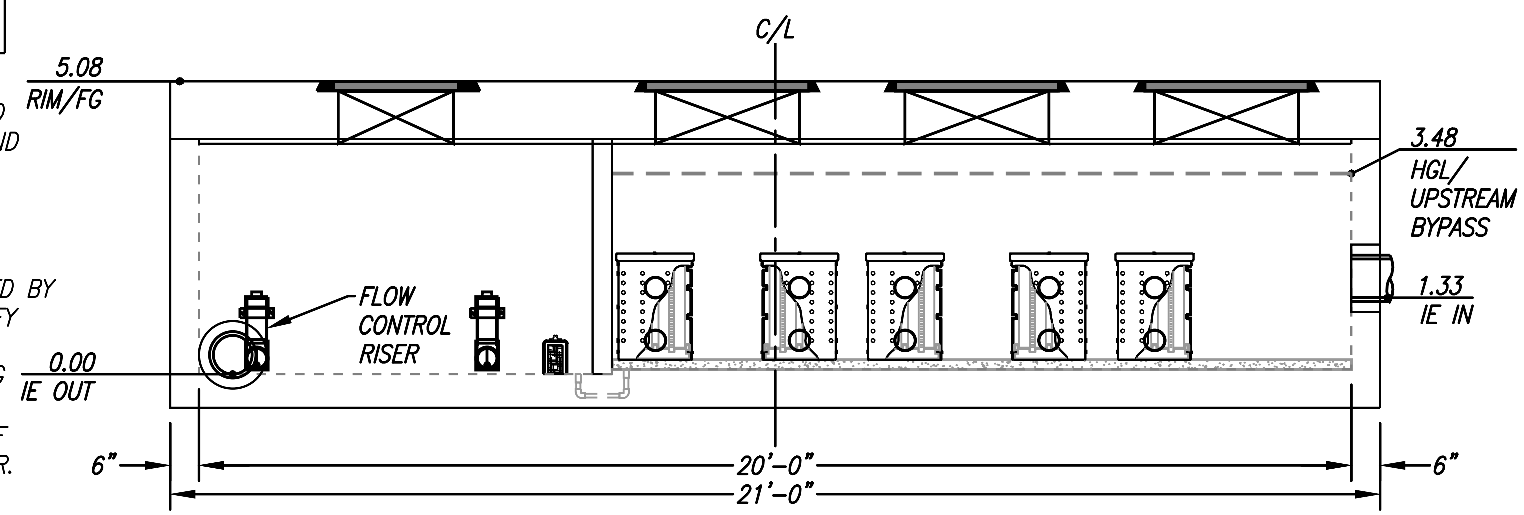


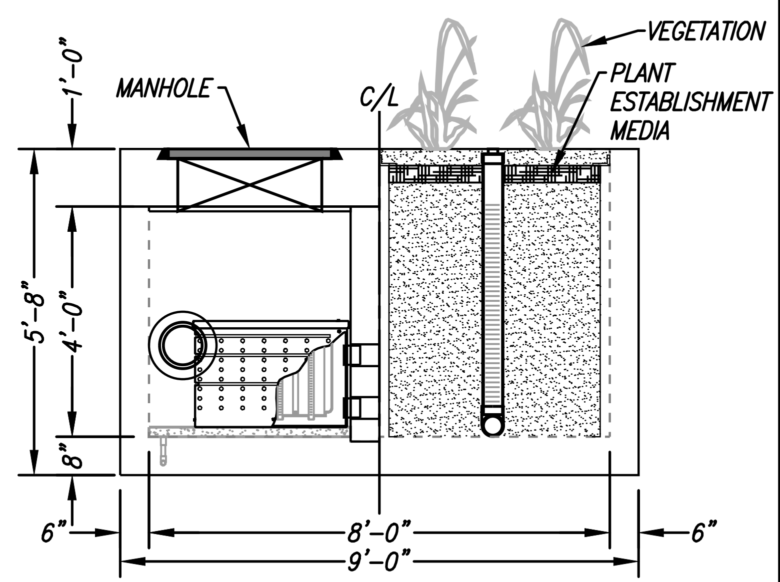
PLAN VIEW



LEFT END VIEW



ELEVATION VIEW



RIGHT END VIEW

TREATMENT FLOW (CFS)	0.577
OPERATING HEAD (FT)	3.4
PRETREATMENT LOADING RATE (GPM/SF)	2.0
WETLAND MEDIA LOADING RATE (GPM/SF)	1.0

MODULAR WETLANDS

Bio Clean
A Forterra Company

MWS-L-8-20-5'-0"-V
STORMWATER BIOFILTRATION SYSTEM
STANDARD DETAIL

7/30/19CTORRES

SITE SPECIFIC DATA			
PROJECT NUMBER		9338	
ORDER NUMBER		----	
PROJECT NAME		KAISER MEDICAL MORENO VALLEY	
PROJECT LOCATION		MORENO VALLEY, CA	
STRUCTURE ID		MWS F2	
TREATMENT REQUIRED			
VOLUME BASED (CF)		FLOW BASED (CFS)	
N/A		0.55	
TREATMENT HGL AVAILABLE (FT)			N/K
PEAK BYPASS REQUIRED (CFS) – IF APPLICABLE			BYPASS
PIPE DATA	I.E.	MATERIAL	DIAMETER
INLET PIPE 1	1.33	HDPE	8"
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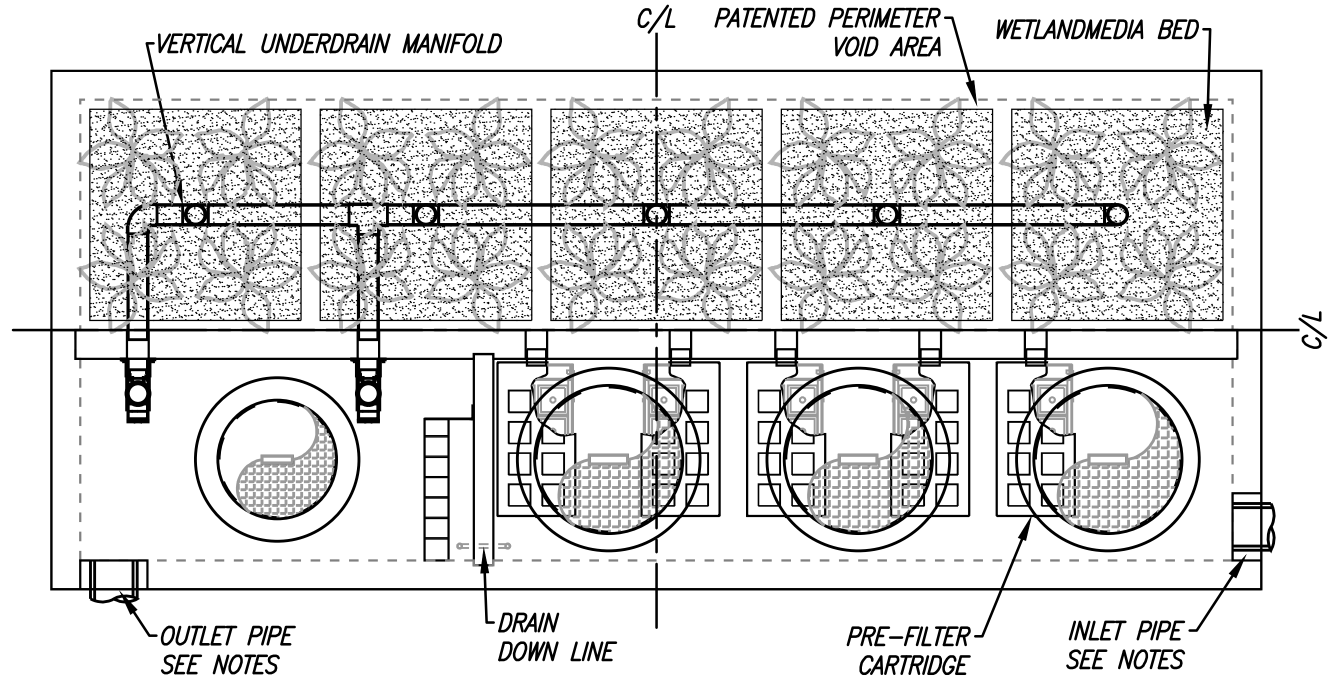
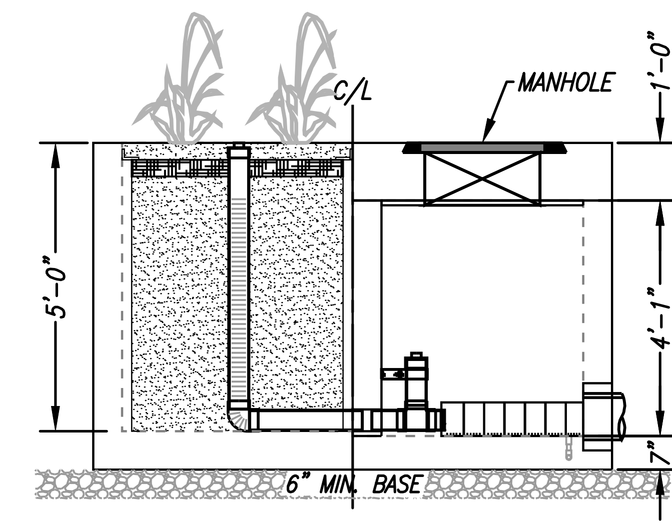


PLAN VIEW



LEFT END VIEW

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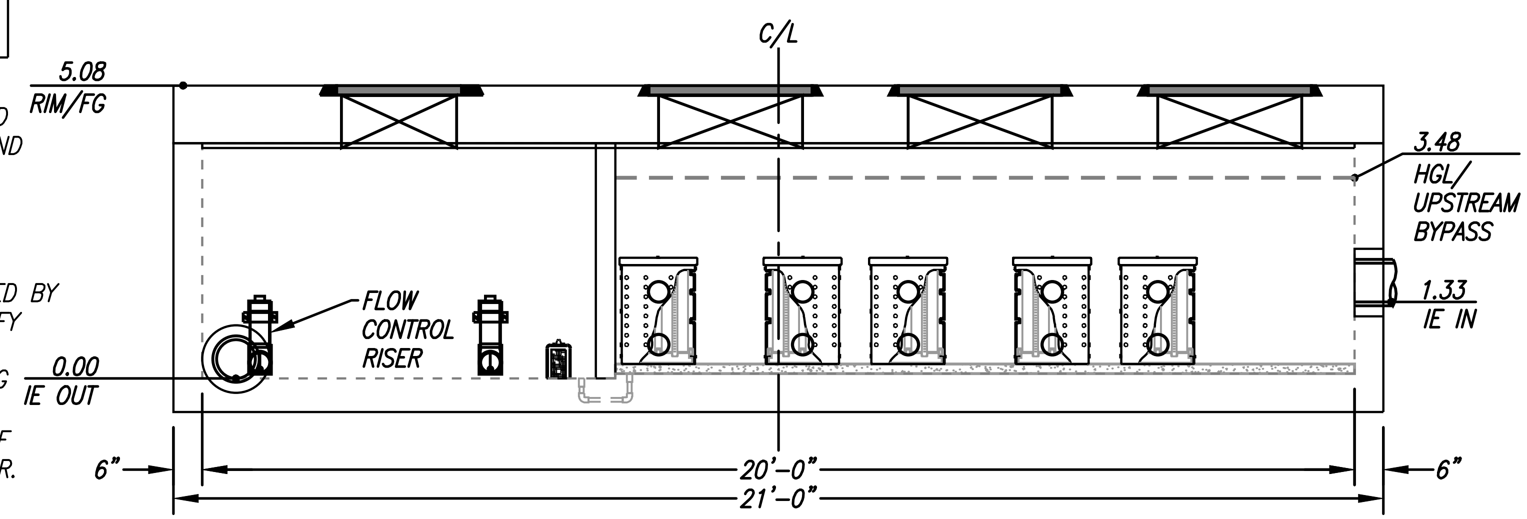
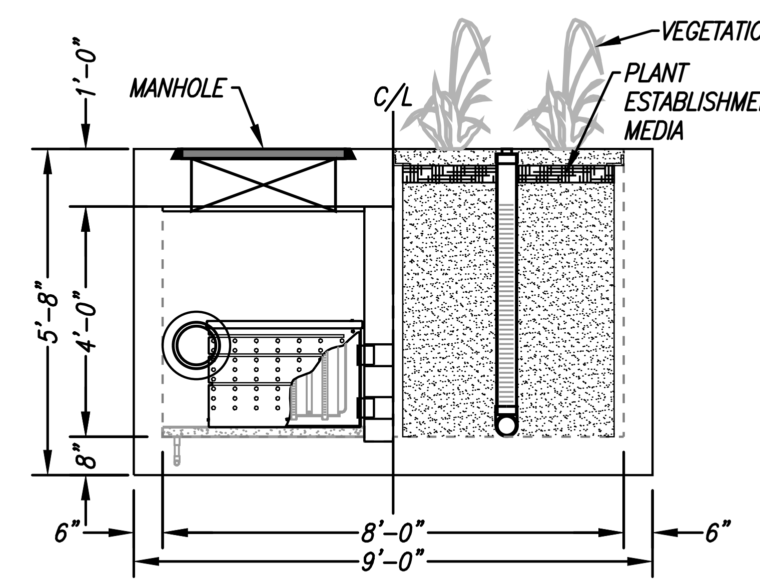


ELEVATION VIEW



RIGHT END VIEW

TREATMENT FLOW (CFS)	0.577
OPERATING HEAD (FT)	3.4
PRETREATMENT LOADING RATE (GPM/SF)	2.0
WETLAND MEDIA LOADING RATE (GPM/SF)	1.0

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MODULAR WETLANDS

Bio Clean
A Forterra Company

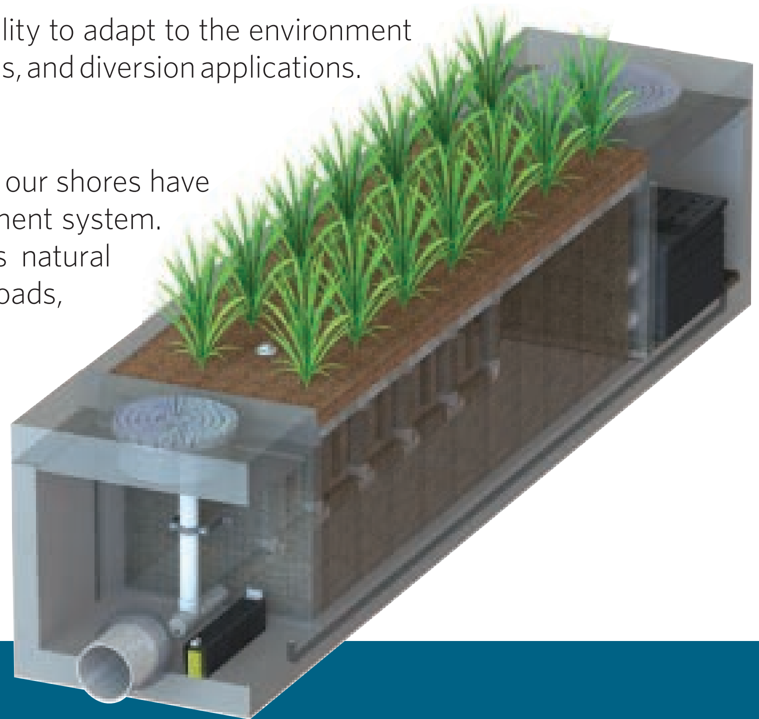
MWS-L-8-20-5'-0"-V
STORMWATER BIOFILTRATION SYSTEM
STANDARD DETAIL

7/30/19CTORRES

OVERVIEW

The Bio Clean Modular Wetlands® System Linear represents a pioneering breakthrough in stormwater technology as the only biofiltration system to utilize patented horizontal flow, allowing for a smaller footprint, higher treatment capacity, and a wide range of versatility. While most biofilters use little or no pretreatment, the Modular Wetlands® incorporates an advanced pretreatment chamber that includes separation and pre-filter cartridges. In this chamber, sediment and hydrocarbons are removed from runoff before entering the biofiltration chamber, reducing maintenance costs and improving performance.

Horizontal flow also gives the system the unique ability to adapt to the environment through a variety of configurations, bypass orientations, and diversion applications.



The Urban Impact

For hundreds of years, natural wetlands surrounding our shores have played an integral role as nature's stormwater treatment system. But as cities grow and develop, our environment's natural filtration systems are blanketed with impervious roads, rooftops, and parking lots.

Bio Clean understands this loss and has spent years re-establishing nature's presence in urban areas, and rejuvenating waterways with the Modular Wetlands® System Linear.

PERFORMANCE

The Modular Wetlands® continues to outperform other treatment methods with superior pollutant removal for TSS, heavy metals, nutrients, hydrocarbons, and bacteria. Since 2007 the Modular Wetlands® has been field tested on numerous sites across the country and is proven to effectively remove pollutants through a combination of physical, chemical, and biological filtration processes. In fact, the Modular Wetlands® harnesses some of the same biological processes found in natural wetlands in order to collect, transform, and remove even the most harmful pollutants.

66% REMOVAL OF DISSOLVED ZINC	69% REMOVAL OF TOTAL ZINC	38% REMOVAL OF DISSOLVED COPPER	64% REMOVAL OF TOTAL PHOSPHORUS	
45% REMOVAL OF NITROGEN	50% REMOVAL OF TOTAL COPPER	95% REMOVAL OF MOTOR OIL	67% REMOVAL OF ORTHO PHOSPHORUS	85% REMOVAL OF TSS

APPROVALS

The Modular Wetlands® System Linear has successfully met years of challenging technical reviews and testing from some of the most prestigious and demanding agencies in the nation and perhaps the world. Here is a list of some of the most high-profile approvals, certifications, and verifications from around the country.

State of Washington TAPE GULD Basic Enhanced/Metals Phosphorus

Washington State Department of Ecology TAPE Approved
The MWS Linear is approved for General Use Level Designation (GULD) for Basic, Enhanced, and Phosphorus treatment at 1 gpm/ft² loading rate. The highest performing BMP on the market for all main pollutant categories.

CA

California Water Resources Control Board, Full Capture Certification
The Modular Wetlands® System is the first biofiltration system to receive certification as a full capture trash treatment control device.

VA

Virginia Department of Environmental Quality, Assignment
The Virginia Department of Environmental Quality assigned the MWS Linear the highest phosphorus removal rating for manufactured treatment devices to meet the new Virginia Stormwater Management Program (VSMP) regulation technical criteria.

MD

Maryland Department of the Environment, Approved ESD
Granted Environmental Site Design (ESD) status for new construction, redevelopment, and retrofitting when designed in accordance with the design manual.

MA

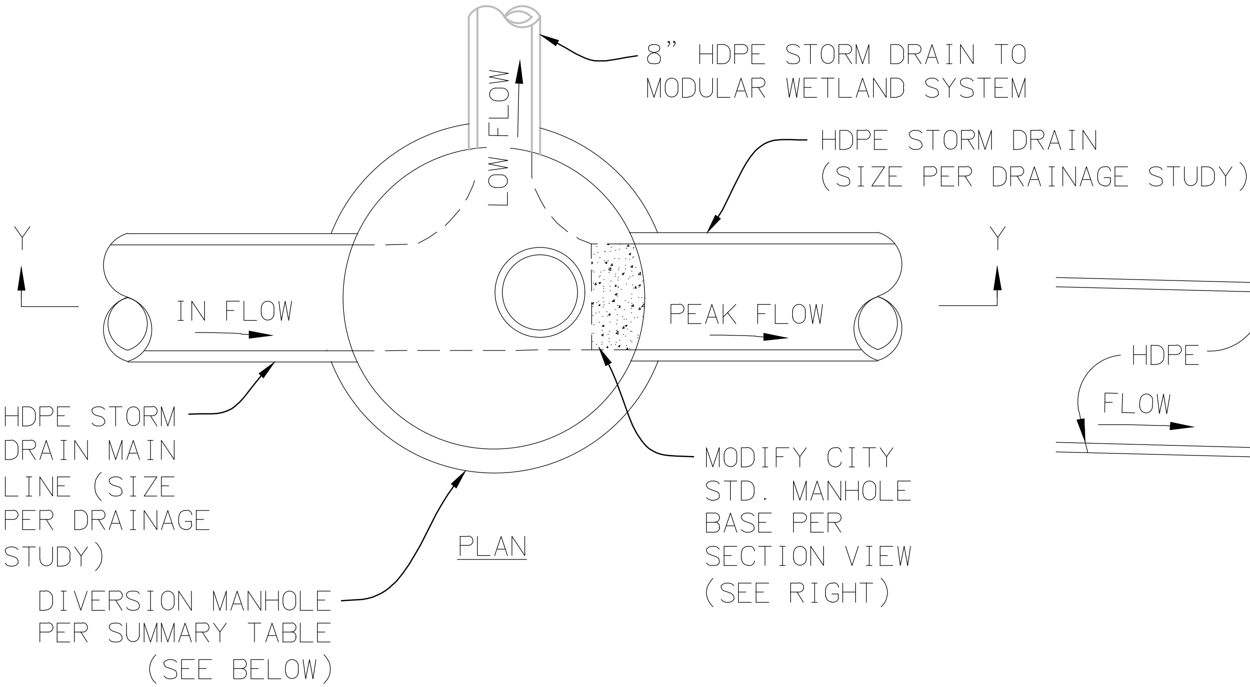
MASTEP Evaluation
The University of Massachusetts at Amherst – Water Resources Research Center issued a technical evaluation report noting removal rates up to 84% TSS, 70% total phosphorus, 68.5% total zinc, and more.

RI

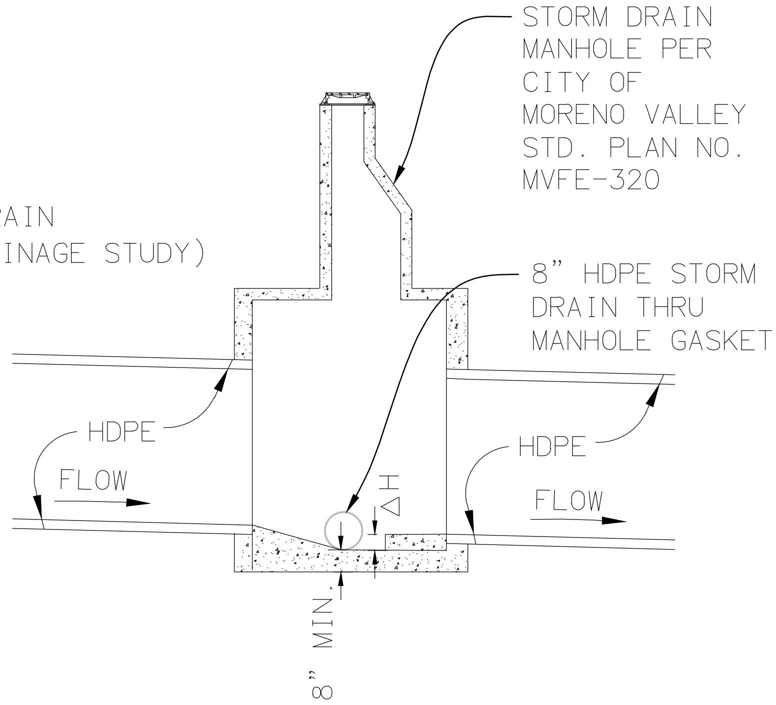
Rhode Island Department of Environmental Management, Approved BMP
Approved as an authorized BMP and noted to achieve the following minimum removal efficiencies: 85% TSS, 60% pathogens, 30% total phosphorus, and 30% total nitrogen.

ADVANTAGES

- HORIZONTAL FLOW BIOFILTRATION
- GREATER FILTER SURFACE AREA
- PRETREATMENT CHAMBER
- PATENTED PERIMETER VOID AREA
- FLOW CONTROL
- NO DEPRESSED PLANTER AREA
- AUTO DRAINDOWN MEANS NO MOSQUITO VECTOR



PLAN



SECTION Y-Y

DIVERSION MANHOLE SUMMARY			
NAME	QBMP (CFS)	CALCULATED Q (CFS)	ΔH (FT)
E	1.1	1.16	0.45
F	1.1	1.16	0.45

NOTE:

1. ΔH (WEIR HEIGHT) IS BASED ON WEIR EQUATION AND QBMP FLOW RATES (SEE APPENDIX 6).

DIVERSION MANHOLE DETAIL

N.T.S.

Michael Baker
INTERNATIONAL
9755 Clairemont Mesa Blvd., San Diego, CA 92124
Phone: (858) 614-5000 · MBAKERINTL.COM

DIVERSION MANHOLE OUTLET PIPE SIZING

WEIR EQUATION CALCULATION

PROJECT: KAISER PERMANENTE MORENO VALLEY

JOB NUMBER: 169814

Using Weir Equation:

$$Q = C*B*(2g)^{(1/2)}*H^{(3/2)}$$

$$B = \cos^{-1}(1-(H/R))*D$$

C =	0.373	Discharge Coefficient of Weir
g =	32.2 ft^2/sec	Acceleration due to Gravity
B=	CALCULATED BELOW	Effective Perimeter
H =	VARIES BELOW	Depth (Head) at Weir
D =	0.67 ft	Diameter of Pipe
Q =	CALCULATED BELOW	Calculated Discharge

DMA E (8" HDPE OUTLET AT DIVERSION MANHOLE)

Head (ft)	Perimeter (ft)	Calculated Q (cfs)
0	-	-
0.05	0.37	0.01
0.10	0.53	0.05
0.15	0.66	0.11
0.20	0.77	0.21
0.25	0.88	0.33
0.30	0.98	0.48
0.35	1.08	0.67
0.40	1.18	0.90
0.45	1.29	1.16
0.50	1.40	1.48
0.55	1.52	1.85
0.60	1.66	2.31
0.65	1.87	2.94
0.67	2.10	3.46

DMA F (8" HDPE OUTLET AT DIVERSION MANHOLE)

Head (ft)	Perimeter (ft)	Calculated Q (cfs)
0	-	-
0.05	0.37	0.01
0.10	0.53	0.05
0.15	0.66	0.11
0.20	0.77	0.21
0.25	0.88	0.33
0.30	0.98	0.48
0.35	1.08	0.67
0.40	1.18	0.90
0.45	1.29	1.16
0.50	1.40	1.48
0.55	1.52	1.85
0.60	1.66	2.31
0.65	1.87	2.94
0.67	2.10	3.46

Appendix 7: Hydromodification

Supporting Detail Relating to Hydrologic Conditions of Concern

Appendix 8: Source Control

Pollutant Sources/Source Control Checklist

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

How to use this worksheet (also see instructions in Section G of the WQMP Template):

1. Review Column 1 and identify which of these potential sources of stormwater pollutants apply to your site. Check each box that applies.
2. Review Column 2 and incorporate all of the corresponding applicable BMPs in your WQMP Exhibit.
3. Review Columns 3 and 4 and incorporate all of the corresponding applicable permanent controls and operational BMPs in your WQMP. Use the format shown in Table G.1on page 23 of this WQMP Template. Describe your specific BMPs in an accompanying narrative, and explain any special conditions or situations that required omitting BMPs or substituting alternative BMPs for those shown here.

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
X A. **On-site storm drain inlets**	X **Locations of inlets.**	X **Mark all inlets with the words "Only Rain Down the Storm Drain" or similar. Catch Basin Markers may be available from the Riverside County Flood Control and Water Conservation District, call 951.955.1200 to verify.**	X **Maintain and periodically repaint or replace inlet markings.** X **Provide stormwater pollution prevention information to new site owners, lessees, or operators.** X **See applicable operational BMPs in Fact Sheet SC-44, "Drainage System Maintenance," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com** X **Include the following in lease agreements: "Tenant shall not allow anyone to discharge anything to storm drains or to store or deposit materials so as to create a potential discharge to storm drains."**
X B. **Interior floor drains and elevator shaft sump pumps**		X **State that interior floor drains and elevator shaft sump pumps will be plumbed to sanitary sewer.**	X **Inspect and maintain drains to prevent blockages and overflow.**
❑ C. **Interior parking garages**		❑ **State that parking garage floor drains will be plumbed to the sanitary sewer.**	❑ **Inspect and maintain drains to prevent blockages and overflow.**

IF THESE SOURCES WILL BE ON THE PROJECT SITE …	… THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ D1. **Need for future indoor & structural pest control**		❑ **Note building design features that discourage entry of pests.**	❑ **Provide Integrated Pest Management information to owners, lessees, and operators.**
X D2. **Landscape/ Outdoor Pesticide Use**	❑ **Show locations of native trees or areas of shrubs and ground cover to be undisturbed and retained.** ❑ **Show self-retaining landscape areas, if any.** X **Show stormwater treatment and hydrograph modification management BMPs. (See instructions in Chapter 3, Step 5 and guidance in Chapter 5.)**	**State that final landscape plans will accomplish all of the following.** X **Preserve existing native trees, shrubs, and ground cover to the maximum extent possible.** ❑ **Design landscaping to minimize irrigation and runoff, to promote surface infiltration where appropriate, and to minimize the use of fertilizers and pesticides that can contribute to stormwater pollution.** X **Where landscaped areas are used to retain or detain stormwater, specify plants that are tolerant of saturated soil conditions.** ❑ ❑ **Consider using pest-resistant plants, especially adjacent to hardscape.** X **To insure successful establishment, select plants appropriate to site soils, slopes, climate, sun, wind, rain, land use, air movement, ecological consistency, and plant interactions.**	X **Maintain landscaping using minimum or no pesticides.** X **See applicable operational BMPs in "What you should know for…..Landscape and Gardening"** at http://rcflood.org/stormwater/**Error! Hyperlink reference not valid.** ❑ **Provide IPM information to new owners, lessees and operators.**

IF THESE SOURCES WILL BE ON THE PROJECT SITE …	… THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ E. **Pools, spas, ponds, decorative fountains, and other water features.**	❑ **Show location of water feature and a sanitary sewer cleanout in an accessible area within 10 feet. (Exception: Public pools must be plumbed according to County Department of Environmental Health Guidelines.)**	**If the Co-Permittee requires pools to be plumbed to the sanitary sewer, place a note on the plans and state in the narrative that this connection will be made according to local requirements.**	❑ **See applicable operational BMPs in** "Guidelines for Maintaining Your Swimming Pool, Jacuzzi and Garden Fountain" at http://rcflood.org/stormwater/
❑ F. **Food service**	❑ **For restaurants, grocery stores, and other food service operations, show location (indoors or in a covered area outdoors) of a floor sink or other area for cleaning floor mats, containers, and equipment.** ❑ **On the drawing, show a note that this drain will be connected to a grease interceptor before discharging to the sanitary sewer.**	❑ **Describe the location and features of the designated cleaning area.** ❑ **Describe the items to be cleaned in this facility and how it has been sized to insure that the largest items can be accommodated.**	❑ **See the brochure, "**The Food Service Industry Best Management Practices for: Restaurants, Grocery Stores, Delicatessens and Bakeries" at http://rcflood.org/stormwater/ **Provide this brochure to new site owners, lessees, and operators.**
X G. **Refuse areas**	X **Show where site refuse and recycled materials will be handled and stored for pickup. See local municipal requirements for sizes and other details of refuse areas.** ❑ **If dumpsters or other receptacles are outdoors, show how the designated area will be covered, graded, and paved to prevent run-on and show locations of berms to prevent runoff from the area.** ❑ **Any drains from dumpsters, compactors, and tallow bin areas shall be connected to a grease removal device before discharge to sanitary sewer.**	❑ **State how site refuse will be handled and provide supporting detail to what is shown on plans.** X **State that signs will be posted on or near dumpsters with the words "Do not dump hazardous materials here" or similar.**	X **State how the following will be implemented:** **Provide adequate number of receptacles. Inspect receptacles regularly; repair or replace leaky receptacles. Keep receptacles covered. Prohibit/prevent dumping of liquid or hazardous wastes. Post "no hazardous materials" signs. Inspect and pick up litter daily and clean up spills immediately. Keep spill control materials available on-site. See Fact Sheet SC-34, "Waste Handling and Disposal" in the CASQA Stormwater Quality Handbooks at** **www.cabmphandbooks.com**

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ H. **Industrial processes.**	❑ **Show process area.**	❑ **If industrial processes are to be located on site, state: "All process activities to be performed indoors. No processes to drain to exterior or to storm drain system."**	❑ **See Fact Sheet SC-10, "Non-Stormwater Discharges" in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com** See the brochure "Industrial & Commercial Facilities Best Management Practices for: Industrial, Commercial Facilities" at http://rcflood.org/stormwater/

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ I. **Outdoor storage of equipment or materials. (See rows J and K for source control measures for vehicle cleaning, repair, and maintenance.)**	❑ **Show any outdoor storage areas, including how materials will be covered. Show how areas will be graded and bermed to prevent run-on or run-off from area.** ❑ **Storage of non-hazardous liquids shall be covered by a roof and/or drain to the sanitary sewer system, and be contained by berms, dikes, liners, or vaults.** ❑ **Storage of hazardous materials and wastes must be in compliance with the local hazardous materials ordinance and a Hazardous Materials Management Plan for the site.**	**Include a detailed description of materials to be stored, storage areas, and structural features to prevent pollutants from entering storm drains.** **Where appropriate, reference documentation of compliance with the requirements of Hazardous Materials Programs for:** ▪ **Hazardous Waste Generation** ▪ **Hazardous Materials Release Response and Inventory** ▪ **California Accidental Release (CalARP)** ▪ **Aboveground Storage Tank** ▪ **Uniform Fire Code Article 80 Section 103(b) & (c) 1991** ▪ **Underground Storage Tank** **www.cchealth.org/groups/hazmat/**	❑ **See the Fact Sheets SC-31, "Outdoor Liquid Container Storage" and SC-33, "Outdoor Storage of Raw Materials " in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com**

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ J. **Vehicle and Equipment Cleaning**	❑ **Show on drawings as appropriate:** **(1) Commercial/industrial facilities having vehicle/equipment cleaning needs shall either provide a covered, bermed area for washing activities or discourage vehicle/equipment washing by removing hose bibs and installing signs prohibiting such uses.** **(2) Multi-dwelling complexes shall have a paved, bermed, and covered car wash area (unless car washing is prohibited on-site and hoses are provided with an automatic shut-off to discourage such use).** **(3) Washing areas for cars, vehicles, and equipment shall be paved, designed to prevent run-on to or runoff from the area, and plumbed to drain to the sanitary sewer.** **(4) Commercial car wash facilities shall be designed such that no runoff from the facility is discharged to the storm drain system. Wastewater from the facility shall discharge to the sanitary sewer, or a wastewater reclamation system shall be installed.**	❑ **If a car wash area is not provided, describe any measures taken to discourage on-site car washing and explain how these will be enforced.**	**Describe operational measures to implement the following (if applicable):** ❑ **Washwater from vehicle and equipment washing operations shall not be discharged to the storm drain system.** Refer to "Outdoor Cleaning Activities and Professional Mobile Service Providers" for many of the Potential Sources of Runoff Pollutants categories below. Brochure can be found at http://rcflood.org/stormwater/ ❑**Car dealerships and similar may rinse cars with water only.**

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ K. **Vehicle/Equipment Repair and Maintenance**	❑ **Accommodate all vehicle equipment repair and maintenance indoors. Or designate an outdoor work area and design the area to prevent run-on and runoff of stormwater.** ❑ **Show secondary containment for exterior work areas where motor oil, brake fluid, gasoline, diesel fuel, radiator fluid, acid-containing batteries or other hazardous materials or hazardous wastes are used or stored. Drains shall not be installed within the secondary containment areas.** ❑ **Add a note on the plans that states either (1) there are no floor drains, or (2) floor drains are connected to wastewater pretreatment systems prior to discharge to the sanitary sewer and an industrial waste discharge permit will be obtained.**	❑ **State that no vehicle repair or maintenance will be done outdoors, or else describe the required features of the outdoor work area.** ❑ **State that there are no floor drains or if there are floor drains, note the agency from which an industrial waste discharge permit will be obtained and that the design meets that agency's requirements.** ❑ **State that there are no tanks, containers or sinks to be used for parts cleaning or rinsing or, if there are, note the agency from which an industrial waste discharge permit will be obtained and that the design meets that agency's requirements.**	**In the Stormwater Control Plan, note that all of the following restrictions apply to use the site:** ❑ **No person shall dispose of, nor permit the disposal, directly or indirectly of vehicle fluids, hazardous materials, or rinsewater from parts cleaning into storm drains.** ❑ **No vehicle fluid removal shall be performed outside a building, nor on asphalt or ground surfaces, whether inside or outside a building, except in such a manner as to ensure that any spilled fluid will be in an area of secondary containment. Leaking vehicle fluids shall be contained or drained from the vehicle immediately.** ❑ **No person shall leave unattended drip parts or other open containers containing vehicle fluid, unless such containers are in use or in an area of secondary containment.** Refer to "Automotive Maintenance & Car Care Best Management Practices for Auto Body Shops, Auto Repair Shops, Car Dealerships, Gas Stations and Fleet Service Operations". Brochure can be found at http://rcflood.org/stormwater/ Refer to Outdoor Cleaning Activities and Professional Mobile Service Providers for many of the Potential Sources of Runoff Pollutants categories below. Brochure can be found at http://rcflood.org/stormwater/

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ L. **Fuel Dispensing Areas**	❑ **Fueling areas[6] shall have impermeable floors (i.e., portland cement concrete or equivalent smooth impervious surface) that are: a) graded at the minimum slope necessary to prevent ponding; and b) separated from the rest of the site by a grade break that prevents run-on of stormwater to the maximum extent practicable.** ❑ **Fueling areas shall be covered by a canopy that extends a minimum of ten feet in each direction from each pump. [Alternative: The fueling area must be covered and the cover's minimum dimensions must be equal to or greater than the area within the grade break or fuel dispensing area[1].] The canopy [or cover] shall not drain onto the fueling area.**		❑ **The property owner shall dry sweep the fueling area routinely.** ❑ **See the Fact Sheet SD-30 , "Fueling Areas" in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com**

[6] **The fueling area shall be defined as the area extending a minimum of 6.5 feet from the corner of each fuel dispenser or the length at which the hose and nozzle assembly may be operated plus a minimum of one foot, whichever is greater.**

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ M. **Loading Docks**	❑ **Show a preliminary design for the loading dock area, including roofing and drainage. Loading docks shall be covered and/or graded to minimize run-on to and runoff from the loading area. Roof downspouts shall be positioned to direct stormwater away from the loading area. Water from loading dock areas shall be drained to the sanitary sewer, or diverted and collected for ultimate discharge to the sanitary sewer.** ❑ **Loading dock areas draining directly to the sanitary sewer shall be equipped with a spill control valve or equivalent device, which shall be kept closed during periods of operation.** ❑ **Provide a roof overhang over the loading area or install door skirts (cowling) at each bay that enclose the end of the trailer.**		❑ **Move loaded and unloaded items indoors as soon as possible.** ❑ **See Fact Sheet SC-30, "Outdoor Loading and Unloading," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com**

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
X N. **Fire Sprinkler Test Water**		X **Provide a means to drain fire sprinkler test water to the sanitary sewer.**	X **See the note in Fact Sheet SC-41, "Building and Grounds Maintenance," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com**
O. **Miscellaneous Drain or Wash Water or Other Sources** ❑ **Boiler drain lines** ❑ **Condensate drain lines** ❑ **Rooftop equipment** ❑ **Drainage sumps** X **Roofing, gutters, and trim.** ❑ **Other sources**		❑ **Boiler drain lines shall be directly or indirectly connected to the sanitary sewer system and may not discharge to the storm drain system.** ❑ **Condensate drain lines may discharge to landscaped areas if the flow is small enough that runoff will not occur. Condensate drain lines may not discharge to the storm drain system.** ❑ **Rooftop equipment with potential to produce pollutants shall be roofed and/or have secondary containment.** ❑ **Any drainage sumps on-site shall feature a sediment sump to reduce the quantity of sediment in pumped water.** ❑ **Include controls for other sources as specified by local reviewer.** X **Avoid roofing, gutters, and trim made of copper or other unprotected metals that may leach into runoff.**	

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

IF THESE SOURCES WILL BE ON THE PROJECT SITE …	… THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
X P. **Plazas, sidewalks, and parking lots.**			X **Sweep plazas, sidewalks, and parking lots regularly to prevent accumulation of litter and debris. Collect debris from pressure washing to prevent entry into the storm drain system. Collect washwater containing any cleaning agent or degreaser and discharge to the sanitary sewer not to a storm drain.**

Appendix 9: O&M

Operation and Maintenance Plan and Documentation of Finance, Maintenance and Recording Mechanisms

Appendix 10: Educational Materials

BMP Fact Sheets, Maintenance Guidelines and Other End-User BMP Information

Building & Grounds Maintenance SC-41

Description

Stormwater runoff from building and grounds maintenance activities can be contaminated with toxic hydrocarbons in solvents, fertilizers and pesticides, suspended solids, heavy metals, abnormal pH, and oils and greases. Utilizing the protocols in this fact sheet will prevent or reduce the discharge of pollutants to stormwater from building and grounds maintenance activities by washing and cleaning up with as little water as possible, following good landscape management practices, preventing and cleaning up spills immediately, keeping debris from entering the storm drains, and maintaining the stormwater collection system.

Approach

Reduce potential for pollutant discharge through source control pollution prevention and BMP implementation. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives.

General Pollution Prevention Protocols

- ☐ Switch to non-toxic chemicals for maintenance to the maximum extent possible.
- ☐ Choose cleaning agents that can be recycled.
- ☐ Encourage proper lawn management and landscaping, including use of native vegetation.
- ☐ Encourage use of Integrated Pest Management techniques for pest control.
- ☐ Encourage proper onsite recycling of yard trimmings.
- ☐ Recycle residual paints, solvents, lumber, and other material as much as possible.

Objectives

- *Cover*
- *Contain*
- *Educate*
- *Reduce/Minimize*
- *Product Substitution*

Targeted Constituents	
Sediment	✓
Nutrients	✓
Trash	
Metals	✓
Bacteria	✓
Oil and Grease	
Organics	

Minimum BMPs Covered	
Good Housekeeping	✓
Preventative Maintenance	
Spill and Leak Prevention and Response	✓
Material Handling & Waste Management	✓
Erosion and Sediment Controls	
Employee Training Program	✓
Quality Assurance Record Keeping	✓

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- ☐ Clean work areas at the end of each work shift using dry cleaning methods such as sweeping and vacuuming.

Good Housekeeping

Pressure Washing of Buildings, Rooftops, and Other Large Objects

- ☐ In situations where soaps or detergents are used and the surrounding area is paved, pressure washers must use a water collection device that enables collection of wash water and associated solids. A sump pump, wet vacuum or similarly effective device must be used to collect the runoff and loose materials. The collected runoff and solids must be disposed of properly.

- ☐ If soaps or detergents are not used, and the surrounding area is paved, wash runoff does not have to be collected but must be screened. Pressure washers must use filter fabric or some other type of screen on the ground and/or in the catch basin to trap the particles in wash water runoff.

- ☐ If you are pressure washing on a grassed area (with or without soap), runoff must be dispersed as sheet flow as much as possible, rather than as a concentrated stream. The wash runoff must remain on the grass and not drain to pavement.

Landscaping Activities

- ☐ Dispose of grass clippings, leaves, sticks, or other collected vegetation as garbage, or by composting. Do not dispose of collected vegetation into waterways or storm drainage systems.

- ☐ Use mulch or other erosion control measures on exposed soils. See also SC-40, Contaminated and Erodible Areas, for more information.

Building Repair, Remodeling, and Construction

- ☐ Do not dump any toxic substance or liquid waste on the pavement, the ground, or toward a storm drain.

- ☐ Use ground or drop cloths underneath outdoor painting, scraping, and sandblasting work, and properly dispose of collected material daily.

- ☐ Use a ground cloth or oversized tub for activities such as paint mixing and tool cleaning.

- ☐ Clean paintbrushes and tools covered with water-based paints in sinks connected to sanitary sewers or in portable containers that can be dumped into a sanitary sewer drain. Brushes and tools covered with non-water-based paints, finishes, or other materials must be cleaned in a manner that enables collection of used solvents (e.g., paint thinner, turpentine, etc.) for recycling or proper disposal.

- ☐ Use a storm drain cover, filter fabric, or similarly effective runoff control mechanism if dust, grit, wash water, or other pollutants may escape the work area and enter a catch basin. This is particularly necessary on rainy days. The containment device(s) must be in place at the beginning of the work day, and accumulated dirty runoff and solids must be collected and disposed of before removing the containment device(s) at the end of the work day.

- ☐ If you need to de-water an excavation site, you may need to filter the water before discharging to a catch basin or off-site. If directed off-site, you should direct the water through hay bales and filter fabric or use other sediment filters or traps.

- ☐ Store toxic material under cover during precipitation events and when not in use. A cover would include tarps or other temporary cover material.

Mowing, Trimming, and Planting

- ☐ Dispose of leaves, sticks, or other collected vegetation as garbage, by composting or at a permitted landfill. Do not dispose of collected vegetation into waterways or storm drainage systems.

- ☐ Use mulch or other erosion control measures when soils are exposed.

- ☐ Place temporarily stockpiled material away from watercourses and drain inlets, and berm or cover stockpiles to prevent material releases to the storm drain system.

- ☐ Consider an alternative approach when bailing out muddy water: do not put it in the storm drain; pour over landscaped areas.

- ☐ Use hand weeding where practical.

Fertilizer and Pesticide Management

- ☐ Do not use pesticides if rain is expected.

- ☐ Do not mix or prepare pesticides for application near storm drains.

- ☐ Use the minimum amount needed for the job.

- ☐ Calibrate fertilizer distributors to avoid excessive application.

- ☐ Employ techniques to minimize off-target application (e.g., spray drift) of pesticides, including consideration of alternative application techniques.

- ☐ Apply pesticides only when wind speeds are low.

- ☐ Fertilizers should be worked into the soil rather than dumped or broadcast onto the surface.

- ☐ Irrigate slowly to prevent runoff and then only as much as is needed.

- ☐ Clean pavement and sidewalk if fertilizer is spilled on these surfaces before applying irrigation water.

Inspection

- ☐ Inspect irrigation system periodically to ensure that the right amount of water is being applied and that excessive runoff is not occurring. Minimize excess watering and repair leaks in the irrigation system as soon as they are observed.

Spill Response and Prevention Procedures

- ☐ Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- ☐ Place a stockpile of spill cleanup materials, such as brooms, dustpans, and vacuum sweepers (if desired) near the storage area where it will be readily accessible.
- ☐ Have employees trained in spill containment and cleanup present during the loading/unloading of dangerous wastes, liquid chemicals, or other materials.
- ☐ Familiarize employees with the Spill Prevention Control and Countermeasure Plan.
- ☐ Clean up spills immediately.

Material Handling and Waste Management

- ☐ Follow all federal, state, and local laws and regulations governing the use, storage, and disposal of fertilizers and pesticides and training of applicators and pest control advisors.
- ☐ Use less toxic pesticides that will do the job when applicable. Avoid use of copper-based pesticides if possible.
- ☐ Dispose of empty pesticide containers according to the instructions on the container label.
- ☐ Use up the pesticides. Rinse containers, and use rinse water as product. Dispose of unused pesticide as hazardous waste.
- ☐ Implement storage requirements for pesticide products with guidance from the local fire department and County Agricultural Commissioner. Provide secondary containment for pesticides.

Employee Training Program

- ☐ Educate and train employees on pesticide use and in pesticide application techniques to prevent pollution.
- ☐ Train employees and contractors in proper techniques for spill containment and cleanup.
- ☐ Be sure the frequency of training takes into account the complexity of the operations and the needs of individual staff.

Quality Assurance and Record Keeping

- ☐ Keep accurate logs that document maintenance activities performed and minimum BMP measures implemented.
- ☐ Keep accurate logs of spill response actions that document what was spilled, how it was cleaned up, and how the waste was disposed.
- ☐ Establish procedures to complete logs and file them in the central office.

Potential Capital Facility Costs and Operation & Maintenance Requirements

Facilities

- Additional capital costs are not anticipated for building and grounds maintenance. Implementation of the minimum BMPs described above should be conducted as part of regular site operations.

Maintenance

- Maintenance activities for the BMPs described above will be minimal, and no additional cost is anticipated.

Supplemental Information

Fire Sprinkler Line Flushing

Site fire sprinkler line flushing may be a source of non-stormwater runoff pollution. The water entering the system is usually potable water, though in some areas it may be non-potable reclaimed wastewater. There are subsequent factors that may drastically reduce the quality of the water in such systems. Black iron pipe is usually used since it is cheaper than potable piping, but it is subject to rusting and results in lower quality water. Initially, the black iron pipe has an oil coating to protect it from rusting between manufacture and installation; this will contaminate the water from the first flush but not from subsequent flushes. Nitrates, poly-phosphates and other corrosion inhibitors, as well as fire suppressants and antifreeze may be added to the sprinkler water system. Water generally remains in the sprinkler system a long time (typically a year) and between flushes may accumulate iron, manganese, lead, copper, nickel, and zinc. The water generally becomes anoxic and contains living and dead bacteria and breakdown products from chlorination. This may result in a significant BOD problem and the water often smells. Consequently dispose fire sprinkler line flush water into the sanitary sewer. Do not allow discharge to storm drain or infiltration due to potential high levels of pollutants in fire sprinkler line water.

References and Resources

City of Seattle, Seattle Public Utilities Department of Planning and Development, 2009. *Stormwater Manual Vol. 1 Source Control Technical Requirements Manual.*

Kennedy/Jenks Consultants, 2007. *The Truckee Meadows Industrial and Commercial Storm Water Best Management Practices Handbook.* Available online at: http://www.cityofsparks.us/sites/default/files/assets/documents/env-control/construction/TM-I-C_BMP_Handbook_2-07-final.pdf.

Orange County Stormwater Program, Best Management Practices for Industrial/Commercial Business Activities. Available online at: http://ocwatersheds.com/documents/bmp/industrialcommercialbusinessesactivities.

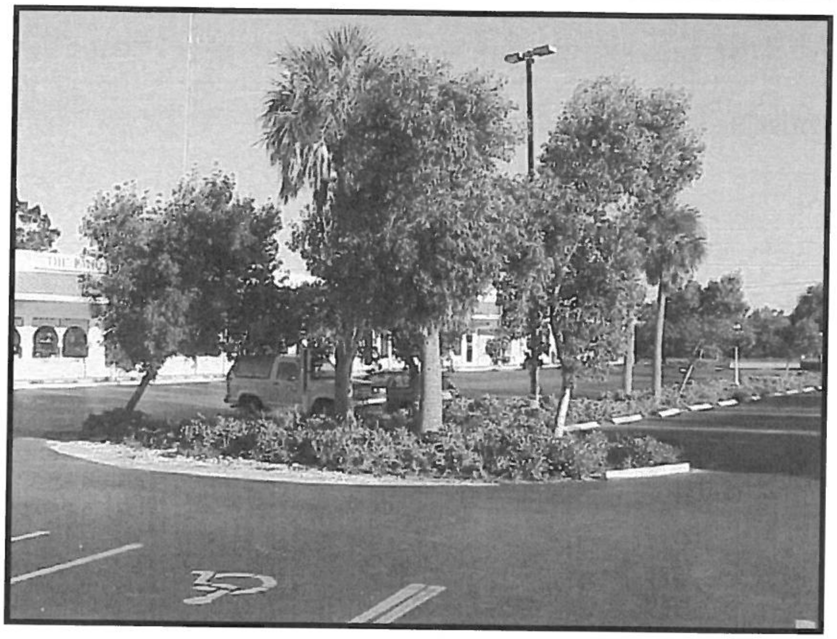
Sacramento Stormwater Management Program. *Best Management Practices for Industrial Storm Water Pollution Control.* Available online at:

http://www.msa.saccounty.net/sactostormwater/documents/guides/industrial-BMP-manual.pdf.

US EPA, 1997. *Best Management Practices Handbook for Hazardous Waste Containers*. Available online at: http://www.epa.gov/region6/6en/h/handbk4.pdf.

Ventura Countywide Stormwater Management Program Clean Business Fact Sheets. Available online at: http://www.vcstormwater.org/documents/programs_business/building.pdf.

Parking/Storage Area Maintenance SC-43



Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

Sediment	✓
Nutrients	✓
Trash	✓
Metals	✓
Bacteria	✓
Oil and Grease	✓
Organics	✓
Oxygen Demanding	✓

CASQA California Stormwater Quality Association

Description

Parking lots and storage areas can contribute a number of substances, such as trash, suspended solids, hydrocarbons, oil and grease, and heavy metals that can enter receiving waters through stormwater runoff or non-stormwater discharges. The following protocols are intended to prevent or reduce the discharge of pollutants from parking/storage areas and include using good housekeeping practices, following appropriate cleaning BMPs, and training employees.

Approach

Pollution Prevention

- Encourage alternative designs and maintenance strategies for impervious parking lots. (See New Development and Redevelopment BMP Handbook).
- Keep accurate maintenance logs to evaluate BMP implementation.

Suggested Protocols

General

- Keep the parking and storage areas clean and orderly. Remove debris in a timely fashion.
- Allow sheet runoff to flow into biofilters (vegetated strip and swale) and/or infiltration devices.
- Utilize sand filters or oleophilic collectors for oily waste in low concentrations.

- Arrange rooftop drains to prevent drainage directly onto paved surfaces.
- Design lot to include semi-permeable hardscape.

Controlling Litter

- Post "No Littering" signs and enforce anti-litter laws.
- Provide an adequate number of litter receptacles.
- Clean out and cover litter receptacles frequently to prevent spillage.
- Provide trash receptacles in parking lots to discourage litter.
- Routinely sweep, shovel and dispose of litter in the trash.

Surface cleaning

- Use dry cleaning methods (e.g. sweeping or vacuuming) to prevent the discharge of pollutants into the stormwater conveyance system.
- Establish frequency of public parking lot sweeping based on usage and field observations of waste accumulation.
- Sweep all parking lots at least once before the onset of the wet season.
- If water is used follow the procedures below:
  - Block the storm drain or contain runoff.
  - Wash water should be collected and pumped to the sanitary sewer or discharged to a pervious surface, do not allow wash water to enter storm drains.
  - Dispose of parking lot sweeping debris and dirt at a landfill.
- When cleaning heavy oily deposits:
  - Use absorbent materials on oily spots prior to sweeping or washing.
  - Dispose of used absorbents appropriately.

Surface Repair

- Pre-heat, transfer or load hot bituminous material away from storm drain inlets.
- Apply concrete, asphalt, and seal coat during dry weather to prevent contamination form contacting stormwater runoff.
- Cover and seal nearby storm drain inlets (with waterproof material or mesh) and manholes before applying seal coat, slurry seal, etc., where applicable. Leave covers in place until job is complete and until all water from emulsified oil sealants has drained or evaporated. Clean any debris from these covered manholes and drains for proper disposal.

- Use only as much water as necessary for dust control, to avoid runoff.
- Catch drips from paving equipment that is not in use with pans or absorbent material placed under the machines. Dispose of collected material and absorbents properly.

Inspection

- Have designated personnel conduct inspections of the parking facilities and stormwater conveyance systems associated with them on a regular basis.
- Inspect cleaning equipment/sweepers for leaks on a regular basis.

Training

- Provide regular training to field employees and/or contractors regarding cleaning of paved areas and proper operation of equipment.
- Train employees and contractors in proper techniques for spill containment and cleanup.

Spill Response and Prevention

- Refer to SC-11, Spill Prevention, Control & Cleanup.
- Keep your Spill Prevention Control and countermeasure (SPCC) plan up-to-date, nad implement accordingly.
- Have spill cleanup materials readily available and in a known location.
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.

Other Considerations

- Limitations related to sweeping activities at large parking facilities may include high equipment costs, the need for sweeper operator training, and the inability of current sweeper technology to remove oil and grease.

Requirements

Costs

Cleaning/sweeping costs can be quite large, construction and maintenance of stormwater structural controls can be quite expensive as well.

Maintenance

- Sweep parking lot to minimize cleaning with water.
- Clean out oil/water/sand separators regularly, especially after heavy storms.
- Clean parking facilities on a regular basis to prevent accumulated wastes and pollutants from being discharged into conveyance systems during rainy conditions.

Supplemental Information

Further Detail of the BMP

Surface Repair

Apply concrete, asphalt, and seal coat during dry weather to prevent contamination form contacting stormwater runoff. Where applicable, cover and seal nearby storm drain inlets (with waterproof material or mesh) and manholes before applying seal coat, slurry seal, etc. Leave covers in place until job is complete and until all water from emulsified oil sealants has drained or evaporated. Clean any debris from these covered manholes and drains for proper disposal. Use only as much water as necessary for dust control, to avoid runoff.

References and Resources

http://www.stormwatercenter.net/

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Model Urban Runoff Program: A How-To Guide for Developing Urban Runoff Programs for Small Municipalities. Prepared by City of Monterey, City of Santa Cruz, California Coastal Commission, Monterey Bay National Marine Sanctuary, Association of Monterey Bay Area Governments, Woodward-Clyde, Central Coast Regional Water Quality control Board. July 1998 (Revised February 2002 by the California Coastal Commission).

Orange County Stormwater Program
http://www.ocwatersheds.com/StormWater/swp_introduction.asp

Oregon Association of Clean Water Agencies. Oregon Municipal Stormwater Toolbox for Maintenance Practices. June 1998.

Pollution from Surface Cleaning Folder. 1996. Bay Area Stormwater Management Agencies Association (BASMAA) http://www.basma.org

San Diego Stormwater Co-permittees Jurisdictional Urban Runoff Management Program (URMP)
http://www.projectcleanwater.org/pdf/Model%20Program%20Municipal%20Facilities.pdf

Description

Promote efficient and safe housekeeping practices (storage, use, and cleanup) when handling potentially harmful materials such as fertilizers, pesticides, cleaning solutions, paint products, automotive products, and swimming pool chemicals. Related information is provided in BMP fact sheets SC-11 Spill Prevention, Control & Cleanup and SC-34 Waste Handling & Disposal.

Approach

Pollution Prevention

- Purchase only the amount of material that will be needed for foreseeable use. In most cases this will result in cost savings in both purchasing and disposal. See SC-61 Safer Alternative Products for additional information.

- Be aware of new products that may do the same job with less environmental risk and for less or the equivalent cost. Total cost must be used here; this includes purchase price, transportation costs, storage costs, use related costs, clean up costs and disposal costs.

Suggested Protocols

General

- Keep work sites clean and orderly. Remove debris in a timely fashion. Sweep the area.

- Dispose of wash water, sweepings, and sediments, properly.

- Recycle or dispose of fluids properly.

- Establish a daily checklist of office, yard and plant areas to confirm cleanliness and adherence to proper storage and security. Specific employees should be assigned specific inspection responsibilities and given the authority to remedy any problems found.

- Post waste disposal charts in appropriate locations detailing for each waste its hazardous nature (poison, corrosive, flammable), prohibitions on its disposal (dumpster, drain, sewer) and the recommended disposal method (recycle, sewer, burn, storage, landfill).

- Summarize the chosen BMPs applicable to your operation and post them in appropriate conspicuous places.

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

Sediment	☑
Nutrients	☑
Trash	☑
Metals	☑
Bacteria	☑
Oil and Grease	☑
Organics	☑
Oxygen Demanding	☑

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- Require a signed checklist from every user of any hazardous material detailing amount taken, amount used, amount returned and disposal of spent material.
- Do a before audit of your site to establish baseline conditions and regular subsequent audits to note any changes and whether conditions are improving or deteriorating.
- Keep records of water, air and solid waste quantities and quality tests and their disposition.
- Maintain a mass balance of incoming, outgoing and on hand materials so you know when there are unknown losses that need to be tracked down and accounted for.
- Use and reward employee suggestions related to BMPs, hazards, pollution reduction, work place safety, cost reduction, alternative materials and procedures, recycling and disposal.
- Have, and review regularly, a contingency plan for spills, leaks, weather extremes etc. Make sure all employees know about it and what their role is so that it comes into force automatically.

Training

- Train all employees, management, office, yard, manufacturing, field and clerical in BMPs and pollution prevention and make them accountable.
- Train municipal employees who handle potentially harmful materials in good housekeeping practices.
- Train personnel who use pesticides in the proper use of the pesticides. The California Department of Pesticide Regulation license pesticide dealers, certify pesticide applicators and conduct onsite inspections.
- Train employees and contractors in proper techniques for spill containment and cleanup. The employee should have the tools and knowledge to immediately begin cleaning up a spill if one should occur.

Spill Response and Prevention

- Refer to SC-11, Spill Prevention, Control & Cleanup.
- Keep your Spill Prevention Control and Countermeasure (SPCC) plant up-to-date, and implement accordingly.
- Have spill cleanup materials readily available and in a known location.
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.

Other Considerations

- There are no major limitations to this best management practice.
- There are no regulatory requirements to this BMP. Existing regulations already require municipalities to properly store, use, and dispose of hazardous materials

Requirements

Costs

- Minimal cost associated with this BMP. Implementation of good housekeeping practices may result in cost savings as these procedures may reduce the need for more costly BMPs.

Maintenance

- Ongoing maintenance required to keep a clean site. Level of effort is a function of site size and type of activities.

Supplemental Information

Further Detail of the BMP

- The California Integrated Waste Management Board's Recycling Hotline, 1-800-553-2962, provides information on household hazardous waste collection programs and facilities.

Examples

There are a number of communities with effective programs. The most pro-active include Santa Clara County and the City of Palo Alto, the City and County of San Francisco, and the Municipality of Metropolitan Seattle (Metro).

References and Resources

British Columbia Lake Stewardship Society. Best Management Practices to Protect Water Quality from Non-Point Source Pollution. March 2000. http://www.nalms.org/bclss/bmphome.html#bmp

King County Stormwater Pollution Control Manual - http://dnr.metrokc.gov/wlr/dss/spcm.htm

Model Urban Runoff Program: A How-To Guide for Developing Urban Runoff Programs for Small Municipalities, Prepared by City of Monterey, City of Santa Cruz, California Coastal Commission, Monterey Bay National Marine Sanctuary, Association of Monterey Bay Area Governments, Woodward-Clyde, Central Coast Regional Water Quality Control Board. July, 1998, Revised by California Coastal Commission, February 2002.

Orange County Stormwater Program http://www.ocwatersheds.com/stormwater/swp_introduction.asp

San Mateo STOPPP - (http://stoppp.tripod.com/bmp.html)

Road and Street Maintenance SC-70

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

Sediment	☑
Nutrients	
Trash	☑
Metals	☑
Bacteria	
Oil and Grease	☑
Organics	☑
Oxygen Demanding	☑

Description

Streets, roads, and highways are significant sources of pollutants in stormwater discharges, and operation and maintenance (O&M) practices, if not conducted properly, can contribute to the problem. Stormwater pollution from roadway and bridge maintenance should be addressed on a site-specific basis. Use of the procedures outlined below, that address street sweeping and repair, bridge and structure maintenance, and unpaved roads will reduce pollutants in stormwater.

Approach

Pollution Prevention

- Use the least toxic materials available (e.g. water based paints, gels or sprays for graffiti removal)
- Recycle paint and other materials whenever possible.
- Enlist the help of citizens to keep yard waste, used oil, and other wastes out of the gutter.

Suggested Protocols

Street Sweeping and Cleaning

- Maintain a consistent sweeping schedule. Provide minimum monthly sweeping of curbed streets.
- Perform street cleaning during dry weather if possible.

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- Avoid wet cleaning or flushing of street, and utilize dry methods where possible.
- Consider increasing sweeping frequency based on factors such as traffic volume, land use, field observations of sediment and trash accumulation, proximity to water courses, etc. For example:
  - Increase the sweeping frequency for streets with high pollutant loadings, especially in high traffic and industrial areas.
  - Increase the sweeping frequency just before the wet season to remove sediments accumulated during the summer.
  - Increase the sweeping frequency for streets in special problem areas such as special events, high litter or erosion zones.
- Maintain cleaning equipment in good working condition and purchase replacement equipment as needed. Old sweepers should be replaced with new technologically advanced sweepers (preferably regenerative air sweepers) that maximize pollutant removal.
- Operate sweepers at manufacturer requested optimal speed levels to increase effectiveness.
- To increase sweeping effectiveness consider the following:
  - Institute a parking policy to restrict parking in problematic areas during periods of street sweeping.
  - Post permanent street sweeping signs in problematic areas; use temporary signs if installation of permanent signs is not possible.
  - Develop and distribute flyers notifying residents of street sweeping schedules.
- Regularly inspect vehicles and equipment for leaks, and repair immediately.
- If available use vacuum or regenerative air sweepers in the high sediment and trash areas (typically industrial/commercial).
- Keep accurate logs of the number of curb-miles swept and the amount of waste collected.
- Dispose of street sweeping debris and dirt at a landfill.
- Do not store swept material along the side of the street or near a storm drain inlet.
- Keep debris storage to a minimum during the wet season or make sure debris piles are contained (e.g. by berming the area) or covered (e.g. with tarps or permanent covers).

Street Repair and Maintenance

Pavement marking

- Schedule pavement marking activities for dry weather.

- Develop paint handling procedures for proper use, storage, and disposal of paints.
- Transfer and load paint and hot thermoplastic away from storm drain inlets.
- Provide drop cloths and drip pans in paint mixing areas.
- Properly maintain application equipment.
- Street sweep thermoplastic grindings. Yellow thermoplastic grindings may require special handling as they may contain lead.
- Paints containing lead or tributyltin are considered a hazardous waste and must be disposed of properly.
- Use water based paints whenever possible. If using water based paints, clean the application equipment in a sink that is connected to the sanitary sewer.
- Properly store leftover paints if they are to be kept for the next job, or dispose of properly.

Concrete installation and repair

- Schedule asphalt and concrete activities for dry weather.
- Take measures to protect any nearby storm drain inlets and adjacent watercourses, prior to breaking up asphalt or concrete (e.g. place san bags around inlets or work areas).
- Limit the amount of fresh concrete or cement mortar mixed, mix only what is needed for the job.
- Store concrete materials under cover, away from drainage areas. Secure bags of cement after they are open. Be sure to keep wind-blown cement powder away from streets, gutters, storm drains, rainfall, and runoff.
- Return leftover materials to the transit mixer. Dispose of small amounts of hardened excess concrete, grout, and mortar in the trash.
- Do not wash sweepings from exposed aggregate concrete into the street or storm drain. Collect and return sweepings to aggregate base stockpile, or dispose in the trash.
- When making saw cuts in pavement, use as little water as possible and perform during dry weather. Cover each storm drain inlet completely with filter fabric or plastic during the sawing operation and contain the slurry by placing straw bales, sandbags, or gravel dams around the inlets. After the liquid drains or evaporates, shovel or vacuum the slurry residue from the pavement or gutter and remove from site. Alternatively, a small onsite vacuum may be used to pick up the slurry as this will prohibit slurry from reaching storm drain inlets.
- Wash concrete trucks off site or in designated areas on site designed to preclude discharge of wash water to drainage system.

Patching, resurfacing, and surface sealing

- Schedule patching, resurfacing and surface sealing for dry weather.
- Stockpile materials away from streets, gutter areas, storm drain inlets or watercourses. During wet weather, cover stockpiles with plastic tarps or berm around them if necessary to prevent transport of materials in runoff.
- Pre-heat, transfer or load hot bituminous material away from drainage systems or watercourses.
- Where applicable, cover and seal nearby storm drain inlets (with waterproof material or mesh) and maintenance holes before applying seal coat, slurry seal, etc. Leave covers in place until job is complete and until all water from emulsified oil sealants has drained or evaporated. Clean any debris from covered maintenance holes and storm drain inlets when the job is complete.
- Prevent excess material from exposed aggregate concrete or similar treatments from entering streets or storm drain inlets. Designate an area for clean up and proper disposal of excess materials.
- Use only as much water as necessary for dust control, to avoid runoff.
- Sweep, never hose down streets to clean up tracked dirt. Use a street sweeper or vacuum truck. Do not dump vacuumed liquid in storm drains.
- Catch drips from paving equipment that is not in use with pans or absorbent material placed under the machines. Dispose of collected material and absorbents properly.

Equipment cleaning maintenance and storage

- Inspect equipment daily and repair any leaks. Place drip pans or absorbent materials under heavy equipment when not in use.
- Perform major equipment repairs at the corporation yard, when practical.
- If refueling or repairing vehicles and equipment must be done onsite, use a location away from storm drain inlets and watercourses.
- Clean equipment including sprayers, sprayer paint supply lines, patch and paving equipment, and mud jacking equipment at the end of each day. Clean in a sink or other area (e.g. vehicle wash area) that is connected to the sanitary sewer.

Bridge and Structure Maintenance

Paint and Paint Removal

- Transport paint and materials to and from job sites in containers with secure lids and tied down to the transport vehicle.
- Do not transfer or load paint near storm drain inlets or watercourses.

- Test and inspect spray equipment prior to starting to paint. Tighten all hoses and connections and do not overfill paint container.
- Plug nearby storm drain inlets prior to starting painting where there is significant risk of a spill reaching storm drains. Remove plugs when job is completed.
- If sand blasting is used to remove paint, cover nearby storm drain inlets prior to starting work.
- Perform work on a maintenance traveler or platform, or use suspended netting or tarps to capture paint, rust, paint removing agents, or other materials, to prevent discharge of materials to surface waters if the bridge crosses a watercourse. If sanding, use a sander with a vacuum filter bag.
- Capture all clean-up water, and dispose of properly.
- Recycle paint when possible (e.g. paint may be used for graffiti removal activities). Dispose of unused paint at an appropriate household hazardous waste facility.

Graffiti Removal

- Schedule graffiti removal activities for dry weather.
- Protect nearby storm drain inlets prior to removing graffiti from walls, signs, sidewalks, or other structures needing graffiti abatement. Clean up afterwards by sweeping or vacuuming thoroughly, and/or by using absorbent and properly disposing of the absorbent.
- When graffiti is removed by painting over, implement the procedures under Painting and Paint Removal above.
- Direct runoff from sand blasting and high pressure washing (with no cleaning agents) into a landscaped or dirt area. If such an area is not available, filter runoff through an appropriate filtering device (e.g. filter fabric) to keep sand, particles, and debris out of storm drains.
- If a graffiti abatement method generates wash water containing a cleaning compound (such as high pressure washing with a cleaning compound), plug nearby storm drains and vacuum/pump wash water to the sanitary sewer.
- Consider using a waterless and non-toxic chemical cleaning method for graffiti removal (e.g. gels or spray compounds).

Repair Work

- Prevent concrete, steel, wood, metal parts, tools, or other work materials from entering storm drains or watercourses.
- Thoroughly clean up the job site when the repair work is completed.
- When cleaning guardrails or fences follow the appropriate surface cleaning methods (depending on the type of surface) outlined in SC-71 Plaza & Sidewalk Cleaning fact sheet.

- If painting is conducted, follow the painting and paint removal procedures above.
- If graffiti removal is conducted, follow the graffiti removal procedures above.
- If construction takes place, see the Construction Activity BMP Handbook.
- Recycle materials whenever possible.

Unpaved Roads and Trails

- Stabilize exposed soil areas to prevent soil from eroding during rain events. This is particularly important on steep slopes.
- For roadside areas with exposed soils, the most cost-effective choice is to vegetate the area, preferably with a mulch or binder that will hold the soils in place while the vegetation is establishing. Native vegetation should be used if possible.
- If vegetation cannot be established immediately, apply temporary erosion control mats/blankets; a comma straw, or gravel as appropriate.
- If sediment is already eroded and mobilized in roadside areas, temporary controls should be installed. These may include: sediment control fences, fabric-covered triangular dikes, gravel-filled burlap bags, biobags, or hay bales staked in place.

Non-Stormwater Discharges

Field crews should be aware of non-stormwater discharges as part of their ongoing street maintenance efforts.

- Refer to SC-10 Non-Stormwater Discharges
- Identify location, time and estimated quantity of discharges.
- Notify appropriate personnel.

Training

- Train employees regarding proper street sweeping operation and street repair and maintenance.
- Instruct employees and subcontractors to ensure that measures to reduce the stormwater impacts of roadway/bridge maintenance are being followed.
- Require engineering staff and/or consulting A/E firms to address stormwater quality in new bridge designs or existing bridge retrofits.
- Use a training log or similar method to document training.
- Train employees on proper spill containment and clean up, and in identifying non-stormwater discharges.

Spill Response and Prevention

- Refer to SC-11, Spill Prevention, Control & Cleanup.
- Keep your Spill Prevention Control and countermeasure (SPCC) plan up-to-date, and implement accordingly.
- Have spill cleanup materials readily available and in a known location.
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.

Other Considerations

- Densely populated areas or heavily used streets may require parking regulations to clear streets for cleaning.
- No currently available conventional sweeper is effective at removing oil and grease. Mechanical sweepers are not effective at removing finer sediments.
- Limitations may arise in the location of new bridges. The availability and cost of land and other economic and political factors may dictate where the placement of a new bridge will occur. Better design of the bridge to control runoff is required if it is being placed near sensitive waters.

Requirements

Costs

- The maintenance of local roads and bridges is already a consideration of most community public works or transportation departments. Therefore, the cost of pollutant reducing management practices will involve the training and equipment required to implement these new practices.
- The largest expenditures for street sweeping programs are in staffing and equipment. The capital cost for a conventional street sweeper is between $60,000 and $120,000. Newer technologies might have prices approaching $180,000. The average useful life of a conventional sweeper is about four years, and programs must budget for equipment replacement. Sweeping frequencies will determine equipment life, so programs that sweep more often should expect to have a higher cost of replacement.
- A street sweeping program may require the following.
  - Sweeper operators, maintenance, supervisory, and administrative personnel are required.
  - Traffic control officers may be required to enforce parking restrictions.
  - Skillful design of cleaning routes is required for program to be productive.
  - Arrangements must be made for disposal of collected wastes.

- If investing in newer technologies, training for operators must be included in operation and maintenance budgets. Costs for public education are small, and mostly deal with the need to obey parking restrictions and litter control. Parking tickets are an effective reminder to obey parking rules, as well as being a source of revenue.

Maintenance

- Not applicable

Supplemental Information

Further Detail of the BMP

Street sweeping

There are advantages and disadvantages to the two common types of sweepers. The best choice depends on your specific conditions. Many communities find it useful to have a compliment of both types in their fleet.

Mechanical Broom Sweepers - More effective at picking up large debris and cleaning wet streets. Less costly to purchase and operate. Create more airborne dust.

Vacuum Sweepers - More effective at removing fine particles and associated heavy metals. Ineffective at cleaning wet streets. Noisier than mechanical broom sweepers which may restrict areas or times of operation. May require an advance vehicle to remove large debris.

Street Flushers - Not affected by biggest interference to cleaning, parked cars. May remove finer sediments, moving them toward the gutter and stormwater inlets. For this reason, flushing fell out of favor and is now used primarily after sweeping. Flushing may be effective for combined sewer systems. Presently street flushing is not allowed under most NPDES permits.

Cross-Media Transfer of Pollutants

The California Air Resources Board (ARB) has established state ambient air quality standards including a standard for respirable particulate matter (less than or equal to 10 microns in diameter, symbolized as PM10). In the effort to sweep up finer sediments to remove attached heavy metals, municipalities should be aware that fine dust, that cannot be captured by the sweeping equipment and becomes airborne, could lead to issues of worker and public safety.

Bridges

Bridges that carry vehicular traffic generate some of the more direct discharges of runoff to surface waters. Bridge scupper drains cause a direct discharge of stormwater into receiving waters and have been shown to carry relatively high concentrations of pollutants. Bridge maintenance also generates wastes that may be either directly deposited to the water below or carried to the receiving water by stormwater. The following steps will help reduce the stormwater impacts of bridge maintenance:

- Site new bridges so that significant adverse impacts to wetlands, sensitive areas, critical habitat, and riparian vegetation are minimized.

- Design new bridges to avoid the use of scupper drains and route runoff to land for treatment control. Existing scupper drains should be cleaned on a regular basis to avoid sediment/debris accumulation.

- Reduce the discharge of pollutants to surface waters during maintenance by using suspended traps, vacuums, or booms in the water to capture paint, rust, and paint removing agents. Many of these wastes may be hazardous. Properly dispose of this waste by referring to CA21 (Hazardous Waste Management) in the Construction Handbook.

- Train employees and subcontractors to reduce the discharge of wastes during bridge maintenance.

De-icing

- Do not over-apply deicing salt and sand, and routinely calibrate spreaders.

- Near reservoirs, restrict the application of deicing salt and redirect any runoff away from reservoirs.

- Consider using alternative deicing agents (less toxic, biodegradable, etc.).

References and Resources

Model Urban Runoff Program: A How-To Guide for Developing Urban Runoff Programs for Small Municipalities. Prepared by City of Monterey, City of Santa Cruz, California Coastal Commission, Monterey Bay National Marine Sanctuary, Association of Monterey Bay Area Governments, Woodward-Clyde, Central Coast Regional Water Quality Control Board. July. 1998.

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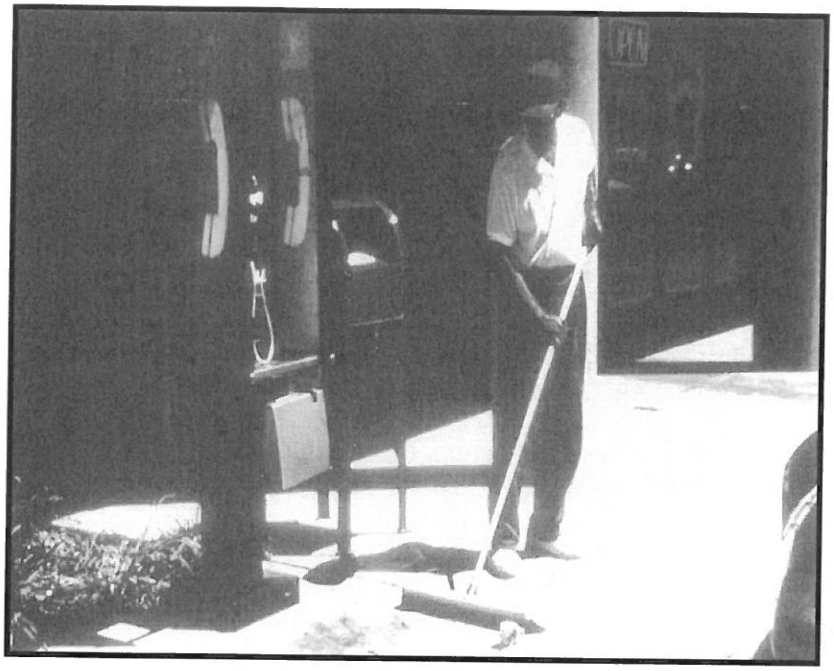
Plaza and Sidewalk Cleaning SC-71



Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

Sediment	☑
Nutrients	☑
Trash	☑
Metals	☑
Bacteria	☑
Oil and Grease	☑
Organics	☑
Oxygen Demanding	☑

Description

Pollutants on sidewalks and other pedestrian traffic areas and plazas are typically due to littering and vehicle use. This fact sheet describes good housekeeping practices that can be incorporated into the municipality's existing cleaning and maintenance program.

Approach

Pollution Prevention

- Use dry cleaning methods whenever practical for surface cleaning activities.
- Use the least toxic materials available (e.g. water based paints, gels or sprays for graffiti removal).

Suggested Protocols

Surface Cleaning

- Regularly broom (dry) sweep sidewalk, plaza and parking lot areas to minimize cleaning with water.
- Dry cleanup first (sweep, collect, and dispose of debris and trash) when cleaning sidewalks or plazas, then wash with or without soap.
- Block the storm drain or contain runoff when cleaning with water. Discharge wash water to landscaping or collect water and pump to a tank or discharge to sanitary sewer if allowed. (Permission may be required from local sanitation district.)

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- Block the storm drain or contain runoff when washing parking areas, driveways or drive-throughs. Use absorbents to pick up oil; then dry sweep. Clean with or without soap. Collect water and pump to a tank or discharge to sanitary sewer if allowed. Street Repair and Maintenance.

Graffiti Removal

- Avoid graffiti abatement activities during rain events.
- Implement the procedures under Painting and Paint Removal in SC-70 Roads, Streets, and Highway Operation and Maintenance fact sheet when graffiti is removed by painting over.
- Direct runoff from sand blasting and high pressure washing (with no cleaning agents) into a dirt or landscaped area after treating with an appropriate filtering device.
- Plug nearby storm drain inlets and vacuum/pump wash water to the sanitary sewer if authorized to do so if a graffiti abatement method generates wash water containing a cleaning compound (such as high pressure washing with a cleaning compound). Ensure that a non-hazardous cleaning compound is used or dispose as hazardous waste, as appropriate.

Surface Removal and Repair

- Schedule surface removal activities for dry weather if possible.
- Avoid creating excess dust when breaking asphalt or concrete.
- Take measures to protect nearby storm drain inlets prior to breaking up asphalt or concrete (e.g. place hay bales or sand bags around inlets). Clean afterwards by sweeping up as much material as possible.
- Designate an area for clean up and proper disposal of excess materials.
- Remove and recycle as much of the broken pavement as possible to avoid contact with rainfall and stormwater runoff.
- When making saw cuts in pavement, use as little water as possible. Cover each storm drain inlet completely with filter fabric during the sawing operation and contain the slurry by placing straw bales, sandbags, or gravel dams around the inlets. After the liquid drains or evaporates, shovel or vacuum the slurry residue from the pavement or gutter and remove from site.
- Always dry sweep first to clean up tracked dirt. Use a street sweeper or vacuum truck. Do not dump vacuumed liquid in storm drains. Once dry sweeping is complete, the area may be hosed down if needed. Wash water should be directed to landscaping or collected and pumped to the sanitary sewer if allowed.

Concrete Installation and Repair

- Schedule asphalt and concrete activities for dry weather.

- Take measures to protect any nearby storm drain inlets and adjacent watercourses, prior to breaking up asphalt or concrete (e.g. place san bags around inlets or work areas).
- Limit the amount of fresh concrete or cement mortar mixed, mix only what is needed for the job.
- Store concrete materials under cover, away from drainage areas. Secure bags of cement after they are open. Be sure to keep wind-blown cement powder away from streets, gutters, storm drains, rainfall, and runoff.
- Return leftover materials to the transit mixer. Dispose of small amounts of hardened excess concrete, grout, and mortar in the trash.
- Do not wash sweepings from exposed aggregate concrete into the street or storm drain. Collect and return sweepings to aggregate base stockpile, or dispose in the trash.
- Protect applications of fresh concrete from rainfall and runoff until the material has dried.
- Do not allow excess concrete to be dumped onsite, except in designated areas.
- Wash concrete trucks off site or in designated areas on site designed to preclude discharge of wash water to drainage system.

Controlling Litter

- Post "No Littering" signs and enforce anti-litter laws.
- Provide litter receptacles in busy, high pedestrian traffic areas of the community, at recreational facilities, and at community events.
- Cover litter receptacles and clean out frequently to prevent leaking/spillage or overflow.
- Clean parking lots on a regular basis with a street sweeper.

Training

- Provide regular training to field employees and/or contractors regarding surface cleaning and proper operation of equipment.
- Train employee and contractors in proper techniques for spill containment and cleanup.
- Use a training log or similar method to document training.

Spill Response and Prevention

- Refer to SC-11, Spill Prevention, Control & Cleanup.
- Have spill cleanup materials readily available and in a known location.
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.

Other Considerations

- Limitations related to sweeping activities at large parking facilities may include current sweeper technology to remove oil and grease.
- Surface cleaning activities that require discharges to the local sewering agency will require coordination with the agency.
- Arrangements for disposal of the swept material collected must be made, as well as accurate tracking of the areas swept and the frequency of sweeping.

Requirements

Costs

- The largest expenditures for sweeping and cleaning of sidewalks, plazas, and parking lots are in staffing and equipment. Sweeping of these areas should be incorporated into street sweeping programs to reduce costs.

Maintenance

Not applicable

Supplemental Information

Further Detail of the BMP

Community education, such as informing residents about their options for recycling and waste disposal, as well as the consequences of littering, can instill a sense of citizen responsibility and potentially reduce the amount of maintenance required by the municipality.

Additional BMPs that should be considered for parking lot areas include:

- Allow sheet runoff to flow into biofilters (vegetated strip and swale) and infiltration devices.
- Utilize sand filters or oleophilic collectors for oily waste in low concentrations.
- Arrange rooftop drains to prevent drainage directly onto paved surfaces.
- Design lot to include semi-permeable hardscape.
- Structural BMPs such as storm drain inlet filters can be very effective in reducing the amount of pollutants discharged from parking facilities during periods of rain.

References and Resources

Bay Area Stormwater Management Agencies Association (BASMAA). 1996. Pollution From Surface Cleaning Folder http://www.basmaa.org

Model Urban Runoff Program: A How-To Guide for Developing Urban Runoff Programs for Small Municipalities. Prepared by City of Monterey, City of Santa Cruz, California Coastal Commission, Monterey Bay National Marine Sanctuary, Association of Monterey Bay Area Governments, Woodward-Clyde, Central Coast Regional Water Quality Control Board. July. 1998.

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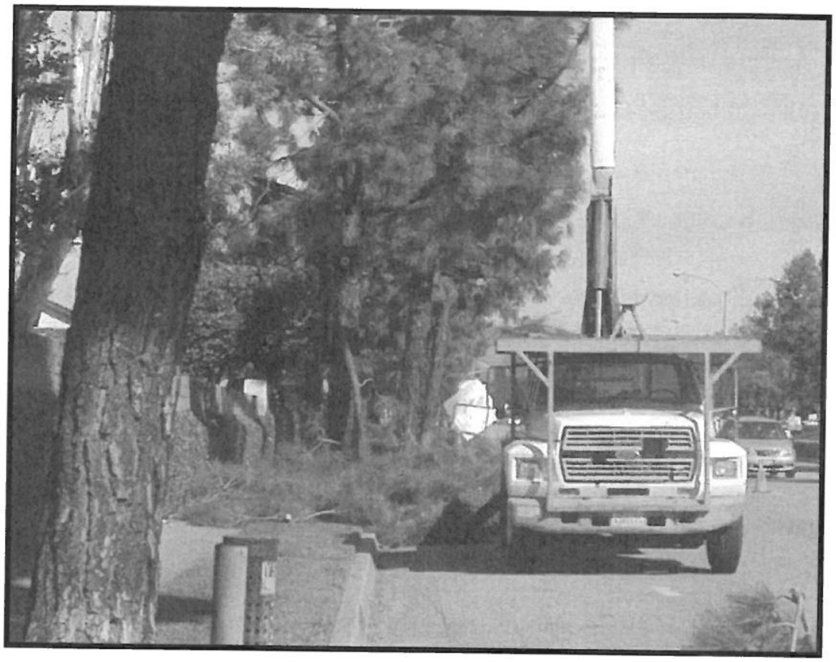

Objectives

- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

Sediment	☑
Nutrients	☑
Trash	☑
Metals	
Bacteria	
Oil and Grease	
Organics	
Oxygen Demanding	☑

Description

Landscape maintenance activities include vegetation removal; herbicide and insecticide application; fertilizer application; watering; and other gardening and lawn care practices. Vegetation control typically involves a combination of chemical (herbicide) application and mechanical methods. All of these maintenance practices have the potential to contribute pollutants to the storm drain system. The major objectives of this BMP are to minimize the discharge of pesticides, herbicides and fertilizers to the storm drain system and receiving waters; prevent the disposal of landscape waste into the storm drain system by collecting and properly disposing of clippings and cuttings, and educating employees and the public.

Approach

Pollution Prevention

- Implement an integrated pest management (IPM) program. IPM is a sustainable approach to managing pests by combining biological, cultural, physical, and chemical tools.
- Choose low water using flowers, trees, shrubs, and groundcover.
- Consider alternative landscaping techniques such as naturescaping and xeriscaping.
- Conduct appropriate maintenance (i.e. properly timed fertilizing, weeding, pest control, and pruning) to help preserve the landscapes water efficiency.

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- Consider grass cycling (grass cycling is the natural recycling of grass by leaving the clippings on the lawn when mowing. Grass clippings decompose quickly and release valuable nutrients back into the lawn).

Suggested Protocols

Mowing, Trimming, and Weeding

- Whenever possible use mechanical methods of vegetation removal (e.g mowing with tractor-type or push mowers, hand cutting with gas or electric powered weed trimmers) rather than applying herbicides. Use hand weeding where practical.

- Avoid loosening the soil when conducting mechanical or manual weed control, this could lead to erosion. Use mulch or other erosion control measures when soils are exposed.

- Performing mowing at optimal times. Mowing should not be performed if significant rain events are predicted.

- Mulching mowers may be recommended for certain flat areas. Other techniques may be employed to minimize mowing such as selective vegetative planting using low maintenance grasses and shrubs.

- Collect lawn and garden clippings, pruning waste, tree trimmings, and weeds. Chip if necessary, and compost or dispose of at a landfill (see waste management section of this fact sheet).

- Place temporarily stockpiled material away from watercourses, and berm or cover stockpiles to prevent material releases to storm drains.

Planting

- Determine existing native vegetation features (location, species, size, function, importance) and consider the feasibility of protecting them. Consider elements such as their effect on drainage and erosion, hardiness, maintenance requirements, and possible conflicts between preserving vegetation and the resulting maintenance needs.

- Retain and/or plant selected native vegetation whose features are determined to be beneficial, where feasible. Native vegetation usually requires less maintenance (e.g., irrigation, fertilizer) than planting new vegetation.

- Consider using low water use groundcovers when planting or replanting.

Waste Management

- Compost leaves, sticks, or other collected vegetation or dispose of at a permitted landfill. Do not dispose of collected vegetation into waterways or storm drainage systems.

- Place temporarily stockpiled material away from watercourses and storm drain inlets, and berm or cover stockpiles to prevent material releases to the storm drain system.

- Reduce the use of high nitrogen fertilizers that produce excess growth requiring more frequent mowing or trimming.

- Avoid landscape wastes in and around storm drain inlets by either using bagging equipment or by manually picking up the material.

Irrigation

- Where practical, use automatic timers to minimize runoff.
- Use popup sprinkler heads in areas with a lot of activity or where there is a chance the pipes may be broken. Consider the use of mechanisms that reduce water flow to sprinkler heads if broken.
- Ensure that there is no runoff from the landscaped area(s) if re-claimed water is used for irrigation.
- If bailing of muddy water is required (e.g. when repairing a water line leak), do not put it in the storm drain; pour over landscaped areas.
- Irrigate slowly or pulse irrigate to prevent runoff and then only irrigate as much as is needed.
- Apply water at rates that do not exceed the infiltration rate of the soil.

Fertilizer and Pesticide Management

- Utilize a comprehensive management system that incorporates integrated pest management (IPM) techniques. There are many methods and types of IPM, including the following:
  - Mulching can be used to prevent weeds where turf is absent, fencing installed to keep rodents out, and netting used to keep birds and insects away from leaves and fruit.
  - Visible insects can be removed by hand (with gloves or tweezers) and placed in soapy water or vegetable oil. Alternatively, insects can be sprayed off the plant with water or in some cases vacuumed off of larger plants.
  - Store-bought traps, such as species-specific, pheromone-based traps or colored sticky cards, can be used.
  - Slugs can be trapped in small cups filled with beer that are set in the ground so the slugs can get in easily.
  - In cases where microscopic parasites, such as bacteria and fungi, are causing damage to plants, the affected plant material can be removed and disposed of (pruning equipment should be disinfected with bleach to prevent spreading the disease organism).
  - Small mammals and birds can be excluded using fences, netting, tree trunk guards.
  - Beneficial organisms, such as bats, birds, green lacewings, ladybugs, praying mantis, ground beetles, parasitic nematodes, trichogramma wasps, seed head weevils, and spiders that prey on detrimental pest species can be promoted.
- Follow all federal, state, and local laws and regulations governing the use, storage, and disposal of fertilizers and pesticides and training of applicators and pest control advisors.

- Use pesticides only if there is an actual pest problem (not on a regular preventative schedule).
- Do not use pesticides if rain is expected. Apply pesticides only when wind speeds are low (less than 5 mph).
- Do not mix or prepare pesticides for application near storm drains.
- Prepare the minimum amount of pesticide needed for the job and use the lowest rate that will effectively control the pest.
- Employ techniques to minimize off-target application (e.g. spray drift) of pesticides, including consideration of alternative application techniques.
- Fertilizers should be worked into the soil rather than dumped or broadcast onto the surface.
- Calibrate fertilizer and pesticide application equipment to avoid excessive application.
- Periodically test soils for determining proper fertilizer use.
- Sweep pavement and sidewalk if fertilizer is spilled on these surfaces before applying irrigation water.
- Purchase only the amount of pesticide that you can reasonably use in a given time period (month or year depending on the product).
- Triple rinse containers, and use rinse water as product. Dispose of unused pesticide as hazardous waste.
- Dispose of empty pesticide containers according to the instructions on the container label.

Inspection

- Inspect irrigation system periodically to ensure that the right amount of water is being applied and that excessive runoff is not occurring. Minimize excess watering, and repair leaks in the irrigation system as soon as they are observed.
- Inspect pesticide/fertilizer equipment and transportation vehicles daily.

Training

- Educate and train employees on use of pesticides and in pesticide application techniques to prevent pollution. Pesticide application must be under the supervision of a California qualified pesticide applicator.
- Train/encourage municipal maintenance crews to use IPM techniques for managing public green areas.
- Annually train employees within departments responsible for pesticide application on the appropriate portions of the agency's IPM Policy, SOPs, and BMPs, and the latest IPM techniques.

- Employees who are not authorized and trained to apply pesticides should be periodically (at least annually) informed that they cannot use over-the-counter pesticides in or around the workplace.

- Use a training log or similar method to document training.

Spill Response and Prevention

- Refer to SC-11, Spill Prevention, Control & Cleanup

- Have spill cleanup materials readily available and in a know in location

- Cleanup spills immediately and use dry methods if possible.

- Properly dispose of spill cleanup material.

Other Considerations

- The Federal Pesticide, Fungicide, and Rodenticide Act and California Title 3, Division 6, Pesticides and Pest Control Operations place strict controls over pesticide application and handling and specify training, annual refresher, and testing requirements. The regulations generally cover: a list of approved pesticides and selected uses, updated regularly; general application information; equipment use and maintenance procedures; and record keeping. The California Department of Pesticide Regulations and the County Agricultural Commission coordinate and maintain the licensing and certification programs. All public agency employees who apply pesticides and herbicides in "agricultural use" areas such as parks, golf courses, rights-of-way and recreation areas should be properly certified in accordance with state regulations. Contracts for landscape maintenance should include similar requirements.

- All employees who handle pesticides should be familiar with the most recent material safety data sheet (MSDS) files.

- Municipalities do not have the authority to regulate the use of pesticides by school districts, however the California Healthy Schools Act of 2000 (AB 2260) has imposed requirements on California school districts regarding pesticide use in schools. Posting of notification prior to the application of pesticides is now required, and IPM is stated as the preferred approach to pest management in schools.

Requirements

Costs

Additional training of municipal employees will be required to address IPM techniques and BMPs. IPM methods will likely increase labor cost for pest control which may be offset by lower chemical costs.

Maintenance

Not applicable

Supplemental Information

Further Detail of the BMP

Waste Management

Composting is one of the better disposal alternatives if locally available. Most municipalities either have or are planning yard waste composting facilities as a means of reducing the amount of waste going to the landfill. Lawn clippings from municipal maintenance programs as well as private sources would probably be compatible with most composting facilities

Contractors and Other Pesticide Users

Municipal agencies should develop and implement a process to ensure that any contractor employed to conduct pest control and pesticide application on municipal property engages in pest control methods consistent with the IPM Policy adopted by the agency. Specifically, municipalities should require contractors to follow the agency's IPM policy, SOPs, and BMPs; provide evidence to the agency of having received training on current IPM techniques when feasible; provide documentation of pesticide use on agency property to the agency in a timely manner.

References and Resources

King County Stormwater Pollution Control Manual. Best Management Practices for Businesses. 1995. King County Surface Water Management. July. On-line: http://dnr.metrokc.gov/wlr/dss/spcm.htm

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Drainage System Maintenance SC-74

Photo Credit: Geoff Brosseau

Description

As a consequence of its function, the stormwater conveyance system collects and transports urban runoff that may contain certain pollutants. Maintaining catch basins, stormwater inlets, and other stormwater conveyance structures on a regular basis will remove pollutants, prevent clogging of the downstream conveyance system, restore catch basins' sediment trapping capacity, and ensure the system functions properly hydraulically to avoid flooding.

Approach

Suggested Protocols

Catch Basins/Inlet Structures

- Municipal staff should regularly inspect facilities to ensure the following:
  - Immediate repair of any deterioration threatening structural integrity.
  - Cleaning before the sump is 40% full. Catch basins should be cleaned as frequently as needed to meet this standard.
  - Stenciling of catch basins and inlets (see SC-75 Waste Handling and Disposal).
- Clean catch basins, storm drain inlets, and other conveyance structures in high pollutant load areas just before the wet season to remove sediments and debris accumulated during the summer.

Objectives

- Contain
- Educate
- Reduce/Minimize

Targeted Constituents

- Sediment ☑
- Nutrients ☑
- Trash ☑
- Metals ☑
- Bacteria ☑
- Oil and Grease ☑
- Organics ☑
- Oxygen Demanding ☑

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- Conduct inspections more frequently during the wet season for problem areas where sediment or trash accumulates more often. Clean and repair as needed.
- Keep accurate logs of the number of catch basins cleaned.
- Record the amount of waste collected.
- Store wastes collected from cleaning activities of the drainage system in appropriate containers or temporary storage sites in a manner that prevents discharge to the storm drain.
- Dewater the wastes with outflow into the sanitary sewer if permitted. Water should be treated with an appropriate filtering device prior to discharge to the sanitary sewer. If discharge to the sanitary sewer is not allowed, water should be pumped or vacuumed to a tank and properly disposed of. Do not dewater near a storm drain or stream.
- Except for small communities with relatively few catch basins that may be cleaned manually, most municipalities will require mechanical cleaners such as eductors, vacuums, or bucket loaders.

Storm Drain Conveyance System

- Locate reaches of storm drain with deposit problems and develop a flushing schedule that keeps the pipe clear of excessive buildup.
- Collect flushed effluent and pump to the sanitary sewer for treatment.

Pump Stations

- Clean all storm drain pump stations prior to the wet season to remove silt and trash.
- Do not allow discharge from cleaning a storm drain pump station or other facility to reach the storm drain system.
- Conduct quarterly routine maintenance at each pump station.
- Inspect, clean, and repair as necessary all outlet structures prior to the wet season.
- Sample collected sediments to determine if landfill disposal is possible, or illegal discharges in the watershed are occurring.

Open Channel

- Consider modification of storm channel characteristics to improve channel hydraulics, to increase pollutant removals, and to enhance channel/creek aesthetic and habitat value.
- Conduct channel modification/improvement in accordance with existing laws. Any person, government agency, or public utility proposing an activity that will change the natural (emphasis added) state of any river, stream, or lake in California, must enter into a steam or Lake Alteration Agreement with the Department of Fish and Game. The developer-applicant should also contact local governments (city, county, special districts), other state agencies

(SWRCB, RWQCB, Department of Forestry, Department of Water Resources), and Federal Corps of Engineers and USFWS

Illicit Connections and Discharges

- During routine maintenance of conveyance system and drainage structures field staff should look for evidence of illegal discharges or illicit connections:
  - Is there evidence of spills such as paints, discoloring, etc.
  - Are there any odors associated with the drainage system
  - Record locations of apparent illegal discharges/illicit connections
  - Track flows back to potential dischargers and conduct aboveground inspections. This can be done through visual inspection of up gradient manholes or alternate techniques including zinc chloride smoke testing, fluorometric dye testing, physical inspection testing, or television camera inspection.
  - Once the origin of flow is established, require illicit discharger to eliminate the discharge.
- Stencil storm drains, where applicable, to prevent illegal disposal of pollutants. Storm drain inlets should have messages such as "Dump No Waste Drains to Stream" stenciled next to them to warn against ignorant or intentional dumping of pollutants into the storm drainage system.
- Refer to fact sheet SC-10 Non-Stormwater Discharges.

Illegal Dumping

- Regularly inspect and clean up hot spots and other storm drainage areas where illegal dumping and disposal occurs.
- Establish a system for tracking incidents. The system should be designed to identify the following:
  - Illegal dumping hot spots
  - Types and quantities (in some cases) of wastes
  - Patterns in time of occurrence (time of day/night, month, or year)
  - Mode of dumping (abandoned containers, "midnight dumping" from moving vehicles, direct dumping of materials, accidents/spills)
  - Responsible parties
- Post "No Dumping" signs in problem areas with a phone number for reporting dumping and disposal. Signs should also indicate fines and penalties for illegal dumping.
- Refer to fact sheet SC-10 Non-Stormwater Discharges.

- The State Department of Fish and Game has a hotline for reporting violations called Cal TIP (1-800-952-5400). The phone number may be used to report any violation of a Fish and Game code (illegal dumping, poaching, etc.).
- The California Department of Toxic Substances Control's Waste Alert Hotline, 1-800-69TOXIC, can be used to report hazardous waste violations.

Training

- Train crews in proper maintenance activities, including record keeping and disposal.
- Only properly trained individuals are allowed to handle hazardous materials/wastes.
- Train municipal employees from all departments (public works, utilities, street cleaning, parks and recreation, industrial waste inspection, hazardous waste inspection, sewer maintenance) to recognize and report illegal dumping.
- Train municipal employees and educate businesses, contractors, and the general public in proper and consistent methods for disposal.
- Train municipal staff regarding non-stormwater discharges (See SC-10 Non-Stormwater Discharges).

Spill Response and Prevention

- Refer to SC-11, Prevention, Control & Cleanup
- Have spill cleanup materials readily available and in a known location.
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.

Other Considerations

- Cleanup activities may create a slight disturbance for local aquatic species. Access to items and material on private property may be limited. Trade-offs may exist between channel hydraulics and water quality/riparian habitat. If storm channels or basins are recognized as wetlands, many activities, including maintenance, may be subject to regulation and permitting.
- Storm drain flushing is most effective in small diameter pipes (36-inch diameter pipe or less, depending on water supply and sediment collection capacity). Other considerations associated with storm drain flushing may include the availability of a water source, finding a downstream area to collect sediments, liquid/sediment disposal, and disposal of flushed effluent to sanitary sewer may be prohibited in some areas.
- Regulations may include adoption of substantial penalties for illegal dumping and disposal.
- Municipal codes should include sections prohibiting the discharge of soil, debris, refuse, hazardous wastes, and other pollutants into the storm drain system.
- Private property access rights may be needed to track illegal discharges up gradient.

- Requirements of municipal ordinance authority for suspected source verification testing for illicit connections necessary for guaranteed rights of entry.

Requirements

Costs

- An aggressive catch basin cleaning program could require a significant capital and O&M budget. A careful study of cleaning effectiveness should be undertaken before increased cleaning is implemented. Catch basin cleaning costs are less expensive if vacuum street sweepers are available; cleaning catch basins manually can cost approximately twice as much as cleaning the basins with a vacuum attached to a sweeper.

- Methods used for illicit connection detection (smoke testing, dye testing, visual inspection, and flow monitoring) can be costly and time-consuming. Site-specific factors, such as the level of impervious area, the density and ages of buildings, and type of land use will determine the level of investigation necessary. Encouraging reporting of illicit discharges by employees can offset costs by saving expense on inspectors and directing resources more efficiently. Some programs have used funds available from "environmental fees" or special assessment districts to fund their illicit connection elimination programs.

Maintenance

- Two-person teams may be required to clean catch basins with vactor trucks.

- Identifying illicit discharges requires teams of at least two people (volunteers can be used), plus administrative personnel, depending on the complexity of the storm sewer system.

- Arrangements must be made for proper disposal of collected wastes.

- Requires technical staff to detect and investigate illegal dumping violations, and to coordinate public education.

Supplemental Information

Further Detail of the BMP

Storm Drain flushing

Sanitary sewer flushing is a common maintenance activity used to improve pipe hydraulics and to remove pollutants in sanitary sewer systems. The same principles that make sanitary sewer flushing effective can be used to flush storm drains. Flushing may be designed to hydraulically convey accumulated material to strategic locations, such as to an open channel, to another point where flushing will be initiated, or over to the sanitary sewer and on to the treatment facilities, thus preventing re-suspension and overflow of a portion of the solids during storm events. Flushing prevents "plug flow" discharges of concentrated pollutant loadings and sediments. The deposits can hinder the designed conveyance capacity of the storm drain system and potentially cause backwater conditions in severe cases of clogging.

Storm drain flushing usually takes place along segments of pipe with grades that are too flat to maintain adequate velocity to keep particles in suspension. An upstream manhole is selected to place an inflatable device that temporarily plugs the pipe. Further upstream, water is pumped into the line to create a flushing wave. When the upstream reach of pipe is sufficiently full to cause a flushing wave, the inflated device is rapidly deflated with the assistance of a vacuum pump, releasing the backed up water and resulting in the cleaning of the storm drain segment.

To further reduce the impacts of stormwater pollution, a second inflatable device, placed well downstream, may be used to re-collect the water after the force of the flushing wave has dissipated. A pump may then be used to transfer the water and accumulated material to the sanitary sewer for treatment. In some cases, an interceptor structure may be more practical or required to re-collect the flushed waters.

It has been found that cleansing efficiency of periodic flush waves is dependent upon flush volume, flush discharge rate, sewer slope, sewer length, sewer flow rate, sewer diameter, and population density. As a rule of thumb, the length of line to be flushed should not exceed 700 feet. At this maximum recommended length, the percent removal efficiency ranges between 65-75 percent for organics and 55-65 percent for dry weather grit/inorganic material. The percent removal efficiency drops rapidly beyond that. Water is commonly supplied by a water truck, but fire hydrants can also supply water. To make the best use of water, it is recommended that reclaimed water be used or that fire hydrant line flushing coincide with storm drain flushing.

Flow Management

Flow management has been one of the principal motivations for designing urban stream corridors in the past. Such needs may or may not be compatible with the stormwater quality goals in the stream corridor.

Downstream flood peaks can be suppressed by reducing through flow velocity. This can be accomplished by reducing gradient with grade control structures or increasing roughness with boulders, dense vegetation, or complex banks forms. Reducing velocity correspondingly increases flood height, so all such measures have a natural association with floodplain open space. Flood elevations laterally adjacent to the stream can be lowered by increasing through flow velocity.

However, increasing velocity increases flooding downstream and inherently conflicts with channel stability and human safety. Where topography permits, another way to lower flood elevation is to lower the level of the floodway with drop structures into a large but subtly excavated bowl where flood flows we allowed to spread out.

Stream Corridor Planning

Urban streams receive and convey stormwater flows from developed or developing watersheds. Planning of stream corridors thus interacts with urban stormwater management programs. If local programs are intended to control or protect downstream environments by managing flows delivered to the channels, then it is logical that such programs should be supplemented by management of the materials, forms, and uses of the downstream riparian corridor. Any proposal for steam alteration or management should be investigated for its potential flow and stability effects on upstream, downstream, and laterally adjacent areas. The timing and rate of flow from various tributaries can combine in complex ways to alter flood hazards. Each section of channel is unique, influenced by its own distribution of roughness elements, management activities, and stream responses.

Flexibility to adapt to stream features and behaviors as they evolve must be included in stream reclamation planning. The amenity and ecology of streams may be enhanced through the landscape design options of 1) corridor reservation, 2) bank treatment, 3) geomorphic restoration, and 4) grade control.

Corridor reservation - Reserving stream corridors and valleys to accommodate natural stream meandering, aggradation, degradation, and over bank flows allows streams to find their own form and generate less ongoing erosion. In California, open stream corridors in recent urban developments have produced recreational open space, irrigation of streamside plantings, and the aesthetic amenity of flowing water.

Bank treatment - The use of armoring, vegetative cover, and flow deflection may be used to influence a channel's form, stability, and biotic habitat. To prevent bank erosion, armoring can be done with rigid construction materials, such as concrete, masonry, wood planks and logs, riprap, and gabions. Concrete linings have been criticized because of their lack of provision of biotic habitat. In contrast, riprap and gabions make relatively porous and flexible linings. Boulders, placed in the bed reduce velocity and erosive power.

Riparian vegetation can stabilize the banks of streams that are at or near a condition of equilibrium. Binding networks of roots increase bank shear strength. During flood flows, resilient vegetation is forced into erosion-inhibiting mats. The roughness of vegetation leads to lower velocity, further reducing erosive effects. Structural flow deflection can protect banks from erosion or alter fish habitat. By concentrating flow, a deflector causes a pool to be scoured in the bed.

Geomorphic restoration – Restoration refers to alteration of disturbed streams so their form and behavior emulate those of undisturbed streams. Natural meanders are retained, with grading to gentle slopes on the inside of curves to allow point bars and riffle-pool sequences to develop. Trees are retained to provide scenic quality, biotic productivity, and roots for bank stabilization, supplemented by plantings where necessary.

A restorative approach can be successful where the stream is already approaching equilibrium. However, if upstream urbanization continues new flow regimes will be generated that could disrupt the equilibrium of the treated system.

Grade Control - A grade control structure is a level shelf of a permanent material, such as stone, masonry, or concrete, over which stream water flows. A grade control structure is called a sill, weir, or drop structure, depending on the relation of its invert elevation to upstream and downstream channels.

A sill is installed at the preexisting channel bed elevation to prevent upstream migration of nick points. It establishes a firm base level below which the upstream channel can not erode.

A weir or check dam is installed with invert above the preexisting bed elevation. A weir raises the local base level of the stream and causes aggradation upstream. The gradient, velocity, and erosive potential of the stream channel are reduced. A drop structure lowers the downstream invert below its preexisting elevation, reducing downstream gradient and velocity. Weirs and drop structure control erosion by dissipating energy and reducing slope velocity.

When carefully applied, grade control structures can be highly versatile in establishing human and environmental benefits in stabilized channels. To be successful, application of grade control structures should be guided by analysis of the stream system both upstream and downstream from the area to he reclaimed.

Examples

The California Department of Water Resources began the Urban Stream Restoration Program in 1985. The program provides grant funds to municipalities and community groups to implement stream restoration projects. The projects reduce damages from streambank aid watershed instability arid floods while restoring streams' aesthetic, recreational, and fish and wildlife values.

In Buena Vista Park, upper floodway slopes are gentle and grassed to achieve continuity of usable park land across the channel of small boulders at the base of the slopes.

The San Diego River is a large, vegetative lined channel, which was planted in a variety of species to support riparian wildlife while stabilizing the steep banks of the floodway.

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General Description

Retention/irrigation refers to the capture of stormwater runoff in a holding pond and subsequent use of the captured volume for irrigation of landscape or natural pervious areas. This technology is very effective as a stormwater quality practice in that, for the captured water quality volume, it provides virtually no discharge to receiving waters and high stormwater constituent removal efficiencies. This technology mimics natural undeveloped watershed conditions wherein the vast majority of the rainfall volume during smaller rainfall events is infiltrated through the soil profile. Their main advantage over other infiltration technologies is the use of an irrigation system to spread the runoff over a larger area for infiltration. This allows them to be used in areas with low permeability soils.

Capture of stormwater can be accomplished in almost any kind of runoff storage facility, ranging from dry, concrete-lined ponds to those with vegetated basins and permanent pools. The pump and wet well should be automated with a rainfall sensor to provide irrigation only during periods when required infiltration rates can be realized. Generally, a spray irrigation system is required to provide an adequate flow rate for distributing the water quality volume (LCRA, 1998). Collection of roof runoff for subsequent use (rainwater harvesting) also qualifies as a retention/irrigation practice.

Inspection/Maintenance Considerations

Pollutant removal rates are estimated to be nearly 100% for all pollutants in the captured and irrigated stormwater volume. However, relatively frequent inspection and maintenance is necessary to verify proper operation of these facilities.

Maintenance Concerns, Objectives, and Goals

- Sediment Accumulation
- Mechanical malfunction
- Vector Control

Targeted Constituents

✓	Sediment	■
✓	Nutrients	■
✓	Trash	■
✓	Metals	■
✓	Bacteria	■
✓	Oil and Grease	■
✓	Organics	■
✓	Oxygen Demanding	■

Legend ***(Removal Effectiveness)***

● Low ■ High

▲ Medium

CASQA
California Stormwater Quality Association

Inspection Activities	Suggested Frequency
■ The irrigation system should be inspected and tested (or observed while in operation) to verify proper operation multiple times annually. Two of these inspections should occur during or immediately following wet weather. Any leaks, broken spray heads, or other malfunctions with the irrigation system should be repaired immediately.	Frequently (3-6 times per year)

Maintenance Activities	Suggested Frequency
■ The upper stage, side slopes, and embankment of a retention basin must be mowed regularly to discourage woody growth and control weeds.	Frequently
■ Remove sediment from inlet structure/sediment forebay, and from around the sump area at least 2 times annually or when depth reaches 3 inches. When sediment in other areas of the basin fills the volume allocated for sediment accumulation, all sediment should be removed and disposed of properly. ■ Grass areas in and around basins must be mowed at least twice annually to limit vegetation height to 18 inches. More frequent mowing to maintain aesthetic appeal may be necessary in landscaped areas. When mowing is performed, a mulching mower should be used, or grass clippings should be caught and removed. ■ Debris and litter will accumulate near the basin pump and should be removed during regular mowing operations and inspections. Particular attention should be paid to floating debris that can eventually clog the irrigation system.	Semi-annual
■ The pond side slopes and embankment may periodically suffer from slumping and erosion, although this should not occur often if the soils are properly compacted during construction. Regrading and revegetation may be required to correct the problems.	Infrequently

Maintenance Concerns, Objectives, and Goals

- Clogged Soil or Outlet Structures
- Invasive Species
- Vegetation/Landscape Maintenance
- Erosion
- Channelization of Flow
- Aesthetics

General Description

The bioretention best management practice (BMP) functions as a soil and plant-based filtration device that removes pollutants through a variety of physical, biological, and chemical treatment processes. These facilities normally consist of a grass buffer strip, sand bed, ponding area, organic layer or mulch layer, planting soil, and plants. The runoff's velocity is reduced by passing over or through a sand bed and is subsequently distributed evenly along a ponding area. Exfiltration of the stored water in the bioretention area planting soil into the underlying soils occurs over a period of days.

Inspection/Maintenance Considerations

Bioretention requires frequent landscaping maintenance, including measures to ensure that the area is functioning properly, as well as maintenance of the landscaping on the practice. In many cases, bioretention areas initially require intense maintenance, but less maintenance is needed over time. In many cases, maintenance tasks can be completed by a landscaping contractor, who may already be hired at the site. In cold climates the soil may freeze, preventing runoff from infiltrating into the planting soil.

Targeted Constituents

✓	Sediment	■
✓	Nutrients	▲
✓	Trash	■
✓	Metals	■
✓	Bacteria	■
✓	Oil and Grease	■
✓	Organics	■
✓	Oxygen Demanding	■

Legend ***(Removal Effectiveness)***

● Low ■ High

▲ Medium

CASQA California Stormwater Quality Association

Inspection Activities	Suggested Frequency
■ Inspect soil and repair eroded areas.	Monthly
■ Inspect for erosion or damage to vegetation, preferably at the end of the wet season to schedule summer maintenance and before major fall runoff to be sure the strips are ready for winter. However, additional inspection after periods of heavy runoff is desirable.	Semi-annual inspection
■ Inspect to ensure grass is well established. If not, either prepare soil and reseed or replace with alternative species. Install erosion control blanket. ■ Check for debris and litter, and areas of sediment accumulation. ■ Inspect health of trees and shrubs.	

Maintenance Activities	Suggested Frequency
■ Water plants daily for 2 weeks.	At project completion
■ Remove litter and debris.	Monthly
■ Remove sediment. ■ Remulch void areas. ■ Treat diseased trees and shrubs. ■ Mow turf areas. ■ Repair erosion at inflow points. ■ Repair outflow structures. ■ Unclog underdrain. ■ Regulate soil pH regulation.	As needed
■ Remove and replace dead and diseased vegetation.	Semi-annual
■ Add mulch. ■ Replace tree stakes and wires.	Annual
■ Mulch should be replaced every 2 to 3 years or when bare spots appear. Remulch prior to the wet season.	Every 2-3 years, or as needed

Additional Information

Landscaping is critical to the function and aesthetic value of bioretention areas. It is preferable to plant the area with native vegetation, or plants that provide habitat value, where possible. Another important design feature is to select species that can withstand the hydrologic regime they will experience. At the bottom of the bioretention facility, plants that tolerate both wet and dry conditions are preferable. At the edges, which will remain primarily dry, upland species will be the most resilient. It is best to select a combination of trees, shrubs, and herbaceous materials.

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Adopt a pet from your local animal shelter or adoption centers at pet stores. A variety of animals, from purebred to mixed breed are waiting for loving arms and good homes. Consider volunteering at your local animal shelters. Volunteers, donations, food, newspapers, old towels and linens are needed to help the animals.

RIVERSIDE COUNTY
ANIMAL SHELTER LOCATIONS:

BLYTHE
16450 West Hobson Way
Blythe, CA 92225
760-921-7857

HEMET
800 South Sanderson
Hemet, CA 92545
909 925-8025

INDIO
45-355 Van Buren
Indio, CA 92201
760-347-2319

RIVERSIDE
5950 Wilderness Avenue
Riverside, CA 92504
909-358-7387

FOR ALL OTHER AREAS
CALL 1-888-636-7387

Riverside County gratefully acknowledges the City of Los Angeles Stormwater Program for the design concept of this brochure.

What's the Scoop?

TIPS FOR A HEALTHY PET AND A HEALTHIER ENVIRONMENT

CREATE A HEALTHY ENVIRONMENT in and around your home by following these simple pet practices. Your pet, family and neighbors will appreciate their clean comfortable surroundings.

HOUSEHOLD PETS

We all love our pets, but pet waste is a subject everyone likes to avoid. Pet waste left on trails, sidewalks, streets, and grassy areas is immediately flushed into the nearest waterway when it rains. Even if you can't see water near you, the rain or waste water WASHES all that PET WASTE and BACTERIA INTO THE STORMDRAIN, where it travels to your neighborhood creek or lake untreated. These animal droppings also contain nutrients that can promote the growth of algae, if they enter our streams and lakes. The risk of STORMWATER CONTAMINATION INCREASES, if pet wastes is allowed to accumulate in animal pen areas or left on sidewalks, streets, or driveways where runoff can carry them to storm sewers.

Some of the DISEASES THAT CAN SPREAD from pet waste are:

Campylobacteriosis — a bacterial infection that causes diarrhea in humans.

Salmonellosis — the most common bacterial infection transmitted to humans from animals.

Toxocarisis — roundworms transmitted from animals to humans.

Flies and other pest insects can also increase when pet waste is disposed of improperly, becoming a nuisance and adding yet another vector for disease transmission.

WHAT CAN YOU DO?

- SCOOP up pet waste and flush it down the toilet.
- NEVER DUMP pet waste into a storm drain or catch basin.
- USE the complimentary BAGS or mutt mitts offered in dispensers at local parks.
- CARRY EXTRA BAGS when walking your dog and make them available to other pet owners who are without.
- TEACH CHILDREN how to properly clean up after a pet.
- TELL FRIENDS AND NEIGHBORS about the ill effects of animal waste on the environment. Encourage them to clean up after pets.

Did You Know . . .

that Californians illegally dump about 80 million gallons of motor oil each year?

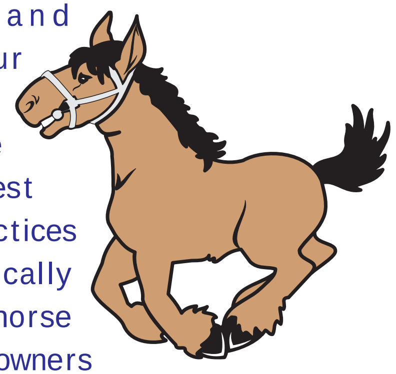
Many communities have "Scoop the Poop" laws that govern pet waste cleanup. Some of these laws specifically require anyone who walks an animal off of their property to carry a bag, shovel, or scooper. Any waste left by the animal must be cleaned up immediately. CALL YOUR LOCAL CODE ENFORCEMENT OFFICER to find out more about pet waste regulations.

Pets are only one of the many fixtures of suburban America that add to water pollution. Lawn fertilizers, rinse water from driveways and motor oil commonly end up in streams and lakes. CALL 1-800-506-2555 FOR HOUSEHOLD HAZARDOUS WASTE COLLECTION LOCATION AND DATES. Maintain your automobile to avoid leaks. Dispose of used vehicle fluids properly. Your pets can be poisoned if they ingest gas, oil or antifreeze that drips onto the pavement or is stored in open containers.

NEVER HOSE VEHICLE FLUIDS into the street or gutter. USE ABSORBENT MATERIALS such as cat litter to clean-up spills. SWEEP UP used absorbent materials and place in the trash.

HORSES AND LIVESTOCK

Fortunate enough to own a horse or livestock? You, too, can play a part in protecting and cleaning up our water resources. The following are a few simple Best Management Practices (BMPs) specifically designed for horse owners and landowners with horses.



- STORE your manure properly. Do not store unprotected piles of manure in places where runoff may enter streams, or flood waters may wash the manure away. Place a cover or tarp over the pile to keep rainwater out.
- CHECK with your local conservation district to design manure storage facilities to protect water quality. These structures usually consist of a concrete pad to protect ground water and a short wall on one or two sides to make manure handling easier.
- TRY composting – A vegetative cover placed around buildings or on steeper slopes can help minimize erosion and absorb nutrients while improving the appearance of your property. In addition, avoid costlier erosion controls, vegetative covers will provide animals with better traction during wet or icy conditions.

- KEEP animals out of steams – Designed stream crossings provide a safe, easy way for horses and livestock to ford streams. Fencing encourages the use of the crossing instead of the streambed to navigate streams. This will allow vegetation to stabilize stream banks and reduce sediment pollution.
- MOW pastures to proper height, six inches is typically recommended.
- Material STORAGE SAFETY TIPS – Many of the chemicals found in barns require careful handling and proper disposal. When using these chemicals, be certain to follow these common sense guidelines:
  - Buy only what you need.
- Treat spills of hoof oils like fuel spill. Use kitty litter to soak up the oil and dispose in a tightly sealed plastic bag.
- Store pesticides in a locked, dry, well-ventilated area.
- Protect stored fertilizer and pesticides from rain and surface water.

Call 1-800-506-2555 to locate your local conservation district to find out what to do with your current backyard manure pile, how to re-establish a healthy pasture, what to do about weeds, and what grasses grow best in your soils.

Thank you for doing your part to protect your watershed, the environment, and the equestrian way of life in your community!

After the Storm

A Citizen's Guide to Understanding Stormwater

For more information contact:

or visit
www.epa.gov/npdes/stormwater
www.epa.gov/nps

United States Environmental Protection Agency

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What is stormwater runoff?

Stormwater runoff occurs when precipitation from rain or snowmelt flows over the ground. Impervious surfaces like driveways, sidewalks, and streets prevent stormwater from naturally soaking into the ground.

Why is stormwater runoff a problem?

Stormwater can pick up debris, chemicals, dirt, and other pollutants and flow into a storm sewer system or directly to a lake, stream, river, wetland, or coastal water. Anything that enters a storm sewer system is discharged untreated into the waterbodies we use for swimming, fishing, and providing drinking water.

The effects of pollution

Polluted stormwater runoff can have many adverse effects on plants, fish, animals, and people.

- Sediment can cloud the water and make it difficult or impossible for aquatic plants to grow. Sediment also can destroy aquatic habitats.
- Excess nutrients can cause algae blooms. When algae die, they sink to the bottom and decompose in a process that removes oxygen from the water. Fish and other aquatic organisms can't exist in water with low dissolved oxygen levels.

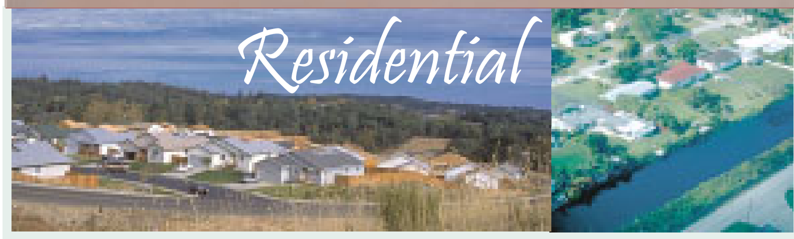
- Bacteria and other pathogens can wash into swimming areas and create health hazards, often making beach closures necessary.
- Debris—plastic bags, six-pack rings, bottles, and cigarette butts—washed into waterbodies can choke, suffocate, or disable aquatic life like ducks, fish, turtles, and birds.
- Household hazardous wastes like insecticides, pesticides, paint, solvents, used motor oil, and other auto fluids can poison aquatic life. Land animals and people can become sick or die from eating diseased fish and shellfish or ingesting polluted water.

- Polluted stormwater often affects drinking water sources. This, in turn, can affect human health and increase drinking water treatment costs.

Stormwater Pollution Solutions

Education is essential to changing people's behavior. Signs and markers near storm drains warn residents that pollutants entering the drains will be carried untreated into a local waterbody.

Residential



Recycle or properly dispose of household products that contain chemicals, such as insecticides, pesticides, paint, solvents, and used motor oil and other auto fluids. Don't pour them onto the ground or into storm drains.

Lawn care

Excess fertilizers and pesticides applied to lawns and gardens wash off and pollute streams. In addition, yard clippings and leaves can wash into storm drains and contribute nutrients and organic matter to streams.

- Don't overwater your lawn. Consider using a soaker hose instead of a sprinkler.
- Use pesticides and fertilizers sparingly. When use is necessary, use these chemicals in the recommended amounts. Use organic mulch or safer pest control methods whenever possible.
- Compost or mulch yard waste. Don't leave it in the street or sweep it into storm drains or streams.
- Cover piles of dirt or mulch being used in landscaping projects.

Auto care

Washing your car and degreasing auto parts at home can send detergents and other contaminants through the storm sewer system. Dumping automotive fluids into storm drains has the same result as dumping the materials directly into a waterbody.

- Use a commercial car wash that treats or recycles its wastewater, or wash your car on your yard so the water infiltrates into the ground.
- Repair leaks and dispose of used auto fluids and batteries at designated drop-off or recycling locations.

Septic systems

Leaking and poorly maintained septic systems release nutrients and pathogens (bacteria and viruses) that can be picked up by stormwater and discharged into nearby waterbodies. Pathogens can cause public health problems and environmental concerns.

- Inspect your system every 3 years and pump your tank as necessary (every 3 to 5 years).
- Don't dispose of household hazardous waste in sinks or toilets.

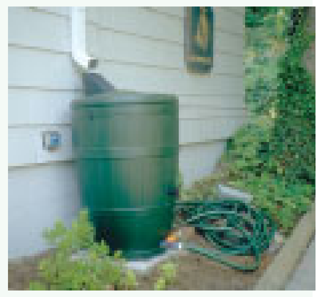
Pet waste

Pet waste can be a major source of bacteria and excess nutrients in local waters.

- When walking your pet, remember to pick up the waste and dispose of it properly. Flushing pet waste is the best disposal method. Leaving pet waste on the ground increases public health risks by allowing harmful bacteria and nutrients to wash into the storm drain and eventually into local waterbodies.

Residential landscaping

Permeable Pavement—Traditional concrete and asphalt don't allow water to soak into the ground. Instead these surfaces rely on storm drains to divert unwanted water. Permeable pavement systems allow rain and snowmelt to soak through, decreasing stormwater runoff.



Rain Barrels—You can collect rainwater from rooftops in mosquito-proof containers. The water can be used later on lawn or garden areas.

Rain Gardens and Grassy Swales—Specially designed areas planted with native plants can provide natural places for rainwater to collect and soak into the ground. Rain from rooftop areas or paved areas can be diverted into these areas rather than into storm drains.

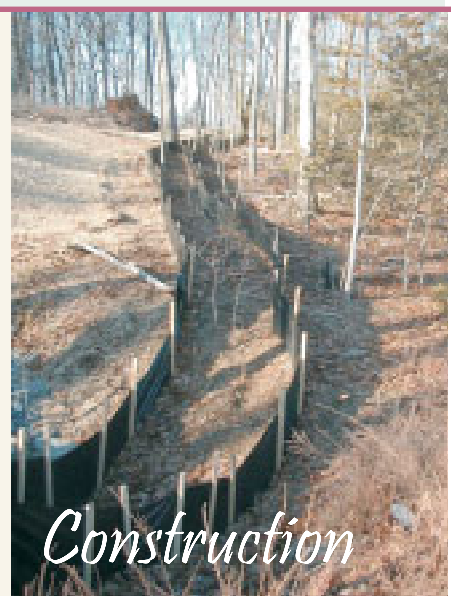
Vegetated Filter Strips—Filter strips are areas of native grass or plants created along roadways or streams. They trap the pollutants stormwater picks up as it flows across driveways and streets.

Commercial

Dirt, oil, and debris that collect in parking lots and paved areas can be washed into the storm sewer system and eventually enter local waterbodies.

- Sweep up litter and debris from sidewalks, driveways and parking lots, especially around storm drains.
- Cover grease storage and dumpsters and keep them clean to avoid leaks.
- Report any chemical spill to the local hazardous waste cleanup team. They'll know the best way to keep spills from harming the environment.

Construction



Erosion controls that aren't maintained can cause excessive amounts of sediment and debris to be carried into the stormwater system. Construction vehicles can leak fuel, oil, and other harmful fluids that can be picked up by stormwater and deposited into local waterbodies.

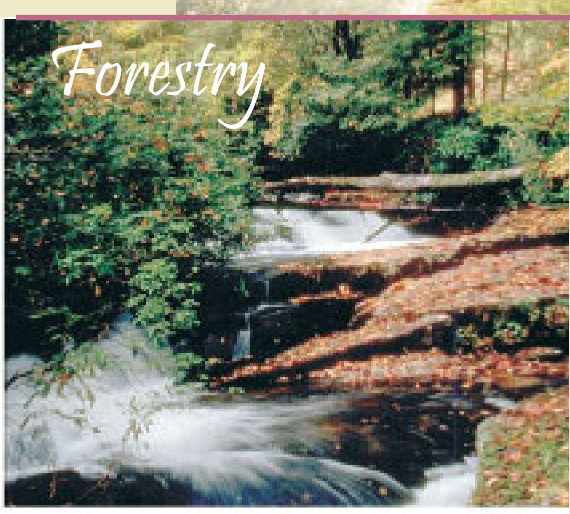
- Divert stormwater away from disturbed or exposed areas of the construction site.
- Install silt fences, vehicle mud removal areas, vegetative cover, and other sediment and erosion controls and properly maintain them, especially after rainstorms.
- Prevent soil erosion by minimizing disturbed areas during construction projects, and seed and mulch bare areas as soon as possible.

Agriculture

Lack of vegetation on streambanks can lead to erosion. Overgrazed pastures can also contribute excessive amounts of sediment to local waterbodies. Excess fertilizers and pesticides can poison aquatic animals and lead to destructive algae blooms. Livestock in streams can contaminate waterways with bacteria, making them unsafe for human contact.

- Keep livestock away from streambanks and provide them a water source away from waterbodies.
- Store and apply manure away from waterbodies and in accordance with a nutrient management plan.
- Vegetate riparian areas along waterways.
- Rotate animal grazing to prevent soil erosion in fields.
- Apply fertilizers and pesticides according to label instructions to save money and minimize pollution.

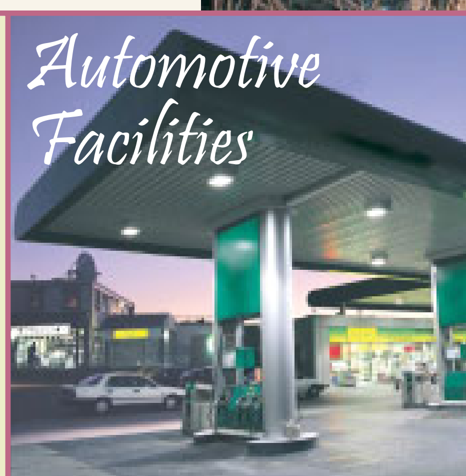
Forestry



Improperly managed logging operations can result in erosion and sedimentation.

- Conduct preharvest planning to prevent erosion and lower costs.
- Use logging methods and equipment that minimize soil disturbance.
- Plan and design skid trails, yard areas, and truck access roads to minimize stream crossings and avoid disturbing the forest floor.
- Construct stream crossings so that they minimize erosion and physical changes to streams.
- Expedite revegetation of cleared areas.

Automotive Facilities



Uncovered fueling stations allow spills to be washed into storm drains. Cars waiting to be repaired can leak fuel, oil, and other harmful fluids that can be picked up by stormwater.

- Clean up spills immediately and properly dispose of cleanup materials.
- Provide cover over fueling stations and design or retrofit facilities for spill containment.
- Properly maintain fleet vehicles to prevent oil, gas, and other discharges from being washed into local waterbodies.
- Install and maintain oil/water separators.

AUTO MAINTENANCE

Oil and grease from cars, asbestos worn from brake linings, zinc from tires, and toxics from spilled fluids often make their way into the San Bernardino County storm drain system and DO NOT GET TREATED before reaching the Santa Ana River. These wastes pollute our drinking water, and make our waters unhealthy and unsafe for people and wildlife.

Follow these practices to help prevent stormwater pollution...

Cleanin' Work Sites...

Avoid hosing down your garage floor and driveway; instead, sweep regularly. Also, use non-toxic cleaning products. A water and baking soda mixture works great on removing corrosion from battery terminals and cleaning chrome; mix the soda with a mild, biodegradable dishwashing soap to clean wheels and tires. Additionally, a mixture of white vinegar or lemon juice with water can be used to clean windows.

Spills...

Avoid accidental spills by using a drip pan and funnel when draining or pouring fluids. Be ready for unexpected spills by preparing and using spill containment and cleanup kits. Kits should include safety equipment and cleanup materials such as kitty litter, sawdust or cornmeal. Furthermore, prevent leaks from stored vehicles by draining gas, hydraulic oil, and transmission, brake & radiator fluid. To report serious spills, call 1-800-33-TOXIC.

Recycling...

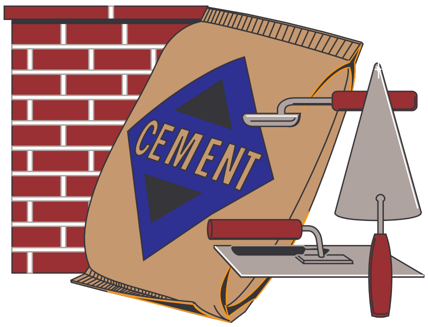
The law requires people to recycle motor oil and lead acid batteries. REMEMBER: Never dump them down storm drains. Other items which can be recycled include oil filters, antifreeze, cleaning solutions, hydraulic & transmission fluids, metal scraps, water-based paints, and used tires. For recycling information, call 386-8401.

Washin' Vehicles...

Take vehicles to a washing facility to prevent oil & grease, suspended solids and other toxics from washing into our storm drains. Otherwise, use bermed wash areas to prevent contact with stormwater. Discharge wash water to sewer only after contacting local sewer authority to find out if pretreatment is required. At home, vehicles should be washed on the lawn, which can absorb unwanted runoff.

For more information, call your city's stormwater representative

FRESH CONCRETE & MORTAR APPLICATION



Cement, cement wash, gravel, asphalt, solvents, and motor oil from fresh concrete and mortar activities often make their way into the San Bernardino County storm drain system and DO NOT GET TREATED before reaching the Santa Ana River. These wastes pollute our drinking water, and make our waters unhealthy and unsafe for people and wildlife.

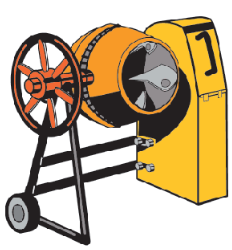
Follow these practices to help prevent stormwater pollution...

General Business Practices...

Schedule excavation and grading work during dry weather, and in case it rains, prevent materials from contacting stormwater by storing them under cover. Also, secure open bags of cement to keep wind-blown cement powder away from streets, gutters and storm drains.

During Construction...

Prevent mortar and cement from entering the storm drains by placing erosion controls (i.e., berms or temporary vegetation) down-slope to capture runoff. When breaking up paving, be sure to pick up all pieces and recycle them at a crushing company; small amounts of excess dry concrete, grout and mortar can be disposed of in the trash. Setup small mixers on tarps or heavy drop cloths to allow for easy cleanup of debris. REMEMBER: Never bury waste material -- recycle or dispose of it as hazardous waste. Call 386-8401 for recycling and disposal information.



Handling Materials & Wastes...

Minimize wastes when ordering materials by ordering only the amounts needed to complete the job. Whenever possible, use recycled or recyclable materials. Recycle broken asphalt, concrete, wood, and cleared vegetation. Unrecyclable materials must be taken to an appropriate landfill or disposed of as hazardous waste. For recycling and disposal information, call 386-8401.

Cleaning up...

When cleaning up after driveway or sidewalk construction, wash concrete dust onto designated dirt areas, not down the driveway or into the street or storm drain. Also, wash out concrete mixers and equipment only in specified wash-out areas, where the water flows into containment ponds. Cement washwater can be recycled by pumping it back into cement mixers for reuse. REMEMBER: Never dispose of cement washout into driveways, streets, gutters, storm drains or drainage ditches.

San Bernardino County STORMWATER PROGRAM

For more information, call your city's stormwater representative

San Bernardino County STORMWATER PROGRAM

For Information:

For more information on the General Industrial Storm Water Permit contact:

State Water Resources Control Board (SWRCB) (916) 657-1146 or www.swrcb.ca.gov/ or, at your Regional Water Quality Control Board (RWQCB).

Santa Ana Region (8)
California Tower
3737 Main Street, Ste. 500
Riverside, CA 92501-3339
(909) 782-4130

San Diego Region (9)
9771 Clairemont Mesa Blvd., Ste. A
San Diego, CA 92124
(619) 467-2952

Colorado River Basin Region (7)
73-720 Fred Waring Dr., Ste. 100
Palm Desert, CA 92260
(760) 346-7491

SPILL RESPONSE AGENCY:

HAZ-MAT:	(909) 358-5055
HAZARDOUS WASTE DISPOSAL:	(909) 358-5055
RECYCLING INFORMATION:	1-800-366-SAVE
TO REPORT ILLEGAL DUMPING OR A CLOGGED STORM DRAIN:	1-800-506-2555

To order additional brochures or to obtain information on other pollution prevention activities, call: (909) 955-1111.

StormWater CleanWater
PROTECTION PROGRAM

Riverside County gratefully acknowledges the State Water Quality Control Board and the American Public Works Association, Storm Water Quality Task Force for the information provided in this brochure.

DID YOU KNOW . . .

YOUR FACILITY MAY NEED A STORM WATER PERMIT?

Many industrial facilities and manufacturing operations must obtain coverage under the Industrial Activities Storm Water General Permit

FIND OUT
IF YOUR FACILITY MUST OBTAIN A PERMIT

StormWater Pollution . . . What you should know

Riverside County has two drainage systems - sanitary sewers and storm drains. The storm drain system is designed to help prevent flooding by carrying excess rainwater away from streets. Since the storm drain system does not provide for water treatment, it also serves the *unintended* function of transporting pollutants directly to our waterways.

Unlike sanitary sewers, storm drains are not connected to a treatment plant - they flow directly to our local streams, rivers and lakes.

In recent years, awareness of the need to protect water quality has increased. As a result, federal, state, and local programs have been established to reduce polluted stormwater discharges to our waterways. The emphasis of these programs is to prevent stormwater pollution since it's much easier, and less costly, than cleaning up "after the fact."

National Pollutant Discharge Elimination System (NPDES)

In 1987, the Federal Clean Water Act was amended to establish a framework for regulating industrial stormwater discharges under the NPDES permit program. In California, NPDES permits are issued by the State Water Resources Control Board (SWRCB) and the nine (9) Regional Water Quality Control Boards (RWQCB). In general, certain industrial facilities and manufacturing operations must obtain coverage under the Industrial Activities Storm Water General Permit if the type of facilities or operations falls into one of the several categories described in this brochure.

How Do I Know If I Need A Permit?

Following are ***general descriptions*** of the industry categories types that are regulated by the Industrial Activities Storm Water General Permit. Contact your local Region Water Quality Control Board to determine if your facility/operation requires coverage under the Permit.

➜ Facilities such as cement manufacturing; feedlots; fertilizer manufacturing; petroleum refining; phosphate manufacturing; steam electric power generation; coal mining; mineral mining and processing; ore mining and dressing; and asphalt emulsion;

➜ Facilities classified as lumber and wood products (except wood kitchen cabinets); pulp, paper, and paperboard mills; chemical producers (except some pharmaceutical and biological products); petroleum and coal products; leather production and products; stone, clay and glass products; primary metal industries; fabricated structural metal; ship and boat building and repairing;

➜ Active or inactive mining operations and oil and gas exploration, production, processing, or treatment operations;

➜ Hazardous waste treatment, storage, or disposal facilities;

➜ Landfills, land application sites and open dumps that receive or have received any industrial waste; unless there is a new overlying land use such as a golf course, park, etc., and there is no discharge associated with the landfill;

➜ Facilities involved in the recycling of materials, including metal scrap yards, battery reclaimers, salvage yards, and automobile junkyards;

➜ Steam electric power generating facilities, facilities that generate steam for electric power by combustion;

➜ Transportation facilities that have vehicle maintenance shops, fueling facilities, equipment cleaning operations, or airport deicing operations. This includes school bus maintenance facilities operated by a school district;

➜ Sewage treatment facilities;

➜ Facilities that have areas where material handling equipment or activities, raw materials, intermediate products, final products, waste materials, by-products, or industrial machinery are exposed to storm water.

How do I obtain coverage under the Industrial Activities Storm Water General Permit?

Obtain a permit application package from your local Regional Water Quality Control Board listed on the back of this brochure or the State Water Resources Control Board (SWRCB). Submit a completed Notice of Intent (NOI) form, site map and the appropriate fee ($250 or $500) to the SWRCB. Facilities must submit an NOI thirty (30) days prior to beginning operation. Once you submit the NOI, the State Board will send you a letter acknowledging receipt of your NOI and will assign your facility a waste discharge identification number (WDID No.). You will also receive an annual fee billing. These billings should roughly coincide with the date the State Board processed your original NOI submittal.

What are the requirements of the Industrial Activities Storm Water General Permit?

The basic requirements of the Permit are:

1. The facility must eliminate any non-stormwater discharges or obtain a separate permit for such discharges.

2. The facility must develop and implement a Storm Water Pollution Prevention Plan (SWPPP). The SWPPP must identify sources of pollutants that may be exposed to stormwater. Once the sources of pollutants have been identified, the facility operator must develop and implement Best Management Practices (BMPs) to minimize or prevent polluted runoff.

   Guidance in preparing a SWPPP is available from a document prepared by the California Storm Water Quality Task Force called the California Storm Water Best Management Practice Handbook.

3. The facility must develop and implement a Monitoring Program that includes conducting visual observations and collecting samples of the facility's storm water discharges associated with industrial activity. The General Permit requires that the analysis be conducted by a laboratory that is certified by the State of California.

4. The facility must submit to the Regional Board, every July 1, an annual report that includes the results of its monitoring program.

A Non-Storm Water Discharge is... *any discharge to a storm drain system that is not composed entirely of storm water. The following non-storm water discharges are authorized by the General Permit: fire hydrant flushing; potable water sources, including potable water related to the operation, maintenance, or testing of potable water systems; drinking fountain water; atmospheric condensates including refrigeration, air conditioning, and compressor condensate; irrigation drainage; landscape watering; springs; non-contaminated ground water; foundation or footing drainage; and sea water infiltration where the sea waters are discharged back into the sea water source.*

A BMP is . . . *a technique, process, activity, or structure used to reduce the pollutant content of a storm water discharge. BMPs may include simple, non-structural methods such as good housekeeping, staff training and preventive maintenance. Additionally, BMPs may include structural modifications such as the installation of berms, canopies or treatment control (e.g. setting basins, oil/water separators, etc.)*

WARNING*: There are significant penalties for non-compliance: a minimum fine of $5,000 for failing to obtain permit coverage, and, up to $10,000 per day, per violation plus $10 per gallon of discharge in excess of 1,000 gallons.*

HOME & GARDEN

Yard waste and household toxics such as paints, solvents, and pesticides often make their way into the San Bernardino County storm drain system and DO NOT GET TREATED before reaching the Santa Ana River. These wastes pollute our drinking water and make our waters unhealthy and unsafe for people and wildlife.

Follow these practices to help prevent stormwater pollution...

In Your Home...

Household products such as paints, paint thinners, drain openers, motor oil, wood polishes, insecticides & herbicides, oven cleaners, and many other general cleaners frequently get dumped on the ground, or into a gutter, street or storm drain. Instead of polluting our stormwaters, take these items to a household hazardous waste collection facility. Call 1-800-OILY-CAT for a facility in your area.

Fertilizers and Pesticides...

Fertilizers and pesticides are often carried into our storm drains by sprinkler runoff. To minimize stormwater pollution, use organic or non-toxic pesticides and fertilizers as directed, and keep them away from ditches, gutters and storm drains. Store them in a covered area, off the ground, to prevent contact with water. For additional gardening questions, call the San Bernardino Master Gardeners at 387-2182.

Trimmin' the Garden...

Decaying organic materials that enter our storm drains, such as grass, leaves, yard clippings, and pet waste, will use up oxygen in nearby streams, stressing aquatic life. Prevent stormwater pollution by not blowing, sweeping, raking or hosing yard waste into the street, gutter, or storm drain. Alternatively, leave grass clippings on your lawn after mowing, or compost your clippings and yard waste. Pet waste should not be composted, but rather disposed of in the trash to prevent the potential spread of diseases.

Planting In The Yard

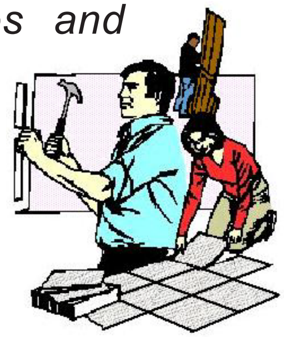
Produce less yard waste and save water by planting low maintenance trees and shrubs. Also, conserve water and minimize unwanted runoff by using drip irrigation, soaker hoses, or micro-spray systems to water vegetation.

San Bernardino County STORMWATER PROGRAM

For more information, call your city's stormwater representative

San Bernardino County STORMWATER PROGRAM

HOME REPAIR & REMODELING



Paints, solvents, adhesives, dusts, sediments, pesticides and household toxics commonly associated with home repair and remodeling activities often make their way into the San Bernardino County storm drain system and DO NOT GET TREATED before reaching the Santa Ana River. These wastes pollute our drinking water, and make our waters unhealthy and unsafe for people and wildlife.

Follow these practices to help prevent stormwater pollution...

Household Hazardous Wastes...

Common household cleaners, paint products, and wallpaper & tile adhesives contain toxic substances. Dispose of these products properly. REMEMBER: Toxic wastes should never enter the storm drain system. For disposal information, call 1-800-OILY-CAT.

Construction...

Keep all construction debris away from the street, gutter and storm drain, and if possible, schedule grading and excavation projects for dry weather. Cover excavated material and stockpiles of asphalt, sand, etc. with plastic tarps, and prevent erosion by planting fast-growing annual and perennial grasses, which will shield and bind the soil.

Landscape & Gardening...

Use fertilizers and pesticides as directed. Keep them away from ditches, gutters and storm drains, and store them in a covered area to prevent contact with rain water. Also, minimize runoff and conserve water by using drip irrigation, soaker hoses, or micro-spray systems. REMEMBER: Do not deposit leaves into the street, gutter, or storm drain.

Painting...

CLEANUP... Avoid cleaning brushes or rinsing paint containers into a street, gutter, or storm drain. For water-based paints, "brush out" as much paint as possible, and rinse in the sink. For oil-based paints, "brush out" as much paint as possible, clean with thinner, and then filter and reuse thinner or solvent.

REMOVAL... Paint stripping residue, chips & dust from marine paints, and paints containing lead or tributyl tin are hazardous wastes. Sweep them up and call 1-800-OILY-CAT for disposal information.

RECYCLING... Recycle or reuse leftover paint by using it for touch-ups, or by giving it to someone who can us it, such as a theatre group, school, city or other community organization. If you're unable to give it away, contact 1-800-OILY-CAT for disposal information.

Concrete & Masonry...

Store bags of cement and plaster away from gutters and storm drains, and under cover, protected from rainfall, runoff and wind. REMEMBER: Never dispose of cement washout or concrete dust onto driveways, streets, gutters or storm drains.

San Bernardino County STORMWATER PROGRAM

For more information, call your city's stormwater representative

San Bernardino County STORMWATER PROGRAM

Helpful telephone numbers and links:

RIVERSIDE COUNTY WATER AGENCIES

City of Banning	(951) 922-3130
City of Beaumont/Cherry Valley	(951) 845-9581
City of Blythe	(760) 922-6161
City of Coachella	(760) 398-3502
City of Corona	(951) 736-2263
City of Hemet	(951) 765-3710
City of Norco	(951) 270 5607
City of Riverside Public Works	(951) 351-6140
City of San Jacinto	(951) 654-4041
Coachella Valley Water District	(760) 398-2651
Desert Water Agency (Palm Springs)	(760) 323-4971
Eastern Municipal Water District	(951) 928-3777
Elsinore Valley Municipal Water District	(951) 674 3146
Elsinore Water District	(951) 674-2168
Farm Mutual Water Company	(951) 244-4198
Idyllwild Water District	(951) 659-2143
Indio Water Authority	(760) 391-4129
Jurupa Community Services District	(951) 685-7434
Lee Lake Water	(951) 658-3241
Mission Springs Water	(760) 329-6448
Rancho California Water District	(951) 296-6900
Ripley, CSA #62	(760) 922-4951
Riverside Co. Service Area #51	(760) 227-3203
Rubidoux Community Services District	(951) 684-7580
Valley Sanitary District	(760) 347-2356
Western Municipal Water District	(951) 789-5000
Yucaipa Valley Water District	(909) 797-5117

REPORT ILLEGAL STORM DRAIN DISPOSAL
1-800-506-2555 or e-mail us at
fcnpdes@rcflood.org

- Riverside County Flood Control and Water Conservation District
  www.rcflood.org

Online resources include:

- California Storm Water Quality Association
  www.casqa.org
- State Water Resources Control Board
  www.waterboards.ca.gov
- Power Washers of North America
  www.thepwna.org

Stormwater Pollution

What you should know for...

Outdoor Cleaning Activities and Professional Mobile Service Providers

Storm drain pollution prevention information for:

- Car Washing / Mobile Detailers
- Window and Carpet Cleaners
- Power Washers
- Waterproofers / Street Sweepers
- Equipment cleaners or degreasers and all mobile service providers

Do you know where street flows actually go?

Storm drains are NOT connected to sanitary sewer systems and treatment plants!

The primary purpose of storm drains is to carry rain water away from developed areas to prevent flooding. Pollutants discharged to storm drains are transported directly into rivers, lakes and streams. Soaps, degreasers, automotive fluids, litter and a host of materials are washed off buildings, sidewalks, plazas and parking areas. Vehicles and equipment must be properly managed to prevent the pollution of local waterways.

Unintentional spills by mobile service operators can flow into storm drains and pollute our waterways. **Avoid mishaps.** *Always* have a **Spill Response Kit** on hand to clean up unintentional spills. Only emergency **Mechanical** repairs should be done in City streets, using drip pans for spills. **Plumbing** should be done on private property. Always store chemicals in a leak-proof container and keep covered when not in use. **Window/Power Washing** waste water shouldn't be released into the streets, but should be disposed of in a sanitary sewer, landscaped area or in the soil. Soiled **Carpet Cleaning** wash water should be filtered before being discharged into the sanitary sewer. Dispose of all filter debris properly. **Car Washing/Detailing** operators should wash cars on private property and use a regulated hose nozzle for water flow control and runoff prevention. Capture and dispose of waste water and chemicals properly. Remember, storm drains are for receiving rain water runoff only.

REPORT ILLEGAL STORM DRAIN DISPOSAL 1-800-506-2555

Help Protect Our Waterways!

Use these guidelines for Outdoor Cleaning Activities and Wash Water Disposal

Did you know that disposing of pollutants into the street, gutter, storm drain or body of water is *PROHIBITED* by law and can result in stiff penalties?

Best Management Practices

Waste wash water from Mechanics, Plumbers, Window/Power Washers, Carpet Cleaners, Car Washing and Mobile Detailing activities may contain significant quantities of motor oil, grease, chemicals, dirt, detergents, brake pad dust, litter and other materials.

Best Management Practices, or BMPs as they are known, are guides to prevent pollutants from entering the storm drains. *Each of us* can do our part to keep storm water clean by using the suggested BMPs below:

Simple solutions for both light and heavy duty jobs:

Do...consider dry cleaning methods first such as a mop, broom, rag or wire brush. Always keep a spill response kit on site.

Do...prepare the work area before power cleaning by using sand bags, rubber mats, vacuum booms, containment pads or temporary berms to keep wash water away from the gutters and storm drains.

Do...use vacuums or other machines to remove and collect loose debris or litter before applying water.

Do...obtain the property owner's permission to dispose of ***small amounts*** of power washing waste water on to landscaped, gravel or unpaved surfaces.

Do...check your local sanitary sewer agency's policies on wash water disposal regulations before disposing wash water to the sewer. (See list on reverse side)

Do...be aware that if discharging to landscape areas, soapy wash water may damage landscaping. Residual wash water may remain on paved surfaces to evaporate. Sweep up solid residuals and dispose of properly. Vacuum booms are another option for capturing and collecting wash water.

Do...check to see if local ordinances prevent certain activities.

Do not let...wash or waste water from sidewalk, plaza or building cleaning go into a street or storm drain.

Report illegal storm drain disposal,
Call Toll Free
1-800-506-2555

Using Cleaning Agents

Try using biodegradable/phosphate-free products. They are easier on the environment, but don't confuse them for being toxic free. Soapy water entering the storm drain system can impact the delicate aquatic environment.

When cleaning surfaces with a ***high-pressure washer*** or ***steam cleaner***, additional precautions should be taken to prevent the discharge of pollutants into the storm drain system. These two methods of surface cleaning can loosen additional material that can contaminate local waterways.

Think Water Conservation

Minimize water use by using high pressure, low volume nozzles. Be sure to check all hoses for leaks. Water is a precious resource, don't let it flow freely and be sure to shut it off in between uses.

Screening Wash Water

Conduct thorough dry cleanup before washing exterior surfaces, such as buildings and decks ***with loose paint***, sidewalks or plaza areas. Keep debris from entering the storm drain after cleaning by first passing the wash water through a "20 mesh" or finer screen to catch the solid materials, then dispose of the mesh in a refuse container. Do not let the remaining wash water enter a street, gutter or storm drain.

Drain Inlet Protection & Collection of Wash Water

- Prior to any washing, block all storm drains with an impervious barrier such as sandbags or berms, or seal the storm drain with plugs or other appropriate materials.
- Create a containment area with berms and traps or take advantage of a low spot to keep wash water contained.
- Wash vehicles and equipment on grassy or gravel areas so that the wash water can seep into the ground.
- Pump or vacuum up all wash water in the contained area.

Concrete/Coring/Saw Cutting and Drilling Projects

Protect any down-gradient inlet by using dry activity techniques whenever possible. If water is used, minimize the amount of water used during the coring/drilling or saw cutting process. Place a barrier of sandbags and/or absorbent berms to protect the storm drain inlet or watercourse. Use a shovel or wet vacuum to remove the residue from the pavement. Do not wash residue or particulate matter into a storm drain inlet or watercourse.

For Information:

LOCAL SEWERING AGENCIES IN RIVERSIDE COUNTY:

City of Beaumont	(909) 769-8520
Belair Homeowners Association	(909) 277-1414
City of Banning	(909) 922-3130
City of Blythe	(760) 922-6161
City of Coachella	(760) 391-5008
Coachella Valley Water District	(760) 398-2651
City of Corona	(909) 736-2259
Desert Center, CSA #51	(760) 227-3203
Eastern Municipal Water District	(909) 928-3777
Elsinore Valley MWD	(909) 674-3146
Farm Mutual Water Company	(909) 244-4198
Idyllwild Water District	(909) 659-2143
Jurupa Community Services Dist.	(909) 685-7434
Lake Hemet MWD	(909) 658-3241
Lee Lake Water District	(909) 277-1414
March Air Force Base	(909) 656-7000
Mission Springs Water District	(760) 329-6448
City of Palm Springs	(760) 323-8242
Rancho Caballero	(909) 780-9272
Rancho California Water Dist.	(909) 676-4101
Ripley, CSA #62	(760) 922-4909
Rubidoux Community Services Dist.	(909) 684-7580
City of Riverside	(909) 782-5341
Silent Valley Club, Inc	(909) 849-4501
Valley Sanitary District	(760) 347-2356
Western Municipal Water District	(909) 780-4170

SPILL RESPONSE AGENCY:

HAZ-MAT:	(909) 358-5055
HAZARDOUS WASTE DISPOSAL:	(909) 358-5055
TO REPORT ILLEGAL DUMPING OR A CLOGGED STORM DRAIN:	1-800-506-2555

StormWater CleanWater PROTECTION PROGRAM

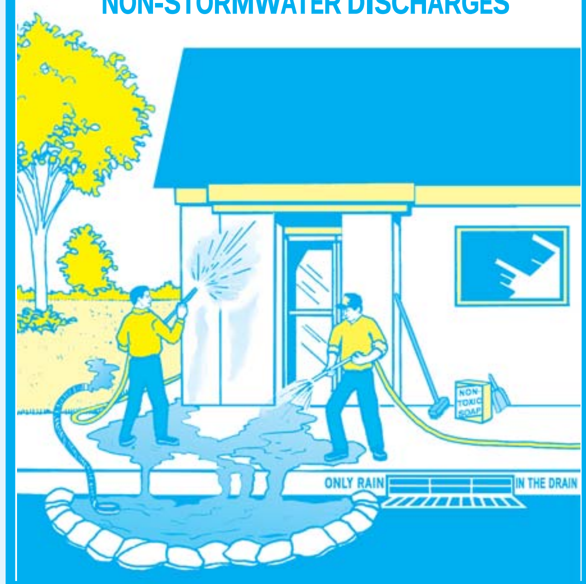
Riverside County gratefully acknowledges the Bay Area Stormwater Management Agencies Association and the Cleaning Equipment Trade Association for information provided in this brochure.

StormWater Pollution

What you should know for...

OUTDOOR CLEANING ACTIVITIES

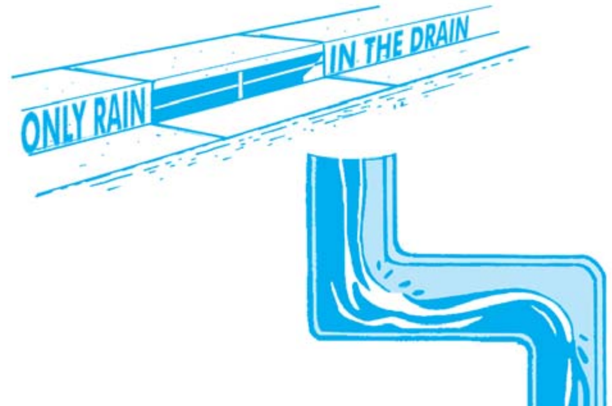
NON-STORMWATER DISCHARGES



GUIDELINES for disposal of washwater from:

- Sidewalk, plaza or parking lot cleaning
- Vehicle washing or detailing
- Building exterior cleaning
- Waterproofing
- Equipment cleaning or degreasing

Do you know . . . where the water should go?



Riverside County has two drainage systems - sanitary sewers and storm drains. The storm drain system is designed to prevent flooding by carrying excess rainwater away from streets. . . it's not designed to be a waste disposal system. Since the storm drain system does not provide for water treatment, it often serves the unintended function of transporting pollutants directly to our waterways.

Unlike sanitary sewers, storm drains are not connected to a treatment plant - they flow directly to our local streams, rivers and lakes.

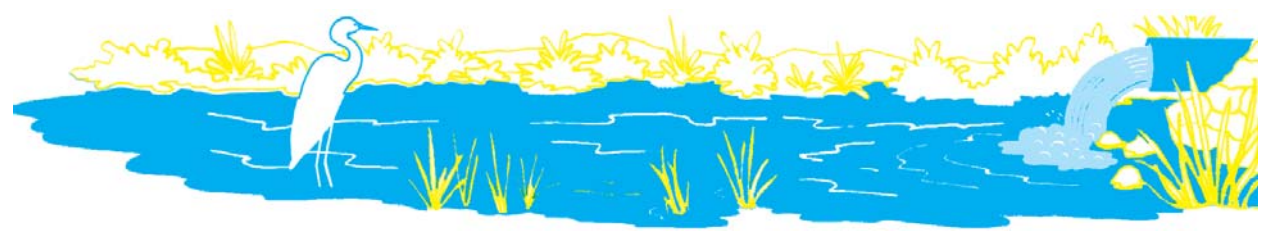
Non-stormwater discharges such as washwater generated from outdoor cleaning projects often transport harmful pollutants into storm drains and our local waterways. Polluted runoff contaminates local waterways and poses a threat to groundwater resources.

Soaps, degreasers, automotive fluids, litter, and a host of other materials washed off buildings, sidewalks, plazas, parking areas, vehicles, and equipment can all pollute our waterways.

The Cities and County of Riverside StormWater/CleanWater Protection Program

Since preventing pollution is much easier, and less costly than cleaning up "after the fact," the Cities and County of Riverside StormWater/CleanWater Protection Program informs residents and businesses of pollution prevention activities such as those described in this pamphlet.

The Cities and County of Riverside have adopted ordinances for stormwater management and discharge control. In accordance with state and federal law, these local stormwater ordinances **prohibit** the discharge of wastes into the storm drain system or local surface waters. This includes non-stormwater discharges containing oil, grease, detergents, degreasers, trash, or other waste materials.



PLEASE NOTE: The discharge of pollutants into the street, gutters, storm drain system, or waterways - without a Regional Water Quality Control Board permit or waiver - is ***strictly prohibited*** by local ordinances and state and federal law.

Help Protect Our Waterways!

Use These Guidelines For Outdoor Cleaning Activities and Washwater Disposal

DO . . . Dispose of **small amounts** of **washwater from cleaning building exteriors, sidewalks, or plazas** onto landscaped or unpaved surfaces provided you have the owner's permission and the discharge will not cause flooding or nuisance problems, or flow into a storm drain.

DO NOT . . . Discharge **large amounts** of these types of washwater onto landscaped areas or soil where water may run to a street or storm drain. Wastewater from exterior cleaning may be pumped to a sewer line with specific permission from the local sewering agency.

DO . . . Check with your local sewering agency's policies and requirements concerning waste water disposal. **Water from many outdoor cleaning activities** may be acceptable for disposal to the sewer system. See the list on the back of this flyer for phone numbers of the sewering agencies in your area.

DO NOT . . . Pour **hazardous wastes** or toxic materials into the storm drain or sewer system . . . properly dispose of it instead. When in doubt, contact the local sewering agency! The agency will tell you what types of liquid wastes can be accepted.

DO . . . Understand that **water (without soap) used to remove dust from clean vehicles** may be discharged to a street or storm drain. **Washwater from sidewalk, plaza, and building surface cleaning** may go into a street or storm drain if ALL of the following conditions are met:

1) The surface being washed is free of residual oil stains, debris and similar pollutants by using dry cleanup methods (sweeping, and cleaning any oil or chemical spills with rags or other absorbent materials before using water).
2) Washing is done with water only - no soap or other cleaning materials.
3) You have not used the water to remove paint from surfaces during cleaning.

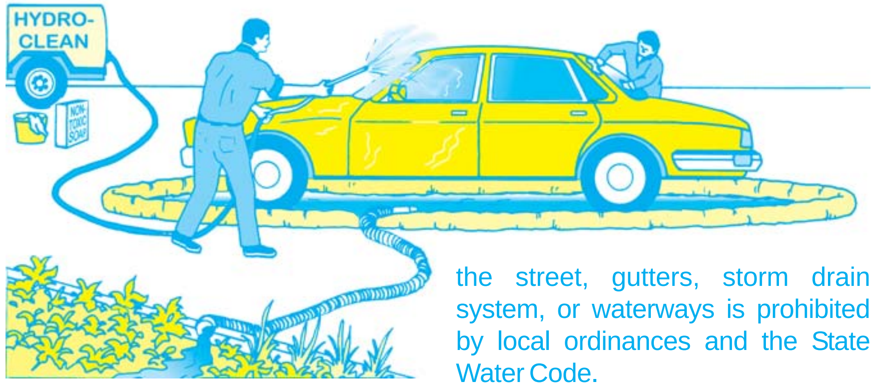
DO NOT . . . Dispose of water containing **soap or any other type of cleaning agent** into a storm drain or water body. This is a direct violation of state and/or local regulations. Because **wastewater from cleaning parking areas or roadways** normally contains metallic brake pad dust, oil and other automotive fluids, it should never be discharged to a street, gutter, or storm drain.

DO . . . Understand that **mobile auto detailers** should divert washwater to landscaped or dirt areas. Note: Be aware that soapy washwater may adversely affect landscaping; consult with the property owner. Residual washwater may remain on paved surfaces to evaporate; sweep up any remaining residue. If there is sufficient water volume to reach the storm drain, collect the runoff and obtain permission to pump it into the sanitary sewer. Follow local sewering agency's requirements for disposal.

DO NOT . . . Dispose of left over cleaning agents into the gutter, storm drain or sanitary sewer.

Regarding Cleaning Agents:

If you must use soap, use biodegradable/phosphate free cleaners. Avoid use of petroleum based cleaning products. Although the use of nontoxic cleaning products is strongly encouraged, ***do*** understand that these products can still degrade water quality and, therefore, the discharge of these products into



the street, gutters, storm drain system, or waterways is prohibited by local ordinances and the State Water Code.

Note: When cleaning surfaces with a high pressure washer or steam cleaning methods, additional precautions should be taken to prevent the discharge of pollutants into the storm drain system. These two methods of surface cleaning, as compared to the use of a low pressure hose, can remove additional materials that can contaminate local waterways.

OTHER TIPS TO HELP PROTECT OUR WATER . . .

SCREENING WASH WATER

A thorough dry cleanup before washing (without soap) surfaces such as building exteriors and decks without loose paint, sidewalks, or plaza areas, *should be sufficient to protect storm drains.* **However**, if any debris (solids) could enter storm drains or remain in the gutter or street after cleaning, washwater should first pass through a "20 mesh" or finer screen to catch the solid material, which should then be disposed of in the trash.

DRAIN INLET PROTECTION/ CONTAINING & COLLECTING WASH WATER

- Sand bags can be used to create a barrier around storm drain inlets.
- Plugs or rubber mats can be used to temporarily seal storm drain openings.
- You can also use vacuum booms, containment pads, or temporary berms to keep wash water away from the street, gutter, or storm drain.

EQUIPMENT AND SUPPLIES

Special materials such as absorbents, storm drain plugs and seals, small sump pumps, and vacuum booms are available from many vendors. For more information check catalogs such as New Pig (800-468-4647), Lab Safety Supply (800-356-0783), C&H (800-558-9966), and W.W. Grainger (800-994-9174); or call the Cleaning Equipment Trade Association (800-441-0111) or the Power Washers of North America (800-393-PWNA).

PAINTING

Paints, solvents, adhesives, and toxic chemicals from painting operations often make their way into the San Bernardino County storm drain system and DO NOT GET TREATED before reaching the Santa Ana River. These wastes pollute our drinking water, and make our waters unhealthy and unsafe for people and wildlife.

Follow these practices to help prevent stormwater pollution...

General Business Practices...

Keep all paint products and wastes away from the street, gutter, and storm drains. Reuse paint thinner by setting used thinner aside in a closed, labeled jar to settle out paint particles, and then pouring off the clear liquid for future use. Wrap dried paint residue in newspaper and dispose of it in the trash.

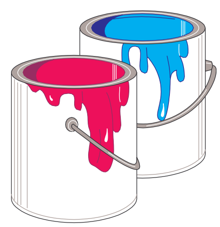
Water-Based Paints...

Purchase water-based paints whenever possible. Look for products labeled “latex” or “clean up with water.”

Recycle or Reuse Paints...

Recycle/reuse leftover paint by using it for touch-ups, or by giving it to someone who can use it, such as a theatre group, school, city or other community organization. If you’re unable to give it away, contact 386-8401 for information on hazardous waste pick-up.

Paint Cleanup...



Avoid cleaning brushes and rinsing paint containers in a street, gutter, or storm drain. For water-based paints, “brush out” as much paint as possible and and rinse in the sink. For oil-based paints, “brush out” as much paint as possible, clean with thinner, and then filter and reuse thinner or solvent.

Paint Removal...

Chemical paint stripping residue, chips & dust from marine paints, and paints containing lead or tributyl tin are hazardous wastes. For disposal information, call 386-8401. Also, when stripping or cleaning building exteriors with high-pressure water, block storm drains and divert the washwater onto a designated dirt area. Check with your local wastewater treatment authority to find out if you can collect building cleaning water and discharge it to the sewer.

For more information, call your city’s stormwater representative

Helpful telephone numbers and links:

Riverside County Water Agencies:

City of Banning	(951) 922-3130
City of Beaumont	(951) 769-8520
City of Blythe	(760) 922-6161
City of Coachella	(760) 398-3502
Coachella Valley Water District	(760) 398-2651
City of Corona	(951) 736-2259
Desert Center, CSA #51	(760) 227-3203
Eastern Municipal Water District	(951) 928-3777
Elsinore Valley MWD	(951) 674-3146
Farm Mutual Water Company	(951) 244-4198
City of Hemet	(951) 765-3712
Idyllwild Water District	(951) 659-2143
Jurupa Community Services District	(951) 360-8795
Lake Hemet MWD	(951) 658-3241
Lee Lake Water District	(951) 277-1414
March Air Force Base	(951) 656-7000
Mission Springs Water District	(760) 329-6448
City of Palm Springs	(760) 323-8253
Rancho Caballero	(951) 780-9272
Rancho California Water District	(951) 296-6900
Ripley, CSA #62	(760) 922-4951
City of Riverside	(951) 351-6170
Rubidoux Community Services District	(951) 684-7580
Silent Valley Club, Inc	(951) 849-4501
Valley Sanitary District	(760) 347-2356
Western Municipal Water District	(951) 789-5000
Yucaipa Valley Water District	(909) 797-5117

CALL 1-800-506-2555 to:

- Report clogged storm drains or illegal storm drain disposal from residential, industrial, construction and commercial sites into public streets, storm drains and/or water bodies.
- Find out about our various storm drain pollution prevention materials.
- Locate the dates and times of Household Hazardous Waste (HHW) Collection Event.
- Request adult, neighborhood, or classroom presentations.
- Locate other County environmental services.
- Receive grasscycling information and composting workshop information.

Or visit our (Riverside County Flood Control District website at: www.floodcontrol.co.riverside.ca.us

Other links to additional storm drain pollution information:

- County of Riverside Environmental Health: www.rivcoeh.org
- California State Water Resource Conservation Board: www.swrcb.ca.gov/stormwtr/links.html
- California Water Quality Task Force: www.cabmphandbooks.com/
- United State Environmental Protection Agency (EPA): www.epa.gov/opptintr/p2home/programs/busprc.htm (compliance assistance information)

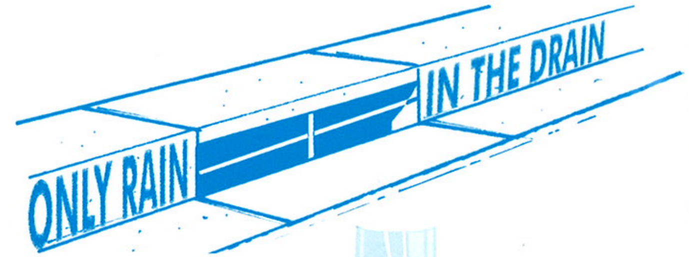
Riverside County Only Rain in the Storm Drain Pollution Protection Program gratefully acknowledges the Bay Area Stormwater Management Agencies Association and the Cleaning Equipment Trade Association for information provided in this brochure.

StormWater Pollution

What you should know for...

Swimming Pool, Jacuzzi and Fountain Maintenance

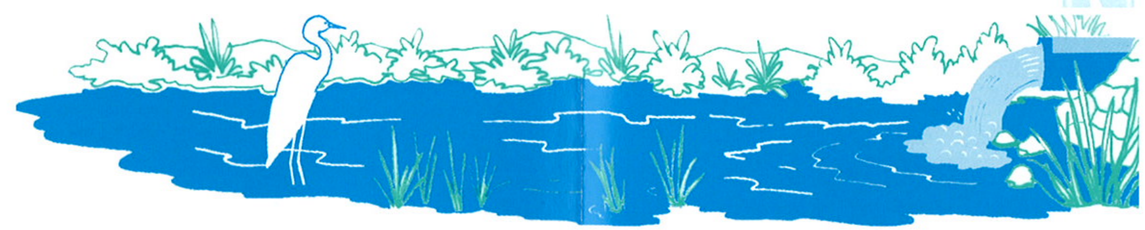
Do you know . . . where the water actually goes?



Storm Drains are not connected to sanitary sewer systems and treatment plants!

The primary purpose of storm drains is to carry rain water away from developed areas to prevent flooding. Untreated storm water and the pollutants it carries flow directly into rivers, lakes, and streams. Wastewater from residential swimming pools, jacuzzis, fishponds, and fountains often contain chemicals used for sanitizing or cleansing purposes. Toxic chemicals (such as chlorine or copper-based algaecides) can damage the environment when wastewater is allowed to flow into our local rivers, lakes, and streams by way of the storm drain system. Each of us can do our part to help clean our water, and that adds up to a pollution solution.

The Cities and County of Riverside have adopted ordinances for storm drain pollution management to maintain discharge control and prevent illegal storm drain discharge. In accordance with state and federal law, these local storm water ordinances prohibit the discharge of pollutants into the storm drain system or local surface waters. The Only Rain in the Storm Drain Pollution Program informs residents and businesses of storm drain pollution prevention activities such as those described in this brochure.



PLEASE NOTE: The discharge of pollutants into the street, gutters, storm drain system, or waterways – without a Regional Water Quality Control board permit or waiver – is strictly prohibited by local ordinances and state and federal law.

Do Your Part to Protect Our Waterways!

Use These Guidelines For Proper Draining of Your Swimming Pool, Jacuzzi and Fountain Water

Discharge Regulations

Requirements for pool draining may differ from city to city. Check with your water agency to see if disposal to the sanitary sewer line is allowed for pool discharges (see reverse side for Riverside County water purveyors).

If sewer discharge is allowed, a hose can be run from your swimming pool pump to the washing machine drain or a sink or bathtub. If sewer discharge is not allowed, or if your house is served by a septic tank, review the options presented below.

Discharge Options

If your local sewer agency will not accept pool water into their system, or if you are on a septic tank system, follow these guidelines:

1. Reduce or eliminate solids (e.g., debris, leaves or dirt) in the pool water.
2. Allow the chemicals in the pool water to dissipate. This could take up to seven (7) days depending on the time of year. Create a co-op; let your neighbor share your pool while theirs is being prepared for draining, then use their pool while yours is being drained. Chlorinated water should not be discharged into the storm drain or surface waters. This includes large pools such as community swimming pools or spas.
3. When the pool water is free of all chemicals (verify by a home pool water test kit) drain pool water to landscaped areas, lawns, yards, or any areas that will absorb the water.
4. You may have to drain the pool water over a period of a few days to allow the landscape areas to absorb most of the water.
5. Control the flow of the draining pool water to prevent soil erosion. Do not allow sediment to enter the street, gutter or storm drain.
6. Avoid discharging pool water into the street and storm drain system. Water runoff that enters the street can pick up motor oil, pet waste, trash and other pollutants, eventually carrying them into the storm drain system and local surface waters.

Refinishing Pool Surfaces

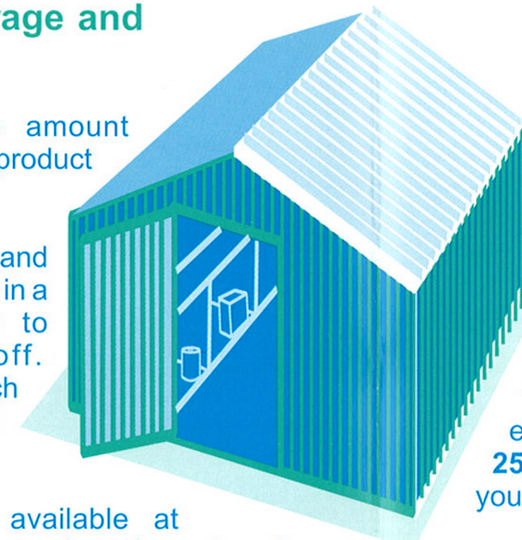
If you are resurfacing your pool, or resurfacing the pool patio area, be sure to hose down mixers, tools and trailers in a dirt area where rinse water won't flow into the street, gutter or storm drain. Local storm water ordinances strictly prohibit the discharge of pollutants into the storm drain system.

Residues from acid washing and similar activities require special handling. Never discharge low or high pH wastewater into the street, gutter or storm drain.

Cleaning Filters

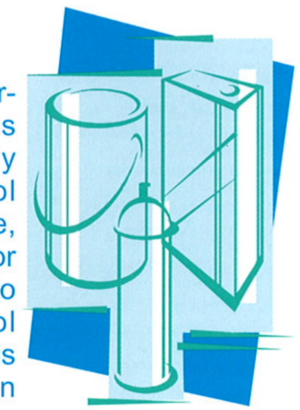
Discharge of pool filter rinse water and backflush to a stream, ditch, or storm drain is prohibited. Backflush from pool filters must be discharged to the sanitary sewer, on-site septic tank and drainfield system (if properly designed and adequately sized), or a seepage pit. Alternatively, pool filter rinse water and backwash may be diverted to dirt or landscaped areas. Filter media and other solids should be picked up and disposed of in the trash.

Chemical Storage and Handling



- Use only the amount indicated on product labels.
- Store chlorine and other chemicals in a covered area to prevent runoff. Keep out of reach of children and pets.
- Chlorine kits, available at retail swimming pool equipment and supply stores, should be used to monitor the chlorine and pH levels.
- Chlorine and other pool chemicals should never be allowed to flow into the gutter or the storm drain system.

Algaecides



Avoid using copper-based algaecides unless absolutely necessary. Control algae with chlorine, organic polymers or other alternatives to copper-based pool chemicals. Copper is a heavy metal that can be toxic to aquatic life.

Proper Disposal of Pool Chemicals

If you need to dispose of unwanted pool chemicals, first try giving them to a neighbor with a pool. If that doesn't work, bring unwanted pool chemicals to a Household Hazardous Waste (HHW) Collection Event. There's no cost for bringing HHW items to collection events - it's FREE! Call **1-800-506-2555** for a schedule of HHW events in your community.

<u>NEVER</u> put unused chemicals into the trash, onto the ground or down a storm drain.

PRELIMINARY TECHNICAL DRAINAGE STUDY

KAISER PERMANENTE MORENO VALLEY MEDICAL CENTER

City of Moreno Valley, California
August 08, 2019

Prepared for:

LST18-0052
PEN18-0228 - 0230

Kaiser Permanente.
27300 Iris Avenue
Moreno Valley, CA 91188
626.405-6333 ph.

Revision History	
1/2019	2nd Submittal
6/2019	3rd Submittal
8/2019	4th Submittal

CITY OF MORENO VALLEY CASE # XXXXXXX

Report Prepared By:

Michael Baker INTERNATIONAL

9755 Clairemont Mesa Blvd. San Diego, CA. 92124
858.614.5000 telephone
858.614.5001 fax

Engineer of Work/ Contact Person:
Scott Davis, P.E.

JN 169814

Table of Contents

I. INTRODUCTION

This drainage study for Kaiser Permanente Moreno Valley Medical Center accompanies the development plan. It specifically accomplishes the following:

- Determine the peak onsite 10 & 100-year runoff according to the precise grading plan.
- Define design for storm drain systems to convey the offsite and onsite flows.

1. Area Description

The project site is in the City of Moreno Valley in the County of Riverside, California. It is located between Nason Street and Oliver Street and North of Iris Avenue. The project site will be developed in 29.8 acres of combined area of APN 486-310-033 and 486-310-034, with current legal descriptions as parcel 6 and 7 of Parcel Map MB 11/10. These two parcels have full width improvements with curb and within the property limits. Figure 1 shows the location of this project.

2. Project Description

The proposed project will develop three (3) multi-story parking structures, an energy center, emergency department, two (2) medical office buildings, multi-story patient bed towers, new D&T building, driveways, walkways, and landscape areas. It will develop 27.7 acres of the combined area parcel 7 and 6 of Parcel map MB 11/10 with the 2.1 acres of existing parking lot and medical office to remain. All on-site facilities will be privately maintained.

3. Surrounding Projects and Drainage Considerations

The project site is currently a Kaiser Permanente Medical Center and office along with a pharmacy. It has been a medical facility for as long back as two decades. It has moderate vegetation, and it has relatively flat terrain draining from southeast to northwest to the adjacent property to the northwest. There is expected to be no offsite flow oncoming to the property as the perimeter of the worked area contains berms and measures to keep offsite flow away. There is currently no storm drain network located in the site. The report was completed with a conceptual design of the project and will be updated to reflect revisions made to the grading plan or the site plan.

II. HYDROLOGIC/HYDRAULIC METHODOLOGY

The methodology presented in this study is in compliance with the RCFC&WCD 1978 Hydrology Manual (Reference 5), hereinafter referred to as the Manual).

Model Descriptions -The Integrated Rational Method Hydrology System Model Version 8.0, dated January 1, 2006, (Reference 3) within the Advanced Engineering Systems Software (AES) was used to generate the peak 100-year onsite flows. The Unit Hydrograph System Model Version 9.0, dated 2014 within the Civildesign software was used to generate the volume needed to attenuate the 100-year 24-hour storm event.

Soil Type - The Manual utilizes the Soil Conservation Service (SCS) soil classification system, which classifies soils into four (4) hydrological groups (HSG): A through D, with D being the least pervious. The soil Plates C-1.17 of the Manual showing location of project is included in Appendix B. According to this figure, this tract is located within a mixture of HSG “A”, HSG “B”. For this report, HSG “B” was conservatively used in the hydrologic models.

Development Type- For the proposed developed conditions the runoff was calculated considering a commercial development.

Intensity- The 10-minute / 60-minute intensity values (inches/hour) for the 10-year and 100-year storm events, obtained from Plate D-4.1 (6 of 6) of the Manual, are 2.01/0.82 and 2.94/1.20, respectively.

Drainage Areas and Flow Patterns - The drainage areas and flow patterns for existing and proposed conditions were determined using the existing topography (Cad) and the Tentative Tract Map, respectively. The areas were measured using the computer capabilities of AutoCAD.

III. HYDROLOGY/HYDRAULIC ANALYSIS

Figure 3 in Appendix A shows the proposed onsite drainage patterns for this project. The majority of the flows will be conveyed through a storm drain system which travel through various basins and storage facilities to treat the runoff. Velocities in the pipes will vary from 6 fps to 9 fps and are subject to change due to the conceptual nature of the storm drain system that is subject to change. These pipes will outlet to existing storm water overflow paths separated by east and west.

The undeveloped conditions outflows to the west overflow path at 23.19/34.56 CFS for the 10-year and 100-year storm respectively. The eastern overflow path received a flow of 26.39/39.08 CFS for the 10-year and 100-year storm respectively.

The developed conditions of the site outflow to the same over flow paths with the western overflow receiving 19.16/28.01CFS for the 10-year and 100-year storm respectively. The eastern peak flow will be 37.48/54.46 CFS for the 10-year and 100-year storm respectively.

The western peak flow is lower than predevelopment peak flow, thus attenuation is not applied. The eastern peak flow is higher than existing conditions, thus sized storage vaults will be installed to limit increase of overflow runoff to stay at existing conditions. The storage vaults are sized for the 100-year 24-hour storm event and these calculations are provided in Appendix B. The exact volumes are also provided in the conclusions below. These storage vaults are needed to mitigate the increase of flow offsite.

Hydraulic analysis was performed on major sections of the storm drain network to size for the 100-year storm event. See Appendix D for data pertaining to the size of the network.

The flow going to the discharge points of the developed site are subject to change as the site plans develops past the conceptual level.

IV. CONCLUSIONS

1. Methodology used in this report is in compliance with the Riverside County Flood Control and Water Conservation District.
2. There are no anticipated negative downstream or upstream impacts.
3. The western DMA is decreasing in size and the eastern DMA is increasing which is reflected the table below.

	DMA West	DMA East
Size Existing	14.20 Acres	15.25 Acres
Size Proposed	9.89 Acres	19.56 Acres
Q Existing	34.56 CFS	39.08 CFS
Q Proposed	28.01 CFS	54.46 CFS

4. WQMP modular wetland basins and pipelines are sized per WQMP report. All pipelines otherwise are sized to 100-year 1-hour storm event. See Storm Drain Network Exhibit in Appendix D for proposed sizes.
5. Storage vaults and pipes will be sized to the volumes provided in the table below in compliance with the 100-year 24 hour storm event. See DMA Exhibit in Appendix B for the proposed DMA locations.

DMA "B" (PROPOSED)					DMA "B" (EXISTING)					DIFFERENCE	
	100-YEAR					100-YEAR				WORST CASE	
	1-HR	3-HR	6-HR	24-HR		1-HR	3-HR	6-HR	24-HR		
Q (CFS)	18.4	9.2	8.37	2.75	Q	16.69	8.63	7.75	2.37		
V (AC-FT)	0.48	0.68	0.89	1.47	V	0.46	0.58	0.74	1.15	0.32	AC-FT
										13,939	CU-FT

DMA "C" (PROPOSED)					DMA "C" (EXISTING)					DIFFERENCE	
	100-YEAR					100-YEAR				WORST CASE	
	1-HR	3-HR	6-HR	24-HR		1-HR	3-HR	6-HR	24-HR		
Q (CFS)	23.4	13.26	12.01	4.25	Q	20.15	11.97	10.77	3.48		
V (AC-FT)	0.73	1.05	1.38	2.34	V	0.66	0.85	1.09	1.7	0.64	AC-FT
										27,878	CU-FT

DMA "D" (PROPOSED)					DMA "D" (EXISTING)					DIFFERENCE	
	100-YEAR					100-YEAR				WORST CASE	
	1-HR	3-HR	6-HR	24-HR		1-HR	3-HR	6-HR	24-HR		
Q (CFS)	18.83	11.98	10.89	4.16	Q	17.51	9.32	7.85	2.17		
V (AC-FT)	0.7	1.02	1.37	2.35	V	0.51	0.55	0.64	0.77	1.58	AC-FT
										68,825	CU-FT

VI. REFERENCES

1. AEI-CASC Engineering, Hydrology Study Report for Bluestone Murrieta, October 5, 2001.

2. Riverside Flood Control District and Water Conservation District (RCFC&WCD) *Hydrology Manual*, 1978.

3. Advanced Engineering Systems Software (AES), Rational Method Hydrology System Model Version 8.0, January 1, 2006.

4. Advanced Engineering Systems Software (AES), Hydraulic Elements Program Package

(HELE1) Version 8.0, January 1, 2006.

5. Civildesign Engineering Software, Unit Hydrograph System Model, 1989-2014, Version 9.0.

6. Riverside Flood Control District and Water Conservation District, Riverside Design Handbook or Low Impact Development, Best Management Practices, September 2011.

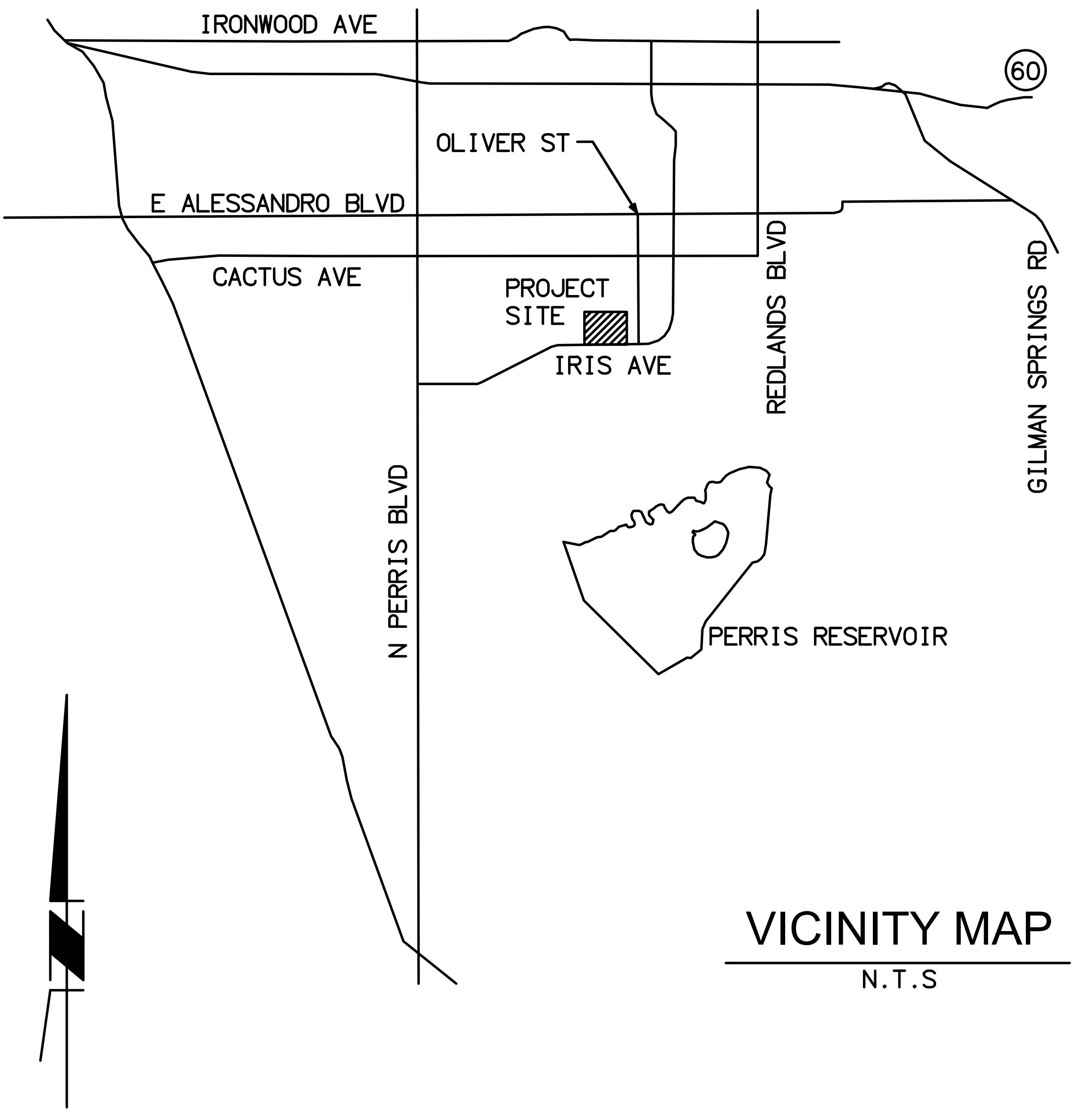


FIGURE 1

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9755 Clairemont Mesa Blvd., San Diego, CA 92124
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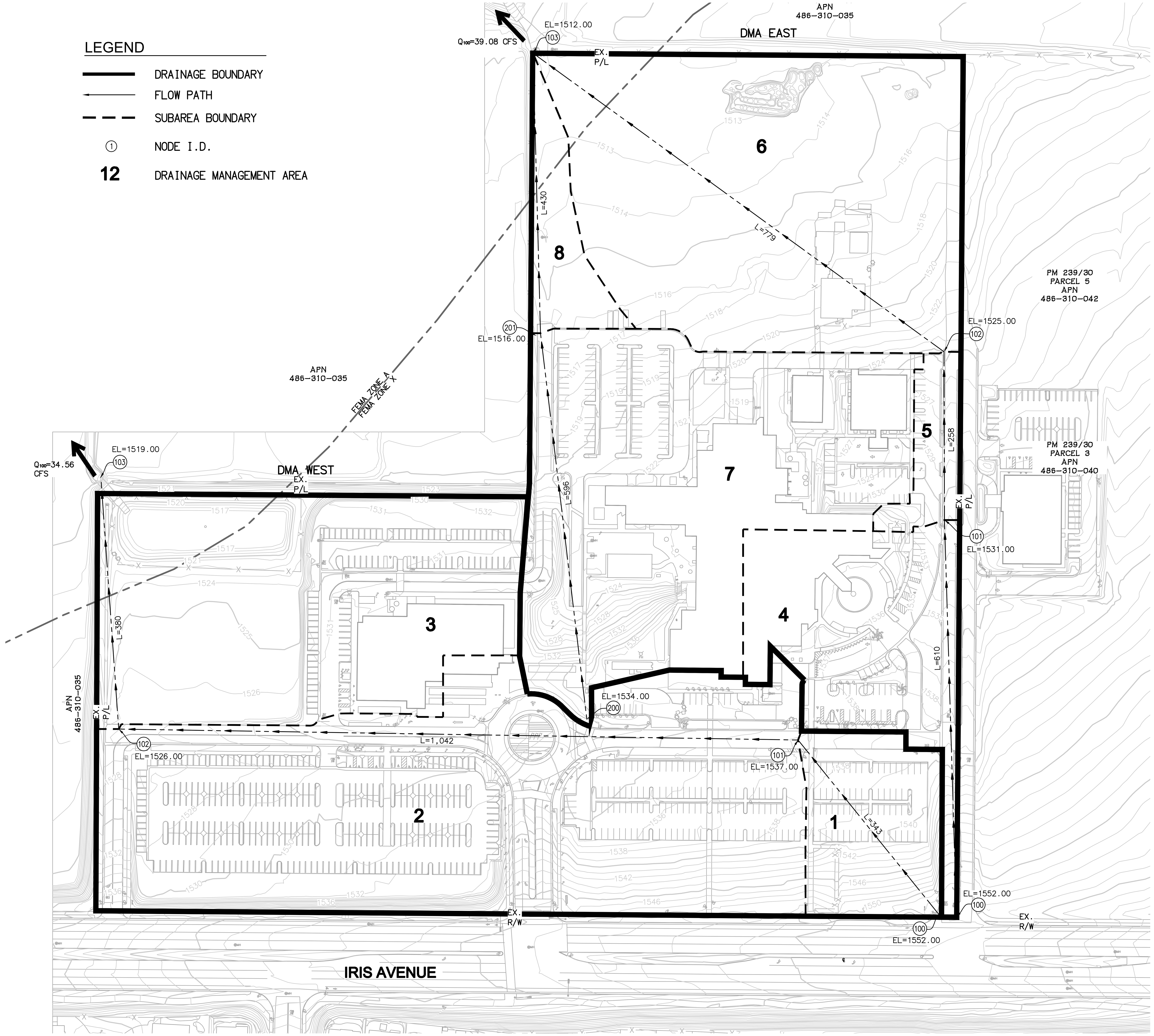
KAISER PERMANENTE MORENO VALLEY AREAMASTER PLAN AND MEDICAL OFFICE BUILDING

VICINITY MAP

APPENDIX A

HYDROLOGY CALCULATIONS

Undeveloped Condition
10 & 100-Year Hydrology
Rational Method Calculations



DMA WEST

DMA	SIZE [ACRE]
1	1.34
2	8.21
3	4.65

DMA EAST

DMA	SIZE [ACRE]
4	2.36
5	0.48
6	6.05
7	5.69
8	0.67

SCALE: 1"=80'

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FIGURE 2-EXISTING
HYDROLOGY MAP - EXISTING CONDITIONS Q100

KAISER MEDICAL MORENO VALLEY

H:\PDATA\169814\CADD\STRMWATER\FIGURE 2 - EXISTING HYD MAP.DWG FRANKIE.ABBOTT 7/15/19 5:41 pm

```
****************************************************************************
              RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM BASED ON
          RIVERSIDE COUNTY FLOOD CONTROL & WATER CONSERVATION DISTRICT
                        (RCFC&WCD)  1978 HYDROLOGY MANUAL
           (c) Copyright 1982-2013 Advanced Engineering Software (aes)
                        (Rational Tabling Version 20.0)
                   Release Date: 06/01/2013  License ID 1264

                              Analysis prepared by:






 ************************** DESCRIPTION OF STUDY **************************
 * KAISER PERMANENTE MORENO VALLEY MEDICAL CENTER                           *
 * ON-SITE HYDROLOGY                                                        *
 * 10-YEAR STORM EVENT EXISTING CONDITIONS                                  *
 **************************************************************************

  FILE NAME: PREW10.DAT
  TIME/DATE OF STUDY: 17:08 07/15/2019
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  USER SPECIFIED STORM EVENT(YEAR) =   10.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  10-YEAR STORM 10-MINUTE INTENSITY(INCH/HOUR) =  2.010
  10-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) =  0.820
  100-YEAR STORM 10-MINUTE INTENSITY(INCH/HOUR) =  2.940
  100-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) =  1.200
  SLOPE OF 10-YEAR INTENSITY-DURATION CURVE =  0.5003939
  SLOPE OF 100-YEAR INTENSITY-DURATION CURVE =  0.5001161
  COMPUTED RAINFALL INTENSITY DATA:
  STORM EVENT =   10.00   1-HOUR INTENSITY(INCH/HOUR) =   0.828
  SLOPE OF INTENSITY DURATION CURVE = 0.5004
  RCFC&WCD HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: COMPUTE CONFLUENCE VALUES ACCORDING TO RCFC&WCD HYDROLOGY MANUAL
        AND IGNORE OTHER CONFLUENCE COMBINATIONS FOR DOWNSTREAM ANALYSES
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===   =====  =========  ================  ======   ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
```

```
  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  1.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
  FLOW PROCESS FROM NODE    100.00 TO NODE    101.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
         ASSUMED INITIAL SUBAREA UNIFORM
         DEVELOPMENT IS COMMERCIAL
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   343.00
  UPSTREAM ELEVATION(FEET) =   1552.00
  DOWNSTREAM ELEVATION(FEET) =   1537.00
  ELEVATION DIFFERENCE(FEET) =     15.00
  TC = 0.303*[(  343.00**3)/(    15.00)]**.2 =    5.855
    10 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.654
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8745
  SOIL CLASSIFICATION IS "B"
  SUBAREA RUNOFF(CFS) =      3.11
  TOTAL AREA(ACRES) =      1.34   TOTAL RUNOFF(CFS) =      3.11

****************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    102.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) = 1537.00  DOWNSTREAM ELEVATION(FEET) = 1526.00
  STREET LENGTH(FEET) =  1042.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  2
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       9.69
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
```

```
    STREET FLOW DEPTH(FEET) =  0.40
    HALFSTREET FLOOD WIDTH(FEET) =   13.55
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.64
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.07
  STREET FLOW TRAVEL TIME(MIN.) =   6.57   Tc(MIN.) =   12.43
    10 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.821
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8671
  SOIL CLASSIFICATION IS "B"
  SUBAREA AREA(ACRES) =    8.21      SUBAREA RUNOFF(CFS) =   12.96
  TOTAL AREA(ACRES) =        9.6        PEAK FLOW RATE(CFS) =      16.07

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.46   HALFSTREET FLOOD WIDTH(FEET) =  16.84
  FLOW VELOCITY(FEET/SEC.) =  2.95   DEPTH*VELOCITY(FT*FT/SEC.) =   1.37
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    102.00 =    1385.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    103.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1526.00  DOWNSTREAM(FEET) =   1519.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   380.00   CHANNEL SLOPE =  0.0184
  CHANNEL BASE(FEET) =    4.00   "Z" FACTOR =   0.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   2.00
    10 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.766
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8665
  SOIL CLASSIFICATION IS "B"
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      19.63
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   8.08
  AVERAGE FLOW DEPTH(FEET) =   0.61   TRAVEL TIME(MIN.) =   0.78
  Tc(MIN.) =   13.21
  SUBAREA AREA(ACRES) =     4.65       SUBAREA RUNOFF(CFS) =    7.12
  TOTAL AREA(ACRES) =       14.2         PEAK FLOW RATE(CFS) =      23.19

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.68   FLOW VELOCITY(FEET/SEC.) =   8.57
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    103.00 =    1765.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =       14.2  TC(MIN.) =     13.21
  PEAK FLOW RATE(CFS)    =      23.19
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
****************************************************************************
              RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM BASED ON
          RIVERSIDE COUNTY FLOOD CONTROL & WATER CONSERVATION DISTRICT
                      (RCFC&WCD)  1978 HYDROLOGY MANUAL
           (c) Copyright 1982-2013 Advanced Engineering Software (aes)
                       (Rational Tabling Version 20.0)
                    Release Date: 06/01/2013  License ID 1264

                            Analysis prepared by:





 ************************** DESCRIPTION OF STUDY **************************
 * KAISER PERMANENTE MORENO VALLEY MEDICAL CENTER                           *
 * ON-SITE HYDROLOGY                                                        *
 * 100-YEAR STORM EVENT EXISTING CONDITIONS                                 *
 **************************************************************************

  FILE NAME: PREW100.DAT
  TIME/DATE OF STUDY: 17:04 07/15/2019
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  10-YEAR STORM 10-MINUTE INTENSITY(INCH/HOUR) =  2.010
  10-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) =  0.820
  100-YEAR STORM 10-MINUTE INTENSITY(INCH/HOUR) =  2.940
  100-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) =  1.200
  SLOPE OF 10-YEAR INTENSITY-DURATION CURVE =  0.5003939
  SLOPE OF 100-YEAR INTENSITY-DURATION CURVE =  0.5001161
  COMPUTED RAINFALL INTENSITY DATA:
  STORM EVENT =  100.00   1-HOUR INTENSITY(INCH/HOUR) =   1.200
  SLOPE OF INTENSITY DURATION CURVE = 0.5001
  RCFC&WCD HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: COMPUTE CONFLUENCE VALUES ACCORDING TO RCFC&WCD HYDROLOGY MANUAL
        AND IGNORE OTHER CONFLUENCE COMBINATIONS FOR DOWNSTREAM ANALYSES
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.  (FT)     (FT)     SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  ================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150
```

```
  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  1.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
  FLOW PROCESS FROM NODE    100.00 TO NODE    101.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
        ASSUMED INITIAL SUBAREA UNIFORM
        DEVELOPMENT IS COMMERCIAL
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   343.00
  UPSTREAM ELEVATION(FEET) =   1552.00
  DOWNSTREAM ELEVATION(FEET) =   1537.00
  ELEVATION DIFFERENCE(FEET) =     15.00
  TC = 0.303*[(  343.00**3)/(    15.00)]**.2 =    5.855
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.842
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8807
  SOIL CLASSIFICATION IS "B"
  SUBAREA RUNOFF(CFS) =      4.53
  TOTAL AREA(ACRES) =      1.34   TOTAL RUNOFF(CFS) =      4.53

****************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    102.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) = 1537.00  DOWNSTREAM ELEVATION(FEET) = 1526.00
  STREET LENGTH(FEET) =  1042.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  2
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      14.37
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
```

```
    STREET FLOW DEPTH(FEET) =  0.45
    HALFSTREET FLOOD WIDTH(FEET) =   16.05
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.88
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.29
  STREET FLOW TRAVEL TIME(MIN.) =   6.03   Tc(MIN.) =   11.89
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.696
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8748
  SOIL CLASSIFICATION IS "B"
  SUBAREA AREA(ACRES) =    8.21      SUBAREA RUNOFF(CFS) =   19.37
  TOTAL AREA(ACRES) =        9.6        PEAK FLOW RATE(CFS) =      23.90

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.51   HALFSTREET FLOOD WIDTH(FEET) =  19.73
  FLOW VELOCITY(FEET/SEC.) =  3.26   DEPTH*VELOCITY(FT*FT/SEC.) =   1.68
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    102.00 =    1385.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    103.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1526.00  DOWNSTREAM(FEET) =   1519.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   380.00   CHANNEL SLOPE =  0.0184
  CHANNEL BASE(FEET) =    4.00   "Z" FACTOR =   0.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   2.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.622
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8743
  SOIL CLASSIFICATION IS "B"
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      29.23
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   9.24
  AVERAGE FLOW DEPTH(FEET) =   0.79   TRAVEL TIME(MIN.) =   0.69
  Tc(MIN.) =   12.57
  SUBAREA AREA(ACRES) =     4.65      SUBAREA RUNOFF(CFS) =   10.66
  TOTAL AREA(ACRES) =       14.2         PEAK FLOW RATE(CFS) =      34.56

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.89   FLOW VELOCITY(FEET/SEC.) =   9.73
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    103.00 =    1765.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =       14.2  TC(MIN.) =     12.57
  PEAK FLOW RATE(CFS)   =      34.56
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
****************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM BASED ON
         RIVERSIDE COUNTY FLOOD CONTROL & WATER CONSERVATION DISTRICT
                    (RCFC&WCD)  1978 HYDROLOGY MANUAL
          (c) Copyright 1982-2013 Advanced Engineering Software (aes)
                    (Rational Tabling Version 20.0)
                 Release Date: 06/01/2013  License ID 1264

                          Analysis prepared by:




 ************************** DESCRIPTION OF STUDY **************************
* KAISER PERMANENTE MORENO VALLEY MEDICAL CENTER                           *
* ON-SITE HYDROLOGY                                                        *
* 10-YEAR STORM EVENT EXISTING CONDITIONS                                  *
 **************************************************************************

  FILE NAME: PREE10.DAT
  TIME/DATE OF STUDY: 14:04 07/14/2019
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  USER SPECIFIED STORM EVENT(YEAR) =   10.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  10-YEAR STORM 10-MINUTE INTENSITY(INCH/HOUR) =  2.010
  10-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) =  0.820
  100-YEAR STORM 10-MINUTE INTENSITY(INCH/HOUR) =  2.940
  100-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) =  1.200
  SLOPE OF 10-YEAR INTENSITY-DURATION CURVE =  0.5003939
  SLOPE OF 100-YEAR INTENSITY-DURATION CURVE =  0.5001161
  COMPUTED RAINFALL INTENSITY DATA:
  STORM EVENT =   10.00   1-HOUR INTENSITY(INCH/HOUR) =   0.828
  SLOPE OF INTENSITY DURATION CURVE = 0.5004
  RCFC&WCD HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: COMPUTE CONFLUENCE VALUES ACCORDING TO RCFC&WCD HYDROLOGY MANUAL
        AND IGNORE OTHER CONFLUENCE COMBINATIONS FOR DOWNSTREAM ANALYSES
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  ================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150
```

```
  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
  FLOW PROCESS FROM NODE    100.00 TO NODE    101.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
        ASSUMED INITIAL SUBAREA UNIFORM
        DEVELOPMENT IS COMMERCIAL
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   610.00
  UPSTREAM ELEVATION(FEET) =   1552.00
  DOWNSTREAM ELEVATION(FEET) =   1531.00
  ELEVATION DIFFERENCE(FEET) =     21.00
  TC = 0.303*[(  610.00**3)/(    21.00)]**.2 =    7.733
    10 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.309
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8719
  SOIL CLASSIFICATION IS "B"
  SUBAREA RUNOFF(CFS) =      4.75
  TOTAL AREA(ACRES) =      2.36   TOTAL RUNOFF(CFS) =      4.75

****************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    102.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) = 1531.00  DOWNSTREAM ELEVATION(FEET) = 1525.00
  STREET LENGTH(FEET) =   258.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  2
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       5.20
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
```

```
    STREET FLOW DEPTH(FEET) =  0.31
    HALFSTREET FLOOD WIDTH(FEET) =    8.47
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.11
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.98
  STREET FLOW TRAVEL TIME(MIN.) =   1.38   Tc(MIN.) =    9.11
    10 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.127
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8703
  SOIL CLASSIFICATION IS "B"
  SUBAREA AREA(ACRES) =    0.48      SUBAREA RUNOFF(CFS) =    0.89
  TOTAL AREA(ACRES) =        2.8        PEAK FLOW RATE(CFS) =       5.64

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.32   HALFSTREET FLOOD WIDTH(FEET) =   8.78
  FLOW VELOCITY(FEET/SEC.) =  3.20   DEPTH*VELOCITY(FT*FT/SEC.) =   1.02
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    102.00 =     868.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    103.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1525.00  DOWNSTREAM(FEET) =   1512.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   779.00   CHANNEL SLOPE =  0.0167
  CHANNEL BASE(FEET) =   20.00   "Z" FACTOR =   0.500
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   2.00
    10 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.792
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8668
  SOIL CLASSIFICATION IS "B"
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      10.38
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   3.50
  AVERAGE FLOW DEPTH(FEET) =   0.15   TRAVEL TIME(MIN.) =   3.71
  Tc(MIN.) =   12.83
  SUBAREA AREA(ACRES) =     6.05       SUBAREA RUNOFF(CFS) =    9.40
  TOTAL AREA(ACRES) =        8.9         PEAK FLOW RATE(CFS) =      15.04

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.19   FLOW VELOCITY(FEET/SEC.) =   4.02
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    103.00 =    1647.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    103.00 TO NODE    103.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    200.00 TO NODE    201.00 IS CODE =  21
```

```
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
         ASSUMED INITIAL SUBAREA UNIFORM
         DEVELOPMENT IS COMMERCIAL
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   596.00
  UPSTREAM ELEVATION(FEET) =   1534.00
  DOWNSTREAM ELEVATION(FEET) =   1516.00
  ELEVATION DIFFERENCE(FEET) =     18.00
  TC = 0.303*[(  596.00**3)/(    18.00)]**.2 =    7.865
    10 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.289
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8717
  SOIL CLASSIFICATION IS "B"
  SUBAREA RUNOFF(CFS) =     11.36
  TOTAL AREA(ACRES) =      5.69   TOTAL RUNOFF(CFS) =     11.36

****************************************************************************
  FLOW PROCESS FROM NODE    201.00 TO NODE    103.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1516.00  DOWNSTREAM(FEET) =   1512.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   430.00   CHANNEL SLOPE =  0.0093
  CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =   0.500
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
    10 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.975
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8688
  SOIL CLASSIFICATION IS "B"
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      11.93
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.66
  AVERAGE FLOW DEPTH(FEET) =   0.44   TRAVEL TIME(MIN.) =   2.70
  Tc(MIN.) =   10.56
  SUBAREA AREA(ACRES) =     0.67       SUBAREA RUNOFF(CFS) =    1.15
  TOTAL AREA(ACRES) =        6.4         PEAK FLOW RATE(CFS) =      12.51

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.45   FLOW VELOCITY(FEET/SEC.) =   2.69
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    103.00 =    1026.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    103.00 TO NODE    103.00 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
```

```
 STREAM     RUNOFF      Tc      INTENSITY     AREA
 NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
     1       12.51    10.56       1.975        6.36
 LONGEST FLOWPATH FROM NODE    200.00 TO NODE    103.00 =    1026.00 FEET.

 ** MEMORY BANK #  1 CONFLUENCE DATA **
 STREAM     RUNOFF      Tc      INTENSITY     AREA
 NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
     1       15.04    12.83       1.792        8.89
 LONGEST FLOWPATH FROM NODE    100.00 TO NODE    103.00 =    1647.00 FEET.

*********************************WARNING**********************************
 IN THIS COMPUTER PROGRAM, THE CONFLUENCE VALUE USED IS BASED
 ON THE RCFC&WCD FORMULA OF PLATE D-1 AS DEFAULT VALUE. THIS FORMULA
 WILL NOT NECESSARILY RESULT IN THE MAXIMUM VALUE OF PEAK FLOW.
**************************************************************************

 ** PEAK FLOW RATE TABLE **
 STREAM    RUNOFF       Tc      INTENSITY
 NUMBER     (CFS)     (MIN.)   (INCH/HOUR)
     1      24.89      10.56        1.975
     2      26.39      12.83        1.792

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =      26.39   Tc(MIN.) =   12.83
 TOTAL AREA(ACRES) =       15.2
============================================================================
 END OF STUDY SUMMARY:
 TOTAL AREA(ACRES)     =       15.2  TC(MIN.) =     12.83
 PEAK FLOW RATE(CFS)   =      26.39
============================================================================
============================================================================
 END OF RATIONAL METHOD ANALYSIS
```

```
************************************************************************
            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM BASED ON
        RIVERSIDE COUNTY FLOOD CONTROL & WATER CONSERVATION DISTRICT
                   (RCFC&WCD)  1978 HYDROLOGY MANUAL
         (c) Copyright 1982-2013 Advanced Engineering Software (aes)
                   (Rational Tabling Version 20.0)
                Release Date: 06/01/2013  License ID 1264

                         Analysis prepared by:




 ************************** DESCRIPTION OF STUDY **************************
* KAISER PERMANENTE MORENO VALLEY MEDICAL CENTER                          *
* ON-SITE HYDROLOGY                                                      *
* 100-YEAR STORM EVENT EXISTING CONDITIONS                               *
 **************************************************************************

  FILE NAME: PREE100.DAT
  TIME/DATE OF STUDY: 11:40 07/15/2019
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  10-YEAR STORM 10-MINUTE INTENSITY(INCH/HOUR) =  2.010
  10-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) =  0.820
  100-YEAR STORM 10-MINUTE INTENSITY(INCH/HOUR) =  2.940
  100-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) =  1.200
  SLOPE OF 10-YEAR INTENSITY-DURATION CURVE =  0.5003939
  SLOPE OF 100-YEAR INTENSITY-DURATION CURVE =  0.5001161
  COMPUTED RAINFALL INTENSITY DATA:
  STORM EVENT =  100.00   1-HOUR INTENSITY(INCH/HOUR) =   1.200
  SLOPE OF INTENSITY DURATION CURVE = 0.5001
  RCFC&WCD HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: COMPUTE CONFLUENCE VALUES ACCORDING TO RCFC&WCD HYDROLOGY MANUAL
        AND IGNORE OTHER CONFLUENCE COMBINATIONS FOR DOWNSTREAM ANALYSES
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  ================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150
```

```
  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
  FLOW PROCESS FROM NODE    100.00 TO NODE    101.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
        ASSUMED INITIAL SUBAREA UNIFORM
        DEVELOPMENT IS COMMERCIAL
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   610.00
  UPSTREAM ELEVATION(FEET) =   1552.00
  DOWNSTREAM ELEVATION(FEET) =   1531.00
  ELEVATION DIFFERENCE(FEET) =     21.00
  TC = 0.303*[(  610.00**3)/(    21.00)]**.2 =    7.733
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.343
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8785
  SOIL CLASSIFICATION IS "B"
  SUBAREA RUNOFF(CFS) =      6.93
  TOTAL AREA(ACRES) =      2.36   TOTAL RUNOFF(CFS) =      6.93

****************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    102.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) = 1531.00  DOWNSTREAM ELEVATION(FEET) = 1525.00
  STREET LENGTH(FEET) =   258.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  2
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       7.58
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
```

```
    STREET FLOW DEPTH(FEET) =  0.34
    HALFSTREET FLOOD WIDTH(FEET) =   10.20
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.38
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.16
  STREET FLOW TRAVEL TIME(MIN.) =   1.27   Tc(MIN.) =    9.01
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.098
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8773
  SOIL CLASSIFICATION IS "B"
  SUBAREA AREA(ACRES) =    0.48      SUBAREA RUNOFF(CFS) =    1.30
  TOTAL AREA(ACRES) =        2.8        PEAK FLOW RATE(CFS) =       8.24

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.35   HALFSTREET FLOOD WIDTH(FEET) =  10.59
  FLOW VELOCITY(FEET/SEC.) =  3.45   DEPTH*VELOCITY(FT*FT/SEC.) =   1.21
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    102.00 =     868.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    103.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1525.00  DOWNSTREAM(FEET) =   1512.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   779.00   CHANNEL SLOPE =  0.0167
  CHANNEL BASE(FEET) =   20.00   "Z" FACTOR =   0.500
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   2.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.665
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8746
  SOIL CLASSIFICATION IS "B"
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      15.34
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   4.10
  AVERAGE FLOW DEPTH(FEET) =   0.19   TRAVEL TIME(MIN.) =   3.16
  Tc(MIN.) =   12.17
  SUBAREA AREA(ACRES) =     6.05       SUBAREA RUNOFF(CFS) =   14.10
  TOTAL AREA(ACRES) =        8.9         PEAK FLOW RATE(CFS) =      22.34

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.23   FLOW VELOCITY(FEET/SEC.) =   4.79
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    103.00 =    1647.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    103.00 TO NODE    103.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    200.00 TO NODE    201.00 IS CODE =  21
```

```
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
         ASSUMED INITIAL SUBAREA UNIFORM
         DEVELOPMENT IS COMMERCIAL
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   596.00
  UPSTREAM ELEVATION(FEET) =   1534.00
  DOWNSTREAM ELEVATION(FEET) =   1516.00
  ELEVATION DIFFERENCE(FEET) =     18.00
  TC = 0.303*[(  596.00**3)/(    18.00)]**.2 =    7.865
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.315
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8784
  SOIL CLASSIFICATION IS "B"
  SUBAREA RUNOFF(CFS) =     16.57
  TOTAL AREA(ACRES) =      5.69   TOTAL RUNOFF(CFS) =     16.57

****************************************************************************
  FLOW PROCESS FROM NODE    201.00 TO NODE    103.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1516.00  DOWNSTREAM(FEET) =   1512.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   430.00   CHANNEL SLOPE =  0.0093
  CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =   0.500
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.910
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8762
  SOIL CLASSIFICATION IS "B"
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      17.42
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   3.06
  AVERAGE FLOW DEPTH(FEET) =   0.55   TRAVEL TIME(MIN.) =   2.34
  Tc(MIN.) =   10.21
  SUBAREA AREA(ACRES) =     0.67       SUBAREA RUNOFF(CFS) =    1.71
  TOTAL AREA(ACRES) =       6.4         PEAK FLOW RATE(CFS) =     18.28

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.58   FLOW VELOCITY(FEET/SEC.) =   3.09
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    103.00 =    1026.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    103.00 TO NODE    103.00 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
```

```
 STREAM     RUNOFF      Tc      INTENSITY     AREA
 NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
     1       18.28    10.21       2.910        6.36
 LONGEST FLOWPATH FROM NODE    200.00 TO NODE    103.00 =    1026.00 FEET.

 ** MEMORY BANK #  1 CONFLUENCE DATA **
 STREAM     RUNOFF      Tc      INTENSITY     AREA
 NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
     1       22.34    12.17       2.665        8.89
 LONGEST FLOWPATH FROM NODE    100.00 TO NODE    103.00 =    1647.00 FEET.

*********************************WARNING**********************************
 IN THIS COMPUTER PROGRAM, THE CONFLUENCE VALUE USED IS BASED
 ON THE RCFC&WCD FORMULA OF PLATE D-1 AS DEFAULT VALUE. THIS FORMULA
 WILL NOT NECESSARILY RESULT IN THE MAXIMUM VALUE OF PEAK FLOW.
**************************************************************************

 ** PEAK FLOW RATE TABLE **
 STREAM    RUNOFF       Tc      INTENSITY
 NUMBER     (CFS)     (MIN.)   (INCH/HOUR)
     1      37.02      10.21        2.910
     2      39.08      12.17        2.665

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =      39.08   Tc(MIN.) =   12.17
 TOTAL AREA(ACRES) =       15.2
============================================================================
 END OF STUDY SUMMARY:
 TOTAL AREA(ACRES)     =       15.2  TC(MIN.) =     12.17
 PEAK FLOW RATE(CFS)   =      39.08
============================================================================
============================================================================
 END OF RATIONAL METHOD ANALYSIS
```

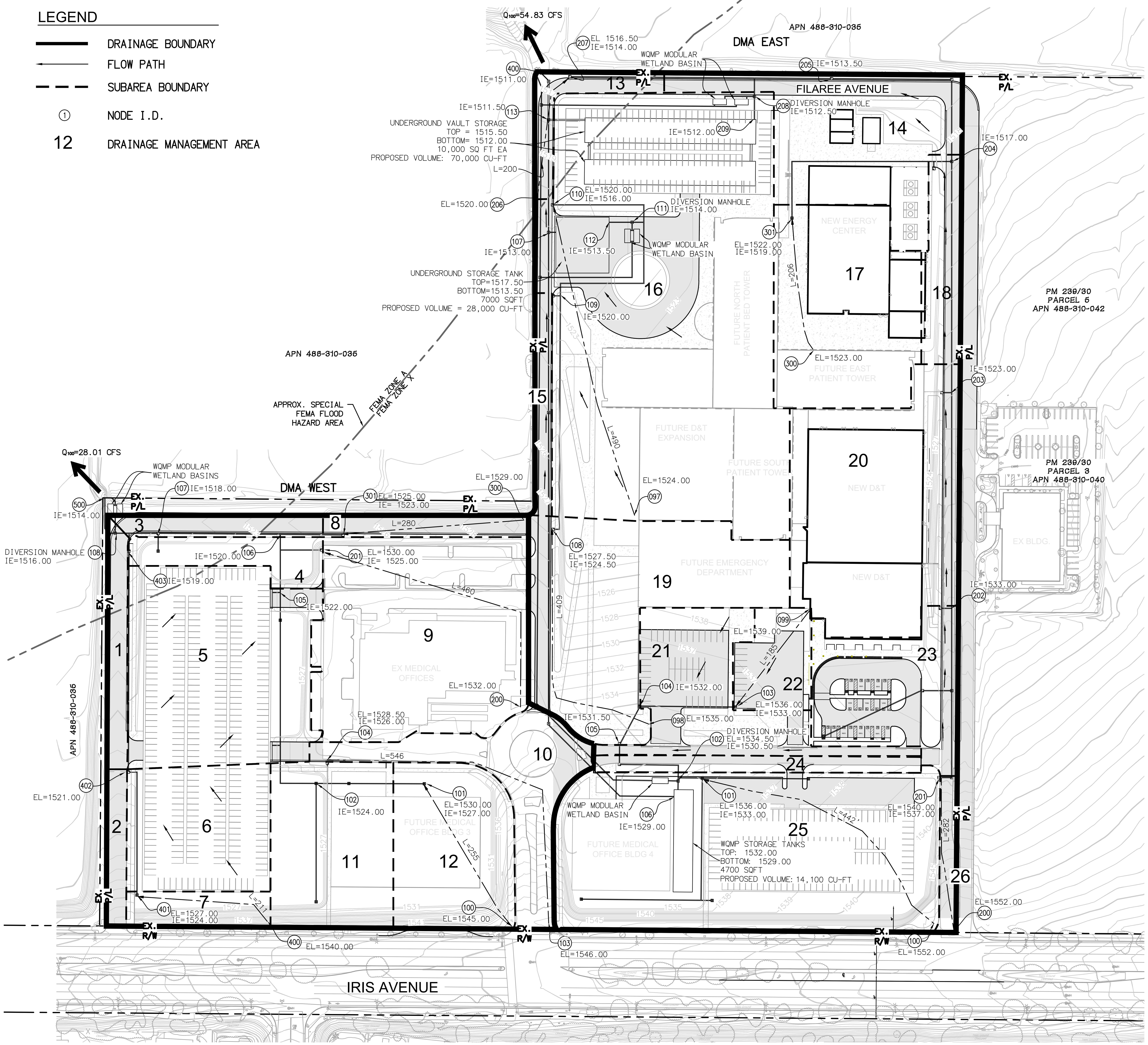
APPENDIX A

HYDROLOGY CALCULATIONS

Developed Condition
10 & 100-Year Hydrology
Rational Method Calculations

LEGEND

DRAINAGE BOUNDARY
FLOW PATH
SUBAREA BOUNDARY
NODE I.D.
DRAINAGE MANAGEMENT AREA



DMA WEST

DMA	SIZE [ACRE]
1	0.27
2	0.17
3	0.20
4	0.42
5	1.95
6	0.98
7	0.28
8	0.24
9	2.31
10	0.91
11	1.10
12	1.06

DMA EAST

DMA	SIZE [ACRE]
13	0.23
14	1.42
15	0.21
16	5.44
17	1.36
18	0.60
19	1.97
20	2.14
21	1.04
22	0.39
23	0.99
24	0.26
25	3.36
26	0.15

Michael Baker
INTERNATIONAL
9755 Clairemont Mesa Blvd., San Diego, CA 92124
Phone: (858) 614-5000 · MBAKERINTL.COM

FIGURE 3-PROPOSED
HYDROLOGY MAP – PROPOSED CONDITIONS Q100

KAISER MEDICAL MORENO VALLEY

H:\PDATA\169814\CADD\STRMWATER\FIGURE 3 – PROPOSED HYD MAP.DWG FRANKIE.ABBOTT 7/15/19 5:36 pm

```
****************************************************************************
              RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM BASED ON
        RIVERSIDE COUNTY FLOOD CONTROL & WATER CONSERVATION DISTRICT
                      (RCFC&WCD)  1978 HYDROLOGY MANUAL
         (c) Copyright 1982-2013 Advanced Engineering Software (aes)
                      (Rational Tabling Version 20.0)
                   Release Date: 06/01/2013  License ID 1264

                           Analysis prepared by:



 ************************** DESCRIPTION OF STUDY **************************
* KAISER PERMANENTE MORENO VALLEY MEDICAL CENTER                            *
* ON-SITE HYDROLOGY                                                         *
* 10-YEAR STORM EVENT DEVELOPED CONDITIONS                                  *
 **************************************************************************

  FILE NAME: PROPW10.DAT
  TIME/DATE OF STUDY: 11:09 07/14/2019
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  USER SPECIFIED STORM EVENT(YEAR) =   10.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  10-YEAR STORM 10-MINUTE INTENSITY(INCH/HOUR) =  2.010
  10-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) =  0.820
  100-YEAR STORM 10-MINUTE INTENSITY(INCH/HOUR) =  2.940
  100-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) =  1.200
  SLOPE OF 10-YEAR INTENSITY-DURATION CURVE =  0.5003939
  SLOPE OF 100-YEAR INTENSITY-DURATION CURVE =  0.5001161
  COMPUTED RAINFALL INTENSITY DATA:
  STORM EVENT =   10.00   1-HOUR INTENSITY(INCH/HOUR) =   0.828
  SLOPE OF INTENSITY DURATION CURVE = 0.5004
  RCFC&WCD HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: COMPUTE CONFLUENCE VALUES ACCORDING TO RCFC&WCD HYDROLOGY MANUAL
        AND IGNORE OTHER CONFLUENCE COMBINATIONS FOR DOWNSTREAM ANALYSES
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  ================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
```

```
  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
  FLOW PROCESS FROM NODE    100.00 TO NODE    101.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
         ASSUMED INITIAL SUBAREA UNIFORM
         DEVELOPMENT IS COMMERCIAL
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   255.00
  UPSTREAM ELEVATION(FEET) =   1545.00
  DOWNSTREAM ELEVATION(FEET) =   1530.00
  ELEVATION DIFFERENCE(FEET) =     15.00
  TC = 0.303*[(  255.00**3)/(    15.00)]**.2 =    4.901
  COMPUTED TIME OF CONCENTRATION INCREASED TO 5 MIN.
    10 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.872
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8759
  SOIL CLASSIFICATION IS "B"
  SUBAREA RUNOFF(CFS) =      2.67
  TOTAL AREA(ACRES) =      1.06   TOTAL RUNOFF(CFS) =      2.67

****************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    102.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1527.00  DOWNSTREAM(FEET) =  1524.00
  FLOW LENGTH(FEET) =   110.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   5.8 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   7.16
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       2.67
  PIPE TRAVEL TIME(MIN.) =   0.26    Tc(MIN.) =    5.26
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    102.00 =     365.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    102.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
```

```
   10 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.801
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8755
  SOIL CLASSIFICATION IS "B"
  SUBAREA AREA(ACRES) =    1.10   SUBAREA RUNOFF(CFS) =    2.70
  TOTAL AREA(ACRES) =        2.2   TOTAL RUNOFF(CFS) =       5.36
  TC(MIN.) =    5.26

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    102.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    103.00 TO NODE    104.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
        ASSUMED INITIAL SUBAREA UNIFORM
        DEVELOPMENT IS COMMERCIAL
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   546.00
  UPSTREAM ELEVATION(FEET) =   1546.00
  DOWNSTREAM ELEVATION(FEET) =   1528.50
  ELEVATION DIFFERENCE(FEET) =     17.50
  TC = 0.303*[(  546.00**3)/(    17.50)]**.2 =    7.504
   10 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.344
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8722
  SOIL CLASSIFICATION IS "B"
  SUBAREA RUNOFF(CFS) =      1.86
  TOTAL AREA(ACRES) =      0.91   TOTAL RUNOFF(CFS) =      1.86

****************************************************************************
  FLOW PROCESS FROM NODE    104.00 TO NODE    102.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1526.00  DOWNSTREAM(FEET) =  1524.00
  FLOW LENGTH(FEET) =    45.00   MANNING'S N =  0.013
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 12.000
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   4.1 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   7.77
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       1.86
  PIPE TRAVEL TIME(MIN.) =   0.10    Tc(MIN.) =    7.60
  LONGEST FLOWPATH FROM NODE    103.00 TO NODE    102.00 =     591.00 FEET.
```

```
****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    102.00 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
     1        1.86     7.60       2.329        0.91
  LONGEST FLOWPATH FROM NODE    103.00 TO NODE    102.00 =     591.00 FEET.

  ** MEMORY BANK #  1 CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
     1        5.36     5.26       2.801        2.16
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    102.00 =     365.00 FEET.

 *********************************WARNING**********************************
  IN THIS COMPUTER PROGRAM, THE CONFLUENCE VALUE USED IS BASED
  ON THE RCFC&WCD FORMULA OF PLATE D-1 AS DEFAULT VALUE. THIS FORMULA
  WILL NOT NECESSARILY RESULT IN THE MAXIMUM VALUE OF PEAK FLOW.
 **************************************************************************

  ** PEAK FLOW RATE TABLE **
  STREAM    RUNOFF       Tc      INTENSITY
  NUMBER     (CFS)     (MIN.)   (INCH/HOUR)
     1       6.65       5.26        2.801
     2       6.32       7.60        2.329

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       6.65   Tc(MIN.) =    5.26
  TOTAL AREA(ACRES) =        3.1

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    105.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1524.00  DOWNSTREAM(FEET) =  1522.00
  FLOW LENGTH(FEET) =   350.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  12.9 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.92
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       6.65
  PIPE TRAVEL TIME(MIN.) =   1.19    Tc(MIN.) =    6.44
  LONGEST FLOWPATH FROM NODE    103.00 TO NODE    105.00 =     941.00 FEET.
```

```
****************************************************************************
  FLOW PROCESS FROM NODE    105.00 TO NODE    105.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    10 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.530
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8736
  SOIL CLASSIFICATION IS "B"
  SUBAREA AREA(ACRES) =    1.95   SUBAREA RUNOFF(CFS) =    4.31
  TOTAL AREA(ACRES) =        5.0   TOTAL RUNOFF(CFS) =      10.96
  TC(MIN.) =    6.44

****************************************************************************
  FLOW PROCESS FROM NODE    105.00 TO NODE    106.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1524.00  DOWNSTREAM(FEET) =  1520.00
  FLOW LENGTH(FEET) =   130.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  15.0 INCH PIPE IS  12.2 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  10.26
  ESTIMATED PIPE DIAMETER(INCH) =  15.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      10.96
  PIPE TRAVEL TIME(MIN.) =   0.21    Tc(MIN.) =    6.65
  LONGEST FLOWPATH FROM NODE    103.00 TO NODE    106.00 =    1071.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    106.00 TO NODE    106.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 2 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    200.00 TO NODE    201.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
         ASSUMED INITIAL SUBAREA UNIFORM
         DEVELOPMENT IS COMMERCIAL
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   460.00
  UPSTREAM ELEVATION(FEET) =   1532.00
  DOWNSTREAM ELEVATION(FEET) =   1530.00
  ELEVATION DIFFERENCE(FEET) =      2.00
  TC = 0.303*[(  460.00**3)/(     2.00)]**.2 =   10.448
    10 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.986
```

```
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8689
  SOIL CLASSIFICATION IS "B"
  SUBAREA RUNOFF(CFS) =      3.99
  TOTAL AREA(ACRES) =      2.31   TOTAL RUNOFF(CFS) =      3.99

****************************************************************************
  FLOW PROCESS FROM NODE    201.00 TO NODE    106.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1525.00  DOWNSTREAM(FEET) =  1520.00
  FLOW LENGTH(FEET) =    80.00   MANNING'S N =  0.013
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 12.000
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   5.7 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  10.82
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       3.99
  PIPE TRAVEL TIME(MIN.) =   0.12    Tc(MIN.) =   10.57
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    106.00 =     540.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    106.00 TO NODE    106.00 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 2 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
     1        3.99    10.57       1.974        2.31
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    106.00 =     540.00 FEET.

  ** MEMORY BANK #  2 CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
     1       10.96     6.65       2.489        5.02
  LONGEST FLOWPATH FROM NODE    103.00 TO NODE    106.00 =    1071.00 FEET.

 ********************************WARNING**********************************
  IN THIS COMPUTER PROGRAM, THE CONFLUENCE VALUE USED IS BASED
  ON THE RCFC&WCD FORMULA OF PLATE D-1 AS DEFAULT VALUE. THIS FORMULA
  WILL NOT NECESSARILY RESULT IN THE MAXIMUM VALUE OF PEAK FLOW.
 *************************************************************************

  ** PEAK FLOW RATE TABLE **
  STREAM    RUNOFF       Tc      INTENSITY
  NUMBER     (CFS)     (MIN.)   (INCH/HOUR)
```

```
     1      13.47       6.65        2.489
     2      12.68      10.57        1.974

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      13.47   Tc(MIN.) =    6.65
  TOTAL AREA(ACRES) =        7.3

****************************************************************************
  FLOW PROCESS FROM NODE    106.00 TO NODE    106.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 3 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    300.00 TO NODE    301.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
         ASSUMED INITIAL SUBAREA UNIFORM
         DEVELOPMENT IS COMMERCIAL
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   280.00
  UPSTREAM ELEVATION(FEET) =   1529.00
  DOWNSTREAM ELEVATION(FEET) =   1525.00
  ELEVATION DIFFERENCE(FEET) =      4.00
  TC = 0.303*[(  280.00**3)/(     4.00)]**.2 =    6.753
    10 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.471
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8732
  SOIL CLASSIFICATION IS "B"
  SUBAREA RUNOFF(CFS) =      0.52
  TOTAL AREA(ACRES) =      0.24   TOTAL RUNOFF(CFS) =      0.52

****************************************************************************
  FLOW PROCESS FROM NODE    301.00 TO NODE    106.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1523.00  DOWNSTREAM(FEET) =  1520.00
  FLOW LENGTH(FEET) =    95.00   MANNING'S N =  0.013
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 12.000
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   2.3 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.79
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       0.52
  PIPE TRAVEL TIME(MIN.) =   0.33    Tc(MIN.) =    7.08
  LONGEST FLOWPATH FROM NODE    300.00 TO NODE    106.00 =     375.00 FEET.
```

```
****************************************************************************
  FLOW PROCESS FROM NODE    106.00 TO NODE    106.00 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 3 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
      1        0.52     7.08       2.412        0.24
  LONGEST FLOWPATH FROM NODE    300.00 TO NODE    106.00 =     375.00 FEET.

  ** MEMORY BANK #  3 CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
      1       13.47     6.65       2.489        7.33
  LONGEST FLOWPATH FROM NODE    103.00 TO NODE    106.00 =    1071.00 FEET.

 *********************************WARNING**********************************
  IN THIS COMPUTER PROGRAM, THE CONFLUENCE VALUE USED IS BASED
  ON THE RCFC&WCD FORMULA OF PLATE D-1 AS DEFAULT VALUE. THIS FORMULA
  WILL NOT NECESSARILY RESULT IN THE MAXIMUM VALUE OF PEAK FLOW.
 **************************************************************************

  ** PEAK FLOW RATE TABLE **
  STREAM    RUNOFF       Tc      INTENSITY
  NUMBER     (CFS)     (MIN.)   (INCH/HOUR)
      1      13.96       6.65        2.489
      2      13.57       7.08        2.412

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      13.96   Tc(MIN.) =    6.65
  TOTAL AREA(ACRES) =        7.6

****************************************************************************
  FLOW PROCESS FROM NODE    106.00 TO NODE    107.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1520.00  DOWNSTREAM(FEET) =  1518.00
  FLOW LENGTH(FEET) =   188.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  21.0 INCH PIPE IS  15.2 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   7.47
  ESTIMATED PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      13.96
  PIPE TRAVEL TIME(MIN.) =   0.42    Tc(MIN.) =    7.07
  LONGEST FLOWPATH FROM NODE    103.00 TO NODE    107.00 =    1259.00 FEET.
```

```
****************************************************************************
  FLOW PROCESS FROM NODE    107.00 TO NODE    107.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    10 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.414
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8728
  SOIL CLASSIFICATION IS "B"
  SUBAREA AREA(ACRES) =    0.20   SUBAREA RUNOFF(CFS) =    0.42
  TOTAL AREA(ACRES) =        7.8   TOTAL RUNOFF(CFS) =      14.38
  TC(MIN.) =    7.07

****************************************************************************
  FLOW PROCESS FROM NODE    107.00 TO NODE    107.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    10 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.414
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8728
  SOIL CLASSIFICATION IS "B"
  SUBAREA AREA(ACRES) =    0.42   SUBAREA RUNOFF(CFS) =    0.89
  TOTAL AREA(ACRES) =        8.2   TOTAL RUNOFF(CFS) =      15.26
  TC(MIN.) =    7.07

****************************************************************************
  FLOW PROCESS FROM NODE    107.00 TO NODE    108.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1518.00  DOWNSTREAM(FEET) =  1516.00
  FLOW LENGTH(FEET) =    45.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  11.2 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  13.25
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      15.26
  PIPE TRAVEL TIME(MIN.) =   0.06    Tc(MIN.) =    7.13
  LONGEST FLOWPATH FROM NODE    103.00 TO NODE    108.00 =    1304.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    108.00 TO NODE    108.00 IS CODE =  12
----------------------------------------------------------------------------
  >>>>>CLEAR MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    108.00 TO NODE    108.00 IS CODE =  10
```

```
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    400.00 TO NODE    401.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
         ASSUMED INITIAL SUBAREA UNIFORM
         DEVELOPMENT IS COMMERCIAL
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   211.00
  UPSTREAM ELEVATION(FEET) =   1540.00
  DOWNSTREAM ELEVATION(FEET) =   1527.00
  ELEVATION DIFFERENCE(FEET) =     13.00
  TC = 0.303*[(  211.00**3)/(    13.00)]**.2 =    4.502
  COMPUTED TIME OF CONCENTRATION INCREASED TO 5 MIN.
    10 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.872
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8759
  SOIL CLASSIFICATION IS "B"
  SUBAREA RUNOFF(CFS) =      0.70
  TOTAL AREA(ACRES) =      0.28   TOTAL RUNOFF(CFS) =      0.70

****************************************************************************
  FLOW PROCESS FROM NODE    401.00 TO NODE    402.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1524.00  DOWNSTREAM(FEET) =  1521.00
  FLOW LENGTH(FEET) =   200.00   MANNING'S N =  0.013
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 12.000
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   3.3 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.00
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       0.70
  PIPE TRAVEL TIME(MIN.) =   0.83    Tc(MIN.) =    5.83
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    402.00 =     411.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    402.00 TO NODE    402.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    10 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.658
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8746
  SOIL CLASSIFICATION IS "B"
```

```
  SUBAREA AREA(ACRES) =    0.17   SUBAREA RUNOFF(CFS) =    0.40
  TOTAL AREA(ACRES) =        0.4   TOTAL RUNOFF(CFS) =       1.10
  TC(MIN.) =    5.83

****************************************************************************
  FLOW PROCESS FROM NODE    402.00 TO NODE    402.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    10 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.658
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8746
  SOIL CLASSIFICATION IS "B"
  SUBAREA AREA(ACRES) =    0.98   SUBAREA RUNOFF(CFS) =    2.28
  TOTAL AREA(ACRES) =        1.4   TOTAL RUNOFF(CFS) =       3.38
  TC(MIN.) =    5.83

****************************************************************************
  FLOW PROCESS FROM NODE    402.00 TO NODE    403.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1521.00  DOWNSTREAM(FEET) =  1519.00
  FLOW LENGTH(FEET) =   340.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  15.0 INCH PIPE IS   9.2 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.26
  ESTIMATED PIPE DIAMETER(INCH) =  15.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       3.38
  PIPE TRAVEL TIME(MIN.) =   1.33    Tc(MIN.) =    7.16
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    403.00 =     751.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    403.00 TO NODE    403.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    10 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.399
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8726
  SOIL CLASSIFICATION IS "B"
  SUBAREA AREA(ACRES) =    0.27   SUBAREA RUNOFF(CFS) =    0.57
  TOTAL AREA(ACRES) =        1.7   TOTAL RUNOFF(CFS) =       3.94
  TC(MIN.) =    7.16

****************************************************************************
  FLOW PROCESS FROM NODE    403.00 TO NODE    108.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
```

```
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1519.00  DOWNSTREAM(FEET) =  1516.00
  FLOW LENGTH(FEET) =    30.00   MANNING'S N =  0.013
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 12.000
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   5.0 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  12.82
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       3.94
  PIPE TRAVEL TIME(MIN.) =   0.04    Tc(MIN.) =    7.20
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    108.00 =     781.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    108.00 TO NODE    108.00 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
     1        3.94     7.20       2.392        1.70
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    108.00 =     781.00 FEET.

  ** MEMORY BANK #  1 CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
     1       15.26     7.13       2.405        8.19
  LONGEST FLOWPATH FROM NODE    103.00 TO NODE    108.00 =    1304.00 FEET.

 *********************************WARNING**********************************
  IN THIS COMPUTER PROGRAM, THE CONFLUENCE VALUE USED IS BASED
  ON THE RCFC&WCD FORMULA OF PLATE D-1 AS DEFAULT VALUE. THIS FORMULA
  WILL NOT NECESSARILY RESULT IN THE MAXIMUM VALUE OF PEAK FLOW.
 **************************************************************************

  ** PEAK FLOW RATE TABLE **
  STREAM    RUNOFF       Tc      INTENSITY
  NUMBER     (CFS)     (MIN.)   (INCH/HOUR)
     1      19.16       7.13        2.405
     2      19.13       7.20        2.392

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      19.16   Tc(MIN.) =    7.13
  TOTAL AREA(ACRES) =        9.9

****************************************************************************
  FLOW PROCESS FROM NODE    108.00 TO NODE    500.00 IS CODE =  31
----------------------------------------------------------------------------
```

```
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1516.00  DOWNSTREAM(FEET) =  1514.00
  FLOW LENGTH(FEET) =    70.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  21.0 INCH PIPE IS  13.4 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  11.86
  ESTIMATED PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      19.16
  PIPE TRAVEL TIME(MIN.) =   0.10    Tc(MIN.) =    7.23
  LONGEST FLOWPATH FROM NODE    103.00 TO NODE    500.00 =    1374.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        9.9  TC(MIN.) =      7.23
  PEAK FLOW RATE(CFS)   =      19.16
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
****************************************************************************
              RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM BASED ON
          RIVERSIDE COUNTY FLOOD CONTROL & WATER CONSERVATION DISTRICT
                     (RCFC&WCD)  1978 HYDROLOGY MANUAL
          (c) Copyright 1982-2013 Advanced Engineering Software (aes)
                     (Rational Tabling Version 20.0)
                  Release Date: 06/01/2013  License ID 1264

                          Analysis prepared by:




 ************************** DESCRIPTION OF STUDY **************************
* KAISER PERMANENTE MORENO VALLEY MEDICAL CENTER                            *
* ON-SITE HYDROLOGY                                                         *
* 100-YEAR STORM EVENT DEVELOPED CONDITIONS                                 *
 **************************************************************************

  FILE NAME: PROPW100.DAT
  TIME/DATE OF STUDY: 10:53 07/14/2019
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  10-YEAR STORM 10-MINUTE INTENSITY(INCH/HOUR) =  2.010
  10-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) =  0.820
  100-YEAR STORM 10-MINUTE INTENSITY(INCH/HOUR) =  2.940
  100-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) =  1.200
  SLOPE OF 10-YEAR INTENSITY-DURATION CURVE =  0.5003939
  SLOPE OF 100-YEAR INTENSITY-DURATION CURVE =  0.5001161
  COMPUTED RAINFALL INTENSITY DATA:
  STORM EVENT =  100.00   1-HOUR INTENSITY(INCH/HOUR) =   1.200
  SLOPE OF INTENSITY DURATION CURVE = 0.5001
  RCFC&WCD HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: COMPUTE CONFLUENCE VALUES ACCORDING TO RCFC&WCD HYDROLOGY MANUAL
        AND IGNORE OTHER CONFLUENCE COMBINATIONS FOR DOWNSTREAM ANALYSES
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  ================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
```

```
  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
  FLOW PROCESS FROM NODE    100.00 TO NODE    101.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
        ASSUMED INITIAL SUBAREA UNIFORM
        DEVELOPMENT IS COMMERCIAL
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   255.00
  UPSTREAM ELEVATION(FEET) =   1545.00
  DOWNSTREAM ELEVATION(FEET) =   1530.00
  ELEVATION DIFFERENCE(FEET) =     15.00
  TC = 0.303*[(  255.00**3)/(    15.00)]**.2 =    4.901
  COMPUTED TIME OF CONCENTRATION INCREASED TO 5 MIN.
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.158
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8819
  SOIL CLASSIFICATION IS "B"
  SUBAREA RUNOFF(CFS) =      3.89
  TOTAL AREA(ACRES) =      1.06   TOTAL RUNOFF(CFS) =      3.89

****************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    102.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1527.00  DOWNSTREAM(FEET) =  1524.00
  FLOW LENGTH(FEET) =   110.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   7.2 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   7.84
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       3.89
  PIPE TRAVEL TIME(MIN.) =   0.23    Tc(MIN.) =    5.23
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    102.00 =     365.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    102.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
```

```
 100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.064
COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8816
SOIL CLASSIFICATION IS "B"
SUBAREA AREA(ACRES) =    1.10   SUBAREA RUNOFF(CFS) =    3.94
TOTAL AREA(ACRES) =        2.2   TOTAL RUNOFF(CFS) =       7.83
TC(MIN.) =    5.23

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    102.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    103.00 TO NODE    104.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
         ASSUMED INITIAL SUBAREA UNIFORM
         DEVELOPMENT IS COMMERCIAL
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   546.00
  UPSTREAM ELEVATION(FEET) =   1546.00
  DOWNSTREAM ELEVATION(FEET) =   1528.50
  ELEVATION DIFFERENCE(FEET) =     17.50
  TC = 0.303*[(  546.00**3)/(    17.50)]**.2 =    7.504
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.394
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8788
  SOIL CLASSIFICATION IS "B"
  SUBAREA RUNOFF(CFS) =      2.71
  TOTAL AREA(ACRES) =      0.91   TOTAL RUNOFF(CFS) =      2.71

****************************************************************************
  FLOW PROCESS FROM NODE    104.00 TO NODE    102.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1526.00  DOWNSTREAM(FEET) =  1524.00
  FLOW LENGTH(FEET) =    45.00   MANNING'S N =  0.013
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 12.000
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   5.1 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   8.63
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       2.71
  PIPE TRAVEL TIME(MIN.) =   0.09    Tc(MIN.) =    7.59
  LONGEST FLOWPATH FROM NODE    103.00 TO NODE    102.00 =     591.00 FEET.
```

```
****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    102.00 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
     1        2.71     7.59       3.375        0.91
  LONGEST FLOWPATH FROM NODE    103.00 TO NODE    102.00 =     591.00 FEET.

  ** MEMORY BANK #  1 CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
     1        7.83     5.23       4.064        2.16
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    102.00 =     365.00 FEET.

 *********************************WARNING**********************************
  IN THIS COMPUTER PROGRAM, THE CONFLUENCE VALUE USED IS BASED
  ON THE RCFC&WCD FORMULA OF PLATE D-1 AS DEFAULT VALUE. THIS FORMULA
  WILL NOT NECESSARILY RESULT IN THE MAXIMUM VALUE OF PEAK FLOW.
 **************************************************************************

  ** PEAK FLOW RATE TABLE **
  STREAM    RUNOFF       Tc      INTENSITY
  NUMBER     (CFS)     (MIN.)   (INCH/HOUR)
     1       9.70       5.23        4.064
     2       9.21       7.59        3.375

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       9.70   Tc(MIN.) =    5.23
  TOTAL AREA(ACRES) =        3.1

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    105.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1524.00  DOWNSTREAM(FEET) =  1522.00
  FLOW LENGTH(FEET) =   350.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  21.0 INCH PIPE IS  14.6 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.43
  ESTIMATED PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       9.70
  PIPE TRAVEL TIME(MIN.) =   1.07    Tc(MIN.) =    6.31
  LONGEST FLOWPATH FROM NODE    103.00 TO NODE    105.00 =     941.00 FEET.
```

```
****************************************************************************
  FLOW PROCESS FROM NODE    105.00 TO NODE    105.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.702
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8801
  SOIL CLASSIFICATION IS "B"
  SUBAREA AREA(ACRES) =    1.95   SUBAREA RUNOFF(CFS) =    6.35
  TOTAL AREA(ACRES) =        5.0   TOTAL RUNOFF(CFS) =      16.05
  TC(MIN.) =    6.31

****************************************************************************
  FLOW PROCESS FROM NODE    105.00 TO NODE    106.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1524.00  DOWNSTREAM(FEET) =  1520.00
  FLOW LENGTH(FEET) =   130.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  13.3 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  11.49
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      16.05
  PIPE TRAVEL TIME(MIN.) =   0.19    Tc(MIN.) =    6.50
  LONGEST FLOWPATH FROM NODE    103.00 TO NODE    106.00 =    1071.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    106.00 TO NODE    106.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 2 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    200.00 TO NODE    201.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
         ASSUMED INITIAL SUBAREA UNIFORM
         DEVELOPMENT IS COMMERCIAL
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   460.00
  UPSTREAM ELEVATION(FEET) =   1532.00
  DOWNSTREAM ELEVATION(FEET) =   1530.00
  ELEVATION DIFFERENCE(FEET) =      2.00
  TC = 0.303*[(  460.00**3)/(     2.00)]**.2 =   10.448
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.876
```

```
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8760
  SOIL CLASSIFICATION IS "B"
  SUBAREA RUNOFF(CFS) =      5.82
  TOTAL AREA(ACRES) =      2.31   TOTAL RUNOFF(CFS) =      5.82

****************************************************************************
  FLOW PROCESS FROM NODE    201.00 TO NODE    106.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1525.00  DOWNSTREAM(FEET) =  1520.00
  FLOW LENGTH(FEET) =    80.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   7.2 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  11.85
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       5.82
  PIPE TRAVEL TIME(MIN.) =   0.11    Tc(MIN.) =   10.56
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    106.00 =     540.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    106.00 TO NODE    106.00 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 2 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
      1        5.82    10.56       2.861        2.31
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    106.00 =     540.00 FEET.

  ** MEMORY BANK #  2 CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
      1       16.05     6.50       3.648        5.02
  LONGEST FLOWPATH FROM NODE    103.00 TO NODE    106.00 =    1071.00 FEET.

 *********************************WARNING**********************************
  IN THIS COMPUTER PROGRAM, THE CONFLUENCE VALUE USED IS BASED
  ON THE RCFC&WCD FORMULA OF PLATE D-1 AS DEFAULT VALUE. THIS FORMULA
  WILL NOT NECESSARILY RESULT IN THE MAXIMUM VALUE OF PEAK FLOW.
 **************************************************************************

  ** PEAK FLOW RATE TABLE **
  STREAM    RUNOFF       Tc      INTENSITY
  NUMBER     (CFS)     (MIN.)   (INCH/HOUR)
      1      19.63       6.50        3.648
```

```
     2      18.41      10.56        2.861

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      19.63   Tc(MIN.) =    6.50
  TOTAL AREA(ACRES) =        7.3

****************************************************************************
  FLOW PROCESS FROM NODE    106.00 TO NODE    106.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 3 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    300.00 TO NODE    301.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
         ASSUMED INITIAL SUBAREA UNIFORM
         DEVELOPMENT IS COMMERCIAL
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   280.00
  UPSTREAM ELEVATION(FEET) =   1529.00
  DOWNSTREAM ELEVATION(FEET) =   1525.00
  ELEVATION DIFFERENCE(FEET) =      4.00
  TC = 0.303*[(  280.00**3)/(     4.00)]**.2 =    6.753
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.578
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8796
  SOIL CLASSIFICATION IS "B"
  SUBAREA RUNOFF(CFS) =      0.76
  TOTAL AREA(ACRES) =      0.24   TOTAL RUNOFF(CFS) =      0.76

****************************************************************************
  FLOW PROCESS FROM NODE    301.00 TO NODE    106.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1523.00  DOWNSTREAM(FEET) =  1520.00
  FLOW LENGTH(FEET) =    95.00   MANNING'S N =  0.013
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 12.000
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   2.8 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.33
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       0.76
  PIPE TRAVEL TIME(MIN.) =   0.30    Tc(MIN.) =    7.05
  LONGEST FLOWPATH FROM NODE    300.00 TO NODE    106.00 =     375.00 FEET.

****************************************************************************
```

```
  FLOW PROCESS FROM NODE    106.00 TO NODE    106.00 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 3 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
     1        0.76     7.05       3.502        0.24
  LONGEST FLOWPATH FROM NODE    300.00 TO NODE    106.00 =     375.00 FEET.

  ** MEMORY BANK #  3 CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
     1       19.63     6.50       3.648        7.33
  LONGEST FLOWPATH FROM NODE    103.00 TO NODE    106.00 =    1071.00 FEET.

 *********************************WARNING*********************************
  IN THIS COMPUTER PROGRAM, THE CONFLUENCE VALUE USED IS BASED
  ON THE RCFC&WCD FORMULA OF PLATE D-1 AS DEFAULT VALUE. THIS FORMULA
  WILL NOT NECESSARILY RESULT IN THE MAXIMUM VALUE OF PEAK FLOW.
 **************************************************************************

  ** PEAK FLOW RATE TABLE **
  STREAM    RUNOFF       Tc      INTENSITY
  NUMBER     (CFS)     (MIN.)   (INCH/HOUR)
     1      20.33       6.50        3.648
     2      19.60       7.05        3.502

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      20.33   Tc(MIN.) =    6.50
  TOTAL AREA(ACRES) =        7.6

****************************************************************************
  FLOW PROCESS FROM NODE    106.00 TO NODE    107.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1520.00  DOWNSTREAM(FEET) =  1518.00
  FLOW LENGTH(FEET) =   188.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  24.0 INCH PIPE IS  17.7 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   8.18
  ESTIMATED PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      20.33
  PIPE TRAVEL TIME(MIN.) =   0.38    Tc(MIN.) =    6.88
  LONGEST FLOWPATH FROM NODE    103.00 TO NODE    107.00 =    1259.00 FEET.
```

```
****************************************************************************
  FLOW PROCESS FROM NODE    107.00 TO NODE    107.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.545
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8795
  SOIL CLASSIFICATION IS "B"
  SUBAREA AREA(ACRES) =    0.20   SUBAREA RUNOFF(CFS) =    0.62
  TOTAL AREA(ACRES) =        7.8   TOTAL RUNOFF(CFS) =      20.95
  TC(MIN.) =    6.88

****************************************************************************
  FLOW PROCESS FROM NODE    107.00 TO NODE    107.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.545
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8795
  SOIL CLASSIFICATION IS "B"
  SUBAREA AREA(ACRES) =    0.42   SUBAREA RUNOFF(CFS) =    1.31
  TOTAL AREA(ACRES) =        8.2   TOTAL RUNOFF(CFS) =      22.26
  TC(MIN.) =    6.88

****************************************************************************
  FLOW PROCESS FROM NODE    107.00 TO NODE    108.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1518.00  DOWNSTREAM(FEET) =  1516.00
  FLOW LENGTH(FEET) =    45.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  21.0 INCH PIPE IS  12.7 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  14.57
  ESTIMATED PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      22.26
  PIPE TRAVEL TIME(MIN.) =   0.05    Tc(MIN.) =    6.93
  LONGEST FLOWPATH FROM NODE    103.00 TO NODE    108.00 =    1304.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    108.00 TO NODE    108.00 IS CODE =  12
----------------------------------------------------------------------------
  >>>>>CLEAR MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    108.00 TO NODE    108.00 IS CODE =  10
----------------------------------------------------------------------------
```

```
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    400.00 TO NODE    401.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
         ASSUMED INITIAL SUBAREA UNIFORM
         DEVELOPMENT IS COMMERCIAL
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   211.00
  UPSTREAM ELEVATION(FEET) =   1540.00
  DOWNSTREAM ELEVATION(FEET) =   1527.00
  ELEVATION DIFFERENCE(FEET) =     13.00
  TC = 0.303*[(  211.00**3)/(    13.00)]**.2 =    4.502
  COMPUTED TIME OF CONCENTRATION INCREASED TO 5 MIN.
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.158
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8819
  SOIL CLASSIFICATION IS "B"
  SUBAREA RUNOFF(CFS) =      1.03
  TOTAL AREA(ACRES) =      0.28   TOTAL RUNOFF(CFS) =      1.03

****************************************************************************
  FLOW PROCESS FROM NODE    401.00 TO NODE    402.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1524.00  DOWNSTREAM(FEET) =  1521.00
  FLOW LENGTH(FEET) =   200.00   MANNING'S N =  0.013
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 12.000
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   4.0 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.45
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       1.03
  PIPE TRAVEL TIME(MIN.) =   0.75    Tc(MIN.) =    5.75
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    402.00 =     411.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    402.00 TO NODE    402.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.878
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8809
  SOIL CLASSIFICATION IS "B"
  SUBAREA AREA(ACRES) =    0.17   SUBAREA RUNOFF(CFS) =    0.58
```

```
  TOTAL AREA(ACRES) =        0.4   TOTAL RUNOFF(CFS) =       1.61
  TC(MIN.) =    5.75

****************************************************************************
  FLOW PROCESS FROM NODE    402.00 TO NODE    402.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.878
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8809
  SOIL CLASSIFICATION IS "B"
  SUBAREA AREA(ACRES) =    0.98   SUBAREA RUNOFF(CFS) =    3.35
  TOTAL AREA(ACRES) =        1.4   TOTAL RUNOFF(CFS) =       4.96
  TC(MIN.) =    5.75

****************************************************************************
  FLOW PROCESS FROM NODE    402.00 TO NODE    403.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1521.00  DOWNSTREAM(FEET) =  1519.00
  FLOW LENGTH(FEET) =   340.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  10.4 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.70
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       4.96
  PIPE TRAVEL TIME(MIN.) =   1.21    Tc(MIN.) =    6.95
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    403.00 =     751.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    403.00 TO NODE    403.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.526
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8794
  SOIL CLASSIFICATION IS "B"
  SUBAREA AREA(ACRES) =    0.27   SUBAREA RUNOFF(CFS) =    0.84
  TOTAL AREA(ACRES) =        1.7   TOTAL RUNOFF(CFS) =       5.79
  TC(MIN.) =    6.95

****************************************************************************
  FLOW PROCESS FROM NODE    403.00 TO NODE    108.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
```

```
  ELEVATION DATA: UPSTREAM(FEET) =  1519.00  DOWNSTREAM(FEET) =  1516.00
  FLOW LENGTH(FEET) =    30.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   6.2 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  14.17
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       5.79
  PIPE TRAVEL TIME(MIN.) =   0.04    Tc(MIN.) =    6.99
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    108.00 =     781.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    108.00 TO NODE    108.00 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
     1        5.79     6.99       3.517        1.70
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    108.00 =     781.00 FEET.

  ** MEMORY BANK #  1 CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
     1       22.26     6.93       3.531        8.19
  LONGEST FLOWPATH FROM NODE    103.00 TO NODE    108.00 =    1304.00 FEET.

 *********************************WARNING**********************************
  IN THIS COMPUTER PROGRAM, THE CONFLUENCE VALUE USED IS BASED
  ON THE RCFC&WCD FORMULA OF PLATE D-1 AS DEFAULT VALUE. THIS FORMULA
  WILL NOT NECESSARILY RESULT IN THE MAXIMUM VALUE OF PEAK FLOW.
 **************************************************************************

  ** PEAK FLOW RATE TABLE **
  STREAM    RUNOFF       Tc      INTENSITY
  NUMBER     (CFS)     (MIN.)   (INCH/HOUR)
     1      28.01       6.93        3.531
     2      27.96       6.99        3.517

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      28.01   Tc(MIN.) =    6.93
  TOTAL AREA(ACRES) =        9.9

****************************************************************************
  FLOW PROCESS FROM NODE    108.00 TO NODE    500.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
```

```
================================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1516.00  DOWNSTREAM(FEET) =  1514.00
  FLOW LENGTH(FEET) =    70.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  24.0 INCH PIPE IS  15.5 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  13.02
  ESTIMATED PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      28.01
  PIPE TRAVEL TIME(MIN.) =   0.09    Tc(MIN.) =    7.02
  LONGEST FLOWPATH FROM NODE    103.00 TO NODE    500.00 =    1374.00 FEET.
================================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        9.9  TC(MIN.) =      7.02
  PEAK FLOW RATE(CFS)   =      28.01
================================================================================
================================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
****************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM BASED ON
         RIVERSIDE COUNTY FLOOD CONTROL & WATER CONSERVATION DISTRICT
                      (RCFC&WCD)  1978 HYDROLOGY MANUAL
          (c) Copyright 1982-2013 Advanced Engineering Software (aes)
                      (Rational Tabling Version 20.0)
                   Release Date: 06/01/2013  License ID 1264

                           Analysis prepared by:





 ************************** DESCRIPTION OF STUDY **************************
* KAISER PERMANENTE MORENO VALLEY MEDICAL CENTER                           *
* ON-SITE HYDROLOGY                                                        *
* 10-YEAR STORM EVENT DEVELOPED CONDITIONS                                 *
 **************************************************************************

  FILE NAME: PROPE10.DAT
  TIME/DATE OF STUDY: 10:20 07/30/2019
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  USER SPECIFIED STORM EVENT(YEAR) =   10.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  10-YEAR STORM 10-MINUTE INTENSITY(INCH/HOUR) =  2.010
  10-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) =  0.820
  100-YEAR STORM 10-MINUTE INTENSITY(INCH/HOUR) =  2.940
  100-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) =  1.200
  SLOPE OF 10-YEAR INTENSITY-DURATION CURVE =  0.5003939
  SLOPE OF 100-YEAR INTENSITY-DURATION CURVE =  0.5001161
  COMPUTED RAINFALL INTENSITY DATA:
  STORM EVENT =   10.00   1-HOUR INTENSITY(INCH/HOUR) =   0.828
  SLOPE OF INTENSITY DURATION CURVE = 0.5004
  RCFC&WCD HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: COMPUTE CONFLUENCE VALUES ACCORDING TO RCFC&WCD HYDROLOGY MANUAL
        AND IGNORE OTHER CONFLUENCE COMBINATIONS FOR DOWNSTREAM ANALYSES
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  ================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150
```

```
  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
  FLOW PROCESS FROM NODE    100.00 TO NODE    101.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
        ASSUMED INITIAL SUBAREA UNIFORM
        DEVELOPMENT IS COMMERCIAL
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   442.00
  UPSTREAM ELEVATION(FEET) =   1552.00
  DOWNSTREAM ELEVATION(FEET) =   1536.00
  ELEVATION DIFFERENCE(FEET) =     16.00
  TC = 0.303*[(  442.00**3)/(    16.00)]**.2 =    6.730
    10 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.475
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8732
  SOIL CLASSIFICATION IS "B"
  SUBAREA RUNOFF(CFS) =      7.26
  TOTAL AREA(ACRES) =      3.36   TOTAL RUNOFF(CFS) =      7.26

****************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    102.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1533.00  DOWNSTREAM(FEET) =  1530.50
  FLOW LENGTH(FEET) =    40.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   8.4 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  12.38
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       7.26
  PIPE TRAVEL TIME(MIN.) =   0.05    Tc(MIN.) =    6.78
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    102.00 =     482.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    102.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================
```

```
****************************************************************************
  FLOW PROCESS FROM NODE     99.00 TO NODE    103.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
         ASSUMED INITIAL SUBAREA UNIFORM
         DEVELOPMENT IS COMMERCIAL
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   185.00
  UPSTREAM ELEVATION(FEET) =   1539.00
  DOWNSTREAM ELEVATION(FEET) =   1536.00
  ELEVATION DIFFERENCE(FEET) =      3.00
  TC = 0.303*[(  185.00**3)/(     3.00)]**.2 =    5.578
    10 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.719
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8750
  SOIL CLASSIFICATION IS "B"
  SUBAREA RUNOFF(CFS) =      0.93
  TOTAL AREA(ACRES) =      0.39   TOTAL RUNOFF(CFS) =      0.93

****************************************************************************
  FLOW PROCESS FROM NODE    103.00 TO NODE    104.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1533.00  DOWNSTREAM(FEET) =  1532.00
  FLOW LENGTH(FEET) =   145.00   MANNING'S N =  0.013
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 12.000
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   4.7 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   3.27
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       0.93
  PIPE TRAVEL TIME(MIN.) =   0.74    Tc(MIN.) =    6.32
  LONGEST FLOWPATH FROM NODE     99.00 TO NODE    104.00 =     330.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    104.00 TO NODE    105.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1532.00  DOWNSTREAM(FEET) =  1531.50
  FLOW LENGTH(FEET) =    60.00   MANNING'S N =  0.013
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 12.000
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   4.4 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   3.50
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       0.93
```

```
  PIPE TRAVEL TIME(MIN.) =   0.29    Tc(MIN.) =    6.60
  LONGEST FLOWPATH FROM NODE     99.00 TO NODE    105.00 =     390.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    105.00 TO NODE    105.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    10 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.499
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8734
  SOIL CLASSIFICATION IS "B"
  SUBAREA AREA(ACRES) =    1.04   SUBAREA RUNOFF(CFS) =    2.27
  TOTAL AREA(ACRES) =        1.4   TOTAL RUNOFF(CFS) =       3.20
  TC(MIN.) =    6.60

****************************************************************************
  FLOW PROCESS FROM NODE    105.00 TO NODE    102.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1531.50  DOWNSTREAM(FEET) =  1530.50
  FLOW LENGTH(FEET) =   140.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  15.0 INCH PIPE IS   8.4 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.53
  ESTIMATED PIPE DIAMETER(INCH) =  15.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       3.20
  PIPE TRAVEL TIME(MIN.) =   0.52    Tc(MIN.) =    7.12
  LONGEST FLOWPATH FROM NODE     99.00 TO NODE    102.00 =     530.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    102.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    10 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.407
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8727
  SOIL CLASSIFICATION IS "B"
  SUBAREA AREA(ACRES) =    0.26   SUBAREA RUNOFF(CFS) =    0.55
  TOTAL AREA(ACRES) =        1.7   TOTAL RUNOFF(CFS) =       3.74
  TC(MIN.) =    7.12

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    102.00 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================
```

```
 ** MAIN STREAM CONFLUENCE DATA **
 STREAM     RUNOFF      Tc      INTENSITY     AREA
 NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
     1        3.74     7.12       2.407        1.69
 LONGEST FLOWPATH FROM NODE     99.00 TO NODE    102.00 =     530.00 FEET.

 ** MEMORY BANK #  1 CONFLUENCE DATA **
 STREAM     RUNOFF      Tc      INTENSITY     AREA
 NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
     1        7.26     6.78       2.465        3.36
 LONGEST FLOWPATH FROM NODE    100.00 TO NODE    102.00 =     482.00 FEET.

********************************WARNING**********************************
 IN THIS COMPUTER PROGRAM, THE CONFLUENCE VALUE USED IS BASED
 ON THE RCFC&WCD FORMULA OF PLATE D-1 AS DEFAULT VALUE. THIS FORMULA
 WILL NOT NECESSARILY RESULT IN THE MAXIMUM VALUE OF PEAK FLOW.
*************************************************************************

 ** PEAK FLOW RATE TABLE **
 STREAM    RUNOFF       Tc      INTENSITY
 NUMBER     (CFS)     (MIN.)   (INCH/HOUR)
     1      10.83       6.78        2.465
     2      10.83       7.12        2.407

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =      10.83   Tc(MIN.) =    6.78
 TOTAL AREA(ACRES) =        5.0

****************************************************************************
 FLOW PROCESS FROM NODE    102.00 TO NODE    106.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =  1530.50  DOWNSTREAM(FEET) =  1529.00
 FLOW LENGTH(FEET) =    10.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  12.0 INCH PIPE IS   8.2 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =  19.05
 ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =      10.83
 PIPE TRAVEL TIME(MIN.) =   0.01    Tc(MIN.) =    6.79
 LONGEST FLOWPATH FROM NODE     99.00 TO NODE    106.00 =     540.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    106.00 TO NODE    107.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
```

```
================================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1529.00  DOWNSTREAM(FEET) =  1513.00
  FLOW LENGTH(FEET) =   900.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  12.1 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   8.57
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      10.83
  PIPE TRAVEL TIME(MIN.) =   1.75    Tc(MIN.) =    8.54
  LONGEST FLOWPATH FROM NODE     99.00 TO NODE    107.00 =    1440.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    107.00 TO NODE    107.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 2 <<<<<
================================================================================

****************************************************************************
  FLOW PROCESS FROM NODE     98.00 TO NODE    108.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
================================================================================
         ASSUMED INITIAL SUBAREA UNIFORM
         DEVELOPMENT IS COMMERCIAL
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   409.00
  UPSTREAM ELEVATION(FEET) =   1535.00
  DOWNSTREAM ELEVATION(FEET) =   1527.50
  ELEVATION DIFFERENCE(FEET) =      7.50
  TC = 0.303*[(  409.00**3)/(     7.50)]**.2 =    7.475
    10 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.348
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8722
  SOIL CLASSIFICATION IS "B"
  SUBAREA RUNOFF(CFS) =      4.04
  TOTAL AREA(ACRES) =      1.97   TOTAL RUNOFF(CFS) =      4.04

****************************************************************************
  FLOW PROCESS FROM NODE    108.00 TO NODE    109.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
================================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1524.50  DOWNSTREAM(FEET) =  1520.00
  FLOW LENGTH(FEET) =   370.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  15.0 INCH PIPE IS   8.2 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.87
  ESTIMATED PIPE DIAMETER(INCH) =  15.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       4.04
  PIPE TRAVEL TIME(MIN.) =   1.05    Tc(MIN.) =    8.52
```

```
  LONGEST FLOWPATH FROM NODE     98.00 TO NODE    109.00 =     779.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    109.00 TO NODE    109.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    10 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.199
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8710
  SOIL CLASSIFICATION IS "B"
  SUBAREA AREA(ACRES) =    0.21   SUBAREA RUNOFF(CFS) =    0.40
  TOTAL AREA(ACRES) =        2.2   TOTAL RUNOFF(CFS) =       4.44
  TC(MIN.) =    8.52

****************************************************************************
  FLOW PROCESS FROM NODE    109.00 TO NODE    111.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1520.00  DOWNSTREAM(FEET) =  1514.00
  FLOW LENGTH(FEET) =   250.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   8.3 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   7.65
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       4.44
  PIPE TRAVEL TIME(MIN.) =   0.54    Tc(MIN.) =    9.07
  LONGEST FLOWPATH FROM NODE     98.00 TO NODE    111.00 =    1029.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    111.00 TO NODE    111.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 3 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE     97.00 TO NODE    110.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
        ASSUMED INITIAL SUBAREA UNIFORM
        DEVELOPMENT IS COMMERCIAL
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   490.00
  UPSTREAM ELEVATION(FEET) =   1524.00
  DOWNSTREAM ELEVATION(FEET) =   1520.00
  ELEVATION DIFFERENCE(FEET) =      4.00
  TC = 0.303*[(  490.00**3)/(     4.00)]**.2 =    9.447
```

```
   10 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.089
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8699
  SOIL CLASSIFICATION IS "B"
  SUBAREA RUNOFF(CFS) =      9.88
  TOTAL AREA(ACRES) =      5.44   TOTAL RUNOFF(CFS) =      9.88

****************************************************************************
  FLOW PROCESS FROM NODE    110.00 TO NODE    111.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1516.00  DOWNSTREAM(FEET) =  1514.00
  FLOW LENGTH(FEET) =   180.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  13.5 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   6.93
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       9.88
  PIPE TRAVEL TIME(MIN.) =   0.43    Tc(MIN.) =    9.88
  LONGEST FLOWPATH FROM NODE     97.00 TO NODE    111.00 =     670.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    111.00 TO NODE    111.00 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 3 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
      1        9.88     9.88       2.042        5.44
  LONGEST FLOWPATH FROM NODE     97.00 TO NODE    111.00 =     670.00 FEET.

  ** MEMORY BANK #  3 CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
      1        4.44     9.07       2.132        2.18
  LONGEST FLOWPATH FROM NODE     98.00 TO NODE    111.00 =    1029.00 FEET.

 *********************************WARNING**********************************
  IN THIS COMPUTER PROGRAM, THE CONFLUENCE VALUE USED IS BASED
  ON THE RCFC&WCD FORMULA OF PLATE D-1 AS DEFAULT VALUE. THIS FORMULA
  WILL NOT NECESSARILY RESULT IN THE MAXIMUM VALUE OF PEAK FLOW.
 **************************************************************************

  ** PEAK FLOW RATE TABLE **
  STREAM    RUNOFF       Tc      INTENSITY
  NUMBER     (CFS)     (MIN.)   (INCH/HOUR)
```

```
    1      13.51       9.07        2.132
    2      14.14       9.88        2.042

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =      14.14   Tc(MIN.) =    9.88
 TOTAL AREA(ACRES) =        7.6

****************************************************************************
 FLOW PROCESS FROM NODE    111.00 TO NODE    112.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =  1514.00  DOWNSTREAM(FEET) =  1513.50
 FLOW LENGTH(FEET) =    34.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  21.0 INCH PIPE IS  13.6 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   8.56
 ESTIMATED PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =      14.14
 PIPE TRAVEL TIME(MIN.) =   0.07    Tc(MIN.) =    9.95
 LONGEST FLOWPATH FROM NODE     98.00 TO NODE    112.00 =    1063.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    112.00 TO NODE    107.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =  1513.50  DOWNSTREAM(FEET) =  1513.00
 FLOW LENGTH(FEET) =    10.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  18.0 INCH PIPE IS  10.2 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =  13.63
 ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =      14.14
 PIPE TRAVEL TIME(MIN.) =   0.01    Tc(MIN.) =    9.96
 LONGEST FLOWPATH FROM NODE     98.00 TO NODE    107.00 =    1073.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    107.00 TO NODE    107.00 IS CODE =  11
----------------------------------------------------------------------------
 >>>>>CONFLUENCE MEMORY BANK # 2 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

 ** MAIN STREAM CONFLUENCE DATA **
 STREAM     RUNOFF      Tc      INTENSITY     AREA
 NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
    1       14.14     9.96       2.034        7.62
 LONGEST FLOWPATH FROM NODE     98.00 TO NODE    107.00 =    1073.00 FEET.
```

```
 ** MEMORY BANK #  2 CONFLUENCE DATA **
 STREAM     RUNOFF      Tc      INTENSITY     AREA
 NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
     1       10.83     8.54       2.197        5.05
 LONGEST FLOWPATH FROM NODE     99.00 TO NODE    107.00 =    1440.00 FEET.

 ********************************WARNING**********************************
 IN THIS COMPUTER PROGRAM, THE CONFLUENCE VALUE USED IS BASED
 ON THE RCFC&WCD FORMULA OF PLATE D-1 AS DEFAULT VALUE. THIS FORMULA
 WILL NOT NECESSARILY RESULT IN THE MAXIMUM VALUE OF PEAK FLOW.
 *************************************************************************

 ** PEAK FLOW RATE TABLE **
 STREAM    RUNOFF       Tc      INTENSITY
 NUMBER     (CFS)     (MIN.)   (INCH/HOUR)
     1      22.96       8.54        2.197
     2      24.17       9.96        2.034

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =      24.17   Tc(MIN.) =    9.96
 TOTAL AREA(ACRES) =       12.7

****************************************************************************
 FLOW PROCESS FROM NODE    107.00 TO NODE    113.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =  1513.00  DOWNSTREAM(FEET) =  1511.50
 FLOW LENGTH(FEET) =   170.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  27.0 INCH PIPE IS  19.2 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   8.01
 ESTIMATED PIPE DIAMETER(INCH) =  27.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =      24.17
 PIPE TRAVEL TIME(MIN.) =   0.35    Tc(MIN.) =   10.31
 LONGEST FLOWPATH FROM NODE     99.00 TO NODE    113.00 =    1610.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    113.00 TO NODE    113.00 IS CODE =  12
----------------------------------------------------------------------------
 >>>>>CLEAR MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE    113.00 TO NODE    113.00 IS CODE =  10
----------------------------------------------------------------------------
 >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
```

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==========================================================================

**************************************************************************
  FLOW PROCESS FROM NODE    200.00 TO NODE    201.00 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
==========================================================================
         ASSUMED INITIAL SUBAREA UNIFORM
         DEVELOPMENT IS COMMERCIAL
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   282.00
  UPSTREAM ELEVATION(FEET) =   1552.00
  DOWNSTREAM ELEVATION(FEET) =   1540.00
  ELEVATION DIFFERENCE(FEET) =     12.00
  TC = 0.303*[(  282.00**3)/(    12.00)]**.2 =    5.444
    10 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.752
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8752
  SOIL CLASSIFICATION IS "B"
  SUBAREA RUNOFF(CFS) =      0.36
  TOTAL AREA(ACRES) =      0.15   TOTAL RUNOFF(CFS) =      0.36

**************************************************************************
  FLOW PROCESS FROM NODE    201.00 TO NODE    202.00 IS CODE =  31
--------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
==========================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1537.00  DOWNSTREAM(FEET) =  1533.00
  FLOW LENGTH(FEET) =   270.00   MANNING'S N =  0.013
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 12.000
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   2.4 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   3.30
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       0.36
  PIPE TRAVEL TIME(MIN.) =   1.36    Tc(MIN.) =    6.81
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    202.00 =     552.00 FEET.

**************************************************************************
  FLOW PROCESS FROM NODE    202.00 TO NODE    202.00 IS CODE =  81
--------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
==========================================================================
    10 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.461
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8731
  SOIL CLASSIFICATION IS "B"
  SUBAREA AREA(ACRES) =    0.99   SUBAREA RUNOFF(CFS) =    2.13
  TOTAL AREA(ACRES) =        1.1   TOTAL RUNOFF(CFS) =       2.49
  TC(MIN.) =    6.81
```

```
****************************************************************************
  FLOW PROCESS FROM NODE    202.00 TO NODE    203.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1533.00  DOWNSTREAM(FEET) =  1523.00
  FLOW LENGTH(FEET) =   325.00   MANNING'S N =  0.013
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 12.000
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   5.3 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   7.35
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       2.49
  PIPE TRAVEL TIME(MIN.) =   0.74    Tc(MIN.) =    7.54
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    203.00 =     877.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    203.00 TO NODE    203.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    10 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.338
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8721
  SOIL CLASSIFICATION IS "B"
  SUBAREA AREA(ACRES) =    2.14   SUBAREA RUNOFF(CFS) =    4.36
  TOTAL AREA(ACRES) =        3.3   TOTAL RUNOFF(CFS) =       6.85
  TC(MIN.) =    7.54

****************************************************************************
  FLOW PROCESS FROM NODE    203.00 TO NODE    204.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1523.00  DOWNSTREAM(FEET) =  1517.00
  FLOW LENGTH(FEET) =   350.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  15.0 INCH PIPE IS  10.4 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   7.51
  ESTIMATED PIPE DIAMETER(INCH) =  15.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       6.85
  PIPE TRAVEL TIME(MIN.) =   0.78    Tc(MIN.) =    8.32
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    204.00 =    1227.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    204.00 TO NODE    204.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
```

```
============================================================================
    10 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.226
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8712
  SOIL CLASSIFICATION IS "B"
  SUBAREA AREA(ACRES) =    0.60   SUBAREA RUNOFF(CFS) =    1.16
  TOTAL AREA(ACRES) =        3.9   TOTAL RUNOFF(CFS) =       8.01
  TC(MIN.) =    8.32

****************************************************************************
  FLOW PROCESS FROM NODE    204.00 TO NODE    204.00 IS CODE =  12
----------------------------------------------------------------------------
  >>>>>CLEAR MEMORY BANK # 2 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    204.00 TO NODE    204.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 2 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    300.00 TO NODE    301.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
        ASSUMED INITIAL SUBAREA UNIFORM
        DEVELOPMENT IS COMMERCIAL
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   206.00
  UPSTREAM ELEVATION(FEET) =   1523.00
  DOWNSTREAM ELEVATION(FEET) =   1522.00
  ELEVATION DIFFERENCE(FEET) =      1.00
  TC = 0.303*[(  206.00**3)/(     1.00)]**.2 =    7.412
    10 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.358
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8723
  SOIL CLASSIFICATION IS "B"
  SUBAREA RUNOFF(CFS) =      2.80
  TOTAL AREA(ACRES) =      1.36   TOTAL RUNOFF(CFS) =      2.80

****************************************************************************
  FLOW PROCESS FROM NODE    301.00 TO NODE    204.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1519.00  DOWNSTREAM(FEET) =  1517.00
  FLOW LENGTH(FEET) =   340.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  15.0 INCH PIPE IS   8.2 INCHES
```

```
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.08
  ESTIMATED PIPE DIAMETER(INCH) =  15.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       2.80
  PIPE TRAVEL TIME(MIN.) =   1.39    Tc(MIN.) =    8.80
  LONGEST FLOWPATH FROM NODE    300.00 TO NODE    204.00 =     546.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    204.00 TO NODE    204.00 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 2 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
      1        2.80     8.80       2.164        1.36
  LONGEST FLOWPATH FROM NODE    300.00 TO NODE    204.00 =     546.00 FEET.

  ** MEMORY BANK #  2 CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
      1        8.01     8.32       2.226        3.88
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    204.00 =    1227.00 FEET.

 *********************************WARNING**********************************
  IN THIS COMPUTER PROGRAM, THE CONFLUENCE VALUE USED IS BASED
  ON THE RCFC&WCD FORMULA OF PLATE D-1 AS DEFAULT VALUE. THIS FORMULA
  WILL NOT NECESSARILY RESULT IN THE MAXIMUM VALUE OF PEAK FLOW.
 **************************************************************************

  ** PEAK FLOW RATE TABLE **
  STREAM    RUNOFF       Tc      INTENSITY
  NUMBER     (CFS)     (MIN.)   (INCH/HOUR)
      1      10.66       8.32        2.226
      2      10.59       8.80        2.164

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      10.66   Tc(MIN.) =    8.32
  TOTAL AREA(ACRES) =        5.2

****************************************************************************
  FLOW PROCESS FROM NODE    204.00 TO NODE    205.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1517.00  DOWNSTREAM(FEET) =  1513.50
  FLOW LENGTH(FEET) =   306.00   MANNING'S N =  0.013
```

```
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  14.3 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   7.06
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      10.66
  PIPE TRAVEL TIME(MIN.) =   0.72    Tc(MIN.) =    9.04
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    205.00 =    1533.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    205.00 TO NODE    205.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
    10 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.135
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8704
  SOIL CLASSIFICATION IS "B"
  SUBAREA AREA(ACRES) =    1.42   SUBAREA RUNOFF(CFS) =    2.64
  TOTAL AREA(ACRES) =        6.7   TOTAL RUNOFF(CFS) =      13.30
  TC(MIN.) =    9.04

****************************************************************************
  FLOW PROCESS FROM NODE    205.00 TO NODE    208.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1513.50  DOWNSTREAM(FEET) =  1512.50
  FLOW LENGTH(FEET) =   130.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  21.0 INCH PIPE IS  16.9 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   6.42
  ESTIMATED PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      13.30
  PIPE TRAVEL TIME(MIN.) =   0.34    Tc(MIN.) =    9.38
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    208.00 =    1663.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    208.00 TO NODE    208.00 IS CODE =  12
----------------------------------------------------------------------------
  >>>>>CLEAR MEMORY BANK # 2 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    208.00 TO NODE    208.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 2 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    206.00 TO NODE    207.00 IS CODE =  21
```

```
------------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
==============================================================================
         ASSUMED INITIAL SUBAREA UNIFORM
         DEVELOPMENT IS COMMERCIAL
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   200.00
  UPSTREAM ELEVATION(FEET) =   1520.00
  DOWNSTREAM ELEVATION(FEET) =   1516.50
  ELEVATION DIFFERENCE(FEET) =      3.50
  TC = 0.303*[(  200.00**3)/(     3.50)]**.2 =    5.667
    10 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.697
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8748
  SOIL CLASSIFICATION IS "B"
  SUBAREA RUNOFF(CFS) =      0.54
  TOTAL AREA(ACRES) =      0.23   TOTAL RUNOFF(CFS) =      0.54

******************************************************************************
  FLOW PROCESS FROM NODE    207.00 TO NODE    208.00 IS CODE =  31
------------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
==============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1514.00  DOWNSTREAM(FEET) =  1512.50
  FLOW LENGTH(FEET) =   300.00   MANNING'S N =  0.013
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 12.000
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   3.8 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   2.50
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       0.54
  PIPE TRAVEL TIME(MIN.) =   2.00    Tc(MIN.) =    7.67
  LONGEST FLOWPATH FROM NODE    206.00 TO NODE    208.00 =     500.00 FEET.

******************************************************************************
  FLOW PROCESS FROM NODE    208.00 TO NODE    208.00 IS CODE =  11
------------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 2 WITH THE MAIN-STREAM MEMORY<<<<<
==============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
      1        0.54     7.67       2.319        0.23
  LONGEST FLOWPATH FROM NODE    206.00 TO NODE    208.00 =     500.00 FEET.

  ** MEMORY BANK #  2 CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
```

```
    1       13.30     9.38       2.096        6.66
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    208.00 =    1663.00 FEET.

 *******************************WARNING**********************************
  IN THIS COMPUTER PROGRAM, THE CONFLUENCE VALUE USED IS BASED
  ON THE RCFC&WCD FORMULA OF PLATE D-1 AS DEFAULT VALUE. THIS FORMULA
  WILL NOT NECESSARILY RESULT IN THE MAXIMUM VALUE OF PEAK FLOW.
 ************************************************************************

  ** PEAK FLOW RATE TABLE **
  STREAM    RUNOFF       Tc      INTENSITY
  NUMBER     (CFS)     (MIN.)   (INCH/HOUR)
      1      11.41       7.67        2.319
      2      13.79       9.38        2.096

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      13.79   Tc(MIN.) =    9.38
  TOTAL AREA(ACRES) =        6.9

****************************************************************************
  FLOW PROCESS FROM NODE    208.00 TO NODE    209.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1512.50  DOWNSTREAM(FEET) =  1512.00
  FLOW LENGTH(FEET) =    50.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  21.0 INCH PIPE IS  15.5 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   7.26
  ESTIMATED PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      13.79
  PIPE TRAVEL TIME(MIN.) =   0.11    Tc(MIN.) =    9.49
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    209.00 =    1713.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    209.00 TO NODE    113.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1512.00  DOWNSTREAM(FEET) =  1511.50
  FLOW LENGTH(FEET) =    50.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  21.0 INCH PIPE IS  15.5 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   7.26
  ESTIMATED PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      13.79
  PIPE TRAVEL TIME(MIN.) =   0.11    Tc(MIN.) =    9.61
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    113.00 =    1763.00 FEET.
```

```
****************************************************************************
  FLOW PROCESS FROM NODE    113.00 TO NODE    113.00 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
      1       13.79     9.61       2.071        6.89
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    113.00 =    1763.00 FEET.

  ** MEMORY BANK #  1 CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
      1       24.17    10.31       1.999       12.67
  LONGEST FLOWPATH FROM NODE     99.00 TO NODE    113.00 =    1610.00 FEET.

 ********************************WARNING**********************************
  IN THIS COMPUTER PROGRAM, THE CONFLUENCE VALUE USED IS BASED
  ON THE RCFC&WCD FORMULA OF PLATE D-1 AS DEFAULT VALUE. THIS FORMULA
  WILL NOT NECESSARILY RESULT IN THE MAXIMUM VALUE OF PEAK FLOW.
 **************************************************************************

  ** PEAK FLOW RATE TABLE **
  STREAM    RUNOFF       Tc      INTENSITY
  NUMBER     (CFS)     (MIN.)   (INCH/HOUR)
      1      36.31       9.61        2.071
      2      37.48      10.31        1.999

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      37.48   Tc(MIN.) =   10.31
  TOTAL AREA(ACRES) =       19.6

****************************************************************************
  FLOW PROCESS FROM NODE    113.00 TO NODE    400.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1511.50  DOWNSTREAM(FEET) =  1511.00
  FLOW LENGTH(FEET) =    90.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  33.0 INCH PIPE IS  26.3 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   7.37
  ESTIMATED PIPE DIAMETER(INCH) =  33.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      37.48
  PIPE TRAVEL TIME(MIN.) =   0.20    Tc(MIN.) =   10.52
```

```
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    400.00 =    1853.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =       19.6  TC(MIN.) =     10.52
  PEAK FLOW RATE(CFS)   =      37.48
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
*****************************************************************************
               RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM BASED ON
           RIVERSIDE COUNTY FLOOD CONTROL & WATER CONSERVATION DISTRICT
                      (RCFC&WCD)  1978 HYDROLOGY MANUAL
             (c) Copyright 1982-2013 Advanced Engineering Software (aes)
                      (Rational Tabling Version 20.0)
                   Release Date: 06/01/2013  License ID 1264

                           Analysis prepared by:




 ************************** DESCRIPTION OF STUDY **************************
 * KAISER PERMANENTE MORENO VALLEY MEDICAL CENTER                           *
 * ON-SITE HYDROLOGY                                                        *
 * 100-YEAR STORM EVENT DEVELOPED CONDITIONS                                *
 **************************************************************************

  FILE NAME: PROPE100.DAT
  TIME/DATE OF STUDY: 14:29 07/30/2019
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  10-YEAR STORM 10-MINUTE INTENSITY(INCH/HOUR) =  2.010
  10-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) =  0.820
  100-YEAR STORM 10-MINUTE INTENSITY(INCH/HOUR) =  2.940
  100-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) =  1.200
  SLOPE OF 10-YEAR INTENSITY-DURATION CURVE =  0.5003939
  SLOPE OF 100-YEAR INTENSITY-DURATION CURVE =  0.5001161
  COMPUTED RAINFALL INTENSITY DATA:
  STORM EVENT =  100.00   1-HOUR INTENSITY(INCH/HOUR) =   1.200
  SLOPE OF INTENSITY DURATION CURVE = 0.5001
  RCFC&WCD HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: COMPUTE CONFLUENCE VALUES ACCORDING TO RCFC&WCD HYDROLOGY MANUAL
        AND IGNORE OTHER CONFLUENCE COMBINATIONS FOR DOWNSTREAM ANALYSES
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  ================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150
```

```
  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
  FLOW PROCESS FROM NODE    100.00 TO NODE    101.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
         ASSUMED INITIAL SUBAREA UNIFORM
         DEVELOPMENT IS COMMERCIAL
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   442.00
  UPSTREAM ELEVATION(FEET) =   1552.00
  DOWNSTREAM ELEVATION(FEET) =   1536.00
  ELEVATION DIFFERENCE(FEET) =     16.00
  TC = 0.303*[(  442.00**3)/(    16.00)]**.2 =    6.730
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.584
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8796
  SOIL CLASSIFICATION IS "B"
  SUBAREA RUNOFF(CFS) =     10.59
  TOTAL AREA(ACRES) =      3.36   TOTAL RUNOFF(CFS) =     10.59

****************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    102.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1533.00  DOWNSTREAM(FEET) =  1530.50
  FLOW LENGTH(FEET) =    40.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  15.0 INCH PIPE IS   9.0 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  13.76
  ESTIMATED PIPE DIAMETER(INCH) =  15.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      10.59
  PIPE TRAVEL TIME(MIN.) =   0.05    Tc(MIN.) =    6.78
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    102.00 =     482.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    102.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================
```

```
****************************************************************************
  FLOW PROCESS FROM NODE     99.00 TO NODE    103.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
         ASSUMED INITIAL SUBAREA UNIFORM
         DEVELOPMENT IS COMMERCIAL
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   185.00
  UPSTREAM ELEVATION(FEET) =   1539.00
  DOWNSTREAM ELEVATION(FEET) =   1536.00
  ELEVATION DIFFERENCE(FEET) =      3.00
  TC = 0.303*[(  185.00**3)/(     3.00)]**.2 =    5.578
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.937
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8811
  SOIL CLASSIFICATION IS "B"
  SUBAREA RUNOFF(CFS) =      1.35
  TOTAL AREA(ACRES) =      0.39   TOTAL RUNOFF(CFS) =      1.35

****************************************************************************
  FLOW PROCESS FROM NODE    103.00 TO NODE    104.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1533.00  DOWNSTREAM(FEET) =  1532.00
  FLOW LENGTH(FEET) =   145.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   5.8 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   3.61
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       1.35
  PIPE TRAVEL TIME(MIN.) =   0.67    Tc(MIN.) =    6.25
  LONGEST FLOWPATH FROM NODE     99.00 TO NODE    104.00 =     330.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    104.00 TO NODE    105.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1532.00  DOWNSTREAM(FEET) =  1531.50
  FLOW LENGTH(FEET) =    60.00   MANNING'S N =  0.013
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 12.000
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   5.5 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   3.88
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       1.35
  PIPE TRAVEL TIME(MIN.) =   0.26    Tc(MIN.) =    6.50
```

```
  LONGEST FLOWPATH FROM NODE     99.00 TO NODE    105.00 =     390.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    105.00 TO NODE    105.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.646
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8799
  SOIL CLASSIFICATION IS "B"
  SUBAREA AREA(ACRES) =    1.04   SUBAREA RUNOFF(CFS) =    3.34
  TOTAL AREA(ACRES) =        1.4   TOTAL RUNOFF(CFS) =       4.69
  TC(MIN.) =    6.50

****************************************************************************
  FLOW PROCESS FROM NODE    105.00 TO NODE    102.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1531.50  DOWNSTREAM(FEET) =  1530.50
  FLOW LENGTH(FEET) =   140.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  15.0 INCH PIPE IS  10.9 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.90
  ESTIMATED PIPE DIAMETER(INCH) =  15.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       4.69
  PIPE TRAVEL TIME(MIN.) =   0.48    Tc(MIN.) =    6.98
  LONGEST FLOWPATH FROM NODE     99.00 TO NODE    102.00 =     530.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    102.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.519
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8794
  SOIL CLASSIFICATION IS "B"
  SUBAREA AREA(ACRES) =    0.26   SUBAREA RUNOFF(CFS) =    0.80
  TOTAL AREA(ACRES) =        1.7   TOTAL RUNOFF(CFS) =       5.49
  TC(MIN.) =    6.98

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    102.00 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
```

```
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
     1        5.49     6.98       3.519        1.69
  LONGEST FLOWPATH FROM NODE     99.00 TO NODE    102.00 =     530.00 FEET.

  ** MEMORY BANK #  1 CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
     1       10.59     6.78       3.571        3.36
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    102.00 =     482.00 FEET.

 *******************************WARNING**********************************
  IN THIS COMPUTER PROGRAM, THE CONFLUENCE VALUE USED IS BASED
  ON THE RCFC&WCD FORMULA OF PLATE D-1 AS DEFAULT VALUE. THIS FORMULA
  WILL NOT NECESSARILY RESULT IN THE MAXIMUM VALUE OF PEAK FLOW.
 ************************************************************************

  ** PEAK FLOW RATE TABLE **
  STREAM    RUNOFF       Tc      INTENSITY
  NUMBER     (CFS)     (MIN.)   (INCH/HOUR)
     1      15.93       6.78        3.571
     2      15.93       6.98        3.519

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      15.93   Tc(MIN.) =    6.78
  TOTAL AREA(ACRES) =        5.0

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    106.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1530.50  DOWNSTREAM(FEET) =  1529.00
  FLOW LENGTH(FEET) =    10.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  15.0 INCH PIPE IS   8.8 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  21.18
  ESTIMATED PIPE DIAMETER(INCH) =  15.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      15.93
  PIPE TRAVEL TIME(MIN.) =   0.01    Tc(MIN.) =    6.79
  LONGEST FLOWPATH FROM NODE     99.00 TO NODE    106.00 =     540.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    106.00 TO NODE    107.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
```

```
  ELEVATION DATA: UPSTREAM(FEET) =  1529.00  DOWNSTREAM(FEET) =  1513.00
  FLOW LENGTH(FEET) =   900.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  21.0 INCH PIPE IS  13.9 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   9.45
  ESTIMATED PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      15.93
  PIPE TRAVEL TIME(MIN.) =   1.59    Tc(MIN.) =    8.37
  LONGEST FLOWPATH FROM NODE     99.00 TO NODE    107.00 =    1440.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    107.00 TO NODE    107.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 2 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE     98.00 TO NODE    108.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
         ASSUMED INITIAL SUBAREA UNIFORM
         DEVELOPMENT IS COMMERCIAL
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   409.00
  UPSTREAM ELEVATION(FEET) =   1535.00
  DOWNSTREAM ELEVATION(FEET) =   1527.50
  ELEVATION DIFFERENCE(FEET) =      7.50
  TC = 0.303*[(  409.00**3)/(     7.50)]**.2 =    7.475
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.401
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8788
  SOIL CLASSIFICATION IS "B"
  SUBAREA RUNOFF(CFS) =      5.89
  TOTAL AREA(ACRES) =      1.97   TOTAL RUNOFF(CFS) =      5.89

****************************************************************************
  FLOW PROCESS FROM NODE    108.00 TO NODE    109.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1524.50  DOWNSTREAM(FEET) =  1520.00
  FLOW LENGTH(FEET) =   370.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  15.0 INCH PIPE IS  10.6 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   6.35
  ESTIMATED PIPE DIAMETER(INCH) =  15.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       5.89
  PIPE TRAVEL TIME(MIN.) =   0.97    Tc(MIN.) =    8.45
  LONGEST FLOWPATH FROM NODE     98.00 TO NODE    109.00 =     779.00 FEET.
```

```
****************************************************************************
  FLOW PROCESS FROM NODE    109.00 TO NODE    109.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.199
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8778
  SOIL CLASSIFICATION IS "B"
  SUBAREA AREA(ACRES) =    0.21   SUBAREA RUNOFF(CFS) =    0.59
  TOTAL AREA(ACRES) =        2.2   TOTAL RUNOFF(CFS) =       6.48
  TC(MIN.) =    8.45

****************************************************************************
  FLOW PROCESS FROM NODE    109.00 TO NODE    111.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1520.00  DOWNSTREAM(FEET) =  1514.00
  FLOW LENGTH(FEET) =   250.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  15.0 INCH PIPE IS   8.9 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   8.51
  ESTIMATED PIPE DIAMETER(INCH) =  15.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       6.48
  PIPE TRAVEL TIME(MIN.) =   0.49    Tc(MIN.) =    8.94
  LONGEST FLOWPATH FROM NODE     98.00 TO NODE    111.00 =    1029.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    111.00 TO NODE    111.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 3 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE     97.00 TO NODE    110.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
         ASSUMED INITIAL SUBAREA UNIFORM
         DEVELOPMENT IS COMMERCIAL
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   490.00
  UPSTREAM ELEVATION(FEET) =   1524.00
  DOWNSTREAM ELEVATION(FEET) =   1520.00
  ELEVATION DIFFERENCE(FEET) =      4.00
  TC = 0.303*[(  490.00**3)/(     4.00)]**.2 =    9.447
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.025
```

```
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8768
  SOIL CLASSIFICATION IS "B"
  SUBAREA RUNOFF(CFS) =     14.43
  TOTAL AREA(ACRES) =      5.44   TOTAL RUNOFF(CFS) =     14.43

****************************************************************************
  FLOW PROCESS FROM NODE    110.00 TO NODE    111.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1516.00  DOWNSTREAM(FEET) =  1514.00
  FLOW LENGTH(FEET) =   180.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  21.0 INCH PIPE IS  15.4 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   7.64
  ESTIMATED PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      14.43
  PIPE TRAVEL TIME(MIN.) =   0.39    Tc(MIN.) =    9.84
  LONGEST FLOWPATH FROM NODE     97.00 TO NODE    111.00 =     670.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    111.00 TO NODE    111.00 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 3 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
     1       14.43     9.84       2.964        5.44
  LONGEST FLOWPATH FROM NODE     97.00 TO NODE    111.00 =     670.00 FEET.

  ** MEMORY BANK #  3 CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
     1        6.48     8.94       3.110        2.18
  LONGEST FLOWPATH FROM NODE     98.00 TO NODE    111.00 =    1029.00 FEET.

 *********************************WARNING**********************************
  IN THIS COMPUTER PROGRAM, THE CONFLUENCE VALUE USED IS BASED
  ON THE RCFC&WCD FORMULA OF PLATE D-1 AS DEFAULT VALUE. THIS FORMULA
  WILL NOT NECESSARILY RESULT IN THE MAXIMUM VALUE OF PEAK FLOW.
 **************************************************************************

  ** PEAK FLOW RATE TABLE **
  STREAM    RUNOFF       Tc      INTENSITY
  NUMBER     (CFS)     (MIN.)   (INCH/HOUR)
     1      19.58       8.94        3.110
```

```
    2      20.60       9.84        2.964

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      20.60   Tc(MIN.) =    9.84
  TOTAL AREA(ACRES) =        7.6

****************************************************************************
  FLOW PROCESS FROM NODE    111.00 TO NODE    112.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1514.00  DOWNSTREAM(FEET) =  1513.50
  FLOW LENGTH(FEET) =    34.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  24.0 INCH PIPE IS  15.8 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   9.39
  ESTIMATED PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      20.60
  PIPE TRAVEL TIME(MIN.) =   0.06    Tc(MIN.) =    9.90
  LONGEST FLOWPATH FROM NODE     98.00 TO NODE    112.00 =    1063.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    112.00 TO NODE    107.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1513.50  DOWNSTREAM(FEET) =  1513.00
  FLOW LENGTH(FEET) =    10.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  13.4 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  14.66
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      20.60
  PIPE TRAVEL TIME(MIN.) =   0.01    Tc(MIN.) =    9.91
  LONGEST FLOWPATH FROM NODE     98.00 TO NODE    107.00 =    1073.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    107.00 TO NODE    107.00 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 2 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
     1       20.60     9.91       2.953        7.62
  LONGEST FLOWPATH FROM NODE     98.00 TO NODE    107.00 =    1073.00 FEET.
```

```
 ** MEMORY BANK #  2 CONFLUENCE DATA **
 STREAM     RUNOFF      Tc      INTENSITY     AREA
 NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
     1       15.93     8.37       3.213        5.05
 LONGEST FLOWPATH FROM NODE     99.00 TO NODE    107.00 =    1440.00 FEET.

*********************************WARNING**********************************
 IN THIS COMPUTER PROGRAM, THE CONFLUENCE VALUE USED IS BASED
 ON THE RCFC&WCD FORMULA OF PLATE D-1 AS DEFAULT VALUE. THIS FORMULA
 WILL NOT NECESSARILY RESULT IN THE MAXIMUM VALUE OF PEAK FLOW.
**************************************************************************

 ** PEAK FLOW RATE TABLE **
 STREAM    RUNOFF       Tc      INTENSITY
 NUMBER     (CFS)     (MIN.)   (INCH/HOUR)
     1      33.33       8.37        3.213
     2      35.24       9.91        2.953

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =      35.24   Tc(MIN.) =    9.91
 TOTAL AREA(ACRES) =       12.7

****************************************************************************
 FLOW PROCESS FROM NODE    107.00 TO NODE    113.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =  1513.00  DOWNSTREAM(FEET) =  1511.50
 FLOW LENGTH(FEET) =   170.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  30.0 INCH PIPE IS  23.1 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   8.70
 ESTIMATED PIPE DIAMETER(INCH) =  30.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =      35.24
 PIPE TRAVEL TIME(MIN.) =   0.33    Tc(MIN.) =   10.24
 LONGEST FLOWPATH FROM NODE     99.00 TO NODE    113.00 =    1610.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    113.00 TO NODE    113.00 IS CODE =  12
----------------------------------------------------------------------------
 >>>>>CLEAR MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE    113.00 TO NODE    113.00 IS CODE =  10
----------------------------------------------------------------------------
 >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================
```

```
**************************************************************************
  FLOW PROCESS FROM NODE    200.00 TO NODE    201.00 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
==========================================================================
        ASSUMED INITIAL SUBAREA UNIFORM
        DEVELOPMENT IS COMMERCIAL
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   282.00
  UPSTREAM ELEVATION(FEET) =   1552.00
  DOWNSTREAM ELEVATION(FEET) =   1540.00
  ELEVATION DIFFERENCE(FEET) =     12.00
  TC = 0.303*[(  282.00**3)/(    12.00)]**.2 =    5.444
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.985
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8813
  SOIL CLASSIFICATION IS "B"
  SUBAREA RUNOFF(CFS) =      0.53
  TOTAL AREA(ACRES) =      0.15   TOTAL RUNOFF(CFS) =      0.53

**************************************************************************
  FLOW PROCESS FROM NODE    201.00 TO NODE    202.00 IS CODE =  31
--------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
==========================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1537.00  DOWNSTREAM(FEET) =  1533.00
  FLOW LENGTH(FEET) =   270.00   MANNING'S N =  0.013
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 12.000
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   2.9 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   3.66
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       0.53
  PIPE TRAVEL TIME(MIN.) =   1.23    Tc(MIN.) =    6.67
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    202.00 =     552.00 FEET.

**************************************************************************
  FLOW PROCESS FROM NODE    202.00 TO NODE    202.00 IS CODE =  81
--------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
==========================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.599
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8797
  SOIL CLASSIFICATION IS "B"
  SUBAREA AREA(ACRES) =    0.99   SUBAREA RUNOFF(CFS) =    3.13
  TOTAL AREA(ACRES) =        1.1   TOTAL RUNOFF(CFS) =       3.66
  TC(MIN.) =    6.67
```

```
************************************************************************
  FLOW PROCESS FROM NODE    202.00 TO NODE    203.00 IS CODE =  31
------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
========================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1533.00  DOWNSTREAM(FEET) =  1523.00
  FLOW LENGTH(FEET) =   325.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   6.7 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   8.10
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       3.66
  PIPE TRAVEL TIME(MIN.) =   0.67    Tc(MIN.) =    7.34
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    203.00 =     877.00 FEET.

************************************************************************
  FLOW PROCESS FROM NODE    203.00 TO NODE    203.00 IS CODE =  81
------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
========================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.431
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8789
  SOIL CLASSIFICATION IS "B"
  SUBAREA AREA(ACRES) =    2.14   SUBAREA RUNOFF(CFS) =    6.45
  TOTAL AREA(ACRES) =        3.3   TOTAL RUNOFF(CFS) =      10.11
  TC(MIN.) =    7.34

************************************************************************
  FLOW PROCESS FROM NODE    203.00 TO NODE    204.00 IS CODE =  31
------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
========================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1523.00  DOWNSTREAM(FEET) =  1517.00
  FLOW LENGTH(FEET) =   350.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  11.7 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   8.34
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      10.11
  PIPE TRAVEL TIME(MIN.) =   0.70    Tc(MIN.) =    8.04
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    204.00 =    1227.00 FEET.

************************************************************************
  FLOW PROCESS FROM NODE    204.00 TO NODE    204.00 IS CODE =  81
------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
========================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.278
```

```
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8782
  SOIL CLASSIFICATION IS "B"
  SUBAREA AREA(ACRES) =    0.60   SUBAREA RUNOFF(CFS) =    1.73
  TOTAL AREA(ACRES) =        3.9   TOTAL RUNOFF(CFS) =      11.84
  TC(MIN.) =    8.04

****************************************************************************
  FLOW PROCESS FROM NODE    204.00 TO NODE    204.00 IS CODE =  12
----------------------------------------------------------------------------
  >>>>>CLEAR MEMORY BANK # 2 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    204.00 TO NODE    204.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 2 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    300.00 TO NODE    301.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
        ASSUMED INITIAL SUBAREA UNIFORM
        DEVELOPMENT IS COMMERCIAL
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   206.00
  UPSTREAM ELEVATION(FEET) =   1523.00
  DOWNSTREAM ELEVATION(FEET) =   1522.00
  ELEVATION DIFFERENCE(FEET) =      1.00
  TC = 0.303*[(  206.00**3)/(     1.00)]**.2 =    7.412
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.415
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8789
  SOIL CLASSIFICATION IS "B"
  SUBAREA RUNOFF(CFS) =      4.08
  TOTAL AREA(ACRES) =      1.36   TOTAL RUNOFF(CFS) =      4.08

****************************************************************************
  FLOW PROCESS FROM NODE    301.00 TO NODE    204.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1519.00  DOWNSTREAM(FEET) =  1517.00
  FLOW LENGTH(FEET) =   340.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  15.0 INCH PIPE IS  10.6 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.41
  ESTIMATED PIPE DIAMETER(INCH) =  15.00    NUMBER OF PIPES =   1
```

```
  PIPE-FLOW(CFS) =       4.08
  PIPE TRAVEL TIME(MIN.) =   1.28    Tc(MIN.) =    8.70
  LONGEST FLOWPATH FROM NODE    300.00 TO NODE    204.00 =     546.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    204.00 TO NODE    204.00 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 2 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
      1        4.08     8.70       3.153        1.36
  LONGEST FLOWPATH FROM NODE    300.00 TO NODE    204.00 =     546.00 FEET.

  ** MEMORY BANK #  2 CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
      1       11.84     8.04       3.278        3.88
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    204.00 =    1227.00 FEET.

 *********************************WARNING**********************************
  IN THIS COMPUTER PROGRAM, THE CONFLUENCE VALUE USED IS BASED
  ON THE RCFC&WCD FORMULA OF PLATE D-1 AS DEFAULT VALUE. THIS FORMULA
  WILL NOT NECESSARILY RESULT IN THE MAXIMUM VALUE OF PEAK FLOW.
 **************************************************************************

  ** PEAK FLOW RATE TABLE **
  STREAM    RUNOFF       Tc      INTENSITY
  NUMBER     (CFS)     (MIN.)   (INCH/HOUR)
      1      15.62       8.04        3.278
      2      15.47       8.70        3.153

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      15.62   Tc(MIN.) =    8.04
  TOTAL AREA(ACRES) =        5.2

****************************************************************************
  FLOW PROCESS FROM NODE    204.00 TO NODE    205.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1517.00  DOWNSTREAM(FEET) =  1513.50
  FLOW LENGTH(FEET) =   306.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  21.0 INCH PIPE IS  16.3 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   7.81
```

```
  ESTIMATED PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      15.62
  PIPE TRAVEL TIME(MIN.) =   0.65    Tc(MIN.) =    8.70
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    205.00 =    1533.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    205.00 TO NODE    205.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.153
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8776
  SOIL CLASSIFICATION IS "B"
  SUBAREA AREA(ACRES) =    1.42   SUBAREA RUNOFF(CFS) =    3.93
  TOTAL AREA(ACRES) =        6.7   TOTAL RUNOFF(CFS) =      19.55
  TC(MIN.) =    8.70

****************************************************************************
  FLOW PROCESS FROM NODE    205.00 TO NODE    208.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1513.50  DOWNSTREAM(FEET) =  1512.50
  FLOW LENGTH(FEET) =   130.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  27.0 INCH PIPE IS  17.3 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   7.28
  ESTIMATED PIPE DIAMETER(INCH) =  27.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      19.55
  PIPE TRAVEL TIME(MIN.) =   0.30    Tc(MIN.) =    8.99
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    208.00 =    1663.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    208.00 TO NODE    208.00 IS CODE =  12
----------------------------------------------------------------------------
  >>>>>CLEAR MEMORY BANK # 2 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    208.00 TO NODE    208.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 2 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    206.00 TO NODE    207.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
```

```
==========================================================================
        ASSUMED INITIAL SUBAREA UNIFORM
        DEVELOPMENT IS COMMERCIAL
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   200.00
  UPSTREAM ELEVATION(FEET) =   1520.00
  DOWNSTREAM ELEVATION(FEET) =   1516.50
  ELEVATION DIFFERENCE(FEET) =      3.50
  TC = 0.303*[(  200.00**3)/(     3.50)]**.2 =    5.667
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.906
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8810
  SOIL CLASSIFICATION IS "B"
  SUBAREA RUNOFF(CFS) =      0.79
  TOTAL AREA(ACRES) =      0.23   TOTAL RUNOFF(CFS) =      0.79

****************************************************************************
  FLOW PROCESS FROM NODE    207.00 TO NODE    208.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
==========================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1514.00  DOWNSTREAM(FEET) =  1512.50
  FLOW LENGTH(FEET) =   300.00   MANNING'S N =  0.013
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 12.000
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   4.7 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   2.79
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       0.79
  PIPE TRAVEL TIME(MIN.) =   1.79    Tc(MIN.) =    7.46
  LONGEST FLOWPATH FROM NODE    206.00 TO NODE    208.00 =     500.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    208.00 TO NODE    208.00 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 2 WITH THE MAIN-STREAM MEMORY<<<<<
==========================================================================

  ** MAIN STREAM CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
      1        0.79     7.46       3.404        0.23
  LONGEST FLOWPATH FROM NODE    206.00 TO NODE    208.00 =     500.00 FEET.

  ** MEMORY BANK #  2 CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
      1       19.55     8.99       3.100        6.66
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    208.00 =    1663.00 FEET.
```

```
 ******************************WARNING*********************************
  IN THIS COMPUTER PROGRAM, THE CONFLUENCE VALUE USED IS BASED
  ON THE RCFC&WCD FORMULA OF PLATE D-1 AS DEFAULT VALUE. THIS FORMULA
  WILL NOT NECESSARILY RESULT IN THE MAXIMUM VALUE OF PEAK FLOW.
 **********************************************************************

  ** PEAK FLOW RATE TABLE **
  STREAM    RUNOFF       Tc      INTENSITY
  NUMBER     (CFS)     (MIN.)   (INCH/HOUR)
      1      17.00       7.46        3.404
      2      20.27       8.99        3.100

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      20.27   Tc(MIN.) =    8.99
  TOTAL AREA(ACRES) =        6.9

****************************************************************************
  FLOW PROCESS FROM NODE    208.00 TO NODE    209.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1512.50  DOWNSTREAM(FEET) =  1512.00
  FLOW LENGTH(FEET) =    50.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  24.0 INCH PIPE IS  18.1 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   7.96
  ESTIMATED PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      20.27
  PIPE TRAVEL TIME(MIN.) =   0.10    Tc(MIN.) =    9.10
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    209.00 =    1713.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    209.00 TO NODE    113.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1512.00  DOWNSTREAM(FEET) =  1511.50
  FLOW LENGTH(FEET) =    50.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  24.0 INCH PIPE IS  18.1 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   7.96
  ESTIMATED PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      20.27
  PIPE TRAVEL TIME(MIN.) =   0.10    Tc(MIN.) =    9.20
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    113.00 =    1763.00 FEET.

****************************************************************************
```

```
  FLOW PROCESS FROM NODE    113.00 TO NODE    113.00 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
      1       20.27     9.20       3.065        6.89
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    113.00 =    1763.00 FEET.

  ** MEMORY BANK #  1 CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
      1       35.24    10.24       2.906       12.67
  LONGEST FLOWPATH FROM NODE     99.00 TO NODE    113.00 =    1610.00 FEET.

 *********************************WARNING**********************************
  IN THIS COMPUTER PROGRAM, THE CONFLUENCE VALUE USED IS BASED
  ON THE RCFC&WCD FORMULA OF PLATE D-1 AS DEFAULT VALUE. THIS FORMULA
  WILL NOT NECESSARILY RESULT IN THE MAXIMUM VALUE OF PEAK FLOW.
 **************************************************************************

  ** PEAK FLOW RATE TABLE **
  STREAM    RUNOFF       Tc      INTENSITY
  NUMBER     (CFS)     (MIN.)   (INCH/HOUR)
      1      51.95       9.20        3.065
      2      54.46      10.24        2.906

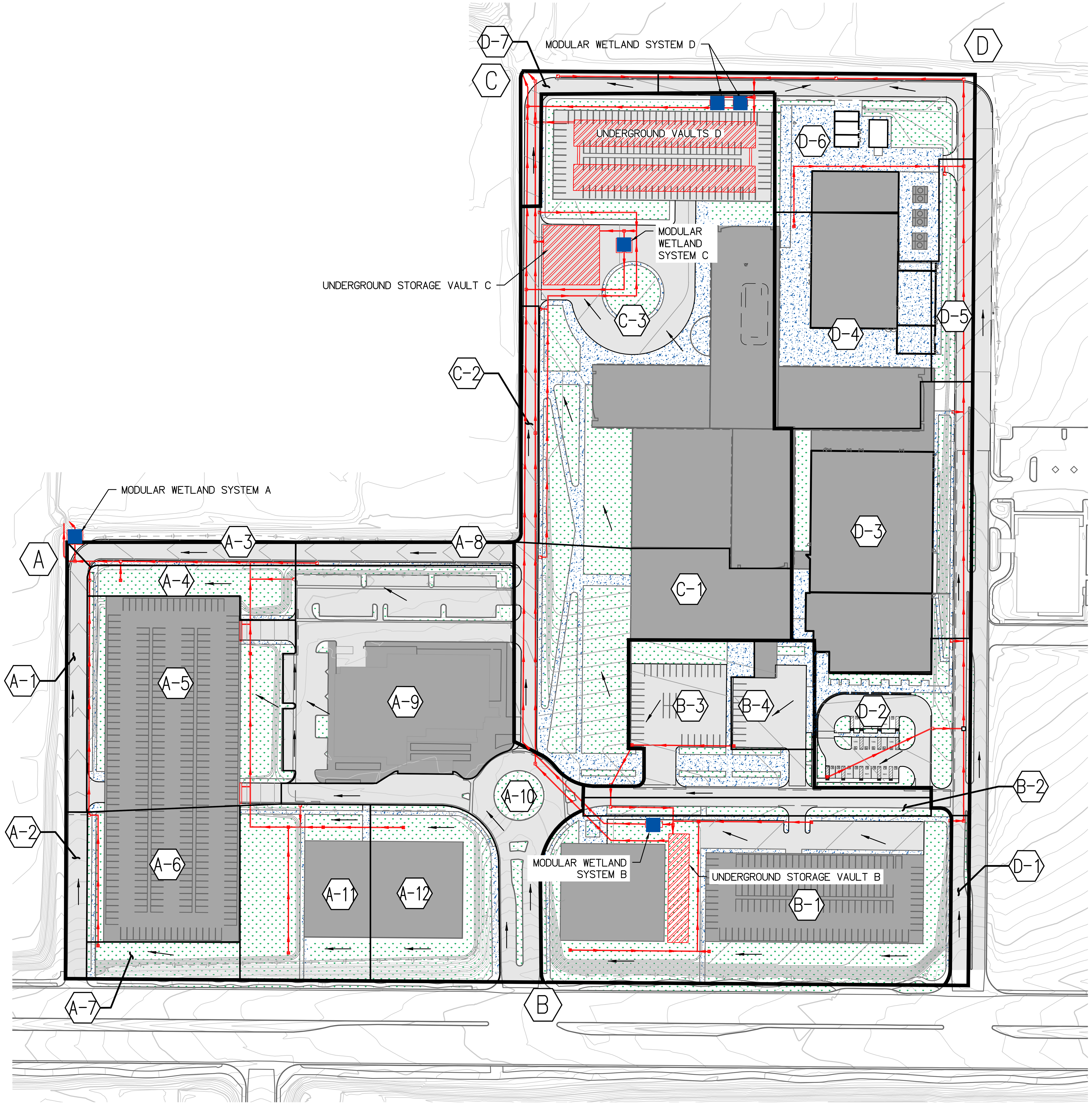
  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      54.46   Tc(MIN.) =   10.24
  TOTAL AREA(ACRES) =       19.6

****************************************************************************
  FLOW PROCESS FROM NODE    113.00 TO NODE    400.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1511.50  DOWNSTREAM(FEET) =  1511.00
  FLOW LENGTH(FEET) =    90.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  39.0 INCH PIPE IS  29.1 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   8.19
  ESTIMATED PIPE DIAMETER(INCH) =  39.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      54.46
  PIPE TRAVEL TIME(MIN.) =   0.18    Tc(MIN.) =   10.42
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    400.00 =    1853.00 FEET.
============================================================================
```

```
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =       19.6  TC(MIN.) =     10.42
  PEAK FLOW RATE(CFS)   =      54.46
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

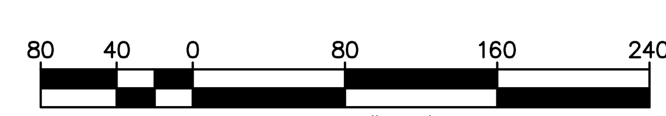
APPENDIX B

UNIT HYDROGRAPH ANALYSIS
DMA EXHIBIT



LEGEND

■	MODULAR WETLAND
— - - —	EXISTING RIGHT-OF-WAY
——	DMA SUB-AREA BOUNDARY
═	PROPOSED STORM DRAIN
═	STORAGE PIPES
▨	UNDERGROUND STORAGE VAULT
⬡ A	DMA NUMBER
⬡ A-1	DMA SUB-AREA NUMBER



Michael Baker INTERNATIONAL
9755 Clairemont Mesa Blvd., San Diego, CA 92124
Phone: (858) 614-5000 · MBAKERINTL.COM

WQMP DMA EXHIBIT
MASTER SITE PLAN

KAISER MEDICAL MORENO VALLEY

APPENDIX B

EXISTING AND PROPOSED
UNIT HYDROGRAPH CALCULATIONS
DMA B

```
      U n i t   H y d r o g r a p h   A n a l y s i s

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             Study date  07/22/19 File: dmab5exist15.out


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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978


Program License Serial Number 6388

---------------------------------------------------------------------
 English (in-lb) Input Units Used
 English Rainfall Data (Inches) Input Values Used

 English Units used in output format



---------------------------------------------------------------------
KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
EXISTING CONDITION
5-YR  1-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019
--------------------------------------------------------------------
Drainage Area =       5.10(Ac.)  =      0.008 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =       5.10(Ac.)  =      0.008 Sq. Mi.
Length along longest watercourse =     461.00(Ft.)
Length along longest watercourse measured to centroid =     391.00(Ft.)
Length along longest watercourse =      0.087 Mi.
Length along longest watercourse measured to centroid =      0.074 Mi.
Difference in elevation =      19.00(Ft.)
Slope along watercourse =    217.6139 Ft./Mi.
Average Manning's 'N' = 0.020
Lag time =    0.025 Hr.
Lag time =     1.52 Min.
25% of lag time =     0.38 Min.
40% of lag time =     0.61 Min.
Unit time =     5.00 Min.
Duration of storm = 1 Hour(s)
User Entered Base Flow =     0.00(CFS)

2 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        5.10           0.49                  2.49

100 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        5.10           1.33                  6.78

STORM EVENT (YEAR) =    5.00
Area Averaged 2-Year Rainfall =    0.489(In)
Area Averaged 100-Year Rainfall =    1.330(In)

Point rain (area averaged) =    0.686(In)
Areal adjustment factor =  100.00 %
Adjusted average point rain =    0.686(In)

Sub-Area Data:
Area(Ac.)         Runoff Index   Impervious %
     5.100           56.00         0.500
 Total Area Entered =      5.10(Ac.)


RI    RI   Infil. Rate Impervious   Adj. Infil. Rate  Area%     F
AMC2 AMC-1     (In/Hr)    (Dec.%)      (In/Hr)      (Dec.)    (In/Hr)
56.0  36.0      0.706     0.500        0.388       1.000      0.388
                                                  Sum (F) =   0.388
Area averaged mean soil loss (F) (In/Hr) =  0.388
Minimum soil loss rate ((In/Hr)) =  0.194
```

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.500

Slope of intensity-duration curve for a 1 hour storm =0.5000

U n i t   H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

	Unit time period (hrs)	Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.083	327.873	59.371	3.052
2	0.167	655.747	35.647	1.832
3	0.250	983.620	4.982	0.256
			Sum = 100.000	Sum= 5.140

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Loss rate(In./Hr) Low	Effective (In/Hr)
1	0.08	4.20	0.346	(0.388)	0.173	0.173
2	0.17	4.30	0.354	(0.388)	0.177	0.177
3	0.25	5.00	0.412	(0.388)	0.206	0.206
4	0.33	5.00	0.412	(0.388)	0.206	0.206
5	0.42	5.80	0.477	(0.388)	0.239	0.239
6	0.50	6.50	0.535	(0.388)	0.268	0.268
7	0.58	7.40	0.609	(0.388)	0.305	0.305
8	0.67	8.60	0.708	(0.388)	0.354	0.354
9	0.75	12.30	1.012	0.388	(0.506)	0.624
10	0.83	29.10	2.395	0.388	(1.198)	2.007
11	0.92	6.80	0.560	(0.388)	0.280	0.280
12	1.00	5.00	0.412	(0.388)	0.206	0.206

(Loss Rate Not Used)
Sum = 100.0 Sum = 5.0

Flood volume = Effective rainfall 0.42(In)
times area 5.1(Ac.)/[(In)/(Ft.)] = 0.2(Ac.Ft)
Total soil loss = 0.27(In)
Total soil loss = 0.113(Ac.Ft)
Total rainfall = 0.69(In)
Flood volume = 7780.1 Cubic Feet
Total soil loss = 4918.9 Cubic Feet

Peak flow rate of this hydrograph = 7.363(CFS)

++

1 - H O U R   S T O R M
R u n o f f   H y d r o g r a p h

Hydrograph in 5 Minute intervals ((CFS))

```
Time(h+m) Volume Ac.Ft   Q(CFS)  0        2.5       5.0       7.5      10.0
-----------------------------------------------------------------------
  0+ 5      0.0036     0.53  V Q        |         |         |         |
  0+10      0.0095     0.86  | VQ       |         |         |         |
  0+15      0.0164     1.00  |  Q       |         |         |         |
  0+20      0.0236     1.05  |   QV     |         |         |         |
  0+25      0.0316     1.16  |   Q  V   |         |         |         |
  0+30      0.0406     1.31  |    Q   V|         |         |         |
  0+35      0.0508     1.48  |    Q    |V        |         |         |
  0+40      0.0626     1.71  |     Q   |   V     |         |         |
  0+45      0.0807     2.63  |         Q       V |         |         |
  0+50      0.1314     7.36  |          |         |        Q|         |
  0+55      0.1638     4.69  |          |       Q |         |      V  |
  1+ 0      0.1752     1.66  |     Q    |         |         |         V|
  1+ 5      0.1782     0.45  |Q         |         |         |         V|
  1+10      0.1786     0.05  Q          |         |         |          V
-----------------------------------------------------------------------
```

```
      U n i t   H y d r o g r a p h   A n a l y s i s

       Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2014, Version 9.0
               Study date  07/22/19 File: dmab5exist35.out


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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978


Program License Serial Number 6388

---------------------------------------------------------------------
 English (in-lb) Input Units Used
 English Rainfall Data (Inches) Input Values Used

 English Units used in output format



---------------------------------------------------------------------
KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
EXISTING CONDITION
5-YR  3-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019
--------------------------------------------------------------------
Drainage Area =       5.10(Ac.)  =      0.008 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =       5.10(Ac.)  =      0.008 Sq. Mi.
Length along longest watercourse =     461.00(Ft.)
Length along longest watercourse measured to centroid =     391.00(Ft.)
Length along longest watercourse =      0.087 Mi.
Length along longest watercourse measured to centroid =      0.074 Mi.
Difference in elevation =      19.00(Ft.)
Slope along watercourse =    217.6139 Ft./Mi.
Average Manning's 'N' = 0.020
Lag time =    0.025 Hr.
Lag time =     1.52 Min.
25% of lag time =     0.38 Min.
40% of lag time =     0.61 Min.
Unit time =     5.00 Min.
Duration of storm = 3 Hour(s)
User Entered Base Flow =     0.00(CFS)

2 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        5.10           0.87                  4.42

100 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        5.10           2.09                 10.66

STORM EVENT (YEAR) =    5.00
Area Averaged 2-Year Rainfall =    0.866(In)
Area Averaged 100-Year Rainfall =    2.090(In)

Point rain (area averaged) =    1.153(In)
Areal adjustment factor =  100.00 %
Adjusted average point rain =    1.153(In)

Sub-Area Data:
Area(Ac.)         Runoff Index   Impervious %
     5.100           56.00         0.500
 Total Area Entered =      5.10(Ac.)


RI    RI   Infil. Rate Impervious   Adj. Infil. Rate  Area%     F
AMC2 AMC-1     (In/Hr)    (Dec.%)      (In/Hr)      (Dec.)    (In/Hr)
56.0  36.0      0.706     0.500        0.388       1.000      0.388
                                                  Sum (F) =   0.388
Area averaged mean soil loss (F) (In/Hr) =  0.388
Minimum soil loss rate ((In/Hr)) =  0.194
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(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.500

U n i t H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.083	327.873	59.371	3.052
2	0.167	655.747	35.647	1.832
3	0.250	983.620	4.982	0.256
			Sum = 100.000	Sum= 5.140

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Loss rate(In./Hr) Low	Effective (In/Hr)
1	0.08	1.30	0.180	(0.388)	0.090	0.090
2	0.17	1.30	0.180	(0.388)	0.090	0.090
3	0.25	1.10	0.152	(0.388)	0.076	0.076
4	0.33	1.50	0.207	(0.388)	0.104	0.104
5	0.42	1.50	0.207	(0.388)	0.104	0.104
6	0.50	1.80	0.249	(0.388)	0.124	0.124
7	0.58	1.50	0.207	(0.388)	0.104	0.104
8	0.67	1.80	0.249	(0.388)	0.124	0.124
9	0.75	1.80	0.249	(0.388)	0.124	0.124
10	0.83	1.50	0.207	(0.388)	0.104	0.104
11	0.92	1.60	0.221	(0.388)	0.111	0.111
12	1.00	1.80	0.249	(0.388)	0.124	0.124
13	1.08	2.20	0.304	(0.388)	0.152	0.152
14	1.17	2.20	0.304	(0.388)	0.152	0.152
15	1.25	2.20	0.304	(0.388)	0.152	0.152
16	1.33	2.00	0.277	(0.388)	0.138	0.138
17	1.42	2.60	0.360	(0.388)	0.180	0.180
18	1.50	2.70	0.373	(0.388)	0.187	0.187
19	1.58	2.40	0.332	(0.388)	0.166	0.166
20	1.67	2.70	0.373	(0.388)	0.187	0.187
21	1.75	3.30	0.456	(0.388)	0.228	0.228
22	1.83	3.10	0.429	(0.388)	0.214	0.214
23	1.92	2.90	0.401	(0.388)	0.201	0.201
24	2.00	3.00	0.415	(0.388)	0.207	0.207
25	2.08	3.10	0.429	(0.388)	0.214	0.214
26	2.17	4.20	0.581	(0.388)	0.290	0.290
27	2.25	5.00	0.692	(0.388)	0.346	0.346
28	2.33	3.50	0.484	(0.388)	0.242	0.242
29	2.42	6.80	0.941	0.388	(0.470)	0.552
30	2.50	7.30	1.010	0.388	(0.505)	0.621
31	2.58	8.20	1.134	0.388	(0.567)	0.746
32	2.67	5.90	0.816	0.388	(0.408)	0.428
33	2.75	2.00	0.277	(0.388)	0.138	0.138
34	2.83	1.80	0.249	(0.388)	0.124	0.124
35	2.92	1.80	0.249	(0.388)	0.124	0.124
36	3.00	0.60	0.083	(0.388)	0.041	0.041
		(Loss Rate Not Used)				
Sum =		100.0				Sum = 7.3

Flood volume = Effective rainfall 0.61(In)
times area 5.1(Ac.)/[(In)/(Ft.)] = 0.3(Ac.Ft)
Total soil loss = 0.54(In)
Total soil loss = 0.231(Ac.Ft)
Total rainfall = 1.15(In)
Flood volume = 11282.3 Cubic Feet
Total soil loss = 10057.0 Cubic Feet

Peak flow rate of this hydrograph = 3.558(CFS)

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3 - H O U R S T O R M
R u n o f f H y d r o g r a p h

Hydrograph in 5 Minute intervals ((CFS))

```
  Time(h+m) Volume Ac.Ft   Q(CFS)  0        2.5       5.0       7.5      10.0
  -----------------------------------------------------------------------
    0+ 5       0.0019      0.27  VQ        |         |         |         |
    0+10       0.0049      0.44  VQ        |         |         |         |
    0+15       0.0078      0.42  |Q        |         |         |         |
    0+20       0.0111      0.48  |Q        |         |         |         |
    0+25       0.0147      0.53  | Q       |         |         |         |
    0+30       0.0188      0.60  | Q       |         |         |         |
    0+35       0.0228      0.57  | QV      |         |         |         |
    0+40       0.0269      0.60  | Q V     |         |         |         |
    0+45       0.0313      0.63  | Q V     |         |         |         |
    0+50       0.0353      0.58  | Q  V    |         |         |         |
    0+55       0.0391      0.56  | Q   V   |         |         |         |
    1+ 0       0.0433      0.61  | Q   V   |         |         |         |
    1+ 5       0.0483      0.72  | Q    V  |         |         |         |
    1+10       0.0536      0.78  |  Q    V |         |         |         |
    1+15       0.0590      0.78  |  Q     V|         |         |         |
    1+20       0.0641      0.74  | Q      V|         |         |         |
    1+25       0.0699      0.84  |  Q      V         |         |         |
    1+30       0.0764      0.94  |  Q      |V        |         |         |
    1+35       0.0825      0.90  |  Q      | V       |         |         |
    1+40       0.0889      0.92  |  Q      |  V      |         |         |
    1+45       0.0963      1.08  |   Q     |   V     |         |         |
    1+50       0.1040      1.12  |   Q     |     V   |         |         |
    1+55       0.1114      1.06  |   Q     |      V  |         |         |
    2+ 0       0.1186      1.06  |   Q     |       V |         |         |
    2+ 5       0.1261      1.09  |   Q     |        V|         |         |
    2+10       0.1353      1.33  |    Q    |         V         |         |
    2+15       0.1466      1.64  |     Q   |         | V       |         |
    2+20       0.1566      1.45  |    Q    |         |   V     |         |
    2+25       0.1719      2.22  |       Q |         |     V   |         |
    2+30       0.1923      2.97  |         |Q        |        V|         |
    2+35       0.2168      3.56  |         |   Q     |         |  V      |
    2+40       0.2363      2.83  |         |Q        |         |     V   |
    2+45       0.2460      1.40  |    Q    |         |         |      V  |
    2+50       0.2511      0.74  | Q       |         |         |       V |
    2+55       0.2555      0.64  | Q       |         |         |        V|
    3+ 0       0.2582      0.39  |Q        |         |         |        V|
    3+ 5       0.2589      0.11  Q         |         |         |        V|
    3+10       0.2590      0.01  Q         |         |         |         V
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      U n i t   H y d r o g r a p h   A n a l y s i s

      Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2014, Version 9.0
             Study date  07/22/19 File: dmab5exist65.out


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Riverside County Synthetic Unit Hydrology Method
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Program License Serial Number 6388

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 English Rainfall Data (Inches) Input Values Used

 English Units used in output format



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EXISTING CONDITION
5-YR 6-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019
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Drainage Area for Depth-Area Areal Adjustment =       5.10(Ac.)  =      0.008 Sq. Mi.
Length along longest watercourse =     461.00(Ft.)
Length along longest watercourse measured to centroid =     391.00(Ft.)
Length along longest watercourse =      0.087 Mi.
Length along longest watercourse measured to centroid =      0.074 Mi.
Difference in elevation =      19.00(Ft.)
Slope along watercourse =    217.6139 Ft./Mi.
Average Manning's 'N' = 0.020
Lag time =    0.025 Hr.
Lag time =     1.52 Min.
25% of lag time =     0.38 Min.
40% of lag time =     0.61 Min.
Unit time =     5.00 Min.
Duration of storm = 6 Hour(s)
User Entered Base Flow =     0.00(CFS)

2 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        5.10           1.21                  6.17

100 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        5.10           2.86                 14.59

STORM EVENT (YEAR) =    5.00
Area Averaged 2-Year Rainfall =    1.210(In)
Area Averaged 100-Year Rainfall =    2.860(In)

Point rain (area averaged) =    1.596(In)
Areal adjustment factor =  100.00 %
Adjusted average point rain =    1.596(In)

Sub-Area Data:
Area(Ac.)         Runoff Index   Impervious %
     5.100           56.00         0.500
 Total Area Entered =      5.10(Ac.)


RI    RI   Infil. Rate Impervious   Adj. Infil. Rate  Area%     F
AMC2 AMC-1     (In/Hr)    (Dec.%)      (In/Hr)      (Dec.)    (In/Hr)
56.0  36.0      0.706     0.500        0.388       1.000      0.388
                                                Sum (F) =   0.388
Area averaged mean soil loss (F) (In/Hr) =  0.388
Minimum soil loss rate ((In/Hr)) =  0.194
```

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.500

U n i t H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.083	327.873	59.371	3.052
2	0.167	655.747	35.647	1.832
3	0.250	983.620	4.982	0.256
			Sum = 100.000	Sum= 5.140

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Low	Effective (In/Hr)
1	0.08	0.50	0.096	(0.388)	0.048	0.048
2	0.17	0.60	0.115	(0.388)	0.057	0.057
3	0.25	0.60	0.115	(0.388)	0.057	0.057
4	0.33	0.60	0.115	(0.388)	0.057	0.057
5	0.42	0.60	0.115	(0.388)	0.057	0.057
6	0.50	0.70	0.134	(0.388)	0.067	0.067
7	0.58	0.70	0.134	(0.388)	0.067	0.067
8	0.67	0.70	0.134	(0.388)	0.067	0.067
9	0.75	0.70	0.134	(0.388)	0.067	0.067
10	0.83	0.70	0.134	(0.388)	0.067	0.067
11	0.92	0.70	0.134	(0.388)	0.067	0.067
12	1.00	0.80	0.153	(0.388)	0.077	0.077
13	1.08	0.80	0.153	(0.388)	0.077	0.077
14	1.17	0.80	0.153	(0.388)	0.077	0.077
15	1.25	0.80	0.153	(0.388)	0.077	0.077
16	1.33	0.80	0.153	(0.388)	0.077	0.077
17	1.42	0.80	0.153	(0.388)	0.077	0.077
18	1.50	0.80	0.153	(0.388)	0.077	0.077
19	1.58	0.80	0.153	(0.388)	0.077	0.077
20	1.67	0.80	0.153	(0.388)	0.077	0.077
21	1.75	0.80	0.153	(0.388)	0.077	0.077
22	1.83	0.80	0.153	(0.388)	0.077	0.077
23	1.92	0.80	0.153	(0.388)	0.077	0.077
24	2.00	0.90	0.172	(0.388)	0.086	0.086
25	2.08	0.80	0.153	(0.388)	0.077	0.077
26	2.17	0.90	0.172	(0.388)	0.086	0.086
27	2.25	0.90	0.172	(0.388)	0.086	0.086
28	2.33	0.90	0.172	(0.388)	0.086	0.086
29	2.42	0.90	0.172	(0.388)	0.086	0.086
30	2.50	0.90	0.172	(0.388)	0.086	0.086
31	2.58	0.90	0.172	(0.388)	0.086	0.086
32	2.67	0.90	0.172	(0.388)	0.086	0.086
33	2.75	1.00	0.192	(0.388)	0.096	0.096
34	2.83	1.00	0.192	(0.388)	0.096	0.096
35	2.92	1.00	0.192	(0.388)	0.096	0.096
36	3.00	1.00	0.192	(0.388)	0.096	0.096
37	3.08	1.00	0.192	(0.388)	0.096	0.096
38	3.17	1.10	0.211	(0.388)	0.105	0.105
39	3.25	1.10	0.211	(0.388)	0.105	0.105
40	3.33	1.10	0.211	(0.388)	0.105	0.105
41	3.42	1.20	0.230	(0.388)	0.115	0.115
42	3.50	1.30	0.249	(0.388)	0.125	0.125
43	3.58	1.40	0.268	(0.388)	0.134	0.134
44	3.67	1.40	0.268	(0.388)	0.134	0.134
45	3.75	1.50	0.287	(0.388)	0.144	0.144
46	3.83	1.50	0.287	(0.388)	0.144	0.144
47	3.92	1.60	0.307	(0.388)	0.153	0.153
48	4.00	1.60	0.307	(0.388)	0.153	0.153
49	4.08	1.70	0.326	(0.388)	0.163	0.163
50	4.17	1.80	0.345	(0.388)	0.172	0.172
51	4.25	1.90	0.364	(0.388)	0.182	0.182
52	4.33	2.00	0.383	(0.388)	0.192	0.192
53	4.42	2.10	0.402	(0.388)	0.201	0.201
54	4.50	2.10	0.402	(0.388)	0.201	0.201
55	4.58	2.20	0.421	(0.388)	0.211	0.211

```
56   4.67     2.30      0.441       (  0.388)       0.220        0.220
57   4.75     2.40      0.460       (  0.388)       0.230        0.230
58   4.83     2.40      0.460       (  0.388)       0.230        0.230
59   4.92     2.50      0.479       (  0.388)       0.239        0.239
60   5.00     2.60      0.498       (  0.388)       0.249        0.249
61   5.08     3.10      0.594       (  0.388)       0.297        0.297
62   5.17     3.60      0.690       (  0.388)       0.345        0.345
63   5.25     3.90      0.747       (  0.388)       0.374        0.374
64   5.33     4.20      0.805          0.388    (  0.402)        0.416
65   5.42     4.70      0.900          0.388    (  0.450)        0.512
66   5.50     5.60      1.073          0.388    (  0.536)        0.685
67   5.58     1.90      0.364       (  0.388)       0.182        0.182
68   5.67     0.90      0.172       (  0.388)       0.086        0.086
69   5.75     0.60      0.115       (  0.388)       0.057        0.057
70   5.83     0.50      0.096       (  0.388)       0.048        0.048
71   5.92     0.30      0.057       (  0.388)       0.029        0.029
72   6.00     0.20      0.038       (  0.388)       0.019        0.019
            (Loss Rate Not Used)
   Sum =     100.0                                 Sum =     9.8
     Flood volume = Effective rainfall      0.82(In)
      times area       5.1(Ac.)/[(In)/(Ft.)] =       0.3(Ac.Ft)
     Total soil loss =      0.78(In)
     Total soil loss =     0.331(Ac.Ft)
     Total rainfall =      1.60(In)
     Flood volume =       15123.0 Cubic Feet
     Total soil loss =       14431.9 Cubic Feet
     --------------------------------------------------------------------
      Peak flow rate of this hydrograph =      3.135(CFS)
     --------------------------------------------------------------------
     ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                         6 - H O U R   S T O R M
                    R u n o f f     H y d r o g r a p h
     --------------------------------------------------------------------
                 Hydrograph in   5   Minute intervals ((CFS))

     --------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0         2.5       5.0       7.5      10.0
-----------------------------------------------------------------------
  0+ 5       0.0010      0.15  Q         |         |         |         |
  0+10       0.0028      0.26  VQ        |         |         |         |
  0+15       0.0048      0.29  VQ        |         |         |         |
  0+20       0.0069      0.30  VQ        |         |         |         |
  0+25       0.0089      0.30  |Q        |         |         |         |
  0+30       0.0111      0.32  |Q        |         |         |         |
  0+35       0.0135      0.34  |Q        |         |         |         |
  0+40       0.0159      0.34  |Q        |         |         |         |
  0+45       0.0183      0.34  |QV       |         |         |         |
  0+50       0.0206      0.34  |QV       |         |         |         |
  0+55       0.0230      0.34  |QV       |         |         |         |
  1+ 0       0.0256      0.37  |QV       |         |         |         |
  1+ 5       0.0283      0.39  |Q V      |         |         |         |
  1+10       0.0310      0.39  |Q V      |         |         |         |
  1+15       0.0337      0.39  |Q V      |         |         |         |
  1+20       0.0364      0.39  |Q  V     |         |         |         |
  1+25       0.0391      0.39  |Q  V     |         |         |         |
  1+30       0.0418      0.39  |Q  V     |         |         |         |
  1+35       0.0446      0.39  |Q   V    |         |         |         |
  1+40       0.0473      0.39  |Q   V    |         |         |         |
  1+45       0.0500      0.39  |Q   V    |         |         |         |
  1+50       0.0527      0.39  |Q    V   |         |         |         |
  1+55       0.0554      0.39  |Q    V   |         |         |         |
  2+ 0       0.0583      0.42  |Q    V   |         |         |         |
  2+ 5       0.0612      0.41  |Q     V  |         |         |         |
  2+10       0.0641      0.43  |Q     V  |         |         |         |
  2+15       0.0671      0.44  |Q     V  |         |         |         |
  2+20       0.0702      0.44  |Q      V |         |         |         |
  2+25       0.0732      0.44  |Q      V |         |         |         |
  2+30       0.0763      0.44  |Q      V |         |         |         |
  2+35       0.0793      0.44  |Q       V|         |         |         |
  2+40       0.0824      0.44  |Q       V|         |         |         |
  2+45       0.0857      0.47  |Q       V|         |         |         |
  2+50       0.0890      0.49  |Q        V         |         |         |
  2+55       0.0924      0.49  |Q        V         |         |         |
  3+ 0       0.0958      0.49  |Q        |V        |         |         |
  3+ 5       0.0992      0.49  |Q        |V        |         |         |
  3+10       0.1028      0.52  | Q       |V        |         |         |
  3+15       0.1065      0.54  | Q       | V       |         |         |
  3+20       0.1102      0.54  | Q       | V       |         |         |
  3+25       0.1142      0.57  | Q       |  V      |         |         |
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    3+30       0.1184      0.62  | Q       |  V      |         |         |
    3+35       0.1230      0.67  | Q       |   V     |         |         |
    3+40       0.1278      0.69  | Q       |   V     |         |         |
    3+45       0.1327      0.72  | Q       |    V    |         |         |
    3+50       0.1378      0.74  | Q       |    V    |         |         |
    3+55       0.1431      0.77  |  Q      |     V   |         |         |
    4+ 0       0.1485      0.79  |  Q      |      V  |         |         |
    4+ 5       0.1541      0.82  |  Q      |      V  |         |         |
    4+10       0.1601      0.86  |  Q      |       V |         |         |
    4+15       0.1664      0.91  |  Q      |        V|         |         |
    4+20       0.1730      0.96  |  Q      |        V|         |         |
    4+25       0.1800      1.01  |   Q     |         V         |         |
    4+30       0.1871      1.03  |   Q     |         |V        |         |
    4+35       0.1944      1.06  |   Q     |         | V       |         |
    4+40       0.2020      1.11  |   Q     |         |  V      |         |
    4+45       0.2100      1.16  |   Q     |         |   V     |         |
    4+50       0.2182      1.18  |   Q     |         |    V    |         |
    4+55       0.2265      1.21  |   Q     |         |     V   |         |
    5+ 0       0.2352      1.26  |    Q    |         |      V  |         |
    5+ 5       0.2450      1.42  |    Q    |         |       V |         |
    5+10       0.2564      1.66  |     Q   |         |        V|         |
    5+15       0.2691      1.85  |      Q  |         |         |V        |
    5+20       0.2832      2.04  |       Q |         |         | V       |
    5+25       0.2999      2.42  |        Q|         |         |   V     |
    5+30       0.3215      3.14  |         |  Q      |         |      V  |
    5+35       0.3349      1.94  |      Q  |         |         |       V |
    5+40       0.3402      0.77  |  Q      |         |         |        V|
    5+45       0.3428      0.38  |Q        |         |         |        V|
    5+50       0.3447      0.27  |Q        |         |         |        V|
    5+55       0.3460      0.19  Q         |         |         |        V|
    6+ 0       0.3469      0.12  Q         |         |         |        V|
    6+ 5       0.3471      0.04  Q         |         |         |        V|
    6+10       0.3472      0.00  Q         |         |         |         V
-----------------------------------------------------------------------
```

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      U n i t   H y d r o g r a p h   A n a l y s i s

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             Study date  07/22/19 File: DMAB5EXIST245.out


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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978


Program License Serial Number 6388

---------------------------------------------------------------------
 English (in-lb) Input Units Used
 English Rainfall Data (Inches) Input Values Used

 English Units used in output format



---------------------------------------------------------------------
KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
EXISTING CONDITION
5-YR 24-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019
--------------------------------------------------------------------
Drainage Area =       5.10(Ac.)  =      0.008 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =       5.10(Ac.)  =      0.008 Sq. Mi.
Length along longest watercourse =     461.00(Ft.)
Length along longest watercourse measured to centroid =     391.00(Ft.)
Length along longest watercourse =      0.087 Mi.
Length along longest watercourse measured to centroid =      0.074 Mi.
Difference in elevation =      19.00(Ft.)
Slope along watercourse =    217.6139 Ft./Mi.
Average Manning's 'N' = 0.020
Lag time =    0.025 Hr.
Lag time =     1.52 Min.
25% of lag time =     0.38 Min.
40% of lag time =     0.61 Min.
Unit time =    15.00 Min.
Duration of storm = 24 Hour(s)
User Entered Base Flow =     0.00(CFS)

2 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        5.10           2.05                 10.45

100 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        5.10           5.16                 26.32

STORM EVENT (YEAR) =    5.00
Area Averaged 2-Year Rainfall =    2.050(In)
Area Averaged 100-Year Rainfall =    5.160(In)

Point rain (area averaged) =    2.778(In)
Areal adjustment factor =  100.00 %
Adjusted average point rain =    2.778(In)

Sub-Area Data:
Area(Ac.)         Runoff Index   Impervious %
     5.100           56.00         0.500
 Total Area Entered =      5.10(Ac.)


RI    RI   Infil. Rate Impervious   Adj. Infil. Rate  Area%     F
AMC2 AMC-1     (In/Hr)    (Dec.%)      (In/Hr)      (Dec.)    (In/Hr)
56.0  36.0      0.706     0.500        0.388       1.000      0.388
                                                  Sum (F) =   0.388
Area averaged mean soil loss (F) (In/Hr) =  0.388
Minimum soil loss rate ((In/Hr)) =  0.194
```

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.500

U n i t H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.250	983.620	100.000	5.140
			Sum = 100.000	Sum= 5.140

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Loss rate(In./Hr) Low	Effective (In/Hr)
1	0.25	0.20	0.022	(0.686)	0.011	0.011
2	0.50	0.30	0.033	(0.678)	0.017	0.017
3	0.75	0.30	0.033	(0.670)	0.017	0.017
4	1.00	0.40	0.044	(0.662)	0.022	0.022
5	1.25	0.30	0.033	(0.654)	0.017	0.017
6	1.50	0.30	0.033	(0.646)	0.017	0.017
7	1.75	0.30	0.033	(0.639)	0.017	0.017
8	2.00	0.40	0.044	(0.631)	0.022	0.022
9	2.25	0.40	0.044	(0.623)	0.022	0.022
10	2.50	0.40	0.044	(0.616)	0.022	0.022
11	2.75	0.50	0.056	(0.608)	0.028	0.028
12	3.00	0.50	0.056	(0.601)	0.028	0.028
13	3.25	0.50	0.056	(0.593)	0.028	0.028
14	3.50	0.50	0.056	(0.586)	0.028	0.028
15	3.75	0.50	0.056	(0.579)	0.028	0.028
16	4.00	0.60	0.067	(0.571)	0.033	0.033
17	4.25	0.60	0.067	(0.564)	0.033	0.033
18	4.50	0.70	0.078	(0.557)	0.039	0.039
19	4.75	0.70	0.078	(0.550)	0.039	0.039
20	5.00	0.80	0.089	(0.543)	0.044	0.044
21	5.25	0.60	0.067	(0.536)	0.033	0.033
22	5.50	0.70	0.078	(0.529)	0.039	0.039
23	5.75	0.80	0.089	(0.522)	0.044	0.044
24	6.00	0.80	0.089	(0.515)	0.044	0.044
25	6.25	0.90	0.100	(0.508)	0.050	0.050
26	6.50	0.90	0.100	(0.501)	0.050	0.050
27	6.75	1.00	0.111	(0.494)	0.056	0.056
28	7.00	1.00	0.111	(0.488)	0.056	0.056
29	7.25	1.00	0.111	(0.481)	0.056	0.056
30	7.50	1.10	0.122	(0.475)	0.061	0.061
31	7.75	1.20	0.133	(0.468)	0.067	0.067
32	8.00	1.30	0.144	(0.462)	0.072	0.072
33	8.25	1.50	0.167	(0.455)	0.083	0.083
34	8.50	1.50	0.167	(0.449)	0.083	0.083
35	8.75	1.60	0.178	(0.443)	0.089	0.089
36	9.00	1.70	0.189	(0.436)	0.094	0.094
37	9.25	1.90	0.211	(0.430)	0.106	0.106
38	9.50	2.00	0.222	(0.424)	0.111	0.111
39	9.75	2.10	0.233	(0.418)	0.117	0.117
40	10.00	2.20	0.245	(0.412)	0.122	0.122
41	10.25	1.50	0.167	(0.406)	0.083	0.083
42	10.50	1.50	0.167	(0.400)	0.083	0.083
43	10.75	2.00	0.222	(0.394)	0.111	0.111
44	11.00	2.00	0.222	(0.389)	0.111	0.111
45	11.25	1.90	0.211	(0.383)	0.106	0.106
46	11.50	1.90	0.211	(0.377)	0.106	0.106
47	11.75	1.70	0.189	(0.372)	0.094	0.094
48	12.00	1.80	0.200	(0.366)	0.100	0.100
49	12.25	2.50	0.278	(0.361)	0.139	0.139
50	12.50	2.60	0.289	(0.355)	0.144	0.144
51	12.75	2.80	0.311	(0.350)	0.156	0.156
52	13.00	2.90	0.322	(0.345)	0.161	0.161
53	13.25	3.40	0.378	(0.339)	0.189	0.189
54	13.50	3.40	0.378	(0.334)	0.189	0.189
55	13.75	2.30	0.256	(0.329)	0.128	0.128
56	14.00	2.30	0.256	(0.324)	0.128	0.128
57	14.25	2.70	0.300	(0.319)	0.150	0.150

58	14.50	2.60	0.289	(0.314)	0.144	0.144
59	14.75	2.60	0.289	(0.310)	0.144	0.144
60	15.00	2.50	0.278	(0.305)	0.139	0.139
61	15.25	2.40	0.267	(0.300)	0.133	0.133
62	15.50	2.30	0.256	(0.296)	0.128	0.128
63	15.75	1.90	0.211	(0.291)	0.106	0.106
64	16.00	1.90	0.211	(0.287)	0.106	0.106
65	16.25	0.40	0.044	(0.282)	0.022	0.022
66	16.50	0.40	0.044	(0.278)	0.022	0.022
67	16.75	0.30	0.033	(0.274)	0.017	0.017
68	17.00	0.30	0.033	(0.270)	0.017	0.017
69	17.25	0.50	0.056	(0.266)	0.028	0.028
70	17.50	0.50	0.056	(0.262)	0.028	0.028
71	17.75	0.50	0.056	(0.258)	0.028	0.028
72	18.00	0.40	0.044	(0.254)	0.022	0.022
73	18.25	0.40	0.044	(0.250)	0.022	0.022
74	18.50	0.40	0.044	(0.246)	0.022	0.022
75	18.75	0.30	0.033	(0.243)	0.017	0.017
76	19.00	0.20	0.022	(0.239)	0.011	0.011
77	19.25	0.30	0.033	(0.236)	0.017	0.017
78	19.50	0.40	0.044	(0.233)	0.022	0.022
79	19.75	0.30	0.033	(0.230)	0.017	0.017
80	20.00	0.20	0.022	(0.226)	0.011	0.011
81	20.25	0.30	0.033	(0.223)	0.017	0.017
82	20.50	0.30	0.033	(0.221)	0.017	0.017
83	20.75	0.30	0.033	(0.218)	0.017	0.017
84	21.00	0.20	0.022	(0.215)	0.011	0.011
85	21.25	0.30	0.033	(0.213)	0.017	0.017
86	21.50	0.20	0.022	(0.210)	0.011	0.011
87	21.75	0.30	0.033	(0.208)	0.017	0.017
88	22.00	0.20	0.022	(0.206)	0.011	0.011
89	22.25	0.30	0.033	(0.204)	0.017	0.017
90	22.50	0.20	0.022	(0.202)	0.011	0.011
91	22.75	0.20	0.022	(0.200)	0.011	0.011
92	23.00	0.20	0.022	(0.198)	0.011	0.011
93	23.25	0.20	0.022	(0.197)	0.011	0.011
94	23.50	0.20	0.022	(0.196)	0.011	0.011
95	23.75	0.20	0.022	(0.195)	0.011	0.011
96	24.00	0.20	0.022	(0.194)	0.011	0.011
		(Loss Rate Not Used)				
Sum =		100.0			Sum =	5.6

```
      Flood volume = Effective rainfall      1.39(In)
       times area       5.1(Ac.)/[(In)/(Ft.)] =       0.6(Ac.Ft)
      Total soil loss =      1.39(In)
      Total soil loss =     0.590(Ac.Ft)
      Total rainfall =      2.78(In)
      Flood volume =       25718.4 Cubic Feet
      Total soil loss =       25718.4 Cubic Feet
      --------------------------------------------------------------------
       Peak flow rate of this hydrograph =      0.972(CFS)
      --------------------------------------------------------------------
      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                          24 - H O U R   S T O R M
                     R u n o f f     H y d r o g r a p h
      --------------------------------------------------------------------
                  Hydrograph in  15   Minute intervals ((CFS))

      --------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0        2.5       5.0       7.5      10.0
-----------------------------------------------------------------------
  0+15       0.0012      0.06  Q         |         |         |         |
  0+30       0.0030      0.09  Q         |         |         |         |
  0+45       0.0047      0.09  Q         |         |         |         |
  1+ 0       0.0071      0.11  Q         |         |         |         |
  1+15       0.0089      0.09  Q         |         |         |         |
  1+30       0.0106      0.09  Q         |         |         |         |
  1+45       0.0124      0.09  Q         |         |         |         |
  2+ 0       0.0148      0.11  Q         |         |         |         |
  2+15       0.0171      0.11  QV        |         |         |         |
  2+30       0.0195      0.11  QV        |         |         |         |
  2+45       0.0224      0.14  QV        |         |         |         |
  3+ 0       0.0254      0.14  QV        |         |         |         |
  3+15       0.0283      0.14  QV        |         |         |         |
  3+30       0.0313      0.14  Q V       |         |         |         |
  3+45       0.0342      0.14  Q V       |         |         |         |
  4+ 0       0.0378      0.17  Q V       |         |         |         |
  4+15       0.0413      0.17  Q V       |         |         |         |
  4+30       0.0455      0.20  Q  V      |         |         |         |
  4+45       0.0496      0.20  Q  V      |         |         |         |
```

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    5+ 0       0.0543      0.23  Q  V      |         |         |         |
    5+15       0.0579      0.17  Q  V      |         |         |         |
    5+30       0.0620      0.20  Q   V     |         |         |         |
    5+45       0.0667      0.23  Q   V     |         |         |         |
    6+ 0       0.0714      0.23  Q   V     |         |         |         |
    6+15       0.0768      0.26  |Q   V    |         |         |         |
    6+30       0.0821      0.26  |Q   V    |         |         |         |
    6+45       0.0880      0.29  |Q   V    |         |         |         |
    7+ 0       0.0939      0.29  |Q    V   |         |         |         |
    7+15       0.0998      0.29  |Q    V   |         |         |         |
    7+30       0.1063      0.31  |Q     V  |         |         |         |
    7+45       0.1134      0.34  |Q     V  |         |         |         |
    8+ 0       0.1210      0.37  |Q      V |         |         |         |
    8+15       0.1299      0.43  |Q      V |         |         |         |
    8+30       0.1387      0.43  |Q       V|         |         |         |
    8+45       0.1482      0.46  |Q        V         |         |         |
    9+ 0       0.1582      0.49  |Q        V         |         |         |
    9+15       0.1694      0.54  | Q        V        |         |         |
    9+30       0.1813      0.57  | Q       | V       |         |         |
    9+45       0.1937      0.60  | Q       |  V      |         |         |
   10+ 0       0.2066      0.63  | Q       |  V      |         |         |
   10+15       0.2155      0.43  |Q        |   V     |         |         |
   10+30       0.2244      0.43  |Q        |    V    |         |         |
   10+45       0.2362      0.57  | Q       |    V    |         |         |
   11+ 0       0.2480      0.57  | Q       |     V   |         |         |
   11+15       0.2592      0.54  | Q       |      V  |         |         |
   11+30       0.2704      0.54  | Q       |       V |         |         |
   11+45       0.2804      0.49  |Q        |       V |         |         |
   12+ 0       0.2911      0.51  | Q       |        V|         |         |
   12+15       0.3058      0.71  | Q       |         V         |         |
   12+30       0.3212      0.74  | Q       |         |V        |         |
   12+45       0.3377      0.80  |  Q      |         | V       |         |
   13+ 0       0.3548      0.83  |  Q      |         |   V     |         |
   13+15       0.3749      0.97  |  Q      |         |    V    |         |
   13+30       0.3950      0.97  |  Q      |         |     V   |         |
   13+45       0.4086      0.66  | Q       |         |      V  |         |
   14+ 0       0.4221      0.66  | Q       |         |       V |         |
   14+15       0.4381      0.77  |  Q      |         |        V|         |
   14+30       0.4534      0.74  | Q       |         |         V         |
   14+45       0.4688      0.74  | Q       |         |         |V        |
   15+ 0       0.4835      0.71  | Q       |         |         | V       |
   15+15       0.4977      0.69  | Q       |         |         |  V      |
   15+30       0.5113      0.66  | Q       |         |         |   V     |
   15+45       0.5225      0.54  | Q       |         |         |    V    |
   16+ 0       0.5337      0.54  | Q       |         |         |     V   |
   16+15       0.5361      0.11  Q         |         |         |     V   |
   16+30       0.5385      0.11  Q         |         |         |     V   |
   16+45       0.5402      0.09  Q         |         |         |     V   |
   17+ 0       0.5420      0.09  Q         |         |         |     V   |
   17+15       0.5450      0.14  Q         |         |         |     V   |
   17+30       0.5479      0.14  Q         |         |         |      V  |
   17+45       0.5509      0.14  Q         |         |         |      V  |
   18+ 0       0.5532      0.11  Q         |         |         |      V  |
   18+15       0.5556      0.11  Q         |         |         |      V  |
   18+30       0.5579      0.11  Q         |         |         |      V  |
   18+45       0.5597      0.09  Q         |         |         |      V  |
   19+ 0       0.5609      0.06  Q         |         |         |      V  |
   19+15       0.5627      0.09  Q         |         |         |       V |
   19+30       0.5650      0.11  Q         |         |         |       V |
   19+45       0.5668      0.09  Q         |         |         |       V |
   20+ 0       0.5680      0.06  Q         |         |         |       V |
   20+15       0.5697      0.09  Q         |         |         |       V |
   20+30       0.5715      0.09  Q         |         |         |       V |
   20+45       0.5733      0.09  Q         |         |         |       V |
   21+ 0       0.5745      0.06  Q         |         |         |       V |
   21+15       0.5762      0.09  Q         |         |         |        V|
   21+30       0.5774      0.06  Q         |         |         |        V|
   21+45       0.5792      0.09  Q         |         |         |        V|
   22+ 0       0.5804      0.06  Q         |         |         |        V|
   22+15       0.5821      0.09  Q         |         |         |        V|
   22+30       0.5833      0.06  Q         |         |         |        V|
   22+45       0.5845      0.06  Q         |         |         |        V|
   23+ 0       0.5857      0.06  Q         |         |         |        V|
   23+15       0.5869      0.06  Q         |         |         |        V|
   23+30       0.5881      0.06  Q         |         |         |        V|
   23+45       0.5892      0.06  Q         |         |         |        V|
   24+ 0       0.5904      0.06  Q         |         |         |         V
-----------------------------------------------------------------------
```

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      U n i t   H y d r o g r a p h   A n a l y s i s

      Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2014, Version 9.0
             Study date  07/23/19 File: DMAB5PROP15.out


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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978


Program License Serial Number 6388

---------------------------------------------------------------------
 English (in-lb) Input Units Used
 English Rainfall Data (Inches) Input Values Used

 English Units used in output format



---------------------------------------------------------------------
KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
PROPOSED CONDITION, DMA B
5-YR 1-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019
--------------------------------------------------------------------
Drainage Area =       5.10(Ac.)  =      0.008 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =       5.10(Ac.)  =      0.008 Sq. Mi.
Length along longest watercourse =     461.00(Ft.)
Length along longest watercourse measured to centroid =     391.00(Ft.)
Length along longest watercourse =      0.087 Mi.
Length along longest watercourse measured to centroid =      0.074 Mi.
Difference in elevation =      19.00(Ft.)
Slope along watercourse =    217.6139 Ft./Mi.
Average Manning's 'N' = 0.015
Lag time =    0.019 Hr.
Lag time =     1.14 Min.
25% of lag time =     0.29 Min.
40% of lag time =     0.46 Min.
Unit time =     5.00 Min.
Duration of storm = 1 Hour(s)
User Entered Base Flow =     0.00(CFS)

2 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        5.10           0.49                  2.49

100 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        5.10           1.33                  6.78

STORM EVENT (YEAR) =    5.00
Area Averaged 2-Year Rainfall =    0.489(In)
Area Averaged 100-Year Rainfall =    1.330(In)

Point rain (area averaged) =    0.686(In)
Areal adjustment factor =  100.00 %
Adjusted average point rain =    0.686(In)

Sub-Area Data:
Area(Ac.)         Runoff Index   Impervious %
     5.100           56.00         0.690
 Total Area Entered =      5.10(Ac.)


RI    RI   Infil. Rate Impervious   Adj. Infil. Rate  Area%     F
AMC2 AMC-1     (In/Hr)    (Dec.%)      (In/Hr)      (Dec.)    (In/Hr)
56.0  36.0      0.706     0.690        0.268       1.000      0.268
                                                  Sum (F) =   0.268
Area averaged mean soil loss (F) (In/Hr) =  0.268
Minimum soil loss rate ((In/Hr)) =  0.134
```

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.350

Slope of intensity-duration curve for a 1 hour storm =0.5000

U n i t   H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.083	437.165	67.483	3.469
2	0.167	874.329	32.517	1.671
			Sum = 100.000	Sum= 5.140

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Loss rate(In./Hr) Low	Effective (In/Hr)
1	0.08	4.20	0.346	(0.268)	0.121	0.225
2	0.17	4.30	0.354	(0.268)	0.124	0.230
3	0.25	5.00	0.412	(0.268)	0.144	0.268
4	0.33	5.00	0.412	(0.268)	0.144	0.268
5	0.42	5.80	0.477	(0.268)	0.167	0.310
6	0.50	6.50	0.535	(0.268)	0.187	0.348
7	0.58	7.40	0.609	(0.268)	0.213	0.396
8	0.67	8.60	0.708	(0.268)	0.248	0.460
9	0.75	12.30	1.012	0.268	(0.354)	0.745
10	0.83	29.10	2.395	0.268	(0.838)	2.128
11	0.92	6.80	0.560	(0.268)	0.196	0.364
12	1.00	5.00	0.412	(0.268)	0.144	0.268

(Loss Rate Not Used)
Sum = 100.0 Sum = 6.0

Flood volume = Effective rainfall 0.50(In)
times area 5.1(Ac.)/[(In)/(Ft.)] = 0.2(Ac.Ft)
Total soil loss = 0.19(In)
Total soil loss = 0.079(Ac.Ft)
Total rainfall = 0.69(In)
Flood volume = 9268.8 Cubic Feet
Total soil loss = 3430.2 Cubic Feet

Peak flow rate of this hydrograph = 8.630(CFS)

+++

1 - H O U R   S T O R M
R u n o f f   H y d r o g r a p h

Hydrograph in 5 Minute intervals ((CFS))

```
 Time(h+m) Volume Ac.Ft   Q(CFS)  0        2.5       5.0       7.5      10.0
-----------------------------------------------------------------------
   0+ 5       0.0054      0.78 |V Q      |         |         |         |
   0+10       0.0135      1.17 | V Q     |         |         |         |
   0+15       0.0225      1.31 |   VQ    |         |         |         |
   0+20       0.0320      1.38 |    QV   |         |         |         |
   0+25       0.0425      1.52 |     QV  |         |         |         |
   0+30       0.0544      1.73 |     Q   V         |         |         |
   0+35       0.0678      1.96 |      Q  | V       |         |         |
   0+40       0.0834      2.26 |        Q|    V    |         |         |
   0+45       0.1065      3.35 |         |  Q      V         |         |
   0+50       0.1659      8.63 |         |         |         |V  Q     |
   0+55       0.1991      4.82 |         |        Q|         |      V  |
   1+ 0       0.2097      1.54 |     Q   |         |         |        V|
   1+ 5       0.2128      0.45 |Q        |         |         |        V|
-----------------------------------------------------------------------
```

U n i t   H y d r o g r a p h   A n a l y s i s

Study date 07/23/19 File: DMAB5PROP35.out

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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978

Program License Serial Number 6388

English (in-lb) Input Units Used
English Rainfall Data (Inches) Input Values Used

English Units used in output format

KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
PROPOSED CONDITION, DMA B
5-YR 3-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019

Drainage Area = 5.10(Ac.) = 0.008 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment = 5.10(Ac.) = 0.008 Sq. Mi.
Length along longest watercourse = 461.00(Ft.)
Length along longest watercourse measured to centroid = 391.00(Ft.)
Length along longest watercourse = 0.087 Mi.
Length along longest watercourse measured to centroid = 0.074 Mi.
Difference in elevation = 19.00(Ft.)
Slope along watercourse = 217.6139 Ft./Mi.
Average Manning's 'N' = 0.015
Lag time = 0.019 Hr.
Lag time = 1.14 Min.
25% of lag time = 0.29 Min.
40% of lag time = 0.46 Min.
Unit time = 5.00 Min.
Duration of storm = 3 Hour(s)
User Entered Base Flow = 0.00(CFS)

2 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	Weighting[1*2]
5.10	0.87	4.42

100 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	Weighting[1*2]
5.10	2.09	10.66

STORM EVENT (YEAR) = 5.00
Area Averaged 2-Year Rainfall = 0.866(In)
Area Averaged 100-Year Rainfall = 2.090(In)

Point rain (area averaged) = 1.153(In)
Areal adjustment factor = 100.00 %
Adjusted average point rain = 1.153(In)

Sub-Area Data:

Area(Ac.)	Runoff Index	Impervious %
5.100	56.00	0.690

Total Area Entered = 5.10(Ac.)

RI AMC2	RI AMC-1	Infil. Rate (In/Hr)	Impervious (Dec.%)	Adj. Infil. Rate (In/Hr)	Area% (Dec.)	F (In/Hr)
56.0	36.0	0.706	0.690	0.268	1.000	0.268
					Sum (F) =	0.268

Area averaged mean soil loss (F) (In/Hr) = 0.268
Minimum soil loss rate ((In/Hr)) = 0.134

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.350

U n i t   H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.083	437.165	67.483	3.469
2	0.167	874.329	32.517	1.671
			Sum = 100.000	Sum= 5.140

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Loss rate(In./Hr) Low	Effective (In/Hr)
1	0.08	1.30	0.180	(0.268)	0.063	0.117
2	0.17	1.30	0.180	(0.268)	0.063	0.117
3	0.25	1.10	0.152	(0.268)	0.053	0.099
4	0.33	1.50	0.207	(0.268)	0.073	0.135
5	0.42	1.50	0.207	(0.268)	0.073	0.135
6	0.50	1.80	0.249	(0.268)	0.087	0.162
7	0.58	1.50	0.207	(0.268)	0.073	0.135
8	0.67	1.80	0.249	(0.268)	0.087	0.162
9	0.75	1.80	0.249	(0.268)	0.087	0.162
10	0.83	1.50	0.207	(0.268)	0.073	0.135
11	0.92	1.60	0.221	(0.268)	0.077	0.144
12	1.00	1.80	0.249	(0.268)	0.087	0.162
13	1.08	2.20	0.304	(0.268)	0.107	0.198
14	1.17	2.20	0.304	(0.268)	0.107	0.198
15	1.25	2.20	0.304	(0.268)	0.107	0.198
16	1.33	2.00	0.277	(0.268)	0.097	0.180
17	1.42	2.60	0.360	(0.268)	0.126	0.234
18	1.50	2.70	0.373	(0.268)	0.131	0.243
19	1.58	2.40	0.332	(0.268)	0.116	0.216
20	1.67	2.70	0.373	(0.268)	0.131	0.243
21	1.75	3.30	0.456	(0.268)	0.160	0.297
22	1.83	3.10	0.429	(0.268)	0.150	0.279
23	1.92	2.90	0.401	(0.268)	0.140	0.261
24	2.00	3.00	0.415	(0.268)	0.145	0.270
25	2.08	3.10	0.429	(0.268)	0.150	0.279
26	2.17	4.20	0.581	(0.268)	0.203	0.378
27	2.25	5.00	0.692	(0.268)	0.242	0.450
28	2.33	3.50	0.484	(0.268)	0.169	0.315
29	2.42	6.80	0.941	0.268	(0.329)	0.673
30	2.50	7.30	1.010	0.268	(0.353)	0.742
31	2.58	8.20	1.134	0.268	(0.397)	0.867
32	2.67	5.90	0.816	0.268	(0.286)	0.549
33	2.75	2.00	0.277	(0.268)	0.097	0.180
34	2.83	1.80	0.249	(0.268)	0.087	0.162
35	2.92	1.80	0.249	(0.268)	0.087	0.162
36	3.00	0.60	0.083	(0.268)	0.029	0.054
		(Loss Rate Not Used)				
Sum =		100.0			Sum =	9.3

Flood volume = Effective rainfall 0.77(In)
times area 5.1(Ac.)/[(In)/(Ft.)] = 0.3(Ac.Ft)
Total soil loss = 0.38(In)
Total soil loss = 0.161(Ac.Ft)
Total rainfall = 1.15(In)
Flood volume = 14325.5 Cubic Feet
Total soil loss = 7013.8 Cubic Feet

Peak flow rate of this hydrograph = 4.249(CFS)

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3 - H O U R   S T O R M
R u n o f f   H y d r o g r a p h

Hydrograph in 5 Minute intervals ((CFS))

Time(h+m) Volume Ac.Ft Q(CFS) 0 2.5 5.0 7.5 10.0

```
  -----------------------------------------------------------------------
    0+ 5       0.0028      0.41  VQ        |         |         |         |
    0+10       0.0069      0.60  V Q       |         |         |         |
    0+15       0.0106      0.54  |VQ       |         |         |         |
    0+20       0.0150      0.63  |VQ       |         |         |         |
    0+25       0.0198      0.69  | Q       |         |         |         |
    0+30       0.0252      0.79  |  Q      |         |         |         |
    0+35       0.0303      0.74  | QV      |         |         |         |
    0+40       0.0357      0.79  |  QV     |         |         |         |
    0+45       0.0414      0.83  |  Q V    |         |         |         |
    0+50       0.0465      0.74  | Q  V    |         |         |         |
    0+55       0.0515      0.72  | Q   V   |         |         |         |
    1+ 0       0.0570      0.80  |  Q  V   |         |         |         |
    1+ 5       0.0636      0.96  |  Q   V  |         |         |         |
    1+10       0.0706      1.02  |   Q   V |         |         |         |
    1+15       0.0776      1.02  |   Q    V|         |         |         |
    1+20       0.0842      0.95  |  Q      V         |         |         |
    1+25       0.0919      1.11  |   Q     |V        |         |         |
    1+30       0.1004      1.23  |   Q     | V       |         |         |
    1+35       0.1083      1.15  |   Q     |  V      |         |         |
    1+40       0.1166      1.20  |   Q     |   V     |         |         |
    1+45       0.1265      1.44  |    Q    |    V    |         |         |
    1+50       0.1366      1.46  |    Q    |     V   |         |         |
    1+55       0.1460      1.37  |    Q    |      V  |         |         |
    2+ 0       0.1555      1.37  |    Q    |       V |         |         |
    2+ 5       0.1652      1.42  |    Q    |         V         |         |
    2+10       0.1775      1.78  |      Q  |         |V        |         |
    2+15       0.1926      2.19  |       Q |         |  V      |         |
    2+20       0.2053      1.84  |      Q  |         |   V     |         |
    2+25       0.2250      2.86  |         |Q        |      V  |         |
    2+30       0.2505      3.70  |         |   Q     |         V         |
    2+35       0.2797      4.25  |         |     Q   |         |   V     |
    2+40       0.3028      3.35  |         |  Q      |         |     V   |
    2+45       0.3134      1.54  |     Q   |         |         |       V |
    2+50       0.3194      0.86  |  Q      |         |         |       V |
    2+55       0.3251      0.83  |  Q      |         |         |        V|
    3+ 0       0.3282      0.46  |Q        |         |         |        V|
    3+ 5       0.3289      0.09  Q         |         |         |         V
-----------------------------------------------------------------------
```

U n i t   H y d r o g r a p h   A n a l y s i s

Study date 07/23/19 File: DMAB5PROP65.out

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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978

Program License Serial Number 6388

English (in-lb) Input Units Used
English Rainfall Data (Inches) Input Values Used

English Units used in output format

KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
PROPOSED CONDITION, DMA B
5-YR 6-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019

Drainage Area = 5.10(Ac.) = 0.008 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment = 5.10(Ac.) = 0.008 Sq. Mi.
Length along longest watercourse = 461.00(Ft.)
Length along longest watercourse measured to centroid = 391.00(Ft.)
Length along longest watercourse = 0.087 Mi.
Length along longest watercourse measured to centroid = 0.074 Mi.
Difference in elevation = 19.00(Ft.)
Slope along watercourse = 217.6139 Ft./Mi.
Average Manning's 'N' = 0.015
Lag time = 0.019 Hr.
Lag time = 1.14 Min.
25% of lag time = 0.29 Min.
40% of lag time = 0.46 Min.
Unit time = 5.00 Min.
Duration of storm = 6 Hour(s)
User Entered Base Flow = 0.00(CFS)

2 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	Weighting[1*2]
5.10	1.21	6.17

100 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	Weighting[1*2]
5.10	2.86	14.59

STORM EVENT (YEAR) = 5.00
Area Averaged 2-Year Rainfall = 1.210(In)
Area Averaged 100-Year Rainfall = 2.860(In)

Point rain (area averaged) = 1.596(In)
Areal adjustment factor = 100.00 %
Adjusted average point rain = 1.596(In)

Sub-Area Data:

Area(Ac.)	Runoff Index	Impervious %
5.100	56.00	0.690

Total Area Entered = 5.10(Ac.)

RI AMC2	RI AMC-1	Infil. Rate (In/Hr)	Impervious (Dec.%)	Adj. Infil. Rate (In/Hr)	Area% (Dec.)	F (In/Hr)
56.0	36.0	0.706	0.690	0.268	1.000	0.268
					Sum (F) =	0.268

Area averaged mean soil loss (F) (In/Hr) = 0.268
Minimum soil loss rate ((In/Hr)) = 0.134

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.350

U n i t H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.083	437.165	67.483	3.469
2	0.167	874.329	32.517	1.671
			Sum = 100.000	Sum= 5.140

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Low	Effective (In/Hr)
1	0.08	0.50	0.096	(0.268)	0.034	0.062
2	0.17	0.60	0.115	(0.268)	0.040	0.075
3	0.25	0.60	0.115	(0.268)	0.040	0.075
4	0.33	0.60	0.115	(0.268)	0.040	0.075
5	0.42	0.60	0.115	(0.268)	0.040	0.075
6	0.50	0.70	0.134	(0.268)	0.047	0.087
7	0.58	0.70	0.134	(0.268)	0.047	0.087
8	0.67	0.70	0.134	(0.268)	0.047	0.087
9	0.75	0.70	0.134	(0.268)	0.047	0.087
10	0.83	0.70	0.134	(0.268)	0.047	0.087
11	0.92	0.70	0.134	(0.268)	0.047	0.087
12	1.00	0.80	0.153	(0.268)	0.054	0.100
13	1.08	0.80	0.153	(0.268)	0.054	0.100
14	1.17	0.80	0.153	(0.268)	0.054	0.100
15	1.25	0.80	0.153	(0.268)	0.054	0.100
16	1.33	0.80	0.153	(0.268)	0.054	0.100
17	1.42	0.80	0.153	(0.268)	0.054	0.100
18	1.50	0.80	0.153	(0.268)	0.054	0.100
19	1.58	0.80	0.153	(0.268)	0.054	0.100
20	1.67	0.80	0.153	(0.268)	0.054	0.100
21	1.75	0.80	0.153	(0.268)	0.054	0.100
22	1.83	0.80	0.153	(0.268)	0.054	0.100
23	1.92	0.80	0.153	(0.268)	0.054	0.100
24	2.00	0.90	0.172	(0.268)	0.060	0.112
25	2.08	0.80	0.153	(0.268)	0.054	0.100
26	2.17	0.90	0.172	(0.268)	0.060	0.112
27	2.25	0.90	0.172	(0.268)	0.060	0.112
28	2.33	0.90	0.172	(0.268)	0.060	0.112
29	2.42	0.90	0.172	(0.268)	0.060	0.112
30	2.50	0.90	0.172	(0.268)	0.060	0.112
31	2.58	0.90	0.172	(0.268)	0.060	0.112
32	2.67	0.90	0.172	(0.268)	0.060	0.112
33	2.75	1.00	0.192	(0.268)	0.067	0.125
34	2.83	1.00	0.192	(0.268)	0.067	0.125
35	2.92	1.00	0.192	(0.268)	0.067	0.125
36	3.00	1.00	0.192	(0.268)	0.067	0.125
37	3.08	1.00	0.192	(0.268)	0.067	0.125
38	3.17	1.10	0.211	(0.268)	0.074	0.137
39	3.25	1.10	0.211	(0.268)	0.074	0.137
40	3.33	1.10	0.211	(0.268)	0.074	0.137
41	3.42	1.20	0.230	(0.268)	0.080	0.149
42	3.50	1.30	0.249	(0.268)	0.087	0.162
43	3.58	1.40	0.268	(0.268)	0.094	0.174
44	3.67	1.40	0.268	(0.268)	0.094	0.174
45	3.75	1.50	0.287	(0.268)	0.101	0.187
46	3.83	1.50	0.287	(0.268)	0.101	0.187
47	3.92	1.60	0.307	(0.268)	0.107	0.199
48	4.00	1.60	0.307	(0.268)	0.107	0.199
49	4.08	1.70	0.326	(0.268)	0.114	0.212
50	4.17	1.80	0.345	(0.268)	0.121	0.224
51	4.25	1.90	0.364	(0.268)	0.127	0.237
52	4.33	2.00	0.383	(0.268)	0.134	0.249
53	4.42	2.10	0.402	(0.268)	0.141	0.261
54	4.50	2.10	0.402	(0.268)	0.141	0.261
55	4.58	2.20	0.421	(0.268)	0.148	0.274
56	4.67	2.30	0.441	(0.268)	0.154	0.286

```
57   4.75     2.40      0.460       (  0.268)       0.161        0.299
58   4.83     2.40      0.460       (  0.268)       0.161        0.299
59   4.92     2.50      0.479       (  0.268)       0.168        0.311
60   5.00     2.60      0.498       (  0.268)       0.174        0.324
61   5.08     3.10      0.594       (  0.268)       0.208        0.386
62   5.17     3.60      0.690       (  0.268)       0.241        0.448
63   5.25     3.90      0.747       (  0.268)       0.261        0.486
64   5.33     4.20      0.805          0.268    (  0.282)        0.537
65   5.42     4.70      0.900          0.268    (  0.315)        0.633
66   5.50     5.60      1.073          0.268    (  0.375)        0.805
67   5.58     1.90      0.364       (  0.268)       0.127        0.237
68   5.67     0.90      0.172       (  0.268)       0.060        0.112
69   5.75     0.60      0.115       (  0.268)       0.040        0.075
70   5.83     0.50      0.096       (  0.268)       0.034        0.062
71   5.92     0.30      0.057       (  0.268)       0.020        0.037
72   6.00     0.20      0.038       (  0.268)       0.013        0.025
             (Loss Rate Not Used)
   Sum =     100.0                                     Sum =    12.6
     Flood volume = Effective rainfall      1.05(In)
      times area       5.1(Ac.)/[(In)/(Ft.)] =       0.4(Ac.Ft)
     Total soil loss =      0.54(In)
     Total soil loss =     0.231(Ac.Ft)
     Total rainfall =      1.60(In)
     Flood volume =       19472.2 Cubic Feet
     Total soil loss =       10082.7 Cubic Feet
     --------------------------------------------------------------------
      Peak flow rate of this hydrograph =      3.853(CFS)
     --------------------------------------------------------------------
     ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                          6 - H O U R   S T O R M
                     R u n o f f     H y d r o g r a p h
     --------------------------------------------------------------------
                 Hydrograph in   5   Minute intervals ((CFS))

     --------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0        2.5       5.0       7.5      10.0
-----------------------------------------------------------------------
  0+ 5       0.0015      0.22  Q         |         |         |         |
  0+10       0.0040      0.36  VQ        |         |         |         |
  0+15       0.0066      0.38  VQ        |         |         |         |
  0+20       0.0093      0.38  VQ        |         |         |         |
  0+25       0.0119      0.38  |Q        |         |         |         |
  0+30       0.0149      0.43  |Q        |         |         |         |
  0+35       0.0180      0.45  |Q        |         |         |         |
  0+40       0.0210      0.45  |Q        |         |         |         |
  0+45       0.0241      0.45  |QV       |         |         |         |
  0+50       0.0272      0.45  |QV       |         |         |         |
  0+55       0.0303      0.45  |QV       |         |         |         |
  1+ 0       0.0337      0.49  |Q V      |         |         |         |
  1+ 5       0.0372      0.51  | QV      |         |         |         |
  1+10       0.0407      0.51  | QV      |         |         |         |
  1+15       0.0443      0.51  | QV      |         |         |         |
  1+20       0.0478      0.51  | Q V     |         |         |         |
  1+25       0.0513      0.51  | Q V     |         |         |         |
  1+30       0.0549      0.51  | Q V     |         |         |         |
  1+35       0.0584      0.51  | Q  V    |         |         |         |
  1+40       0.0619      0.51  | Q  V    |         |         |         |
  1+45       0.0654      0.51  | Q  V    |         |         |         |
  1+50       0.0690      0.51  | Q   V   |         |         |         |
  1+55       0.0725      0.51  | Q   V   |         |         |         |
  2+ 0       0.0763      0.56  | Q   V   |         |         |         |
  2+ 5       0.0800      0.53  | Q    V  |         |         |         |
  2+10       0.0838      0.56  | Q    V  |         |         |         |
  2+15       0.0878      0.58  | Q    V  |         |         |         |
  2+20       0.0918      0.58  | Q     V |         |         |         |
  2+25       0.0957      0.58  | Q     V |         |         |         |
  2+30       0.0997      0.58  | Q     V |         |         |         |
  2+35       0.1037      0.58  | Q      V|         |         |         |
  2+40       0.1076      0.58  | Q      V|         |         |         |
  2+45       0.1119      0.62  | Q       V         |         |         |
  2+50       0.1163      0.64  | Q       V         |         |         |
  2+55       0.1207      0.64  | Q       V         |         |         |
  3+ 0       0.1251      0.64  | Q       |V        |         |         |
  3+ 5       0.1295      0.64  | Q       |V        |         |         |
  3+10       0.1343      0.68  | Q       | V       |         |         |
  3+15       0.1391      0.70  | Q       | V       |         |         |
  3+20       0.1440      0.70  | Q       | V       |         |         |
  3+25       0.1491      0.75  | Q       |  V      |         |         |
  3+30       0.1547      0.81  |  Q      |  V      |         |         |
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    3+35       0.1607      0.88  |  Q      |   V     |         |         |
    3+40       0.1669      0.90  |  Q      |   V     |         |         |
    3+45       0.1734      0.94  |  Q      |    V    |         |         |
    3+50       0.1800      0.96  |  Q      |     V   |         |         |
    3+55       0.1869      1.00  |   Q     |     V   |         |         |
    4+ 0       0.1940      1.02  |   Q     |      V  |         |         |
    4+ 5       0.2013      1.07  |   Q     |       V |         |         |
    4+10       0.2091      1.13  |   Q     |       V |         |         |
    4+15       0.2173      1.20  |   Q     |        V|         |         |
    4+20       0.2260      1.26  |    Q    |         V         |         |
    4+25       0.2351      1.32  |    Q    |         |V        |         |
    4+30       0.2444      1.34  |    Q    |         |V        |         |
    4+35       0.2540      1.39  |    Q    |         | V       |         |
    4+40       0.2640      1.45  |    Q    |         |  V      |         |
    4+45       0.2744      1.52  |     Q   |         |   V     |         |
    4+50       0.2850      1.54  |     Q   |         |    V    |         |
    4+55       0.2959      1.58  |     Q   |         |     V   |         |
    5+ 0       0.3072      1.64  |     Q   |         |      V  |         |
    5+ 5       0.3201      1.88  |      Q  |         |       V |         |
    5+10       0.3353      2.20  |       Q |         |         V         |
    5+15       0.3521      2.43  |        Q|         |         |V        |
    5+20       0.3705      2.68  |         Q         |         |  V      |
    5+25       0.3918      3.09  |         | Q       |         |    V    |
    5+30       0.4183      3.85  |         |    Q    |         |      V  |
    5+35       0.4333      2.17  |       Q |         |         |       V |
    5+40       0.4387      0.78  |  Q      |         |         |        V|
    5+45       0.4418      0.45  |Q        |         |         |        V|
    5+50       0.4441      0.34  |Q        |         |         |        V|
    5+55       0.4457      0.23  Q         |         |         |        V|
    6+ 0       0.4467      0.15  Q         |         |         |        V|
    6+ 5       0.4470      0.04  Q         |         |         |        V|
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U n i t   H y d r o g r a p h   A n a l y s i s

Study date 07/23/19 File: DMAB5PROP245.out

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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978

Program License Serial Number 6388

English (in-lb) Input Units Used
English Rainfall Data (Inches) Input Values Used

English Units used in output format

KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
PROPOSED CONDITION, DMA B
5-YR 24-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019

Drainage Area = 5.10(Ac.) = 0.008 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment = 5.10(Ac.) = 0.008 Sq. Mi.
Length along longest watercourse = 461.00(Ft.)
Length along longest watercourse measured to centroid = 391.00(Ft.)
Length along longest watercourse = 0.087 Mi.
Length along longest watercourse measured to centroid = 0.074 Mi.
Difference in elevation = 19.00(Ft.)
Slope along watercourse = 217.6139 Ft./Mi.
Average Manning's 'N' = 0.015
Lag time = 0.019 Hr.
Lag time = 1.14 Min.
25% of lag time = 0.29 Min.
40% of lag time = 0.46 Min.
Unit time = 15.00 Min.
Duration of storm = 24 Hour(s)
User Entered Base Flow = 0.00(CFS)

2 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	Weighting[1*2]
5.10	2.05	10.45

100 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	Weighting[1*2]
5.10	5.16	26.32

STORM EVENT (YEAR) = 5.00
Area Averaged 2-Year Rainfall = 2.050(In)
Area Averaged 100-Year Rainfall = 5.160(In)

Point rain (area averaged) = 2.778(In)
Areal adjustment factor = 100.00 %
Adjusted average point rain = 2.778(In)

Sub-Area Data:

Area(Ac.)	Runoff Index	Impervious %
5.100	56.00	0.690

Total Area Entered = 5.10(Ac.)

RI AMC2	RI AMC-1	Infil. Rate (In/Hr)	Impervious (Dec.%)	Adj. Infil. Rate (In/Hr)	Area% (Dec.)	F (In/Hr)
56.0	36.0	0.706	0.690	0.268	1.000	0.268
					Sum (F) =	0.268

Area averaged mean soil loss (F) (In/Hr) = 0.268
Minimum soil loss rate ((In/Hr)) = 0.134

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.350

U n i t H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.250	1311.494	100.000	5.140
			Sum = 100.000	Sum= 5.140

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Loss rate(In./Hr) Low	Effective (In/Hr)
1	0.25	0.20	0.022	(0.473)	0.008	0.014
2	0.50	0.30	0.033	(0.467)	0.012	0.022
3	0.75	0.30	0.033	(0.462)	0.012	0.022
4	1.00	0.40	0.044	(0.456)	0.016	0.029
5	1.25	0.30	0.033	(0.451)	0.012	0.022
6	1.50	0.30	0.033	(0.445)	0.012	0.022
7	1.75	0.30	0.033	(0.440)	0.012	0.022
8	2.00	0.40	0.044	(0.435)	0.016	0.029
9	2.25	0.40	0.044	(0.430)	0.016	0.029
10	2.50	0.40	0.044	(0.424)	0.016	0.029
11	2.75	0.50	0.056	(0.419)	0.019	0.036
12	3.00	0.50	0.056	(0.414)	0.019	0.036
13	3.25	0.50	0.056	(0.409)	0.019	0.036
14	3.50	0.50	0.056	(0.404)	0.019	0.036
15	3.75	0.50	0.056	(0.399)	0.019	0.036
16	4.00	0.60	0.067	(0.394)	0.023	0.043
17	4.25	0.60	0.067	(0.389)	0.023	0.043
18	4.50	0.70	0.078	(0.384)	0.027	0.051
19	4.75	0.70	0.078	(0.379)	0.027	0.051
20	5.00	0.80	0.089	(0.374)	0.031	0.058
21	5.25	0.60	0.067	(0.369)	0.023	0.043
22	5.50	0.70	0.078	(0.364)	0.027	0.051
23	5.75	0.80	0.089	(0.360)	0.031	0.058
24	6.00	0.80	0.089	(0.355)	0.031	0.058
25	6.25	0.90	0.100	(0.350)	0.035	0.065
26	6.50	0.90	0.100	(0.345)	0.035	0.065
27	6.75	1.00	0.111	(0.341)	0.039	0.072
28	7.00	1.00	0.111	(0.336)	0.039	0.072
29	7.25	1.00	0.111	(0.332)	0.039	0.072
30	7.50	1.10	0.122	(0.327)	0.043	0.079
31	7.75	1.20	0.133	(0.323)	0.047	0.087
32	8.00	1.30	0.144	(0.318)	0.051	0.094
33	8.25	1.50	0.167	(0.314)	0.058	0.108
34	8.50	1.50	0.167	(0.309)	0.058	0.108
35	8.75	1.60	0.178	(0.305)	0.062	0.116
36	9.00	1.70	0.189	(0.301)	0.066	0.123
37	9.25	1.90	0.211	(0.296)	0.074	0.137
38	9.50	2.00	0.222	(0.292)	0.078	0.144
39	9.75	2.10	0.233	(0.288)	0.082	0.152
40	10.00	2.20	0.245	(0.284)	0.086	0.159
41	10.25	1.50	0.167	(0.280)	0.058	0.108
42	10.50	1.50	0.167	(0.276)	0.058	0.108
43	10.75	2.00	0.222	(0.272)	0.078	0.144
44	11.00	2.00	0.222	(0.268)	0.078	0.144
45	11.25	1.90	0.211	(0.264)	0.074	0.137
46	11.50	1.90	0.211	(0.260)	0.074	0.137
47	11.75	1.70	0.189	(0.256)	0.066	0.123
48	12.00	1.80	0.200	(0.252)	0.070	0.130
49	12.25	2.50	0.278	(0.249)	0.097	0.181
50	12.50	2.60	0.289	(0.245)	0.101	0.188
51	12.75	2.80	0.311	(0.241)	0.109	0.202
52	13.00	2.90	0.322	(0.237)	0.113	0.209
53	13.25	3.40	0.378	(0.234)	0.132	0.246
54	13.50	3.40	0.378	(0.230)	0.132	0.246
55	13.75	2.30	0.256	(0.227)	0.089	0.166
56	14.00	2.30	0.256	(0.223)	0.089	0.166
57	14.25	2.70	0.300	(0.220)	0.105	0.195

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58  14.50     2.60      0.289       (  0.217)       0.101        0.188
59  14.75     2.60      0.289       (  0.213)       0.101        0.188
60  15.00     2.50      0.278       (  0.210)       0.097        0.181
61  15.25     2.40      0.267       (  0.207)       0.093        0.173
62  15.50     2.30      0.256       (  0.204)       0.089        0.166
63  15.75     1.90      0.211       (  0.201)       0.074        0.137
64  16.00     1.90      0.211       (  0.198)       0.074        0.137
65  16.25     0.40      0.044       (  0.194)       0.016        0.029
66  16.50     0.40      0.044       (  0.192)       0.016        0.029
67  16.75     0.30      0.033       (  0.189)       0.012        0.022
68  17.00     0.30      0.033       (  0.186)       0.012        0.022
69  17.25     0.50      0.056       (  0.183)       0.019        0.036
70  17.50     0.50      0.056       (  0.180)       0.019        0.036
71  17.75     0.50      0.056       (  0.178)       0.019        0.036
72  18.00     0.40      0.044       (  0.175)       0.016        0.029
73  18.25     0.40      0.044       (  0.172)       0.016        0.029
74  18.50     0.40      0.044       (  0.170)       0.016        0.029
75  18.75     0.30      0.033       (  0.167)       0.012        0.022
76  19.00     0.20      0.022       (  0.165)       0.008        0.014
77  19.25     0.30      0.033       (  0.163)       0.012        0.022
78  19.50     0.40      0.044       (  0.160)       0.016        0.029
79  19.75     0.30      0.033       (  0.158)       0.012        0.022
80  20.00     0.20      0.022       (  0.156)       0.008        0.014
81  20.25     0.30      0.033       (  0.154)       0.012        0.022
82  20.50     0.30      0.033       (  0.152)       0.012        0.022
83  20.75     0.30      0.033       (  0.150)       0.012        0.022
84  21.00     0.20      0.022       (  0.148)       0.008        0.014
85  21.25     0.30      0.033       (  0.147)       0.012        0.022
86  21.50     0.20      0.022       (  0.145)       0.008        0.014
87  21.75     0.30      0.033       (  0.143)       0.012        0.022
88  22.00     0.20      0.022       (  0.142)       0.008        0.014
89  22.25     0.30      0.033       (  0.140)       0.012        0.022
90  22.50     0.20      0.022       (  0.139)       0.008        0.014
91  22.75     0.20      0.022       (  0.138)       0.008        0.014
92  23.00     0.20      0.022       (  0.137)       0.008        0.014
93  23.25     0.20      0.022       (  0.136)       0.008        0.014
94  23.50     0.20      0.022       (  0.135)       0.008        0.014
95  23.75     0.20      0.022       (  0.134)       0.008        0.014
96  24.00     0.20      0.022       (  0.134)       0.008        0.014
           (Loss Rate Not Used)
   Sum =     100.0                                  Sum =     7.2
     Flood volume = Effective rainfall      1.81(In)
      times area       5.1(Ac.)/[(In)/(Ft.)] =       0.8(Ac.Ft)
     Total soil loss =      0.97(In)
     Total soil loss =     0.413(Ac.Ft)
     Total rainfall =      2.78(In)
     Flood volume =      33433.9 Cubic Feet
     Total soil loss =      18002.8 Cubic Feet
     --------------------------------------------------------------------
      Peak flow rate of this hydrograph =      1.263(CFS)
     --------------------------------------------------------------------
     ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                         24 - H O U R   S T O R M
                    R u n o f f     H y d r o g r a p h
     --------------------------------------------------------------------
                 Hydrograph in  15   Minute intervals ((CFS))

     --------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0        2.5       5.0       7.5      10.0
-----------------------------------------------------------------------
  0+15       0.0015      0.07  Q          |         |         |         |
  0+30       0.0038      0.11  Q          |         |         |         |
  0+45       0.0061      0.11  Q          |         |         |         |
  1+ 0       0.0092      0.15  Q          |         |         |         |
  1+15       0.0115      0.11  Q          |         |         |         |
  1+30       0.0138      0.11  Q          |         |         |         |
  1+45       0.0161      0.11  Q          |         |         |         |
  2+ 0       0.0192      0.15  QV         |         |         |         |
  2+15       0.0223      0.15  QV         |         |         |         |
  2+30       0.0253      0.15  QV         |         |         |         |
  2+45       0.0292      0.19  QV         |         |         |         |
  3+ 0       0.0330      0.19  QV         |         |         |         |
  3+15       0.0368      0.19  QV         |         |         |         |
  3+30       0.0407      0.19  Q V        |         |         |         |
  3+45       0.0445      0.19  Q V        |         |         |         |
  4+ 0       0.0491      0.22  Q V        |         |         |         |
  4+15       0.0537      0.22  Q V        |         |         |         |
  4+30       0.0591      0.26  |Q V       |         |         |         |
  4+45       0.0645      0.26  |Q V       |         |         |         |
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    5+ 0       0.0706      0.30  |Q V      |         |         |         |
    5+15       0.0752      0.22  Q  V      |         |         |         |
    5+30       0.0806      0.26  |Q  V     |         |         |         |
    5+45       0.0867      0.30  |Q  V     |         |         |         |
    6+ 0       0.0929      0.30  |Q  V     |         |         |         |
    6+15       0.0998      0.33  |Q   V    |         |         |         |
    6+30       0.1067      0.33  |Q   V    |         |         |         |
    6+45       0.1144      0.37  |Q   V    |         |         |         |
    7+ 0       0.1220      0.37  |Q    V   |         |         |         |
    7+15       0.1297      0.37  |Q    V   |         |         |         |
    7+30       0.1382      0.41  |Q     V  |         |         |         |
    7+45       0.1474      0.45  |Q     V  |         |         |         |
    8+ 0       0.1573      0.48  |Q      V |         |         |         |
    8+15       0.1689      0.56  | Q     V |         |         |         |
    8+30       0.1804      0.56  | Q      V|         |         |         |
    8+45       0.1927      0.59  | Q       V         |         |         |
    9+ 0       0.2057      0.63  | Q       V         |         |         |
    9+15       0.2203      0.71  | Q        V        |         |         |
    9+30       0.2356      0.74  | Q       | V       |         |         |
    9+45       0.2518      0.78  |  Q      |  V      |         |         |
   10+ 0       0.2686      0.82  |  Q      |   V     |         |         |
   10+15       0.2802      0.56  | Q       |   V     |         |         |
   10+30       0.2917      0.56  | Q       |    V    |         |         |
   10+45       0.3070      0.74  | Q       |     V   |         |         |
   11+ 0       0.3224      0.74  | Q       |     V   |         |         |
   11+15       0.3369      0.71  | Q       |      V  |         |         |
   11+30       0.3515      0.71  | Q       |       V |         |         |
   11+45       0.3646      0.63  | Q       |        V|         |         |
   12+ 0       0.3784      0.67  | Q       |        V|         |         |
   12+15       0.3976      0.93  |  Q      |         V         |         |
   12+30       0.4175      0.97  |  Q      |         |V        |         |
   12+45       0.4390      1.04  |   Q     |         | V       |         |
   13+ 0       0.4613      1.08  |   Q     |         |   V     |         |
   13+15       0.4874      1.26  |    Q    |         |    V    |         |
   13+30       0.5135      1.26  |    Q    |         |     V   |         |
   13+45       0.5311      0.85  |  Q      |         |      V  |         |
   14+ 0       0.5488      0.85  |  Q      |         |       V |         |
   14+15       0.5695      1.00  |   Q     |         |        V|         |
   14+30       0.5895      0.97  |  Q      |         |         V         |
   14+45       0.6094      0.97  |  Q      |         |         |V        |
   15+ 0       0.6286      0.93  |  Q      |         |         | V       |
   15+15       0.6470      0.89  |  Q      |         |         |  V      |
   15+30       0.6647      0.85  |  Q      |         |         |   V     |
   15+45       0.6793      0.71  | Q       |         |         |    V    |
   16+ 0       0.6939      0.71  | Q       |         |         |     V   |
   16+15       0.6969      0.15  Q         |         |         |     V   |
   16+30       0.7000      0.15  Q         |         |         |     V   |
   16+45       0.7023      0.11  Q         |         |         |     V   |
   17+ 0       0.7046      0.11  Q         |         |         |     V   |
   17+15       0.7084      0.19  Q         |         |         |     V   |
   17+30       0.7123      0.19  Q         |         |         |      V  |
   17+45       0.7161      0.19  Q         |         |         |      V  |
   18+ 0       0.7192      0.15  Q         |         |         |      V  |
   18+15       0.7223      0.15  Q         |         |         |      V  |
   18+30       0.7253      0.15  Q         |         |         |      V  |
   18+45       0.7276      0.11  Q         |         |         |      V  |
   19+ 0       0.7292      0.07  Q         |         |         |       V |
   19+15       0.7315      0.11  Q         |         |         |       V |
   19+30       0.7345      0.15  Q         |         |         |       V |
   19+45       0.7368      0.11  Q         |         |         |       V |
   20+ 0       0.7384      0.07  Q         |         |         |       V |
   20+15       0.7407      0.11  Q         |         |         |       V |
   20+30       0.7430      0.11  Q         |         |         |       V |
   20+45       0.7453      0.11  Q         |         |         |       V |
   21+ 0       0.7468      0.07  Q         |         |         |       V |
   21+15       0.7491      0.11  Q         |         |         |        V|
   21+30       0.7506      0.07  Q         |         |         |        V|
   21+45       0.7530      0.11  Q         |         |         |        V|
   22+ 0       0.7545      0.07  Q         |         |         |        V|
   22+15       0.7568      0.11  Q         |         |         |        V|
   22+30       0.7583      0.07  Q         |         |         |        V|
   22+45       0.7599      0.07  Q         |         |         |        V|
   23+ 0       0.7614      0.07  Q         |         |         |        V|
   23+15       0.7629      0.07  Q         |         |         |        V|
   23+30       0.7645      0.07  Q         |         |         |        V|
   23+45       0.7660      0.07  Q         |         |         |        V|
   24+ 0       0.7675      0.07  Q         |         |         |        V|
-----------------------------------------------------------------------
```

```
      U n i t   H y d r o g r a p h   A n a l y s i s

      Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2014, Version 9.0
              Study date  07/22/19 File: DMAB10EXIST110.out

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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978


Program License Serial Number 6388

---------------------------------------------------------------------
 English (in-lb) Input Units Used
 English Rainfall Data (Inches) Input Values Used

 English Units used in output format



---------------------------------------------------------------------
KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
EXISTING CONDITION
10-YR 1-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019
--------------------------------------------------------------------
Drainage Area =       5.10(Ac.)  =      0.008 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =       5.10(Ac.)  =      0.008 Sq. Mi.
Length along longest watercourse =     461.00(Ft.)
Length along longest watercourse measured to centroid =     391.00(Ft.)
Length along longest watercourse =      0.087 Mi.
Length along longest watercourse measured to centroid =      0.074 Mi.
Difference in elevation =      19.00(Ft.)
Slope along watercourse =    217.6139 Ft./Mi.
Average Manning's 'N' = 0.020
Lag time =    0.025 Hr.
Lag time =     1.52 Min.
25% of lag time =     0.38 Min.
40% of lag time =     0.61 Min.
Unit time =     5.00 Min.
Duration of storm = 1 Hour(s)
User Entered Base Flow =     0.00(CFS)

2 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        5.10           0.49                  2.49

100 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        5.10           1.33                  6.78

STORM EVENT (YEAR) =   10.00
Area Averaged 2-Year Rainfall =    0.489(In)
Area Averaged 100-Year Rainfall =    1.330(In)

Point rain (area averaged) =    0.835(In)
Areal adjustment factor =  100.00 %
Adjusted average point rain =    0.835(In)

Sub-Area Data:
Area(Ac.)         Runoff Index   Impervious %
     5.100           56.00         0.500
 Total Area Entered =      5.10(Ac.)


RI    RI   Infil. Rate Impervious   Adj. Infil. Rate  Area%     F
AMC2 AMC-2     (In/Hr)    (Dec.%)      (In/Hr)      (Dec.)    (In/Hr)
56.0  56.0      0.511     0.500        0.281       1.000      0.281
                                                  Sum (F) =   0.281
Area averaged mean soil loss (F) (In/Hr) =  0.281
Minimum soil loss rate ((In/Hr)) =  0.140
```

```
      (for 24 hour storm duration)
      Soil low loss rate (decimal) =   0.500
      --------------------------------------------------------------------
      Slope of intensity-duration curve for a 1 hour storm =0.5000
      ---------------------------------------------------------------------

                     U n i t   H y d r o g r a p h
                            VALLEY S-Curve
      --------------------------------------------------------------------
                     Unit Hydrograph Data
      --------------------------------------------------------------------
      Unit time period   Time % of lag   Distribution   Unit Hydrograph
          (hrs)                             Graph %          (CFS)
      --------------------------------------------------------------------
          1   0.083        327.873         59.371             3.052
          2   0.167        655.747         35.647             1.832
          3   0.250        983.620          4.982             0.256
                                   Sum = 100.000   Sum=       5.140
----------------------------------------------------------------------


 The following loss rate calculations reflect use of the minimum calculated loss
 rate subtracted from the Storm Rain to produce the maximum Effective Rain value

  Unit Time   Pattern   Storm Rain     Loss rate(In./Hr)     Effective
       (Hr.)  Percent   (In/Hr)          Max    |    Low        (In/Hr)
   1   0.08     4.20      0.421       (  0.281)       0.210        0.210
   2   0.17     4.30      0.431       (  0.281)       0.215        0.215
   3   0.25     5.00      0.501       (  0.281)       0.250        0.250
   4   0.33     5.00      0.501       (  0.281)       0.250        0.250
   5   0.42     5.80      0.581          0.281    (  0.291)        0.300
   6   0.50     6.50      0.651          0.281    (  0.326)        0.370
   7   0.58     7.40      0.741          0.281    (  0.371)        0.461
   8   0.67     8.60      0.862          0.281    (  0.431)        0.581
   9   0.75    12.30      1.232          0.281    (  0.616)        0.951
  10   0.83    29.10      2.916          0.281    (  1.458)        2.635
  11   0.92     6.80      0.681          0.281    (  0.341)        0.400
  12   1.00     5.00      0.501       (  0.281)       0.250        0.250
                (Loss Rate Not Used)
     Sum =     100.0                                    Sum =     6.9
      Flood volume = Effective rainfall      0.57(In)
       times area       5.1(Ac.)/[(In)/(Ft.)] =       0.2(Ac.Ft)
      Total soil loss =      0.26(In)
      Total soil loss =     0.111(Ac.Ft)
      Total rainfall =      0.83(In)
      Flood volume =       10607.3 Cubic Feet
      Total soil loss =        4850.2 Cubic Feet
      --------------------------------------------------------------------
       Peak flow rate of this hydrograph =      9.937(CFS)
      --------------------------------------------------------------------
      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                          1 - H O U R   S T O R M
                     R u n o f f     H y d r o g r a p h
      --------------------------------------------------------------------
                  Hydrograph in   5   Minute intervals ((CFS))

      --------------------------------------------------------------------
  Time(h+m) Volume Ac.Ft   Q(CFS)  0        2.5       5.0       7.5      10.0
  -----------------------------------------------------------------------
    0+ 5       0.0044      0.64  V Q       |         |         |         |
    0+10       0.0116      1.04  |V  Q     |         |         |         |
    0+15       0.0200      1.21  |  VQ     |         |         |         |
    0+20       0.0288      1.28  |   VQ    |         |         |         |
    0+25       0.0387      1.44  |    QV   |         |         |         |
    0+30       0.0507      1.75  |     Q V |         |         |         |
    0+35       0.0656      2.16  |       Q V         |         |         |
    0+40       0.0843      2.71  |         Q  V      |         |         |
    0+45       0.1124      4.09  |         |     Q V |         |         |
    0+50       0.1809      9.94  |         |         |       V|         Q|
    0+55       0.2242      6.30  |         |         |   Q     |     V   |
    1+ 0       0.2392      2.17  |       Q |         |         |        V|
    1+ 5       0.2431      0.56  | Q       |         |         |        V|
    1+10       0.2435      0.06  Q         |         |         |         V
----------------------------------------------------------------------
```

U n i t   H y d r o g r a p h   A n a l y s i s

Study date 07/22/19 File: DMAB10EXIST310.out

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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978

Program License Serial Number 6388

English (in-lb) Input Units Used
English Rainfall Data (Inches) Input Values Used

English Units used in output format

KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
EXISTING CONDITION
10-YR 3-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019

Drainage Area =   5.10(Ac.) =   0.008 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =   5.10(Ac.) =   0.008 Sq. Mi.
Length along longest watercourse =   461.00(Ft.)
Length along longest watercourse measured to centroid =   391.00(Ft.)
Length along longest watercourse =   0.087 Mi.
Length along longest watercourse measured to centroid =   0.074 Mi.
Difference in elevation =   19.00(Ft.)
Slope along watercourse =   217.6139 Ft./Mi.
Average Manning's 'N' = 0.020
Lag time =   0.025 Hr.
Lag time =   1.52 Min.
25% of lag time =   0.38 Min.
40% of lag time =   0.61 Min.
Unit time =   5.00 Min.
Duration of storm = 3 Hour(s)
User Entered Base Flow =   0.00(CFS)

2 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	Weighting[1*2]
5.10	0.87	4.42

100 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	Weighting[1*2]
5.10	2.09	10.66

STORM EVENT (YEAR) =   10.00
Area Averaged 2-Year Rainfall =   0.866(In)
Area Averaged 100-Year Rainfall =   2.090(In)

Point rain (area averaged) =   1.370(In)
Areal adjustment factor = 100.00 %
Adjusted average point rain =   1.370(In)

Sub-Area Data:

Area(Ac.)	Runoff Index	Impervious %
5.100	56.00	0.500

Total Area Entered =   5.10(Ac.)

RI AMC2	RI AMC-2	Infil. Rate (In/Hr)	Impervious (Dec.%)	Adj. Infil. Rate (In/Hr)	Area% (Dec.)	F (In/Hr)
56.0	56.0	0.511	0.500	0.281	1.000	0.281
					Sum (F) =	0.281

Area averaged mean soil loss (F) (In/Hr) = 0.281
Minimum soil loss rate ((In/Hr)) = 0.140

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.500

U n i t H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %		Unit Hydrograph (CFS)
1	0.083	327.873	59.371		3.052
2	0.167	655.747	35.647		1.832
3	0.250	983.620	4.982		0.256
			Sum = 100.000	Sum=	5.140

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Loss rate(In./Hr) Low	Effective (In/Hr)
1	0.08	1.30	0.214	(0.281)	0.107	0.107
2	0.17	1.30	0.214	(0.281)	0.107	0.107
3	0.25	1.10	0.181	(0.281)	0.090	0.090
4	0.33	1.50	0.247	(0.281)	0.123	0.123
5	0.42	1.50	0.247	(0.281)	0.123	0.123
6	0.50	1.80	0.296	(0.281)	0.148	0.148
7	0.58	1.50	0.247	(0.281)	0.123	0.123
8	0.67	1.80	0.296	(0.281)	0.148	0.148
9	0.75	1.80	0.296	(0.281)	0.148	0.148
10	0.83	1.50	0.247	(0.281)	0.123	0.123
11	0.92	1.60	0.263	(0.281)	0.131	0.131
12	1.00	1.80	0.296	(0.281)	0.148	0.148
13	1.08	2.20	0.362	(0.281)	0.181	0.181
14	1.17	2.20	0.362	(0.281)	0.181	0.181
15	1.25	2.20	0.362	(0.281)	0.181	0.181
16	1.33	2.00	0.329	(0.281)	0.164	0.164
17	1.42	2.60	0.427	(0.281)	0.214	0.214
18	1.50	2.70	0.444	(0.281)	0.222	0.222
19	1.58	2.40	0.394	(0.281)	0.197	0.197
20	1.67	2.70	0.444	(0.281)	0.222	0.222
21	1.75	3.30	0.542	(0.281)	0.271	0.271
22	1.83	3.10	0.509	(0.281)	0.255	0.255
23	1.92	2.90	0.477	(0.281)	0.238	0.238
24	2.00	3.00	0.493	(0.281)	0.247	0.247
25	2.08	3.10	0.509	(0.281)	0.255	0.255
26	2.17	4.20	0.690	0.281	(0.345)	0.409
27	2.25	5.00	0.822	0.281	(0.411)	0.541
28	2.33	3.50	0.575	0.281	(0.288)	0.294
29	2.42	6.80	1.118	0.281	(0.559)	0.837
30	2.50	7.30	1.200	0.281	(0.600)	0.919
31	2.58	8.20	1.348	0.281	(0.674)	1.067
32	2.67	5.90	0.970	0.281	(0.485)	0.689
33	2.75	2.00	0.329	(0.281)	0.164	0.164
34	2.83	1.80	0.296	(0.281)	0.148	0.148
35	2.92	1.80	0.296	(0.281)	0.148	0.148
36	3.00	0.60	0.099	(0.281)	0.049	0.049
		(Loss Rate Not Used)				
Sum =		100.0			Sum =	9.6

Flood volume = Effective rainfall 0.80(In)
times area 5.1(Ac.)/[(In)/(Ft.)] = 0.3(Ac.Ft)
Total soil loss = 0.57(In)
Total soil loss = 0.242(Ac.Ft)
Total rainfall = 1.37(In)
Flood volume = 14828.1 Cubic Feet
Total soil loss = 10526.1 Cubic Feet

Peak flow rate of this hydrograph = 5.155(CFS)

++

3 - H O U R S T O R M
R u n o f f H y d r o g r a p h

Hydrograph in 5 Minute intervals ((CFS))

```
  Time(h+m) Volume Ac.Ft   Q(CFS)  0         2.5       5.0       7.5      10.0
  -----------------------------------------------------------------------
    0+ 5       0.0022       0.33  VQ        |         |         |         |
    0+10       0.0058       0.52  V Q       |         |         |         |
    0+15       0.0093       0.50  |Q        |         |         |         |
    0+20       0.0132       0.57  |VQ       |         |         |         |
    0+25       0.0175       0.63  | Q       |         |         |         |
    0+30       0.0224       0.71  | Q       |         |         |         |
    0+35       0.0271       0.68  | QV      |         |         |         |
    0+40       0.0320       0.72  | QV      |         |         |         |
    0+45       0.0372       0.75  |  QV     |         |         |         |
    0+50       0.0419       0.69  | Q V     |         |         |         |
    0+55       0.0465       0.67  | Q  V    |         |         |         |
    1+ 0       0.0515       0.72  | Q   V   |         |         |         |
    1+ 5       0.0574       0.86  |  Q  V   |         |         |         |
    1+10       0.0637       0.92  |  Q   V  |         |         |         |
    1+15       0.0701       0.93  |  Q    V |         |         |         |
    1+20       0.0762       0.88  |  Q    V |         |         |         |
    1+25       0.0831       1.00  |  Q     V|         |         |         |
    1+30       0.0907       1.11  |   Q     V         |         |         |
    1+35       0.0980       1.06  |   Q     |V        |         |         |
    1+40       0.1056       1.10  |   Q     | V       |         |         |
    1+45       0.1144       1.29  |    Q    |  V      |         |         |
    1+50       0.1236       1.33  |    Q    |   V     |         |         |
    1+55       0.1323       1.26  |    Q    |    V    |         |         |
    2+ 0       0.1410       1.25  |    Q    |     V   |         |         |
    2+ 5       0.1499       1.29  |    Q    |      V  |         |         |
    2+10       0.1621       1.78  |      Q  |        V|         |         |
    2+15       0.1791       2.47  |        Q|         |V        |         |
    2+20       0.1928       1.99  |      Q  |         | V       |         |
    2+25       0.2151       3.23  |         | Q       |    V    |         |
    2+30       0.2455       4.41  |         |      Q  |       V |         |
    2+35       0.2810       5.16  |         |         Q         |  V      |
    2+40       0.3106       4.29  |         |      Q  |         |     V   |
    2+45       0.3246       2.04  |       Q |         |         |       V |
    2+50       0.3310       0.93  |  Q      |         |         |       V |
    2+55       0.3363       0.76  |  Q      |         |         |        V|
    3+ 0       0.3394       0.46  |Q        |         |         |        V|
    3+ 5       0.3403       0.13  Q         |         |         |        V|
    3+10       0.3404       0.01  Q         |         |         |        V|
-----------------------------------------------------------------------
```

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      U n i t   H y d r o g r a p h   A n a l y s i s

      Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2014, Version 9.0
              Study date  07/22/19 File: DMAB10EXIST610.out

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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978


Program License Serial Number 6388

---------------------------------------------------------------------
 English (in-lb) Input Units Used
 English Rainfall Data (Inches) Input Values Used

 English Units used in output format



---------------------------------------------------------------------
KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
EXISTING CONDITION
10-YR 6-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019
--------------------------------------------------------------------
Drainage Area =       5.10(Ac.)  =      0.008 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =       5.10(Ac.)  =      0.008 Sq. Mi.
Length along longest watercourse =     461.00(Ft.)
Length along longest watercourse measured to centroid =     391.00(Ft.)
Length along longest watercourse =      0.087 Mi.
Length along longest watercourse measured to centroid =      0.074 Mi.
Difference in elevation =      19.00(Ft.)
Slope along watercourse =    217.6139 Ft./Mi.
Average Manning's 'N' = 0.020
Lag time =    0.025 Hr.
Lag time =     1.52 Min.
25% of lag time =     0.38 Min.
40% of lag time =     0.61 Min.
Unit time =     5.00 Min.
Duration of storm = 6 Hour(s)
User Entered Base Flow =     0.00(CFS)

2 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        5.10           1.21                  6.17

100 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        5.10           2.86                 14.59

STORM EVENT (YEAR) =   10.00
Area Averaged 2-Year Rainfall =    1.210(In)
Area Averaged 100-Year Rainfall =    2.860(In)

Point rain (area averaged) =    1.889(In)
Areal adjustment factor =  100.00 %
Adjusted average point rain =    1.889(In)

Sub-Area Data:
Area(Ac.)         Runoff Index   Impervious %
     5.100           56.00          0.500
 Total Area Entered =      5.10(Ac.)


RI    RI   Infil. Rate Impervious   Adj. Infil. Rate  Area%     F
AMC2 AMC-2     (In/Hr)    (Dec.%)      (In/Hr)      (Dec.)    (In/Hr)
56.0  56.0      0.511     0.500        0.281       1.000      0.281
                                                 Sum (F) =   0.281
Area averaged mean soil loss (F) (In/Hr) =  0.281
Minimum soil loss rate ((In/Hr)) =  0.140
```

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.500

U n i t H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %		Unit Hydrograph (CFS)
1	0.083	327.873	59.371		3.052
2	0.167	655.747	35.647		1.832
3	0.250	983.620	4.982		0.256
			Sum = 100.000	Sum=	5.140

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Low	Effective (In/Hr)
1	0.08	0.50	0.113	(0.281)	0.057	0.057
2	0.17	0.60	0.136	(0.281)	0.068	0.068
3	0.25	0.60	0.136	(0.281)	0.068	0.068
4	0.33	0.60	0.136	(0.281)	0.068	0.068
5	0.42	0.60	0.136	(0.281)	0.068	0.068
6	0.50	0.70	0.159	(0.281)	0.079	0.079
7	0.58	0.70	0.159	(0.281)	0.079	0.079
8	0.67	0.70	0.159	(0.281)	0.079	0.079
9	0.75	0.70	0.159	(0.281)	0.079	0.079
10	0.83	0.70	0.159	(0.281)	0.079	0.079
11	0.92	0.70	0.159	(0.281)	0.079	0.079
12	1.00	0.80	0.181	(0.281)	0.091	0.091
13	1.08	0.80	0.181	(0.281)	0.091	0.091
14	1.17	0.80	0.181	(0.281)	0.091	0.091
15	1.25	0.80	0.181	(0.281)	0.091	0.091
16	1.33	0.80	0.181	(0.281)	0.091	0.091
17	1.42	0.80	0.181	(0.281)	0.091	0.091
18	1.50	0.80	0.181	(0.281)	0.091	0.091
19	1.58	0.80	0.181	(0.281)	0.091	0.091
20	1.67	0.80	0.181	(0.281)	0.091	0.091
21	1.75	0.80	0.181	(0.281)	0.091	0.091
22	1.83	0.80	0.181	(0.281)	0.091	0.091
23	1.92	0.80	0.181	(0.281)	0.091	0.091
24	2.00	0.90	0.204	(0.281)	0.102	0.102
25	2.08	0.80	0.181	(0.281)	0.091	0.091
26	2.17	0.90	0.204	(0.281)	0.102	0.102
27	2.25	0.90	0.204	(0.281)	0.102	0.102
28	2.33	0.90	0.204	(0.281)	0.102	0.102
29	2.42	0.90	0.204	(0.281)	0.102	0.102
30	2.50	0.90	0.204	(0.281)	0.102	0.102
31	2.58	0.90	0.204	(0.281)	0.102	0.102
32	2.67	0.90	0.204	(0.281)	0.102	0.102
33	2.75	1.00	0.227	(0.281)	0.113	0.113
34	2.83	1.00	0.227	(0.281)	0.113	0.113
35	2.92	1.00	0.227	(0.281)	0.113	0.113
36	3.00	1.00	0.227	(0.281)	0.113	0.113
37	3.08	1.00	0.227	(0.281)	0.113	0.113
38	3.17	1.10	0.249	(0.281)	0.125	0.125
39	3.25	1.10	0.249	(0.281)	0.125	0.125
40	3.33	1.10	0.249	(0.281)	0.125	0.125
41	3.42	1.20	0.272	(0.281)	0.136	0.136
42	3.50	1.30	0.295	(0.281)	0.147	0.147
43	3.58	1.40	0.317	(0.281)	0.159	0.159
44	3.67	1.40	0.317	(0.281)	0.159	0.159
45	3.75	1.50	0.340	(0.281)	0.170	0.170
46	3.83	1.50	0.340	(0.281)	0.170	0.170
47	3.92	1.60	0.363	(0.281)	0.181	0.181
48	4.00	1.60	0.363	(0.281)	0.181	0.181
49	4.08	1.70	0.385	(0.281)	0.193	0.193
50	4.17	1.80	0.408	(0.281)	0.204	0.204
51	4.25	1.90	0.431	(0.281)	0.215	0.215
52	4.33	2.00	0.453	(0.281)	0.227	0.227
53	4.42	2.10	0.476	(0.281)	0.238	0.238
54	4.50	2.10	0.476	(0.281)	0.238	0.238
55	4.58	2.20	0.499	(0.281)	0.249	0.249

```
56   4.67     2.30      0.521       (  0.281)       0.261        0.261
57   4.75     2.40      0.544       (  0.281)       0.272        0.272
58   4.83     2.40      0.544       (  0.281)       0.272        0.272
59   4.92     2.50      0.567          0.281    (  0.283)        0.286
60   5.00     2.60      0.589          0.281    (  0.295)        0.308
61   5.08     3.10      0.703          0.281    (  0.351)        0.422
62   5.17     3.60      0.816          0.281    (  0.408)        0.535
63   5.25     3.90      0.884          0.281    (  0.442)        0.603
64   5.33     4.20      0.952          0.281    (  0.476)        0.671
65   5.42     4.70      1.065          0.281    (  0.533)        0.784
66   5.50     5.60      1.269          0.281    (  0.635)        0.988
67   5.58     1.90      0.431       (  0.281)       0.215        0.215
68   5.67     0.90      0.204       (  0.281)       0.102        0.102
69   5.75     0.60      0.136       (  0.281)       0.068        0.068
70   5.83     0.50      0.113       (  0.281)       0.057        0.057
71   5.92     0.30      0.068       (  0.281)       0.034        0.034
72   6.00     0.20      0.045       (  0.281)       0.023        0.023
              (Loss Rate Not Used)
   Sum =     100.0                               Sum =    12.5
     Flood volume = Effective rainfall      1.04(In)
      times area       5.1(Ac.)/[(In)/(Ft.)] =       0.4(Ac.Ft)
     Total soil loss =      0.85(In)
     Total soil loss =     0.360(Ac.Ft)
     Total rainfall =      1.89(In)
     Flood volume =       19296.3 Cubic Feet
     Total soil loss =       15670.9 Cubic Feet
     --------------------------------------------------------------------
      Peak flow rate of this hydrograph =      4.627(CFS)
     --------------------------------------------------------------------
     ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                         6 - H O U R    S T O R M
                    R u n o f f     H y d r o g r a p h
     --------------------------------------------------------------------
                Hydrograph in   5   Minute intervals ((CFS))

     --------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0        2.5       5.0       7.5      10.0
-----------------------------------------------------------------------
  0+ 5       0.0012      0.17  Q         |         |         |         |
  0+10       0.0033      0.31  VQ        |         |         |         |
  0+15       0.0057      0.35  VQ        |         |         |         |
  0+20       0.0081      0.35  VQ        |         |         |         |
  0+25       0.0105      0.35  VQ        |         |         |         |
  0+30       0.0132      0.38  |Q        |         |         |         |
  0+35       0.0160      0.41  |Q        |         |         |         |
  0+40       0.0188      0.41  |Q        |         |         |         |
  0+45       0.0216      0.41  |Q        |         |         |         |
  0+50       0.0244      0.41  |QV       |         |         |         |
  0+55       0.0272      0.41  |QV       |         |         |         |
  1+ 0       0.0303      0.44  |QV       |         |         |         |
  1+ 5       0.0335      0.46  |Q V      |         |         |         |
  1+10       0.0367      0.47  |Q V      |         |         |         |
  1+15       0.0399      0.47  |Q V      |         |         |         |
  1+20       0.0431      0.47  |Q V      |         |         |         |
  1+25       0.0463      0.47  |Q  V     |         |         |         |
  1+30       0.0495      0.47  |Q  V     |         |         |         |
  1+35       0.0527      0.47  |Q  V     |         |         |         |
  1+40       0.0559      0.47  |Q   V    |         |         |         |
  1+45       0.0591      0.47  |Q   V    |         |         |         |
  1+50       0.0624      0.47  |Q   V    |         |         |         |
  1+55       0.0656      0.47  |Q   V    |         |         |         |
  2+ 0       0.0690      0.50  | Q   V   |         |         |         |
  2+ 5       0.0724      0.49  |Q    V   |         |         |         |
  2+10       0.0758      0.50  | Q   V   |         |         |         |
  2+15       0.0794      0.52  | Q    V  |         |         |         |
  2+20       0.0830      0.52  | Q    V  |         |         |         |
  2+25       0.0867      0.52  | Q    V  |         |         |         |
  2+30       0.0903      0.52  | Q     V |         |         |         |
  2+35       0.0939      0.52  | Q     V |         |         |         |
  2+40       0.0975      0.52  | Q     V |         |         |         |
  2+45       0.1013      0.56  | Q      V|         |         |         |
  2+50       0.1053      0.58  | Q      V|         |         |         |
  2+55       0.1093      0.58  | Q      V|         |         |         |
  3+ 0       0.1134      0.58  | Q       V         |         |         |
  3+ 5       0.1174      0.58  | Q       V         |         |         |
  3+10       0.1216      0.62  | Q       V         |         |         |
  3+15       0.1260      0.64  | Q       |V        |         |         |
  3+20       0.1304      0.64  | Q       |V        |         |         |
  3+25       0.1351      0.68  | Q       | V       |         |         |
```

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    3+30       0.1401      0.73  | Q       | V       |         |         |
    3+35       0.1456      0.79  |  Q      |  V      |         |         |
    3+40       0.1512      0.81  |  Q      |  V      |         |         |
    3+45       0.1570      0.85  |  Q      |   V     |         |         |
    3+50       0.1630      0.87  |  Q      |   V     |         |         |
    3+55       0.1693      0.91  |  Q      |    V    |         |         |
    4+ 0       0.1757      0.93  |  Q      |    V    |         |         |
    4+ 5       0.1823      0.97  |  Q      |     V   |         |         |
    4+10       0.1894      1.02  |   Q     |      V  |         |         |
    4+15       0.1968      1.08  |   Q     |      V  |         |         |
    4+20       0.2047      1.14  |   Q     |       V |         |         |
    4+25       0.2129      1.20  |   Q     |        V|         |         |
    4+30       0.2213      1.22  |   Q     |        V|         |         |
    4+35       0.2300      1.26  |    Q    |         V         |         |
    4+40       0.2390      1.31  |    Q    |         |V        |         |
    4+45       0.2485      1.37  |    Q    |         | V       |         |
    4+50       0.2581      1.40  |    Q    |         |  V      |         |
    4+55       0.2680      1.44  |    Q    |         |   V     |         |
    5+ 0       0.2786      1.53  |     Q   |         |    V    |         |
    5+ 5       0.2919      1.93  |      Q  |         |     V   |         |
    5+10       0.3090      2.49  |        Q|         |      V  |         |
    5+15       0.3292      2.93  |         |Q        |        V|         |
    5+20       0.3518      3.29  |         |  Q      |         |V        |
    5+25       0.3778      3.78  |         |    Q    |         |   V     |
    5+30       0.4097      4.63  |         |       Q |         |     V   |
    5+35       0.4281      2.67  |         Q         |         |       V |
    5+40       0.4347      0.96  |  Q      |         |         |        V|
    5+45       0.4378      0.45  |Q        |         |         |        V|
    5+50       0.4400      0.32  |Q        |         |         |        V|
    5+55       0.4416      0.23  Q         |         |         |        V|
    6+ 0       0.4426      0.15  Q         |         |         |        V|
    6+ 5       0.4429      0.05  Q         |         |         |        V|
    6+10       0.4430      0.01  Q         |         |         |         V
-----------------------------------------------------------------------
```

```
      U n i t   H y d r o g r a p h   A n a l y s i s

      Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2014, Version 9.0
             Study date  07/22/19 File: DMAB10EXIST2410.out


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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978


Program License Serial Number 6388

---------------------------------------------------------------------
 English (in-lb) Input Units Used
 English Rainfall Data (Inches) Input Values Used

 English Units used in output format



---------------------------------------------------------------------
KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
EXISTING CONDITION
10-YR 24-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019
--------------------------------------------------------------------
Drainage Area =       5.10(Ac.)  =      0.008 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =       5.10(Ac.)  =      0.008 Sq. Mi.
Length along longest watercourse =     461.00(Ft.)
Length along longest watercourse measured to centroid =     391.00(Ft.)
Length along longest watercourse =      0.087 Mi.
Length along longest watercourse measured to centroid =      0.074 Mi.
Difference in elevation =      19.00(Ft.)
Slope along watercourse =    217.6139 Ft./Mi.
Average Manning's 'N' = 0.020
Lag time =    0.025 Hr.
Lag time =     1.52 Min.
25% of lag time =     0.38 Min.
40% of lag time =     0.61 Min.
Unit time =    15.00 Min.
Duration of storm = 24 Hour(s)
User Entered Base Flow =     0.00(CFS)

2 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        5.10           2.05                 10.45

100 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        5.10           5.16                 26.32

STORM EVENT (YEAR) =   10.00
Area Averaged 2-Year Rainfall =    2.050(In)
Area Averaged 100-Year Rainfall =    5.160(In)

Point rain (area averaged) =    3.329(In)
Areal adjustment factor =  100.00 %
Adjusted average point rain =    3.329(In)

Sub-Area Data:
Area(Ac.)         Runoff Index   Impervious %
     5.100           56.00         0.500
 Total Area Entered =      5.10(Ac.)


RI    RI   Infil. Rate Impervious   Adj. Infil. Rate  Area%     F
AMC2 AMC-2     (In/Hr)    (Dec.%)      (In/Hr)       (Dec.)    (In/Hr)
56.0  56.0      0.511     0.500        0.281       1.000      0.281
                                                  Sum (F) =   0.281
Area averaged mean soil loss (F) (In/Hr) =  0.281
Minimum soil loss rate ((In/Hr)) =  0.140
```

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.500

Unit Hydrograph
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.250	983.620	100.000	5.140
			Sum = 100.000	Sum= 5.140

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Low	Effective (In/Hr)
1	0.25	0.20	0.027	(0.496)	0.013	0.013
2	0.50	0.30	0.040	(0.490)	0.020	0.020
3	0.75	0.30	0.040	(0.485)	0.020	0.020
4	1.00	0.40	0.053	(0.479)	0.027	0.027
5	1.25	0.30	0.040	(0.473)	0.020	0.020
6	1.50	0.30	0.040	(0.468)	0.020	0.020
7	1.75	0.30	0.040	(0.462)	0.020	0.020
8	2.00	0.40	0.053	(0.457)	0.027	0.027
9	2.25	0.40	0.053	(0.451)	0.027	0.027
10	2.50	0.40	0.053	(0.446)	0.027	0.027
11	2.75	0.50	0.067	(0.440)	0.033	0.033
12	3.00	0.50	0.067	(0.435)	0.033	0.033
13	3.25	0.50	0.067	(0.429)	0.033	0.033
14	3.50	0.50	0.067	(0.424)	0.033	0.033
15	3.75	0.50	0.067	(0.419)	0.033	0.033
16	4.00	0.60	0.080	(0.413)	0.040	0.040
17	4.25	0.60	0.080	(0.408)	0.040	0.040
18	4.50	0.70	0.093	(0.403)	0.047	0.047
19	4.75	0.70	0.093	(0.398)	0.047	0.047
20	5.00	0.80	0.107	(0.393)	0.053	0.053
21	5.25	0.60	0.080	(0.388)	0.040	0.040
22	5.50	0.70	0.093	(0.382)	0.047	0.047
23	5.75	0.80	0.107	(0.377)	0.053	0.053
24	6.00	0.80	0.107	(0.372)	0.053	0.053
25	6.25	0.90	0.120	(0.368)	0.060	0.060
26	6.50	0.90	0.120	(0.363)	0.060	0.060
27	6.75	1.00	0.133	(0.358)	0.067	0.067
28	7.00	1.00	0.133	(0.353)	0.067	0.067
29	7.25	1.00	0.133	(0.348)	0.067	0.067
30	7.50	1.10	0.146	(0.343)	0.073	0.073
31	7.75	1.20	0.160	(0.339)	0.080	0.080
32	8.00	1.30	0.173	(0.334)	0.087	0.087
33	8.25	1.50	0.200	(0.329)	0.100	0.100
34	8.50	1.50	0.200	(0.325)	0.100	0.100
35	8.75	1.60	0.213	(0.320)	0.107	0.107
36	9.00	1.70	0.226	(0.316)	0.113	0.113
37	9.25	1.90	0.253	(0.311)	0.127	0.127
38	9.50	2.00	0.266	(0.307)	0.133	0.133
39	9.75	2.10	0.280	(0.302)	0.140	0.140
40	10.00	2.20	0.293	(0.298)	0.146	0.146
41	10.25	1.50	0.200	(0.294)	0.100	0.100
42	10.50	1.50	0.200	(0.290)	0.100	0.100
43	10.75	2.00	0.266	(0.285)	0.133	0.133
44	11.00	2.00	0.266	(0.281)	0.133	0.133
45	11.25	1.90	0.253	(0.277)	0.127	0.127
46	11.50	1.90	0.253	(0.273)	0.127	0.127
47	11.75	1.70	0.226	(0.269)	0.113	0.113
48	12.00	1.80	0.240	(0.265)	0.120	0.120
49	12.25	2.50	0.333	(0.261)	0.166	0.166
50	12.50	2.60	0.346	(0.257)	0.173	0.173
51	12.75	2.80	0.373	(0.253)	0.186	0.186
52	13.00	2.90	0.386	(0.249)	0.193	0.193
53	13.25	3.40	0.453	(0.246)	0.226	0.226
54	13.50	3.40	0.453	(0.242)	0.226	0.226
55	13.75	2.30	0.306	(0.238)	0.153	0.153
56	14.00	2.30	0.306	(0.235)	0.153	0.153
57	14.25	2.70	0.360	(0.231)	0.180	0.180

```
58  14.50     2.60      0.346       (  0.227)       0.173        0.173
59  14.75     2.60      0.346       (  0.224)       0.173        0.173
60  15.00     2.50      0.333       (  0.221)       0.166        0.166
61  15.25     2.40      0.320       (  0.217)       0.160        0.160
62  15.50     2.30      0.306       (  0.214)       0.153        0.153
63  15.75     1.90      0.253       (  0.211)       0.127        0.127
64  16.00     1.90      0.253       (  0.207)       0.127        0.127
65  16.25     0.40      0.053       (  0.204)       0.027        0.027
66  16.50     0.40      0.053       (  0.201)       0.027        0.027
67  16.75     0.30      0.040       (  0.198)       0.020        0.020
68  17.00     0.30      0.040       (  0.195)       0.020        0.020
69  17.25     0.50      0.067       (  0.192)       0.033        0.033
70  17.50     0.50      0.067       (  0.189)       0.033        0.033
71  17.75     0.50      0.067       (  0.186)       0.033        0.033
72  18.00     0.40      0.053       (  0.184)       0.027        0.027
73  18.25     0.40      0.053       (  0.181)       0.027        0.027
74  18.50     0.40      0.053       (  0.178)       0.027        0.027
75  18.75     0.30      0.040       (  0.176)       0.020        0.020
76  19.00     0.20      0.027       (  0.173)       0.013        0.013
77  19.25     0.30      0.040       (  0.171)       0.020        0.020
78  19.50     0.40      0.053       (  0.168)       0.027        0.027
79  19.75     0.30      0.040       (  0.166)       0.020        0.020
80  20.00     0.20      0.027       (  0.164)       0.013        0.013
81  20.25     0.30      0.040       (  0.162)       0.020        0.020
82  20.50     0.30      0.040       (  0.160)       0.020        0.020
83  20.75     0.30      0.040       (  0.158)       0.020        0.020
84  21.00     0.20      0.027       (  0.156)       0.013        0.013
85  21.25     0.30      0.040       (  0.154)       0.020        0.020
86  21.50     0.20      0.027       (  0.152)       0.013        0.013
87  21.75     0.30      0.040       (  0.150)       0.020        0.020
88  22.00     0.20      0.027       (  0.149)       0.013        0.013
89  22.25     0.30      0.040       (  0.147)       0.020        0.020
90  22.50     0.20      0.027       (  0.146)       0.013        0.013
91  22.75     0.20      0.027       (  0.145)       0.013        0.013
92  23.00     0.20      0.027       (  0.144)       0.013        0.013
93  23.25     0.20      0.027       (  0.143)       0.013        0.013
94  23.50     0.20      0.027       (  0.142)       0.013        0.013
95  23.75     0.20      0.027       (  0.141)       0.013        0.013
96  24.00     0.20      0.027       (  0.141)       0.013        0.013
            (Loss Rate Not Used)
   Sum =     100.0                                  Sum =     6.7
     Flood volume = Effective rainfall      1.66(In)
      times area       5.1(Ac.)/[(In)/(Ft.)] =       0.7(Ac.Ft)
     Total soil loss =      1.66(In)
     Total soil loss =     0.708(Ac.Ft)
     Total rainfall =      3.33(In)
     Flood volume =       30819.0 Cubic Feet
     Total soil loss =       30819.0 Cubic Feet
     --------------------------------------------------------------------
      Peak flow rate of this hydrograph =      1.164(CFS)
     --------------------------------------------------------------------
     ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                         24 - H O U R   S T O R M
                    R u n o f f     H y d r o g r a p h
     --------------------------------------------------------------------
                Hydrograph in  15   Minute intervals ((CFS))

     --------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0        2.5       5.0       7.5      10.0
-----------------------------------------------------------------------
  0+15       0.0014      0.07  Q         |         |         |         |
  0+30       0.0035      0.10  Q         |         |         |         |
  0+45       0.0057      0.10  Q         |         |         |         |
  1+ 0       0.0085      0.14  Q         |         |         |         |
  1+15       0.0106      0.10  Q         |         |         |         |
  1+30       0.0127      0.10  Q         |         |         |         |
  1+45       0.0149      0.10  Q         |         |         |         |
  2+ 0       0.0177      0.14  Q         |         |         |         |
  2+15       0.0205      0.14  QV        |         |         |         |
  2+30       0.0233      0.14  QV        |         |         |         |
  2+45       0.0269      0.17  QV        |         |         |         |
  3+ 0       0.0304      0.17  QV        |         |         |         |
  3+15       0.0340      0.17  QV        |         |         |         |
  3+30       0.0375      0.17  Q V       |         |         |         |
  3+45       0.0410      0.17  Q V       |         |         |         |
  4+ 0       0.0453      0.21  Q V       |         |         |         |
  4+15       0.0495      0.21  Q V       |         |         |         |
  4+30       0.0545      0.24  Q  V      |         |         |         |
  4+45       0.0594      0.24  Q  V      |         |         |         |
```

```
    5+ 0       0.0651      0.27  |Q V      |         |         |         |
    5+15       0.0693      0.21  Q  V      |         |         |         |
    5+30       0.0743      0.24  Q   V     |         |         |         |
    5+45       0.0799      0.27  |Q  V     |         |         |         |
    6+ 0       0.0856      0.27  |Q  V     |         |         |         |
    6+15       0.0920      0.31  |Q   V    |         |         |         |
    6+30       0.0983      0.31  |Q   V    |         |         |         |
    6+45       0.1054      0.34  |Q   V    |         |         |         |
    7+ 0       0.1125      0.34  |Q    V   |         |         |         |
    7+15       0.1196      0.34  |Q    V   |         |         |         |
    7+30       0.1274      0.38  |Q     V  |         |         |         |
    7+45       0.1358      0.41  |Q     V  |         |         |         |
    8+ 0       0.1450      0.45  |Q      V |         |         |         |
    8+15       0.1557      0.51  | Q     V |         |         |         |
    8+30       0.1663      0.51  | Q      V|         |         |         |
    8+45       0.1776      0.55  | Q       V         |         |         |
    9+ 0       0.1896      0.58  | Q       V         |         |         |
    9+15       0.2031      0.65  | Q        V        |         |         |
    9+30       0.2172      0.68  | Q       | V       |         |         |
    9+45       0.2321      0.72  | Q       |  V      |         |         |
   10+ 0       0.2476      0.75  |  Q      |  V      |         |         |
   10+15       0.2582      0.51  | Q       |   V     |         |         |
   10+30       0.2689      0.51  | Q       |    V    |         |         |
   10+45       0.2830      0.68  | Q       |    V    |         |         |
   11+ 0       0.2972      0.68  | Q       |     V   |         |         |
   11+15       0.3106      0.65  | Q       |      V  |         |         |
   11+30       0.3240      0.65  | Q       |       V |         |         |
   11+45       0.3361      0.58  | Q       |       V |         |         |
   12+ 0       0.3488      0.62  | Q       |        V|         |         |
   12+15       0.3665      0.86  |  Q      |         V         |         |
   12+30       0.3849      0.89  |  Q      |         |V        |         |
   12+45       0.4047      0.96  |  Q      |         | V       |         |
   13+ 0       0.4252      0.99  |  Q      |         |   V     |         |
   13+15       0.4493      1.16  |   Q     |         |    V    |         |
   13+30       0.4733      1.16  |   Q     |         |     V   |         |
   13+45       0.4896      0.79  |  Q      |         |      V  |         |
   14+ 0       0.5059      0.79  |  Q      |         |       V |         |
   14+15       0.5250      0.92  |  Q      |         |        V|         |
   14+30       0.5434      0.89  |  Q      |         |         V         |
   14+45       0.5618      0.89  |  Q      |         |         |V        |
   15+ 0       0.5794      0.86  |  Q      |         |         | V       |
   15+15       0.5964      0.82  |  Q      |         |         |  V      |
   15+30       0.6127      0.79  |  Q      |         |         |   V     |
   15+45       0.6261      0.65  | Q       |         |         |    V    |
   16+ 0       0.6396      0.65  | Q       |         |         |     V   |
   16+15       0.6424      0.14  Q         |         |         |     V   |
   16+30       0.6452      0.14  Q         |         |         |     V   |
   16+45       0.6474      0.10  Q         |         |         |     V   |
   17+ 0       0.6495      0.10  Q         |         |         |     V   |
   17+15       0.6530      0.17  Q         |         |         |     V   |
   17+30       0.6566      0.17  Q         |         |         |      V  |
   17+45       0.6601      0.17  Q         |         |         |      V  |
   18+ 0       0.6629      0.14  Q         |         |         |      V  |
   18+15       0.6658      0.14  Q         |         |         |      V  |
   18+30       0.6686      0.14  Q         |         |         |      V  |
   18+45       0.6707      0.10  Q         |         |         |      V  |
   19+ 0       0.6721      0.07  Q         |         |         |       V |
   19+15       0.6743      0.10  Q         |         |         |       V |
   19+30       0.6771      0.14  Q         |         |         |       V |
   19+45       0.6792      0.10  Q         |         |         |       V |
   20+ 0       0.6806      0.07  Q         |         |         |       V |
   20+15       0.6827      0.10  Q         |         |         |       V |
   20+30       0.6849      0.10  Q         |         |         |       V |
   20+45       0.6870      0.10  Q         |         |         |       V |
   21+ 0       0.6884      0.07  Q         |         |         |       V |
   21+15       0.6905      0.10  Q         |         |         |        V|
   21+30       0.6919      0.07  Q         |         |         |        V|
   21+45       0.6941      0.10  Q         |         |         |        V|
   22+ 0       0.6955      0.07  Q         |         |         |        V|
   22+15       0.6976      0.10  Q         |         |         |        V|
   22+30       0.6990      0.07  Q         |         |         |        V|
   22+45       0.7004      0.07  Q         |         |         |        V|
   23+ 0       0.7018      0.07  Q         |         |         |        V|
   23+15       0.7033      0.07  Q         |         |         |        V|
   23+30       0.7047      0.07  Q         |         |         |        V|
   23+45       0.7061      0.07  Q         |         |         |        V|
   24+ 0       0.7075      0.07  Q         |         |         |         V
-----------------------------------------------------------------------
```

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      U n i t   H y d r o g r a p h   A n a l y s i s

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               Study date  07/23/19 File: DMAB10PROP110.out

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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978


Program License Serial Number 6388

---------------------------------------------------------------------
 English (in-lb) Input Units Used
 English Rainfall Data (Inches) Input Values Used

 English Units used in output format



---------------------------------------------------------------------
KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
PROPOSED CONDITION, DMA B
10-YR 1-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019
--------------------------------------------------------------------
Drainage Area =       5.10(Ac.)  =      0.008 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =       5.10(Ac.)  =      0.008 Sq. Mi.
Length along longest watercourse =     461.00(Ft.)
Length along longest watercourse measured to centroid =     391.00(Ft.)
Length along longest watercourse =      0.087 Mi.
Length along longest watercourse measured to centroid =      0.074 Mi.
Difference in elevation =      19.00(Ft.)
Slope along watercourse =    217.6139 Ft./Mi.
Average Manning's 'N' = 0.015
Lag time =    0.019 Hr.
Lag time =     1.14 Min.
25% of lag time =     0.29 Min.
40% of lag time =     0.46 Min.
Unit time =     5.00 Min.
Duration of storm = 1 Hour(s)
User Entered Base Flow =     0.00(CFS)

2 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        5.10           0.49                  2.49

100 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        5.10           1.33                  6.78

STORM EVENT (YEAR) =   10.00
Area Averaged 2-Year Rainfall =    0.489(In)
Area Averaged 100-Year Rainfall =    1.330(In)

Point rain (area averaged) =    0.835(In)
Areal adjustment factor =  100.00 %
Adjusted average point rain =    0.835(In)

Sub-Area Data:
Area(Ac.)         Runoff Index   Impervious %
     5.100           56.00         0.690
 Total Area Entered =      5.10(Ac.)


RI    RI   Infil. Rate Impervious   Adj. Infil. Rate  Area%     F
AMC2 AMC-2     (In/Hr)    (Dec.%)      (In/Hr)       (Dec.)    (In/Hr)
56.0  56.0      0.511     0.690        0.194       1.000      0.194
                                                  Sum (F) =   0.194
Area averaged mean soil loss (F) (In/Hr) =  0.194
Minimum soil loss rate ((In/Hr)) =  0.097
```

(for 24 hour storm duration)
Soil low loss rate (decimal) =   0.350

Slope of intensity-duration curve for a 1 hour storm =0.5000

U n i t   H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.083	437.165	67.483	3.469
2	0.167	874.329	32.517	1.671
			Sum = 100.000	Sum= 5.140

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Loss rate(In./Hr) Low	Effective (In/Hr)
1	0.08	4.20	0.421	(0.194)	0.147	0.274
2	0.17	4.30	0.431	(0.194)	0.151	0.280
3	0.25	5.00	0.501	(0.194)	0.175	0.326
4	0.33	5.00	0.501	(0.194)	0.175	0.326
5	0.42	5.80	0.581	0.194	(0.203)	0.388
6	0.50	6.50	0.651	0.194	(0.228)	0.458
7	0.58	7.40	0.741	0.194	(0.260)	0.548
8	0.67	8.60	0.862	0.194	(0.302)	0.668
9	0.75	12.30	1.232	0.194	(0.431)	1.039
10	0.83	29.10	2.916	0.194	(1.020)	2.722
11	0.92	6.80	0.681	0.194	(0.238)	0.488
12	1.00	5.00	0.501	(0.194)	0.175	0.326

(Loss Rate Not Used)
Sum =   100.0   Sum =   7.8

Flood volume = Effective rainfall   0.65(In)
times area   5.1(Ac.)/[(In)/(Ft.)] =   0.3(Ac.Ft)
Total soil loss =   0.18(In)
Total soil loss =   0.077(Ac.Ft)
Total rainfall =   0.83(In)
Flood volume =   12095.5 Cubic Feet
Total soil loss =   3362.0 Cubic Feet

Peak flow rate of this hydrograph =   11.184(CFS)

```
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                    1 - H O U R   S T O R M
               R u n o f f     H y d r o g r a p h
----------------------------------------------------------------------
            Hydrograph in   5   Minute intervals ((CFS))

----------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0        5.0      10.0      15.0      20.0
---------------------------------------------------------------------
  0+ 5       0.0065      0.95  VQ        |         |         |         |
  0+10       0.0164      1.43  | Q       |         |         |         |
  0+15       0.0274      1.60  |  Q      |         |         |         |
  0+20       0.0389      1.67  |  Q V    |         |         |         |
  0+25       0.0519      1.89  |  Q   V  |         |         |         |
  0+30       0.0673      2.24  |   Q    V|         |         |         |
  0+35       0.0857      2.67  |    Q    |  V      |         |         |
  0+40       0.1080      3.23  |     Q   |     V   |         |         |
  0+45       0.1405      4.72  |        Q|         V         |         |
  0+50       0.2175     11.18  |         |         | Q       |V        |
  0+55       0.2605      6.24  |         |  Q      |         |      V  |
  1+ 0       0.2739      1.95  |  Q      |         |         |        V|
  1+ 5       0.2777      0.54  |Q        |         |         |        V|
----------------------------------------------------------------------
```

```
      U n i t   H y d r o g r a p h   A n a l y s i s

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             Study date  07/23/19 File: DMAB10PROP310.out


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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978


Program License Serial Number 6388

---------------------------------------------------------------------
 English (in-lb) Input Units Used
 English Rainfall Data (Inches) Input Values Used

 English Units used in output format



---------------------------------------------------------------------
KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
PROPOSED CONDITION, DMA B
10-YR 3-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019
--------------------------------------------------------------------
Drainage Area =       5.10(Ac.)  =      0.008 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =       5.10(Ac.)  =      0.008 Sq. Mi.
Length along longest watercourse =     461.00(Ft.)
Length along longest watercourse measured to centroid =     391.00(Ft.)
Length along longest watercourse =      0.087 Mi.
Length along longest watercourse measured to centroid =      0.074 Mi.
Difference in elevation =      19.00(Ft.)
Slope along watercourse =    217.6139 Ft./Mi.
Average Manning's 'N' = 0.015
Lag time =    0.019 Hr.
Lag time =     1.14 Min.
25% of lag time =     0.29 Min.
40% of lag time =     0.46 Min.
Unit time =     5.00 Min.
Duration of storm = 3 Hour(s)
User Entered Base Flow =     0.00(CFS)

2 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        5.10           0.87                  4.42

100 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        5.10           2.09                 10.66

STORM EVENT (YEAR) =   10.00
Area Averaged 2-Year Rainfall =    0.866(In)
Area Averaged 100-Year Rainfall =    2.090(In)

Point rain (area averaged) =    1.370(In)
Areal adjustment factor =  100.00 %
Adjusted average point rain =    1.370(In)

Sub-Area Data:
Area(Ac.)         Runoff Index   Impervious %
     5.100           56.00         0.690
 Total Area Entered =      5.10(Ac.)


RI    RI   Infil. Rate Impervious   Adj. Infil. Rate  Area%     F
AMC2 AMC-2     (In/Hr)    (Dec.%)      (In/Hr)      (Dec.)    (In/Hr)
56.0  56.0      0.511     0.690        0.194       1.000      0.194
                                                 Sum (F) =   0.194
Area averaged mean soil loss (F) (In/Hr) =  0.194
Minimum soil loss rate ((In/Hr)) =  0.097
```

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.350

U n i t   H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %		Unit Hydrograph (CFS)
1	0.083	437.165	67.483		3.469
2	0.167	874.329	32.517		1.671
			Sum = 100.000	Sum=	5.140

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Low	Effective (In/Hr)
1	0.08	1.30	0.214	(0.194)	0.075	0.139
2	0.17	1.30	0.214	(0.194)	0.075	0.139
3	0.25	1.10	0.181	(0.194)	0.063	0.118
4	0.33	1.50	0.247	(0.194)	0.086	0.160
5	0.42	1.50	0.247	(0.194)	0.086	0.160
6	0.50	1.80	0.296	(0.194)	0.104	0.192
7	0.58	1.50	0.247	(0.194)	0.086	0.160
8	0.67	1.80	0.296	(0.194)	0.104	0.192
9	0.75	1.80	0.296	(0.194)	0.104	0.192
10	0.83	1.50	0.247	(0.194)	0.086	0.160
11	0.92	1.60	0.263	(0.194)	0.092	0.171
12	1.00	1.80	0.296	(0.194)	0.104	0.192
13	1.08	2.20	0.362	(0.194)	0.127	0.235
14	1.17	2.20	0.362	(0.194)	0.127	0.235
15	1.25	2.20	0.362	(0.194)	0.127	0.235
16	1.33	2.00	0.329	(0.194)	0.115	0.214
17	1.42	2.60	0.427	(0.194)	0.150	0.278
18	1.50	2.70	0.444	(0.194)	0.155	0.288
19	1.58	2.40	0.394	(0.194)	0.138	0.256
20	1.67	2.70	0.444	(0.194)	0.155	0.288
21	1.75	3.30	0.542	(0.194)	0.190	0.353
22	1.83	3.10	0.509	(0.194)	0.178	0.331
23	1.92	2.90	0.477	(0.194)	0.167	0.310
24	2.00	3.00	0.493	(0.194)	0.173	0.320
25	2.08	3.10	0.509	(0.194)	0.178	0.331
26	2.17	4.20	0.690	0.194	(0.242)	0.497
27	2.25	5.00	0.822	0.194	(0.288)	0.628
28	2.33	3.50	0.575	0.194	(0.201)	0.382
29	2.42	6.80	1.118	0.194	(0.391)	0.924
30	2.50	7.30	1.200	0.194	(0.420)	1.006
31	2.58	8.20	1.348	0.194	(0.472)	1.154
32	2.67	5.90	0.970	0.194	(0.339)	0.776
33	2.75	2.00	0.329	(0.194)	0.115	0.214
34	2.83	1.80	0.296	(0.194)	0.104	0.192
35	2.92	1.80	0.296	(0.194)	0.104	0.192
36	3.00	0.60	0.099	(0.194)	0.035	0.064

(Loss Rate Not Used)

Sum = 100.0 Sum = 11.7

Flood volume = Effective rainfall 0.97(In)
times area 5.1(Ac.)/[(In)/(Ft.)] = 0.4(Ac.Ft)
Total soil loss = 0.40(In)
Total soil loss = 0.168(Ac.Ft)
Total rainfall = 1.37(In)
Flood volume = 18019.0 Cubic Feet
Total soil loss = 7335.2 Cubic Feet

Peak flow rate of this hydrograph = 5.687(CFS)

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3 - H O U R   S T O R M
R u n o f f   H y d r o g r a p h

Hydrograph in 5 Minute intervals ((CFS))

Time(h+m) Volume Ac.Ft Q(CFS) 0 2.5 5.0 7.5 10.0

```
  ----------------------------------------------------------------------
   0+ 5       0.0033      0.48  VQ        |         |         |         |
   0+10       0.0082      0.71  V Q       |         |         |         |
   0+15       0.0126      0.64  |VQ       |         |         |         |
   0+20       0.0178      0.75  |V Q      |         |         |         |
   0+25       0.0235      0.82  | VQ      |         |         |         |
   0+30       0.0299      0.94  | VQ      |         |         |         |
   0+35       0.0360      0.88  |  Q      |         |         |         |
   0+40       0.0424      0.94  |  QV     |         |         |         |
   0+45       0.0492      0.99  |  QV     |         |         |         |
   0+50       0.0553      0.88  |  Q V    |         |         |         |
   0+55       0.0612      0.86  |  Q V    |         |         |         |
   1+ 0       0.0678      0.95  |  Q  V   |         |         |         |
   1+ 5       0.0756      1.14  |   Q  V  |         |         |         |
   1+10       0.0839      1.21  |   Q   V |         |         |         |
   1+15       0.0923      1.21  |   Q   V |         |         |         |
   1+20       0.1001      1.13  |   Q    V|         |         |         |
   1+25       0.1092      1.32  |    Q    V         |         |         |
   1+30       0.1193      1.47  |    Q    |V        |         |         |
   1+35       0.1287      1.37  |    Q    | V       |         |         |
   1+40       0.1386      1.43  |    Q    |  V      |         |         |
   1+45       0.1503      1.71  |     Q   |   V     |         |         |
   1+50       0.1623      1.74  |     Q   |    V    |         |         |
   1+55       0.1735      1.63  |     Q   |     V   |         |         |
   2+ 0       0.1847      1.63  |     Q   |      V  |         |         |
   2+ 5       0.1963      1.69  |     Q   |       V |         |         |
   2+10       0.2120      2.28  |        Q|         V         |         |
   2+15       0.2327      3.01  |         | Q       | V       |         |
   2+20       0.2491      2.37  |        Q|         |   V     |         |
   2+25       0.2756      3.84  |         |    Q    |     V   |         |
   2+30       0.3103      5.04  |         |         Q         V         |
   2+35       0.3494      5.69  |         |         | Q       |  V      |
   2+40       0.3813      4.62  |         |       Q |         |     V   |
   2+45       0.3953      2.04  |       Q |         |         |       V |
   2+50       0.4024      1.02  |   Q     |         |         |       V |
   2+55       0.4092      0.99  |  Q      |         |         |        V|
   3+ 0       0.4129      0.54  | Q       |         |         |        V|
   3+ 5       0.4137      0.11  Q         |         |         |         V
----------------------------------------------------------------------
```

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      U n i t   H y d r o g r a p h   A n a l y s i s

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              Study date  07/23/19 File: DMAB10PROP610.out

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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978


Program License Serial Number 6388

---------------------------------------------------------------------
 English (in-lb) Input Units Used
 English Rainfall Data (Inches) Input Values Used

 English Units used in output format



---------------------------------------------------------------------
KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
PROPOSED CONDITION, DMA B
10-YR 6-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019
--------------------------------------------------------------------
Drainage Area =       5.10(Ac.)  =      0.008 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =       5.10(Ac.)  =      0.008 Sq. Mi.
Length along longest watercourse =     461.00(Ft.)
Length along longest watercourse measured to centroid =     391.00(Ft.)
Length along longest watercourse =      0.087 Mi.
Length along longest watercourse measured to centroid =      0.074 Mi.
Difference in elevation =      19.00(Ft.)
Slope along watercourse =    217.6139 Ft./Mi.
Average Manning's 'N' = 0.015
Lag time =    0.019 Hr.
Lag time =     1.14 Min.
25% of lag time =     0.29 Min.
40% of lag time =     0.46 Min.
Unit time =     5.00 Min.
Duration of storm = 6 Hour(s)
User Entered Base Flow =     0.00(CFS)

2 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        5.10           1.21                  6.17

100 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        5.10           2.86                 14.59

STORM EVENT (YEAR) =   10.00
Area Averaged 2-Year Rainfall =    1.210(In)
Area Averaged 100-Year Rainfall =    2.860(In)

Point rain (area averaged) =    1.889(In)
Areal adjustment factor =  100.00 %
Adjusted average point rain =    1.889(In)

Sub-Area Data:
Area(Ac.)         Runoff Index   Impervious %
     5.100           56.00         0.690
 Total Area Entered =      5.10(Ac.)


RI    RI   Infil. Rate Impervious   Adj. Infil. Rate  Area%     F
AMC2 AMC-2     (In/Hr)    (Dec.%)      (In/Hr)      (Dec.)    (In/Hr)
56.0  56.0      0.511     0.690        0.194       1.000      0.194
                                                  Sum (F) =   0.194
Area averaged mean soil loss (F) (In/Hr) =  0.194
Minimum soil loss rate ((In/Hr)) =  0.097
```

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.350

U n i t   H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.083	437.165	67.483	3.469
2	0.167	874.329	32.517	1.671
			Sum = 100.000	Sum= 5.140

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Low	Effective (In/Hr)
1	0.08	0.50	0.113	(0.194)	0.040	0.074
2	0.17	0.60	0.136	(0.194)	0.048	0.088
3	0.25	0.60	0.136	(0.194)	0.048	0.088
4	0.33	0.60	0.136	(0.194)	0.048	0.088
5	0.42	0.60	0.136	(0.194)	0.048	0.088
6	0.50	0.70	0.159	(0.194)	0.056	0.103
7	0.58	0.70	0.159	(0.194)	0.056	0.103
8	0.67	0.70	0.159	(0.194)	0.056	0.103
9	0.75	0.70	0.159	(0.194)	0.056	0.103
10	0.83	0.70	0.159	(0.194)	0.056	0.103
11	0.92	0.70	0.159	(0.194)	0.056	0.103
12	1.00	0.80	0.181	(0.194)	0.063	0.118
13	1.08	0.80	0.181	(0.194)	0.063	0.118
14	1.17	0.80	0.181	(0.194)	0.063	0.118
15	1.25	0.80	0.181	(0.194)	0.063	0.118
16	1.33	0.80	0.181	(0.194)	0.063	0.118
17	1.42	0.80	0.181	(0.194)	0.063	0.118
18	1.50	0.80	0.181	(0.194)	0.063	0.118
19	1.58	0.80	0.181	(0.194)	0.063	0.118
20	1.67	0.80	0.181	(0.194)	0.063	0.118
21	1.75	0.80	0.181	(0.194)	0.063	0.118
22	1.83	0.80	0.181	(0.194)	0.063	0.118
23	1.92	0.80	0.181	(0.194)	0.063	0.118
24	2.00	0.90	0.204	(0.194)	0.071	0.133
25	2.08	0.80	0.181	(0.194)	0.063	0.118
26	2.17	0.90	0.204	(0.194)	0.071	0.133
27	2.25	0.90	0.204	(0.194)	0.071	0.133
28	2.33	0.90	0.204	(0.194)	0.071	0.133
29	2.42	0.90	0.204	(0.194)	0.071	0.133
30	2.50	0.90	0.204	(0.194)	0.071	0.133
31	2.58	0.90	0.204	(0.194)	0.071	0.133
32	2.67	0.90	0.204	(0.194)	0.071	0.133
33	2.75	1.00	0.227	(0.194)	0.079	0.147
34	2.83	1.00	0.227	(0.194)	0.079	0.147
35	2.92	1.00	0.227	(0.194)	0.079	0.147
36	3.00	1.00	0.227	(0.194)	0.079	0.147
37	3.08	1.00	0.227	(0.194)	0.079	0.147
38	3.17	1.10	0.249	(0.194)	0.087	0.162
39	3.25	1.10	0.249	(0.194)	0.087	0.162
40	3.33	1.10	0.249	(0.194)	0.087	0.162
41	3.42	1.20	0.272	(0.194)	0.095	0.177
42	3.50	1.30	0.295	(0.194)	0.103	0.192
43	3.58	1.40	0.317	(0.194)	0.111	0.206
44	3.67	1.40	0.317	(0.194)	0.111	0.206
45	3.75	1.50	0.340	(0.194)	0.119	0.221
46	3.83	1.50	0.340	(0.194)	0.119	0.221
47	3.92	1.60	0.363	(0.194)	0.127	0.236
48	4.00	1.60	0.363	(0.194)	0.127	0.236
49	4.08	1.70	0.385	(0.194)	0.135	0.250
50	4.17	1.80	0.408	(0.194)	0.143	0.265
51	4.25	1.90	0.431	(0.194)	0.151	0.280
52	4.33	2.00	0.453	(0.194)	0.159	0.295
53	4.42	2.10	0.476	(0.194)	0.167	0.309
54	4.50	2.10	0.476	(0.194)	0.167	0.309
55	4.58	2.20	0.499	(0.194)	0.175	0.324
56	4.67	2.30	0.521	(0.194)	0.182	0.339

```
57   4.75     2.40      0.544       (  0.194)       0.190        0.354
58   4.83     2.40      0.544       (  0.194)       0.190        0.354
59   4.92     2.50      0.567          0.194    (  0.198)        0.373
60   5.00     2.60      0.589          0.194    (  0.206)        0.396
61   5.08     3.10      0.703          0.194    (  0.246)        0.509
62   5.17     3.60      0.816          0.194    (  0.286)        0.622
63   5.25     3.90      0.884          0.194    (  0.309)        0.690
64   5.33     4.20      0.952          0.194    (  0.333)        0.758
65   5.42     4.70      1.065          0.194    (  0.373)        0.872
66   5.50     5.60      1.269          0.194    (  0.444)        1.076
67   5.58     1.90      0.431       (  0.194)       0.151        0.280
68   5.67     0.90      0.204       (  0.194)       0.071        0.133
69   5.75     0.60      0.136       (  0.194)       0.048        0.088
70   5.83     0.50      0.113       (  0.194)       0.040        0.074
71   5.92     0.30      0.068       (  0.194)       0.024        0.044
72   6.00     0.20      0.045       (  0.194)       0.016        0.029
              (Loss Rate Not Used)
   Sum =     100.0                                 Sum =    15.6
     Flood volume = Effective rainfall      1.30(In)
      times area       5.1(Ac.)/[(In)/(Ft.)] =       0.6(Ac.Ft)
     Total soil loss =      0.59(In)
     Total soil loss =     0.251(Ac.Ft)
     Total rainfall =      1.89(In)
     Flood volume =       24035.4 Cubic Feet
     Total soil loss =       10931.8 Cubic Feet
     --------------------------------------------------------------------
      Peak flow rate of this hydrograph =      5.191(CFS)
     --------------------------------------------------------------------
     ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                         6 - H O U R   S T O R M
                    R u n o f f     H y d r o g r a p h
     --------------------------------------------------------------------
                 Hydrograph in   5   Minute intervals ((CFS))

     --------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0        2.5       5.0       7.5      10.0
-----------------------------------------------------------------------
  0+ 5       0.0018      0.26  VQ        |         |         |         |
  0+10       0.0047      0.43  VQ        |         |         |         |
  0+15       0.0079      0.45  VQ        |         |         |         |
  0+20       0.0110      0.45  VQ        |         |         |         |
  0+25       0.0141      0.45  |Q        |         |         |         |
  0+30       0.0176      0.51  |VQ       |         |         |         |
  0+35       0.0212      0.53  |VQ       |         |         |         |
  0+40       0.0249      0.53  |VQ       |         |         |         |
  0+45       0.0286      0.53  | Q       |         |         |         |
  0+50       0.0322      0.53  | Q       |         |         |         |
  0+55       0.0359      0.53  | Q       |         |         |         |
  1+ 0       0.0399      0.58  | Q       |         |         |         |
  1+ 5       0.0440      0.61  | QV      |         |         |         |
  1+10       0.0482      0.61  | QV      |         |         |         |
  1+15       0.0524      0.61  | QV      |         |         |         |
  1+20       0.0566      0.61  | Q V     |         |         |         |
  1+25       0.0607      0.61  | Q V     |         |         |         |
  1+30       0.0649      0.61  | Q V     |         |         |         |
  1+35       0.0691      0.61  | Q  V    |         |         |         |
  1+40       0.0733      0.61  | Q  V    |         |         |         |
  1+45       0.0774      0.61  | Q  V    |         |         |         |
  1+50       0.0816      0.61  | Q  V    |         |         |         |
  1+55       0.0858      0.61  | Q   V   |         |         |         |
  2+ 0       0.0903      0.66  | Q   V   |         |         |         |
  2+ 5       0.0946      0.63  | Q   V   |         |         |         |
  2+10       0.0992      0.66  | Q    V  |         |         |         |
  2+15       0.1039      0.68  | Q    V  |         |         |         |
  2+20       0.1086      0.68  | Q    V  |         |         |         |
  2+25       0.1133      0.68  | Q     V |         |         |         |
  2+30       0.1180      0.68  | Q     V |         |         |         |
  2+35       0.1227      0.68  | Q     V |         |         |         |
  2+40       0.1274      0.68  | Q      V|         |         |         |
  2+45       0.1324      0.73  | Q      V|         |         |         |
  2+50       0.1376      0.76  |  Q     V|         |         |         |
  2+55       0.1428      0.76  |  Q      V         |         |         |
  3+ 0       0.1481      0.76  |  Q      V         |         |         |
  3+ 5       0.1533      0.76  |  Q      |V        |         |         |
  3+10       0.1588      0.81  |  Q      |V        |         |         |
  3+15       0.1646      0.83  |  Q      |V        |         |         |
  3+20       0.1703      0.83  |  Q      | V       |         |         |
  3+25       0.1764      0.88  |  Q      | V       |         |         |
  3+30       0.1830      0.96  |  Q      |  V      |         |         |
```

```
    3+35       0.1902      1.04  |   Q     |  V      |         |         |
    3+40       0.1975      1.06  |   Q     |   V     |         |         |
    3+45       0.2051      1.11  |   Q     |   V     |         |         |
    3+50       0.2129      1.14  |   Q     |    V    |         |         |
    3+55       0.2211      1.19  |   Q     |     V   |         |         |
    4+ 0       0.2295      1.21  |   Q     |     V   |         |         |
    4+ 5       0.2382      1.26  |    Q    |      V  |         |         |
    4+10       0.2474      1.34  |    Q    |      V  |         |         |
    4+15       0.2571      1.41  |    Q    |       V |         |         |
    4+20       0.2674      1.49  |    Q    |        V|         |         |
    4+25       0.2782      1.57  |     Q   |         V         |         |
    4+30       0.2892      1.59  |     Q   |         V         |         |
    4+35       0.3005      1.64  |     Q   |         |V        |         |
    4+40       0.3123      1.72  |     Q   |         | V       |         |
    4+45       0.3246      1.79  |      Q  |         |  V      |         |
    4+50       0.3372      1.82  |      Q  |         |   V     |         |
    4+55       0.3502      1.89  |      Q  |         |    V    |         |
    5+ 0       0.3639      2.00  |      Q  |         |     V   |         |
    5+ 5       0.3806      2.43  |        Q|         |      V  |         |
    5+10       0.4014      3.01  |         | Q       |        V|         |
    5+15       0.4250      3.44  |         |  Q      |         V         |
    5+20       0.4511      3.79  |         |    Q    |         | V       |
    5+25       0.4807      4.29  |         |      Q  |         |   V     |
    5+30       0.5164      5.19  |         |         Q         |      V  |
    5+35       0.5355      2.77  |         |Q        |         |       V |
    5+40       0.5419      0.93  |  Q      |         |         |        V|
    5+45       0.5455      0.53  | Q       |         |         |        V|
    5+50       0.5483      0.40  |Q        |         |         |        V|
    5+55       0.5502      0.28  |Q        |         |         |        V|
    6+ 0       0.5514      0.18  Q         |         |         |        V|
    6+ 5       0.5518      0.05  Q         |         |         |         V
-----------------------------------------------------------------------
```

```
      U n i t   H y d r o g r a p h   A n a l y s i s

      Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2014, Version 9.0
             Study date  07/23/19 File: DMAB10PROP2410.out

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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978


Program License Serial Number 6388

---------------------------------------------------------------------
 English (in-lb) Input Units Used
 English Rainfall Data (Inches) Input Values Used

 English Units used in output format



---------------------------------------------------------------------
KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
PROPOSED CONDITION, DMA B
10-YR 24-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019
--------------------------------------------------------------------
Drainage Area =       5.10(Ac.)  =      0.008 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =       5.10(Ac.)  =      0.008 Sq. Mi.
Length along longest watercourse =     461.00(Ft.)
Length along longest watercourse measured to centroid =     391.00(Ft.)
Length along longest watercourse =      0.087 Mi.
Length along longest watercourse measured to centroid =      0.074 Mi.
Difference in elevation =      19.00(Ft.)
Slope along watercourse =    217.6139 Ft./Mi.
Average Manning's 'N' = 0.015
Lag time =    0.019 Hr.
Lag time =     1.14 Min.
25% of lag time =     0.29 Min.
40% of lag time =     0.46 Min.
Unit time =    15.00 Min.
Duration of storm = 24 Hour(s)
User Entered Base Flow =     0.00(CFS)

2 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        5.10           2.05                 10.45

100 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        5.10           5.16                 26.32

STORM EVENT (YEAR) =   10.00
Area Averaged 2-Year Rainfall =    2.050(In)
Area Averaged 100-Year Rainfall =    5.160(In)

Point rain (area averaged) =    3.329(In)
Areal adjustment factor =  100.00 %
Adjusted average point rain =    3.329(In)

Sub-Area Data:
Area(Ac.)         Runoff Index   Impervious %
     5.100           56.00         0.690
 Total Area Entered =      5.10(Ac.)


RI    RI   Infil. Rate Impervious   Adj. Infil. Rate  Area%     F
AMC2 AMC-2     (In/Hr)    (Dec.%)      (In/Hr)      (Dec.)    (In/Hr)
56.0  56.0      0.511     0.690        0.194        1.000      0.194
                                                  Sum (F) =   0.194
Area averaged mean soil loss (F) (In/Hr) =  0.194
Minimum soil loss rate ((In/Hr)) =  0.097
```

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.350

U n i t H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.250	1311.494	100.000	5.140
			Sum = 100.000	Sum= 5.140

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Low	Effective (In/Hr)
1	0.25	0.20	0.027	(0.342)	0.009	0.017
2	0.50	0.30	0.040	(0.338)	0.014	0.026
3	0.75	0.30	0.040	(0.334)	0.014	0.026
4	1.00	0.40	0.053	(0.330)	0.019	0.035
5	1.25	0.30	0.040	(0.326)	0.014	0.026
6	1.50	0.30	0.040	(0.322)	0.014	0.026
7	1.75	0.30	0.040	(0.318)	0.014	0.026
8	2.00	0.40	0.053	(0.315)	0.019	0.035
9	2.25	0.40	0.053	(0.311)	0.019	0.035
10	2.50	0.40	0.053	(0.307)	0.019	0.035
11	2.75	0.50	0.067	(0.303)	0.023	0.043
12	3.00	0.50	0.067	(0.300)	0.023	0.043
13	3.25	0.50	0.067	(0.296)	0.023	0.043
14	3.50	0.50	0.067	(0.292)	0.023	0.043
15	3.75	0.50	0.067	(0.288)	0.023	0.043
16	4.00	0.60	0.080	(0.285)	0.028	0.052
17	4.25	0.60	0.080	(0.281)	0.028	0.052
18	4.50	0.70	0.093	(0.278)	0.033	0.061
19	4.75	0.70	0.093	(0.274)	0.033	0.061
20	5.00	0.80	0.107	(0.271)	0.037	0.069
21	5.25	0.60	0.080	(0.267)	0.028	0.052
22	5.50	0.70	0.093	(0.264)	0.033	0.061
23	5.75	0.80	0.107	(0.260)	0.037	0.069
24	6.00	0.80	0.107	(0.257)	0.037	0.069
25	6.25	0.90	0.120	(0.253)	0.042	0.078
26	6.50	0.90	0.120	(0.250)	0.042	0.078
27	6.75	1.00	0.133	(0.247)	0.047	0.087
28	7.00	1.00	0.133	(0.243)	0.047	0.087
29	7.25	1.00	0.133	(0.240)	0.047	0.087
30	7.50	1.10	0.146	(0.237)	0.051	0.095
31	7.75	1.20	0.160	(0.233)	0.056	0.104
32	8.00	1.30	0.173	(0.230)	0.061	0.113
33	8.25	1.50	0.200	(0.227)	0.070	0.130
34	8.50	1.50	0.200	(0.224)	0.070	0.130
35	8.75	1.60	0.213	(0.221)	0.075	0.139
36	9.00	1.70	0.226	(0.218)	0.079	0.147
37	9.25	1.90	0.253	(0.214)	0.089	0.164
38	9.50	2.00	0.266	(0.211)	0.093	0.173
39	9.75	2.10	0.280	(0.208)	0.098	0.182
40	10.00	2.20	0.293	(0.205)	0.103	0.190
41	10.25	1.50	0.200	(0.202)	0.070	0.130
42	10.50	1.50	0.200	(0.200)	0.070	0.130
43	10.75	2.00	0.266	(0.197)	0.093	0.173
44	11.00	2.00	0.266	(0.194)	0.093	0.173
45	11.25	1.90	0.253	(0.191)	0.089	0.164
46	11.50	1.90	0.253	(0.188)	0.089	0.164
47	11.75	1.70	0.226	(0.185)	0.079	0.147
48	12.00	1.80	0.240	(0.183)	0.084	0.156
49	12.25	2.50	0.333	(0.180)	0.117	0.216
50	12.50	2.60	0.346	(0.177)	0.121	0.225
51	12.75	2.80	0.373	(0.174)	0.131	0.242
52	13.00	2.90	0.386	(0.172)	0.135	0.251
53	13.25	3.40	0.453	(0.169)	0.158	0.294
54	13.50	3.40	0.453	(0.167)	0.158	0.294
55	13.75	2.30	0.306	(0.164)	0.107	0.199
56	14.00	2.30	0.306	(0.162)	0.107	0.199
57	14.25	2.70	0.360	(0.159)	0.126	0.234

58	14.50	2.60	0.346	(0.157)	0.121	0.225
59	14.75	2.60	0.346	(0.154)	0.121	0.225
60	15.00	2.50	0.333	(0.152)	0.117	0.216
61	15.25	2.40	0.320	(0.150)	0.112	0.208
62	15.50	2.30	0.306	(0.147)	0.107	0.199
63	15.75	1.90	0.253	(0.145)	0.089	0.164
64	16.00	1.90	0.253	(0.143)	0.089	0.164
65	16.25	0.40	0.053	(0.141)	0.019	0.035
66	16.50	0.40	0.053	(0.139)	0.019	0.035
67	16.75	0.30	0.040	(0.136)	0.014	0.026
68	17.00	0.30	0.040	(0.134)	0.014	0.026
69	17.25	0.50	0.067	(0.132)	0.023	0.043
70	17.50	0.50	0.067	(0.130)	0.023	0.043
71	17.75	0.50	0.067	(0.128)	0.023	0.043
72	18.00	0.40	0.053	(0.127)	0.019	0.035
73	18.25	0.40	0.053	(0.125)	0.019	0.035
74	18.50	0.40	0.053	(0.123)	0.019	0.035
75	18.75	0.30	0.040	(0.121)	0.014	0.026
76	19.00	0.20	0.027	(0.119)	0.009	0.017
77	19.25	0.30	0.040	(0.118)	0.014	0.026
78	19.50	0.40	0.053	(0.116)	0.019	0.035
79	19.75	0.30	0.040	(0.114)	0.014	0.026
80	20.00	0.20	0.027	(0.113)	0.009	0.017
81	20.25	0.30	0.040	(0.111)	0.014	0.026
82	20.50	0.30	0.040	(0.110)	0.014	0.026
83	20.75	0.30	0.040	(0.109)	0.014	0.026
84	21.00	0.20	0.027	(0.107)	0.009	0.017
85	21.25	0.30	0.040	(0.106)	0.014	0.026
86	21.50	0.20	0.027	(0.105)	0.009	0.017
87	21.75	0.30	0.040	(0.104)	0.014	0.026
88	22.00	0.20	0.027	(0.103)	0.009	0.017
89	22.25	0.30	0.040	(0.102)	0.014	0.026
90	22.50	0.20	0.027	(0.101)	0.009	0.017
91	22.75	0.20	0.027	(0.100)	0.009	0.017
92	23.00	0.20	0.027	(0.099)	0.009	0.017
93	23.25	0.20	0.027	(0.098)	0.009	0.017
94	23.50	0.20	0.027	(0.098)	0.009	0.017
95	23.75	0.20	0.027	(0.097)	0.009	0.017
96	24.00	0.20	0.027	(0.097)	0.009	0.017

```
            (Loss Rate Not Used)
   Sum =     100.0                             Sum =     8.7
     Flood volume = Effective rainfall      2.16(In)
      times area       5.1(Ac.)/[(In)/(Ft.)] =       0.9(Ac.Ft)
     Total soil loss =      1.17(In)
     Total soil loss =     0.495(Ac.Ft)
     Total rainfall =      3.33(In)
     Flood volume =      40064.7 Cubic Feet
     Total soil loss =       21573.3 Cubic Feet
     --------------------------------------------------------------------
      Peak flow rate of this hydrograph =      1.514(CFS)
     --------------------------------------------------------------------
     ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                         24 - H O U R   S T O R M
                    R u n o f f     H y d r o g r a p h
     --------------------------------------------------------------------
                Hydrograph in  15   Minute intervals ((CFS))

     --------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0        2.5       5.0       7.5      10.0
-----------------------------------------------------------------------
  0+15       0.0018      0.09  Q          |         |         |         |
  0+30       0.0046      0.13  Q          |         |         |         |
  0+45       0.0074      0.13  Q          |         |         |         |
  1+ 0       0.0110      0.18  Q          |         |         |         |
  1+15       0.0138      0.13  Q          |         |         |         |
  1+30       0.0166      0.13  Q          |         |         |         |
  1+45       0.0193      0.13  Q          |         |         |         |
  2+ 0       0.0230      0.18  QV         |         |         |         |
  2+15       0.0267      0.18  QV         |         |         |         |
  2+30       0.0304      0.18  QV         |         |         |         |
  2+45       0.0350      0.22  QV         |         |         |         |
  3+ 0       0.0395      0.22  QV         |         |         |         |
  3+15       0.0441      0.22  QV         |         |         |         |
  3+30       0.0487      0.22  Q V        |         |         |         |
  3+45       0.0533      0.22  Q V        |         |         |         |
  4+ 0       0.0589      0.27  |QV        |         |         |         |
  4+15       0.0644      0.27  |QV        |         |         |         |
  4+30       0.0708      0.31  |Q V       |         |         |         |
  4+45       0.0773      0.31  |Q V       |         |         |         |
```

```
    5+ 0       0.0846      0.36  |Q V      |         |         |         |
    5+15       0.0901      0.27  |Q V      |         |         |         |
    5+30       0.0966      0.31  |Q  V     |         |         |         |
    5+45       0.1039      0.36  |Q  V     |         |         |         |
    6+ 0       0.1113      0.36  |Q  V     |         |         |         |
    6+15       0.1196      0.40  |Q   V    |         |         |         |
    6+30       0.1278      0.40  |Q   V    |         |         |         |
    6+45       0.1370      0.45  |Q   V    |         |         |         |
    7+ 0       0.1462      0.45  |Q    V   |         |         |         |
    7+15       0.1554      0.45  |Q    V   |         |         |         |
    7+30       0.1656      0.49  |Q     V  |         |         |         |
    7+45       0.1766      0.53  | Q    V  |         |         |         |
    8+ 0       0.1886      0.58  | Q     V |         |         |         |
    8+15       0.2023      0.67  | Q     V |         |         |         |
    8+30       0.2161      0.67  | Q      V|         |         |         |
    8+45       0.2309      0.71  | Q       V         |         |         |
    9+ 0       0.2465      0.76  |  Q      V         |         |         |
    9+15       0.2640      0.85  |  Q       V        |         |         |
    9+30       0.2824      0.89  |  Q      | V       |         |         |
    9+45       0.3017      0.93  |  Q      |  V      |         |         |
   10+ 0       0.3219      0.98  |  Q      |   V     |         |         |
   10+15       0.3357      0.67  | Q       |   V     |         |         |
   10+30       0.3495      0.67  | Q       |    V    |         |         |
   10+45       0.3679      0.89  |  Q      |     V   |         |         |
   11+ 0       0.3863      0.89  |  Q      |     V   |         |         |
   11+15       0.4038      0.85  |  Q      |      V  |         |         |
   11+30       0.4212      0.85  |  Q      |       V |         |         |
   11+45       0.4369      0.76  |  Q      |        V|         |         |
   12+ 0       0.4534      0.80  |  Q      |        V|         |         |
   12+15       0.4764      1.11  |   Q     |         V         |         |
   12+30       0.5003      1.16  |   Q     |         |V        |         |
   12+45       0.5261      1.25  |   Q     |         | V       |         |
   13+ 0       0.5528      1.29  |    Q    |         |   V     |         |
   13+15       0.5840      1.51  |     Q   |         |    V    |         |
   13+30       0.6153      1.51  |     Q   |         |     V   |         |
   13+45       0.6365      1.02  |   Q     |         |      V  |         |
   14+ 0       0.6576      1.02  |   Q     |         |       V |         |
   14+15       0.6825      1.20  |   Q     |         |        V|         |
   14+30       0.7064      1.16  |   Q     |         |         V         |
   14+45       0.7303      1.16  |   Q     |         |         |V        |
   15+ 0       0.7533      1.11  |   Q     |         |         | V       |
   15+15       0.7754      1.07  |   Q     |         |         |  V      |
   15+30       0.7965      1.02  |   Q     |         |         |   V     |
   15+45       0.8140      0.85  |  Q      |         |         |    V    |
   16+ 0       0.8315      0.85  |  Q      |         |         |     V   |
   16+15       0.8351      0.18  Q         |         |         |     V   |
   16+30       0.8388      0.18  Q         |         |         |     V   |
   16+45       0.8416      0.13  Q         |         |         |     V   |
   17+ 0       0.8443      0.13  Q         |         |         |     V   |
   17+15       0.8489      0.22  Q         |         |         |     V   |
   17+30       0.8535      0.22  Q         |         |         |      V  |
   17+45       0.8581      0.22  Q         |         |         |      V  |
   18+ 0       0.8618      0.18  Q         |         |         |      V  |
   18+15       0.8655      0.18  Q         |         |         |      V  |
   18+30       0.8692      0.18  Q         |         |         |      V  |
   18+45       0.8719      0.13  Q         |         |         |      V  |
   19+ 0       0.8738      0.09  Q         |         |         |       V |
   19+15       0.8765      0.13  Q         |         |         |       V |
   19+30       0.8802      0.18  Q         |         |         |       V |
   19+45       0.8830      0.13  Q         |         |         |       V |
   20+ 0       0.8848      0.09  Q         |         |         |       V |
   20+15       0.8876      0.13  Q         |         |         |       V |
   20+30       0.8903      0.13  Q         |         |         |       V |
   20+45       0.8931      0.13  Q         |         |         |       V |
   21+ 0       0.8949      0.09  Q         |         |         |       V |
   21+15       0.8977      0.13  Q         |         |         |        V|
   21+30       0.8995      0.09  Q         |         |         |        V|
   21+45       0.9023      0.13  Q         |         |         |        V|
   22+ 0       0.9041      0.09  Q         |         |         |        V|
   22+15       0.9069      0.13  Q         |         |         |        V|
   22+30       0.9087      0.09  Q         |         |         |        V|
   22+45       0.9106      0.09  Q         |         |         |        V|
   23+ 0       0.9124      0.09  Q         |         |         |        V|
   23+15       0.9142      0.09  Q         |         |         |        V|
   23+30       0.9161      0.09  Q         |         |         |        V|
   23+45       0.9179      0.09  Q         |         |         |        V|
   24+ 0       0.9198      0.09  Q         |         |         |         V
----------------------------------------------------------------------
```

U n i t   H y d r o g r a p h   A n a l y s i s

Study date 07/22/19 File: DMAB100EXIST1100.out

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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978

Program License Serial Number 6388

English (in-lb) Input Units Used
English Rainfall Data (Inches) Input Values Used

English Units used in output format

KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
EXISTING CONDITION
100-YR 1-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019

Drainage Area =   5.10(Ac.) =   0.008 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =   5.10(Ac.) =   0.008 Sq. Mi.
Length along longest watercourse =   461.00(Ft.)
Length along longest watercourse measured to centroid =   391.00(Ft.)
Length along longest watercourse =   0.087 Mi.
Length along longest watercourse measured to centroid =   0.074 Mi.
Difference in elevation =   19.00(Ft.)
Slope along watercourse =   217.6139 Ft./Mi.
Average Manning's 'N' = 0.020
Lag time =   0.025 Hr.
Lag time =   1.52 Min.
25% of lag time =   0.38 Min.
40% of lag time =   0.61 Min.
Unit time =   5.00 Min.
Duration of storm = 1 Hour(s)
User Entered Base Flow =   0.00(CFS)

2 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	Weighting[1*2]
5.10	0.49	2.49

100 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	Weighting[1*2]
5.10	1.33	6.78

STORM EVENT (YEAR) = 100.00
Area Averaged 2-Year Rainfall =   0.489(In)
Area Averaged 100-Year Rainfall =   1.330(In)

Point rain (area averaged) =   1.330(In)
Areal adjustment factor = 100.00 %
Adjusted average point rain =   1.330(In)

Sub-Area Data:

Area(Ac.)	Runoff Index	Impervious %
5.100	56.00	0.500

Total Area Entered =   5.10(Ac.)

RI AMC2	RI AMC-2	Infil. Rate (In/Hr)	Impervious (Dec.%)	Adj. Infil. Rate (In/Hr)	Area% (Dec.)	F (In/Hr)
56.0	56.0	0.511	0.500	0.281	1.000	0.281
					Sum (F) =	0.281

Area averaged mean soil loss (F) (In/Hr) = 0.281
Minimum soil loss rate ((In/Hr)) = 0.140

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.500

Slope of intensity-duration curve for a 1 hour storm =0.5000

U n i t H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.083	327.873	59.371	3.052
2	0.167	655.747	35.647	1.832
3	0.250	983.620	4.982	0.256
			Sum = 100.000	Sum= 5.140

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Low	Effective (In/Hr)
1	0.08	4.20	0.670	0.281	(0.335)	0.389
2	0.17	4.30	0.686	0.281	(0.343)	0.405
3	0.25	5.00	0.798	0.281	(0.399)	0.517
4	0.33	5.00	0.798	0.281	(0.399)	0.517
5	0.42	5.80	0.926	0.281	(0.463)	0.645
6	0.50	6.50	1.037	0.281	(0.519)	0.756
7	0.58	7.40	1.181	0.281	(0.590)	0.900
8	0.67	8.60	1.372	0.281	(0.686)	1.092
9	0.75	12.30	1.963	0.281	(0.981)	1.682
10	0.83	29.10	4.644	0.281	(2.322)	4.363
11	0.92	6.80	1.085	0.281	(0.543)	0.804
12	1.00	5.00	0.798	0.281	(0.399)	0.517
		(Loss Rate Not Used)				
Sum =		100.0			Sum =	12.6

Flood volume = Effective rainfall 1.05(In)
times area 5.1(Ac.)/[(In)/(Ft.)] = 0.4(Ac.Ft)
Total soil loss = 0.28(In)
Total soil loss = 0.119(Ac.Ft)
Total rainfall = 1.33(In)
Flood volume = 19420.1 Cubic Feet
Total soil loss = 5201.0 Cubic Feet

Peak flow rate of this hydrograph = 16.685(CFS)

++

1 - H O U R S T O R M
R u n o f f H y d r o g r a p h

Hydrograph in 5 Minute intervals ((CFS))

```
Time(h+m) Volume Ac.Ft   Q(CFS)  0        5.0      10.0      15.0      20.0
-----------------------------------------------------------------------
  0+ 5      0.0082      1.19  V Q       |         |         |         |
  0+10      0.0216      1.95  |V Q      |         |         |         |
  0+15      0.0383      2.42  |  VQ     |         |         |         |
  0+20      0.0564      2.63  |    Q    |         |         |         |
  0+25      0.0774      3.05  |     Q   |         |         |         |
  0+30      0.1024      3.62  |      Q V|         |         |         |
  0+35      0.1320      4.30  |       Q |V        |         |         |
  0+40      0.1676      5.18  |         Q    V    |         |         |
  0+45      0.2184      7.37  |         |   Q    V|         |         |
  0+50      0.3333     16.68  |         |         |        V|   Q     |
  0+55      0.4082     10.88  |         |         |Q        |     V   |
  1+ 0      0.4370      4.17  |       Q |         |         |        V|
  1+ 5      0.4449      1.15  | Q       |         |         |        V|
  1+10      0.4458      0.13  Q         |         |         |         V
-----------------------------------------------------------------------
```

```
       U n i t   H y d r o g r a p h   A n a l y s i s

       Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2014, Version 9.0
               Study date  07/22/19 File: DMAB100EXIST3100.out


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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978


Program License Serial Number 6388

---------------------------------------------------------------------
 English (in-lb) Input Units Used
 English Rainfall Data (Inches) Input Values Used

 English Units used in output format



---------------------------------------------------------------------
KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
EXISTING CONDITION
100-YR 3-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019
--------------------------------------------------------------------
Drainage Area =       5.10(Ac.)  =      0.008 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =       5.10(Ac.)  =      0.008 Sq. Mi.
Length along longest watercourse =     461.00(Ft.)
Length along longest watercourse measured to centroid =     391.00(Ft.)
Length along longest watercourse =      0.087 Mi.
Length along longest watercourse measured to centroid =      0.074 Mi.
Difference in elevation =      19.00(Ft.)
Slope along watercourse =    217.6139 Ft./Mi.
Average Manning's 'N' = 0.020
Lag time =    0.025 Hr.
Lag time =     1.52 Min.
25% of lag time =     0.38 Min.
40% of lag time =     0.61 Min.
Unit time =     5.00 Min.
Duration of storm = 3 Hour(s)
User Entered Base Flow =     0.00(CFS)

2 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        5.10           0.87                  4.42

100 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        5.10           2.09                 10.66

STORM EVENT (YEAR) =  100.00
Area Averaged 2-Year Rainfall =    0.866(In)
Area Averaged 100-Year Rainfall =    2.090(In)

Point rain (area averaged) =    2.090(In)
Areal adjustment factor =  100.00 %
Adjusted average point rain =    2.090(In)

Sub-Area Data:
Area(Ac.)         Runoff Index   Impervious %
     5.100           56.00         0.500
 Total Area Entered =      5.10(Ac.)


RI    RI   Infil. Rate Impervious   Adj. Infil. Rate  Area%     F
AMC2 AMC-2     (In/Hr)    (Dec.%)      (In/Hr)      (Dec.)    (In/Hr)
56.0  56.0      0.511     0.500        0.281       1.000      0.281
                                                  Sum (F) =   0.281
Area averaged mean soil loss (F) (In/Hr) =  0.281
Minimum soil loss rate ((In/Hr)) =  0.140
```

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.500

U n i t H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %		Unit Hydrograph (CFS)
1	0.083	327.873	59.371		3.052
2	0.167	655.747	35.647		1.832
3	0.250	983.620	4.982		0.256
			Sum = 100.000	Sum=	5.140

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Low	Effective (In/Hr)
1	0.08	1.30	0.326	(0.281)	0.163	0.163
2	0.17	1.30	0.326	(0.281)	0.163	0.163
3	0.25	1.10	0.276	(0.281)	0.138	0.138
4	0.33	1.50	0.376	(0.281)	0.188	0.188
5	0.42	1.50	0.376	(0.281)	0.188	0.188
6	0.50	1.80	0.451	(0.281)	0.226	0.226
7	0.58	1.50	0.376	(0.281)	0.188	0.188
8	0.67	1.80	0.451	(0.281)	0.226	0.226
9	0.75	1.80	0.451	(0.281)	0.226	0.226
10	0.83	1.50	0.376	(0.281)	0.188	0.188
11	0.92	1.60	0.401	(0.281)	0.201	0.201
12	1.00	1.80	0.451	(0.281)	0.226	0.226
13	1.08	2.20	0.552	(0.281)	0.276	0.276
14	1.17	2.20	0.552	(0.281)	0.276	0.276
15	1.25	2.20	0.552	(0.281)	0.276	0.276
16	1.33	2.00	0.502	(0.281)	0.251	0.251
17	1.42	2.60	0.652	0.281	(0.326)	0.371
18	1.50	2.70	0.677	0.281	(0.339)	0.396
19	1.58	2.40	0.602	0.281	(0.301)	0.321
20	1.67	2.70	0.677	0.281	(0.339)	0.396
21	1.75	3.30	0.828	0.281	(0.414)	0.547
22	1.83	3.10	0.777	0.281	(0.389)	0.497
23	1.92	2.90	0.727	0.281	(0.364)	0.446
24	2.00	3.00	0.752	0.281	(0.376)	0.471
25	2.08	3.10	0.777	0.281	(0.389)	0.497
26	2.17	4.20	1.053	0.281	(0.527)	0.772
27	2.25	5.00	1.254	0.281	(0.627)	0.973
28	2.33	3.50	0.878	0.281	(0.439)	0.597
29	2.42	6.80	1.705	0.281	(0.853)	1.424
30	2.50	7.30	1.831	0.281	(0.915)	1.550
31	2.58	8.20	2.057	0.281	(1.028)	1.776
32	2.67	5.90	1.480	0.281	(0.740)	1.199
33	2.75	2.00	0.502	(0.281)	0.251	0.251
34	2.83	1.80	0.451	(0.281)	0.226	0.226
35	2.92	1.80	0.451	(0.281)	0.226	0.226
36	3.00	0.60	0.150	(0.281)	0.075	0.075

(Loss Rate Not Used)
Sum = 100.0 Sum = 16.4
Flood volume = Effective rainfall 1.37(In)
times area 5.1(Ac.)/[(In)/(Ft.)] = 0.6(Ac.Ft)
Total soil loss = 0.72(In)
Total soil loss = 0.307(Ac.Ft)
Total rainfall = 2.09(In)
Flood volume = 25314.5 Cubic Feet
Total soil loss = 13376.8 Cubic Feet

Peak flow rate of this hydrograph = 8.627(CFS)

+++

3 - H O U R S T O R M
R u n o f f H y d r o g r a p h

Hydrograph in 5 Minute intervals ((CFS))

```
  Time(h+m) Volume Ac.Ft   Q(CFS)  0        2.5       5.0       7.5      10.0
  -----------------------------------------------------------------------
    0+ 5       0.0034      0.50  VQ        |         |         |         |
    0+10       0.0089      0.80  V  Q      |         |         |         |
    0+15       0.0142      0.76  V  Q      |         |         |         |
    0+20       0.0201      0.87  |V Q      |         |         |         |
    0+25       0.0267      0.95  |V Q      |         |         |         |
    0+30       0.0342      1.08  | V Q     |         |         |         |
    0+35       0.0413      1.04  | V Q     |         |         |         |
    0+40       0.0488      1.09  |  VQ     |         |         |         |
    0+45       0.0568      1.15  |  VQ     |         |         |         |
    0+50       0.0640      1.05  |   Q     |         |         |         |
    0+55       0.0709      1.02  |   Q     |         |         |         |
    1+ 0       0.0786      1.11  |   QV    |         |         |         |
    1+ 5       0.0876      1.31  |    QV   |         |         |         |
    1+10       0.0972      1.41  |    QV   |         |         |         |
    1+15       0.1070      1.42  |    Q V  |         |         |         |
    1+20       0.1163      1.34  |    Q  V |         |         |         |
    1+25       0.1277      1.66  |     Q V |         |         |         |
    1+30       0.1412      1.95  |      Q V|         |         |         |
    1+35       0.1536      1.80  |      Q  V         |         |         |
    1+40       0.1667      1.90  |      Q  |V        |         |         |
    1+45       0.1837      2.48  |        Q| V       |         |         |
    1+50       0.2018      2.62  |         Q  V      |         |         |
    1+55       0.2184      2.41  |        Q|    V    |         |         |
    2+ 0       0.2348      2.38  |        Q|     V   |         |         |
    2+ 5       0.2520      2.49  |        Q|      V  |         |         |
    2+10       0.2753      3.39  |         |  Q    V |         |         |
    2+15       0.3064      4.51  |         |       Q |V        |         |
    2+20       0.3326      3.80  |         |    Q    | V       |         |
    2+25       0.3718      5.69  |         |         | Q  V    |         |
    2+30       0.4235      7.50  |         |         |        Q|         |
    2+35       0.4829      8.63  |         |         |         |  VQ     |
    2+40       0.5332      7.31  |         |         |        Q|     V   |
    2+45       0.5568      3.42  |         |  Q      |         |       V |
    2+50       0.5668      1.46  |    Q    |         |         |        V|
    2+55       0.5748      1.17  |   Q     |         |         |        V|
    3+ 0       0.5797      0.70  | Q       |         |         |        V|
    3+ 5       0.5810      0.20  Q         |         |         |        V|
    3+10       0.5811      0.02  Q         |         |         |         V
-----------------------------------------------------------------------
```

U n i t   H y d r o g r a p h   A n a l y s i s

Study date 07/22/19 File: DMAB100EXIST6100.out

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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978

Program License Serial Number 6388

English (in-lb) Input Units Used
English Rainfall Data (Inches) Input Values Used

English Units used in output format

KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
EXISTING CONDITION
100-YR 6-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019

Drainage Area = 5.10(Ac.) = 0.008 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment = 5.10(Ac.) = 0.008 Sq. Mi.
Length along longest watercourse = 461.00(Ft.)
Length along longest watercourse measured to centroid = 391.00(Ft.)
Length along longest watercourse = 0.087 Mi.
Length along longest watercourse measured to centroid = 0.074 Mi.
Difference in elevation = 19.00(Ft.)
Slope along watercourse = 217.6139 Ft./Mi.
Average Manning's 'N' = 0.020
Lag time = 0.025 Hr.
Lag time = 1.52 Min.
25% of lag time = 0.38 Min.
40% of lag time = 0.61 Min.
Unit time = 5.00 Min.
Duration of storm = 6 Hour(s)
User Entered Base Flow = 0.00(CFS)

2 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	Weighting[1*2]
5.10	1.21	6.17

100 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	Weighting[1*2]
5.10	2.86	14.59

STORM EVENT (YEAR) = 100.00
Area Averaged 2-Year Rainfall = 1.210(In)
Area Averaged 100-Year Rainfall = 2.860(In)

Point rain (area averaged) = 2.860(In)
Areal adjustment factor = 100.00 %
Adjusted average point rain = 2.860(In)

Sub-Area Data:

Area(Ac.)	Runoff Index	Impervious %
5.100	56.00	0.500

Total Area Entered = 5.10(Ac.)

RI AMC2	RI AMC-2	Infil. Rate (In/Hr)	Impervious (Dec.%)	Adj. Infil. Rate (In/Hr)	Area% (Dec.)	F (In/Hr)
56.0	56.0	0.511	0.500	0.281	1.000	0.281
					Sum (F) =	0.281

Area averaged mean soil loss (F) (In/Hr) = 0.281
Minimum soil loss rate ((In/Hr)) = 0.140

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.500

U n i t H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.083	327.873	59.371	3.052
2	0.167	655.747	35.647	1.832
3	0.250	983.620	4.982	0.256
			Sum = 100.000	Sum= 5.140

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Low	Effective (In/Hr)
1	0.08	0.50	0.172	(0.281)	0.086	0.086
2	0.17	0.60	0.206	(0.281)	0.103	0.103
3	0.25	0.60	0.206	(0.281)	0.103	0.103
4	0.33	0.60	0.206	(0.281)	0.103	0.103
5	0.42	0.60	0.206	(0.281)	0.103	0.103
6	0.50	0.70	0.240	(0.281)	0.120	0.120
7	0.58	0.70	0.240	(0.281)	0.120	0.120
8	0.67	0.70	0.240	(0.281)	0.120	0.120
9	0.75	0.70	0.240	(0.281)	0.120	0.120
10	0.83	0.70	0.240	(0.281)	0.120	0.120
11	0.92	0.70	0.240	(0.281)	0.120	0.120
12	1.00	0.80	0.275	(0.281)	0.137	0.137
13	1.08	0.80	0.275	(0.281)	0.137	0.137
14	1.17	0.80	0.275	(0.281)	0.137	0.137
15	1.25	0.80	0.275	(0.281)	0.137	0.137
16	1.33	0.80	0.275	(0.281)	0.137	0.137
17	1.42	0.80	0.275	(0.281)	0.137	0.137
18	1.50	0.80	0.275	(0.281)	0.137	0.137
19	1.58	0.80	0.275	(0.281)	0.137	0.137
20	1.67	0.80	0.275	(0.281)	0.137	0.137
21	1.75	0.80	0.275	(0.281)	0.137	0.137
22	1.83	0.80	0.275	(0.281)	0.137	0.137
23	1.92	0.80	0.275	(0.281)	0.137	0.137
24	2.00	0.90	0.309	(0.281)	0.154	0.154
25	2.08	0.80	0.275	(0.281)	0.137	0.137
26	2.17	0.90	0.309	(0.281)	0.154	0.154
27	2.25	0.90	0.309	(0.281)	0.154	0.154
28	2.33	0.90	0.309	(0.281)	0.154	0.154
29	2.42	0.90	0.309	(0.281)	0.154	0.154
30	2.50	0.90	0.309	(0.281)	0.154	0.154
31	2.58	0.90	0.309	(0.281)	0.154	0.154
32	2.67	0.90	0.309	(0.281)	0.154	0.154
33	2.75	1.00	0.343	(0.281)	0.172	0.172
34	2.83	1.00	0.343	(0.281)	0.172	0.172
35	2.92	1.00	0.343	(0.281)	0.172	0.172
36	3.00	1.00	0.343	(0.281)	0.172	0.172
37	3.08	1.00	0.343	(0.281)	0.172	0.172
38	3.17	1.10	0.378	(0.281)	0.189	0.189
39	3.25	1.10	0.378	(0.281)	0.189	0.189
40	3.33	1.10	0.378	(0.281)	0.189	0.189
41	3.42	1.20	0.412	(0.281)	0.206	0.206
42	3.50	1.30	0.446	(0.281)	0.223	0.223
43	3.58	1.40	0.480	(0.281)	0.240	0.240
44	3.67	1.40	0.480	(0.281)	0.240	0.240
45	3.75	1.50	0.515	(0.281)	0.257	0.257
46	3.83	1.50	0.515	(0.281)	0.257	0.257
47	3.92	1.60	0.549	(0.281)	0.275	0.275
48	4.00	1.60	0.549	(0.281)	0.275	0.275
49	4.08	1.70	0.583	0.281	(0.292)	0.302
50	4.17	1.80	0.618	0.281	(0.309)	0.337
51	4.25	1.90	0.652	0.281	(0.326)	0.371
52	4.33	2.00	0.686	0.281	(0.343)	0.405
53	4.42	2.10	0.721	0.281	(0.360)	0.440
54	4.50	2.10	0.721	0.281	(0.360)	0.440
55	4.58	2.20	0.755	0.281	(0.378)	0.474

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56   4.67     2.30      0.789          0.281    (  0.395)        0.508
57   4.75     2.40      0.824          0.281    (  0.412)        0.543
58   4.83     2.40      0.824          0.281    (  0.412)        0.543
59   4.92     2.50      0.858          0.281    (  0.429)        0.577
60   5.00     2.60      0.892          0.281    (  0.446)        0.611
61   5.08     3.10      1.064          0.281    (  0.532)        0.783
62   5.17     3.60      1.235          0.281    (  0.618)        0.955
63   5.25     3.90      1.338          0.281    (  0.669)        1.058
64   5.33     4.20      1.441          0.281    (  0.721)        1.160
65   5.42     4.70      1.613          0.281    (  0.807)        1.332
66   5.50     5.60      1.922          0.281    (  0.961)        1.641
67   5.58     1.90      0.652          0.281    (  0.326)        0.371
68   5.67     0.90      0.309       (  0.281)       0.154        0.154
69   5.75     0.60      0.206       (  0.281)       0.103        0.103
70   5.83     0.50      0.172       (  0.281)       0.086        0.086
71   5.92     0.30      0.103       (  0.281)       0.051        0.051
72   6.00     0.20      0.069       (  0.281)       0.034        0.034
              (Loss Rate Not Used)
   Sum =     100.0                                   Sum =    20.9
     Flood volume = Effective rainfall      1.74(In)
      times area       5.1(Ac.)/[(In)/(Ft.)] =       0.7(Ac.Ft)
     Total soil loss =      1.12(In)
     Total soil loss =     0.475(Ac.Ft)
     Total rainfall =      2.86(In)
     Flood volume =       32268.9 Cubic Feet
     Total soil loss =       20677.4 Cubic Feet
     ---------------------------------------------------------------------
      Peak flow rate of this hydrograph =      7.749(CFS)
     ---------------------------------------------------------------------
     +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                         6 - H O U R   S T O R M
                    R u n o f f     H y d r o g r a p h
     ---------------------------------------------------------------------
                 Hydrograph in   5   Minute intervals ((CFS))

     ---------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0         2.5       5.0       7.5      10.0
-----------------------------------------------------------------------
  0+ 5       0.0018      0.26  VQ        |         |         |         |
  0+10       0.0051      0.47  VQ        |         |         |         |
  0+15       0.0087      0.53  V Q       |         |         |         |
  0+20       0.0123      0.53  V Q       |         |         |         |
  0+25       0.0160      0.53  V Q       |         |         |         |
  0+30       0.0200      0.58  |VQ       |         |         |         |
  0+35       0.0242      0.61  |VQ       |         |         |         |
  0+40       0.0284      0.62  |VQ       |         |         |         |
  0+45       0.0327      0.62  |VQ       |         |         |         |
  0+50       0.0370      0.62  |VQ       |         |         |         |
  0+55       0.0412      0.62  | Q       |         |         |         |
  1+ 0       0.0458      0.67  | Q       |         |         |         |
  1+ 5       0.0507      0.70  | Q       |         |         |         |
  1+10       0.0555      0.71  | Q       |         |         |         |
  1+15       0.0604      0.71  | QV      |         |         |         |
  1+20       0.0652      0.71  | QV      |         |         |         |
  1+25       0.0701      0.71  | QV      |         |         |         |
  1+30       0.0750      0.71  | Q V     |         |         |         |
  1+35       0.0798      0.71  | Q V     |         |         |         |
  1+40       0.0847      0.71  | Q V     |         |         |         |
  1+45       0.0896      0.71  | Q V     |         |         |         |
  1+50       0.0944      0.71  | Q  V    |         |         |         |
  1+55       0.0993      0.71  | Q  V    |         |         |         |
  2+ 0       0.1045      0.76  |  Q V    |         |         |         |
  2+ 5       0.1096      0.74  | Q  V    |         |         |         |
  2+10       0.1148      0.76  |  Q  V   |         |         |         |
  2+15       0.1203      0.79  |  Q  V   |         |         |         |
  2+20       0.1257      0.79  |  Q  V   |         |         |         |
  2+25       0.1312      0.79  |  Q   V  |         |         |         |
  2+30       0.1367      0.79  |  Q   V  |         |         |         |
  2+35       0.1421      0.79  |  Q   V  |         |         |         |
  2+40       0.1476      0.79  |  Q   V  |         |         |         |
  2+45       0.1534      0.85  |  Q    V |         |         |         |
  2+50       0.1595      0.88  |  Q    V |         |         |         |
  2+55       0.1656      0.88  |  Q    V |         |         |         |
  3+ 0       0.1716      0.88  |  Q     V|         |         |         |
  3+ 5       0.1777      0.88  |  Q     V|         |         |         |
  3+10       0.1842      0.93  |  Q     V|         |         |         |
  3+15       0.1908      0.97  |  Q      V         |         |         |
  3+20       0.1975      0.97  |  Q      V         |         |         |
  3+25       0.2046      1.02  |   Q     |V        |         |         |
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    3+30       0.2122      1.11  |   Q     |V        |         |         |
    3+35       0.2204      1.20  |   Q     |V        |         |         |
    3+40       0.2289      1.23  |   Q     | V       |         |         |
    3+45       0.2378      1.29  |    Q    | V       |         |         |
    3+50       0.2468      1.32  |    Q    |  V      |         |         |
    3+55       0.2563      1.38  |    Q    |  V      |         |         |
    4+ 0       0.2660      1.41  |    Q    |   V     |         |         |
    4+ 5       0.2763      1.50  |    Q    |   V     |         |         |
    4+10       0.2877      1.65  |     Q   |    V    |         |         |
    4+15       0.3003      1.83  |      Q  |     V   |         |         |
    4+20       0.3141      2.00  |       Q |     V   |         |         |
    4+25       0.3291      2.18  |       Q |      V  |         |         |
    4+30       0.3446      2.25  |        Q|       V |         |         |
    4+35       0.3609      2.37  |        Q|        V|         |         |
    4+40       0.3784      2.53  |         Q         V         |         |
    4+45       0.3971      2.71  |         Q         |V        |         |
    4+50       0.4162      2.78  |         |Q        | V       |         |
    4+55       0.4362      2.90  |         |Q        |  V      |         |
    5+ 0       0.4573      3.06  |         | Q       |   V     |         |
    5+ 5       0.4825      3.66  |         |   Q     |     V   |         |
    5+10       0.5135      4.51  |         |       Q |      V  |         |
    5+15       0.5492      5.18  |         |         Q        V|         |
    5+20       0.5886      5.73  |         |         | Q       |V        |
    5+25       0.6331      6.47  |         |         |    Q    |   V     |
    5+30       0.6865      7.75  |         |         |         Q      V  |
    5+35       0.7174      4.48  |         |      Q  |         |       V |
    5+40       0.7282      1.57  |     Q   |         |         |        V|
    5+45       0.7330      0.69  | Q       |         |         |        V|
    5+50       0.7363      0.49  |Q        |         |         |        V|
    5+55       0.7387      0.34  |Q        |         |         |        V|
    6+ 0       0.7402      0.22  Q         |         |         |        V|
    6+ 5       0.7407      0.08  Q         |         |         |        V|
    6+10       0.7408      0.01  Q         |         |         |        V|
-----------------------------------------------------------------------
```

```
       U n i t   H y d r o g r a p h   A n a l y s i s

       Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2014, Version 9.0
              Study date  07/22/19 File: DMAB100EXIST24100.out


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------------------------------------------------------------------------

Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978


Program License Serial Number 6388

---------------------------------------------------------------------
 English (in-lb) Input Units Used
 English Rainfall Data (Inches) Input Values Used

 English Units used in output format



---------------------------------------------------------------------
KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
EXISTING CONDITION
100-YR 24-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019
--------------------------------------------------------------------
Drainage Area =       5.10(Ac.)  =      0.008 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =       5.10(Ac.)  =      0.008 Sq. Mi.
Length along longest watercourse =     461.00(Ft.)
Length along longest watercourse measured to centroid =     391.00(Ft.)
Length along longest watercourse =      0.087 Mi.
Length along longest watercourse measured to centroid =      0.074 Mi.
Difference in elevation =      19.00(Ft.)
Slope along watercourse =    217.6139 Ft./Mi.
Average Manning's 'N' = 0.020
Lag time =    0.025 Hr.
Lag time =     1.52 Min.
25% of lag time =     0.38 Min.
40% of lag time =     0.61 Min.
Unit time =    15.00 Min.
Duration of storm = 24 Hour(s)
User Entered Base Flow =     0.00(CFS)

2 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        5.10           2.05                 10.45

100 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        5.10           5.16                 26.32

STORM EVENT (YEAR) =  100.00
Area Averaged 2-Year Rainfall =    2.050(In)
Area Averaged 100-Year Rainfall =    5.160(In)

Point rain (area averaged) =    5.160(In)
Areal adjustment factor =  100.00 %
Adjusted average point rain =    5.160(In)

Sub-Area Data:
Area(Ac.)         Runoff Index   Impervious %
     5.100           56.00         0.500
 Total Area Entered =      5.10(Ac.)


RI    RI   Infil. Rate Impervious   Adj. Infil. Rate  Area%     F
AMC2 AMC-2     (In/Hr)    (Dec.%)      (In/Hr)      (Dec.)    (In/Hr)
56.0  56.0      0.511     0.500        0.281       1.000      0.281
                                                  Sum (F) =   0.281
Area averaged mean soil loss (F) (In/Hr) =  0.281
Minimum soil loss rate ((In/Hr)) =  0.140
```

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.500

U n i t H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %		Unit Hydrograph (CFS)
1	0.250	983.620	100.000		5.140
			Sum = 100.000	Sum=	5.140

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Low	Effective (In/Hr)
1	0.25	0.20	0.041	(0.496)	0.021	0.021
2	0.50	0.30	0.062	(0.490)	0.031	0.031
3	0.75	0.30	0.062	(0.485)	0.031	0.031
4	1.00	0.40	0.083	(0.479)	0.041	0.041
5	1.25	0.30	0.062	(0.473)	0.031	0.031
6	1.50	0.30	0.062	(0.468)	0.031	0.031
7	1.75	0.30	0.062	(0.462)	0.031	0.031
8	2.00	0.40	0.083	(0.457)	0.041	0.041
9	2.25	0.40	0.083	(0.451)	0.041	0.041
10	2.50	0.40	0.083	(0.446)	0.041	0.041
11	2.75	0.50	0.103	(0.440)	0.052	0.052
12	3.00	0.50	0.103	(0.435)	0.052	0.052
13	3.25	0.50	0.103	(0.429)	0.052	0.052
14	3.50	0.50	0.103	(0.424)	0.052	0.052
15	3.75	0.50	0.103	(0.419)	0.052	0.052
16	4.00	0.60	0.124	(0.413)	0.062	0.062
17	4.25	0.60	0.124	(0.408)	0.062	0.062
18	4.50	0.70	0.144	(0.403)	0.072	0.072
19	4.75	0.70	0.144	(0.398)	0.072	0.072
20	5.00	0.80	0.165	(0.393)	0.083	0.083
21	5.25	0.60	0.124	(0.388)	0.062	0.062
22	5.50	0.70	0.144	(0.382)	0.072	0.072
23	5.75	0.80	0.165	(0.377)	0.083	0.083
24	6.00	0.80	0.165	(0.372)	0.083	0.083
25	6.25	0.90	0.186	(0.368)	0.093	0.093
26	6.50	0.90	0.186	(0.363)	0.093	0.093
27	6.75	1.00	0.206	(0.358)	0.103	0.103
28	7.00	1.00	0.206	(0.353)	0.103	0.103
29	7.25	1.00	0.206	(0.348)	0.103	0.103
30	7.50	1.10	0.227	(0.343)	0.114	0.114
31	7.75	1.20	0.248	(0.339)	0.124	0.124
32	8.00	1.30	0.268	(0.334)	0.134	0.134
33	8.25	1.50	0.310	(0.329)	0.155	0.155
34	8.50	1.50	0.310	(0.325)	0.155	0.155
35	8.75	1.60	0.330	(0.320)	0.165	0.165
36	9.00	1.70	0.351	(0.316)	0.175	0.175
37	9.25	1.90	0.392	(0.311)	0.196	0.196
38	9.50	2.00	0.413	(0.307)	0.206	0.206
39	9.75	2.10	0.433	(0.302)	0.217	0.217
40	10.00	2.20	0.454	(0.298)	0.227	0.227
41	10.25	1.50	0.310	(0.294)	0.155	0.155
42	10.50	1.50	0.310	(0.290)	0.155	0.155
43	10.75	2.00	0.413	(0.285)	0.206	0.206
44	11.00	2.00	0.413	(0.281)	0.206	0.206
45	11.25	1.90	0.392	(0.277)	0.196	0.196
46	11.50	1.90	0.392	(0.273)	0.196	0.196
47	11.75	1.70	0.351	(0.269)	0.175	0.175
48	12.00	1.80	0.372	(0.265)	0.186	0.186
49	12.25	2.50	0.516	(0.261)	0.258	0.258
50	12.50	2.60	0.537	0.257	(0.268)	0.280
51	12.75	2.80	0.578	0.253	(0.289)	0.325
52	13.00	2.90	0.599	0.249	(0.299)	0.349
53	13.25	3.40	0.702	0.246	(0.351)	0.456
54	13.50	3.40	0.702	0.242	(0.351)	0.460
55	13.75	2.30	0.475	(0.238)	0.237	0.237
56	14.00	2.30	0.475	0.235	(0.237)	0.240
57	14.25	2.70	0.557	0.231	(0.279)	0.326

58	14.50	2.60	0.537	0.227	(0.268)	0.309
59	14.75	2.60	0.537	0.224	(0.268)	0.313
60	15.00	2.50	0.516	0.221	(0.258)	0.295
61	15.25	2.40	0.495	0.217	(0.248)	0.278
62	15.50	2.30	0.475	0.214	(0.237)	0.261
63	15.75	1.90	0.392	(0.211)	0.196	0.196
64	16.00	1.90	0.392	(0.207)	0.196	0.196
65	16.25	0.40	0.083	(0.204)	0.041	0.041
66	16.50	0.40	0.083	(0.201)	0.041	0.041
67	16.75	0.30	0.062	(0.198)	0.031	0.031
68	17.00	0.30	0.062	(0.195)	0.031	0.031
69	17.25	0.50	0.103	(0.192)	0.052	0.052
70	17.50	0.50	0.103	(0.189)	0.052	0.052
71	17.75	0.50	0.103	(0.186)	0.052	0.052
72	18.00	0.40	0.083	(0.184)	0.041	0.041
73	18.25	0.40	0.083	(0.181)	0.041	0.041
74	18.50	0.40	0.083	(0.178)	0.041	0.041
75	18.75	0.30	0.062	(0.176)	0.031	0.031
76	19.00	0.20	0.041	(0.173)	0.021	0.021
77	19.25	0.30	0.062	(0.171)	0.031	0.031
78	19.50	0.40	0.083	(0.168)	0.041	0.041
79	19.75	0.30	0.062	(0.166)	0.031	0.031
80	20.00	0.20	0.041	(0.164)	0.021	0.021
81	20.25	0.30	0.062	(0.162)	0.031	0.031
82	20.50	0.30	0.062	(0.160)	0.031	0.031
83	20.75	0.30	0.062	(0.158)	0.031	0.031
84	21.00	0.20	0.041	(0.156)	0.021	0.021
85	21.25	0.30	0.062	(0.154)	0.031	0.031
86	21.50	0.20	0.041	(0.152)	0.021	0.021
87	21.75	0.30	0.062	(0.150)	0.031	0.031
88	22.00	0.20	0.041	(0.149)	0.021	0.021
89	22.25	0.30	0.062	(0.147)	0.031	0.031
90	22.50	0.20	0.041	(0.146)	0.021	0.021
91	22.75	0.20	0.041	(0.145)	0.021	0.021
92	23.00	0.20	0.041	(0.144)	0.021	0.021
93	23.25	0.20	0.041	(0.143)	0.021	0.021
94	23.50	0.20	0.041	(0.142)	0.021	0.021
95	23.75	0.20	0.041	(0.141)	0.021	0.021
96	24.00	0.20	0.041	(0.141)	0.021	0.021
		(Loss Rate Not Used)				
	Sum =	100.0			Sum =	10.9

Flood volume = Effective rainfall 2.71(In)
times area 5.1(Ac.)/[(In)/(Ft.)] = 1.2(Ac.Ft)
Total soil loss = 2.45(In)
Total soil loss = 1.039(Ac.Ft)
Total rainfall = 5.16(In)
Flood volume = 50254.9 Cubic Feet
Total soil loss = 45271.2 Cubic Feet

Peak flow rate of this hydrograph = 2.365(CFS)

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+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                    24 - H O U R     S T O R M
               R u n o f f      H y d r o g r a p h
---------------------------------------------------------------------
           Hydrograph in  15   Minute intervals ((CFS))

---------------------------------------------------------------------
Time(h+m) Volume Ac.Ft    Q(CFS)  0         2.5       5.0       7.5      10.0
-----------------------------------------------------------------------
  0+15       0.0022      0.11  Q         |         |         |         |
  0+30       0.0055      0.16  Q         |         |         |         |
  0+45       0.0088      0.16  Q         |         |         |         |
  1+ 0       0.0132      0.21  Q         |         |         |         |
  1+15       0.0164      0.16  Q         |         |         |         |
  1+30       0.0197      0.16  Q         |         |         |         |
  1+45       0.0230      0.16  Q         |         |         |         |
  2+ 0       0.0274      0.21  Q         |         |         |         |
  2+15       0.0318      0.21  QV        |         |         |         |
  2+30       0.0362      0.21  QV        |         |         |         |
  2+45       0.0417      0.27  |Q        |         |         |         |
  3+ 0       0.0471      0.27  |Q        |         |         |         |
  3+15       0.0526      0.27  |Q        |         |         |         |
  3+30       0.0581      0.27  |QV       |         |         |         |
  3+45       0.0636      0.27  |QV       |         |         |         |
  4+ 0       0.0702      0.32  |QV       |         |         |         |
  4+15       0.0768      0.32  |QV       |         |         |         |
  4+30       0.0844      0.37  |QV       |         |         |         |
  4+45       0.0921      0.37  |Q V      |         |         |         |
```

```
    5+ 0       0.1009      0.42  |Q V      |         |         |         |
    5+15       0.1075      0.32  |Q V      |         |         |         |
    5+30       0.1151      0.37  |Q V      |         |         |         |
    5+45       0.1239      0.42  |Q  V     |         |         |         |
    6+ 0       0.1327      0.42  |Q  V     |         |         |         |
    6+15       0.1425      0.48  |Q  V     |         |         |         |
    6+30       0.1524      0.48  |Q   V    |         |         |         |
    6+45       0.1634      0.53  | Q  V    |         |         |         |
    7+ 0       0.1743      0.53  | Q   V   |         |         |         |
    7+15       0.1853      0.53  | Q   V   |         |         |         |
    7+30       0.1974      0.58  | Q   V   |         |         |         |
    7+45       0.2105      0.64  | Q    V  |         |         |         |
    8+ 0       0.2248      0.69  | Q    V  |         |         |         |
    8+15       0.2412      0.80  |  Q    V |         |         |         |
    8+30       0.2577      0.80  |  Q    V |         |         |         |
    8+45       0.2752      0.85  |  Q     V|         |         |         |
    9+ 0       0.2939      0.90  |  Q      V         |         |         |
    9+15       0.3147      1.01  |   Q     V         |         |         |
    9+30       0.3366      1.06  |   Q     |V        |         |         |
    9+45       0.3596      1.11  |   Q     | V       |         |         |
   10+ 0       0.3838      1.17  |   Q     |  V      |         |         |
   10+15       0.4002      0.80  |  Q      |  V      |         |         |
   10+30       0.4167      0.80  |  Q      |   V     |         |         |
   10+45       0.4386      1.06  |   Q     |    V    |         |         |
   11+ 0       0.4605      1.06  |   Q     |    V    |         |         |
   11+15       0.4814      1.01  |   Q     |     V   |         |         |
   11+30       0.5022      1.01  |   Q     |      V  |         |         |
   11+45       0.5208      0.90  |  Q      |       V |         |         |
   12+ 0       0.5406      0.96  |  Q      |       V |         |         |
   12+15       0.5680      1.33  |    Q    |        V|         |         |
   12+30       0.5977      1.44  |    Q    |         V         |         |
   12+45       0.6322      1.67  |     Q   |         |V        |         |
   13+ 0       0.6693      1.80  |      Q  |         |  V      |         |
   13+15       0.7178      2.35  |        Q|         |   V     |         |
   13+30       0.7666      2.36  |        Q|         |     V   |         |
   13+45       0.7918      1.22  |   Q     |         |      V  |         |
   14+ 0       0.8174      1.23  |   Q     |         |       V |         |
   14+15       0.8520      1.68  |     Q   |         |        V|         |
   14+30       0.8849      1.59  |     Q   |         |         V         |
   14+45       0.9181      1.61  |     Q   |         |         |V        |
   15+ 0       0.9495      1.52  |     Q   |         |         | V       |
   15+15       0.9790      1.43  |    Q    |         |         |  V      |
   15+30       1.0068      1.34  |    Q    |         |         |   V     |
   15+45       1.0276      1.01  |   Q     |         |         |    V    |
   16+ 0       1.0484      1.01  |   Q     |         |         |     V   |
   16+15       1.0528      0.21  Q         |         |         |     V   |
   16+30       1.0572      0.21  Q         |         |         |     V   |
   16+45       1.0605      0.16  Q         |         |         |     V   |
   17+ 0       1.0638      0.16  Q         |         |         |     V   |
   17+15       1.0693      0.27  |Q        |         |         |      V  |
   17+30       1.0747      0.27  |Q        |         |         |      V  |
   17+45       1.0802      0.27  |Q        |         |         |      V  |
   18+ 0       1.0846      0.21  Q         |         |         |      V  |
   18+15       1.0890      0.21  Q         |         |         |      V  |
   18+30       1.0934      0.21  Q         |         |         |      V  |
   18+45       1.0967      0.16  Q         |         |         |       V |
   19+ 0       1.0989      0.11  Q         |         |         |       V |
   19+15       1.1022      0.16  Q         |         |         |       V |
   19+30       1.1065      0.21  Q         |         |         |       V |
   19+45       1.1098      0.16  Q         |         |         |       V |
   20+ 0       1.1120      0.11  Q         |         |         |       V |
   20+15       1.1153      0.16  Q         |         |         |       V |
   20+30       1.1186      0.16  Q         |         |         |       V |
   20+45       1.1219      0.16  Q         |         |         |       V |
   21+ 0       1.1241      0.11  Q         |         |         |       V |
   21+15       1.1274      0.16  Q         |         |         |        V|
   21+30       1.1296      0.11  Q         |         |         |        V|
   21+45       1.1329      0.16  Q         |         |         |        V|
   22+ 0       1.1351      0.11  Q         |         |         |        V|
   22+15       1.1383      0.16  Q         |         |         |        V|
   22+30       1.1405      0.11  Q         |         |         |        V|
   22+45       1.1427      0.11  Q         |         |         |        V|
   23+ 0       1.1449      0.11  Q         |         |         |        V|
   23+15       1.1471      0.11  Q         |         |         |        V|
   23+30       1.1493      0.11  Q         |         |         |        V|
   23+45       1.1515      0.11  Q         |         |         |        V|
   24+ 0       1.1537      0.11  Q         |         |         |        V|
----------------------------------------------------------------------
```

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      U n i t   H y d r o g r a p h   A n a l y s i s

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              Study date  07/23/19 File: DMAB100PROP1100.out


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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978


Program License Serial Number 6388

---------------------------------------------------------------------
 English (in-lb) Input Units Used
 English Rainfall Data (Inches) Input Values Used

 English Units used in output format



---------------------------------------------------------------------
KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
PROPOSED CONDITION, DMA B
100-YR 1-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019
--------------------------------------------------------------------
Drainage Area =       5.10(Ac.)  =      0.008 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =       5.10(Ac.)  =      0.008 Sq. Mi.
Length along longest watercourse =     461.00(Ft.)
Length along longest watercourse measured to centroid =     391.00(Ft.)
Length along longest watercourse =      0.087 Mi.
Length along longest watercourse measured to centroid =      0.074 Mi.
Difference in elevation =      19.00(Ft.)
Slope along watercourse =    217.6139 Ft./Mi.
Average Manning's 'N' = 0.015
Lag time =    0.019 Hr.
Lag time =     1.14 Min.
25% of lag time =     0.29 Min.
40% of lag time =     0.46 Min.
Unit time =     5.00 Min.
Duration of storm = 1 Hour(s)
User Entered Base Flow =     0.00(CFS)

2 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        5.10           0.49                  2.49

100 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        5.10           1.33                  6.78

STORM EVENT (YEAR) =  100.00
Area Averaged 2-Year Rainfall =    0.489(In)
Area Averaged 100-Year Rainfall =    1.330(In)

Point rain (area averaged) =    1.330(In)
Areal adjustment factor =  100.00 %
Adjusted average point rain =    1.330(In)

Sub-Area Data:
Area(Ac.)         Runoff Index   Impervious %
     5.100           56.00         0.690
 Total Area Entered =      5.10(Ac.)


RI    RI   Infil. Rate Impervious   Adj. Infil. Rate  Area%     F
AMC2 AMC-2     (In/Hr)    (Dec.%)      (In/Hr)      (Dec.)    (In/Hr)
56.0  56.0      0.511     0.690        0.194       1.000      0.194
                                                  Sum (F) =   0.194
Area averaged mean soil loss (F) (In/Hr) =  0.194
Minimum soil loss rate ((In/Hr)) =  0.097
```

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.350

Slope of intensity-duration curve for a 1 hour storm =0.5000

U n i t   H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.083	437.165	67.483	3.469
2	0.167	874.329	32.517	1.671
			Sum = 100.000	Sum= 5.140

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Low	Effective (In/Hr)
1	0.08	4.20	0.670	0.194	(0.235)	0.477
2	0.17	4.30	0.686	0.194	(0.240)	0.493
3	0.25	5.00	0.798	0.194	(0.279)	0.604
4	0.33	5.00	0.798	0.194	(0.279)	0.604
5	0.42	5.80	0.926	0.194	(0.324)	0.732
6	0.50	6.50	1.037	0.194	(0.363)	0.844
7	0.58	7.40	1.181	0.194	(0.413)	0.987
8	0.67	8.60	1.372	0.194	(0.480)	1.179
9	0.75	12.30	1.963	0.194	(0.687)	1.769
10	0.83	29.10	4.644	0.194	(1.625)	4.451
11	0.92	6.80	1.085	0.194	(0.380)	0.892
12	1.00	5.00	0.798	0.194	(0.279)	0.604
		(Loss Rate Not Used)				
Sum =		100.0				Sum = 13.6

Flood volume = Effective rainfall 1.14(In)
times area 5.1(Ac.)/[(In)/(Ft.)] = 0.5(Ac.Ft)
Total soil loss = 0.19(In)
Total soil loss = 0.082(Ac.Ft)
Total rainfall = 1.33(In)
Flood volume = 21037.2 Cubic Feet
Total soil loss = 3584.0 Cubic Feet

Peak flow rate of this hydrograph = 18.404(CFS)

++

1 - H O U R   S T O R M
R u n o f f   H y d r o g r a p h

Hydrograph in 5 Minute intervals ((CFS))

```
Time(h+m) Volume Ac.Ft   Q(CFS)  0        5.0       10.0      15.0      20.0
-----------------------------------------------------------------------
  0+ 5      0.0114       1.65  V  Q       |         |         |         |
  0+10      0.0287       2.51  | V  Q     |         |         |         |
  0+15      0.0488       2.92  |   VQ     |         |         |         |
  0+20      0.0702       3.11  |    VQ    |         |         |         |
  0+25      0.0946       3.55  |      Q   |         |         |         |
  0+30      0.1232       4.15  |       Q V|         |         |         |
  0+35      0.1565       4.84  |        Q| V        |         |         |
  0+40      0.1961       5.74  |         |Q    V    |         |         |
  0+45      0.2520       8.11  |         |     Q   V|         |         |
  0+50      0.3787      18.40  |         |         |         |V    Q   |
  0+55      0.4513      10.54  |         |         |Q        |      V  |
  1+ 0      0.4760       3.59  |      Q  |         |         |        V|
  1+ 5      0.4829       1.01  | Q       |         |         |         V
-----------------------------------------------------------------------
```

```
      U n i t   H y d r o g r a p h   A n a l y s i s

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              Study date  07/23/19 File: DMAB100PROP3100.out


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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978


Program License Serial Number 6388

---------------------------------------------------------------------
 English (in-lb) Input Units Used
 English Rainfall Data (Inches) Input Values Used

 English Units used in output format



---------------------------------------------------------------------
KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
PROPOSED CONDITION, DMA B
100-YR 3-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019
--------------------------------------------------------------------
Drainage Area =       5.10(Ac.)  =      0.008 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =       5.10(Ac.)  =      0.008 Sq. Mi.
Length along longest watercourse =     461.00(Ft.)
Length along longest watercourse measured to centroid =     391.00(Ft.)
Length along longest watercourse =      0.087 Mi.
Length along longest watercourse measured to centroid =      0.074 Mi.
Difference in elevation =      19.00(Ft.)
Slope along watercourse =    217.6139 Ft./Mi.
Average Manning's 'N' = 0.015
Lag time =    0.019 Hr.
Lag time =     1.14 Min.
25% of lag time =     0.29 Min.
40% of lag time =     0.46 Min.
Unit time =     5.00 Min.
Duration of storm = 3 Hour(s)
User Entered Base Flow =     0.00(CFS)

2 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        5.10           0.87                  4.42

100 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        5.10           2.09                 10.66

STORM EVENT (YEAR) =  100.00
Area Averaged 2-Year Rainfall =    0.866(In)
Area Averaged 100-Year Rainfall =    2.090(In)

Point rain (area averaged) =    2.090(In)
Areal adjustment factor =  100.00 %
Adjusted average point rain =    2.090(In)

Sub-Area Data:
Area(Ac.)         Runoff Index   Impervious %
     5.100           56.00          0.690
 Total Area Entered =      5.10(Ac.)


RI    RI   Infil. Rate Impervious   Adj. Infil. Rate  Area%     F
AMC2 AMC-2     (In/Hr)    (Dec.%)      (In/Hr)      (Dec.)    (In/Hr)
56.0  56.0      0.511     0.690        0.194       1.000      0.194
                                                  Sum (F) =   0.194
Area averaged mean soil loss (F) (In/Hr) =  0.194
Minimum soil loss rate ((In/Hr)) =  0.097
```

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.350

U n i t H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.083	437.165	67.483	3.469
2	0.167	874.329	32.517	1.671
			Sum = 100.000	Sum= 5.140

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Low	Effective (In/Hr)
1	0.08	1.30	0.326	(0.194)	0.114	0.212
2	0.17	1.30	0.326	(0.194)	0.114	0.212
3	0.25	1.10	0.276	(0.194)	0.097	0.179
4	0.33	1.50	0.376	(0.194)	0.132	0.245
5	0.42	1.50	0.376	(0.194)	0.132	0.245
6	0.50	1.80	0.451	(0.194)	0.158	0.293
7	0.58	1.50	0.376	(0.194)	0.132	0.245
8	0.67	1.80	0.451	(0.194)	0.158	0.293
9	0.75	1.80	0.451	(0.194)	0.158	0.293
10	0.83	1.50	0.376	(0.194)	0.132	0.245
11	0.92	1.60	0.401	(0.194)	0.140	0.261
12	1.00	1.80	0.451	(0.194)	0.158	0.293
13	1.08	2.20	0.552	(0.194)	0.193	0.359
14	1.17	2.20	0.552	(0.194)	0.193	0.359
15	1.25	2.20	0.552	(0.194)	0.193	0.359
16	1.33	2.00	0.502	(0.194)	0.176	0.326
17	1.42	2.60	0.652	0.194	(0.228)	0.458
18	1.50	2.70	0.677	0.194	(0.237)	0.484
19	1.58	2.40	0.602	0.194	(0.211)	0.408
20	1.67	2.70	0.677	0.194	(0.237)	0.484
21	1.75	3.30	0.828	0.194	(0.290)	0.634
22	1.83	3.10	0.777	0.194	(0.272)	0.584
23	1.92	2.90	0.727	0.194	(0.255)	0.534
24	2.00	3.00	0.752	0.194	(0.263)	0.559
25	2.08	3.10	0.777	0.194	(0.272)	0.584
26	2.17	4.20	1.053	0.194	(0.369)	0.860
27	2.25	5.00	1.254	0.194	(0.439)	1.060
28	2.33	3.50	0.878	0.194	(0.307)	0.684
29	2.42	6.80	1.705	0.194	(0.597)	1.512
30	2.50	7.30	1.831	0.194	(0.641)	1.637
31	2.58	8.20	2.057	0.194	(0.720)	1.863
32	2.67	5.90	1.480	0.194	(0.518)	1.286
33	2.75	2.00	0.502	(0.194)	0.176	0.326
34	2.83	1.80	0.451	(0.194)	0.158	0.293
35	2.92	1.80	0.451	(0.194)	0.158	0.293
36	3.00	0.60	0.150	(0.194)	0.053	0.098
		(Loss Rate Not Used)				
Sum =		100.0				Sum = 19.1

Flood volume = Effective rainfall 1.59(In)
times area 5.1(Ac.)/[(In)/(Ft.)] = 0.7(Ac.Ft)
Total soil loss = 0.50(In)
Total soil loss = 0.213(Ac.Ft)
Total rainfall = 2.09(In)
Flood volume = 29403.2 Cubic Feet
Total soil loss = 9288.1 Cubic Feet

Peak flow rate of this hydrograph = 9.203(CFS)

+++

3 - H O U R S T O R M
R u n o f f H y d r o g r a p h

Hydrograph in 5 Minute intervals ((CFS))

Time(h+m) Volume Ac.Ft Q(CFS) 0 2.5 5.0 7.5 10.0

```
  -----------------------------------------------------------------------
    0+ 5       0.0051      0.74  V Q       |         |         |         |
    0+10       0.0126      1.09  V   Q     |         |         |         |
    0+15       0.0193      0.98  |V Q      |         |         |         |
    0+20       0.0272      1.15  |V  Q     |         |         |         |
    0+25       0.0359      1.26  | V  Q    |         |         |         |
    0+30       0.0457      1.43  | V  Q    |         |         |         |
    0+35       0.0549      1.34  |  V Q    |         |         |         |
    0+40       0.0647      1.43  |  V Q    |         |         |         |
    0+45       0.0751      1.51  |   V Q   |         |         |         |
    0+50       0.0844      1.34  |   VQ    |         |         |         |
    0+55       0.0934      1.31  |    Q    |         |         |         |
    1+ 0       0.1034      1.45  |    QV   |         |         |         |
    1+ 5       0.1154      1.74  |     Q   |         |         |         |
    1+10       0.1281      1.84  |      Q  |         |         |         |
    1+15       0.1408      1.84  |      QV |         |         |         |
    1+20       0.1527      1.73  |     Q  V|         |         |         |
    1+25       0.1674      2.14  |       QV|         |         |         |
    1+30       0.1843      2.44  |        QV         |         |         |
    1+35       0.1996      2.23  |       Q |V        |         |         |
    1+40       0.2158      2.36  |        Q| V       |         |         |
    1+45       0.2366      3.01  |         | Q V     |         |         |
    1+50       0.2578      3.09  |         | Q  V    |         |         |
    1+55       0.2773      2.83  |         |Q    V   |         |         |
    2+ 0       0.2968      2.83  |         |Q     V  |         |         |
    2+ 5       0.3172      2.96  |         |Q      V |         |         |
    2+10       0.3445      3.96  |         |    Q    V         |         |
    2+15       0.3797      5.12  |         |         Q V       |         |
    2+20       0.4083      4.15  |         |     Q   |   V     |         |
    2+25       0.4523      6.39  |         |         |    QV   |         |
    2+30       0.5088      8.21  |         |         |         V Q       |
    2+35       0.5722      9.20  |         |         |         |  V  Q   |
    2+40       0.6244      7.58  |         |         |         Q      V  |
    2+45       0.6470      3.28  |         |  Q      |         |       V |
    2+50       0.6578      1.56  |     Q   |         |         |       V |
    2+55       0.6682      1.51  |     Q   |         |         |        V|
    3+ 0       0.6739      0.83  |  Q      |         |         |        V|
    3+ 5       0.6750      0.16  Q         |         |         |         V
----------------------------------------------------------------------
```

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       U n i t   H y d r o g r a p h   A n a l y s i s

       Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2014, Version 9.0
               Study date  07/23/19 File: DMAB100PROP6100.out


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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978


Program License Serial Number 6388

---------------------------------------------------------------------
 English (in-lb) Input Units Used
 English Rainfall Data (Inches) Input Values Used

 English Units used in output format



---------------------------------------------------------------------
KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
PROPOSED CONDITION, DMA B
100-YR 6-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019
--------------------------------------------------------------------
Drainage Area =       5.10(Ac.)  =      0.008 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =       5.10(Ac.)  =      0.008 Sq. Mi.
Length along longest watercourse =     461.00(Ft.)
Length along longest watercourse measured to centroid =     391.00(Ft.)
Length along longest watercourse =      0.087 Mi.
Length along longest watercourse measured to centroid =      0.074 Mi.
Difference in elevation =      19.00(Ft.)
Slope along watercourse =    217.6139 Ft./Mi.
Average Manning's 'N' = 0.015
Lag time =    0.019 Hr.
Lag time =     1.14 Min.
25% of lag time =     0.29 Min.
40% of lag time =     0.46 Min.
Unit time =     5.00 Min.
Duration of storm = 6 Hour(s)
User Entered Base Flow =     0.00(CFS)

2 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        5.10           1.21                  6.17

100 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        5.10           2.86                 14.59

STORM EVENT (YEAR) =  100.00
Area Averaged 2-Year Rainfall =    1.210(In)
Area Averaged 100-Year Rainfall =    2.860(In)

Point rain (area averaged) =    2.860(In)
Areal adjustment factor =  100.00 %
Adjusted average point rain =    2.860(In)

Sub-Area Data:
Area(Ac.)         Runoff Index   Impervious %
     5.100           56.00         0.690
 Total Area Entered =      5.10(Ac.)


RI    RI   Infil. Rate Impervious   Adj. Infil. Rate  Area%     F
AMC2 AMC-2     (In/Hr)    (Dec.%)      (In/Hr)      (Dec.)    (In/Hr)
56.0  56.0      0.511     0.690        0.194       1.000      0.194
                                                 Sum (F) =   0.194
Area averaged mean soil loss (F) (In/Hr) =  0.194
Minimum soil loss rate ((In/Hr)) =  0.097
```

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.350

U n i t   H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.083	437.165	67.483	3.469
2	0.167	874.329	32.517	1.671
			Sum = 100.000	Sum= 5.140

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Loss rate(In./Hr) Low	Effective (In/Hr)
1	0.08	0.50	0.172	(0.194)	0.060	0.112
2	0.17	0.60	0.206	(0.194)	0.072	0.134
3	0.25	0.60	0.206	(0.194)	0.072	0.134
4	0.33	0.60	0.206	(0.194)	0.072	0.134
5	0.42	0.60	0.206	(0.194)	0.072	0.134
6	0.50	0.70	0.240	(0.194)	0.084	0.156
7	0.58	0.70	0.240	(0.194)	0.084	0.156
8	0.67	0.70	0.240	(0.194)	0.084	0.156
9	0.75	0.70	0.240	(0.194)	0.084	0.156
10	0.83	0.70	0.240	(0.194)	0.084	0.156
11	0.92	0.70	0.240	(0.194)	0.084	0.156
12	1.00	0.80	0.275	(0.194)	0.096	0.178
13	1.08	0.80	0.275	(0.194)	0.096	0.178
14	1.17	0.80	0.275	(0.194)	0.096	0.178
15	1.25	0.80	0.275	(0.194)	0.096	0.178
16	1.33	0.80	0.275	(0.194)	0.096	0.178
17	1.42	0.80	0.275	(0.194)	0.096	0.178
18	1.50	0.80	0.275	(0.194)	0.096	0.178
19	1.58	0.80	0.275	(0.194)	0.096	0.178
20	1.67	0.80	0.275	(0.194)	0.096	0.178
21	1.75	0.80	0.275	(0.194)	0.096	0.178
22	1.83	0.80	0.275	(0.194)	0.096	0.178
23	1.92	0.80	0.275	(0.194)	0.096	0.178
24	2.00	0.90	0.309	(0.194)	0.108	0.201
25	2.08	0.80	0.275	(0.194)	0.096	0.178
26	2.17	0.90	0.309	(0.194)	0.108	0.201
27	2.25	0.90	0.309	(0.194)	0.108	0.201
28	2.33	0.90	0.309	(0.194)	0.108	0.201
29	2.42	0.90	0.309	(0.194)	0.108	0.201
30	2.50	0.90	0.309	(0.194)	0.108	0.201
31	2.58	0.90	0.309	(0.194)	0.108	0.201
32	2.67	0.90	0.309	(0.194)	0.108	0.201
33	2.75	1.00	0.343	(0.194)	0.120	0.223
34	2.83	1.00	0.343	(0.194)	0.120	0.223
35	2.92	1.00	0.343	(0.194)	0.120	0.223
36	3.00	1.00	0.343	(0.194)	0.120	0.223
37	3.08	1.00	0.343	(0.194)	0.120	0.223
38	3.17	1.10	0.378	(0.194)	0.132	0.245
39	3.25	1.10	0.378	(0.194)	0.132	0.245
40	3.33	1.10	0.378	(0.194)	0.132	0.245
41	3.42	1.20	0.412	(0.194)	0.144	0.268
42	3.50	1.30	0.446	(0.194)	0.156	0.290
43	3.58	1.40	0.480	(0.194)	0.168	0.312
44	3.67	1.40	0.480	(0.194)	0.168	0.312
45	3.75	1.50	0.515	(0.194)	0.180	0.335
46	3.83	1.50	0.515	(0.194)	0.180	0.335
47	3.92	1.60	0.549	(0.194)	0.192	0.357
48	4.00	1.60	0.549	(0.194)	0.192	0.357
49	4.08	1.70	0.583	0.194	(0.204)	0.390
50	4.17	1.80	0.618	0.194	(0.216)	0.424
51	4.25	1.90	0.652	0.194	(0.228)	0.458
52	4.33	2.00	0.686	0.194	(0.240)	0.493
53	4.42	2.10	0.721	0.194	(0.252)	0.527
54	4.50	2.10	0.721	0.194	(0.252)	0.527
55	4.58	2.20	0.755	0.194	(0.264)	0.561
56	4.67	2.30	0.789	0.194	(0.276)	0.596

57	4.75	2.40	0.824	0.194	(0.288)	0.630
58	4.83	2.40	0.824	0.194	(0.288)	0.630
59	4.92	2.50	0.858	0.194	(0.300)	0.664
60	5.00	2.60	0.892	0.194	(0.312)	0.699
61	5.08	3.10	1.064	0.194	(0.372)	0.870
62	5.17	3.60	1.235	0.194	(0.432)	1.042
63	5.25	3.90	1.338	0.194	(0.468)	1.145
64	5.33	4.20	1.441	0.194	(0.504)	1.248
65	5.42	4.70	1.613	0.194	(0.565)	1.419
66	5.50	5.60	1.922	0.194	(0.673)	1.728
67	5.58	1.90	0.652	0.194	(0.228)	0.458
68	5.67	0.90	0.309	(0.194)	0.108	0.201
69	5.75	0.60	0.206	(0.194)	0.072	0.134
70	5.83	0.50	0.172	(0.194)	0.060	0.112
71	5.92	0.30	0.103	(0.194)	0.036	0.067
72	6.00	0.20	0.069	(0.194)	0.024	0.045

(Loss Rate Not Used)

Sum = 100.0 Sum = 25.0

Flood volume = Effective rainfall 2.08(In)
times area 5.1(Ac.)/[(In)/(Ft.)] = 0.9(Ac.Ft)
Total soil loss = 0.78(In)
Total soil loss = 0.330(Ac.Ft)
Total rainfall = 2.86(In)
Flood volume = 38561.9 Cubic Feet
Total soil loss = 14384.3 Cubic Feet

Peak flow rate of this hydrograph = 8.371(CFS)

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                   6 - H O U R     S T O R M
               R u n o f f      H y d r o g r a p h
---------------------------------------------------------------------
            Hydrograph in   5   Minute intervals ((CFS))

---------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0         2.5       5.0       7.5      10.0
-----------------------------------------------------------------------
  0+ 5       0.0027      0.39  VQ        |         |         |         |
  0+10       0.0071      0.65  V Q       |         |         |         |
  0+15       0.0119      0.69  V Q       |         |         |         |
  0+20       0.0166      0.69  V Q       |         |         |         |
  0+25       0.0214      0.69  V Q       |         |         |         |
  0+30       0.0266      0.77  |V Q      |         |         |         |
  0+35       0.0322      0.80  |V Q      |         |         |         |
  0+40       0.0377      0.80  |V Q      |         |         |         |
  0+45       0.0432      0.80  |V Q      |         |         |         |
  0+50       0.0488      0.80  | VQ      |         |         |         |
  0+55       0.0543      0.80  | VQ      |         |         |         |
  1+ 0       0.0604      0.88  | VQ      |         |         |         |
  1+ 5       0.0667      0.92  |  Q      |         |         |         |
  1+10       0.0730      0.92  |  Q      |         |         |         |
  1+15       0.0793      0.92  |  Q      |         |         |         |
  1+20       0.0856      0.92  |  Q      |         |         |         |
  1+25       0.0920      0.92  |  QV     |         |         |         |
  1+30       0.0983      0.92  |  QV     |         |         |         |
  1+35       0.1046      0.92  |  QV     |         |         |         |
  1+40       0.1109      0.92  |  Q V    |         |         |         |
  1+45       0.1172      0.92  |  Q V    |         |         |         |
  1+50       0.1236      0.92  |  Q V    |         |         |         |
  1+55       0.1299      0.92  |  Q V    |         |         |         |
  2+ 0       0.1367      1.00  |  Q  V   |         |         |         |
  2+ 5       0.1433      0.96  |  Q  V   |         |         |         |
  2+10       0.1502      1.00  |  Q  V   |         |         |         |
  2+15       0.1573      1.03  |   Q  V  |         |         |         |
  2+20       0.1644      1.03  |   Q  V  |         |         |         |
  2+25       0.1715      1.03  |   Q  V  |         |         |         |
  2+30       0.1786      1.03  |   Q   V |         |         |         |
  2+35       0.1857      1.03  |   Q   V |         |         |         |
  2+40       0.1928      1.03  |   Q   V |         |         |         |
  2+45       0.2005      1.11  |   Q    V|         |         |         |
  2+50       0.2084      1.15  |   Q    V|         |         |         |
  2+55       0.2163      1.15  |   Q    V|         |         |         |
  3+ 0       0.2242      1.15  |   Q     V         |         |         |
  3+ 5       0.2321      1.15  |   Q     V         |         |         |
  3+10       0.2405      1.22  |   Q     V         |         |         |
  3+15       0.2492      1.26  |    Q    |V        |         |         |
  3+20       0.2579      1.26  |    Q    |V        |         |         |
  3+25       0.2671      1.34  |    Q    | V       |         |         |
  3+30       0.2771      1.45  |    Q    | V       |         |         |
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    3+35       0.2879      1.57  |     Q   |  V      |         |         |
    3+40       0.2990      1.61  |     Q   |  V      |         |         |
    3+45       0.3106      1.68  |     Q   |   V     |         |         |
    3+50       0.3224      1.72  |     Q   |   V     |         |         |
    3+55       0.3348      1.80  |      Q  |    V    |         |         |
    4+ 0       0.3475      1.84  |      Q  |    V    |         |         |
    4+ 5       0.3609      1.95  |      Q  |     V   |         |         |
    4+10       0.3755      2.12  |       Q |     V   |         |         |
    4+15       0.3914      2.30  |        Q|      V  |         |         |
    4+20       0.4084      2.48  |        Q|       V |         |         |
    4+25       0.4267      2.65  |         Q        V|         |         |
    4+30       0.4454      2.71  |         Q         V         |         |
    4+35       0.4649      2.83  |         |Q        |V        |         |
    4+40       0.4856      3.01  |         | Q       |V        |         |
    4+45       0.5075      3.18  |         | Q       | V       |         |
    4+50       0.5298      3.24  |         | Q       |  V      |         |
    4+55       0.5529      3.36  |         |  Q      |   V     |         |
    5+ 0       0.5773      3.54  |         |   Q     |     V   |         |
    5+ 5       0.6061      4.19  |         |     Q   |      V  |         |
    5+10       0.6410      5.07  |         |         Q       V |         |
    5+15       0.6804      5.72  |         |         | Q       V         |
    5+20       0.7234      6.24  |         |         |   Q     | V       |
    5+25       0.7717      7.01  |         |         |       Q |   V     |
    5+30       0.8294      8.37  |         |         |         |  Q   V  |
    5+35       0.8602      4.48  |         |      Q  |         |       V |
    5+40       0.8703      1.46  |    Q    |         |         |        V|
    5+45       0.8758      0.80  |  Q      |         |         |        V|
    5+50       0.8800      0.61  | Q       |         |         |        V|
    5+55       0.8829      0.42  |Q        |         |         |        V|
    6+ 0       0.8847      0.27  |Q        |         |         |        V|
    6+ 5       0.8853      0.07  Q         |         |         |        V|
-----------------------------------------------------------------------
```

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       U n i t   H y d r o g r a p h   A n a l y s i s

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              Study date  07/23/19 File: DMAB100PROP24100.out


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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978


Program License Serial Number 6388

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 English (in-lb) Input Units Used
 English Rainfall Data (Inches) Input Values Used

 English Units used in output format



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PROPOSED CONDITION, DMA B
100-YR 24-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019
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Drainage Area for Depth-Area Areal Adjustment =       5.10(Ac.)  =      0.008 Sq. Mi.
Length along longest watercourse =     461.00(Ft.)
Length along longest watercourse measured to centroid =     391.00(Ft.)
Length along longest watercourse =      0.087 Mi.
Length along longest watercourse measured to centroid =      0.074 Mi.
Difference in elevation =      19.00(Ft.)
Slope along watercourse =    217.6139 Ft./Mi.
Average Manning's 'N' = 0.015
Lag time =    0.019 Hr.
Lag time =     1.14 Min.
25% of lag time =     0.29 Min.
40% of lag time =     0.46 Min.
Unit time =    15.00 Min.
Duration of storm = 24 Hour(s)
User Entered Base Flow =     0.00(CFS)

2 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        5.10           2.05                 10.45

100 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        5.10           5.16                 26.32

STORM EVENT (YEAR) =  100.00
Area Averaged 2-Year Rainfall =    2.050(In)
Area Averaged 100-Year Rainfall =    5.160(In)

Point rain (area averaged) =    5.160(In)
Areal adjustment factor =  100.00 %
Adjusted average point rain =    5.160(In)

Sub-Area Data:
Area(Ac.)         Runoff Index   Impervious %
     5.100           56.00          0.690
 Total Area Entered =      5.10(Ac.)


RI    RI   Infil. Rate Impervious   Adj. Infil. Rate  Area%     F
AMC2 AMC-2     (In/Hr)    (Dec.%)      (In/Hr)      (Dec.)    (In/Hr)
56.0  56.0      0.511     0.690        0.194       1.000      0.194
                                                  Sum (F) =   0.194
Area averaged mean soil loss (F) (In/Hr) =  0.194
Minimum soil loss rate ((In/Hr)) =  0.097
```

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.350

U n i t H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.250	1311.494	100.000	5.140
			Sum = 100.000	Sum= 5.140

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Loss rate(In./Hr) Low	Effective (In/Hr)
1	0.25	0.20	0.041	(0.342)	0.014	0.027
2	0.50	0.30	0.062	(0.338)	0.022	0.040
3	0.75	0.30	0.062	(0.334)	0.022	0.040
4	1.00	0.40	0.083	(0.330)	0.029	0.054
5	1.25	0.30	0.062	(0.326)	0.022	0.040
6	1.50	0.30	0.062	(0.322)	0.022	0.040
7	1.75	0.30	0.062	(0.318)	0.022	0.040
8	2.00	0.40	0.083	(0.315)	0.029	0.054
9	2.25	0.40	0.083	(0.311)	0.029	0.054
10	2.50	0.40	0.083	(0.307)	0.029	0.054
11	2.75	0.50	0.103	(0.303)	0.036	0.067
12	3.00	0.50	0.103	(0.300)	0.036	0.067
13	3.25	0.50	0.103	(0.296)	0.036	0.067
14	3.50	0.50	0.103	(0.292)	0.036	0.067
15	3.75	0.50	0.103	(0.288)	0.036	0.067
16	4.00	0.60	0.124	(0.285)	0.043	0.080
17	4.25	0.60	0.124	(0.281)	0.043	0.080
18	4.50	0.70	0.144	(0.278)	0.051	0.094
19	4.75	0.70	0.144	(0.274)	0.051	0.094
20	5.00	0.80	0.165	(0.271)	0.058	0.107
21	5.25	0.60	0.124	(0.267)	0.043	0.080
22	5.50	0.70	0.144	(0.264)	0.051	0.094
23	5.75	0.80	0.165	(0.260)	0.058	0.107
24	6.00	0.80	0.165	(0.257)	0.058	0.107
25	6.25	0.90	0.186	(0.253)	0.065	0.121
26	6.50	0.90	0.186	(0.250)	0.065	0.121
27	6.75	1.00	0.206	(0.247)	0.072	0.134
28	7.00	1.00	0.206	(0.243)	0.072	0.134
29	7.25	1.00	0.206	(0.240)	0.072	0.134
30	7.50	1.10	0.227	(0.237)	0.079	0.148
31	7.75	1.20	0.248	(0.233)	0.087	0.161
32	8.00	1.30	0.268	(0.230)	0.094	0.174
33	8.25	1.50	0.310	(0.227)	0.108	0.201
34	8.50	1.50	0.310	(0.224)	0.108	0.201
35	8.75	1.60	0.330	(0.221)	0.116	0.215
36	9.00	1.70	0.351	(0.218)	0.123	0.228
37	9.25	1.90	0.392	(0.214)	0.137	0.255
38	9.50	2.00	0.413	(0.211)	0.144	0.268
39	9.75	2.10	0.433	(0.208)	0.152	0.282
40	10.00	2.20	0.454	(0.205)	0.159	0.295
41	10.25	1.50	0.310	(0.202)	0.108	0.201
42	10.50	1.50	0.310	(0.200)	0.108	0.201
43	10.75	2.00	0.413	(0.197)	0.144	0.268
44	11.00	2.00	0.413	(0.194)	0.144	0.268
45	11.25	1.90	0.392	(0.191)	0.137	0.255
46	11.50	1.90	0.392	(0.188)	0.137	0.255
47	11.75	1.70	0.351	(0.185)	0.123	0.228
48	12.00	1.80	0.372	(0.183)	0.130	0.241
49	12.25	2.50	0.516	0.180	(0.181)	0.336
50	12.50	2.60	0.537	0.177	(0.188)	0.360
51	12.75	2.80	0.578	0.174	(0.202)	0.403
52	13.00	2.90	0.599	0.172	(0.209)	0.427
53	13.25	3.40	0.702	0.169	(0.246)	0.533
54	13.50	3.40	0.702	0.167	(0.246)	0.535
55	13.75	2.30	0.475	0.164	(0.166)	0.311
56	14.00	2.30	0.475	0.162	(0.166)	0.313
57	14.25	2.70	0.557	0.159	(0.195)	0.398

```
58  14.50     2.60      0.537          0.157    (  0.188)        0.380
59  14.75     2.60      0.537          0.154    (  0.188)        0.382
60  15.00     2.50      0.516          0.152    (  0.181)        0.364
61  15.25     2.40      0.495          0.150    (  0.173)        0.346
62  15.50     2.30      0.475          0.147    (  0.166)        0.327
63  15.75     1.90      0.392      (  0.145)       0.137         0.255
64  16.00     1.90      0.392      (  0.143)       0.137         0.255
65  16.25     0.40      0.083      (  0.141)       0.029         0.054
66  16.50     0.40      0.083      (  0.139)       0.029         0.054
67  16.75     0.30      0.062      (  0.136)       0.022         0.040
68  17.00     0.30      0.062      (  0.134)       0.022         0.040
69  17.25     0.50      0.103      (  0.132)       0.036         0.067
70  17.50     0.50      0.103      (  0.130)       0.036         0.067
71  17.75     0.50      0.103      (  0.128)       0.036         0.067
72  18.00     0.40      0.083      (  0.127)       0.029         0.054
73  18.25     0.40      0.083      (  0.125)       0.029         0.054
74  18.50     0.40      0.083      (  0.123)       0.029         0.054
75  18.75     0.30      0.062      (  0.121)       0.022         0.040
76  19.00     0.20      0.041      (  0.119)       0.014         0.027
77  19.25     0.30      0.062      (  0.118)       0.022         0.040
78  19.50     0.40      0.083      (  0.116)       0.029         0.054
79  19.75     0.30      0.062      (  0.114)       0.022         0.040
80  20.00     0.20      0.041      (  0.113)       0.014         0.027
81  20.25     0.30      0.062      (  0.111)       0.022         0.040
82  20.50     0.30      0.062      (  0.110)       0.022         0.040
83  20.75     0.30      0.062      (  0.109)       0.022         0.040
84  21.00     0.20      0.041      (  0.107)       0.014         0.027
85  21.25     0.30      0.062      (  0.106)       0.022         0.040
86  21.50     0.20      0.041      (  0.105)       0.014         0.027
87  21.75     0.30      0.062      (  0.104)       0.022         0.040
88  22.00     0.20      0.041      (  0.103)       0.014         0.027
89  22.25     0.30      0.062      (  0.102)       0.022         0.040
90  22.50     0.20      0.041      (  0.101)       0.014         0.027
91  22.75     0.20      0.041      (  0.100)       0.014         0.027
92  23.00     0.20      0.041      (  0.099)       0.014         0.027
93  23.25     0.20      0.041      (  0.098)       0.014         0.027
94  23.50     0.20      0.041      (  0.098)       0.014         0.027
95  23.75     0.20      0.041      (  0.097)       0.014         0.027
96  24.00     0.20      0.041      (  0.097)       0.014         0.027
             (Loss Rate Not Used)
   Sum =     100.0                                   Sum =    13.8
     Flood volume = Effective rainfall      3.46(In)
      times area       5.1(Ac.)/[(In)/(Ft.)] =       1.5(Ac.Ft)
     Total soil loss =      1.70(In)
     Total soil loss =     0.724(Ac.Ft)
     Total rainfall =      5.16(In)
     Flood volume =     63991.4 Cubic Feet
     Total soil loss =      31534.7 Cubic Feet
     --------------------------------------------------------------------
      Peak flow rate of this hydrograph =      2.752(CFS)
     --------------------------------------------------------------------
     ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                        24 - H O U R    S T O R M
                   R u n o f f     H y d r o g r a p h
     --------------------------------------------------------------------
                Hydrograph in  15   Minute intervals ((CFS))

     --------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0        2.5       5.0       7.5      10.0
-----------------------------------------------------------------------
  0+15       0.0029      0.14  Q         |         |         |         |
  0+30       0.0071      0.21  Q         |         |         |         |
  0+45       0.0114      0.21  Q         |         |         |         |
  1+ 0       0.0171      0.28  VQ        |         |         |         |
  1+15       0.0214      0.21  Q         |         |         |         |
  1+30       0.0257      0.21  Q         |         |         |         |
  1+45       0.0299      0.21  Q         |         |         |         |
  2+ 0       0.0356      0.28  VQ        |         |         |         |
  2+15       0.0413      0.28  |Q        |         |         |         |
  2+30       0.0470      0.28  |Q        |         |         |         |
  2+45       0.0542      0.34  |Q        |         |         |         |
  3+ 0       0.0613      0.34  |Q        |         |         |         |
  3+15       0.0684      0.34  |Q        |         |         |         |
  3+30       0.0755      0.34  |QV       |         |         |         |
  3+45       0.0827      0.34  |QV       |         |         |         |
  4+ 0       0.0912      0.41  |QV       |         |         |         |
  4+15       0.0998      0.41  |QV       |         |         |         |
  4+30       0.1098      0.48  |QV       |         |         |         |
  4+45       0.1197      0.48  |Q V      |         |         |         |
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    5+ 0       0.1311      0.55  | QV      |         |         |         |
    5+15       0.1397      0.41  |Q V      |         |         |         |
    5+30       0.1497      0.48  |Q  V     |         |         |         |
    5+45       0.1611      0.55  | Q V     |         |         |         |
    6+ 0       0.1725      0.55  | Q V     |         |         |         |
    6+15       0.1853      0.62  | Q  V    |         |         |         |
    6+30       0.1981      0.62  | Q  V    |         |         |         |
    6+45       0.2124      0.69  | Q  V    |         |         |         |
    7+ 0       0.2266      0.69  | Q   V   |         |         |         |
    7+15       0.2409      0.69  | Q   V   |         |         |         |
    7+30       0.2566      0.76  |  Q  V   |         |         |         |
    7+45       0.2737      0.83  |  Q   V  |         |         |         |
    8+ 0       0.2922      0.90  |  Q   V  |         |         |         |
    8+15       0.3136      1.03  |   Q   V |         |         |         |
    8+30       0.3350      1.03  |   Q    V|         |         |         |
    8+45       0.3578      1.10  |   Q    V|         |         |         |
    9+ 0       0.3820      1.17  |   Q     V         |         |         |
    9+15       0.4091      1.31  |    Q    |V        |         |         |
    9+30       0.4376      1.38  |    Q    |V        |         |         |
    9+45       0.4675      1.45  |    Q    | V       |         |         |
   10+ 0       0.4989      1.52  |     Q   |  V      |         |         |
   10+15       0.5203      1.03  |   Q     |   V     |         |         |
   10+30       0.5417      1.03  |   Q     |   V     |         |         |
   10+45       0.5702      1.38  |    Q    |    V    |         |         |
   11+ 0       0.5987      1.38  |    Q    |     V   |         |         |
   11+15       0.6258      1.31  |    Q    |      V  |         |         |
   11+30       0.6528      1.31  |    Q    |      V  |         |         |
   11+45       0.6771      1.17  |   Q     |       V |         |         |
   12+ 0       0.7027      1.24  |   Q     |        V|         |         |
   12+15       0.7385      1.73  |     Q   |         V         |         |
   12+30       0.7767      1.85  |      Q  |         |V        |         |
   12+45       0.8195      2.07  |       Q |         | V       |         |
   13+ 0       0.8649      2.19  |       Q |         |  V      |         |
   13+15       0.9214      2.74  |         Q         |    V    |         |
   13+30       0.9783      2.75  |         |Q        |     V   |         |
   13+45       1.0113      1.60  |     Q   |         |      V  |         |
   14+ 0       1.0446      1.61  |     Q   |         |       V |         |
   14+15       1.0869      2.05  |       Q |         |        V|         |
   14+30       1.1272      1.95  |      Q  |         |         V         |
   14+45       1.1678      1.97  |      Q  |         |         |V        |
   15+ 0       1.2065      1.87  |      Q  |         |         | V       |
   15+15       1.2433      1.78  |      Q  |         |         |  V      |
   15+30       1.2780      1.68  |     Q   |         |         |   V     |
   15+45       1.3051      1.31  |    Q    |         |         |    V    |
   16+ 0       1.3322      1.31  |    Q    |         |         |     V   |
   16+15       1.3379      0.28  |Q        |         |         |     V   |
   16+30       1.3436      0.28  |Q        |         |         |     V   |
   16+45       1.3479      0.21  Q         |         |         |     V   |
   17+ 0       1.3522      0.21  Q         |         |         |     V   |
   17+15       1.3593      0.34  |Q        |         |         |      V  |
   17+30       1.3664      0.34  |Q        |         |         |      V  |
   17+45       1.3735      0.34  |Q        |         |         |      V  |
   18+ 0       1.3792      0.28  |Q        |         |         |      V  |
   18+15       1.3849      0.28  |Q        |         |         |      V  |
   18+30       1.3906      0.28  |Q        |         |         |      V  |
   18+45       1.3949      0.21  Q         |         |         |      V  |
   19+ 0       1.3978      0.14  Q         |         |         |       V |
   19+15       1.4020      0.21  Q         |         |         |       V |
   19+30       1.4077      0.28  |Q        |         |         |       V |
   19+45       1.4120      0.21  Q         |         |         |       V |
   20+ 0       1.4149      0.14  Q         |         |         |       V |
   20+15       1.4192      0.21  Q         |         |         |       V |
   20+30       1.4234      0.21  Q         |         |         |       V |
   20+45       1.4277      0.21  Q         |         |         |       V |
   21+ 0       1.4306      0.14  Q         |         |         |       V |
   21+15       1.4348      0.21  Q         |         |         |        V|
   21+30       1.4377      0.14  Q         |         |         |        V|
   21+45       1.4420      0.21  Q         |         |         |        V|
   22+ 0       1.4448      0.14  Q         |         |         |        V|
   22+15       1.4491      0.21  Q         |         |         |        V|
   22+30       1.4519      0.14  Q         |         |         |        V|
   22+45       1.4548      0.14  Q         |         |         |        V|
   23+ 0       1.4576      0.14  Q         |         |         |        V|
   23+15       1.4605      0.14  Q         |         |         |        V|
   23+30       1.4633      0.14  Q         |         |         |        V|
   23+45       1.4662      0.14  Q         |         |         |        V|
   24+ 0       1.4690      0.14  Q         |         |         |        V|
-----------------------------------------------------------------------
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APPENDIX B

EXISTING AND PROPOSED
UNIT HYDROGRAPH CALCULATIONS
DMA C

U n i t   H y d r o g r a p h   A n a l y s i s

Study date 07/23/19 File: DMAC5EXIST15.out

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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978

Program License Serial Number 6388

English (in-lb) Input Units Used
English Rainfall Data (Inches) Input Values Used

English Units used in output format

KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
EXISTING CONDITION, DMA C
5-YR 1-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019

Drainage Area = 7.50(Ac.) = 0.012 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment = 7.50(Ac.) = 0.012 Sq. Mi.
Length along longest watercourse = 860.00(Ft.)
Length along longest watercourse measured to centroid = 749.00(Ft.)
Length along longest watercourse = 0.163 Mi.
Length along longest watercourse measured to centroid = 0.142 Mi.
Difference in elevation = 21.50(Ft.)
Slope along watercourse = 132.0000 Ft./Mi.
Average Manning's 'N' = 0.020
Lag time = 0.045 Hr.
Lag time = 2.72 Min.
25% of lag time = 0.68 Min.
40% of lag time = 1.09 Min.
Unit time = 5.00 Min.
Duration of storm = 1 Hour(s)
User Entered Base Flow = 0.00(CFS)

2 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	Weighting[1*2]
7.50	0.49	3.67

100 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	Weighting[1*2]
7.50	1.33	9.98

STORM EVENT (YEAR) = 5.00
Area Averaged 2-Year Rainfall = 0.489(In)
Area Averaged 100-Year Rainfall = 1.330(In)

Point rain (area averaged) = 0.686(In)
Areal adjustment factor = 99.99 %
Adjusted average point rain = 0.686(In)

Sub-Area Data:

Area(Ac.)	Runoff Index	Impervious %
7.500	56.00	0.500

Total Area Entered = 7.50(Ac.)

RI AMC2	RI AMC-1	Infil. Rate (In/Hr)	Impervious (Dec.%)	Adj. Infil. Rate (In/Hr)	Area% (Dec.)	F (In/Hr)
56.0	36.0	0.706	0.500	0.388	1.000	0.388
					Sum (F) =	0.388

Area averaged mean soil loss (F) (In/Hr) = 0.388
Minimum soil loss rate ((In/Hr)) = 0.194

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.500

Slope of intensity-duration curve for a 1 hour storm =0.5000

U n i t   H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.083	183.771	40.452	3.058
2	0.167	367.541	44.515	3.365
3	0.250	551.312	9.487	0.717
4	0.333	735.082	3.846	0.291
5	0.417	918.853	1.700	0.128
			Sum = 100.000	Sum= 7.559

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Low	Effective (In/Hr)
1	0.08	4.20	0.346	(0.388)	0.173	0.173
2	0.17	4.30	0.354	(0.388)	0.177	0.177
3	0.25	5.00	0.412	(0.388)	0.206	0.206
4	0.33	5.00	0.412	(0.388)	0.206	0.206
5	0.42	5.80	0.477	(0.388)	0.239	0.239
6	0.50	6.50	0.535	(0.388)	0.268	0.268
7	0.58	7.40	0.609	(0.388)	0.305	0.305
8	0.67	8.60	0.708	(0.388)	0.354	0.354
9	0.75	12.30	1.012	0.388	(0.506)	0.624
10	0.83	29.10	2.395	0.388	(1.198)	2.007
11	0.92	6.80	0.560	(0.388)	0.280	0.280
12	1.00	5.00	0.412	(0.388)	0.206	0.206

(Loss Rate Not Used)
Sum = 100.0 Sum = 5.0

Flood volume = Effective rainfall 0.42(In)
times area 7.5(Ac.)/[(In)/(Ft.)] = 0.3(Ac.Ft)
Total soil loss = 0.27(In)
Total soil loss = 0.166(Ac.Ft)
Total rainfall = 0.69(In)
Flood volume = 11441.0 Cubic Feet
Total soil loss = 7233.6 Cubic Feet

Peak flow rate of this hydrograph = 8.618(CFS)

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++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                    1 - H O U R     S T O R M
               R u n o f f      H y d r o g r a p h
--------------------------------------------------------------------
            Hydrograph in   5   Minute intervals ((CFS))

--------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0        2.5       5.0       7.5      10.0
-----------------------------------------------------------------------
  0+ 5      0.0036      0.53  V Q       |         |         |         |
  0+10      0.0114      1.12  |V  Q     |         |         |         |
  0+15      0.0207      1.35  |  V Q    |         |         |         |
  0+20      0.0310      1.50  |   VQ    |         |         |         |
  0+25      0.0423      1.64  |     Q   |         |         |         |
  0+30      0.0551      1.85  |      QV |         |         |         |
  0+35      0.0695      2.09  |       Q V         |         |         |
  0+40      0.0860      2.40  |        Q|  V      |         |         |
  0+45      0.1096      3.43  |         |  Q  V   |         |         |
  0+50      0.1689      8.62  |         |         |    V    |   Q     |
  0+55      0.2254      8.20  |         |         |         | Q V     |
  1+ 0      0.2477      3.24  |         | Q       |         |      V  |
  1+ 5      0.2585      1.56  |     Q   |         |         |        V|
  1+10      0.2618      0.49  |Q        |         |         |        V|
  1+15      0.2625      0.10  Q         |         |         |        V|
  1+20      0.2627      0.03  Q         |         |         |        V|
-----------------------------------------------------------------------
```

```
      U n i t   H y d r o g r a p h   A n a l y s i s

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              Study date  07/23/19 File: DMAC5EXIST35.out


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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978


Program License Serial Number 6388

---------------------------------------------------------------------
 English (in-lb) Input Units Used
 English Rainfall Data (Inches) Input Values Used

 English Units used in output format



---------------------------------------------------------------------
KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
EXISTING CONDITION, DMA C
5-YR 3-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019
--------------------------------------------------------------------
Drainage Area =       7.50(Ac.)  =      0.012 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =       7.50(Ac.)  =      0.012 Sq. Mi.
Length along longest watercourse =     860.00(Ft.)
Length along longest watercourse measured to centroid =     749.00(Ft.)
Length along longest watercourse =      0.163 Mi.
Length along longest watercourse measured to centroid =      0.142 Mi.
Difference in elevation =      21.50(Ft.)
Slope along watercourse =    132.0000 Ft./Mi.
Average Manning's 'N' = 0.020
Lag time =    0.045 Hr.
Lag time =     2.72 Min.
25% of lag time =     0.68 Min.
40% of lag time =     1.09 Min.
Unit time =     5.00 Min.
Duration of storm = 3 Hour(s)
User Entered Base Flow =     0.00(CFS)

2 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        7.50           0.87                   6.50

100 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        7.50           2.09                  15.67

STORM EVENT (YEAR) =    5.00
Area Averaged 2-Year Rainfall =    0.866(In)
Area Averaged 100-Year Rainfall =    2.090(In)

Point rain (area averaged) =    1.153(In)
Areal adjustment factor =  100.00 %
Adjusted average point rain =    1.153(In)

Sub-Area Data:
Area(Ac.)         Runoff Index   Impervious %
     7.500           56.00         0.500
 Total Area Entered =      7.50(Ac.)


RI    RI   Infil. Rate Impervious   Adj. Infil. Rate  Area%     F
AMC2 AMC-1     (In/Hr)    (Dec.%)      (In/Hr)      (Dec.)    (In/Hr)
56.0  36.0      0.706     0.500        0.388       1.000      0.388
                                                  Sum (F) =   0.388
Area averaged mean soil loss (F) (In/Hr) =  0.388
Minimum soil loss rate ((In/Hr)) =  0.194
```

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.500

U n i t H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %		Unit Hydrograph (CFS)
1	0.083	183.771	40.452		3.058
2	0.167	367.541	44.515		3.365
3	0.250	551.312	9.487		0.717
4	0.333	735.082	3.846		0.291
5	0.417	918.853	1.700		0.128
			Sum = 100.000	Sum=	7.559

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Loss rate(In./Hr) Low	Effective (In/Hr)
1	0.08	1.30	0.180	(0.388)	0.090	0.090
2	0.17	1.30	0.180	(0.388)	0.090	0.090
3	0.25	1.10	0.152	(0.388)	0.076	0.076
4	0.33	1.50	0.207	(0.388)	0.104	0.104
5	0.42	1.50	0.207	(0.388)	0.104	0.104
6	0.50	1.80	0.249	(0.388)	0.124	0.124
7	0.58	1.50	0.207	(0.388)	0.104	0.104
8	0.67	1.80	0.249	(0.388)	0.124	0.124
9	0.75	1.80	0.249	(0.388)	0.124	0.124
10	0.83	1.50	0.207	(0.388)	0.104	0.104
11	0.92	1.60	0.221	(0.388)	0.111	0.111
12	1.00	1.80	0.249	(0.388)	0.124	0.124
13	1.08	2.20	0.304	(0.388)	0.152	0.152
14	1.17	2.20	0.304	(0.388)	0.152	0.152
15	1.25	2.20	0.304	(0.388)	0.152	0.152
16	1.33	2.00	0.277	(0.388)	0.138	0.138
17	1.42	2.60	0.360	(0.388)	0.180	0.180
18	1.50	2.70	0.373	(0.388)	0.187	0.187
19	1.58	2.40	0.332	(0.388)	0.166	0.166
20	1.67	2.70	0.373	(0.388)	0.187	0.187
21	1.75	3.30	0.456	(0.388)	0.228	0.228
22	1.83	3.10	0.429	(0.388)	0.214	0.214
23	1.92	2.90	0.401	(0.388)	0.201	0.201
24	2.00	3.00	0.415	(0.388)	0.207	0.207
25	2.08	3.10	0.429	(0.388)	0.214	0.214
26	2.17	4.20	0.581	(0.388)	0.290	0.290
27	2.25	5.00	0.692	(0.388)	0.346	0.346
28	2.33	3.50	0.484	(0.388)	0.242	0.242
29	2.42	6.80	0.941	0.388	(0.470)	0.552
30	2.50	7.30	1.010	0.388	(0.505)	0.621
31	2.58	8.20	1.134	0.388	(0.567)	0.746
32	2.67	5.90	0.816	0.388	(0.408)	0.428
33	2.75	2.00	0.277	(0.388)	0.138	0.138
34	2.83	1.80	0.249	(0.388)	0.124	0.124
35	2.92	1.80	0.249	(0.388)	0.124	0.124
36	3.00	0.60	0.083	(0.388)	0.041	0.041
		(Loss Rate Not Used)				
Sum =		100.0			Sum =	7.3

Flood volume = Effective rainfall 0.61(In)
times area 7.5(Ac.)/[(In)/(Ft.)] = 0.4(Ac.Ft)
Total soil loss = 0.54(In)
Total soil loss = 0.340(Ac.Ft)
Total rainfall = 1.15(In)
Flood volume = 16591.4 Cubic Feet
Total soil loss = 14789.6 Cubic Feet

Peak flow rate of this hydrograph = 4.885(CFS)

++

3 - H O U R S T O R M
R u n o f f H y d r o g r a p h

Hydrograph in 5 Minute intervals ((CFS))

```
       --------------------------------------------------------------------
  Time(h+m) Volume Ac.Ft   Q(CFS)  0         2.5       5.0       7.5      10.0
  -----------------------------------------------------------------------
    0+ 5       0.0019      0.28  VQ        |         |         |         |
    0+10       0.0059      0.58  V Q       |         |         |         |
    0+15       0.0100      0.60  |VQ       |         |         |         |
    0+20       0.0146      0.66  |VQ       |         |         |         |
    0+25       0.0198      0.76  | VQ      |         |         |         |
    0+30       0.0256      0.84  | VQ      |         |         |         |
    0+35       0.0314      0.85  |  Q      |         |         |         |
    0+40       0.0374      0.86  |  Q      |         |         |         |
    0+45       0.0437      0.92  |  QV     |         |         |         |
    0+50       0.0497      0.87  |  Q V    |         |         |         |
    0+55       0.0554      0.83  |  Q V    |         |         |         |
    1+ 0       0.0615      0.88  |  Q  V   |         |         |         |
    1+ 5       0.0685      1.01  |   Q  V  |         |         |         |
    1+10       0.0761      1.11  |   Q  V  |         |         |         |
    1+15       0.0840      1.14  |   Q   V |         |         |         |
    1+20       0.0916      1.10  |   Q    V|         |         |         |
    1+25       0.0997      1.19  |   Q     V         |         |         |
    1+30       0.1090      1.34  |    Q    |V        |         |         |
    1+35       0.1181      1.33  |    Q    | V       |         |         |
    1+40       0.1273      1.33  |    Q    |  V      |         |         |
    1+45       0.1378      1.52  |     Q   |   V     |         |         |
    1+50       0.1490      1.63  |     Q   |    V    |         |         |
    1+55       0.1599      1.57  |     Q   |     V   |         |         |
    2+ 0       0.1706      1.55  |     Q   |      V  |         |         |
    2+ 5       0.1815      1.59  |     Q   |        V|         |         |
    2+10       0.1942      1.85  |      Q  |         V         |         |
    2+15       0.2099      2.28  |        Q|         | V       |         |
    2+20       0.2251      2.20  |       Q |         |  V      |         |
    2+25       0.2448      2.86  |         |Q        |    V    |         |
    2+30       0.2728      4.07  |         |     Q   |       V |         |
    2+35       0.3065      4.88  |         |        Q|         | V       |
    2+40       0.3372      4.46  |         |      Q  |         |    V    |
    2+45       0.3554      2.65  |         Q         |         |      V  |
    2+50       0.3654      1.45  |    Q    |         |         |       V |
    2+55       0.3731      1.12  |   Q     |         |         |        V|
    3+ 0       0.3781      0.73  | Q       |         |         |        V|
    3+ 5       0.3801      0.28  |Q        |         |         |        V|
    3+10       0.3807      0.08  Q         |         |         |        V|
    3+15       0.3808      0.03  Q         |         |         |        V|
    3+20       0.3809      0.01  Q         |         |         |        V|
-----------------------------------------------------------------------
```

U n i t   H y d r o g r a p h   A n a l y s i s

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Study date 07/23/19 File: DMAC5EXIST65.out

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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978

Program License Serial Number 6388

English (in-lb) Input Units Used
English Rainfall Data (Inches) Input Values Used

English Units used in output format

KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
EXISTING CONDITION, DMA C
5-YR 6-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019

Drainage Area = 7.50(Ac.) = 0.012 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment = 7.50(Ac.) = 0.012 Sq. Mi.
Length along longest watercourse = 860.00(Ft.)
Length along longest watercourse measured to centroid = 749.00(Ft.)
Length along longest watercourse = 0.163 Mi.
Length along longest watercourse measured to centroid = 0.142 Mi.
Difference in elevation = 21.50(Ft.)
Slope along watercourse = 132.0000 Ft./Mi.
Average Manning's 'N' = 0.020
Lag time = 0.045 Hr.
Lag time = 2.72 Min.
25% of lag time = 0.68 Min.
40% of lag time = 1.09 Min.
Unit time = 5.00 Min.
Duration of storm = 6 Hour(s)
User Entered Base Flow = 0.00(CFS)

2 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	Weighting[1*2]
7.50	1.21	9.07

100 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	Weighting[1*2]
7.50	2.86	21.45

STORM EVENT (YEAR) = 5.00
Area Averaged 2-Year Rainfall = 1.210(In)
Area Averaged 100-Year Rainfall = 2.860(In)

Point rain (area averaged) = 1.596(In)
Areal adjustment factor = 100.00 %
Adjusted average point rain = 1.596(In)

Sub-Area Data:

Area(Ac.)	Runoff Index	Impervious %
7.500	56.00	0.500

Total Area Entered = 7.50(Ac.)

RI AMC2	RI AMC-1	Infil. Rate (In/Hr)	Impervious (Dec.%)	Adj. Infil. Rate (In/Hr)	Area% (Dec.)	F (In/Hr)
56.0	36.0	0.706	0.500	0.388	1.000	0.388
					Sum (F) =	0.388

Area averaged mean soil loss (F) (In/Hr) = 0.388
Minimum soil loss rate ((In/Hr)) = 0.194

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.500

U n i t H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.083	183.771	40.452	3.058
2	0.167	367.541	44.515	3.365
3	0.250	551.312	9.487	0.717
4	0.333	735.082	3.846	0.291
5	0.417	918.853	1.700	0.128
			Sum = 100.000	Sum= 7.559

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Low	Effective (In/Hr)
1	0.08	0.50	0.096	(0.388)	0.048	0.048
2	0.17	0.60	0.115	(0.388)	0.057	0.057
3	0.25	0.60	0.115	(0.388)	0.057	0.057
4	0.33	0.60	0.115	(0.388)	0.057	0.057
5	0.42	0.60	0.115	(0.388)	0.057	0.057
6	0.50	0.70	0.134	(0.388)	0.067	0.067
7	0.58	0.70	0.134	(0.388)	0.067	0.067
8	0.67	0.70	0.134	(0.388)	0.067	0.067
9	0.75	0.70	0.134	(0.388)	0.067	0.067
10	0.83	0.70	0.134	(0.388)	0.067	0.067
11	0.92	0.70	0.134	(0.388)	0.067	0.067
12	1.00	0.80	0.153	(0.388)	0.077	0.077
13	1.08	0.80	0.153	(0.388)	0.077	0.077
14	1.17	0.80	0.153	(0.388)	0.077	0.077
15	1.25	0.80	0.153	(0.388)	0.077	0.077
16	1.33	0.80	0.153	(0.388)	0.077	0.077
17	1.42	0.80	0.153	(0.388)	0.077	0.077
18	1.50	0.80	0.153	(0.388)	0.077	0.077
19	1.58	0.80	0.153	(0.388)	0.077	0.077
20	1.67	0.80	0.153	(0.388)	0.077	0.077
21	1.75	0.80	0.153	(0.388)	0.077	0.077
22	1.83	0.80	0.153	(0.388)	0.077	0.077
23	1.92	0.80	0.153	(0.388)	0.077	0.077
24	2.00	0.90	0.172	(0.388)	0.086	0.086
25	2.08	0.80	0.153	(0.388)	0.077	0.077
26	2.17	0.90	0.172	(0.388)	0.086	0.086
27	2.25	0.90	0.172	(0.388)	0.086	0.086
28	2.33	0.90	0.172	(0.388)	0.086	0.086
29	2.42	0.90	0.172	(0.388)	0.086	0.086
30	2.50	0.90	0.172	(0.388)	0.086	0.086
31	2.58	0.90	0.172	(0.388)	0.086	0.086
32	2.67	0.90	0.172	(0.388)	0.086	0.086
33	2.75	1.00	0.192	(0.388)	0.096	0.096
34	2.83	1.00	0.192	(0.388)	0.096	0.096
35	2.92	1.00	0.192	(0.388)	0.096	0.096
36	3.00	1.00	0.192	(0.388)	0.096	0.096
37	3.08	1.00	0.192	(0.388)	0.096	0.096
38	3.17	1.10	0.211	(0.388)	0.105	0.105
39	3.25	1.10	0.211	(0.388)	0.105	0.105
40	3.33	1.10	0.211	(0.388)	0.105	0.105
41	3.42	1.20	0.230	(0.388)	0.115	0.115
42	3.50	1.30	0.249	(0.388)	0.125	0.125
43	3.58	1.40	0.268	(0.388)	0.134	0.134
44	3.67	1.40	0.268	(0.388)	0.134	0.134
45	3.75	1.50	0.287	(0.388)	0.144	0.144
46	3.83	1.50	0.287	(0.388)	0.144	0.144
47	3.92	1.60	0.307	(0.388)	0.153	0.153
48	4.00	1.60	0.307	(0.388)	0.153	0.153
49	4.08	1.70	0.326	(0.388)	0.163	0.163
50	4.17	1.80	0.345	(0.388)	0.172	0.172
51	4.25	1.90	0.364	(0.388)	0.182	0.182
52	4.33	2.00	0.383	(0.388)	0.192	0.192
53	4.42	2.10	0.402	(0.388)	0.201	0.201

```
54   4.50     2.10      0.402       (  0.388)       0.201        0.201
55   4.58     2.20      0.421       (  0.388)       0.211        0.211
56   4.67     2.30      0.441       (  0.388)       0.220        0.220
57   4.75     2.40      0.460       (  0.388)       0.230        0.230
58   4.83     2.40      0.460       (  0.388)       0.230        0.230
59   4.92     2.50      0.479       (  0.388)       0.239        0.239
60   5.00     2.60      0.498       (  0.388)       0.249        0.249
61   5.08     3.10      0.594       (  0.388)       0.297        0.297
62   5.17     3.60      0.690       (  0.388)       0.345        0.345
63   5.25     3.90      0.747       (  0.388)       0.374        0.374
64   5.33     4.20      0.805          0.388    (  0.402)        0.416
65   5.42     4.70      0.900          0.388    (  0.450)        0.512
66   5.50     5.60      1.073          0.388    (  0.536)        0.685
67   5.58     1.90      0.364       (  0.388)       0.182        0.182
68   5.67     0.90      0.172       (  0.388)       0.086        0.086
69   5.75     0.60      0.115       (  0.388)       0.057        0.057
70   5.83     0.50      0.096       (  0.388)       0.048        0.048
71   5.92     0.30      0.057       (  0.388)       0.029        0.029
72   6.00     0.20      0.038       (  0.388)       0.019        0.019
              (Loss Rate Not Used)
   Sum =     100.0                                 Sum =     9.8
     Flood volume = Effective rainfall      0.82(In)
      times area       7.5(Ac.)/[(In)/(Ft.)] =       0.5(Ac.Ft)
     Total soil loss =      0.78(In)
     Total soil loss =     0.487(Ac.Ft)
     Total rainfall =      1.60(In)
     Flood volume =       22239.6 Cubic Feet
     Total soil loss =       21223.2 Cubic Feet
     --------------------------------------------------------------------
      Peak flow rate of this hydrograph =      4.270(CFS)
     --------------------------------------------------------------------
     ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                         6 - H O U R    S T O R M
                    R u n o f f     H y d r o g r a p h
     --------------------------------------------------------------------
                 Hydrograph in   5   Minute intervals ((CFS))

     --------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0        2.5       5.0       7.5      10.0
-----------------------------------------------------------------------
  0+ 5       0.0010      0.15  Q         |         |         |         |
  0+10       0.0033      0.34  VQ        |         |         |         |
  0+15       0.0061      0.40  VQ        |         |         |         |
  0+20       0.0090      0.42  VQ        |         |         |         |
  0+25       0.0120      0.43  VQ        |         |         |         |
  0+30       0.0152      0.46  |Q        |         |         |         |
  0+35       0.0186      0.50  |Q        |         |         |         |
  0+40       0.0221      0.50  |VQ       |         |         |         |
  0+45       0.0256      0.51  | Q       |         |         |         |
  0+50       0.0291      0.51  | Q       |         |         |         |
  0+55       0.0326      0.51  | Q       |         |         |         |
  1+ 0       0.0363      0.54  | Q       |         |         |         |
  1+ 5       0.0402      0.57  | QV      |         |         |         |
  1+10       0.0441      0.58  | QV      |         |         |         |
  1+15       0.0481      0.58  | QV      |         |         |         |
  1+20       0.0521      0.58  | Q V     |         |         |         |
  1+25       0.0561      0.58  | Q V     |         |         |         |
  1+30       0.0601      0.58  | Q V     |         |         |         |
  1+35       0.0641      0.58  | Q  V    |         |         |         |
  1+40       0.0681      0.58  | Q  V    |         |         |         |
  1+45       0.0721      0.58  | Q  V    |         |         |         |
  1+50       0.0761      0.58  | Q  V    |         |         |         |
  1+55       0.0800      0.58  | Q   V   |         |         |         |
  2+ 0       0.0842      0.61  | Q   V   |         |         |         |
  2+ 5       0.0885      0.61  | Q   V   |         |         |         |
  2+10       0.0927      0.62  | Q    V  |         |         |         |
  2+15       0.0971      0.64  | Q    V  |         |         |         |
  2+20       0.1016      0.65  | Q    V  |         |         |         |
  2+25       0.1061      0.65  | Q     V |         |         |         |
  2+30       0.1106      0.65  | Q     V |         |         |         |
  2+35       0.1151      0.65  | Q      V|         |         |         |
  2+40       0.1196      0.65  | Q      V|         |         |         |
  2+45       0.1242      0.68  | Q      V|         |         |         |
  2+50       0.1292      0.71  | Q       V         |         |         |
  2+55       0.1341      0.72  | Q       V         |         |         |
  3+ 0       0.1391      0.72  | Q       V         |         |         |
  3+ 5       0.1441      0.72  | Q       |V        |         |         |
  3+10       0.1493      0.75  |  Q      |V        |         |         |
  3+15       0.1547      0.79  |  Q      | V       |         |         |
```

```
    3+20       0.1601      0.79  |  Q      | V       |         |         |
    3+25       0.1658      0.82  |  Q      | V       |         |         |
    3+30       0.1719      0.89  |  Q      |  V      |         |         |
    3+35       0.1785      0.96  |  Q      |  V      |         |         |
    3+40       0.1854      1.00  |  Q      |   V     |         |         |
    3+45       0.1926      1.04  |   Q     |    V    |         |         |
    3+50       0.2000      1.07  |   Q     |    V    |         |         |
    3+55       0.2076      1.11  |   Q     |     V   |         |         |
    4+ 0       0.2155      1.15  |   Q     |     V   |         |         |
    4+ 5       0.2237      1.18  |   Q     |      V  |         |         |
    4+10       0.2323      1.25  |   Q     |       V |         |         |
    4+15       0.2413      1.32  |    Q    |       V |         |         |
    4+20       0.2509      1.39  |    Q    |        V|         |         |
    4+25       0.2610      1.46  |    Q    |         V         |         |
    4+30       0.2713      1.51  |     Q   |         |V        |         |
    4+35       0.2820      1.55  |     Q   |         | V       |         |
    4+40       0.2931      1.61  |     Q   |         | V       |         |
    4+45       0.3047      1.68  |     Q   |         |  V      |         |
    4+50       0.3165      1.72  |     Q   |         |   V     |         |
    4+55       0.3287      1.76  |      Q  |         |    V    |         |
    5+ 0       0.3412      1.83  |      Q  |         |     V   |         |
    5+ 5       0.3551      2.01  |       Q |         |      V  |         |
    5+10       0.3712      2.33  |        Q|         |        V|         |
    5+15       0.3892      2.62  |         Q         |         V         |
    5+20       0.4092      2.90  |         |Q        |         | V       |
    5+25       0.4324      3.37  |         |  Q      |         |  V      |
    5+30       0.4618      4.27  |         |      Q  |         |     V   |
    5+35       0.4852      3.40  |         |  Q      |         |       V |
    5+40       0.4960      1.57  |     Q   |         |         |       V |
    5+45       0.5020      0.86  |  Q      |         |         |        V|
    5+50       0.5057      0.54  | Q       |         |         |        V|
    5+55       0.5080      0.34  |Q        |         |         |        V|
    6+ 0       0.5095      0.22  Q         |         |         |        V|
    6+ 5       0.5103      0.11  Q         |         |         |        V|
    6+10       0.5105      0.03  Q         |         |         |        V|
    6+15       0.5105      0.01  Q         |         |         |        V|
    6+20       0.5106      0.00  Q         |         |         |         V
-----------------------------------------------------------------------
```

```
      U n i t   H y d r o g r a p h   A n a l y s i s

      Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2014, Version 9.0
              Study date  07/23/19 File: DMAC5EXIST245.out

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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978


Program License Serial Number 6388

---------------------------------------------------------------------
 English (in-lb) Input Units Used
 English Rainfall Data (Inches) Input Values Used

 English Units used in output format



---------------------------------------------------------------------
KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
EXISTING CONDITION, DMA C
5-YR 24-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019
--------------------------------------------------------------------
Drainage Area =       7.50(Ac.)  =      0.012 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =       7.50(Ac.)  =      0.012 Sq. Mi.
Length along longest watercourse =     860.00(Ft.)
Length along longest watercourse measured to centroid =     749.00(Ft.)
Length along longest watercourse =      0.163 Mi.
Length along longest watercourse measured to centroid =      0.142 Mi.
Difference in elevation =      21.50(Ft.)
Slope along watercourse =    132.0000 Ft./Mi.
Average Manning's 'N' = 0.020
Lag time =    0.045 Hr.
Lag time =     2.72 Min.
25% of lag time =     0.68 Min.
40% of lag time =     1.09 Min.
Unit time =    15.00 Min.
Duration of storm = 24 Hour(s)
User Entered Base Flow =     0.00(CFS)

2 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        7.50           2.05                 15.37

100 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        7.50           5.16                 38.70

STORM EVENT (YEAR) =    5.00
Area Averaged 2-Year Rainfall =    2.050(In)
Area Averaged 100-Year Rainfall =    5.160(In)

Point rain (area averaged) =    2.778(In)
Areal adjustment factor =  100.00 %
Adjusted average point rain =    2.778(In)

Sub-Area Data:
Area(Ac.)         Runoff Index   Impervious %
     7.500           56.00         0.500
 Total Area Entered =      7.50(Ac.)


RI    RI   Infil. Rate Impervious   Adj. Infil. Rate  Area%     F
AMC2 AMC-1     (In/Hr)    (Dec.%)      (In/Hr)      (Dec.)    (In/Hr)
56.0  36.0      0.706     0.500        0.388       1.000      0.388
                                                  Sum (F) =   0.388
Area averaged mean soil loss (F) (In/Hr) =  0.388
Minimum soil loss rate ((In/Hr)) =  0.194
```

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.500

U n i t H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.250	551.312	73.291	5.540
2	0.500	1102.623	26.709	2.019
			Sum = 100.000	Sum= 7.559

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Loss rate(In./Hr) Low	Effective (In/Hr)
1	0.25	0.20	0.022	(0.686)	0.011	0.011
2	0.50	0.30	0.033	(0.678)	0.017	0.017
3	0.75	0.30	0.033	(0.670)	0.017	0.017
4	1.00	0.40	0.044	(0.662)	0.022	0.022
5	1.25	0.30	0.033	(0.654)	0.017	0.017
6	1.50	0.30	0.033	(0.646)	0.017	0.017
7	1.75	0.30	0.033	(0.639)	0.017	0.017
8	2.00	0.40	0.044	(0.631)	0.022	0.022
9	2.25	0.40	0.044	(0.623)	0.022	0.022
10	2.50	0.40	0.044	(0.616)	0.022	0.022
11	2.75	0.50	0.056	(0.608)	0.028	0.028
12	3.00	0.50	0.056	(0.601)	0.028	0.028
13	3.25	0.50	0.056	(0.593)	0.028	0.028
14	3.50	0.50	0.056	(0.586)	0.028	0.028
15	3.75	0.50	0.056	(0.579)	0.028	0.028
16	4.00	0.60	0.067	(0.571)	0.033	0.033
17	4.25	0.60	0.067	(0.564)	0.033	0.033
18	4.50	0.70	0.078	(0.557)	0.039	0.039
19	4.75	0.70	0.078	(0.550)	0.039	0.039
20	5.00	0.80	0.089	(0.543)	0.044	0.044
21	5.25	0.60	0.067	(0.536)	0.033	0.033
22	5.50	0.70	0.078	(0.529)	0.039	0.039
23	5.75	0.80	0.089	(0.522)	0.044	0.044
24	6.00	0.80	0.089	(0.515)	0.044	0.044
25	6.25	0.90	0.100	(0.508)	0.050	0.050
26	6.50	0.90	0.100	(0.501)	0.050	0.050
27	6.75	1.00	0.111	(0.494)	0.056	0.056
28	7.00	1.00	0.111	(0.488)	0.056	0.056
29	7.25	1.00	0.111	(0.481)	0.056	0.056
30	7.50	1.10	0.122	(0.475)	0.061	0.061
31	7.75	1.20	0.133	(0.468)	0.067	0.067
32	8.00	1.30	0.144	(0.462)	0.072	0.072
33	8.25	1.50	0.167	(0.455)	0.083	0.083
34	8.50	1.50	0.167	(0.449)	0.083	0.083
35	8.75	1.60	0.178	(0.443)	0.089	0.089
36	9.00	1.70	0.189	(0.436)	0.094	0.094
37	9.25	1.90	0.211	(0.430)	0.106	0.106
38	9.50	2.00	0.222	(0.424)	0.111	0.111
39	9.75	2.10	0.233	(0.418)	0.117	0.117
40	10.00	2.20	0.244	(0.412)	0.122	0.122
41	10.25	1.50	0.167	(0.406)	0.083	0.083
42	10.50	1.50	0.167	(0.400)	0.083	0.083
43	10.75	2.00	0.222	(0.394)	0.111	0.111
44	11.00	2.00	0.222	(0.389)	0.111	0.111
45	11.25	1.90	0.211	(0.383)	0.106	0.106
46	11.50	1.90	0.211	(0.377)	0.106	0.106
47	11.75	1.70	0.189	(0.372)	0.094	0.094
48	12.00	1.80	0.200	(0.366)	0.100	0.100
49	12.25	2.50	0.278	(0.361)	0.139	0.139
50	12.50	2.60	0.289	(0.355)	0.144	0.144
51	12.75	2.80	0.311	(0.350)	0.156	0.156
52	13.00	2.90	0.322	(0.345)	0.161	0.161
53	13.25	3.40	0.378	(0.339)	0.189	0.189
54	13.50	3.40	0.378	(0.334)	0.189	0.189
55	13.75	2.30	0.256	(0.329)	0.128	0.128
56	14.00	2.30	0.256	(0.324)	0.128	0.128

57	14.25	2.70	0.300	(0.319)	0.150	0.150
58	14.50	2.60	0.289	(0.314)	0.144	0.144
59	14.75	2.60	0.289	(0.310)	0.144	0.144
60	15.00	2.50	0.278	(0.305)	0.139	0.139
61	15.25	2.40	0.267	(0.300)	0.133	0.133
62	15.50	2.30	0.256	(0.296)	0.128	0.128
63	15.75	1.90	0.211	(0.291)	0.106	0.106
64	16.00	1.90	0.211	(0.287)	0.106	0.106
65	16.25	0.40	0.044	(0.282)	0.022	0.022
66	16.50	0.40	0.044	(0.278)	0.022	0.022
67	16.75	0.30	0.033	(0.274)	0.017	0.017
68	17.00	0.30	0.033	(0.270)	0.017	0.017
69	17.25	0.50	0.056	(0.266)	0.028	0.028
70	17.50	0.50	0.056	(0.262)	0.028	0.028
71	17.75	0.50	0.056	(0.258)	0.028	0.028
72	18.00	0.40	0.044	(0.254)	0.022	0.022
73	18.25	0.40	0.044	(0.250)	0.022	0.022
74	18.50	0.40	0.044	(0.246)	0.022	0.022
75	18.75	0.30	0.033	(0.243)	0.017	0.017
76	19.00	0.20	0.022	(0.239)	0.011	0.011
77	19.25	0.30	0.033	(0.236)	0.017	0.017
78	19.50	0.40	0.044	(0.233)	0.022	0.022
79	19.75	0.30	0.033	(0.230)	0.017	0.017
80	20.00	0.20	0.022	(0.226)	0.011	0.011
81	20.25	0.30	0.033	(0.223)	0.017	0.017
82	20.50	0.30	0.033	(0.221)	0.017	0.017
83	20.75	0.30	0.033	(0.218)	0.017	0.017
84	21.00	0.20	0.022	(0.215)	0.011	0.011
85	21.25	0.30	0.033	(0.213)	0.017	0.017
86	21.50	0.20	0.022	(0.210)	0.011	0.011
87	21.75	0.30	0.033	(0.208)	0.017	0.017
88	22.00	0.20	0.022	(0.206)	0.011	0.011
89	22.25	0.30	0.033	(0.204)	0.017	0.017
90	22.50	0.20	0.022	(0.202)	0.011	0.011
91	22.75	0.20	0.022	(0.200)	0.011	0.011
92	23.00	0.20	0.022	(0.198)	0.011	0.011
93	23.25	0.20	0.022	(0.197)	0.011	0.011
94	23.50	0.20	0.022	(0.196)	0.011	0.011
95	23.75	0.20	0.022	(0.195)	0.011	0.011
96	24.00	0.20	0.022	(0.194)	0.011	0.011
				(Loss Rate Not Used)		
	Sum =	100.0			Sum =	5.6

```
      Flood volume = Effective rainfall      1.39(In)
       times area       7.5(Ac.)/[(In)/(Ft.)] =       0.9(Ac.Ft)
      Total soil loss =      1.39(In)
      Total soil loss =     0.868(Ac.Ft)
      Total rainfall =      2.78(In)
      Flood volume =       37820.9 Cubic Feet
      Total soil loss =       37820.9 Cubic Feet
      --------------------------------------------------------------------
       Peak flow rate of this hydrograph =      1.429(CFS)
      --------------------------------------------------------------------
      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                          24 - H O U R   S T O R M
                     R u n o f f     H y d r o g r a p h
      --------------------------------------------------------------------
                  Hydrograph in  15   Minute intervals ((CFS))

      --------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0        2.5       5.0       7.5      10.0
-----------------------------------------------------------------------
  0+15       0.0013      0.06  Q         |         |         |         |
  0+30       0.0036      0.11  Q         |         |         |         |
  0+45       0.0063      0.13  Q         |         |         |         |
  1+ 0       0.0095      0.16  Q         |         |         |         |
  1+15       0.0123      0.14  Q         |         |         |         |
  1+30       0.0149      0.13  Q         |         |         |         |
  1+45       0.0175      0.13  Q         |         |         |         |
  2+ 0       0.0208      0.16  Q         |         |         |         |
  2+15       0.0243      0.17  QV        |         |         |         |
  2+30       0.0277      0.17  QV        |         |         |         |
  2+45       0.0318      0.20  QV        |         |         |         |
  3+ 0       0.0362      0.21  QV        |         |         |         |
  3+15       0.0405      0.21  QV        |         |         |         |
  3+30       0.0449      0.21  Q V       |         |         |         |
  3+45       0.0492      0.21  Q V       |         |         |         |
  4+ 0       0.0542      0.24  Q V       |         |         |         |
  4+15       0.0594      0.25  |QV       |         |         |         |
  4+30       0.0652      0.28  |Q V      |         |         |         |
```

```
 4+45       0.0713      0.29  |Q V      |         |         |         |
 5+ 0       0.0780      0.32  |Q V      |         |         |         |
 5+15       0.0837      0.27  |Q V      |         |         |         |
 5+30       0.0895      0.28  |Q  V     |         |         |         |
 5+45       0.0963      0.32  |Q  V     |         |         |         |
 6+ 0       0.1032      0.34  |Q  V     |         |         |         |
 6+15       0.1108      0.37  |Q   V    |         |         |         |
 6+30       0.1186      0.38  |Q   V    |         |         |         |
 6+45       0.1271      0.41  |Q   V    |         |         |         |
 7+ 0       0.1357      0.42  |Q    V   |         |         |         |
 7+15       0.1444      0.42  |Q    V   |         |         |         |
 7+30       0.1537      0.45  |Q     V  |         |         |         |
 7+45       0.1639      0.49  |Q     V  |         |         |         |
 8+ 0       0.1750      0.54  | Q     V |         |         |         |
 8+15       0.1875      0.61  | Q     V |         |         |         |
 8+30       0.2006      0.63  | Q      V|         |         |         |
 8+45       0.2142      0.66  | Q      V|         |         |         |
 9+ 0       0.2287      0.70  | Q       V         |         |         |
 9+15       0.2448      0.78  |  Q       V        |         |         |
 9+30       0.2619      0.83  |  Q      | V       |         |         |
 9+45       0.2799      0.87  |  Q      | V       |         |         |
10+ 0       0.2988      0.91  |  Q      |  V      |         |         |
10+15       0.3134      0.71  | Q       |   V     |         |         |
10+30       0.3265      0.63  | Q       |    V    |         |         |
10+45       0.3427      0.78  |  Q      |    V    |         |         |
11+ 0       0.3600      0.84  |  Q      |     V   |         |         |
11+15       0.3768      0.81  |  Q      |      V  |         |         |
11+30       0.3933      0.80  |  Q      |       V |         |         |
11+45       0.4085      0.74  | Q       |       V |         |         |
12+ 0       0.4239      0.75  | Q       |        V|         |         |
12+15       0.4440      0.97  |  Q      |         V         |         |
12+30       0.4663      1.08  |   Q     |          V        |         |
12+45       0.4901      1.15  |   Q     |         | V       |         |
13+ 0       0.5151      1.21  |   Q     |         |  V      |         |
13+15       0.5435      1.37  |    Q    |         |    V    |         |
13+30       0.5730      1.43  |    Q    |         |     V   |         |
13+45       0.5955      1.09  |   Q     |         |      V  |         |
14+ 0       0.6155      0.97  |  Q      |         |       V |         |
14+15       0.6380      1.09  |   Q     |         |        V|         |
14+30       0.6608      1.10  |   Q     |         |         V         |
14+45       0.6834      1.09  |   Q     |         |          V        |
15+ 0       0.7053      1.06  |   Q     |         |         | V       |
15+15       0.7264      1.02  |   Q     |         |         |  V      |
15+30       0.7466      0.98  |  Q      |         |         |   V     |
15+45       0.7640      0.84  |  Q      |         |         |    V    |
16+ 0       0.7805      0.80  |  Q      |         |         |    V    |
16+15       0.7874      0.34  |Q        |         |         |     V   |
16+30       0.7909      0.17  Q         |         |         |     V   |
16+45       0.7938      0.14  Q         |         |         |     V   |
17+ 0       0.7964      0.13  Q         |         |         |     V   |
17+15       0.8002      0.19  Q         |         |         |     V   |
17+30       0.8046      0.21  Q         |         |         |      V  |
17+45       0.8089      0.21  Q         |         |         |      V  |
18+ 0       0.8126      0.18  Q         |         |         |      V  |
18+15       0.8161      0.17  Q         |         |         |      V  |
18+30       0.8196      0.17  Q         |         |         |      V  |
18+45       0.8224      0.14  Q         |         |         |      V  |
19+ 0       0.8244      0.10  Q         |         |         |      V  |
19+15       0.8267      0.11  Q         |         |         |       V |
19+30       0.8300      0.16  Q         |         |         |       V |
19+45       0.8328      0.14  Q         |         |         |       V |
20+ 0       0.8348      0.10  Q         |         |         |       V |
20+15       0.8372      0.11  Q         |         |         |       V |
20+30       0.8398      0.13  Q         |         |         |       V |
20+45       0.8424      0.13  Q         |         |         |       V |
21+ 0       0.8443      0.10  Q         |         |         |       V |
21+15       0.8467      0.11  Q         |         |         |        V|
21+30       0.8487      0.10  Q         |         |         |        V|
21+45       0.8511      0.11  Q         |         |         |        V|
22+ 0       0.8530      0.10  Q         |         |         |        V|
22+15       0.8554      0.11  Q         |         |         |        V|
22+30       0.8574      0.10  Q         |         |         |        V|
22+45       0.8591      0.08  Q         |         |         |        V|
23+ 0       0.8608      0.08  Q         |         |         |        V|
23+15       0.8626      0.08  Q         |         |         |        V|
23+30       0.8643      0.08  Q         |         |         |        V|
23+45       0.8660      0.08  Q         |         |         |        V|
24+ 0       0.8678      0.08  Q         |         |         |        V|
24+15       0.8682      0.02  Q         |         |         |         V
```

U n i t   H y d r o g r a p h   A n a l y s i s

Study date 07/23/19 File: DMAC5PROP15.out

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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978

Program License Serial Number 6388

English (in-lb) Input Units Used
English Rainfall Data (Inches) Input Values Used

English Units used in output format

KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
PROPOSED CONDITION, DMA C
5-YR 1-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019

Drainage Area = 7.50(Ac.) = 0.012 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment = 7.50(Ac.) = 0.012 Sq. Mi.
Length along longest watercourse = 860.00(Ft.)
Length along longest watercourse measured to centroid = 749.00(Ft.)
Length along longest watercourse = 0.163 Mi.
Length along longest watercourse measured to centroid = 0.142 Mi.
Difference in elevation = 21.50(Ft.)
Slope along watercourse = 132.0000 Ft./Mi.
Average Manning's 'N' = 0.015
Lag time = 0.034 Hr.
Lag time = 2.04 Min.
25% of lag time = 0.51 Min.
40% of lag time = 0.82 Min.
Unit time = 5.00 Min.
Duration of storm = 1 Hour(s)
User Entered Base Flow = 0.00(CFS)

2 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	Weighting[1*2]
7.50	0.49	3.67

100 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	Weighting[1*2]
7.50	1.33	9.98

STORM EVENT (YEAR) = 5.00
Area Averaged 2-Year Rainfall = 0.489(In)
Area Averaged 100-Year Rainfall = 1.330(In)

Point rain (area averaged) = 0.686(In)
Areal adjustment factor = 99.99 %
Adjusted average point rain = 0.686(In)

Sub-Area Data:

Area(Ac.)	Runoff Index	Impervious %
7.500	56.00	0.760

Total Area Entered = 7.50(Ac.)

RI AMC2	RI AMC-1	Infil. Rate (In/Hr)	Impervious (Dec.%)	Adj. Infil. Rate (In/Hr)	Area% (Dec.)	F (In/Hr)
56.0	36.0	0.706	0.760	0.223	1.000	0.223
					Sum (F) =	0.223

Area averaged mean soil loss (F) (In/Hr) = 0.223
Minimum soil loss rate ((In/Hr)) = 0.112

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.290

Slope of intensity-duration curve for a 1 hour storm =0.5000

U n i t   H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.083	245.027	50.239	3.797
2	0.167	490.055	40.364	3.051
3	0.250	735.082	7.184	0.543
4	0.333	980.109	2.213	0.167
			Sum = 100.000	Sum= 7.559

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Loss rate(In./Hr) Low	Effective (In/Hr)
1	0.08	4.20	0.346	(0.223)	0.100	0.245
2	0.17	4.30	0.354	(0.223)	0.103	0.251
3	0.25	5.00	0.412	(0.223)	0.119	0.292
4	0.33	5.00	0.412	(0.223)	0.119	0.292
5	0.42	5.80	0.477	(0.223)	0.138	0.339
6	0.50	6.50	0.535	(0.223)	0.155	0.380
7	0.58	7.40	0.609	(0.223)	0.177	0.432
8	0.67	8.60	0.708	(0.223)	0.205	0.503
9	0.75	12.30	1.012	0.223	(0.294)	0.789
10	0.83	29.10	2.395	0.223	(0.695)	2.172
11	0.92	6.80	0.560	(0.223)	0.162	0.397
12	1.00	5.00	0.412	(0.223)	0.119	0.292

(Loss Rate Not Used)

Sum = 100.0 Sum = 6.4

Flood volume = Effective rainfall 0.53(In)
times area 7.5(Ac.)/[(In)/(Ft.)] = 0.3(Ac.Ft)
Total soil loss = 0.15(In)
Total soil loss = 0.096(Ac.Ft)
Total rainfall = 0.69(In)
Flood volume = 14488.7 Cubic Feet
Total soil loss = 4185.9 Cubic Feet

Peak flow rate of this hydrograph = 11.008(CFS)

+++

1 - H O U R   S T O R M
R u n o f f   H y d r o g r a p h

Hydrograph in 5 Minute intervals ((CFS))

```
Time(h+m) Volume Ac.Ft   Q(CFS)  0        5.0      10.0      15.0      20.0
-----------------------------------------------------------------------
  0+ 5     0.0064      0.93  VQ        |         |         |         |
  0+10     0.0182      1.70  | VQ      |         |         |         |
  0+15     0.0320      2.01  |  VQ     |         |         |         |
  0+20     0.0470      2.18  |   QV    |         |         |         |
  0+25     0.0634      2.38  |   Q  V  |         |         |         |
  0+30     0.0819      2.69  |    Q   V|         |         |         |
  0+35     0.1028      3.04  |     Q   | V       |         |         |
  0+40     0.1269      3.49  |     Q   |    V    |         |         |
  0+45     0.1601      4.83  |        Q|        V|         |         |
  0+50     0.2360     11.01  |         |         | Q     V |         |
  0+55     0.2956      8.65  |         |     Q   |         |    V    |
  1+ 0     0.3206      3.64  |       Q |         |         |       V |
  1+ 5     0.3307      1.47  | Q       |         |         |        V|
  1+10     0.3323      0.23  Q         |         |         |        V|
  1+15     0.3326      0.05  Q         |         |         |         V
-----------------------------------------------------------------------
```

```
      U n i t   H y d r o g r a p h   A n a l y s i s

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             Study date  07/23/19 File: DMAC5PROP35.out


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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978


Program License Serial Number 6388

---------------------------------------------------------------------
 English (in-lb) Input Units Used
 English Rainfall Data (Inches) Input Values Used

 English Units used in output format



---------------------------------------------------------------------
KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
PROPOSED CONDITION, DMA C
5-YR 3-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019
--------------------------------------------------------------------
Drainage Area =       7.50(Ac.)  =      0.012 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =       7.50(Ac.)  =      0.012 Sq. Mi.
Length along longest watercourse =     860.00(Ft.)
Length along longest watercourse measured to centroid =     749.00(Ft.)
Length along longest watercourse =      0.163 Mi.
Length along longest watercourse measured to centroid =      0.142 Mi.
Difference in elevation =      21.50(Ft.)
Slope along watercourse =    132.0000 Ft./Mi.
Average Manning's 'N' = 0.015
Lag time =    0.034 Hr.
Lag time =     2.04 Min.
25% of lag time =     0.51 Min.
40% of lag time =     0.82 Min.
Unit time =     5.00 Min.
Duration of storm = 3 Hour(s)
User Entered Base Flow =     0.00(CFS)

2 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        7.50           0.87                  6.50

100 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        7.50           2.09                 15.67

STORM EVENT (YEAR) =    5.00
Area Averaged 2-Year Rainfall =    0.866(In)
Area Averaged 100-Year Rainfall =    2.090(In)

Point rain (area averaged) =    1.153(In)
Areal adjustment factor =  100.00 %
Adjusted average point rain =    1.153(In)

Sub-Area Data:
Area(Ac.)         Runoff Index   Impervious %
     7.500           56.00         0.760
 Total Area Entered =      7.50(Ac.)


RI    RI   Infil. Rate Impervious   Adj. Infil. Rate  Area%     F
AMC2 AMC-1     (In/Hr)    (Dec.%)      (In/Hr)      (Dec.)    (In/Hr)
56.0  36.0      0.706     0.760        0.223       1.000      0.223
                                                 Sum (F) =   0.223
Area averaged mean soil loss (F) (In/Hr) =  0.223
Minimum soil loss rate ((In/Hr)) =  0.112
```

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.290

U n i t H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.083	245.027	50.239	3.797
2	0.167	490.055	40.364	3.051
3	0.250	735.082	7.184	0.543
4	0.333	980.109	2.213	0.167
			Sum = 100.000	Sum= 7.559

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Low	Effective (In/Hr)
1	0.08	1.30	0.180	(0.223)	0.052	0.128
2	0.17	1.30	0.180	(0.223)	0.052	0.128
3	0.25	1.10	0.152	(0.223)	0.044	0.108
4	0.33	1.50	0.207	(0.223)	0.060	0.147
5	0.42	1.50	0.207	(0.223)	0.060	0.147
6	0.50	1.80	0.249	(0.223)	0.072	0.177
7	0.58	1.50	0.207	(0.223)	0.060	0.147
8	0.67	1.80	0.249	(0.223)	0.072	0.177
9	0.75	1.80	0.249	(0.223)	0.072	0.177
10	0.83	1.50	0.207	(0.223)	0.060	0.147
11	0.92	1.60	0.221	(0.223)	0.064	0.157
12	1.00	1.80	0.249	(0.223)	0.072	0.177
13	1.08	2.20	0.304	(0.223)	0.088	0.216
14	1.17	2.20	0.304	(0.223)	0.088	0.216
15	1.25	2.20	0.304	(0.223)	0.088	0.216
16	1.33	2.00	0.277	(0.223)	0.080	0.196
17	1.42	2.60	0.360	(0.223)	0.104	0.255
18	1.50	2.70	0.373	(0.223)	0.108	0.265
19	1.58	2.40	0.332	(0.223)	0.096	0.236
20	1.67	2.70	0.373	(0.223)	0.108	0.265
21	1.75	3.30	0.456	(0.223)	0.132	0.324
22	1.83	3.10	0.429	(0.223)	0.124	0.304
23	1.92	2.90	0.401	(0.223)	0.116	0.285
24	2.00	3.00	0.415	(0.223)	0.120	0.295
25	2.08	3.10	0.429	(0.223)	0.124	0.304
26	2.17	4.20	0.581	(0.223)	0.168	0.412
27	2.25	5.00	0.692	(0.223)	0.201	0.491
28	2.33	3.50	0.484	(0.223)	0.140	0.344
29	2.42	6.80	0.941	0.223	(0.273)	0.717
30	2.50	7.30	1.010	0.223	(0.293)	0.787
31	2.58	8.20	1.134	0.223	(0.329)	0.911
32	2.67	5.90	0.816	0.223	(0.237)	0.593
33	2.75	2.00	0.277	(0.223)	0.080	0.196
34	2.83	1.80	0.249	(0.223)	0.072	0.177
35	2.92	1.80	0.249	(0.223)	0.072	0.177
36	3.00	0.60	0.083	(0.223)	0.024	0.059

(Loss Rate Not Used)
Sum = 100.0 Sum = 10.1

Flood volume = Effective rainfall 0.84(In)
times area 7.5(Ac.)/[(In)/(Ft.)] = 0.5(Ac.Ft)
Total soil loss = 0.31(In)
Total soil loss = 0.196(Ac.Ft)
Total rainfall = 1.15(In)
Flood volume = 22822.2 Cubic Feet
Total soil loss = 8558.7 Cubic Feet

Peak flow rate of this hydrograph = 6.310(CFS)

++

3 - H O U R S T O R M
R u n o f f H y d r o g r a p h

Hydrograph in 5 Minute intervals ((CFS))

```
       --------------------------------------------------------------------
  Time(h+m) Volume Ac.Ft   Q(CFS)  0        2.5       5.0       7.5      10.0
  -----------------------------------------------------------------------
    0+ 5       0.0033      0.49  VQ        |         |         |         |
    0+10       0.0094      0.87  V  Q      |         |         |         |
    0+15       0.0154      0.87  |V Q      |         |         |         |
    0+20       0.0221      0.98  |V Q      |         |         |         |
    0+25       0.0296      1.09  | V Q     |         |         |         |
    0+30       0.0380      1.22  | V Q     |         |         |         |
    0+35       0.0463      1.20  |  VQ     |         |         |         |
    0+40       0.0548      1.24  |   Q     |         |         |         |
    0+45       0.0639      1.32  |   VQ    |         |         |         |
    0+50       0.0723      1.22  |   QV    |         |         |         |
    0+55       0.0804      1.17  |   Q V   |         |         |         |
    1+ 0       0.0891      1.26  |    QV   |         |         |         |
    1+ 5       0.0992      1.47  |    Q V  |         |         |         |
    1+10       0.1103      1.60  |     Q V |         |         |         |
    1+15       0.1215      1.63  |     Q  V|         |         |         |
    1+20       0.1322      1.56  |     Q   V         |         |         |
    1+25       0.1441      1.72  |     Q   |V        |         |         |
    1+30       0.1574      1.93  |      Q  | V       |         |         |
    1+35       0.1703      1.88  |      Q  |  V      |         |         |
    1+40       0.1835      1.91  |      Q  |   V     |         |         |
    1+45       0.1987      2.21  |       Q |    V    |         |         |
    1+50       0.2148      2.33  |        Q|     V   |         |         |
    1+55       0.2301      2.23  |       Q |      V  |         |         |
    2+ 0       0.2453      2.21  |       Q |       V |         |         |
    2+ 5       0.2609      2.26  |        Q|        V|         |         |
    2+10       0.2795      2.70  |         Q         |V        |         |
    2+15       0.3025      3.34  |         |  Q      |  V      |         |
    2+20       0.3238      3.08  |         | Q       |   V     |         |
    2+25       0.3521      4.11  |         |     Q   |     V   |         |
    2+30       0.3896      5.45  |         |         |Q       V|         |
    2+35       0.4330      6.31  |         |         |    Q    |  V      |
    2+40       0.4715      5.58  |         |         | Q       |    V    |
    2+45       0.4934      3.18  |         | Q       |         |      V  |
    2+50       0.5054      1.75  |     Q   |         |         |       V |
    2+55       0.5152      1.42  |    Q    |         |         |        V|
    3+ 0       0.5213      0.89  |  Q      |         |         |        V|
    3+ 5       0.5234      0.31  |Q        |         |         |        V|
    3+10       0.5239      0.06  Q         |         |         |        V|
    3+15       0.5239      0.01  Q         |         |         |         V
-----------------------------------------------------------------------
```

```
      U n i t   H y d r o g r a p h   A n a l y s i s

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              Study date  07/23/19 File: DMAC5PROP65.out

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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978


Program License Serial Number 6388

---------------------------------------------------------------------
 English (in-lb) Input Units Used
 English Rainfall Data (Inches) Input Values Used

 English Units used in output format



---------------------------------------------------------------------
KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
PROPOSED CONDITION, DMA C
5-YR 6-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019
--------------------------------------------------------------------
Drainage Area =       7.50(Ac.)  =      0.012 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =       7.50(Ac.)  =      0.012 Sq. Mi.
Length along longest watercourse =     860.00(Ft.)
Length along longest watercourse measured to centroid =     749.00(Ft.)
Length along longest watercourse =      0.163 Mi.
Length along longest watercourse measured to centroid =      0.142 Mi.
Difference in elevation =      21.50(Ft.)
Slope along watercourse =    132.0000 Ft./Mi.
Average Manning's 'N' = 0.015
Lag time =    0.034 Hr.
Lag time =     2.04 Min.
25% of lag time =     0.51 Min.
40% of lag time =     0.82 Min.
Unit time =     5.00 Min.
Duration of storm = 6 Hour(s)
User Entered Base Flow =     0.00(CFS)

2 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        7.50           1.21                  9.07

100 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        7.50           2.86                 21.45

STORM EVENT (YEAR) =    5.00
Area Averaged 2-Year Rainfall =    1.210(In)
Area Averaged 100-Year Rainfall =    2.860(In)

Point rain (area averaged) =    1.596(In)
Areal adjustment factor =  100.00 %
Adjusted average point rain =    1.596(In)

Sub-Area Data:
Area(Ac.)         Runoff Index   Impervious %
     7.500           56.00         0.760
 Total Area Entered =      7.50(Ac.)


RI    RI   Infil. Rate Impervious   Adj. Infil. Rate  Area%     F
AMC2 AMC-1     (In/Hr)    (Dec.%)      (In/Hr)      (Dec.)    (In/Hr)
56.0  36.0      0.706     0.760        0.223       1.000      0.223
                                                 Sum (F) =   0.223
Area averaged mean soil loss (F) (In/Hr) =  0.223
Minimum soil loss rate ((In/Hr)) =  0.112
```

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.290

U n i t H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.083	245.027	50.239	3.797
2	0.167	490.055	40.364	3.051
3	0.250	735.082	7.184	0.543
4	0.333	980.109	2.213	0.167
			Sum = 100.000	Sum= 7.559

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Loss rate(In./Hr) Low	Effective (In/Hr)
1	0.08	0.50	0.096	(0.223)	0.028	0.068
2	0.17	0.60	0.115	(0.223)	0.033	0.082
3	0.25	0.60	0.115	(0.223)	0.033	0.082
4	0.33	0.60	0.115	(0.223)	0.033	0.082
5	0.42	0.60	0.115	(0.223)	0.033	0.082
6	0.50	0.70	0.134	(0.223)	0.039	0.095
7	0.58	0.70	0.134	(0.223)	0.039	0.095
8	0.67	0.70	0.134	(0.223)	0.039	0.095
9	0.75	0.70	0.134	(0.223)	0.039	0.095
10	0.83	0.70	0.134	(0.223)	0.039	0.095
11	0.92	0.70	0.134	(0.223)	0.039	0.095
12	1.00	0.80	0.153	(0.223)	0.044	0.109
13	1.08	0.80	0.153	(0.223)	0.044	0.109
14	1.17	0.80	0.153	(0.223)	0.044	0.109
15	1.25	0.80	0.153	(0.223)	0.044	0.109
16	1.33	0.80	0.153	(0.223)	0.044	0.109
17	1.42	0.80	0.153	(0.223)	0.044	0.109
18	1.50	0.80	0.153	(0.223)	0.044	0.109
19	1.58	0.80	0.153	(0.223)	0.044	0.109
20	1.67	0.80	0.153	(0.223)	0.044	0.109
21	1.75	0.80	0.153	(0.223)	0.044	0.109
22	1.83	0.80	0.153	(0.223)	0.044	0.109
23	1.92	0.80	0.153	(0.223)	0.044	0.109
24	2.00	0.90	0.172	(0.223)	0.050	0.122
25	2.08	0.80	0.153	(0.223)	0.044	0.109
26	2.17	0.90	0.172	(0.223)	0.050	0.122
27	2.25	0.90	0.172	(0.223)	0.050	0.122
28	2.33	0.90	0.172	(0.223)	0.050	0.122
29	2.42	0.90	0.172	(0.223)	0.050	0.122
30	2.50	0.90	0.172	(0.223)	0.050	0.122
31	2.58	0.90	0.172	(0.223)	0.050	0.122
32	2.67	0.90	0.172	(0.223)	0.050	0.122
33	2.75	1.00	0.192	(0.223)	0.056	0.136
34	2.83	1.00	0.192	(0.223)	0.056	0.136
35	2.92	1.00	0.192	(0.223)	0.056	0.136
36	3.00	1.00	0.192	(0.223)	0.056	0.136
37	3.08	1.00	0.192	(0.223)	0.056	0.136
38	3.17	1.10	0.211	(0.223)	0.061	0.150
39	3.25	1.10	0.211	(0.223)	0.061	0.150
40	3.33	1.10	0.211	(0.223)	0.061	0.150
41	3.42	1.20	0.230	(0.223)	0.067	0.163
42	3.50	1.30	0.249	(0.223)	0.072	0.177
43	3.58	1.40	0.268	(0.223)	0.078	0.190
44	3.67	1.40	0.268	(0.223)	0.078	0.190
45	3.75	1.50	0.287	(0.223)	0.083	0.204
46	3.83	1.50	0.287	(0.223)	0.083	0.204
47	3.92	1.60	0.307	(0.223)	0.089	0.218
48	4.00	1.60	0.307	(0.223)	0.089	0.218
49	4.08	1.70	0.326	(0.223)	0.094	0.231
50	4.17	1.80	0.345	(0.223)	0.100	0.245
51	4.25	1.90	0.364	(0.223)	0.106	0.258
52	4.33	2.00	0.383	(0.223)	0.111	0.272
53	4.42	2.10	0.402	(0.223)	0.117	0.286
54	4.50	2.10	0.402	(0.223)	0.117	0.286

```
55   4.58     2.20      0.421       (  0.223)       0.122        0.299
56   4.67     2.30      0.441       (  0.223)       0.128        0.313
57   4.75     2.40      0.460       (  0.223)       0.133        0.326
58   4.83     2.40      0.460       (  0.223)       0.133        0.326
59   4.92     2.50      0.479       (  0.223)       0.139        0.340
60   5.00     2.60      0.498       (  0.223)       0.144        0.354
61   5.08     3.10      0.594       (  0.223)       0.172        0.422
62   5.17     3.60      0.690       (  0.223)       0.200        0.490
63   5.25     3.90      0.747       (  0.223)       0.217        0.530
64   5.33     4.20      0.805          0.223    (  0.233)        0.582
65   5.42     4.70      0.900          0.223    (  0.261)        0.677
66   5.50     5.60      1.073          0.223    (  0.311)        0.850
67   5.58     1.90      0.364       (  0.223)       0.106        0.258
68   5.67     0.90      0.172       (  0.223)       0.050        0.122
69   5.75     0.60      0.115       (  0.223)       0.033        0.082
70   5.83     0.50      0.096       (  0.223)       0.028        0.068
71   5.92     0.30      0.057       (  0.223)       0.017        0.041
72   6.00     0.20      0.038       (  0.223)       0.011        0.027
              (Loss Rate Not Used)
   Sum =     100.0                                   Sum =    13.7
     Flood volume = Effective rainfall      1.14(In)
      times area       7.5(Ac.)/[(In)/(Ft.)] =       0.7(Ac.Ft)
     Total soil loss =      0.45(In)
     Total soil loss =     0.282(Ac.Ft)
     Total rainfall =      1.60(In)
     Flood volume =       31167.7 Cubic Feet
     Total soil loss =       12295.0 Cubic Feet
     --------------------------------------------------------------------
      Peak flow rate of this hydrograph =      5.700(CFS)
     --------------------------------------------------------------------
     ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                         6 - H O U R    S T O R M
                    R u n o f f     H y d r o g r a p h
     --------------------------------------------------------------------
                 Hydrograph in   5   Minute intervals ((CFS))

     --------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0        2.5       5.0       7.5      10.0
-----------------------------------------------------------------------
  0+ 5       0.0018      0.26  VQ        |         |         |         |
  0+10       0.0053      0.52  V Q       |         |         |         |
  0+15       0.0095      0.60  V Q       |         |         |         |
  0+20       0.0137      0.61  V Q       |         |         |         |
  0+25       0.0179      0.62  |VQ       |         |         |         |
  0+30       0.0225      0.67  |VQ       |         |         |         |
  0+35       0.0274      0.71  |VQ       |         |         |         |
  0+40       0.0324      0.72  |VQ       |         |         |         |
  0+45       0.0373      0.72  | Q       |         |         |         |
  0+50       0.0423      0.72  | Q       |         |         |         |
  0+55       0.0473      0.72  | Q       |         |         |         |
  1+ 0       0.0526      0.77  | VQ      |         |         |         |
  1+ 5       0.0582      0.81  |  Q      |         |         |         |
  1+10       0.0638      0.82  |  Q      |         |         |         |
  1+15       0.0695      0.82  |  Q      |         |         |         |
  1+20       0.0752      0.82  |  QV     |         |         |         |
  1+25       0.0808      0.82  |  QV     |         |         |         |
  1+30       0.0865      0.82  |  QV     |         |         |         |
  1+35       0.0922      0.82  |  Q V    |         |         |         |
  1+40       0.0978      0.82  |  Q V    |         |         |         |
  1+45       0.1035      0.82  |  Q V    |         |         |         |
  1+50       0.1092      0.82  |  Q  V   |         |         |         |
  1+55       0.1148      0.82  |  Q  V   |         |         |         |
  2+ 0       0.1209      0.87  |  Q  V   |         |         |         |
  2+ 5       0.1268      0.86  |  Q   V  |         |         |         |
  2+10       0.1329      0.88  |  Q   V  |         |         |         |
  2+15       0.1392      0.92  |  Q   V  |         |         |         |
  2+20       0.1456      0.92  |  Q    V |         |         |         |
  2+25       0.1519      0.93  |  Q    V |         |         |         |
  2+30       0.1583      0.93  |  Q    V |         |         |         |
  2+35       0.1647      0.93  |  Q     V|         |         |         |
  2+40       0.1711      0.93  |  Q     V|         |         |         |
  2+45       0.1778      0.98  |  Q     V|         |         |         |
  2+50       0.1848      1.02  |   Q     V         |         |         |
  2+55       0.1919      1.03  |   Q     V         |         |         |
  3+ 0       0.1990      1.03  |   Q     |V        |         |         |
  3+ 5       0.2061      1.03  |   Q     |V        |         |         |
  3+10       0.2135      1.08  |   Q     |V        |         |         |
  3+15       0.2212      1.12  |   Q     | V       |         |         |
  3+20       0.2290      1.13  |   Q     | V       |         |         |
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    3+25       0.2371      1.18  |   Q     |  V      |         |         |
    3+30       0.2459      1.28  |    Q    |  V      |         |         |
    3+35       0.2554      1.38  |    Q    |   V     |         |         |
    3+40       0.2653      1.43  |    Q    |   V     |         |         |
    3+45       0.2755      1.49  |    Q    |    V    |         |         |
    3+50       0.2861      1.53  |     Q   |    V    |         |         |
    3+55       0.2970      1.59  |     Q   |     V   |         |         |
    4+ 0       0.3083      1.64  |     Q   |      V  |         |         |
    4+ 5       0.3200      1.70  |     Q   |      V  |         |         |
    4+10       0.3323      1.79  |      Q  |       V |         |         |
    4+15       0.3453      1.89  |      Q  |        V|         |         |
    4+20       0.3591      1.99  |      Q  |         V         |         |
    4+25       0.3735      2.10  |       Q |         V         |         |
    4+30       0.3883      2.15  |       Q |         |V        |         |
    4+35       0.4035      2.21  |       Q |         | V       |         |
    4+40       0.4194      2.30  |        Q|         |  V      |         |
    4+45       0.4360      2.41  |        Q|         |   V     |         |
    4+50       0.4529      2.46  |        Q|         |    V    |         |
    4+55       0.4702      2.52  |         Q         |     V   |         |
    5+ 0       0.4882      2.61  |         Q         |      V  |         |
    5+ 5       0.5083      2.92  |         |Q        |       V |         |
    5+10       0.5317      3.40  |         |  Q      |        V|         |
    5+15       0.5579      3.80  |         |    Q    |         |V        |
    5+20       0.5866      4.17  |         |     Q   |         | V       |
    5+25       0.6191      4.72  |         |       Q |         |   V     |
    5+30       0.6583      5.70  |         |         | Q       |     V   |
    5+35       0.6862      4.04  |         |     Q   |         |       V |
    5+40       0.6988      1.83  |      Q  |         |         |        V|
    5+45       0.7054      0.97  |  Q      |         |         |        V|
    5+50       0.7097      0.62  | Q       |         |         |        V|
    5+55       0.7126      0.43  |Q        |         |         |        V|
    6+ 0       0.7145      0.28  |Q        |         |         |        V|
    6+ 5       0.7153      0.12  Q         |         |         |        V|
    6+10       0.7155      0.02  Q         |         |         |        V|
    6+15       0.7155      0.00  Q         |         |         |         V
-----------------------------------------------------------------------
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U n i t   H y d r o g r a p h   A n a l y s i s

Study date 07/23/19 File: DMAC5PROP245.out

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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978

Program License Serial Number 6388

English (in-lb) Input Units Used
English Rainfall Data (Inches) Input Values Used

English Units used in output format

KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
PROPOSED CONDITION, DMA C
5-YR 24-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019

Drainage Area = 7.50(Ac.) = 0.012 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment = 7.50(Ac.) = 0.012 Sq. Mi.
Length along longest watercourse = 860.00(Ft.)
Length along longest watercourse measured to centroid = 749.00(Ft.)
Length along longest watercourse = 0.163 Mi.
Length along longest watercourse measured to centroid = 0.142 Mi.
Difference in elevation = 21.50(Ft.)
Slope along watercourse = 132.0000 Ft./Mi.
Average Manning's 'N' = 0.015
Lag time = 0.034 Hr.
Lag time = 2.04 Min.
25% of lag time = 0.51 Min.
40% of lag time = 0.82 Min.
Unit time = 15.00 Min.
Duration of storm = 24 Hour(s)
User Entered Base Flow = 0.00(CFS)

2 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	Weighting[1*2]
7.50	2.05	15.37

100 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	Weighting[1*2]
7.50	5.16	38.70

STORM EVENT (YEAR) = 5.00
Area Averaged 2-Year Rainfall = 2.050(In)
Area Averaged 100-Year Rainfall = 5.160(In)

Point rain (area averaged) = 2.778(In)
Areal adjustment factor = 100.00 %
Adjusted average point rain = 2.778(In)

Sub-Area Data:

Area(Ac.)	Runoff Index	Impervious %
7.500	56.00	0.760

Total Area Entered = 7.50(Ac.)

RI AMC2	RI AMC-1	Infil. Rate (In/Hr)	Impervious (Dec.%)	Adj. Infil. Rate (In/Hr)	Area% (Dec.)	F (In/Hr)
56.0	36.0	0.706	0.760	0.223	1.000	0.223
					Sum (F) =	0.223

Area averaged mean soil loss (F) (In/Hr) = 0.223
Minimum soil loss rate ((In/Hr)) = 0.112

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.290

U n i t H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.250	735.082	79.543	6.012
2	0.500	1470.164	20.457	1.546
			Sum = 100.000	Sum= 7.559

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Low	Effective (In/Hr)
1	0.25	0.20	0.022	(0.394)	0.006	0.016
2	0.50	0.30	0.033	(0.389)	0.010	0.024
3	0.75	0.30	0.033	(0.385)	0.010	0.024
4	1.00	0.40	0.044	(0.380)	0.013	0.032
5	1.25	0.30	0.033	(0.376)	0.010	0.024
6	1.50	0.30	0.033	(0.371)	0.010	0.024
7	1.75	0.30	0.033	(0.367)	0.010	0.024
8	2.00	0.40	0.044	(0.363)	0.013	0.032
9	2.25	0.40	0.044	(0.358)	0.013	0.032
10	2.50	0.40	0.044	(0.354)	0.013	0.032
11	2.75	0.50	0.056	(0.349)	0.016	0.039
12	3.00	0.50	0.056	(0.345)	0.016	0.039
13	3.25	0.50	0.056	(0.341)	0.016	0.039
14	3.50	0.50	0.056	(0.337)	0.016	0.039
15	3.75	0.50	0.056	(0.332)	0.016	0.039
16	4.00	0.60	0.067	(0.328)	0.019	0.047
17	4.25	0.60	0.067	(0.324)	0.019	0.047
18	4.50	0.70	0.078	(0.320)	0.023	0.055
19	4.75	0.70	0.078	(0.316)	0.023	0.055
20	5.00	0.80	0.089	(0.312)	0.026	0.063
21	5.25	0.60	0.067	(0.308)	0.019	0.047
22	5.50	0.70	0.078	(0.304)	0.023	0.055
23	5.75	0.80	0.089	(0.300)	0.026	0.063
24	6.00	0.80	0.089	(0.296)	0.026	0.063
25	6.25	0.90	0.100	(0.292)	0.029	0.071
26	6.50	0.90	0.100	(0.288)	0.029	0.071
27	6.75	1.00	0.111	(0.284)	0.032	0.079
28	7.00	1.00	0.111	(0.280)	0.032	0.079
29	7.25	1.00	0.111	(0.276)	0.032	0.079
30	7.50	1.10	0.122	(0.273)	0.035	0.087
31	7.75	1.20	0.133	(0.269)	0.039	0.095
32	8.00	1.30	0.144	(0.265)	0.042	0.103
33	8.25	1.50	0.167	(0.262)	0.048	0.118
34	8.50	1.50	0.167	(0.258)	0.048	0.118
35	8.75	1.60	0.178	(0.254)	0.052	0.126
36	9.00	1.70	0.189	(0.251)	0.055	0.134
37	9.25	1.90	0.211	(0.247)	0.061	0.150
38	9.50	2.00	0.222	(0.244)	0.064	0.158
39	9.75	2.10	0.233	(0.240)	0.068	0.166
40	10.00	2.20	0.244	(0.237)	0.071	0.174
41	10.25	1.50	0.167	(0.233)	0.048	0.118
42	10.50	1.50	0.167	(0.230)	0.048	0.118
43	10.75	2.00	0.222	(0.227)	0.064	0.158
44	11.00	2.00	0.222	(0.223)	0.064	0.158
45	11.25	1.90	0.211	(0.220)	0.061	0.150
46	11.50	1.90	0.211	(0.217)	0.061	0.150
47	11.75	1.70	0.189	(0.214)	0.055	0.134
48	12.00	1.80	0.200	(0.210)	0.058	0.142
49	12.25	2.50	0.278	(0.207)	0.081	0.197
50	12.50	2.60	0.289	(0.204)	0.084	0.205
51	12.75	2.80	0.311	(0.201)	0.090	0.221
52	13.00	2.90	0.322	(0.198)	0.093	0.229
53	13.25	3.40	0.378	(0.195)	0.110	0.268
54	13.50	3.40	0.378	(0.192)	0.110	0.268
55	13.75	2.30	0.256	(0.189)	0.074	0.181
56	14.00	2.30	0.256	(0.186)	0.074	0.181

```
57  14.25     2.70      0.300       (  0.183)       0.087        0.213
58  14.50     2.60      0.289       (  0.181)       0.084        0.205
59  14.75     2.60      0.289       (  0.178)       0.084        0.205
60  15.00     2.50      0.278       (  0.175)       0.081        0.197
61  15.25     2.40      0.267       (  0.172)       0.077        0.189
62  15.50     2.30      0.256       (  0.170)       0.074        0.181
63  15.75     1.90      0.211       (  0.167)       0.061        0.150
64  16.00     1.90      0.211       (  0.165)       0.061        0.150
65  16.25     0.40      0.044       (  0.162)       0.013        0.032
66  16.50     0.40      0.044       (  0.160)       0.013        0.032
67  16.75     0.30      0.033       (  0.157)       0.010        0.024
68  17.00     0.30      0.033       (  0.155)       0.010        0.024
69  17.25     0.50      0.056       (  0.153)       0.016        0.039
70  17.50     0.50      0.056       (  0.150)       0.016        0.039
71  17.75     0.50      0.056       (  0.148)       0.016        0.039
72  18.00     0.40      0.044       (  0.146)       0.013        0.032
73  18.25     0.40      0.044       (  0.144)       0.013        0.032
74  18.50     0.40      0.044       (  0.142)       0.013        0.032
75  18.75     0.30      0.033       (  0.140)       0.010        0.024
76  19.00     0.20      0.022       (  0.138)       0.006        0.016
77  19.25     0.30      0.033       (  0.136)       0.010        0.024
78  19.50     0.40      0.044       (  0.134)       0.013        0.032
79  19.75     0.30      0.033       (  0.132)       0.010        0.024
80  20.00     0.20      0.022       (  0.130)       0.006        0.016
81  20.25     0.30      0.033       (  0.128)       0.010        0.024
82  20.50     0.30      0.033       (  0.127)       0.010        0.024
83  20.75     0.30      0.033       (  0.125)       0.010        0.024
84  21.00     0.20      0.022       (  0.124)       0.006        0.016
85  21.25     0.30      0.033       (  0.122)       0.010        0.024
86  21.50     0.20      0.022       (  0.121)       0.006        0.016
87  21.75     0.30      0.033       (  0.119)       0.010        0.024
88  22.00     0.20      0.022       (  0.118)       0.006        0.016
89  22.25     0.30      0.033       (  0.117)       0.010        0.024
90  22.50     0.20      0.022       (  0.116)       0.006        0.016
91  22.75     0.20      0.022       (  0.115)       0.006        0.016
92  23.00     0.20      0.022       (  0.114)       0.006        0.016
93  23.25     0.20      0.022       (  0.113)       0.006        0.016
94  23.50     0.20      0.022       (  0.113)       0.006        0.016
95  23.75     0.20      0.022       (  0.112)       0.006        0.016
96  24.00     0.20      0.022       (  0.112)       0.006        0.016
             (Loss Rate Not Used)
   Sum =     100.0                                   Sum =     7.9
     Flood volume = Effective rainfall      1.97(In)
      times area       7.5(Ac.)/[(In)/(Ft.)] =       1.2(Ac.Ft)
     Total soil loss =      0.81(In)
     Total soil loss =     0.504(Ac.Ft)
     Total rainfall =      2.78(In)
     Flood volume =      53705.7 Cubic Feet
     Total soil loss =      21936.1 Cubic Feet
     --------------------------------------------------------------------
      Peak flow rate of this hydrograph =      2.029(CFS)
     --------------------------------------------------------------------
     ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                         24 - H O U R   S T O R M
                    R u n o f f     H y d r o g r a p h
     --------------------------------------------------------------------
                 Hydrograph in  15   Minute intervals ((CFS))

     --------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0        2.5       5.0       7.5      10.0
-----------------------------------------------------------------------
  0+15       0.0020      0.09  Q         |         |         |         |
  0+30       0.0054      0.17  Q         |         |         |         |
  0+45       0.0091      0.18  Q         |         |         |         |
  1+ 0       0.0138      0.23  Q         |         |         |         |
  1+15       0.0177      0.19  Q         |         |         |         |
  1+30       0.0214      0.18  Q         |         |         |         |
  1+45       0.0251      0.18  Q         |         |         |         |
  2+ 0       0.0298      0.23  Q         |         |         |         |
  2+15       0.0347      0.24  QV        |         |         |         |
  2+30       0.0397      0.24  QV        |         |         |         |
  2+45       0.0456      0.29  |Q        |         |         |         |
  3+ 0       0.0518      0.30  |Q        |         |         |         |
  3+15       0.0579      0.30  |Q        |         |         |         |
  3+30       0.0641      0.30  |QV       |         |         |         |
  3+45       0.0702      0.30  |QV       |         |         |         |
  4+ 0       0.0774      0.35  |QV       |         |         |         |
  4+15       0.0848      0.36  |QV       |         |         |         |
  4+30       0.0932      0.41  |Q V      |         |         |         |
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 4+45      0.1018      0.42  |Q V      |         |         |         |
 5+ 0      0.1114      0.47  |Q V      |         |         |         |
 5+15      0.1193      0.38  |Q V      |         |         |         |
 5+30      0.1277      0.41  |Q  V     |         |         |         |
 5+45      0.1373      0.47  |Q  V     |         |         |         |
 6+ 0      0.1472      0.48  |Q  V     |         |         |         |
 6+15      0.1580      0.52  | Q  V    |         |         |         |
 6+30      0.1691      0.54  | Q  V    |         |         |         |
 6+45      0.1812      0.58  | Q  V    |         |         |         |
 7+ 0      0.1935      0.60  | Q   V   |         |         |         |
 7+15      0.2058      0.60  | Q   V   |         |         |         |
 7+30      0.2192      0.64  | Q    V  |         |         |         |
 7+45      0.2337      0.70  | Q    V  |         |         |         |
 8+ 0      0.2495      0.76  |  Q    V |         |         |         |
 8+15      0.2675      0.87  |  Q    V |         |         |         |
 8+30      0.2860      0.90  |  Q     V|         |         |         |
 8+45      0.3054      0.94  |  Q     V|         |         |         |
 9+ 0      0.3261      1.00  |   Q     V         |         |         |
 9+15      0.3491      1.11  |   Q      V        |         |         |
 9+30      0.3735      1.18  |   Q     | V       |         |         |
 9+45      0.3991      1.24  |   Q     | V       |         |         |
10+ 0      0.4260      1.30  |    Q    |  V      |         |         |
10+15      0.4462      0.98  |  Q      |   V     |         |         |
10+30      0.4647      0.90  |  Q      |    V    |         |         |
10+45      0.4881      1.13  |   Q     |    V    |         |         |
11+ 0      0.5128      1.19  |   Q     |     V   |         |         |
11+15      0.5365      1.15  |   Q     |      V  |         |         |
11+30      0.5599      1.13  |   Q     |       V |         |         |
11+45      0.5813      1.04  |   Q     |       V |         |         |
12+ 0      0.6033      1.06  |   Q     |        V|         |         |
12+15      0.6323      1.41  |    Q    |         V         |         |
12+30      0.6641      1.54  |     Q   |          V        |         |
12+45      0.6982      1.65  |     Q   |         | V       |         |
13+ 0      0.7337      1.72  |     Q   |         |  V      |         |
13+15      0.7743      1.97  |      Q  |         |    V    |         |
13+30      0.8162      2.03  |       Q |         |     V   |         |
13+45      0.8474      1.51  |     Q   |         |      V  |         |
14+ 0      0.8757      1.37  |    Q    |         |       V |         |
14+15      0.9080      1.56  |     Q   |         |        V|         |
14+30      0.9403      1.56  |     Q   |         |         V         |
14+45      0.9724      1.55  |     Q   |         |          V        |
15+ 0      1.0035      1.50  |     Q   |         |         | V       |
15+15      1.0333      1.44  |    Q    |         |         |  V      |
15+30      1.0619      1.38  |    Q    |         |         |   V     |
15+45      1.0863      1.18  |   Q     |         |         |    V    |
16+ 0      1.1098      1.13  |   Q     |         |         |     V   |
16+15      1.1185      0.42  |Q        |         |         |     V   |
16+30      1.1234      0.24  Q         |         |         |     V   |
16+45      1.1274      0.19  Q         |         |         |     V   |
17+ 0      1.1311      0.18  Q         |         |         |     V   |
17+15      1.1367      0.27  |Q        |         |         |     V   |
17+30      1.1429      0.30  |Q        |         |         |      V  |
17+45      1.1490      0.30  |Q        |         |         |      V  |
18+ 0      1.1542      0.25  |Q        |         |         |      V  |
18+15      1.1592      0.24  Q         |         |         |      V  |
18+30      1.1641      0.24  Q         |         |         |      V  |
18+45      1.1680      0.19  Q         |         |         |      V  |
19+ 0      1.1708      0.13  Q         |         |         |      V  |
19+15      1.1742      0.17  Q         |         |         |       V |
19+30      1.1789      0.23  Q         |         |         |       V |
19+45      1.1828      0.19  Q         |         |         |       V |
20+ 0      1.1856      0.13  Q         |         |         |       V |
20+15      1.1890      0.17  Q         |         |         |       V |
20+30      1.1927      0.18  Q         |         |         |       V |
20+45      1.1964      0.18  Q         |         |         |       V |
21+ 0      1.1991      0.13  Q         |         |         |       V |
21+15      1.2026      0.17  Q         |         |         |        V|
21+30      1.2053      0.13  Q         |         |         |        V|
21+45      1.2087      0.17  Q         |         |         |        V|
22+ 0      1.2114      0.13  Q         |         |         |        V|
22+15      1.2149      0.17  Q         |         |         |        V|
22+30      1.2176      0.13  Q         |         |         |        V|
22+45      1.2201      0.12  Q         |         |         |        V|
23+ 0      1.2225      0.12  Q         |         |         |        V|
23+15      1.2250      0.12  Q         |         |         |        V|
23+30      1.2275      0.12  Q         |         |         |        V|
23+45      1.2299      0.12  Q         |         |         |        V|
24+ 0      1.2324      0.12  Q         |         |         |        V|
24+15      1.2329      0.02  Q         |         |         |        V|
```

```
       U n i t   H y d r o g r a p h   A n a l y s i s

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               Study date  07/23/19 File: DMAC10EXIST110.out

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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978


Program License Serial Number 6388

---------------------------------------------------------------------
 English (in-lb) Input Units Used
 English Rainfall Data (Inches) Input Values Used

 English Units used in output format



---------------------------------------------------------------------
KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
EXISTING CONDITION, DMA C
10-YR 1-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019
--------------------------------------------------------------------
Drainage Area =       7.50(Ac.)  =      0.012 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =       7.50(Ac.)  =      0.012 Sq. Mi.
Length along longest watercourse =     860.00(Ft.)
Length along longest watercourse measured to centroid =     749.00(Ft.)
Length along longest watercourse =      0.163 Mi.
Length along longest watercourse measured to centroid =      0.142 Mi.
Difference in elevation =      21.50(Ft.)
Slope along watercourse =    132.0000 Ft./Mi.
Average Manning's 'N' = 0.020
Lag time =    0.045 Hr.
Lag time =     2.72 Min.
25% of lag time =     0.68 Min.
40% of lag time =     1.09 Min.
Unit time =     5.00 Min.
Duration of storm = 1 Hour(s)
User Entered Base Flow =     0.00(CFS)

2 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        7.50           0.49                  3.67

100 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        7.50           1.33                  9.98

STORM EVENT (YEAR) =   10.00
Area Averaged 2-Year Rainfall =    0.489(In)
Area Averaged 100-Year Rainfall =    1.330(In)

Point rain (area averaged) =    0.835(In)
Areal adjustment factor =   99.99 %
Adjusted average point rain =    0.835(In)

Sub-Area Data:
Area(Ac.)         Runoff Index   Impervious %
     7.500           56.00         0.500
 Total Area Entered =      7.50(Ac.)


RI    RI   Infil. Rate Impervious   Adj. Infil. Rate  Area%     F
AMC2 AMC-2     (In/Hr)    (Dec.%)      (In/Hr)      (Dec.)    (In/Hr)
56.0  56.0      0.511     0.500        0.281       1.000      0.281
                                                 Sum (F) =   0.281
Area averaged mean soil loss (F) (In/Hr) =  0.281
Minimum soil loss rate ((In/Hr)) =  0.140
```

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.500

Slope of intensity-duration curve for a 1 hour storm =0.5000

U n i t   H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.083	183.771	40.452	3.058
2	0.167	367.541	44.515	3.365
3	0.250	551.312	9.487	0.717
4	0.333	735.082	3.846	0.291
5	0.417	918.853	1.700	0.128
			Sum = 100.000	Sum= 7.559

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Loss rate(In./Hr) Low	Effective (In/Hr)
1	0.08	4.20	0.421	(0.281)	0.210	0.210
2	0.17	4.30	0.431	(0.281)	0.215	0.215
3	0.25	5.00	0.501	(0.281)	0.250	0.250
4	0.33	5.00	0.501	(0.281)	0.250	0.250
5	0.42	5.80	0.581	0.281	(0.291)	0.300
6	0.50	6.50	0.651	0.281	(0.326)	0.370
7	0.58	7.40	0.741	0.281	(0.371)	0.460
8	0.67	8.60	0.862	0.281	(0.431)	0.581
9	0.75	12.30	1.232	0.281	(0.616)	0.951
10	0.83	29.10	2.916	0.281	(1.458)	2.635
11	0.92	6.80	0.681	0.281	(0.341)	0.400
12	1.00	5.00	0.501	(0.281)	0.250	0.250

(Loss Rate Not Used)
Sum = 100.0 Sum = 6.9

Flood volume = Effective rainfall 0.57(In)
times area 7.5(Ac.)/[(In)/(Ft.)] = 0.4(Ac.Ft)
Total soil loss = 0.26(In)
Total soil loss = 0.164(Ac.Ft)
Total rainfall = 0.83(In)
Flood volume = 15598.6 Cubic Feet
Total soil loss = 7132.6 Cubic Feet

Peak flow rate of this hydrograph = 11.861(CFS)

++

1 - H O U R   S T O R M
R u n o f f   H y d r o g r a p h

Hydrograph in 5 Minute intervals ((CFS))

```
 ---------------------------------------------------------------------
  Time(h+m) Volume Ac.Ft    Q(CFS)  0         5.0       10.0      15.0      20.0
 -----------------------------------------------------------------------
    0+ 5       0.0044      0.64  VQ        |         |         |         |
    0+10       0.0138      1.37  |VQ       |         |         |         |
    0+15       0.0252      1.64  | VQ      |         |         |         |
    0+20       0.0377      1.83  |  QV     |         |         |         |
    0+25       0.0517      2.03  |   QV    |         |         |         |
    0+30       0.0684      2.42  |   Q  V  |         |         |         |
    0+35       0.0889      2.98  |    Q   V|         |         |         |
    0+40       0.1145      3.71  |      Q  | V       |         |         |
    0+45       0.1513      5.34  |         Q     V   |         |         |
    0+50       0.2329     11.86  |         |         |  Q  V   |         |
    0+55       0.3087     11.00  |         |         | Q       |   V     |
    1+ 0       0.3387      4.36  |       Q |         |         |      V  |
    1+ 5       0.3526      2.02  |   Q     |         |         |        V|
    1+10       0.3570      0.63  |Q        |         |         |        V|
    1+15       0.3579      0.12  Q         |         |         |        V|
    1+20       0.3581      0.03  Q         |         |         |         V
-----------------------------------------------------------------------
```

```
      U n i t   H y d r o g r a p h   A n a l y s i s

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              Study date  07/23/19 File: DMAC10EXIST310.out


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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978


Program License Serial Number 6388

---------------------------------------------------------------------
 English (in-lb) Input Units Used
 English Rainfall Data (Inches) Input Values Used

 English Units used in output format



---------------------------------------------------------------------
KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
EXISTING CONDITION, DMA C
10-YR 3-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019
--------------------------------------------------------------------
Drainage Area =       7.50(Ac.)  =      0.012 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =       7.50(Ac.)  =      0.012 Sq. Mi.
Length along longest watercourse =     860.00(Ft.)
Length along longest watercourse measured to centroid =     749.00(Ft.)
Length along longest watercourse =      0.163 Mi.
Length along longest watercourse measured to centroid =      0.142 Mi.
Difference in elevation =      21.50(Ft.)
Slope along watercourse =    132.0000 Ft./Mi.
Average Manning's 'N' = 0.020
Lag time =    0.045 Hr.
Lag time =     2.72 Min.
25% of lag time =     0.68 Min.
40% of lag time =     1.09 Min.
Unit time =     5.00 Min.
Duration of storm = 3 Hour(s)
User Entered Base Flow =     0.00(CFS)

2 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        7.50           0.87                  6.50

100 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        7.50           2.09                 15.67

STORM EVENT (YEAR) =   10.00
Area Averaged 2-Year Rainfall =    0.866(In)
Area Averaged 100-Year Rainfall =    2.090(In)

Point rain (area averaged) =    1.370(In)
Areal adjustment factor =  100.00 %
Adjusted average point rain =    1.370(In)

Sub-Area Data:
Area(Ac.)         Runoff Index   Impervious %
     7.500           56.00         0.500
 Total Area Entered =      7.50(Ac.)


RI    RI   Infil. Rate Impervious   Adj. Infil. Rate  Area%     F
AMC2 AMC-2     (In/Hr)    (Dec.%)      (In/Hr)      (Dec.)    (In/Hr)
56.0  56.0      0.511     0.500        0.281        1.000      0.281
                                                 Sum (F) =   0.281
Area averaged mean soil loss (F) (In/Hr) =  0.281
Minimum soil loss rate ((In/Hr)) =  0.140
```

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.500

U n i t H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.083	183.771	40.452	3.058
2	0.167	367.541	44.515	3.365
3	0.250	551.312	9.487	0.717
4	0.333	735.082	3.846	0.291
5	0.417	918.853	1.700	0.128
			Sum = 100.000	Sum= 7.559

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Low	Effective (In/Hr)
1	0.08	1.30	0.214	(0.281)	0.107	0.107
2	0.17	1.30	0.214	(0.281)	0.107	0.107
3	0.25	1.10	0.181	(0.281)	0.090	0.090
4	0.33	1.50	0.247	(0.281)	0.123	0.123
5	0.42	1.50	0.247	(0.281)	0.123	0.123
6	0.50	1.80	0.296	(0.281)	0.148	0.148
7	0.58	1.50	0.247	(0.281)	0.123	0.123
8	0.67	1.80	0.296	(0.281)	0.148	0.148
9	0.75	1.80	0.296	(0.281)	0.148	0.148
10	0.83	1.50	0.247	(0.281)	0.123	0.123
11	0.92	1.60	0.263	(0.281)	0.131	0.131
12	1.00	1.80	0.296	(0.281)	0.148	0.148
13	1.08	2.20	0.362	(0.281)	0.181	0.181
14	1.17	2.20	0.362	(0.281)	0.181	0.181
15	1.25	2.20	0.362	(0.281)	0.181	0.181
16	1.33	2.00	0.329	(0.281)	0.164	0.164
17	1.42	2.60	0.427	(0.281)	0.214	0.214
18	1.50	2.70	0.444	(0.281)	0.222	0.222
19	1.58	2.40	0.394	(0.281)	0.197	0.197
20	1.67	2.70	0.444	(0.281)	0.222	0.222
21	1.75	3.30	0.542	(0.281)	0.271	0.271
22	1.83	3.10	0.509	(0.281)	0.255	0.255
23	1.92	2.90	0.477	(0.281)	0.238	0.238
24	2.00	3.00	0.493	(0.281)	0.247	0.247
25	2.08	3.10	0.509	(0.281)	0.255	0.255
26	2.17	4.20	0.690	0.281	(0.345)	0.409
27	2.25	5.00	0.822	0.281	(0.411)	0.541
28	2.33	3.50	0.575	0.281	(0.288)	0.294
29	2.42	6.80	1.118	0.281	(0.559)	0.837
30	2.50	7.30	1.200	0.281	(0.600)	0.919
31	2.58	8.20	1.348	0.281	(0.674)	1.067
32	2.67	5.90	0.970	0.281	(0.485)	0.689
33	2.75	2.00	0.329	(0.281)	0.164	0.164
34	2.83	1.80	0.296	(0.281)	0.148	0.148
35	2.92	1.80	0.296	(0.281)	0.148	0.148
36	3.00	0.60	0.099	(0.281)	0.049	0.049
		(Loss Rate Not Used)				
Sum =		100.0			Sum =	9.6

Flood volume = Effective rainfall 0.80(In)
times area 7.5(Ac.)/[(In)/(Ft.)] = 0.5(Ac.Ft)
Total soil loss = 0.57(In)
Total soil loss = 0.355(Ac.Ft)
Total rainfall = 1.37(In)
Flood volume = 21805.7 Cubic Feet
Total soil loss = 15479.4 Cubic Feet

Peak flow rate of this hydrograph = 7.111(CFS)

++

3 - H O U R S T O R M
R u n o f f H y d r o g r a p h

Hydrograph in 5 Minute intervals ((CFS))

```
      --------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0         2.5       5.0       7.5      10.0
----------------------------------------------------------------------
  0+ 5       0.0023      0.33  VQ        |         |         |         |
  0+10       0.0070      0.69  V Q       |         |         |         |
  0+15       0.0119      0.71  V Q       |         |         |         |
  0+20       0.0173      0.79  |V Q      |         |         |         |
  0+25       0.0235      0.90  |V Q      |         |         |         |
  0+30       0.0304      1.00  | VQ      |         |         |         |
  0+35       0.0374      1.01  | V Q     |         |         |         |
  0+40       0.0444      1.03  |  VQ     |         |         |         |
  0+45       0.0520      1.10  |   Q     |         |         |         |
  0+50       0.0591      1.04  |   Q     |         |         |         |
  0+55       0.0659      0.98  |  Q V    |         |         |         |
  1+ 0       0.0731      1.05  |   QV    |         |         |         |
  1+ 5       0.0813      1.20  |   Q V   |         |         |         |
  1+10       0.0904      1.32  |    Q V  |         |         |         |
  1+15       0.0997      1.35  |    Q V  |         |         |         |
  1+20       0.1088      1.31  |    Q  V |         |         |         |
  1+25       0.1185      1.41  |    Q   V|         |         |         |
  1+30       0.1295      1.59  |     Q   V         |         |         |
  1+35       0.1403      1.57  |     Q   |V        |         |         |
  1+40       0.1512      1.59  |     Q   | V       |         |         |
  1+45       0.1637      1.81  |      Q  |  V      |         |         |
  1+50       0.1770      1.94  |      Q  |   V     |         |         |
  1+55       0.1899      1.87  |      Q  |    V    |         |         |
  2+ 0       0.2026      1.85  |      Q  |     V   |         |         |
  2+ 5       0.2157      1.89  |      Q  |      V  |         |         |
  2+10       0.2321      2.39  |        Q|       V |         |         |
  2+15       0.2550      3.32  |         |  Q      V         |         |
  2+20       0.2764      3.12  |         | Q       | V       |         |
  2+25       0.3046      4.09  |         |     Q   |   V     |         |
  2+30       0.3463      6.05  |         |         |   Q  V  |         |
  2+35       0.3952      7.11  |         |         |       Q |V        |
  2+40       0.4410      6.64  |         |         |     Q   |    V    |
  2+45       0.4682      3.96  |         |    Q    |         |      V  |
  2+50       0.4815      1.93  |      Q  |         |         |       V |
  2+55       0.4912      1.41  |    Q    |         |         |        V|
  3+ 0       0.4973      0.89  |  Q      |         |         |        V|
  3+ 5       0.4996      0.34  |Q        |         |         |        V|
  3+10       0.5003      0.10  Q         |         |         |        V|
  3+15       0.5005      0.03  Q         |         |         |        V|
  3+20       0.5006      0.01  Q         |         |         |         V
----------------------------------------------------------------------
```

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      U n i t   H y d r o g r a p h   A n a l y s i s

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             Study date  07/23/19 File: DMAC10EXIST610.out


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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978


Program License Serial Number 6388

---------------------------------------------------------------------
 English (in-lb) Input Units Used
 English Rainfall Data (Inches) Input Values Used

 English Units used in output format



---------------------------------------------------------------------
KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
EXISTING CONDITION, DMA C
10-YR 6-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019
--------------------------------------------------------------------
Drainage Area =       7.50(Ac.)  =      0.012 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =       7.50(Ac.)  =      0.012 Sq. Mi.
Length along longest watercourse =     860.00(Ft.)
Length along longest watercourse measured to centroid =     749.00(Ft.)
Length along longest watercourse =      0.163 Mi.
Length along longest watercourse measured to centroid =      0.142 Mi.
Difference in elevation =      21.50(Ft.)
Slope along watercourse =    132.0000 Ft./Mi.
Average Manning's 'N' = 0.020
Lag time =    0.045 Hr.
Lag time =     2.72 Min.
25% of lag time =     0.68 Min.
40% of lag time =     1.09 Min.
Unit time =     5.00 Min.
Duration of storm = 6 Hour(s)
User Entered Base Flow =     0.00(CFS)

2 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        7.50           1.21                  9.07

100 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        7.50           2.86                 21.45

STORM EVENT (YEAR) =   10.00
Area Averaged 2-Year Rainfall =    1.210(In)
Area Averaged 100-Year Rainfall =    2.860(In)

Point rain (area averaged) =    1.889(In)
Areal adjustment factor =  100.00 %
Adjusted average point rain =    1.889(In)

Sub-Area Data:
Area(Ac.)         Runoff Index   Impervious %
     7.500           56.00         0.500
 Total Area Entered =      7.50(Ac.)


RI    RI   Infil. Rate Impervious   Adj. Infil. Rate  Area%     F
AMC2 AMC-2     (In/Hr)    (Dec.%)      (In/Hr)      (Dec.)    (In/Hr)
56.0  56.0      0.511     0.500        0.281       1.000      0.281
                                                Sum (F) =   0.281
Area averaged mean soil loss (F) (In/Hr) =  0.281
Minimum soil loss rate ((In/Hr)) =  0.140
```

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.500

U n i t   H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.083	183.771	40.452	3.058
2	0.167	367.541	44.515	3.365
3	0.250	551.312	9.487	0.717
4	0.333	735.082	3.846	0.291
5	0.417	918.853	1.700	0.128
			Sum = 100.000	Sum= 7.559

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Low	Effective (In/Hr)
1	0.08	0.50	0.113	(0.281)	0.057	0.057
2	0.17	0.60	0.136	(0.281)	0.068	0.068
3	0.25	0.60	0.136	(0.281)	0.068	0.068
4	0.33	0.60	0.136	(0.281)	0.068	0.068
5	0.42	0.60	0.136	(0.281)	0.068	0.068
6	0.50	0.70	0.159	(0.281)	0.079	0.079
7	0.58	0.70	0.159	(0.281)	0.079	0.079
8	0.67	0.70	0.159	(0.281)	0.079	0.079
9	0.75	0.70	0.159	(0.281)	0.079	0.079
10	0.83	0.70	0.159	(0.281)	0.079	0.079
11	0.92	0.70	0.159	(0.281)	0.079	0.079
12	1.00	0.80	0.181	(0.281)	0.091	0.091
13	1.08	0.80	0.181	(0.281)	0.091	0.091
14	1.17	0.80	0.181	(0.281)	0.091	0.091
15	1.25	0.80	0.181	(0.281)	0.091	0.091
16	1.33	0.80	0.181	(0.281)	0.091	0.091
17	1.42	0.80	0.181	(0.281)	0.091	0.091
18	1.50	0.80	0.181	(0.281)	0.091	0.091
19	1.58	0.80	0.181	(0.281)	0.091	0.091
20	1.67	0.80	0.181	(0.281)	0.091	0.091
21	1.75	0.80	0.181	(0.281)	0.091	0.091
22	1.83	0.80	0.181	(0.281)	0.091	0.091
23	1.92	0.80	0.181	(0.281)	0.091	0.091
24	2.00	0.90	0.204	(0.281)	0.102	0.102
25	2.08	0.80	0.181	(0.281)	0.091	0.091
26	2.17	0.90	0.204	(0.281)	0.102	0.102
27	2.25	0.90	0.204	(0.281)	0.102	0.102
28	2.33	0.90	0.204	(0.281)	0.102	0.102
29	2.42	0.90	0.204	(0.281)	0.102	0.102
30	2.50	0.90	0.204	(0.281)	0.102	0.102
31	2.58	0.90	0.204	(0.281)	0.102	0.102
32	2.67	0.90	0.204	(0.281)	0.102	0.102
33	2.75	1.00	0.227	(0.281)	0.113	0.113
34	2.83	1.00	0.227	(0.281)	0.113	0.113
35	2.92	1.00	0.227	(0.281)	0.113	0.113
36	3.00	1.00	0.227	(0.281)	0.113	0.113
37	3.08	1.00	0.227	(0.281)	0.113	0.113
38	3.17	1.10	0.249	(0.281)	0.125	0.125
39	3.25	1.10	0.249	(0.281)	0.125	0.125
40	3.33	1.10	0.249	(0.281)	0.125	0.125
41	3.42	1.20	0.272	(0.281)	0.136	0.136
42	3.50	1.30	0.295	(0.281)	0.147	0.147
43	3.58	1.40	0.317	(0.281)	0.159	0.159
44	3.67	1.40	0.317	(0.281)	0.159	0.159
45	3.75	1.50	0.340	(0.281)	0.170	0.170
46	3.83	1.50	0.340	(0.281)	0.170	0.170
47	3.92	1.60	0.363	(0.281)	0.181	0.181
48	4.00	1.60	0.363	(0.281)	0.181	0.181
49	4.08	1.70	0.385	(0.281)	0.193	0.193
50	4.17	1.80	0.408	(0.281)	0.204	0.204
51	4.25	1.90	0.431	(0.281)	0.215	0.215
52	4.33	2.00	0.453	(0.281)	0.227	0.227
53	4.42	2.10	0.476	(0.281)	0.238	0.238

```
54   4.50     2.10      0.476       (  0.281)       0.238        0.238
55   4.58     2.20      0.499       (  0.281)       0.249        0.249
56   4.67     2.30      0.521       (  0.281)       0.261        0.261
57   4.75     2.40      0.544       (  0.281)       0.272        0.272
58   4.83     2.40      0.544       (  0.281)       0.272        0.272
59   4.92     2.50      0.567          0.281    (  0.283)        0.286
60   5.00     2.60      0.589          0.281    (  0.295)        0.308
61   5.08     3.10      0.703          0.281    (  0.351)        0.422
62   5.17     3.60      0.816          0.281    (  0.408)        0.535
63   5.25     3.90      0.884          0.281    (  0.442)        0.603
64   5.33     4.20      0.952          0.281    (  0.476)        0.671
65   5.42     4.70      1.065          0.281    (  0.533)        0.784
66   5.50     5.60      1.269          0.281    (  0.635)        0.988
67   5.58     1.90      0.431       (  0.281)       0.215        0.215
68   5.67     0.90      0.204       (  0.281)       0.102        0.102
69   5.75     0.60      0.136       (  0.281)       0.068        0.068
70   5.83     0.50      0.113       (  0.281)       0.057        0.057
71   5.92     0.30      0.068       (  0.281)       0.034        0.034
72   6.00     0.20      0.045       (  0.281)       0.023        0.023
              (Loss Rate Not Used)
   Sum =     100.0                                    Sum =    12.5
     Flood volume = Effective rainfall      1.04(In)
      times area       7.5(Ac.)/[(In)/(Ft.)] =       0.7(Ac.Ft)
     Total soil loss =      0.85(In)
     Total soil loss =     0.529(Ac.Ft)
     Total rainfall =      1.89(In)
     Flood volume =       28376.6 Cubic Feet
     Total soil loss =       23045.3 Cubic Feet
     --------------------------------------------------------------------
      Peak flow rate of this hydrograph =      6.389(CFS)
     --------------------------------------------------------------------
     ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                         6 - H O U R   S T O R M
                    R u n o f f     H y d r o g r a p h
     --------------------------------------------------------------------
                 Hydrograph in   5   Minute intervals ((CFS))

     --------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0        2.5       5.0       7.5      10.0
-----------------------------------------------------------------------
  0+ 5       0.0012      0.17  Q        |         |         |         |
  0+10       0.0039      0.40  VQ       |         |         |         |
  0+15       0.0072      0.48  VQ       |         |         |         |
  0+20       0.0107      0.50  V Q      |         |         |         |
  0+25       0.0142      0.51  V Q      |         |         |         |
  0+30       0.0180      0.55  |VQ      |         |         |         |
  0+35       0.0220      0.59  |VQ      |         |         |         |
  0+40       0.0261      0.60  |VQ      |         |         |         |
  0+45       0.0303      0.60  |VQ      |         |         |         |
  0+50       0.0344      0.60  | Q      |         |         |         |
  0+55       0.0385      0.60  | Q      |         |         |         |
  1+ 0       0.0429      0.63  | Q      |         |         |         |
  1+ 5       0.0475      0.67  | Q      |         |         |         |
  1+10       0.0522      0.68  | QV     |         |         |         |
  1+15       0.0569      0.68  | QV     |         |         |         |
  1+20       0.0617      0.69  | QV     |         |         |         |
  1+25       0.0664      0.69  | Q V    |         |         |         |
  1+30       0.0711      0.69  | Q V    |         |         |         |
  1+35       0.0758      0.69  | Q V    |         |         |         |
  1+40       0.0805      0.69  | Q V    |         |         |         |
  1+45       0.0853      0.69  | Q  V   |         |         |         |
  1+50       0.0900      0.69  | Q  V   |         |         |         |
  1+55       0.0947      0.69  | Q  V   |         |         |         |
  2+ 0       0.0997      0.72  | Q   V  |         |         |         |
  2+ 5       0.1047      0.72  | Q   V  |         |         |         |
  2+10       0.1097      0.73  | Q   V  |         |         |         |
  2+15       0.1149      0.76  |  Q   V |         |         |         |
  2+20       0.1202      0.77  |  Q   V |         |         |         |
  2+25       0.1255      0.77  |  Q   V |         |         |         |
  2+30       0.1308      0.77  |  Q    V|         |         |         |
  2+35       0.1361      0.77  |  Q    V|         |         |         |
  2+40       0.1414      0.77  |  Q    V|         |         |         |
  2+45       0.1470      0.81  |  Q     V         |         |         |
  2+50       0.1528      0.84  |  Q     V         |         |         |
  2+55       0.1587      0.85  |  Q     V         |         |         |
  3+ 0       0.1646      0.86  |  Q      V        |         |         |
  3+ 5       0.1705      0.86  |  Q      V        |         |         |
  3+10       0.1766      0.89  |  Q      V        |         |         |
  3+15       0.1830      0.93  |  Q     |V        |         |         |
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    3+20       0.1895      0.94  |  Q      |V        |         |         |
    3+25       0.1962      0.98  |  Q      | V       |         |         |
    3+30       0.2034      1.05  |   Q     | V       |         |         |
    3+35       0.2112      1.13  |   Q     | V       |         |         |
    3+40       0.2194      1.18  |   Q     |  V      |         |         |
    3+45       0.2278      1.23  |   Q     |  V      |         |         |
    3+50       0.2366      1.27  |    Q    |   V     |         |         |
    3+55       0.2456      1.32  |    Q    |    V    |         |         |
    4+ 0       0.2550      1.36  |    Q    |    V    |         |         |
    4+ 5       0.2646      1.40  |    Q    |     V   |         |         |
    4+10       0.2748      1.48  |    Q    |     V   |         |         |
    4+15       0.2855      1.56  |     Q   |      V  |         |         |
    4+20       0.2969      1.64  |     Q   |       V |         |         |
    4+25       0.3088      1.73  |     Q   |       V |         |         |
    4+30       0.3210      1.78  |      Q  |        V|         |         |
    4+35       0.3336      1.83  |      Q  |         V         |         |
    4+40       0.3468      1.91  |      Q  |         |V        |         |
    4+45       0.3604      1.99  |      Q  |         | V       |         |
    4+50       0.3745      2.04  |       Q |         | V       |         |
    4+55       0.3889      2.09  |       Q |         |  V      |         |
    5+ 0       0.4041      2.21  |       Q |         |   V     |         |
    5+ 5       0.4224      2.65  |         Q         |    V    |         |
    5+10       0.4457      3.40  |         |  Q      |      V  |         |
    5+15       0.4738      4.07  |         |     Q   |        V|         |
    5+20       0.5057      4.63  |         |       Q |         |V        |
    5+25       0.5422      5.30  |         |         |Q        |  V      |
    5+30       0.5862      6.39  |         |         |    Q    |    V    |
    5+35       0.6194      4.82  |         |        Q|         |       V |
    5+40       0.6336      2.06  |       Q |         |         |       V |
    5+45       0.6411      1.09  |   Q     |         |         |        V|
    5+50       0.6457      0.67  | Q       |         |         |        V|
    5+55       0.6485      0.40  |Q        |         |         |        V|
    6+ 0       0.6502      0.26  |Q        |         |         |        V|
    6+ 5       0.6511      0.13  Q         |         |         |        V|
    6+10       0.6513      0.03  Q         |         |         |        V|
    6+15       0.6514      0.01  Q         |         |         |        V|
    6+20       0.6514      0.00  Q         |         |         |        V|
-----------------------------------------------------------------------
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      U n i t   H y d r o g r a p h   A n a l y s i s

      Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2014, Version 9.0
              Study date  07/23/19 File: DMAC10EXIST2410.out


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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978


Program License Serial Number 6388

---------------------------------------------------------------------
 English (in-lb) Input Units Used
 English Rainfall Data (Inches) Input Values Used

 English Units used in output format



---------------------------------------------------------------------
KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
EXISTING CONDITION, DMA C
10-YR 24-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019
--------------------------------------------------------------------
Drainage Area =       7.50(Ac.)  =      0.012 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =       7.50(Ac.)  =      0.012 Sq. Mi.
Length along longest watercourse =     860.00(Ft.)
Length along longest watercourse measured to centroid =     749.00(Ft.)
Length along longest watercourse =      0.163 Mi.
Length along longest watercourse measured to centroid =      0.142 Mi.
Difference in elevation =      21.50(Ft.)
Slope along watercourse =    132.0000 Ft./Mi.
Average Manning's 'N' = 0.020
Lag time =    0.045 Hr.
Lag time =     2.72 Min.
25% of lag time =     0.68 Min.
40% of lag time =     1.09 Min.
Unit time =     5.00 Min.
Duration of storm = 24 Hour(s)
User Entered Base Flow =     0.00(CFS)

2 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        7.50           2.05                 15.37

100 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        7.50           5.16                 38.70

STORM EVENT (YEAR) =   10.00
Area Averaged 2-Year Rainfall =    2.050(In)
Area Averaged 100-Year Rainfall =    5.160(In)

Point rain (area averaged) =    3.329(In)
Areal adjustment factor =  100.00 %
Adjusted average point rain =    3.329(In)

Sub-Area Data:
Area(Ac.)         Runoff Index   Impervious %
     7.500           56.00         0.500
 Total Area Entered =      7.50(Ac.)


RI    RI   Infil. Rate Impervious   Adj. Infil. Rate  Area%     F
AMC2 AMC-2     (In/Hr)    (Dec.%)      (In/Hr)       (Dec.)    (In/Hr)
56.0  56.0      0.511     0.500        0.281        1.000      0.281
                                                 Sum (F) =   0.281
Area averaged mean soil loss (F) (In/Hr) =  0.281
Minimum soil loss rate ((In/Hr)) =  0.140
```

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.500

U n i t H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.083	183.771	40.452	3.058
2	0.167	367.541	44.515	3.365
3	0.250	551.312	9.487	0.717
4	0.333	735.082	3.846	0.291
5	0.417	918.853	1.700	0.128
			Sum = 100.000	Sum= 7.559

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Low	Effective (In/Hr)
1	0.08	0.07	0.027	(0.498)	0.013	0.013
2	0.17	0.07	0.027	(0.496)	0.013	0.013
3	0.25	0.07	0.027	(0.494)	0.013	0.013
4	0.33	0.10	0.040	(0.492)	0.020	0.020
5	0.42	0.10	0.040	(0.490)	0.020	0.020
6	0.50	0.10	0.040	(0.488)	0.020	0.020
7	0.58	0.10	0.040	(0.487)	0.020	0.020
8	0.67	0.10	0.040	(0.485)	0.020	0.020
9	0.75	0.10	0.040	(0.483)	0.020	0.020
10	0.83	0.13	0.053	(0.481)	0.027	0.027
11	0.92	0.13	0.053	(0.479)	0.027	0.027
12	1.00	0.13	0.053	(0.477)	0.027	0.027
13	1.08	0.10	0.040	(0.475)	0.020	0.020
14	1.17	0.10	0.040	(0.473)	0.020	0.020
15	1.25	0.10	0.040	(0.471)	0.020	0.020
16	1.33	0.10	0.040	(0.470)	0.020	0.020
17	1.42	0.10	0.040	(0.468)	0.020	0.020
18	1.50	0.10	0.040	(0.466)	0.020	0.020
19	1.58	0.10	0.040	(0.464)	0.020	0.020
20	1.67	0.10	0.040	(0.462)	0.020	0.020
21	1.75	0.10	0.040	(0.460)	0.020	0.020
22	1.83	0.13	0.053	(0.458)	0.027	0.027
23	1.92	0.13	0.053	(0.457)	0.027	0.027
24	2.00	0.13	0.053	(0.455)	0.027	0.027
25	2.08	0.13	0.053	(0.453)	0.027	0.027
26	2.17	0.13	0.053	(0.451)	0.027	0.027
27	2.25	0.13	0.053	(0.449)	0.027	0.027
28	2.33	0.13	0.053	(0.447)	0.027	0.027
29	2.42	0.13	0.053	(0.446)	0.027	0.027
30	2.50	0.13	0.053	(0.444)	0.027	0.027
31	2.58	0.17	0.067	(0.442)	0.033	0.033
32	2.67	0.17	0.067	(0.440)	0.033	0.033
33	2.75	0.17	0.067	(0.438)	0.033	0.033
34	2.83	0.17	0.067	(0.436)	0.033	0.033
35	2.92	0.17	0.067	(0.435)	0.033	0.033
36	3.00	0.17	0.067	(0.433)	0.033	0.033
37	3.08	0.17	0.067	(0.431)	0.033	0.033
38	3.17	0.17	0.067	(0.429)	0.033	0.033
39	3.25	0.17	0.067	(0.427)	0.033	0.033
40	3.33	0.17	0.067	(0.426)	0.033	0.033
41	3.42	0.17	0.067	(0.424)	0.033	0.033
42	3.50	0.17	0.067	(0.422)	0.033	0.033
43	3.58	0.17	0.067	(0.420)	0.033	0.033
44	3.67	0.17	0.067	(0.419)	0.033	0.033
45	3.75	0.17	0.067	(0.417)	0.033	0.033
46	3.83	0.20	0.080	(0.415)	0.040	0.040
47	3.92	0.20	0.080	(0.413)	0.040	0.040
48	4.00	0.20	0.080	(0.412)	0.040	0.040
49	4.08	0.20	0.080	(0.410)	0.040	0.040
50	4.17	0.20	0.080	(0.408)	0.040	0.040
51	4.25	0.20	0.080	(0.406)	0.040	0.040
52	4.33	0.23	0.093	(0.405)	0.047	0.047
53	4.42	0.23	0.093	(0.403)	0.047	0.047

54	4.50	0.23	0.093	(0.401)	0.047	0.047
55	4.58	0.23	0.093	(0.399)	0.047	0.047
56	4.67	0.23	0.093	(0.398)	0.047	0.047
57	4.75	0.23	0.093	(0.396)	0.047	0.047
58	4.83	0.27	0.107	(0.394)	0.053	0.053
59	4.92	0.27	0.107	(0.393)	0.053	0.053
60	5.00	0.27	0.107	(0.391)	0.053	0.053
61	5.08	0.20	0.080	(0.389)	0.040	0.040
62	5.17	0.20	0.080	(0.388)	0.040	0.040
63	5.25	0.20	0.080	(0.386)	0.040	0.040
64	5.33	0.23	0.093	(0.384)	0.047	0.047
65	5.42	0.23	0.093	(0.382)	0.047	0.047
66	5.50	0.23	0.093	(0.381)	0.047	0.047
67	5.58	0.27	0.107	(0.379)	0.053	0.053
68	5.67	0.27	0.107	(0.377)	0.053	0.053
69	5.75	0.27	0.107	(0.376)	0.053	0.053
70	5.83	0.27	0.107	(0.374)	0.053	0.053
71	5.92	0.27	0.107	(0.372)	0.053	0.053
72	6.00	0.27	0.107	(0.371)	0.053	0.053
73	6.08	0.30	0.120	(0.369)	0.060	0.060
74	6.17	0.30	0.120	(0.368)	0.060	0.060
75	6.25	0.30	0.120	(0.366)	0.060	0.060
76	6.33	0.30	0.120	(0.364)	0.060	0.060
77	6.42	0.30	0.120	(0.363)	0.060	0.060
78	6.50	0.30	0.120	(0.361)	0.060	0.060
79	6.58	0.33	0.133	(0.359)	0.067	0.067
80	6.67	0.33	0.133	(0.358)	0.067	0.067
81	6.75	0.33	0.133	(0.356)	0.067	0.067
82	6.83	0.33	0.133	(0.355)	0.067	0.067
83	6.92	0.33	0.133	(0.353)	0.067	0.067
84	7.00	0.33	0.133	(0.351)	0.067	0.067
85	7.08	0.33	0.133	(0.350)	0.067	0.067
86	7.17	0.33	0.133	(0.348)	0.067	0.067
87	7.25	0.33	0.133	(0.347)	0.067	0.067
88	7.33	0.37	0.146	(0.345)	0.073	0.073
89	7.42	0.37	0.146	(0.343)	0.073	0.073
90	7.50	0.37	0.146	(0.342)	0.073	0.073
91	7.58	0.40	0.160	(0.340)	0.080	0.080
92	7.67	0.40	0.160	(0.339)	0.080	0.080
93	7.75	0.40	0.160	(0.337)	0.080	0.080
94	7.83	0.43	0.173	(0.336)	0.087	0.087
95	7.92	0.43	0.173	(0.334)	0.087	0.087
96	8.00	0.43	0.173	(0.332)	0.087	0.087
97	8.08	0.50	0.200	(0.331)	0.100	0.100
98	8.17	0.50	0.200	(0.329)	0.100	0.100
99	8.25	0.50	0.200	(0.328)	0.100	0.100
100	8.33	0.50	0.200	(0.326)	0.100	0.100
101	8.42	0.50	0.200	(0.325)	0.100	0.100
102	8.50	0.50	0.200	(0.323)	0.100	0.100
103	8.58	0.53	0.213	(0.322)	0.107	0.107
104	8.67	0.53	0.213	(0.320)	0.107	0.107
105	8.75	0.53	0.213	(0.319)	0.107	0.107
106	8.83	0.57	0.226	(0.317)	0.113	0.113
107	8.92	0.57	0.226	(0.316)	0.113	0.113
108	9.00	0.57	0.226	(0.314)	0.113	0.113
109	9.08	0.63	0.253	(0.313)	0.127	0.127
110	9.17	0.63	0.253	(0.311)	0.127	0.127
111	9.25	0.63	0.253	(0.310)	0.127	0.127
112	9.33	0.67	0.266	(0.308)	0.133	0.133
113	9.42	0.67	0.266	(0.307)	0.133	0.133
114	9.50	0.67	0.266	(0.305)	0.133	0.133
115	9.58	0.70	0.280	(0.304)	0.140	0.140
116	9.67	0.70	0.280	(0.302)	0.140	0.140
117	9.75	0.70	0.280	(0.301)	0.140	0.140
118	9.83	0.73	0.293	(0.300)	0.146	0.146
119	9.92	0.73	0.293	(0.298)	0.146	0.146
120	10.00	0.73	0.293	(0.297)	0.146	0.146
121	10.08	0.50	0.200	(0.295)	0.100	0.100
122	10.17	0.50	0.200	(0.294)	0.100	0.100
123	10.25	0.50	0.200	(0.292)	0.100	0.100
124	10.33	0.50	0.200	(0.291)	0.100	0.100
125	10.42	0.50	0.200	(0.290)	0.100	0.100
126	10.50	0.50	0.200	(0.288)	0.100	0.100
127	10.58	0.67	0.266	(0.287)	0.133	0.133
128	10.67	0.67	0.266	(0.285)	0.133	0.133
129	10.75	0.67	0.266	(0.284)	0.133	0.133
130	10.83	0.67	0.266	(0.283)	0.133	0.133
131	10.92	0.67	0.266	(0.281)	0.133	0.133
132	11.00	0.67	0.266	(0.280)	0.133	0.133

133	11.08	0.63	0.253	(0.278)	0.127	0.127
134	11.17	0.63	0.253	(0.277)	0.127	0.127
135	11.25	0.63	0.253	(0.276)	0.127	0.127
136	11.33	0.63	0.253	(0.274)	0.127	0.127
137	11.42	0.63	0.253	(0.273)	0.127	0.127
138	11.50	0.63	0.253	(0.272)	0.127	0.127
139	11.58	0.57	0.226	(0.270)	0.113	0.113
140	11.67	0.57	0.226	(0.269)	0.113	0.113
141	11.75	0.57	0.226	(0.268)	0.113	0.113
142	11.83	0.60	0.240	(0.266)	0.120	0.120
143	11.92	0.60	0.240	(0.265)	0.120	0.120
144	12.00	0.60	0.240	(0.264)	0.120	0.120
145	12.08	0.83	0.333	(0.262)	0.166	0.166
146	12.17	0.83	0.333	(0.261)	0.166	0.166
147	12.25	0.83	0.333	(0.260)	0.166	0.166
148	12.33	0.87	0.346	(0.258)	0.173	0.173
149	12.42	0.87	0.346	(0.257)	0.173	0.173
150	12.50	0.87	0.346	(0.256)	0.173	0.173
151	12.58	0.93	0.373	(0.254)	0.186	0.186
152	12.67	0.93	0.373	(0.253)	0.186	0.186
153	12.75	0.93	0.373	(0.252)	0.186	0.186
154	12.83	0.97	0.386	(0.251)	0.193	0.193
155	12.92	0.97	0.386	(0.249)	0.193	0.193
156	13.00	0.97	0.386	(0.248)	0.193	0.193
157	13.08	1.13	0.453	(0.247)	0.226	0.226
158	13.17	1.13	0.453	(0.246)	0.226	0.226
159	13.25	1.13	0.453	(0.244)	0.226	0.226
160	13.33	1.13	0.453	(0.243)	0.226	0.226
161	13.42	1.13	0.453	(0.242)	0.226	0.226
162	13.50	1.13	0.453	(0.241)	0.226	0.226
163	13.58	0.77	0.306	(0.239)	0.153	0.153
164	13.67	0.77	0.306	(0.238)	0.153	0.153
165	13.75	0.77	0.306	(0.237)	0.153	0.153
166	13.83	0.77	0.306	(0.236)	0.153	0.153
167	13.92	0.77	0.306	(0.235)	0.153	0.153
168	14.00	0.77	0.306	(0.233)	0.153	0.153
169	14.08	0.90	0.360	(0.232)	0.180	0.180
170	14.17	0.90	0.360	(0.231)	0.180	0.180
171	14.25	0.90	0.360	(0.230)	0.180	0.180
172	14.33	0.87	0.346	(0.229)	0.173	0.173
173	14.42	0.87	0.346	(0.227)	0.173	0.173
174	14.50	0.87	0.346	(0.226)	0.173	0.173
175	14.58	0.87	0.346	(0.225)	0.173	0.173
176	14.67	0.87	0.346	(0.224)	0.173	0.173
177	14.75	0.87	0.346	(0.223)	0.173	0.173
178	14.83	0.83	0.333	(0.222)	0.166	0.166
179	14.92	0.83	0.333	(0.221)	0.166	0.166
180	15.00	0.83	0.333	(0.219)	0.166	0.166
181	15.08	0.80	0.320	(0.218)	0.160	0.160
182	15.17	0.80	0.320	(0.217)	0.160	0.160
183	15.25	0.80	0.320	(0.216)	0.160	0.160
184	15.33	0.77	0.306	(0.215)	0.153	0.153
185	15.42	0.77	0.306	(0.214)	0.153	0.153
186	15.50	0.77	0.306	(0.213)	0.153	0.153
187	15.58	0.63	0.253	(0.212)	0.127	0.127
188	15.67	0.63	0.253	(0.211)	0.127	0.127
189	15.75	0.63	0.253	(0.210)	0.127	0.127
190	15.83	0.63	0.253	(0.208)	0.127	0.127
191	15.92	0.63	0.253	(0.207)	0.127	0.127
192	16.00	0.63	0.253	(0.206)	0.127	0.127
193	16.08	0.13	0.053	(0.205)	0.027	0.027
194	16.17	0.13	0.053	(0.204)	0.027	0.027
195	16.25	0.13	0.053	(0.203)	0.027	0.027
196	16.33	0.13	0.053	(0.202)	0.027	0.027
197	16.42	0.13	0.053	(0.201)	0.027	0.027
198	16.50	0.13	0.053	(0.200)	0.027	0.027
199	16.58	0.10	0.040	(0.199)	0.020	0.020
200	16.67	0.10	0.040	(0.198)	0.020	0.020
201	16.75	0.10	0.040	(0.197)	0.020	0.020
202	16.83	0.10	0.040	(0.196)	0.020	0.020
203	16.92	0.10	0.040	(0.195)	0.020	0.020
204	17.00	0.10	0.040	(0.194)	0.020	0.020
205	17.08	0.17	0.067	(0.193)	0.033	0.033
206	17.17	0.17	0.067	(0.192)	0.033	0.033
207	17.25	0.17	0.067	(0.191)	0.033	0.033
208	17.33	0.17	0.067	(0.190)	0.033	0.033
209	17.42	0.17	0.067	(0.189)	0.033	0.033
210	17.50	0.17	0.067	(0.188)	0.033	0.033
211	17.58	0.17	0.067	(0.187)	0.033	0.033

212	17.67	0.17	0.067	(0.186)	0.033	0.033
213	17.75	0.17	0.067	(0.185)	0.033	0.033
214	17.83	0.13	0.053	(0.185)	0.027	0.027
215	17.92	0.13	0.053	(0.184)	0.027	0.027
216	18.00	0.13	0.053	(0.183)	0.027	0.027
217	18.08	0.13	0.053	(0.182)	0.027	0.027
218	18.17	0.13	0.053	(0.181)	0.027	0.027
219	18.25	0.13	0.053	(0.180)	0.027	0.027
220	18.33	0.13	0.053	(0.179)	0.027	0.027
221	18.42	0.13	0.053	(0.178)	0.027	0.027
222	18.50	0.13	0.053	(0.177)	0.027	0.027
223	18.58	0.10	0.040	(0.177)	0.020	0.020
224	18.67	0.10	0.040	(0.176)	0.020	0.020
225	18.75	0.10	0.040	(0.175)	0.020	0.020
226	18.83	0.07	0.027	(0.174)	0.013	0.013
227	18.92	0.07	0.027	(0.173)	0.013	0.013
228	19.00	0.07	0.027	(0.172)	0.013	0.013
229	19.08	0.10	0.040	(0.172)	0.020	0.020
230	19.17	0.10	0.040	(0.171)	0.020	0.020
231	19.25	0.10	0.040	(0.170)	0.020	0.020
232	19.33	0.13	0.053	(0.169)	0.027	0.027
233	19.42	0.13	0.053	(0.168)	0.027	0.027
234	19.50	0.13	0.053	(0.168)	0.027	0.027
235	19.58	0.10	0.040	(0.167)	0.020	0.020
236	19.67	0.10	0.040	(0.166)	0.020	0.020
237	19.75	0.10	0.040	(0.165)	0.020	0.020
238	19.83	0.07	0.027	(0.165)	0.013	0.013
239	19.92	0.07	0.027	(0.164)	0.013	0.013
240	20.00	0.07	0.027	(0.163)	0.013	0.013
241	20.08	0.10	0.040	(0.162)	0.020	0.020
242	20.17	0.10	0.040	(0.162)	0.020	0.020
243	20.25	0.10	0.040	(0.161)	0.020	0.020
244	20.33	0.10	0.040	(0.160)	0.020	0.020
245	20.42	0.10	0.040	(0.160)	0.020	0.020
246	20.50	0.10	0.040	(0.159)	0.020	0.020
247	20.58	0.10	0.040	(0.158)	0.020	0.020
248	20.67	0.10	0.040	(0.158)	0.020	0.020
249	20.75	0.10	0.040	(0.157)	0.020	0.020
250	20.83	0.07	0.027	(0.156)	0.013	0.013
251	20.92	0.07	0.027	(0.156)	0.013	0.013
252	21.00	0.07	0.027	(0.155)	0.013	0.013
253	21.08	0.10	0.040	(0.154)	0.020	0.020
254	21.17	0.10	0.040	(0.154)	0.020	0.020
255	21.25	0.10	0.040	(0.153)	0.020	0.020
256	21.33	0.07	0.027	(0.153)	0.013	0.013
257	21.42	0.07	0.027	(0.152)	0.013	0.013
258	21.50	0.07	0.027	(0.152)	0.013	0.013
259	21.58	0.10	0.040	(0.151)	0.020	0.020
260	21.67	0.10	0.040	(0.150)	0.020	0.020
261	21.75	0.10	0.040	(0.150)	0.020	0.020
262	21.83	0.07	0.027	(0.149)	0.013	0.013
263	21.92	0.07	0.027	(0.149)	0.013	0.013
264	22.00	0.07	0.027	(0.148)	0.013	0.013
265	22.08	0.10	0.040	(0.148)	0.020	0.020
266	22.17	0.10	0.040	(0.147)	0.020	0.020
267	22.25	0.10	0.040	(0.147)	0.020	0.020
268	22.33	0.07	0.027	(0.146)	0.013	0.013
269	22.42	0.07	0.027	(0.146)	0.013	0.013
270	22.50	0.07	0.027	(0.146)	0.013	0.013
271	22.58	0.07	0.027	(0.145)	0.013	0.013
272	22.67	0.07	0.027	(0.145)	0.013	0.013
273	22.75	0.07	0.027	(0.144)	0.013	0.013
274	22.83	0.07	0.027	(0.144)	0.013	0.013
275	22.92	0.07	0.027	(0.144)	0.013	0.013
276	23.00	0.07	0.027	(0.143)	0.013	0.013
277	23.08	0.07	0.027	(0.143)	0.013	0.013
278	23.17	0.07	0.027	(0.143)	0.013	0.013
279	23.25	0.07	0.027	(0.142)	0.013	0.013
280	23.33	0.07	0.027	(0.142)	0.013	0.013
281	23.42	0.07	0.027	(0.142)	0.013	0.013
282	23.50	0.07	0.027	(0.141)	0.013	0.013
283	23.58	0.07	0.027	(0.141)	0.013	0.013
284	23.67	0.07	0.027	(0.141)	0.013	0.013
285	23.75	0.07	0.027	(0.141)	0.013	0.013
286	23.83	0.07	0.027	(0.141)	0.013	0.013
287	23.92	0.07	0.027	(0.141)	0.013	0.013
288	24.00	0.07	0.027	(0.140)	0.013	0.013
		(Loss Rate Not Used)				
	Sum =	100.0			Sum =	20.0

```
      Flood volume = Effective rainfall      1.66(In)
       times area       7.5(Ac.)/[(In)/(Ft.)] =       1.0(Ac.Ft)
      Total soil loss =      1.66(In)
      Total soil loss =     1.040(Ac.Ft)
      Total rainfall =      3.33(In)
      Flood volume =       45321.9 Cubic Feet
      Total soil loss =       45321.9 Cubic Feet
      --------------------------------------------------------------------
       Peak flow rate of this hydrograph =      1.712(CFS)
      --------------------------------------------------------------------
      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                        24 - H O U R   S T O R M
                   R u n o f f     H y d r o g r a p h
      --------------------------------------------------------------------
                  Hydrograph in   5   Minute intervals ((CFS))

      --------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0        2.5        5.0        7.5      10.0
-----------------------------------------------------------------------
  0+ 5      0.0003      0.04  Q        |          |          |          |
  0+10      0.0009      0.09  Q        |          |          |          |
  0+15      0.0015      0.10  Q        |          |          |          |
  0+20      0.0023      0.12  Q        |          |          |          |
  0+25      0.0033      0.14  Q        |          |          |          |
  0+30      0.0044      0.15  Q        |          |          |          |
  0+35      0.0054      0.15  Q        |          |          |          |
  0+40      0.0064      0.15  Q        |          |          |          |
  0+45      0.0075      0.15  Q        |          |          |          |
  0+50      0.0087      0.17  Q        |          |          |          |
  0+55      0.0100      0.19  Q        |          |          |          |
  1+ 0      0.0114      0.20  Q        |          |          |          |
  1+ 5      0.0126      0.18  Q        |          |          |          |
  1+10      0.0137      0.16  Q        |          |          |          |
  1+15      0.0147      0.15  Q        |          |          |          |
  1+20      0.0158      0.15  Q        |          |          |          |
  1+25      0.0168      0.15  Q        |          |          |          |
  1+30      0.0179      0.15  Q        |          |          |          |
  1+35      0.0189      0.15  Q        |          |          |          |
  1+40      0.0200      0.15  Q        |          |          |          |
  1+45      0.0210      0.15  Q        |          |          |          |
  1+50      0.0222      0.17  Q        |          |          |          |
  1+55      0.0235      0.19  Q        |          |          |          |
  2+ 0      0.0249      0.20  Q        |          |          |          |
  2+ 5      0.0263      0.20  QV       |          |          |          |
  2+10      0.0277      0.20  QV       |          |          |          |
  2+15      0.0290      0.20  QV       |          |          |          |
  2+20      0.0304      0.20  QV       |          |          |          |
  2+25      0.0318      0.20  QV       |          |          |          |
  2+30      0.0332      0.20  QV       |          |          |          |
  2+35      0.0347      0.22  QV       |          |          |          |
  2+40      0.0364      0.24  QV       |          |          |          |
  2+45      0.0381      0.25  QV       |          |          |          |
  2+50      0.0399      0.25  |Q       |          |          |          |
  2+55      0.0416      0.25  |Q       |          |          |          |
  3+ 0      0.0433      0.25  |Q       |          |          |          |
  3+ 5      0.0451      0.25  |Q       |          |          |          |
  3+10      0.0468      0.25  |Q       |          |          |          |
  3+15      0.0485      0.25  |Q       |          |          |          |
  3+20      0.0503      0.25  |Q       |          |          |          |
  3+25      0.0520      0.25  |Q       |          |          |          |
  3+30      0.0537      0.25  |QV      |          |          |          |
  3+35      0.0555      0.25  |QV      |          |          |          |
  3+40      0.0572      0.25  |QV      |          |          |          |
  3+45      0.0589      0.25  |QV      |          |          |          |
  3+50      0.0608      0.27  |QV      |          |          |          |
  3+55      0.0628      0.29  |QV      |          |          |          |
  4+ 0      0.0649      0.30  |QV      |          |          |          |
  4+ 5      0.0670      0.30  |QV      |          |          |          |
  4+10      0.0690      0.30  |QV      |          |          |          |
  4+15      0.0711      0.30  |QV      |          |          |          |
  4+20      0.0733      0.32  |QV      |          |          |          |
  4+25      0.0757      0.34  |QV      |          |          |          |
  4+30      0.0781      0.35  |Q V     |          |          |          |
  4+35      0.0806      0.35  |Q V     |          |          |          |
  4+40      0.0830      0.35  |Q V     |          |          |          |
  4+45      0.0854      0.35  |Q V     |          |          |          |
  4+50      0.0880      0.37  |Q V     |          |          |          |
  4+55      0.0907      0.40  |Q V     |          |          |          |
  5+ 0      0.0935      0.40  |Q V     |          |          |          |
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```
 5+ 5       0.0959      0.36  |Q V      |         |         |         |
 5+10       0.0981      0.32  |Q V      |         |         |         |
 5+15       0.1002      0.31  |Q V      |         |         |         |
 5+20       0.1025      0.32  |Q V      |         |         |         |
 5+25       0.1049      0.34  |Q  V     |         |         |         |
 5+30       0.1073      0.35  |Q  V     |         |         |         |
 5+35       0.1098      0.37  |Q  V     |         |         |         |
 5+40       0.1126      0.40  |Q  V     |         |         |         |
 5+45       0.1153      0.40  |Q  V     |         |         |         |
 5+50       0.1181      0.40  |Q  V     |         |         |         |
 5+55       0.1208      0.40  |Q  V     |         |         |         |
 6+ 0       0.1236      0.40  |Q  V     |         |         |         |
 6+ 5       0.1265      0.42  |Q  V     |         |         |         |
 6+10       0.1296      0.45  |Q  V     |         |         |         |
 6+15       0.1327      0.45  |Q   V    |         |         |         |
 6+20       0.1358      0.45  |Q   V    |         |         |         |
 6+25       0.1389      0.45  |Q   V    |         |         |         |
 6+30       0.1421      0.45  |Q   V    |         |         |         |
 6+35       0.1453      0.47  |Q   V    |         |         |         |
 6+40       0.1487      0.50  |Q   V    |         |         |         |
 6+45       0.1522      0.50  | Q  V    |         |         |         |
 6+50       0.1557      0.50  | Q  V    |         |         |         |
 6+55       0.1591      0.50  | Q   V   |         |         |         |
 7+ 0       0.1626      0.50  | Q   V   |         |         |         |
 7+ 5       0.1661      0.50  | Q   V   |         |         |         |
 7+10       0.1695      0.50  | Q   V   |         |         |         |
 7+15       0.1730      0.50  | Q   V   |         |         |         |
 7+20       0.1766      0.52  | Q   V   |         |         |         |
 7+25       0.1804      0.55  | Q   V   |         |         |         |
 7+30       0.1842      0.55  | Q    V  |         |         |         |
 7+35       0.1881      0.57  | Q    V  |         |         |         |
 7+40       0.1922      0.60  | Q    V  |         |         |         |
 7+45       0.1964      0.60  | Q    V  |         |         |         |
 7+50       0.2007      0.62  | Q    V  |         |         |         |
 7+55       0.2051      0.65  | Q    V  |         |         |         |
 8+ 0       0.2096      0.65  | Q     V |         |         |         |
 8+ 5       0.2144      0.69  | Q     V |         |         |         |
 8+10       0.2195      0.74  | Q     V |         |         |         |
 8+15       0.2247      0.75  | Q     V |         |         |         |
 8+20       0.2298      0.75  |  Q    V |         |         |         |
 8+25       0.2350      0.76  |  Q     V|         |         |         |
 8+30       0.2402      0.76  |  Q     V|         |         |         |
 8+35       0.2456      0.78  |  Q     V|         |         |         |
 8+40       0.2511      0.80  |  Q     V|         |         |         |
 8+45       0.2566      0.80  |  Q     V|         |         |         |
 8+50       0.2623      0.83  |  Q      V         |         |         |
 8+55       0.2681      0.85  |  Q      V         |         |         |
 9+ 0       0.2740      0.85  |  Q      V         |         |         |
 9+ 5       0.2802      0.90  |  Q      V         |         |         |
 9+10       0.2867      0.94  |  Q      |V        |         |         |
 9+15       0.2932      0.95  |  Q      |V        |         |         |
 9+20       0.2999      0.98  |  Q      |V        |         |         |
 9+25       0.3068      1.00  |  Q      |V        |         |         |
 9+30       0.3137      1.00  |   Q     | V       |         |         |
 9+35       0.3208      1.03  |   Q     | V       |         |         |
 9+40       0.3280      1.05  |   Q     | V       |         |         |
 9+45       0.3353      1.05  |   Q     | V       |         |         |
 9+50       0.3427      1.08  |   Q     |  V      |         |         |
 9+55       0.3503      1.10  |   Q     |  V      |         |         |
10+ 0       0.3579      1.11  |   Q     |  V      |         |         |
10+ 5       0.3646      0.96  |  Q      |   V     |         |         |
10+10       0.3701      0.81  |  Q      |   V     |         |         |
10+15       0.3755      0.77  |  Q      |   V     |         |         |
10+20       0.3807      0.76  |  Q      |   V     |         |         |
10+25       0.3859      0.76  |  Q      |   V     |         |         |
10+30       0.3911      0.76  |  Q      |    V    |         |         |
10+35       0.3970      0.86  |  Q      |    V    |         |         |
10+40       0.4037      0.97  |  Q      |    V    |         |         |
10+45       0.4105      0.99  |  Q      |    V    |         |         |
10+50       0.4174      1.00  |   Q     |     V   |         |         |
10+55       0.4244      1.01  |   Q     |     V   |         |         |
11+ 0       0.4313      1.01  |   Q     |     V   |         |         |
11+ 5       0.4381      0.99  |  Q      |     V   |         |         |
11+10       0.4447      0.96  |  Q      |      V  |         |         |
11+15       0.4514      0.96  |  Q      |      V  |         |         |
11+20       0.4580      0.96  |  Q      |      V  |         |         |
11+25       0.4645      0.96  |  Q      |      V  |         |         |
11+30       0.4711      0.96  |  Q      |       V |         |         |
11+35       0.4774      0.92  |  Q      |       V |         |         |
```

11+40	0.4834	0.87	Q	V		
11+45	0.4894	0.86	Q	V		
11+50	0.4954	0.88	Q	V		
11+55	0.5016	0.90	Q	V		
12+ 0	0.5078	0.90	Q	V		
12+ 5	0.5151	1.05	Q	V		
12+10	0.5234	1.21	Q		V	
12+15	0.5319	1.24	Q		V	
12+20	0.5407	1.27	Q		V	
12+25	0.5496	1.30	Q		V	
12+30	0.5586	1.31	Q		V	
12+35	0.5679	1.35	Q		V	
12+40	0.5775	1.39	Q		V	
12+45	0.5872	1.40	Q		V	
12+50	0.5970	1.43	Q		V	
12+55	0.6070	1.45	Q		V	
13+ 0	0.6171	1.46	Q		V	
13+ 5	0.6278	1.56	Q		V	
13+10	0.6394	1.67	Q		V	
13+15	0.6511	1.70	Q		V	
13+20	0.6628	1.71	Q		V	
13+25	0.6746	1.71	Q		V	
13+30	0.6864	1.71	Q		V	
13+35	0.6967	1.49	Q		V	
13+40	0.7052	1.24	Q		V	
13+45	0.7134	1.19	Q		V	
13+50	0.7214	1.17	Q		V	
13+55	0.7294	1.16	Q		V	
14+ 0	0.7374	1.16	Q		V	
14+ 5	0.7459	1.24	Q		V	
14+10	0.7551	1.33	Q		V	
14+15	0.7644	1.35	Q		V	
14+20	0.7736	1.34	Q		V	
14+25	0.7826	1.32	Q			V
14+30	0.7917	1.31	Q			V
14+35	0.8007	1.31	Q			V
14+40	0.8097	1.31	Q			V
14+45	0.8187	1.31	Q			V
14+50	0.8276	1.29	Q			V
14+55	0.8363	1.27	Q			V
15+ 0	0.8450	1.26	Q			V
15+ 5	0.8536	1.24	Q			V
15+10	0.8619	1.22	Q			V
15+15	0.8703	1.21	Q			V
15+20	0.8785	1.19	Q			V
15+25	0.8865	1.17	Q			V
15+30	0.8945	1.16	Q			V
15+35	0.9019	1.08	Q			V
15+40	0.9087	0.99	Q			V
15+45	0.9154	0.97	Q			V
15+50	0.9220	0.96	Q			V
15+55	0.9286	0.96	Q			V
16+ 0	0.9352	0.96	Q			V
16+ 5	0.9397	0.65	Q			V
16+10	0.9418	0.31	Q			V
16+15	0.9435	0.24	Q			V
16+20	0.9450	0.21	Q			V
16+25	0.9464	0.20	Q			V
16+30	0.9478	0.20	Q			V
16+35	0.9490	0.18	Q			V
16+40	0.9501	0.16	Q			V
16+45	0.9512	0.15	Q			V
16+50	0.9522	0.15	Q			V
16+55	0.9532	0.15	Q			V
17+ 0	0.9543	0.15	Q			V
17+ 5	0.9556	0.19	Q			V
17+10	0.9572	0.24	Q			V
17+15	0.9589	0.25	Q			V
17+20	0.9606	0.25	Q			V
17+25	0.9624	0.25	Q			V
17+30	0.9641	0.25	Q			V
17+35	0.9658	0.25	Q			V
17+40	0.9676	0.25	Q			V
17+45	0.9693	0.25	Q			V
17+50	0.9709	0.23	Q			V
17+55	0.9724	0.21	Q			V
18+ 0	0.9738	0.20	Q			V
18+ 5	0.9752	0.20	Q			V
18+10	0.9765	0.20	Q			V

```
  18+15       0.9779      0.20  Q          |         |         |       V  |
  18+20       0.9793      0.20  Q          |         |         |       V  |
  18+25       0.9807      0.20  Q          |         |         |       V  |
  18+30       0.9821      0.20  Q          |         |         |       V  |
  18+35       0.9833      0.18  Q          |         |         |       V  |
  18+40       0.9844      0.16  Q          |         |         |       V  |
  18+45       0.9855      0.15  Q          |         |         |       V  |
  18+50       0.9864      0.13  Q          |         |         |       V  |
  18+55       0.9871      0.11  Q          |         |         |       V  |
  19+ 0       0.9879      0.10  Q          |         |         |       V  |
  19+ 5       0.9887      0.12  Q          |         |         |        V |
  19+10       0.9897      0.14  Q          |         |         |        V |
  19+15       0.9907      0.15  Q          |         |         |        V |
  19+20       0.9919      0.17  Q          |         |         |        V |
  19+25       0.9932      0.19  Q          |         |         |        V |
  19+30       0.9946      0.20  Q          |         |         |        V |
  19+35       0.9958      0.18  Q          |         |         |        V |
  19+40       0.9969      0.16  Q          |         |         |        V |
  19+45       0.9980      0.15  Q          |         |         |        V |
  19+50       0.9989      0.13  Q          |         |         |        V |
  19+55       0.9996      0.11  Q          |         |         |        V |
  20+ 0       1.0003      0.10  Q          |         |         |        V |
  20+ 5       1.0012      0.12  Q          |         |         |        V |
  20+10       1.0022      0.14  Q          |         |         |        V |
  20+15       1.0032      0.15  Q          |         |         |        V |
  20+20       1.0042      0.15  Q          |         |         |        V |
  20+25       1.0053      0.15  Q          |         |         |        V |
  20+30       1.0063      0.15  Q          |         |         |        V |
  20+35       1.0073      0.15  Q          |         |         |        V |
  20+40       1.0084      0.15  Q          |         |         |        V |
  20+45       1.0094      0.15  Q          |         |         |        V |
  20+50       1.0103      0.13  Q          |         |         |        V |
  20+55       1.0111      0.11  Q          |         |         |        V |
  21+ 0       1.0118      0.10  Q          |         |         |        V |
  21+ 5       1.0126      0.12  Q          |         |         |        V |
  21+10       1.0136      0.14  Q          |         |         |        V |
  21+15       1.0146      0.15  Q          |         |         |         V|
  21+20       1.0155      0.13  Q          |         |         |         V|
  21+25       1.0163      0.11  Q          |         |         |         V|
  21+30       1.0170      0.10  Q          |         |         |         V|
  21+35       1.0178      0.12  Q          |         |         |         V|
  21+40       1.0188      0.14  Q          |         |         |         V|
  21+45       1.0198      0.15  Q          |         |         |         V|
  21+50       1.0207      0.13  Q          |         |         |         V|
  21+55       1.0215      0.11  Q          |         |         |         V|
  22+ 0       1.0222      0.10  Q          |         |         |         V|
  22+ 5       1.0230      0.12  Q          |         |         |         V|
  22+10       1.0240      0.14  Q          |         |         |         V|
  22+15       1.0250      0.15  Q          |         |         |         V|
  22+20       1.0259      0.13  Q          |         |         |         V|
  22+25       1.0267      0.11  Q          |         |         |         V|
  22+30       1.0274      0.10  Q          |         |         |         V|
  22+35       1.0281      0.10  Q          |         |         |         V|
  22+40       1.0288      0.10  Q          |         |         |         V|
  22+45       1.0295      0.10  Q          |         |         |         V|
  22+50       1.0302      0.10  Q          |         |         |         V|
  22+55       1.0309      0.10  Q          |         |         |         V|
  23+ 0       1.0316      0.10  Q          |         |         |         V|
  23+ 5       1.0322      0.10  Q          |         |         |         V|
  23+10       1.0329      0.10  Q          |         |         |         V|
  23+15       1.0336      0.10  Q          |         |         |         V|
  23+20       1.0343      0.10  Q          |         |         |         V|
  23+25       1.0350      0.10  Q          |         |         |         V|
  23+30       1.0357      0.10  Q          |         |         |         V|
  23+35       1.0364      0.10  Q          |         |         |         V|
  23+40       1.0371      0.10  Q          |         |         |         V|
  23+45       1.0378      0.10  Q          |         |         |         V|
  23+50       1.0385      0.10  Q          |         |         |         V|
  23+55       1.0392      0.10  Q          |         |         |         V|
  24+ 0       1.0399      0.10  Q          |         |         |         V|
  24+ 5       1.0403      0.06  Q          |         |         |         V|
  24+10       1.0404      0.02  Q          |         |         |         V|
  24+15       1.0404      0.01  Q          |         |         |         V|
  24+20       1.0404      0.00  Q          |         |         |         V|
-----------------------------------------------------------------------
```

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      U n i t   H y d r o g r a p h   A n a l y s i s

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              Study date  07/23/19 File: DMAC10PROP110.out


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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978


Program License Serial Number 6388

---------------------------------------------------------------------
 English (in-lb) Input Units Used
 English Rainfall Data (Inches) Input Values Used

 English Units used in output format



---------------------------------------------------------------------
KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
PROPOSED CONDITION, DMA C
10-YR 1-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019
--------------------------------------------------------------------
Drainage Area =       7.50(Ac.)  =      0.012 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =       7.50(Ac.)  =      0.012 Sq. Mi.
Length along longest watercourse =     860.00(Ft.)
Length along longest watercourse measured to centroid =     749.00(Ft.)
Length along longest watercourse =      0.163 Mi.
Length along longest watercourse measured to centroid =      0.142 Mi.
Difference in elevation =      21.50(Ft.)
Slope along watercourse =    132.0000 Ft./Mi.
Average Manning's 'N' = 0.015
Lag time =    0.034 Hr.
Lag time =     2.04 Min.
25% of lag time =     0.51 Min.
40% of lag time =     0.82 Min.
Unit time =     5.00 Min.
Duration of storm = 1 Hour(s)
User Entered Base Flow =     0.00(CFS)

2 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        7.50           0.49                  3.67

100 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        7.50           1.33                  9.98

STORM EVENT (YEAR) =   10.00
Area Averaged 2-Year Rainfall =    0.489(In)
Area Averaged 100-Year Rainfall =    1.330(In)

Point rain (area averaged) =    0.835(In)
Areal adjustment factor =   99.99 %
Adjusted average point rain =    0.835(In)

Sub-Area Data:
Area(Ac.)         Runoff Index   Impervious %
     7.500           56.00         0.760
 Total Area Entered =      7.50(Ac.)


RI    RI   Infil. Rate Impervious   Adj. Infil. Rate  Area%     F
AMC2 AMC-2     (In/Hr)    (Dec.%)      (In/Hr)      (Dec.)    (In/Hr)
56.0  56.0      0.511     0.760        0.161       1.000      0.161
                                                  Sum (F) =   0.161
Area averaged mean soil loss (F) (In/Hr) =  0.161
Minimum soil loss rate ((In/Hr)) =  0.081
```

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.290

Slope of intensity-duration curve for a 1 hour storm =0.5000

U n i t   H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.083	245.027	50.239	3.797
2	0.167	490.055	40.364	3.051
3	0.250	735.082	7.184	0.543
4	0.333	980.109	2.213	0.167
			Sum = 100.000	Sum= 7.559

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Loss rate(In./Hr) Low	Effective (In/Hr)
1	0.08	4.20	0.421	(0.161)	0.122	0.299
2	0.17	4.30	0.431	(0.161)	0.125	0.306
3	0.25	5.00	0.501	(0.161)	0.145	0.356
4	0.33	5.00	0.501	(0.161)	0.145	0.356
5	0.42	5.80	0.581	0.161	(0.169)	0.420
6	0.50	6.50	0.651	0.161	(0.189)	0.490
7	0.58	7.40	0.741	0.161	(0.215)	0.580
8	0.67	8.60	0.862	0.161	(0.250)	0.700
9	0.75	12.30	1.232	0.161	(0.357)	1.071
10	0.83	29.10	2.916	0.161	(0.846)	2.754
11	0.92	6.80	0.681	0.161	(0.198)	0.520
12	1.00	5.00	0.501	(0.161)	0.145	0.356
		(Loss Rate Not Used)				
Sum =		100.0				Sum = 8.2

Flood volume = Effective rainfall 0.68(In)
times area 7.5(Ac.)/[(In)/(Ft.)] = 0.4(Ac.Ft)
Total soil loss = 0.15(In)
Total soil loss = 0.094(Ac.Ft)
Total rainfall = 0.83(In)
Flood volume = 18618.6 Cubic Feet
Total soil loss = 4112.6 Cubic Feet

Peak flow rate of this hydrograph = 14.211(CFS)

++

1 - H O U R   S T O R M
R u n o f f   H y d r o g r a p h

Hydrograph in 5 Minute intervals ((CFS))

```
--------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0       5.0       10.0      15.0      20.0
--------------------------------------------------------------------
  0+ 5       0.0078      1.14  V Q       |         |         |         |
  0+10       0.0221      2.07  | V Q     |         |         |         |
  0+15       0.0390      2.45  |  VQ     |         |         |         |
  0+20       0.0572      2.65  |    Q    |         |         |         |
  0+25       0.0774      2.92  |    Q V  |         |         |         |
  0+30       0.1008      3.39  |     Q  V|         |         |         |
  0+35       0.1282      3.99  |      Q  |V        |         |         |
  0+40       0.1610      4.77  |        Q|    V    |         |         |
  0+45       0.2065      6.60  |         |  Q     V|         |         |
  0+50       0.3044     14.21  |         |         |       Q |         |
  0+55       0.3807     11.08  |         |         | Q       |    V    |
  1+ 0       0.4125      4.61  |        Q|         |         |       V |
  1+ 5       0.4251      1.83  |  Q      |         |         |        V|
  1+10       0.4270      0.28  Q         |         |         |        V|
  1+15       0.4274      0.06  Q         |         |         |        V|
--------------------------------------------------------------------
```

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       U n i t   H y d r o g r a p h   A n a l y s i s

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               Study date  07/23/19 File: DMAC10PROP310.out


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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978


Program License Serial Number 6388

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 English (in-lb) Input Units Used
 English Rainfall Data (Inches) Input Values Used

 English Units used in output format




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Slope along watercourse =    132.0000 Ft./Mi.
Average Manning's 'N' = 0.015
Lag time =    0.034 Hr.
Lag time =     2.04 Min.
25% of lag time =     0.51 Min.
40% of lag time =     0.82 Min.
Unit time =     5.00 Min.
Duration of storm = 3 Hour(s)
User Entered Base Flow =     0.00(CFS)

2 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        7.50           0.87                  6.50

100 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        7.50           2.09                 15.67

STORM EVENT (YEAR) =   10.00
Area Averaged 2-Year Rainfall =    0.866(In)
Area Averaged 100-Year Rainfall =    2.090(In)

Point rain (area averaged) =    1.370(In)
Areal adjustment factor =  100.00 %
Adjusted average point rain =    1.370(In)

Sub-Area Data:
Area(Ac.)         Runoff Index   Impervious %
     7.500           56.00         0.760
 Total Area Entered =      7.50(Ac.)


RI    RI   Infil. Rate Impervious   Adj. Infil. Rate  Area%     F
AMC2 AMC-2     (In/Hr)    (Dec.%)      (In/Hr)      (Dec.)    (In/Hr)
56.0  56.0      0.511     0.760        0.161        1.000      0.161
                                                  Sum (F) =   0.161
Area averaged mean soil loss (F) (In/Hr) =  0.161
Minimum soil loss rate ((In/Hr)) =  0.081
```

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.290

U n i t H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.083	245.027	50.239	3.797
2	0.167	490.055	40.364	3.051
3	0.250	735.082	7.184	0.543
4	0.333	980.109	2.213	0.167
			Sum = 100.000	Sum= 7.559

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Loss rate(In./Hr) Low	Effective (In/Hr)
1	0.08	1.30	0.214	(0.161)	0.062	0.152
2	0.17	1.30	0.214	(0.161)	0.062	0.152
3	0.25	1.10	0.181	(0.161)	0.052	0.128
4	0.33	1.50	0.247	(0.161)	0.071	0.175
5	0.42	1.50	0.247	(0.161)	0.071	0.175
6	0.50	1.80	0.296	(0.161)	0.086	0.210
7	0.58	1.50	0.247	(0.161)	0.071	0.175
8	0.67	1.80	0.296	(0.161)	0.086	0.210
9	0.75	1.80	0.296	(0.161)	0.086	0.210
10	0.83	1.50	0.247	(0.161)	0.071	0.175
11	0.92	1.60	0.263	(0.161)	0.076	0.187
12	1.00	1.80	0.296	(0.161)	0.086	0.210
13	1.08	2.20	0.362	(0.161)	0.105	0.257
14	1.17	2.20	0.362	(0.161)	0.105	0.257
15	1.25	2.20	0.362	(0.161)	0.105	0.257
16	1.33	2.00	0.329	(0.161)	0.095	0.233
17	1.42	2.60	0.427	(0.161)	0.124	0.303
18	1.50	2.70	0.444	(0.161)	0.129	0.315
19	1.58	2.40	0.394	(0.161)	0.114	0.280
20	1.67	2.70	0.444	(0.161)	0.129	0.315
21	1.75	3.30	0.542	(0.161)	0.157	0.385
22	1.83	3.10	0.509	(0.161)	0.148	0.362
23	1.92	2.90	0.477	(0.161)	0.138	0.338
24	2.00	3.00	0.493	(0.161)	0.143	0.350
25	2.08	3.10	0.509	(0.161)	0.148	0.362
26	2.17	4.20	0.690	0.161	(0.200)	0.529
27	2.25	5.00	0.822	0.161	(0.238)	0.660
28	2.33	3.50	0.575	0.161	(0.167)	0.414
29	2.42	6.80	1.118	0.161	(0.324)	0.956
30	2.50	7.30	1.200	0.161	(0.348)	1.038
31	2.58	8.20	1.348	0.161	(0.391)	1.186
32	2.67	5.90	0.970	0.161	(0.281)	0.808
33	2.75	2.00	0.329	(0.161)	0.095	0.233
34	2.83	1.80	0.296	(0.161)	0.086	0.210
35	2.92	1.80	0.296	(0.161)	0.086	0.210
36	3.00	0.60	0.099	(0.161)	0.029	0.070

(Loss Rate Not Used)
Sum = 100.0 Sum = 12.5

Flood volume = Effective rainfall 1.04(In)
times area 7.5(Ac.)/[(In)/(Ft.)] = 0.7(Ac.Ft)
Total soil loss = 0.33(In)
Total soil loss = 0.206(Ac.Ft)
Total rainfall = 1.37(In)
Flood volume = 28331.4 Cubic Feet
Total soil loss = 8953.7 Cubic Feet

Peak flow rate of this hydrograph = 8.265(CFS)

+++

3 - H O U R S T O R M
R u n o f f H y d r o g r a p h

Hydrograph in 5 Minute intervals ((CFS))

```
        --------------------------------------------------------------------
  Time(h+m) Volume Ac.Ft   Q(CFS)  0        2.5       5.0       7.5      10.0
  -----------------------------------------------------------------------
    0+ 5       0.0040      0.58  V Q       |         |         |         |
    0+10       0.0111      1.04  V   Q     |         |         |         |
    0+15       0.0182      1.03  |V  Q     |         |         |         |
    0+20       0.0263      1.16  |V  Q     |         |         |         |
    0+25       0.0352      1.29  | V  Q    |         |         |         |
    0+30       0.0452      1.45  | V  Q    |         |         |         |
    0+35       0.0550      1.43  |  V Q    |         |         |         |
    0+40       0.0652      1.48  |   VQ    |         |         |         |
    0+45       0.0760      1.57  |   V Q   |         |         |         |
    0+50       0.0860      1.45  |    Q    |         |         |         |
    0+55       0.0956      1.39  |    Q    |         |         |         |
    1+ 0       0.1059      1.50  |    QV   |         |         |         |
    1+ 5       0.1179      1.75  |     QV  |         |         |         |
    1+10       0.1310      1.90  |      QV |         |         |         |
    1+15       0.1443      1.93  |      QV |         |         |         |
    1+20       0.1571      1.85  |      Q V|         |         |         |
    1+25       0.1712      2.05  |       Q V         |         |         |
    1+30       0.1870      2.29  |        Q|V        |         |         |
    1+35       0.2023      2.23  |       Q | V       |         |         |
    1+40       0.2180      2.27  |        Q|  V      |         |         |
    1+45       0.2361      2.63  |         Q   V     |         |         |
    1+50       0.2552      2.77  |         |Q   V    |         |         |
    1+55       0.2734      2.65  |         Q     V   |         |         |
    2+ 0       0.2915      2.62  |         Q      V  |         |         |
    2+ 5       0.3100      2.69  |         Q        V|         |         |
    2+10       0.3331      3.36  |         |  Q      V         |         |
    2+15       0.3633      4.38  |         |      Q  | V       |         |
    2+20       0.3904      3.94  |         |    Q    |   V     |         |
    2+25       0.4272      5.34  |         |         |Q    V   |         |
    2+30       0.4768      7.20  |         |         |       QV|         |
    2+35       0.5337      8.26  |         |         |         | VQ      |
    2+40       0.5848      7.42  |         |         |        Q|    V    |
    2+45       0.6135      4.17  |         |     Q   |         |      V  |
    2+50       0.6283      2.15  |       Q |         |         |       V |
    2+55       0.6400      1.70  |     Q   |         |         |        V|
    3+ 0       0.6473      1.06  |   Q     |         |         |        V|
    3+ 5       0.6498      0.36  |Q        |         |         |        V|
    3+10       0.6503      0.07  Q         |         |         |        V|
    3+15       0.6504      0.01  Q         |         |         |         V
-----------------------------------------------------------------------
```

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      U n i t   H y d r o g r a p h   A n a l y s i s

      Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2014, Version 9.0
              Study date  07/23/19 File: DMAC10PROP610.out

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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978


Program License Serial Number 6388

----------------------------------------------------------------------
 English (in-lb) Input Units Used
 English Rainfall Data (Inches) Input Values Used

 English Units used in output format



----------------------------------------------------------------------
KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
PROPOSED CONDITION, DMA C
10-YR 6-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019
---------------------------------------------------------------------
Drainage Area =       7.50(Ac.)  =      0.012 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =       7.50(Ac.)  =      0.012 Sq. Mi.
Length along longest watercourse =     860.00(Ft.)
Length along longest watercourse measured to centroid =     749.00(Ft.)
Length along longest watercourse =      0.163 Mi.
Length along longest watercourse measured to centroid =      0.142 Mi.
Difference in elevation =      21.50(Ft.)
Slope along watercourse =    132.0000 Ft./Mi.
Average Manning's 'N' = 0.015
Lag time =    0.034 Hr.
Lag time =     2.04 Min.
25% of lag time =     0.51 Min.
40% of lag time =     0.82 Min.
Unit time =     5.00 Min.
Duration of storm = 6 Hour(s)
User Entered Base Flow =     0.00(CFS)

2 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        7.50           1.21                  9.07

100 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        7.50           2.86                 21.45

STORM EVENT (YEAR) =   10.00
Area Averaged 2-Year Rainfall =    1.210(In)
Area Averaged 100-Year Rainfall =    2.860(In)

Point rain (area averaged) =    1.889(In)
Areal adjustment factor =  100.00 %
Adjusted average point rain =    1.889(In)

Sub-Area Data:
Area(Ac.)         Runoff Index   Impervious %
     7.500           56.00         0.760
 Total Area Entered =      7.50(Ac.)


RI    RI   Infil. Rate Impervious   Adj. Infil. Rate  Area%     F
AMC2 AMC-2     (In/Hr)    (Dec.%)      (In/Hr)      (Dec.)    (In/Hr)
56.0  56.0      0.511     0.760        0.161        1.000      0.161
                                                   Sum (F) =   0.161
Area averaged mean soil loss (F) (In/Hr) =  0.161
Minimum soil loss rate ((In/Hr)) =  0.081
```

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.290

Unit Hydrograph
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.083	245.027	50.239	3.797
2	0.167	490.055	40.364	3.051
3	0.250	735.082	7.184	0.543
4	0.333	980.109	2.213	0.167
			Sum = 100.000	Sum= 7.559

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Low	Effective (In/Hr)
1	0.08	0.50	0.113	(0.161)	0.033	0.080
2	0.17	0.60	0.136	(0.161)	0.039	0.097
3	0.25	0.60	0.136	(0.161)	0.039	0.097
4	0.33	0.60	0.136	(0.161)	0.039	0.097
5	0.42	0.60	0.136	(0.161)	0.039	0.097
6	0.50	0.70	0.159	(0.161)	0.046	0.113
7	0.58	0.70	0.159	(0.161)	0.046	0.113
8	0.67	0.70	0.159	(0.161)	0.046	0.113
9	0.75	0.70	0.159	(0.161)	0.046	0.113
10	0.83	0.70	0.159	(0.161)	0.046	0.113
11	0.92	0.70	0.159	(0.161)	0.046	0.113
12	1.00	0.80	0.181	(0.161)	0.053	0.129
13	1.08	0.80	0.181	(0.161)	0.053	0.129
14	1.17	0.80	0.181	(0.161)	0.053	0.129
15	1.25	0.80	0.181	(0.161)	0.053	0.129
16	1.33	0.80	0.181	(0.161)	0.053	0.129
17	1.42	0.80	0.181	(0.161)	0.053	0.129
18	1.50	0.80	0.181	(0.161)	0.053	0.129
19	1.58	0.80	0.181	(0.161)	0.053	0.129
20	1.67	0.80	0.181	(0.161)	0.053	0.129
21	1.75	0.80	0.181	(0.161)	0.053	0.129
22	1.83	0.80	0.181	(0.161)	0.053	0.129
23	1.92	0.80	0.181	(0.161)	0.053	0.129
24	2.00	0.90	0.204	(0.161)	0.059	0.145
25	2.08	0.80	0.181	(0.161)	0.053	0.129
26	2.17	0.90	0.204	(0.161)	0.059	0.145
27	2.25	0.90	0.204	(0.161)	0.059	0.145
28	2.33	0.90	0.204	(0.161)	0.059	0.145
29	2.42	0.90	0.204	(0.161)	0.059	0.145
30	2.50	0.90	0.204	(0.161)	0.059	0.145
31	2.58	0.90	0.204	(0.161)	0.059	0.145
32	2.67	0.90	0.204	(0.161)	0.059	0.145
33	2.75	1.00	0.227	(0.161)	0.066	0.161
34	2.83	1.00	0.227	(0.161)	0.066	0.161
35	2.92	1.00	0.227	(0.161)	0.066	0.161
36	3.00	1.00	0.227	(0.161)	0.066	0.161
37	3.08	1.00	0.227	(0.161)	0.066	0.161
38	3.17	1.10	0.249	(0.161)	0.072	0.177
39	3.25	1.10	0.249	(0.161)	0.072	0.177
40	3.33	1.10	0.249	(0.161)	0.072	0.177
41	3.42	1.20	0.272	(0.161)	0.079	0.193
42	3.50	1.30	0.295	(0.161)	0.085	0.209
43	3.58	1.40	0.317	(0.161)	0.092	0.225
44	3.67	1.40	0.317	(0.161)	0.092	0.225
45	3.75	1.50	0.340	(0.161)	0.099	0.241
46	3.83	1.50	0.340	(0.161)	0.099	0.241
47	3.92	1.60	0.363	(0.161)	0.105	0.257
48	4.00	1.60	0.363	(0.161)	0.105	0.257
49	4.08	1.70	0.385	(0.161)	0.112	0.274
50	4.17	1.80	0.408	(0.161)	0.118	0.290
51	4.25	1.90	0.431	(0.161)	0.125	0.306
52	4.33	2.00	0.453	(0.161)	0.131	0.322
53	4.42	2.10	0.476	(0.161)	0.138	0.338
54	4.50	2.10	0.476	(0.161)	0.138	0.338

```
55   4.58     2.20      0.499       (  0.161)       0.145        0.354
56   4.67     2.30      0.521       (  0.161)       0.151        0.370
57   4.75     2.40      0.544       (  0.161)       0.158        0.386
58   4.83     2.40      0.544       (  0.161)       0.158        0.386
59   4.92     2.50      0.567          0.161    (  0.164)        0.405
60   5.00     2.60      0.589          0.161    (  0.171)        0.428
61   5.08     3.10      0.703          0.161    (  0.204)        0.541
62   5.17     3.60      0.816          0.161    (  0.237)        0.655
63   5.25     3.90      0.884          0.161    (  0.256)        0.723
64   5.33     4.20      0.952          0.161    (  0.276)        0.791
65   5.42     4.70      1.065          0.161    (  0.309)        0.904
66   5.50     5.60      1.269          0.161    (  0.368)        1.108
67   5.58     1.90      0.431       (  0.161)       0.125        0.306
68   5.67     0.90      0.204       (  0.161)       0.059        0.145
69   5.75     0.60      0.136       (  0.161)       0.039        0.097
70   5.83     0.50      0.113       (  0.161)       0.033        0.080
71   5.92     0.30      0.068       (  0.161)       0.020        0.048
72   6.00     0.20      0.045       (  0.161)       0.013        0.032
             (Loss Rate Not Used)
   Sum =     100.0                                    Sum =    16.8
     Flood volume = Effective rainfall      1.40(In)
      times area       7.5(Ac.)/[(In)/(Ft.)] =       0.9(Ac.Ft)
     Total soil loss =      0.49(In)
     Total soil loss =     0.306(Ac.Ft)
     Total rainfall =      1.89(In)
     Flood volume =       38083.4 Cubic Feet
     Total soil loss =       13338.5 Cubic Feet
     --------------------------------------------------------------------
      Peak flow rate of this hydrograph =      7.519(CFS)
     --------------------------------------------------------------------
     ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                         6 - H O U R   S T O R M
                    R u n o f f     H y d r o g r a p h
     --------------------------------------------------------------------
                 Hydrograph in   5   Minute intervals ((CFS))

     --------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0        2.5       5.0       7.5      10.0
-----------------------------------------------------------------------
  0+ 5       0.0021      0.31  VQ        |         |         |         |
  0+10       0.0063      0.61  V Q       |         |         |         |
  0+15       0.0112      0.71  V Q       |         |         |         |
  0+20       0.0162      0.73  V Q       |         |         |         |
  0+25       0.0212      0.73  V Q       |         |         |         |
  0+30       0.0267      0.79  |V Q      |         |         |         |
  0+35       0.0325      0.84  |V Q      |         |         |         |
  0+40       0.0383      0.85  |V Q      |         |         |         |
  0+45       0.0442      0.85  | VQ      |         |         |         |
  0+50       0.0500      0.85  | VQ      |         |         |         |
  0+55       0.0559      0.85  | VQ      |         |         |         |
  1+ 0       0.0622      0.91  | VQ      |         |         |         |
  1+ 5       0.0688      0.96  |  Q      |         |         |         |
  1+10       0.0755      0.97  |  Q      |         |         |         |
  1+15       0.0822      0.97  |  Q      |         |         |         |
  1+20       0.0889      0.97  |  QV     |         |         |         |
  1+25       0.0956      0.97  |  QV     |         |         |         |
  1+30       0.1023      0.97  |  QV     |         |         |         |
  1+35       0.1090      0.97  |  QV     |         |         |         |
  1+40       0.1157      0.97  |  Q V    |         |         |         |
  1+45       0.1224      0.97  |  Q V    |         |         |         |
  1+50       0.1291      0.97  |  Q V    |         |         |         |
  1+55       0.1359      0.97  |  Q  V   |         |         |         |
  2+ 0       0.1430      1.03  |   Q V   |         |         |         |
  2+ 5       0.1500      1.02  |   Q V   |         |         |         |
  2+10       0.1572      1.04  |   Q  V  |         |         |         |
  2+15       0.1647      1.09  |   Q  V  |         |         |         |
  2+20       0.1722      1.09  |   Q  V  |         |         |         |
  2+25       0.1798      1.10  |   Q   V |         |         |         |
  2+30       0.1873      1.10  |   Q   V |         |         |         |
  2+35       0.1948      1.10  |   Q   V |         |         |         |
  2+40       0.2024      1.10  |   Q    V|         |         |         |
  2+45       0.2104      1.16  |   Q    V|         |         |         |
  2+50       0.2187      1.21  |   Q     V         |         |         |
  2+55       0.2270      1.21  |   Q     V         |         |         |
  3+ 0       0.2354      1.22  |   Q     V         |         |         |
  3+ 5       0.2438      1.22  |   Q     |V        |         |         |
  3+10       0.2526      1.28  |    Q    |V        |         |         |
  3+15       0.2617      1.33  |    Q    |V        |         |         |
  3+20       0.2709      1.34  |    Q    | V       |         |         |
```

```
    3+25       0.2806      1.40  |    Q    | V       |         |         |
    3+30       0.2910      1.51  |     Q   |  V      |         |         |
    3+35       0.3022      1.63  |     Q   |  V      |         |         |
    3+40       0.3138      1.69  |     Q   |   V     |         |         |
    3+45       0.3260      1.76  |      Q  |   V     |         |         |
    3+50       0.3385      1.81  |      Q  |    V    |         |         |
    3+55       0.3514      1.88  |      Q  |     V   |         |         |
    4+ 0       0.3648      1.94  |      Q  |     V   |         |         |
    4+ 5       0.3786      2.01  |       Q |      V  |         |         |
    4+10       0.3932      2.12  |       Q |      V  |         |         |
    4+15       0.4086      2.24  |       Q |       V |         |         |
    4+20       0.4248      2.36  |        Q|        V|         |         |
    4+25       0.4419      2.48  |        Q|         V         |         |
    4+30       0.4594      2.54  |         Q         |V        |         |
    4+35       0.4774      2.61  |         Q         |V        |         |
    4+40       0.4962      2.73  |         Q         | V       |         |
    4+45       0.5158      2.85  |         |Q        |  V      |         |
    4+50       0.5358      2.91  |         |Q        |   V     |         |
    4+55       0.5564      2.99  |         |Q        |    V    |         |
    5+ 0       0.5780      3.14  |         | Q       |     V   |         |
    5+ 5       0.6031      3.65  |         |   Q     |      V  |         |
    5+10       0.6337      4.44  |         |      Q  |       V |         |
    5+15       0.6689      5.11  |         |         Q         V         |
    5+20       0.7078      5.66  |         |         | Q       | V       |
    5+25       0.7516      6.35  |         |         |    Q    |   V     |
    5+30       0.8034      7.52  |         |         |         Q     V   |
    5+35       0.8389      5.17  |         |         Q         |       V |
    5+40       0.8543      2.24  |       Q |         |         |        V|
    5+45       0.8623      1.16  |   Q     |         |         |        V|
    5+50       0.8674      0.73  | Q       |         |         |        V|
    5+55       0.8708      0.51  | Q       |         |         |        V|
    6+ 0       0.8731      0.33  |Q        |         |         |        V|
    6+ 5       0.8741      0.14  Q         |         |         |        V|
    6+10       0.8742      0.03  Q         |         |         |        V|
    6+15       0.8743      0.01  Q         |         |         |         V
-----------------------------------------------------------------------
```

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       U n i t   H y d r o g r a p h   A n a l y s i s

       Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2014, Version 9.0
               Study date  07/23/19 File: DMAC10PROP2410.out

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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978


Program License Serial Number 6388

---------------------------------------------------------------------
 English (in-lb) Input Units Used
 English Rainfall Data (Inches) Input Values Used

 English Units used in output format



---------------------------------------------------------------------
KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
PROPOSED CONDITION, DMA C
10-YR 24-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019
--------------------------------------------------------------------
Drainage Area =       7.50(Ac.)  =      0.012 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =       7.50(Ac.)  =      0.012 Sq. Mi.
Length along longest watercourse =     860.00(Ft.)
Length along longest watercourse measured to centroid =     749.00(Ft.)
Length along longest watercourse =      0.163 Mi.
Length along longest watercourse measured to centroid =      0.142 Mi.
Difference in elevation =      21.50(Ft.)
Slope along watercourse =    132.0000 Ft./Mi.
Average Manning's 'N' = 0.015
Lag time =    0.034 Hr.
Lag time =     2.04 Min.
25% of lag time =     0.51 Min.
40% of lag time =     0.82 Min.
Unit time =    15.00 Min.
Duration of storm = 24 Hour(s)
User Entered Base Flow =     0.00(CFS)

2 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        7.50           2.05                 15.37

100 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        7.50           5.16                 38.70

STORM EVENT (YEAR) =   10.00
Area Averaged 2-Year Rainfall =    2.050(In)
Area Averaged 100-Year Rainfall =    5.160(In)

Point rain (area averaged) =    3.329(In)
Areal adjustment factor =  100.00 %
Adjusted average point rain =    3.329(In)

Sub-Area Data:
Area(Ac.)         Runoff Index   Impervious %
     7.500           56.00         0.760
 Total Area Entered =      7.50(Ac.)


RI    RI   Infil. Rate Impervious   Adj. Infil. Rate  Area%     F
AMC2 AMC-2     (In/Hr)    (Dec.%)      (In/Hr)      (Dec.)    (In/Hr)
56.0  56.0      0.511     0.760        0.161        1.000      0.161
                                                  Sum (F) =   0.161
Area averaged mean soil loss (F) (In/Hr) =  0.161
Minimum soil loss rate ((In/Hr)) =  0.081
```

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.290

U n i t H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %		Unit Hydrograph (CFS)
1	0.250	735.082	79.543		6.012
2	0.500	1470.164	20.457		1.546
			Sum = 100.000	Sum=	7.559

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Low	Effective (In/Hr)
1	0.25	0.20	0.027	(0.285)	0.008	0.019
2	0.50	0.30	0.040	(0.282)	0.012	0.028
3	0.75	0.30	0.040	(0.278)	0.012	0.028
4	1.00	0.40	0.053	(0.275)	0.015	0.038
5	1.25	0.30	0.040	(0.272)	0.012	0.028
6	1.50	0.30	0.040	(0.269)	0.012	0.028
7	1.75	0.30	0.040	(0.265)	0.012	0.028
8	2.00	0.40	0.053	(0.262)	0.015	0.038
9	2.25	0.40	0.053	(0.259)	0.015	0.038
10	2.50	0.40	0.053	(0.256)	0.015	0.038
11	2.75	0.50	0.067	(0.253)	0.019	0.047
12	3.00	0.50	0.067	(0.250)	0.019	0.047
13	3.25	0.50	0.067	(0.247)	0.019	0.047
14	3.50	0.50	0.067	(0.244)	0.019	0.047
15	3.75	0.50	0.067	(0.241)	0.019	0.047
16	4.00	0.60	0.080	(0.237)	0.023	0.057
17	4.25	0.60	0.080	(0.234)	0.023	0.057
18	4.50	0.70	0.093	(0.231)	0.027	0.066
19	4.75	0.70	0.093	(0.229)	0.027	0.066
20	5.00	0.80	0.107	(0.226)	0.031	0.076
21	5.25	0.60	0.080	(0.223)	0.023	0.057
22	5.50	0.70	0.093	(0.220)	0.027	0.066
23	5.75	0.80	0.107	(0.217)	0.031	0.076
24	6.00	0.80	0.107	(0.214)	0.031	0.076
25	6.25	0.90	0.120	(0.211)	0.035	0.085
26	6.50	0.90	0.120	(0.208)	0.035	0.085
27	6.75	1.00	0.133	(0.206)	0.039	0.095
28	7.00	1.00	0.133	(0.203)	0.039	0.095
29	7.25	1.00	0.133	(0.200)	0.039	0.095
30	7.50	1.10	0.146	(0.197)	0.042	0.104
31	7.75	1.20	0.160	(0.195)	0.046	0.113
32	8.00	1.30	0.173	(0.192)	0.050	0.123
33	8.25	1.50	0.200	(0.189)	0.058	0.142
34	8.50	1.50	0.200	(0.187)	0.058	0.142
35	8.75	1.60	0.213	(0.184)	0.062	0.151
36	9.00	1.70	0.226	(0.181)	0.066	0.161
37	9.25	1.90	0.253	(0.179)	0.073	0.180
38	9.50	2.00	0.266	(0.176)	0.077	0.189
39	9.75	2.10	0.280	(0.174)	0.081	0.199
40	10.00	2.20	0.293	(0.171)	0.085	0.208
41	10.25	1.50	0.200	(0.169)	0.058	0.142
42	10.50	1.50	0.200	(0.166)	0.058	0.142
43	10.75	2.00	0.266	(0.164)	0.077	0.189
44	11.00	2.00	0.266	(0.162)	0.077	0.189
45	11.25	1.90	0.253	(0.159)	0.073	0.180
46	11.50	1.90	0.253	(0.157)	0.073	0.180
47	11.75	1.70	0.226	(0.154)	0.066	0.161
48	12.00	1.80	0.240	(0.152)	0.070	0.170
49	12.25	2.50	0.333	(0.150)	0.097	0.236
50	12.50	2.60	0.346	(0.148)	0.100	0.246
51	12.75	2.80	0.373	(0.145)	0.108	0.265
52	13.00	2.90	0.386	(0.143)	0.112	0.274
53	13.25	3.40	0.453	(0.141)	0.131	0.321
54	13.50	3.40	0.453	(0.139)	0.131	0.321
55	13.75	2.30	0.306	(0.137)	0.089	0.217
56	14.00	2.30	0.306	(0.135)	0.089	0.217

57	14.25	2.70	0.360	(0.133)	0.104	0.255
58	14.50	2.60	0.346	(0.131)	0.100	0.246
59	14.75	2.60	0.346	(0.129)	0.100	0.246
60	15.00	2.50	0.333	(0.127)	0.097	0.236
61	15.25	2.40	0.320	(0.125)	0.093	0.227
62	15.50	2.30	0.306	(0.123)	0.089	0.217
63	15.75	1.90	0.253	(0.121)	0.073	0.180
64	16.00	1.90	0.253	(0.119)	0.073	0.180
65	16.25	0.40	0.053	(0.117)	0.015	0.038
66	16.50	0.40	0.053	(0.116)	0.015	0.038
67	16.75	0.30	0.040	(0.114)	0.012	0.028
68	17.00	0.30	0.040	(0.112)	0.012	0.028
69	17.25	0.50	0.067	(0.110)	0.019	0.047
70	17.50	0.50	0.067	(0.109)	0.019	0.047
71	17.75	0.50	0.067	(0.107)	0.019	0.047
72	18.00	0.40	0.053	(0.106)	0.015	0.038
73	18.25	0.40	0.053	(0.104)	0.015	0.038
74	18.50	0.40	0.053	(0.102)	0.015	0.038
75	18.75	0.30	0.040	(0.101)	0.012	0.028
76	19.00	0.20	0.027	(0.100)	0.008	0.019
77	19.25	0.30	0.040	(0.098)	0.012	0.028
78	19.50	0.40	0.053	(0.097)	0.015	0.038
79	19.75	0.30	0.040	(0.095)	0.012	0.028
80	20.00	0.20	0.027	(0.094)	0.008	0.019
81	20.25	0.30	0.040	(0.093)	0.012	0.028
82	20.50	0.30	0.040	(0.092)	0.012	0.028
83	20.75	0.30	0.040	(0.091)	0.012	0.028
84	21.00	0.20	0.027	(0.089)	0.008	0.019
85	21.25	0.30	0.040	(0.088)	0.012	0.028
86	21.50	0.20	0.027	(0.087)	0.008	0.019
87	21.75	0.30	0.040	(0.086)	0.012	0.028
88	22.00	0.20	0.027	(0.086)	0.008	0.019
89	22.25	0.30	0.040	(0.085)	0.012	0.028
90	22.50	0.20	0.027	(0.084)	0.008	0.019
91	22.75	0.20	0.027	(0.083)	0.008	0.019
92	23.00	0.20	0.027	(0.083)	0.008	0.019
93	23.25	0.20	0.027	(0.082)	0.008	0.019
94	23.50	0.20	0.027	(0.081)	0.008	0.019
95	23.75	0.20	0.027	(0.081)	0.008	0.019
96	24.00	0.20	0.027	(0.081)	0.008	0.019

(Loss Rate Not Used)

Sum = 100.0 Sum = 9.5

Flood volume = Effective rainfall 2.36(In)
times area 7.5(Ac.)/[(In)/(Ft.)] = 1.5(Ac.Ft)
Total soil loss = 0.97(In)
Total soil loss = 0.603(Ac.Ft)
Total rainfall = 3.33(In)
Flood volume = 64357.1 Cubic Feet
Total soil loss = 26286.7 Cubic Feet

Peak flow rate of this hydrograph = 2.431(CFS)

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--------------------------------------------------------------------
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                    24 - H O U R     S T O R M
               R u n o f f      H y d r o g r a p h
--------------------------------------------------------------------
            Hydrograph in  15   Minute intervals ((CFS))

--------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0        2.5       5.0       7.5      10.0
-----------------------------------------------------------------------
  0+15      0.0024      0.11  Q         |         |         |         |
  0+30      0.0065      0.20  Q         |         |         |         |
  0+45      0.0109      0.21  Q         |         |         |         |
  1+ 0      0.0165      0.27  VQ        |         |         |         |
  1+15      0.0213      0.23  Q         |         |         |         |
  1+30      0.0257      0.21  Q         |         |         |         |
  1+45      0.0301      0.21  Q         |         |         |         |
  2+ 0      0.0357      0.27  VQ        |         |         |         |
  2+15      0.0416      0.29  |Q        |         |         |         |
  2+30      0.0475      0.29  |Q        |         |         |         |
  2+45      0.0546      0.34  |Q        |         |         |         |
  3+ 0      0.0620      0.36  |Q        |         |         |         |
  3+15      0.0694      0.36  |Q        |         |         |         |
  3+30      0.0768      0.36  |QV       |         |         |         |
  3+45      0.0842      0.36  |QV       |         |         |         |
  4+ 0      0.0927      0.41  |QV       |         |         |         |
  4+15      0.1016      0.43  |QV       |         |         |         |
  4+30      0.1116      0.49  |Q V      |         |         |         |
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 4+45       0.1220      0.50  | QV      |         |         |         |
 5+ 0       0.1335      0.56  | QV      |         |         |         |
 5+15       0.1430      0.46  |Q V      |         |         |         |
 5+30       0.1530      0.49  |Q  V     |         |         |         |
 5+45       0.1645      0.56  | Q V     |         |         |         |
 6+ 0       0.1764      0.57  | Q V     |         |         |         |
 6+15       0.1893      0.63  | Q  V    |         |         |         |
 6+30       0.2026      0.64  | Q  V    |         |         |         |
 6+45       0.2171      0.70  | Q  V    |         |         |         |
 7+ 0       0.2319      0.72  | Q   V   |         |         |         |
 7+15       0.2467      0.72  | Q   V   |         |         |         |
 7+30       0.2626      0.77  |  Q   V  |         |         |         |
 7+45       0.2800      0.84  |  Q   V  |         |         |         |
 8+ 0       0.2989      0.91  |  Q    V |         |         |         |
 8+15       0.3205      1.04  |   Q   V |         |         |         |
 8+30       0.3427      1.07  |   Q    V|         |         |         |
 8+45       0.3660      1.13  |   Q    V|         |         |         |
 9+ 0       0.3908      1.20  |   Q     V         |         |         |
 9+15       0.4183      1.33  |    Q     V        |         |         |
 9+30       0.4475      1.42  |    Q    | V       |         |         |
 9+45       0.4783      1.49  |    Q    | V       |         |         |
10+ 0       0.5105      1.56  |     Q   |  V      |         |         |
10+15       0.5347      1.18  |   Q     |   V     |         |         |
10+30       0.5569      1.07  |   Q     |    V    |         |         |
10+45       0.5849      1.36  |    Q    |    V    |         |         |
11+ 0       0.6145      1.43  |    Q    |     V   |         |         |
11+15       0.6429      1.37  |    Q    |      V  |         |         |
11+30       0.6709      1.36  |    Q    |       V |         |         |
11+45       0.6966      1.24  |   Q     |       V |         |         |
12+ 0       0.7229      1.27  |    Q    |        V|         |         |
12+15       0.7578      1.69  |     Q   |         V         |         |
12+30       0.7959      1.84  |      Q  |          V        |         |
12+45       0.8366      1.97  |      Q  |         | V       |         |
13+ 0       0.8792      2.06  |       Q |         |  V      |         |
13+15       0.9279      2.36  |        Q|         |    V    |         |
13+30       0.9781      2.43  |        Q|         |     V   |         |
13+45       1.0154      1.81  |      Q  |         |      V  |         |
14+ 0       1.0494      1.64  |     Q   |         |       V |         |
14+15       1.0881      1.87  |      Q  |         |        V|         |
14+30       1.1268      1.87  |      Q  |         |         V         |
14+45       1.1652      1.86  |      Q  |         |          V        |
15+ 0       1.2025      1.80  |      Q  |         |         | V       |
15+15       1.2382      1.73  |     Q   |         |         |  V      |
15+30       1.2725      1.66  |     Q   |         |         |   V     |
15+45       1.3018      1.42  |    Q    |         |         |    V    |
16+ 0       1.3299      1.36  |    Q    |         |         |     V   |
16+15       1.3403      0.51  | Q       |         |         |     V   |
16+30       1.3462      0.29  |Q        |         |         |     V   |
16+45       1.3509      0.23  Q         |         |         |     V   |
17+ 0       1.3554      0.21  Q         |         |         |     V   |
17+15       1.3622      0.33  |Q        |         |         |     V   |
17+30       1.3695      0.36  |Q        |         |         |      V  |
17+45       1.3769      0.36  |Q        |         |         |      V  |
18+ 0       1.3831      0.30  |Q        |         |         |      V  |
18+15       1.3891      0.29  |Q        |         |         |      V  |
18+30       1.3950      0.29  |Q        |         |         |      V  |
18+45       1.3997      0.23  Q         |         |         |      V  |
19+ 0       1.4030      0.16  Q         |         |         |      V  |
19+15       1.4071      0.20  Q         |         |         |       V |
19+30       1.4127      0.27  |Q        |         |         |       V |
19+45       1.4174      0.23  Q         |         |         |       V |
20+ 0       1.4207      0.16  Q         |         |         |       V |
20+15       1.4248      0.20  Q         |         |         |       V |
20+30       1.4293      0.21  Q         |         |         |       V |
20+45       1.4337      0.21  Q         |         |         |       V |
21+ 0       1.4369      0.16  Q         |         |         |       V |
21+15       1.4411      0.20  Q         |         |         |        V|
21+30       1.4443      0.16  Q         |         |         |        V|
21+45       1.4485      0.20  Q         |         |         |        V|
22+ 0       1.4517      0.16  Q         |         |         |        V|
22+15       1.4558      0.20  Q         |         |         |        V|
22+30       1.4591      0.16  Q         |         |         |        V|
22+45       1.4621      0.14  Q         |         |         |        V|
23+ 0       1.4650      0.14  Q         |         |         |        V|
23+15       1.4680      0.14  Q         |         |         |        V|
23+30       1.4709      0.14  Q         |         |         |        V|
23+45       1.4739      0.14  Q         |         |         |        V|
24+ 0       1.4768      0.14  Q         |         |         |        V|
24+15       1.4774      0.03  Q         |         |         |        V|
```

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       U n i t   H y d r o g r a p h   A n a l y s i s

       Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2014, Version 9.0
               Study date  07/23/19 File: DMAC100EXIST1100.out


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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978


Program License Serial Number 6388

---------------------------------------------------------------------
 English (in-lb) Input Units Used
 English Rainfall Data (Inches) Input Values Used

 English Units used in output format



---------------------------------------------------------------------
KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
EXISTING CONDITION, DMA C
100-YR 1-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019
--------------------------------------------------------------------
Drainage Area =       7.50(Ac.)  =      0.012 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =       7.50(Ac.)  =      0.012 Sq. Mi.
Length along longest watercourse =     860.00(Ft.)
Length along longest watercourse measured to centroid =     749.00(Ft.)
Length along longest watercourse =      0.163 Mi.
Length along longest watercourse measured to centroid =      0.142 Mi.
Difference in elevation =      21.50(Ft.)
Slope along watercourse =    132.0000 Ft./Mi.
Average Manning's 'N' = 0.020
Lag time =    0.045 Hr.
Lag time =     2.72 Min.
25% of lag time =     0.68 Min.
40% of lag time =     1.09 Min.
Unit time =     5.00 Min.
Duration of storm = 1 Hour(s)
User Entered Base Flow =     0.00(CFS)

2 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        7.50           0.49                  3.67

100 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        7.50           1.33                  9.98

STORM EVENT (YEAR) =  100.00
Area Averaged 2-Year Rainfall =    0.489(In)
Area Averaged 100-Year Rainfall =    1.330(In)

Point rain (area averaged) =    1.330(In)
Areal adjustment factor =   99.99 %
Adjusted average point rain =    1.330(In)

Sub-Area Data:
Area(Ac.)         Runoff Index   Impervious %
     7.500           56.00         0.500
 Total Area Entered =      7.50(Ac.)


RI    RI   Infil. Rate Impervious   Adj. Infil. Rate  Area%     F
AMC2 AMC-2     (In/Hr)    (Dec.%)      (In/Hr)      (Dec.)    (In/Hr)
56.0  56.0      0.511     0.500        0.281       1.000      0.281
                                                 Sum (F) =   0.281
Area averaged mean soil loss (F) (In/Hr) =  0.281
Minimum soil loss rate ((In/Hr)) =  0.140
```

(for 24 hour storm duration)
Soil low loss rate (decimal) =   0.500

Slope of intensity-duration curve for a 1 hour storm =0.5000

U n i t   H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.083	183.771	40.452	3.058
2	0.167	367.541	44.515	3.365
3	0.250	551.312	9.487	0.717
4	0.333	735.082	3.846	0.291
5	0.417	918.853	1.700	0.128
			Sum = 100.000	Sum= 7.559

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Low	Effective (In/Hr)
1	0.08	4.20	0.670	0.281	(0.335)	0.389
2	0.17	4.30	0.686	0.281	(0.343)	0.405
3	0.25	5.00	0.798	0.281	(0.399)	0.517
4	0.33	5.00	0.798	0.281	(0.399)	0.517
5	0.42	5.80	0.926	0.281	(0.463)	0.645
6	0.50	6.50	1.037	0.281	(0.519)	0.756
7	0.58	7.40	1.181	0.281	(0.590)	0.900
8	0.67	8.60	1.372	0.281	(0.686)	1.092
9	0.75	12.30	1.963	0.281	(0.981)	1.682
10	0.83	29.10	4.644	0.281	(2.322)	4.363
11	0.92	6.80	1.085	0.281	(0.543)	0.804
12	1.00	5.00	0.798	0.281	(0.399)	0.517

(Loss Rate Not Used)
Sum =   100.0   Sum =   12.6

Flood volume = Effective rainfall   1.05(In)
 times area   7.5(Ac.)/[(In)/(Ft.)] =   0.7(Ac.Ft)
Total soil loss =   0.28(In)
Total soil loss =   0.176(Ac.Ft)
Total rainfall =   1.33(In)
Flood volume =   28558.2 Cubic Feet
Total soil loss =   7648.6 Cubic Feet

Peak flow rate of this hydrograph =   20.152(CFS)

++

1 - H O U R   S T O R M
R u n o f f   H y d r o g r a p h

Hydrograph in   5   Minute intervals ((CFS))

```
Time(h+m) Volume Ac.Ft    Q(CFS)  0         7.5      15.0      22.5      30.0
-----------------------------------------------------------------------
  0+ 5       0.0082       1.19  VQ        |         |         |         |
  0+10       0.0258       2.55  |V Q      |         |         |         |
  0+15       0.0480       3.23  | V Q     |         |         |         |
  0+20       0.0736       3.73  |   Q     |         |         |         |
  0+25       0.1029       4.25  |    QV   |         |         |         |
  0+30       0.1378       5.06  |     Q V |         |         |         |
  0+35       0.1789       5.98  |      Q  V         |         |         |
  0+40       0.2283       7.17  |        Q|  V      |         |         |
  0+45       0.2956       9.77  |         |  Q    V |         |         |
  0+50       0.4343      20.15  |         |         |     Q   |         |
  0+55       0.5637      18.79  |         |         |    Q    |    V    |
  1+ 0       0.6192       8.05  |         Q         |         |       V |
  1+ 5       0.6454       3.80  |    Q    |         |         |         V|
  1+10       0.6534       1.17  |Q        |         |         |         V|
  1+15       0.6551       0.25  Q         |         |         |         V|
  1+20       0.6556       0.07  Q         |         |         |          V
-----------------------------------------------------------------------
```

```
       U n i t   H y d r o g r a p h   A n a l y s i s

       Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2014, Version 9.0
               Study date  07/23/19 File: DMAC100EXIST3100.out


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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978


Program License Serial Number 6388

---------------------------------------------------------------------
 English (in-lb) Input Units Used
 English Rainfall Data (Inches) Input Values Used

 English Units used in output format



---------------------------------------------------------------------
KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
EXISTING CONDITION, DMA C
100-YR 3-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019
--------------------------------------------------------------------
Drainage Area =       7.50(Ac.)  =      0.012 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =       7.50(Ac.)  =      0.012 Sq. Mi.
Length along longest watercourse =     860.00(Ft.)
Length along longest watercourse measured to centroid =     749.00(Ft.)
Length along longest watercourse =      0.163 Mi.
Length along longest watercourse measured to centroid =      0.142 Mi.
Difference in elevation =      21.50(Ft.)
Slope along watercourse =    132.0000 Ft./Mi.
Average Manning's 'N' = 0.020
Lag time =    0.045 Hr.
Lag time =     2.72 Min.
25% of lag time =     0.68 Min.
40% of lag time =     1.09 Min.
Unit time =     5.00 Min.
Duration of storm = 3 Hour(s)
User Entered Base Flow =     0.00(CFS)

2 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        7.50           0.87                  6.50

100 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        7.50           2.09                 15.67

STORM EVENT (YEAR) =  100.00
Area Averaged 2-Year Rainfall =    0.866(In)
Area Averaged 100-Year Rainfall =    2.090(In)

Point rain (area averaged) =    2.090(In)
Areal adjustment factor =  100.00 %
Adjusted average point rain =    2.090(In)

Sub-Area Data:
Area(Ac.)         Runoff Index   Impervious %
     7.500           56.00         0.500
 Total Area Entered =      7.50(Ac.)


RI    RI   Infil. Rate Impervious   Adj. Infil. Rate  Area%     F
AMC2 AMC-2     (In/Hr)    (Dec.%)     (In/Hr)      (Dec.)    (In/Hr)
56.0  56.0      0.511     0.500        0.281       1.000      0.281
                                                   Sum (F) =   0.281
Area averaged mean soil loss (F) (In/Hr) =  0.281
Minimum soil loss rate ((In/Hr)) =  0.140
```

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.500

U n i t   H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.083	183.771	40.452	3.058
2	0.167	367.541	44.515	3.365
3	0.250	551.312	9.487	0.717
4	0.333	735.082	3.846	0.291
5	0.417	918.853	1.700	0.128
			Sum = 100.000	Sum= 7.559

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Loss rate(In./Hr) Low	Effective (In/Hr)
1	0.08	1.30	0.326	(0.281)	0.163	0.163
2	0.17	1.30	0.326	(0.281)	0.163	0.163
3	0.25	1.10	0.276	(0.281)	0.138	0.138
4	0.33	1.50	0.376	(0.281)	0.188	0.188
5	0.42	1.50	0.376	(0.281)	0.188	0.188
6	0.50	1.80	0.451	(0.281)	0.226	0.226
7	0.58	1.50	0.376	(0.281)	0.188	0.188
8	0.67	1.80	0.451	(0.281)	0.226	0.226
9	0.75	1.80	0.451	(0.281)	0.226	0.226
10	0.83	1.50	0.376	(0.281)	0.188	0.188
11	0.92	1.60	0.401	(0.281)	0.201	0.201
12	1.00	1.80	0.451	(0.281)	0.226	0.226
13	1.08	2.20	0.552	(0.281)	0.276	0.276
14	1.17	2.20	0.552	(0.281)	0.276	0.276
15	1.25	2.20	0.552	(0.281)	0.276	0.276
16	1.33	2.00	0.502	(0.281)	0.251	0.251
17	1.42	2.60	0.652	0.281	(0.326)	0.371
18	1.50	2.70	0.677	0.281	(0.339)	0.396
19	1.58	2.40	0.602	0.281	(0.301)	0.321
20	1.67	2.70	0.677	0.281	(0.339)	0.396
21	1.75	3.30	0.828	0.281	(0.414)	0.547
22	1.83	3.10	0.777	0.281	(0.389)	0.497
23	1.92	2.90	0.727	0.281	(0.364)	0.446
24	2.00	3.00	0.752	0.281	(0.376)	0.471
25	2.08	3.10	0.777	0.281	(0.389)	0.497
26	2.17	4.20	1.053	0.281	(0.527)	0.772
27	2.25	5.00	1.254	0.281	(0.627)	0.973
28	2.33	3.50	0.878	0.281	(0.439)	0.597
29	2.42	6.80	1.705	0.281	(0.853)	1.424
30	2.50	7.30	1.831	0.281	(0.915)	1.550
31	2.58	8.20	2.056	0.281	(1.028)	1.776
32	2.67	5.90	1.480	0.281	(0.740)	1.199
33	2.75	2.00	0.502	(0.281)	0.251	0.251
34	2.83	1.80	0.451	(0.281)	0.226	0.226
35	2.92	1.80	0.451	(0.281)	0.226	0.226
36	3.00	0.60	0.150	(0.281)	0.075	0.075
		(Loss Rate Not Used)				
Sum =		100.0			Sum =	16.4

Flood volume = Effective rainfall 1.37(In)
times area 7.5(Ac.)/[(In)/(Ft.)] = 0.9(Ac.Ft)
Total soil loss = 0.72(In)
Total soil loss = 0.452(Ac.Ft)
Total rainfall = 2.09(In)
Flood volume = 37226.7 Cubic Feet
Total soil loss = 19671.7 Cubic Feet

Peak flow rate of this hydrograph = 11.970(CFS)

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3 - H O U R   S T O R M
R u n o f f   H y d r o g r a p h

Hydrograph in 5 Minute intervals ((CFS))

```
       --------------------------------------------------------------------
  Time(h+m) Volume Ac.Ft   Q(CFS)  0        5.0      10.0      15.0      20.0
  -----------------------------------------------------------------------
    0+ 5       0.0034      0.50  Q         |         |         |         |
    0+10       0.0106      1.05  V Q       |         |         |         |
    0+15       0.0181      1.09  V Q       |         |         |         |
    0+20       0.0264      1.20  |VQ       |         |         |         |
    0+25       0.0359      1.38  |VQ       |         |         |         |
    0+30       0.0464      1.52  | VQ      |         |         |         |
    0+35       0.0570      1.54  | VQ      |         |         |         |
    0+40       0.0678      1.56  |  Q      |         |         |         |
    0+45       0.0793      1.68  |  Q      |         |         |         |
    0+50       0.0902      1.58  |  QV     |         |         |         |
    0+55       0.1005      1.50  | Q V     |         |         |         |
    1+ 0       0.1115      1.60  |  Q V    |         |         |         |
    1+ 5       0.1241      1.83  |  Q V    |         |         |         |
    1+10       0.1380      2.02  |   Q V   |         |         |         |
    1+15       0.1522      2.06  |   Q  V  |         |         |         |
    1+20       0.1660      2.00  |   Q  V  |         |         |         |
    1+25       0.1818      2.29  |   Q   V |         |         |         |
    1+30       0.2008      2.76  |    Q   V|         |         |         |
    1+35       0.2193      2.69  |    Q    V         |         |         |
    1+40       0.2380      2.72  |    Q    |V        |         |         |
    1+45       0.2614      3.40  |     Q   | V       |         |         |
    1+50       0.2875      3.79  |      Q  |  V      |         |         |
    1+55       0.3122      3.59  |      Q  |   V     |         |         |
    2+ 0       0.3364      3.51  |      Q  |    V    |         |         |
    2+ 5       0.3615      3.64  |      Q  |     V   |         |         |
    2+10       0.3929      4.57  |        Q|       V |         |         |
    2+15       0.4351      6.13  |         | Q       V         |         |
    2+20       0.4755      5.86  |         |Q        | V       |         |
    2+25       0.5261      7.35  |         |   Q     |   V     |         |
    2+30       0.5974     10.35  |         |         Q      V  |         |
    2+35       0.6798     11.97  |         |         |  Q      |V        |
    2+40       0.7573     11.25  |         |         | Q       |    V    |
    2+45       0.8035      6.71  |         |  Q      |         |      V  |
    2+50       0.8249      3.11  |     Q   |         |         |       V |
    2+55       0.8401      2.21  |   Q     |         |         |        V|
    3+ 0       0.8496      1.38  | Q       |         |         |        V|
    3+ 5       0.8532      0.51  |Q        |         |         |        V|
    3+10       0.8542      0.15  Q         |         |         |        V|
    3+15       0.8545      0.05  Q         |         |         |        V|
    3+20       0.8546      0.01  Q         |         |         |        V|
-----------------------------------------------------------------------
```

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      U n i t   H y d r o g r a p h   A n a l y s i s

      Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2014, Version 9.0
             Study date  07/23/19 File: DMAC100EXIST6100.out


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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978


Program License Serial Number 6388

---------------------------------------------------------------------
 English (in-lb) Input Units Used
 English Rainfall Data (Inches) Input Values Used

 English Units used in output format



---------------------------------------------------------------------
KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
EXISTING CONDITION, DMA C
100-YR 6-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019
--------------------------------------------------------------------
Drainage Area =       7.50(Ac.)  =      0.012 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =       7.50(Ac.)  =      0.012 Sq. Mi.
Length along longest watercourse =     860.00(Ft.)
Length along longest watercourse measured to centroid =     749.00(Ft.)
Length along longest watercourse =      0.163 Mi.
Length along longest watercourse measured to centroid =      0.142 Mi.
Difference in elevation =      21.50(Ft.)
Slope along watercourse =    132.0000 Ft./Mi.
Average Manning's 'N' = 0.020
Lag time =    0.045 Hr.
Lag time =     2.72 Min.
25% of lag time =     0.68 Min.
40% of lag time =     1.09 Min.
Unit time =     5.00 Min.
Duration of storm = 6 Hour(s)
User Entered Base Flow =     0.00(CFS)

2 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        7.50           1.21                  9.07

100 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        7.50           2.86                 21.45

STORM EVENT (YEAR) =  100.00
Area Averaged 2-Year Rainfall =    1.210(In)
Area Averaged 100-Year Rainfall =    2.860(In)

Point rain (area averaged) =    2.860(In)
Areal adjustment factor =  100.00 %
Adjusted average point rain =    2.860(In)

Sub-Area Data:
Area(Ac.)         Runoff Index   Impervious %
     7.500           56.00         0.500
 Total Area Entered =      7.50(Ac.)


RI    RI   Infil. Rate Impervious   Adj. Infil. Rate  Area%     F
AMC2 AMC-2     (In/Hr)    (Dec.%)      (In/Hr)      (Dec.)    (In/Hr)
56.0  56.0      0.511     0.500        0.281       1.000      0.281
                                                    Sum (F) =   0.281
Area averaged mean soil loss (F) (In/Hr) =  0.281
Minimum soil loss rate ((In/Hr)) =  0.140
```

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.500

U n i t H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.083	183.771	40.452	3.058
2	0.167	367.541	44.515	3.365
3	0.250	551.312	9.487	0.717
4	0.333	735.082	3.846	0.291
5	0.417	918.853	1.700	0.128
			Sum = 100.000	Sum= 7.559

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Low	Effective (In/Hr)
1	0.08	0.50	0.172	(0.281)	0.086	0.086
2	0.17	0.60	0.206	(0.281)	0.103	0.103
3	0.25	0.60	0.206	(0.281)	0.103	0.103
4	0.33	0.60	0.206	(0.281)	0.103	0.103
5	0.42	0.60	0.206	(0.281)	0.103	0.103
6	0.50	0.70	0.240	(0.281)	0.120	0.120
7	0.58	0.70	0.240	(0.281)	0.120	0.120
8	0.67	0.70	0.240	(0.281)	0.120	0.120
9	0.75	0.70	0.240	(0.281)	0.120	0.120
10	0.83	0.70	0.240	(0.281)	0.120	0.120
11	0.92	0.70	0.240	(0.281)	0.120	0.120
12	1.00	0.80	0.275	(0.281)	0.137	0.137
13	1.08	0.80	0.275	(0.281)	0.137	0.137
14	1.17	0.80	0.275	(0.281)	0.137	0.137
15	1.25	0.80	0.275	(0.281)	0.137	0.137
16	1.33	0.80	0.275	(0.281)	0.137	0.137
17	1.42	0.80	0.275	(0.281)	0.137	0.137
18	1.50	0.80	0.275	(0.281)	0.137	0.137
19	1.58	0.80	0.275	(0.281)	0.137	0.137
20	1.67	0.80	0.275	(0.281)	0.137	0.137
21	1.75	0.80	0.275	(0.281)	0.137	0.137
22	1.83	0.80	0.275	(0.281)	0.137	0.137
23	1.92	0.80	0.275	(0.281)	0.137	0.137
24	2.00	0.90	0.309	(0.281)	0.154	0.154
25	2.08	0.80	0.275	(0.281)	0.137	0.137
26	2.17	0.90	0.309	(0.281)	0.154	0.154
27	2.25	0.90	0.309	(0.281)	0.154	0.154
28	2.33	0.90	0.309	(0.281)	0.154	0.154
29	2.42	0.90	0.309	(0.281)	0.154	0.154
30	2.50	0.90	0.309	(0.281)	0.154	0.154
31	2.58	0.90	0.309	(0.281)	0.154	0.154
32	2.67	0.90	0.309	(0.281)	0.154	0.154
33	2.75	1.00	0.343	(0.281)	0.172	0.172
34	2.83	1.00	0.343	(0.281)	0.172	0.172
35	2.92	1.00	0.343	(0.281)	0.172	0.172
36	3.00	1.00	0.343	(0.281)	0.172	0.172
37	3.08	1.00	0.343	(0.281)	0.172	0.172
38	3.17	1.10	0.378	(0.281)	0.189	0.189
39	3.25	1.10	0.378	(0.281)	0.189	0.189
40	3.33	1.10	0.378	(0.281)	0.189	0.189
41	3.42	1.20	0.412	(0.281)	0.206	0.206
42	3.50	1.30	0.446	(0.281)	0.223	0.223
43	3.58	1.40	0.480	(0.281)	0.240	0.240
44	3.67	1.40	0.480	(0.281)	0.240	0.240
45	3.75	1.50	0.515	(0.281)	0.257	0.257
46	3.83	1.50	0.515	(0.281)	0.257	0.257
47	3.92	1.60	0.549	(0.281)	0.275	0.275
48	4.00	1.60	0.549	(0.281)	0.275	0.275
49	4.08	1.70	0.583	0.281	(0.292)	0.302
50	4.17	1.80	0.618	0.281	(0.309)	0.337
51	4.25	1.90	0.652	0.281	(0.326)	0.371
52	4.33	2.00	0.686	0.281	(0.343)	0.405
53	4.42	2.10	0.721	0.281	(0.360)	0.440

```
54   4.50     2.10      0.721          0.281    (  0.360)        0.440
55   4.58     2.20      0.755          0.281    (  0.378)        0.474
56   4.67     2.30      0.789          0.281    (  0.395)        0.508
57   4.75     2.40      0.824          0.281    (  0.412)        0.543
58   4.83     2.40      0.824          0.281    (  0.412)        0.543
59   4.92     2.50      0.858          0.281    (  0.429)        0.577
60   5.00     2.60      0.892          0.281    (  0.446)        0.611
61   5.08     3.10      1.064          0.281    (  0.532)        0.783
62   5.17     3.60      1.235          0.281    (  0.618)        0.955
63   5.25     3.90      1.338          0.281    (  0.669)        1.058
64   5.33     4.20      1.441          0.281    (  0.721)        1.160
65   5.42     4.70      1.613          0.281    (  0.806)        1.332
66   5.50     5.60      1.922          0.281    (  0.961)        1.641
67   5.58     1.90      0.652          0.281    (  0.326)        0.371
68   5.67     0.90      0.309        (  0.281)      0.154        0.154
69   5.75     0.60      0.206        (  0.281)      0.103        0.103
70   5.83     0.50      0.172        (  0.281)      0.086        0.086
71   5.92     0.30      0.103        (  0.281)      0.051        0.051
72   6.00     0.20      0.069        (  0.281)      0.034        0.034
              (Loss Rate Not Used)
   Sum =     100.0                                  Sum =    20.9
     Flood volume = Effective rainfall      1.74(In)
      times area       7.5(Ac.)/[(In)/(Ft.)] =       1.1(Ac.Ft)
     Total soil loss =      1.12(In)
     Total soil loss =     0.698(Ac.Ft)
     Total rainfall =      2.86(In)
     Flood volume =      47453.8 Cubic Feet
     Total soil loss =       30407.7 Cubic Feet
     --------------------------------------------------------------------
      Peak flow rate of this hydrograph =     10.767(CFS)
     --------------------------------------------------------------------
     ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                         6 - H O U R    S T O R M
                    R u n o f f     H y d r o g r a p h
     --------------------------------------------------------------------
                 Hydrograph in   5   Minute intervals ((CFS))

     --------------------------------------------------------------------
Time(h+m) Volume Ac.Ft    Q(CFS)  0        5.0       10.0      15.0      20.0
-----------------------------------------------------------------------
  0+ 5       0.0018      0.26  Q          |         |         |         |
  0+10       0.0060      0.60  VQ         |         |         |         |
  0+15       0.0109      0.72  VQ         |         |         |         |
  0+20       0.0162      0.76  VQ         |         |         |         |
  0+25       0.0215      0.78  VQ         |         |         |         |
  0+30       0.0273      0.83  |Q         |         |         |         |
  0+35       0.0334      0.89  |Q         |         |         |         |
  0+40       0.0396      0.90  |Q         |         |         |         |
  0+45       0.0458      0.91  |Q         |         |         |         |
  0+50       0.0521      0.91  |Q         |         |         |         |
  0+55       0.0583      0.91  |QV        |         |         |         |
  1+ 0       0.0650      0.96  |QV        |         |         |         |
  1+ 5       0.0720      1.02  | Q        |         |         |         |
  1+10       0.0791      1.03  | Q        |         |         |         |
  1+15       0.0862      1.04  | QV       |         |         |         |
  1+20       0.0934      1.04  | QV       |         |         |         |
  1+25       0.1005      1.04  | QV       |         |         |         |
  1+30       0.1077      1.04  | QV       |         |         |         |
  1+35       0.1148      1.04  | Q V      |         |         |         |
  1+40       0.1220      1.04  | Q V      |         |         |         |
  1+45       0.1291      1.04  | Q V      |         |         |         |
  1+50       0.1363      1.04  | Q  V     |         |         |         |
  1+55       0.1434      1.04  | Q  V     |         |         |         |
  2+ 0       0.1509      1.09  | Q  V     |         |         |         |
  2+ 5       0.1585      1.10  | Q  V     |         |         |         |
  2+10       0.1661      1.10  | Q   V    |         |         |         |
  2+15       0.1740      1.15  | Q   V    |         |         |         |
  2+20       0.1820      1.16  | Q   V    |         |         |         |
  2+25       0.1900      1.17  | Q   V    |         |         |         |
  2+30       0.1981      1.17  | Q    V   |         |         |         |
  2+35       0.2061      1.17  | Q    V   |         |         |         |
  2+40       0.2142      1.17  | Q    V   |         |         |         |
  2+45       0.2226      1.22  | Q     V  |         |         |         |
  2+50       0.2314      1.28  | Q     V  |         |         |         |
  2+55       0.2403      1.29  | Q     V  |         |         |         |
  3+ 0       0.2492      1.30  | Q      V |         |         |         |
  3+ 5       0.2581      1.30  | Q      V |         |         |         |
  3+10       0.2674      1.35  | Q      V |         |         |         |
  3+15       0.2771      1.41  | Q       V          |         |         |
```

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    3+20       0.2869      1.42  | Q       V         |         |         |
    3+25       0.2971      1.48  | Q       V         |         |         |
    3+30       0.3080      1.59  |  Q      |V        |         |         |
    3+35       0.3198      1.71  |  Q      |V        |         |         |
    3+40       0.3321      1.79  |  Q      | V       |         |         |
    3+45       0.3449      1.86  |  Q      | V       |         |         |
    3+50       0.3582      1.92  |  Q      |  V      |         |         |
    3+55       0.3719      1.99  |  Q      |  V      |         |         |
    4+ 0       0.3861      2.05  |   Q     |   V     |         |         |
    4+ 5       0.4009      2.15  |   Q     |   V     |         |         |
    4+10       0.4172      2.36  |   Q     |    V    |         |         |
    4+15       0.4351      2.60  |    Q    |    V    |         |         |
    4+20       0.4547      2.85  |    Q    |     V   |         |         |
    4+25       0.4762      3.11  |     Q   |      V  |         |         |
    4+30       0.4987      3.27  |     Q   |       V |         |         |
    4+35       0.5222      3.41  |     Q   |        V|         |         |
    4+40       0.5473      3.65  |      Q  |         V         |         |
    4+45       0.5741      3.90  |      Q  |         |V        |         |
    4+50       0.6020      4.05  |       Q |         | V       |         |
    4+55       0.6309      4.19  |       Q |         |  V      |         |
    5+ 0       0.6613      4.43  |       Q |         |   V     |         |
    5+ 5       0.6964      5.09  |         Q         |    V    |         |
    5+10       0.7393      6.23  |         | Q       |      V  |         |
    5+15       0.7894      7.26  |         |   Q     |       V |         |
    5+20       0.8452      8.10  |         |     Q   |         |V        |
    5+25       0.9080      9.12  |         |       Q |         |  V      |
    5+30       0.9821     10.77  |         |         |Q        |     V   |
    5+35       1.0378      8.09  |         |     Q   |         |       V |
    5+40       1.0615      3.44  |     Q   |         |         |       V |
    5+45       1.0735      1.75  |  Q      |         |         |        V|
    5+50       1.0807      1.04  | Q       |         |         |        V|
    5+55       1.0849      0.61  |Q        |         |         |        V|
    6+ 0       1.0876      0.39  Q         |         |         |        V|
    6+ 5       1.0889      0.19  Q         |         |         |        V|
    6+10       1.0892      0.05  Q         |         |         |        V|
    6+15       1.0894      0.02  Q         |         |         |        V|
    6+20       1.0894      0.00  Q         |         |         |         V
-----------------------------------------------------------------------
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       U n i t   H y d r o g r a p h   A n a l y s i s

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               Study date  07/23/19 File: DMAC100EXIST24100.out


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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978


Program License Serial Number 6388

---------------------------------------------------------------------
 English (in-lb) Input Units Used
 English Rainfall Data (Inches) Input Values Used

 English Units used in output format



---------------------------------------------------------------------
KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
EXISTING CONDITION, DMA C
100-YR 24-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019
--------------------------------------------------------------------
Drainage Area =       7.50(Ac.)  =      0.012 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =       7.50(Ac.)  =      0.012 Sq. Mi.
Length along longest watercourse =     860.00(Ft.)
Length along longest watercourse measured to centroid =     749.00(Ft.)
Length along longest watercourse =      0.163 Mi.
Length along longest watercourse measured to centroid =      0.142 Mi.
Difference in elevation =      21.50(Ft.)
Slope along watercourse =    132.0000 Ft./Mi.
Average Manning's 'N' = 0.020
Lag time =    0.045 Hr.
Lag time =     2.72 Min.
25% of lag time =     0.68 Min.
40% of lag time =     1.09 Min.
Unit time =     5.00 Min.
Duration of storm = 24 Hour(s)
User Entered Base Flow =     0.00(CFS)

2 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        7.50           2.05                 15.37

100 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        7.50           5.16                 38.70

STORM EVENT (YEAR) =  100.00
Area Averaged 2-Year Rainfall =    2.050(In)
Area Averaged 100-Year Rainfall =    5.160(In)

Point rain (area averaged) =    5.160(In)
Areal adjustment factor =  100.00 %
Adjusted average point rain =    5.160(In)

Sub-Area Data:
Area(Ac.)         Runoff Index   Impervious %
     7.500           56.00          0.500
 Total Area Entered =      7.50(Ac.)


RI    RI   Infil. Rate Impervious   Adj. Infil. Rate  Area%     F
AMC2 AMC-2     (In/Hr)    (Dec.%)      (In/Hr)      (Dec.)    (In/Hr)
56.0  56.0      0.511     0.500        0.281       1.000      0.281
                                                  Sum (F) =   0.281
Area averaged mean soil loss (F) (In/Hr) =  0.281
Minimum soil loss rate ((In/Hr)) =  0.140
```

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.500

U n i t   H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.083	183.771	40.452	3.058
2	0.167	367.541	44.515	3.365
3	0.250	551.312	9.487	0.717
4	0.333	735.082	3.846	0.291
5	0.417	918.853	1.700	0.128
			Sum = 100.000	Sum= 7.559

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Loss rate(In./Hr) Low	Effective (In/Hr)
1	0.08	0.07	0.041	(0.498)	0.021	0.021
2	0.17	0.07	0.041	(0.496)	0.021	0.021
3	0.25	0.07	0.041	(0.494)	0.021	0.021
4	0.33	0.10	0.062	(0.492)	0.031	0.031
5	0.42	0.10	0.062	(0.490)	0.031	0.031
6	0.50	0.10	0.062	(0.488)	0.031	0.031
7	0.58	0.10	0.062	(0.487)	0.031	0.031
8	0.67	0.10	0.062	(0.485)	0.031	0.031
9	0.75	0.10	0.062	(0.483)	0.031	0.031
10	0.83	0.13	0.083	(0.481)	0.041	0.041
11	0.92	0.13	0.083	(0.479)	0.041	0.041
12	1.00	0.13	0.083	(0.477)	0.041	0.041
13	1.08	0.10	0.062	(0.475)	0.031	0.031
14	1.17	0.10	0.062	(0.473)	0.031	0.031
15	1.25	0.10	0.062	(0.471)	0.031	0.031
16	1.33	0.10	0.062	(0.470)	0.031	0.031
17	1.42	0.10	0.062	(0.468)	0.031	0.031
18	1.50	0.10	0.062	(0.466)	0.031	0.031
19	1.58	0.10	0.062	(0.464)	0.031	0.031
20	1.67	0.10	0.062	(0.462)	0.031	0.031
21	1.75	0.10	0.062	(0.460)	0.031	0.031
22	1.83	0.13	0.083	(0.458)	0.041	0.041
23	1.92	0.13	0.083	(0.457)	0.041	0.041
24	2.00	0.13	0.083	(0.455)	0.041	0.041
25	2.08	0.13	0.083	(0.453)	0.041	0.041
26	2.17	0.13	0.083	(0.451)	0.041	0.041
27	2.25	0.13	0.083	(0.449)	0.041	0.041
28	2.33	0.13	0.083	(0.447)	0.041	0.041
29	2.42	0.13	0.083	(0.446)	0.041	0.041
30	2.50	0.13	0.083	(0.444)	0.041	0.041
31	2.58	0.17	0.103	(0.442)	0.052	0.052
32	2.67	0.17	0.103	(0.440)	0.052	0.052
33	2.75	0.17	0.103	(0.438)	0.052	0.052
34	2.83	0.17	0.103	(0.436)	0.052	0.052
35	2.92	0.17	0.103	(0.435)	0.052	0.052
36	3.00	0.17	0.103	(0.433)	0.052	0.052
37	3.08	0.17	0.103	(0.431)	0.052	0.052
38	3.17	0.17	0.103	(0.429)	0.052	0.052
39	3.25	0.17	0.103	(0.427)	0.052	0.052
40	3.33	0.17	0.103	(0.426)	0.052	0.052
41	3.42	0.17	0.103	(0.424)	0.052	0.052
42	3.50	0.17	0.103	(0.422)	0.052	0.052
43	3.58	0.17	0.103	(0.420)	0.052	0.052
44	3.67	0.17	0.103	(0.419)	0.052	0.052
45	3.75	0.17	0.103	(0.417)	0.052	0.052
46	3.83	0.20	0.124	(0.415)	0.062	0.062
47	3.92	0.20	0.124	(0.413)	0.062	0.062
48	4.00	0.20	0.124	(0.412)	0.062	0.062
49	4.08	0.20	0.124	(0.410)	0.062	0.062
50	4.17	0.20	0.124	(0.408)	0.062	0.062
51	4.25	0.20	0.124	(0.406)	0.062	0.062
52	4.33	0.23	0.144	(0.405)	0.072	0.072
53	4.42	0.23	0.144	(0.403)	0.072	0.072

54	4.50	0.23	0.144	(0.401)	0.072	0.072
55	4.58	0.23	0.144	(0.399)	0.072	0.072
56	4.67	0.23	0.144	(0.398)	0.072	0.072
57	4.75	0.23	0.144	(0.396)	0.072	0.072
58	4.83	0.27	0.165	(0.394)	0.083	0.083
59	4.92	0.27	0.165	(0.393)	0.083	0.083
60	5.00	0.27	0.165	(0.391)	0.083	0.083
61	5.08	0.20	0.124	(0.389)	0.062	0.062
62	5.17	0.20	0.124	(0.388)	0.062	0.062
63	5.25	0.20	0.124	(0.386)	0.062	0.062
64	5.33	0.23	0.144	(0.384)	0.072	0.072
65	5.42	0.23	0.144	(0.382)	0.072	0.072
66	5.50	0.23	0.144	(0.381)	0.072	0.072
67	5.58	0.27	0.165	(0.379)	0.083	0.083
68	5.67	0.27	0.165	(0.377)	0.083	0.083
69	5.75	0.27	0.165	(0.376)	0.083	0.083
70	5.83	0.27	0.165	(0.374)	0.083	0.083
71	5.92	0.27	0.165	(0.372)	0.083	0.083
72	6.00	0.27	0.165	(0.371)	0.083	0.083
73	6.08	0.30	0.186	(0.369)	0.093	0.093
74	6.17	0.30	0.186	(0.368)	0.093	0.093
75	6.25	0.30	0.186	(0.366)	0.093	0.093
76	6.33	0.30	0.186	(0.364)	0.093	0.093
77	6.42	0.30	0.186	(0.363)	0.093	0.093
78	6.50	0.30	0.186	(0.361)	0.093	0.093
79	6.58	0.33	0.206	(0.359)	0.103	0.103
80	6.67	0.33	0.206	(0.358)	0.103	0.103
81	6.75	0.33	0.206	(0.356)	0.103	0.103
82	6.83	0.33	0.206	(0.355)	0.103	0.103
83	6.92	0.33	0.206	(0.353)	0.103	0.103
84	7.00	0.33	0.206	(0.351)	0.103	0.103
85	7.08	0.33	0.206	(0.350)	0.103	0.103
86	7.17	0.33	0.206	(0.348)	0.103	0.103
87	7.25	0.33	0.206	(0.347)	0.103	0.103
88	7.33	0.37	0.227	(0.345)	0.114	0.114
89	7.42	0.37	0.227	(0.343)	0.114	0.114
90	7.50	0.37	0.227	(0.342)	0.114	0.114
91	7.58	0.40	0.248	(0.340)	0.124	0.124
92	7.67	0.40	0.248	(0.339)	0.124	0.124
93	7.75	0.40	0.248	(0.337)	0.124	0.124
94	7.83	0.43	0.268	(0.336)	0.134	0.134
95	7.92	0.43	0.268	(0.334)	0.134	0.134
96	8.00	0.43	0.268	(0.332)	0.134	0.134
97	8.08	0.50	0.310	(0.331)	0.155	0.155
98	8.17	0.50	0.310	(0.329)	0.155	0.155
99	8.25	0.50	0.310	(0.328)	0.155	0.155
100	8.33	0.50	0.310	(0.326)	0.155	0.155
101	8.42	0.50	0.310	(0.325)	0.155	0.155
102	8.50	0.50	0.310	(0.323)	0.155	0.155
103	8.58	0.53	0.330	(0.322)	0.165	0.165
104	8.67	0.53	0.330	(0.320)	0.165	0.165
105	8.75	0.53	0.330	(0.319)	0.165	0.165
106	8.83	0.57	0.351	(0.317)	0.175	0.175
107	8.92	0.57	0.351	(0.316)	0.175	0.175
108	9.00	0.57	0.351	(0.314)	0.175	0.175
109	9.08	0.63	0.392	(0.313)	0.196	0.196
110	9.17	0.63	0.392	(0.311)	0.196	0.196
111	9.25	0.63	0.392	(0.310)	0.196	0.196
112	9.33	0.67	0.413	(0.308)	0.206	0.206
113	9.42	0.67	0.413	(0.307)	0.206	0.206
114	9.50	0.67	0.413	(0.305)	0.206	0.206
115	9.58	0.70	0.433	(0.304)	0.217	0.217
116	9.67	0.70	0.433	(0.302)	0.217	0.217
117	9.75	0.70	0.433	(0.301)	0.217	0.217
118	9.83	0.73	0.454	(0.300)	0.227	0.227
119	9.92	0.73	0.454	(0.298)	0.227	0.227
120	10.00	0.73	0.454	(0.297)	0.227	0.227
121	10.08	0.50	0.310	(0.295)	0.155	0.155
122	10.17	0.50	0.310	(0.294)	0.155	0.155
123	10.25	0.50	0.310	(0.292)	0.155	0.155
124	10.33	0.50	0.310	(0.291)	0.155	0.155
125	10.42	0.50	0.310	(0.290)	0.155	0.155
126	10.50	0.50	0.310	(0.288)	0.155	0.155
127	10.58	0.67	0.413	(0.287)	0.206	0.206
128	10.67	0.67	0.413	(0.285)	0.206	0.206
129	10.75	0.67	0.413	(0.284)	0.206	0.206
130	10.83	0.67	0.413	(0.283)	0.206	0.206
131	10.92	0.67	0.413	(0.281)	0.206	0.206
132	11.00	0.67	0.413	(0.280)	0.206	0.206

133	11.08	0.63	0.392	(0.278)	0.196	0.196
134	11.17	0.63	0.392	(0.277)	0.196	0.196
135	11.25	0.63	0.392	(0.276)	0.196	0.196
136	11.33	0.63	0.392	(0.274)	0.196	0.196
137	11.42	0.63	0.392	(0.273)	0.196	0.196
138	11.50	0.63	0.392	(0.272)	0.196	0.196
139	11.58	0.57	0.351	(0.270)	0.175	0.175
140	11.67	0.57	0.351	(0.269)	0.175	0.175
141	11.75	0.57	0.351	(0.268)	0.175	0.175
142	11.83	0.60	0.372	(0.266)	0.186	0.186
143	11.92	0.60	0.372	(0.265)	0.186	0.186
144	12.00	0.60	0.372	(0.264)	0.186	0.186
145	12.08	0.83	0.516	(0.262)	0.258	0.258
146	12.17	0.83	0.516	(0.261)	0.258	0.258
147	12.25	0.83	0.516	(0.260)	0.258	0.258
148	12.33	0.87	0.537	0.258	(0.268)	0.278
149	12.42	0.87	0.537	0.257	(0.268)	0.280
150	12.50	0.87	0.537	0.256	(0.268)	0.281
151	12.58	0.93	0.578	0.254	(0.289)	0.323
152	12.67	0.93	0.578	0.253	(0.289)	0.325
153	12.75	0.93	0.578	0.252	(0.289)	0.326
154	12.83	0.97	0.599	0.251	(0.299)	0.348
155	12.92	0.97	0.599	0.249	(0.299)	0.349
156	13.00	0.97	0.599	0.248	(0.299)	0.350
157	13.08	1.13	0.702	0.247	(0.351)	0.455
158	13.17	1.13	0.702	0.246	(0.351)	0.456
159	13.25	1.13	0.702	0.244	(0.351)	0.457
160	13.33	1.13	0.702	0.243	(0.351)	0.459
161	13.42	1.13	0.702	0.242	(0.351)	0.460
162	13.50	1.13	0.702	0.241	(0.351)	0.461
163	13.58	0.77	0.475	(0.239)	0.237	0.237
164	13.67	0.77	0.475	(0.238)	0.237	0.237
165	13.75	0.77	0.475	0.237	(0.237)	0.238
166	13.83	0.77	0.475	0.236	(0.237)	0.239
167	13.92	0.77	0.475	0.235	(0.237)	0.240
168	14.00	0.77	0.475	0.233	(0.237)	0.241
169	14.08	0.90	0.557	0.232	(0.279)	0.325
170	14.17	0.90	0.557	0.231	(0.279)	0.326
171	14.25	0.90	0.557	0.230	(0.279)	0.327
172	14.33	0.87	0.537	0.229	(0.268)	0.308
173	14.42	0.87	0.537	0.227	(0.268)	0.309
174	14.50	0.87	0.537	0.226	(0.268)	0.310
175	14.58	0.87	0.537	0.225	(0.268)	0.311
176	14.67	0.87	0.537	0.224	(0.268)	0.313
177	14.75	0.87	0.537	0.223	(0.268)	0.314
178	14.83	0.83	0.516	0.222	(0.258)	0.294
179	14.92	0.83	0.516	0.221	(0.258)	0.295
180	15.00	0.83	0.516	0.219	(0.258)	0.297
181	15.08	0.80	0.495	0.218	(0.248)	0.277
182	15.17	0.80	0.495	0.217	(0.248)	0.278
183	15.25	0.80	0.495	0.216	(0.248)	0.279
184	15.33	0.77	0.475	0.215	(0.237)	0.260
185	15.42	0.77	0.475	0.214	(0.237)	0.261
186	15.50	0.77	0.475	0.213	(0.237)	0.262
187	15.58	0.63	0.392	(0.212)	0.196	0.196
188	15.67	0.63	0.392	(0.211)	0.196	0.196
189	15.75	0.63	0.392	(0.210)	0.196	0.196
190	15.83	0.63	0.392	(0.208)	0.196	0.196
191	15.92	0.63	0.392	(0.207)	0.196	0.196
192	16.00	0.63	0.392	(0.206)	0.196	0.196
193	16.08	0.13	0.083	(0.205)	0.041	0.041
194	16.17	0.13	0.083	(0.204)	0.041	0.041
195	16.25	0.13	0.083	(0.203)	0.041	0.041
196	16.33	0.13	0.083	(0.202)	0.041	0.041
197	16.42	0.13	0.083	(0.201)	0.041	0.041
198	16.50	0.13	0.083	(0.200)	0.041	0.041
199	16.58	0.10	0.062	(0.199)	0.031	0.031
200	16.67	0.10	0.062	(0.198)	0.031	0.031
201	16.75	0.10	0.062	(0.197)	0.031	0.031
202	16.83	0.10	0.062	(0.196)	0.031	0.031
203	16.92	0.10	0.062	(0.195)	0.031	0.031
204	17.00	0.10	0.062	(0.194)	0.031	0.031
205	17.08	0.17	0.103	(0.193)	0.052	0.052
206	17.17	0.17	0.103	(0.192)	0.052	0.052
207	17.25	0.17	0.103	(0.191)	0.052	0.052
208	17.33	0.17	0.103	(0.190)	0.052	0.052
209	17.42	0.17	0.103	(0.189)	0.052	0.052
210	17.50	0.17	0.103	(0.188)	0.052	0.052
211	17.58	0.17	0.103	(0.187)	0.052	0.052

212	17.67	0.17	0.103	(0.186)	0.052	0.052
213	17.75	0.17	0.103	(0.185)	0.052	0.052
214	17.83	0.13	0.083	(0.185)	0.041	0.041
215	17.92	0.13	0.083	(0.184)	0.041	0.041
216	18.00	0.13	0.083	(0.183)	0.041	0.041
217	18.08	0.13	0.083	(0.182)	0.041	0.041
218	18.17	0.13	0.083	(0.181)	0.041	0.041
219	18.25	0.13	0.083	(0.180)	0.041	0.041
220	18.33	0.13	0.083	(0.179)	0.041	0.041
221	18.42	0.13	0.083	(0.178)	0.041	0.041
222	18.50	0.13	0.083	(0.177)	0.041	0.041
223	18.58	0.10	0.062	(0.177)	0.031	0.031
224	18.67	0.10	0.062	(0.176)	0.031	0.031
225	18.75	0.10	0.062	(0.175)	0.031	0.031
226	18.83	0.07	0.041	(0.174)	0.021	0.021
227	18.92	0.07	0.041	(0.173)	0.021	0.021
228	19.00	0.07	0.041	(0.172)	0.021	0.021
229	19.08	0.10	0.062	(0.172)	0.031	0.031
230	19.17	0.10	0.062	(0.171)	0.031	0.031
231	19.25	0.10	0.062	(0.170)	0.031	0.031
232	19.33	0.13	0.083	(0.169)	0.041	0.041
233	19.42	0.13	0.083	(0.168)	0.041	0.041
234	19.50	0.13	0.083	(0.168)	0.041	0.041
235	19.58	0.10	0.062	(0.167)	0.031	0.031
236	19.67	0.10	0.062	(0.166)	0.031	0.031
237	19.75	0.10	0.062	(0.165)	0.031	0.031
238	19.83	0.07	0.041	(0.165)	0.021	0.021
239	19.92	0.07	0.041	(0.164)	0.021	0.021
240	20.00	0.07	0.041	(0.163)	0.021	0.021
241	20.08	0.10	0.062	(0.162)	0.031	0.031
242	20.17	0.10	0.062	(0.162)	0.031	0.031
243	20.25	0.10	0.062	(0.161)	0.031	0.031
244	20.33	0.10	0.062	(0.160)	0.031	0.031
245	20.42	0.10	0.062	(0.160)	0.031	0.031
246	20.50	0.10	0.062	(0.159)	0.031	0.031
247	20.58	0.10	0.062	(0.158)	0.031	0.031
248	20.67	0.10	0.062	(0.158)	0.031	0.031
249	20.75	0.10	0.062	(0.157)	0.031	0.031
250	20.83	0.07	0.041	(0.156)	0.021	0.021
251	20.92	0.07	0.041	(0.156)	0.021	0.021
252	21.00	0.07	0.041	(0.155)	0.021	0.021
253	21.08	0.10	0.062	(0.154)	0.031	0.031
254	21.17	0.10	0.062	(0.154)	0.031	0.031
255	21.25	0.10	0.062	(0.153)	0.031	0.031
256	21.33	0.07	0.041	(0.153)	0.021	0.021
257	21.42	0.07	0.041	(0.152)	0.021	0.021
258	21.50	0.07	0.041	(0.152)	0.021	0.021
259	21.58	0.10	0.062	(0.151)	0.031	0.031
260	21.67	0.10	0.062	(0.150)	0.031	0.031
261	21.75	0.10	0.062	(0.150)	0.031	0.031
262	21.83	0.07	0.041	(0.149)	0.021	0.021
263	21.92	0.07	0.041	(0.149)	0.021	0.021
264	22.00	0.07	0.041	(0.148)	0.021	0.021
265	22.08	0.10	0.062	(0.148)	0.031	0.031
266	22.17	0.10	0.062	(0.147)	0.031	0.031
267	22.25	0.10	0.062	(0.147)	0.031	0.031
268	22.33	0.07	0.041	(0.146)	0.021	0.021
269	22.42	0.07	0.041	(0.146)	0.021	0.021
270	22.50	0.07	0.041	(0.146)	0.021	0.021
271	22.58	0.07	0.041	(0.145)	0.021	0.021
272	22.67	0.07	0.041	(0.145)	0.021	0.021
273	22.75	0.07	0.041	(0.144)	0.021	0.021
274	22.83	0.07	0.041	(0.144)	0.021	0.021
275	22.92	0.07	0.041	(0.144)	0.021	0.021
276	23.00	0.07	0.041	(0.143)	0.021	0.021
277	23.08	0.07	0.041	(0.143)	0.021	0.021
278	23.17	0.07	0.041	(0.143)	0.021	0.021
279	23.25	0.07	0.041	(0.142)	0.021	0.021
280	23.33	0.07	0.041	(0.142)	0.021	0.021
281	23.42	0.07	0.041	(0.142)	0.021	0.021
282	23.50	0.07	0.041	(0.141)	0.021	0.021
283	23.58	0.07	0.041	(0.141)	0.021	0.021
284	23.67	0.07	0.041	(0.141)	0.021	0.021
285	23.75	0.07	0.041	(0.141)	0.021	0.021
286	23.83	0.07	0.041	(0.141)	0.021	0.021
287	23.92	0.07	0.041	(0.141)	0.021	0.021
288	24.00	0.07	0.041	(0.140)	0.021	0.021

(Loss Rate Not Used)

Sum = 100.0 Sum = 32.6

Flood volume = Effective rainfall 2.71(In)
times area 7.5(Ac.)/[(In)/(Ft.)] = 1.7(Ac.Ft)
Total soil loss = 2.45(In)
Total soil loss = 1.528(Ac.Ft)
Total rainfall = 5.16(In)
Flood volume = 73904.5 Cubic Feet
Total soil loss = 66574.4 Cubic Feet

Peak flow rate of this hydrograph = 3.480(CFS)

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24 - H O U R S T O R M
R u n o f f H y d r o g r a p h

Hydrograph in 5 Minute intervals ((CFS))

Time(h+m)	Volume Ac.Ft	Q(CFS)	0	2.5	5.0	7.5	10.0
0+ 5	0.0004	0.06	Q				
0+10	0.0013	0.13	Q				
0+15	0.0024	0.15	Q				
0+20	0.0036	0.19	Q				
0+25	0.0052	0.22	Q				
0+30	0.0068	0.23	Q				
0+35	0.0084	0.23	Q				
0+40	0.0100	0.23	Q				
0+45	0.0116	0.23	Q				
0+50	0.0134	0.27	VQ				
0+55	0.0155	0.30	VQ				
1+ 0	0.0176	0.31	VQ				
1+ 5	0.0195	0.28	VQ				
1+10	0.0212	0.25	Q				
1+15	0.0229	0.24	Q				
1+20	0.0245	0.24	Q				
1+25	0.0261	0.23	Q				
1+30	0.0277	0.23	Q				
1+35	0.0293	0.23	Q				
1+40	0.0309	0.23	Q				
1+45	0.0325	0.23	Q				
1+50	0.0344	0.27	VQ				
1+55	0.0364	0.30	VQ				
2+ 0	0.0386	0.31	VQ				
2+ 5	0.0407	0.31	VQ				
2+10	0.0429	0.31	Q				
2+15	0.0450	0.31	Q				
2+20	0.0472	0.31	Q				
2+25	0.0493	0.31	Q				
2+30	0.0515	0.31	Q				
2+35	0.0538	0.34	Q				
2+40	0.0564	0.38	Q				
2+45	0.0591	0.39	Q				
2+50	0.0618	0.39	Q				
2+55	0.0644	0.39	Q				
3+ 0	0.0671	0.39	Q				
3+ 5	0.0698	0.39	Q				
3+10	0.0725	0.39	Q				
3+15	0.0752	0.39	Q				
3+20	0.0779	0.39	Q				
3+25	0.0806	0.39	Q				
3+30	0.0833	0.39	Q				
3+35	0.0859	0.39	QV				
3+40	0.0886	0.39	QV				
3+45	0.0913	0.39	QV				
3+50	0.0942	0.42	QV				
3+55	0.0974	0.46	QV				
4+ 0	0.1006	0.46	QV				
4+ 5	0.1038	0.47	QV				
4+10	0.1070	0.47	QV				
4+15	0.1102	0.47	QV				
4+20	0.1137	0.50	QV				
4+25	0.1174	0.53	Q				
4+30	0.1211	0.54	Q				
4+35	0.1248	0.54	Q				
4+40	0.1286	0.55	QV				
4+45	0.1324	0.55	QV				
4+50	0.1363	0.58	QV				
4+55	0.1406	0.61	QV				
5+ 0	0.1448	0.62	QV				

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 5+ 5       0.1487      0.56  | QV      |         |         |         |
 5+10       0.1521      0.49  |Q V      |         |         |         |
 5+15       0.1554      0.48  |Q V      |         |         |         |
 5+20       0.1588      0.50  | QV      |         |         |         |
 5+25       0.1625      0.53  | QV      |         |         |         |
 5+30       0.1662      0.54  | QV      |         |         |         |
 5+35       0.1702      0.58  | Q V     |         |         |         |
 5+40       0.1744      0.61  | Q V     |         |         |         |
 5+45       0.1787      0.62  | Q V     |         |         |         |
 5+50       0.1830      0.62  | Q V     |         |         |         |
 5+55       0.1873      0.62  | Q V     |         |         |         |
 6+ 0       0.1916      0.62  | Q V     |         |         |         |
 6+ 5       0.1961      0.66  | Q V     |         |         |         |
 6+10       0.2009      0.69  | Q V     |         |         |         |
 6+15       0.2057      0.70  | Q V     |         |         |         |
 6+20       0.2105      0.70  | Q V     |         |         |         |
 6+25       0.2153      0.70  | Q  V    |         |         |         |
 6+30       0.2202      0.70  | Q  V    |         |         |         |
 6+35       0.2252      0.73  | Q  V    |         |         |         |
 6+40       0.2305      0.77  |  Q V    |         |         |         |
 6+45       0.2359      0.78  |  Q V    |         |         |         |
 6+50       0.2412      0.78  |  Q V    |         |         |         |
 6+55       0.2466      0.78  |  Q V    |         |         |         |
 7+ 0       0.2520      0.78  |  Q V    |         |         |         |
 7+ 5       0.2574      0.78  |  Q  V   |         |         |         |
 7+10       0.2627      0.78  |  Q  V   |         |         |         |
 7+15       0.2681      0.78  |  Q  V   |         |         |         |
 7+20       0.2737      0.81  |  Q  V   |         |         |         |
 7+25       0.2795      0.85  |  Q  V   |         |         |         |
 7+30       0.2854      0.85  |  Q  V   |         |         |         |
 7+35       0.2915      0.89  |  Q  V   |         |         |         |
 7+40       0.2979      0.92  |  Q   V  |         |         |         |
 7+45       0.3043      0.93  |  Q   V  |         |         |         |
 7+50       0.3110      0.97  |  Q   V  |         |         |         |
 7+55       0.3179      1.00  |   Q  V  |         |         |         |
 8+ 0       0.3248      1.01  |   Q  V  |         |         |         |
 8+ 5       0.3323      1.08  |   Q  V  |         |         |         |
 8+10       0.3402      1.15  |   Q   V |         |         |         |
 8+15       0.3482      1.16  |   Q   V |         |         |         |
 8+20       0.3562      1.17  |   Q   V |         |         |         |
 8+25       0.3643      1.17  |   Q   V |         |         |         |
 8+30       0.3723      1.17  |   Q   V |         |         |         |
 8+35       0.3806      1.20  |   Q   V |         |         |         |
 8+40       0.3891      1.24  |   Q    V|         |         |         |
 8+45       0.3977      1.24  |   Q    V|         |         |         |
 8+50       0.4065      1.28  |    Q   V|         |         |         |
 8+55       0.4156      1.32  |    Q   V|         |         |         |
 9+ 0       0.4247      1.32  |    Q    V         |         |         |
 9+ 5       0.4342      1.39  |    Q    V         |         |         |
 9+10       0.4443      1.46  |    Q    V         |         |         |
 9+15       0.4544      1.47  |    Q    V         |         |         |
 9+20       0.4649      1.51  |     Q   V         |         |         |
 9+25       0.4755      1.55  |     Q   |V        |         |         |
 9+30       0.4862      1.56  |     Q   |V        |         |         |
 9+35       0.4972      1.59  |     Q   |V        |         |         |
 9+40       0.5084      1.63  |     Q   |V        |         |         |
 9+45       0.5197      1.63  |     Q   | V       |         |         |
 9+50       0.5312      1.67  |     Q   | V       |         |         |
 9+55       0.5429      1.71  |     Q   | V       |         |         |
10+ 0       0.5547      1.71  |     Q   |  V      |         |         |
10+ 5       0.5650      1.49  |    Q    |  V      |         |         |
10+10       0.5736      1.25  |    Q    |  V      |         |         |
10+15       0.5819      1.20  |   Q     |  V      |         |         |
10+20       0.5900      1.18  |   Q     |  V      |         |         |
10+25       0.5981      1.17  |   Q     |   V     |         |         |
10+30       0.6061      1.17  |   Q     |   V     |         |         |
10+35       0.6153      1.33  |    Q    |   V     |         |         |
10+40       0.6256      1.50  |     Q   |   V     |         |         |
10+45       0.6362      1.54  |     Q   |    V    |         |         |
10+50       0.6469      1.55  |     Q   |    V    |         |         |
10+55       0.6577      1.56  |     Q   |    V    |         |         |
11+ 0       0.6684      1.56  |     Q   |    V    |         |         |
11+ 5       0.6790      1.53  |     Q   |     V   |         |         |
11+10       0.6893      1.49  |    Q    |     V   |         |         |
11+15       0.6995      1.49  |    Q    |     V   |         |         |
11+20       0.7097      1.48  |    Q    |     V   |         |         |
11+25       0.7199      1.48  |    Q    |     V   |         |         |
11+30       0.7302      1.48  |    Q    |      V  |         |         |
11+35       0.7399      1.42  |    Q    |      V  |         |         |
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11+40       0.7492      1.35  |    Q    |      V  |         |         |
11+45       0.7584      1.34  |    Q    |      V  |         |         |
11+50       0.7678      1.36  |    Q    |       V |         |         |
11+55       0.7774      1.39  |    Q    |       V |         |         |
12+ 0       0.7870      1.40  |    Q    |       V |         |         |
12+ 5       0.7982      1.62  |     Q   |       V |         |         |
12+10       0.8111      1.87  |      Q  |        V|         |         |
12+15       0.8243      1.92  |      Q  |        V|         |         |
12+20       0.8381      2.00  |       Q |        V|         |         |
12+25       0.8525      2.09  |       Q |         V         |         |
12+30       0.8670      2.11  |       Q |         V         |         |
12+35       0.8825      2.25  |       Q |         V         |         |
12+40       0.8990      2.40  |        Q|         |V        |         |
12+45       0.9159      2.44  |        Q|         |V        |         |
12+50       0.9332      2.53  |         Q         | V       |         |
12+55       0.9512      2.61  |         Q         | V       |         |
13+ 0       0.9694      2.63  |         Q         | V       |         |
13+ 5       0.9898      2.97  |         |Q        |  V      |         |
13+10       1.0127      3.32  |         |   Q     |  V      |         |
13+15       1.0361      3.41  |         |   Q     |   V     |         |
13+20       1.0599      3.45  |         |   Q     |   V     |         |
13+25       1.0838      3.47  |         |   Q     |    V    |         |
13+30       1.1078      3.48  |         |   Q     |     V   |         |
13+35       1.1270      2.80  |         |Q        |     V   |         |
13+40       1.1412      2.05  |       Q |         |     V   |         |
13+45       1.1542      1.89  |      Q  |         |      V  |         |
13+50       1.1668      1.83  |      Q  |         |      V  |         |
13+55       1.1792      1.81  |      Q  |         |      V  |         |
14+ 0       1.1918      1.82  |      Q  |         |       V |         |
14+ 5       1.2061      2.08  |       Q |         |       V |         |
14+10       1.2224      2.37  |        Q|         |       V |         |
14+15       1.2391      2.43  |        Q|         |        V|         |
14+20       1.2557      2.40  |        Q|         |        V|         |
14+25       1.2719      2.35  |        Q|         |        V|         |
14+30       1.2881      2.35  |        Q|         |         V         |
14+35       1.3043      2.35  |        Q|         |         V         |
14+40       1.3205      2.36  |        Q|         |         |V        |
14+45       1.3368      2.37  |        Q|         |         |V        |
14+50       1.3527      2.31  |        Q|         |         |V        |
14+55       1.3682      2.25  |        Q|         |         | V       |
15+ 0       1.3837      2.24  |       Q |         |         | V       |
15+ 5       1.3987      2.18  |       Q |         |         | V       |
15+10       1.4133      2.12  |       Q |         |         |  V      |
15+15       1.4279      2.11  |       Q |         |         |  V      |
15+20       1.4420      2.05  |       Q |         |         |  V      |
15+25       1.4557      1.99  |      Q  |         |         |   V     |
15+30       1.4694      1.98  |      Q  |         |         |   V     |
15+35       1.4816      1.78  |      Q  |         |         |   V     |
15+40       1.4924      1.56  |     Q   |         |         |    V    |
15+45       1.5028      1.51  |     Q   |         |         |    V    |
15+50       1.5130      1.49  |    Q    |         |         |    V    |
15+55       1.5232      1.48  |    Q    |         |         |    V    |
16+ 0       1.5335      1.48  |    Q    |         |         |     V   |
16+ 5       1.5404      1.01  |   Q     |         |         |     V   |
16+10       1.5438      0.49  |Q        |         |         |     V   |
16+15       1.5464      0.38  |Q        |         |         |     V   |
16+20       1.5487      0.33  |Q        |         |         |     V   |
16+25       1.5508      0.31  |Q        |         |         |     V   |
16+30       1.5530      0.31  |Q        |         |         |     V   |
16+35       1.5549      0.28  |Q        |         |         |     V   |
16+40       1.5566      0.25  Q         |         |         |     V   |
16+45       1.5582      0.24  Q         |         |         |     V   |
16+50       1.5598      0.24  Q         |         |         |     V   |
16+55       1.5615      0.23  Q         |         |         |     V   |
17+ 0       1.5631      0.23  Q         |         |         |     V   |
17+ 5       1.5651      0.30  |Q        |         |         |     V   |
17+10       1.5676      0.37  |Q        |         |         |     V   |
17+15       1.5703      0.38  |Q        |         |         |      V  |
17+20       1.5729      0.39  |Q        |         |         |      V  |
17+25       1.5756      0.39  |Q        |         |         |      V  |
17+30       1.5783      0.39  |Q        |         |         |      V  |
17+35       1.5810      0.39  |Q        |         |         |      V  |
17+40       1.5837      0.39  |Q        |         |         |      V  |
17+45       1.5864      0.39  |Q        |         |         |      V  |
17+50       1.5888      0.36  |Q        |         |         |      V  |
17+55       1.5911      0.32  |Q        |         |         |      V  |
18+ 0       1.5933      0.32  |Q        |         |         |      V  |
18+ 5       1.5954      0.31  |Q        |         |         |      V  |
18+10       1.5976      0.31  |Q        |         |         |      V  |
```

18+15	1.5997	0.31	Q				V
18+20	1.6019	0.31	Q				V
18+25	1.6040	0.31	Q				V
18+30	1.6062	0.31	Q				V
18+35	1.6081	0.28	Q				V
18+40	1.6098	0.25	Q				V
18+45	1.6114	0.24	Q				V
18+50	1.6128	0.20	Q				V
18+55	1.6140	0.17	Q				V
19+ 0	1.6151	0.16	Q				V
19+ 5	1.6164	0.19	Q				V
19+10	1.6179	0.22	Q				V
19+15	1.6195	0.23	Q				V
19+20	1.6213	0.26	Q				V
19+25	1.6234	0.30	Q				V
19+30	1.6255	0.31	Q				V
19+35	1.6275	0.28	Q				V
19+40	1.6291	0.25	Q				V
19+45	1.6308	0.24	Q				V
19+50	1.6322	0.20	Q				V
19+55	1.6333	0.17	Q				V
20+ 0	1.6345	0.16	Q				V
20+ 5	1.6358	0.19	Q				V
20+10	1.6373	0.22	Q				V
20+15	1.6389	0.23	Q				V
20+20	1.6405	0.23	Q				V
20+25	1.6421	0.23	Q				V
20+30	1.6437	0.23	Q				V
20+35	1.6453	0.23	Q				V
20+40	1.6469	0.23	Q				V
20+45	1.6485	0.23	Q				V
20+50	1.6499	0.20	Q				V
20+55	1.6511	0.17	Q				V
21+ 0	1.6522	0.16	Q				V
21+ 5	1.6535	0.19	Q				V
21+10	1.6550	0.22	Q				V
21+15	1.6566	0.23	Q				V
21+20	1.6580	0.20	Q				V
21+25	1.6591	0.17	Q				V
21+30	1.6603	0.16	Q				V
21+35	1.6616	0.19	Q				V
21+40	1.6631	0.22	Q				V
21+45	1.6647	0.23	Q				V
21+50	1.6661	0.20	Q				V
21+55	1.6672	0.17	Q				V
22+ 0	1.6683	0.16	Q				V
22+ 5	1.6696	0.19	Q				V
22+10	1.6711	0.22	Q				V
22+15	1.6727	0.23	Q				V
22+20	1.6741	0.20	Q				V
22+25	1.6753	0.17	Q				V
22+30	1.6764	0.16	Q				V
22+35	1.6775	0.16	Q				V
22+40	1.6785	0.16	Q				V
22+45	1.6796	0.16	Q				V
22+50	1.6807	0.16	Q				V
22+55	1.6818	0.16	Q				V
23+ 0	1.6828	0.16	Q				V
23+ 5	1.6839	0.16	Q				V
23+10	1.6850	0.16	Q				V
23+15	1.6861	0.16	Q				V
23+20	1.6871	0.16	Q				V
23+25	1.6882	0.16	Q				V
23+30	1.6893	0.16	Q				V
23+35	1.6904	0.16	Q				V
23+40	1.6914	0.16	Q				V
23+45	1.6925	0.16	Q				V
23+50	1.6936	0.16	Q				V
23+55	1.6947	0.16	Q				V
24+ 0	1.6957	0.16	Q				V
24+ 5	1.6964	0.09	Q				V
24+10	1.6965	0.02	Q				V
24+15	1.6966	0.01	Q				V
24+20	1.6966	0.00	Q				V

```
      U n i t   H y d r o g r a p h   A n a l y s i s

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             Study date  07/23/19 File: DMAC100PROP1100.out


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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978


Program License Serial Number 6388

---------------------------------------------------------------------
 English (in-lb) Input Units Used
 English Rainfall Data (Inches) Input Values Used

 English Units used in output format



---------------------------------------------------------------------
KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
PROPOSED CONDITION, DMA C
100-YR 1-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019
--------------------------------------------------------------------
Drainage Area =       7.50(Ac.)  =      0.012 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =       7.50(Ac.)  =      0.012 Sq. Mi.
Length along longest watercourse =     860.00(Ft.)
Length along longest watercourse measured to centroid =     749.00(Ft.)
Length along longest watercourse =      0.163 Mi.
Length along longest watercourse measured to centroid =      0.142 Mi.
Difference in elevation =      21.50(Ft.)
Slope along watercourse =    132.0000 Ft./Mi.
Average Manning's 'N' = 0.015
Lag time =    0.034 Hr.
Lag time =     2.04 Min.
25% of lag time =     0.51 Min.
40% of lag time =     0.82 Min.
Unit time =     5.00 Min.
Duration of storm = 1 Hour(s)
User Entered Base Flow =     0.00(CFS)

2 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        7.50           0.49                  3.67

100 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        7.50           1.33                  9.98

STORM EVENT (YEAR) =  100.00
Area Averaged 2-Year Rainfall =    0.489(In)
Area Averaged 100-Year Rainfall =    1.330(In)

Point rain (area averaged) =    1.330(In)
Areal adjustment factor =   99.99 %
Adjusted average point rain =    1.330(In)

Sub-Area Data:
Area(Ac.)         Runoff Index   Impervious %
     7.500           56.00         0.760
 Total Area Entered =      7.50(Ac.)


RI    RI   Infil. Rate Impervious   Adj. Infil. Rate  Area%     F
AMC2 AMC-2     (In/Hr)    (Dec.%)      (In/Hr)      (Dec.)    (In/Hr)
56.0  56.0      0.511     0.760        0.161       1.000      0.161
                                                    Sum (F) =   0.161
Area averaged mean soil loss (F) (In/Hr) =  0.161
Minimum soil loss rate ((In/Hr)) =  0.081
```

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.290

Slope of intensity-duration curve for a 1 hour storm =0.5000

U n i t   H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.083	245.027	50.239	3.797
2	0.167	490.055	40.364	3.051
3	0.250	735.082	7.184	0.543
4	0.333	980.109	2.213	0.167
			Sum = 100.000	Sum= 7.559

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Low	Effective (In/Hr)
1	0.08	4.20	0.670	0.161	(0.194)	0.509
2	0.17	4.30	0.686	0.161	(0.199)	0.525
3	0.25	5.00	0.798	0.161	(0.231)	0.637
4	0.33	5.00	0.798	0.161	(0.231)	0.637
5	0.42	5.80	0.926	0.161	(0.268)	0.764
6	0.50	6.50	1.037	0.161	(0.301)	0.876
7	0.58	7.40	1.181	0.161	(0.342)	1.020
8	0.67	8.60	1.372	0.161	(0.398)	1.211
9	0.75	12.30	1.963	0.161	(0.569)	1.802
10	0.83	29.10	4.644	0.161	(1.347)	4.483
11	0.92	6.80	1.085	0.161	(0.315)	0.924
12	1.00	5.00	0.798	0.161	(0.231)	0.637
		(Loss Rate Not Used)				
Sum =		100.0				Sum = 14.0

Flood volume = Effective rainfall 1.17(In)
times area 7.5(Ac.)/[(In)/(Ft.)] = 0.7(Ac.Ft)
Total soil loss = 0.16(In)
Total soil loss = 0.101(Ac.Ft)
Total rainfall = 1.33(In)
Flood volume = 31812.3 Cubic Feet
Total soil loss = 4394.5 Cubic Feet

Peak flow rate of this hydrograph = 23.359(CFS)

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1 - H O U R   S T O R M
R u n o f f   H y d r o g r a p h

Hydrograph in 5 Minute intervals ((CFS))

```
 Time(h+m)  Volume Ac.Ft   Q(CFS)  0         7.5       15.0      22.5      30.0
-----------------------------------------------------------------------
   0+ 5       0.0133        1.93  V Q       |         |         |         |
   0+10       0.0377        3.55  | V Q     |         |         |         |
   0+15       0.0673        4.30  |  V Q    |         |         |         |
   0+20       0.0999        4.73  |    VQ   |         |         |         |
   0+25       0.1363        5.28  |      Q  |         |         |         |
   0+30       0.1784        6.11  |       QV|         |         |         |
   0+35       0.2271        7.07  |        Q|  V      |         |         |
   0+40       0.2844        8.32  |         |Q   V    |         |         |
   0+45       0.3618       11.24  |         |   Q    V|         |         |
   0+50       0.5227       23.36  |         |         |       V |Q        |
   0+55       0.6492       18.37  |         |         |  Q      |    V    |
   1+ 0       0.7041        7.98  |         Q         |         |       V |
   1+ 5       0.7261        3.20  |   Q     |         |         |        V|
   1+10       0.7296        0.50  Q         |         |         |        V|
   1+15       0.7303        0.11  Q         |         |         |         V
-----------------------------------------------------------------------
```

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      U n i t   H y d r o g r a p h   A n a l y s i s

      Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2014, Version 9.0
              Study date  07/23/19 File: DMAC100PROP3100.out


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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978


Program License Serial Number 6388

---------------------------------------------------------------------
 English (in-lb) Input Units Used
 English Rainfall Data (Inches) Input Values Used

 English Units used in output format



---------------------------------------------------------------------
KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
PROPOSED CONDITION, DMA C
100-YR 3-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019
--------------------------------------------------------------------
Drainage Area =        7.50(Ac.)  =      0.012 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =       7.50(Ac.)  =      0.012 Sq. Mi.
Length along longest watercourse =     860.00(Ft.)
Length along longest watercourse measured to centroid =     749.00(Ft.)
Length along longest watercourse =      0.163 Mi.
Length along longest watercourse measured to centroid =      0.142 Mi.
Difference in elevation =      21.50(Ft.)
Slope along watercourse =    132.0000 Ft./Mi.
Average Manning's 'N' = 0.015
Lag time =    0.034 Hr.
Lag time =     2.04 Min.
25% of lag time =     0.51 Min.
40% of lag time =     0.82 Min.
Unit time =     5.00 Min.
Duration of storm = 3 Hour(s)
User Entered Base Flow =     0.00(CFS)

2 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        7.50           0.87                  6.50

100 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        7.50           2.09                 15.67

STORM EVENT (YEAR) =  100.00
Area Averaged 2-Year Rainfall =    0.866(In)
Area Averaged 100-Year Rainfall =    2.090(In)

Point rain (area averaged) =    2.090(In)
Areal adjustment factor =  100.00 %
Adjusted average point rain =    2.090(In)

Sub-Area Data:
Area(Ac.)         Runoff Index   Impervious %
     7.500           56.00          0.760
 Total Area Entered =      7.50(Ac.)


RI    RI   Infil. Rate Impervious   Adj. Infil. Rate  Area%     F
AMC2 AMC-2     (In/Hr)    (Dec.%)      (In/Hr)      (Dec.)    (In/Hr)
56.0  56.0      0.511     0.760        0.161       1.000      0.161
                                                   Sum (F) =   0.161
Area averaged mean soil loss (F) (In/Hr) =  0.161
Minimum soil loss rate ((In/Hr)) =  0.081
```

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.290

U n i t   H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.083	245.027	50.239	3.797
2	0.167	490.055	40.364	3.051
3	0.250	735.082	7.184	0.543
4	0.333	980.109	2.213	0.167
			Sum = 100.000	Sum= 7.559

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Loss rate(In./Hr) Low	Effective (In/Hr)
1	0.08	1.30	0.326	(0.161)	0.095	0.231
2	0.17	1.30	0.326	(0.161)	0.095	0.231
3	0.25	1.10	0.276	(0.161)	0.080	0.196
4	0.33	1.50	0.376	(0.161)	0.109	0.267
5	0.42	1.50	0.376	(0.161)	0.109	0.267
6	0.50	1.80	0.451	(0.161)	0.131	0.321
7	0.58	1.50	0.376	(0.161)	0.109	0.267
8	0.67	1.80	0.451	(0.161)	0.131	0.321
9	0.75	1.80	0.451	(0.161)	0.131	0.321
10	0.83	1.50	0.376	(0.161)	0.109	0.267
11	0.92	1.60	0.401	(0.161)	0.116	0.285
12	1.00	1.80	0.451	(0.161)	0.131	0.321
13	1.08	2.20	0.552	(0.161)	0.160	0.392
14	1.17	2.20	0.552	(0.161)	0.160	0.392
15	1.25	2.20	0.552	(0.161)	0.160	0.392
16	1.33	2.00	0.502	(0.161)	0.145	0.356
17	1.42	2.60	0.652	0.161	(0.189)	0.491
18	1.50	2.70	0.677	0.161	(0.196)	0.516
19	1.58	2.40	0.602	0.161	(0.175)	0.440
20	1.67	2.70	0.677	0.161	(0.196)	0.516
21	1.75	3.30	0.828	0.161	(0.240)	0.666
22	1.83	3.10	0.777	0.161	(0.225)	0.616
23	1.92	2.90	0.727	0.161	(0.211)	0.566
24	2.00	3.00	0.752	0.161	(0.218)	0.591
25	2.08	3.10	0.777	0.161	(0.225)	0.616
26	2.17	4.20	1.053	0.161	(0.305)	0.892
27	2.25	5.00	1.254	0.161	(0.364)	1.093
28	2.33	3.50	0.878	0.161	(0.255)	0.716
29	2.42	6.80	1.705	0.161	(0.495)	1.544
30	2.50	7.30	1.831	0.161	(0.531)	1.669
31	2.58	8.20	2.056	0.161	(0.596)	1.895
32	2.67	5.90	1.480	0.161	(0.429)	1.318
33	2.75	2.00	0.502	(0.161)	0.145	0.356
34	2.83	1.80	0.451	(0.161)	0.131	0.321
35	2.92	1.80	0.451	(0.161)	0.131	0.321
36	3.00	0.60	0.150	(0.161)	0.044	0.107

(Loss Rate Not Used)
Sum = 100.0 Sum = 20.1
Flood volume = Effective rainfall 1.67(In)
times area 7.5(Ac.)/[(In)/(Ft.)] = 1.0(Ac.Ft)
Total soil loss = 0.42(In)
Total soil loss = 0.261(Ac.Ft)
Total rainfall = 2.09(In)
Flood volume = 45544.4 Cubic Feet
Total soil loss = 11354.0 Cubic Feet

Peak flow rate of this hydrograph = 13.255(CFS)

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3 - H O U R   S T O R M
R u n o f f   H y d r o g r a p h

Hydrograph in 5 Minute intervals ((CFS))

```
      --------------------------------------------------------------------
 Time(h+m) Volume Ac.Ft    Q(CFS)  0         5.0       10.0      15.0      20.0
 -----------------------------------------------------------------------
  0+ 5       0.0061      0.88  VQ        |         |         |         |
  0+10       0.0170      1.59  V  Q      |         |         |         |
  0+15       0.0278      1.58  |V Q      |         |         |         |
  0+20       0.0401      1.78  |V Q      |         |         |         |
  0+25       0.0537      1.98  | VQ      |         |         |         |
  0+30       0.0689      2.21  | V Q     |         |         |         |
  0+35       0.0839      2.18  |  VQ     |         |         |         |
  0+40       0.0995      2.25  |  VQ     |         |         |         |
  0+45       0.1159      2.39  |   Q     |         |         |         |
  0+50       0.1312      2.21  |   QV    |         |         |         |
  0+55       0.1458      2.13  |   QV    |         |         |         |
  1+ 0       0.1616      2.29  |   Q V   |         |         |         |
  1+ 5       0.1799      2.67  |    QV   |         |         |         |
  1+10       0.1999      2.91  |    Q V  |         |         |         |
  1+15       0.2203      2.95  |    Q  V |         |         |         |
  1+20       0.2397      2.83  |    Q   V|         |         |         |
  1+25       0.2620      3.23  |     Q   V         |         |         |
  1+30       0.2876      3.72  |      Q  |V        |         |         |
  1+35       0.3122      3.57  |      Q  |V        |         |         |
  1+40       0.3374      3.67  |      Q  | V       |         |         |
  1+45       0.3679      4.43  |       Q |   V     |         |         |
  1+50       0.4005      4.73  |        Q|    V    |         |         |
  1+55       0.4314      4.48  |       Q |     V   |         |         |
  2+ 0       0.4618      4.42  |       Q |      V  |         |         |
  2+ 5       0.4932      4.56  |        Q|       V |         |         |
  2+10       0.5323      5.68  |         |Q        V         |         |
  2+15       0.5826      7.31  |         |   Q     | V       |         |
  2+20       0.6284      6.64  |         |  Q      |   V     |         |
  2+25       0.6890      8.80  |         |      Q  |     V   |         |
  2+30       0.7690     11.63  |         |         |  Q     V|         |
  2+35       0.8603     13.25  |         |         |     Q   | V       |
  2+40       0.9427     11.96  |         |         |  Q      |     V   |
  2+45       0.9887      6.69  |         |  Q      |         |      V  |
  2+50       1.0117      3.34  |     Q   |         |         |       V |
  2+55       1.0297      2.61  |    Q    |         |         |        V|
  3+ 0       1.0408      1.62  |  Q      |         |         |        V|
  3+ 5       1.0447      0.55  |Q        |         |         |        V|
  3+10       1.0454      0.11  Q         |         |         |        V|
  3+15       1.0456      0.02  Q         |         |         |         V
-----------------------------------------------------------------------
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      U n i t   H y d r o g r a p h   A n a l y s i s

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              Study date  07/23/19 File: DMAC100PROP6100.out


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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978


Program License Serial Number 6388

---------------------------------------------------------------------
 English (in-lb) Input Units Used
 English Rainfall Data (Inches) Input Values Used

 English Units used in output format




---------------------------------------------------------------------
KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
PROPOSED CONDITION, DMA C
100-YR 6-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019
--------------------------------------------------------------------
Drainage Area =       7.50(Ac.)  =      0.012 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =       7.50(Ac.)  =      0.012 Sq. Mi.
Length along longest watercourse =     860.00(Ft.)
Length along longest watercourse measured to centroid =     749.00(Ft.)
Length along longest watercourse =      0.163 Mi.
Length along longest watercourse measured to centroid =      0.142 Mi.
Difference in elevation =      21.50(Ft.)
Slope along watercourse =    132.0000 Ft./Mi.
Average Manning's 'N' = 0.015
Lag time =    0.034 Hr.
Lag time =     2.04 Min.
25% of lag time =     0.51 Min.
40% of lag time =     0.82 Min.
Unit time =     5.00 Min.
Duration of storm = 6 Hour(s)
User Entered Base Flow =     0.00(CFS)

2 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        7.50           1.21                  9.07

100 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        7.50           2.86                 21.45

STORM EVENT (YEAR) =  100.00
Area Averaged 2-Year Rainfall =    1.210(In)
Area Averaged 100-Year Rainfall =    2.860(In)

Point rain (area averaged) =    2.860(In)
Areal adjustment factor =  100.00 %
Adjusted average point rain =    2.860(In)

Sub-Area Data:
Area(Ac.)         Runoff Index   Impervious %
     7.500           56.00         0.760
 Total Area Entered =      7.50(Ac.)


RI    RI   Infil. Rate Impervious   Adj. Infil. Rate  Area%     F
AMC2 AMC-2     (In/Hr)    (Dec.%)      (In/Hr)      (Dec.)    (In/Hr)
56.0  56.0      0.511     0.760        0.161       1.000      0.161
                                                  Sum (F) =   0.161
Area averaged mean soil loss (F) (In/Hr) =  0.161
Minimum soil loss rate ((In/Hr)) =  0.081
```

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.290

U n i t H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.083	245.027	50.239	3.797
2	0.167	490.055	40.364	3.051
3	0.250	735.082	7.184	0.543
4	0.333	980.109	2.213	0.167
			Sum = 100.000	Sum= 7.559

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Low	Effective (In/Hr)
1	0.08	0.50	0.172	(0.161)	0.050	0.122
2	0.17	0.60	0.206	(0.161)	0.060	0.146
3	0.25	0.60	0.206	(0.161)	0.060	0.146
4	0.33	0.60	0.206	(0.161)	0.060	0.146
5	0.42	0.60	0.206	(0.161)	0.060	0.146
6	0.50	0.70	0.240	(0.161)	0.070	0.171
7	0.58	0.70	0.240	(0.161)	0.070	0.171
8	0.67	0.70	0.240	(0.161)	0.070	0.171
9	0.75	0.70	0.240	(0.161)	0.070	0.171
10	0.83	0.70	0.240	(0.161)	0.070	0.171
11	0.92	0.70	0.240	(0.161)	0.070	0.171
12	1.00	0.80	0.275	(0.161)	0.080	0.195
13	1.08	0.80	0.275	(0.161)	0.080	0.195
14	1.17	0.80	0.275	(0.161)	0.080	0.195
15	1.25	0.80	0.275	(0.161)	0.080	0.195
16	1.33	0.80	0.275	(0.161)	0.080	0.195
17	1.42	0.80	0.275	(0.161)	0.080	0.195
18	1.50	0.80	0.275	(0.161)	0.080	0.195
19	1.58	0.80	0.275	(0.161)	0.080	0.195
20	1.67	0.80	0.275	(0.161)	0.080	0.195
21	1.75	0.80	0.275	(0.161)	0.080	0.195
22	1.83	0.80	0.275	(0.161)	0.080	0.195
23	1.92	0.80	0.275	(0.161)	0.080	0.195
24	2.00	0.90	0.309	(0.161)	0.090	0.219
25	2.08	0.80	0.275	(0.161)	0.080	0.195
26	2.17	0.90	0.309	(0.161)	0.090	0.219
27	2.25	0.90	0.309	(0.161)	0.090	0.219
28	2.33	0.90	0.309	(0.161)	0.090	0.219
29	2.42	0.90	0.309	(0.161)	0.090	0.219
30	2.50	0.90	0.309	(0.161)	0.090	0.219
31	2.58	0.90	0.309	(0.161)	0.090	0.219
32	2.67	0.90	0.309	(0.161)	0.090	0.219
33	2.75	1.00	0.343	(0.161)	0.100	0.244
34	2.83	1.00	0.343	(0.161)	0.100	0.244
35	2.92	1.00	0.343	(0.161)	0.100	0.244
36	3.00	1.00	0.343	(0.161)	0.100	0.244
37	3.08	1.00	0.343	(0.161)	0.100	0.244
38	3.17	1.10	0.378	(0.161)	0.109	0.268
39	3.25	1.10	0.378	(0.161)	0.109	0.268
40	3.33	1.10	0.378	(0.161)	0.109	0.268
41	3.42	1.20	0.412	(0.161)	0.119	0.292
42	3.50	1.30	0.446	(0.161)	0.129	0.317
43	3.58	1.40	0.480	(0.161)	0.139	0.341
44	3.67	1.40	0.480	(0.161)	0.139	0.341
45	3.75	1.50	0.515	(0.161)	0.149	0.365
46	3.83	1.50	0.515	(0.161)	0.149	0.365
47	3.92	1.60	0.549	(0.161)	0.159	0.390
48	4.00	1.60	0.549	(0.161)	0.159	0.390
49	4.08	1.70	0.583	0.161	(0.169)	0.422
50	4.17	1.80	0.618	0.161	(0.179)	0.456
51	4.25	1.90	0.652	0.161	(0.189)	0.491
52	4.33	2.00	0.686	0.161	(0.199)	0.525
53	4.42	2.10	0.721	0.161	(0.209)	0.559
54	4.50	2.10	0.721	0.161	(0.209)	0.559

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55   4.58     2.20      0.755          0.161    (  0.219)        0.594
56   4.67     2.30      0.789          0.161    (  0.229)        0.628
57   4.75     2.40      0.824          0.161    (  0.239)        0.662
58   4.83     2.40      0.824          0.161    (  0.239)        0.662
59   4.92     2.50      0.858          0.161    (  0.249)        0.697
60   5.00     2.60      0.892          0.161    (  0.259)        0.731
61   5.08     3.10      1.064          0.161    (  0.309)        0.902
62   5.17     3.60      1.235          0.161    (  0.358)        1.074
63   5.25     3.90      1.338          0.161    (  0.388)        1.177
64   5.33     4.20      1.441          0.161    (  0.418)        1.280
65   5.42     4.70      1.613          0.161    (  0.468)        1.452
66   5.50     5.60      1.922          0.161    (  0.557)        1.760
67   5.58     1.90      0.652          0.161    (  0.189)        0.491
68   5.67     0.90      0.309       (  0.161)       0.090        0.219
69   5.75     0.60      0.206       (  0.161)       0.060        0.146
70   5.83     0.50      0.172       (  0.161)       0.050        0.122
71   5.92     0.30      0.103       (  0.161)       0.030        0.073
72   6.00     0.20      0.069       (  0.161)       0.020        0.049
               (Loss Rate Not Used)
   Sum =     100.0                                 Sum =    26.6
     Flood volume = Effective rainfall      2.21(In)
      times area       7.5(Ac.)/[(In)/(Ft.)] =       1.4(Ac.Ft)
     Total soil loss =      0.65(In)
     Total soil loss =     0.403(Ac.Ft)
     Total rainfall =      2.86(In)
     Flood volume =       60291.1 Cubic Feet
     Total soil loss =       17570.4 Cubic Feet
     --------------------------------------------------------------------
      Peak flow rate of this hydrograph =     12.012(CFS)
     --------------------------------------------------------------------
     ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                         6 - H O U R    S T O R M
                    R u n o f f      H y d r o g r a p h
     --------------------------------------------------------------------
                 Hydrograph in   5   Minute intervals ((CFS))

     --------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0        5.0       10.0      15.0      20.0
-----------------------------------------------------------------------
  0+ 5       0.0032      0.46  Q         |         |         |         |
  0+10       0.0096      0.93  VQ        |         |         |         |
  0+15       0.0169      1.07  V Q       |         |         |         |
  0+20       0.0245      1.10  V Q       |         |         |         |
  0+25       0.0321      1.11  V Q       |         |         |         |
  0+30       0.0404      1.20  |VQ       |         |         |         |
  0+35       0.0491      1.27  |VQ       |         |         |         |
  0+40       0.0580      1.29  |VQ       |         |         |         |
  0+45       0.0669      1.29  |VQ       |         |         |         |
  0+50       0.0758      1.29  | Q       |         |         |         |
  0+55       0.0847      1.29  | Q       |         |         |         |
  1+ 0       0.0942      1.38  | Q       |         |         |         |
  1+ 5       0.1042      1.46  | QV      |         |         |         |
  1+10       0.1143      1.47  | QV      |         |         |         |
  1+15       0.1245      1.47  | QV      |         |         |         |
  1+20       0.1346      1.47  | QV      |         |         |         |
  1+25       0.1448      1.47  | Q V     |         |         |         |
  1+30       0.1549      1.47  | Q V     |         |         |         |
  1+35       0.1651      1.47  | Q V     |         |         |         |
  1+40       0.1752      1.47  | Q  V    |         |         |         |
  1+45       0.1854      1.47  | Q  V    |         |         |         |
  1+50       0.1956      1.47  | Q  V    |         |         |         |
  1+55       0.2057      1.47  | Q  V    |         |         |         |
  2+ 0       0.2165      1.57  |  Q  V   |         |         |         |
  2+ 5       0.2272      1.55  |  Q  V   |         |         |         |
  2+10       0.2380      1.58  |  Q  V   |         |         |         |
  2+15       0.2494      1.65  |  Q   V  |         |         |         |
  2+20       0.2608      1.65  |  Q   V  |         |         |         |
  2+25       0.2722      1.66  |  Q   V  |         |         |         |
  2+30       0.2836      1.66  |  Q    V |         |         |         |
  2+35       0.2950      1.66  |  Q    V |         |         |         |
  2+40       0.3065      1.66  |  Q    V |         |         |         |
  2+45       0.3185      1.75  |  Q     V|         |         |         |
  2+50       0.3311      1.83  |  Q     V|         |         |         |
  2+55       0.3438      1.84  |  Q     V|         |         |         |
  3+ 0       0.3564      1.84  |  Q      V         |         |         |
  3+ 5       0.3691      1.84  |  Q      V         |         |         |
  3+10       0.3825      1.94  |  Q      |V        |         |         |
  3+15       0.3963      2.01  |   Q     |V        |         |         |
  3+20       0.4102      2.02  |   Q     |V        |         |         |
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```
    3+25       0.4248      2.12  |   Q     | V       |         |         |
    3+30       0.4406      2.29  |   Q     | V       |         |         |
    3+35       0.4576      2.47  |   Q     |  V      |         |         |
    3+40       0.4752      2.56  |    Q    |  V      |         |         |
    3+45       0.4936      2.67  |    Q    |   V     |         |         |
    3+50       0.5125      2.75  |    Q    |   V     |         |         |
    3+55       0.5321      2.85  |    Q    |    V    |         |         |
    4+ 0       0.5523      2.93  |    Q    |    V    |         |         |
    4+ 5       0.5734      3.07  |     Q   |     V   |         |         |
    4+10       0.5962      3.30  |     Q   |      V  |         |         |
    4+15       0.6206      3.55  |      Q  |      V  |         |         |
    4+20       0.6469      3.81  |      Q  |       V |         |         |
    4+25       0.6749      4.07  |       Q |        V|         |         |
    4+30       0.7038      4.20  |       Q |         V         |         |
    4+35       0.7338      4.35  |       Q |         |V        |         |
    4+40       0.7654      4.60  |        Q|         | V       |         |
    4+45       0.7988      4.85  |        Q|         |  V      |         |
    4+50       0.8331      4.98  |        Q|         |   V     |         |
    4+55       0.8685      5.13  |         Q         |    V    |         |
    5+ 0       0.9055      5.37  |         Q         |     V   |         |
    5+ 5       0.9478      6.15  |         | Q       |      V  |         |
    5+10       0.9985      7.35  |         |   Q     |       V |         |
    5+15       1.0560      8.36  |         |     Q   |         V         |
    5+20       1.1193      9.19  |         |       Q |         | V       |
    5+25       1.1899     10.24  |         |         Q         |   V     |
    5+30       1.2726     12.01  |         |         |   Q     |     V   |
    5+35       1.3294      8.24  |         |     Q   |         |       V |
    5+40       1.3537      3.53  |      Q  |         |         |        V|
    5+45       1.3660      1.79  |  Q      |         |         |        V|
    5+50       1.3736      1.11  | Q       |         |         |        V|
    5+55       1.3789      0.77  |Q        |         |         |        V|
    6+ 0       1.3823      0.50  Q         |         |         |        V|
    6+ 5       1.3838      0.21  Q         |         |         |        V|
    6+10       1.3840      0.04  Q         |         |         |        V|
    6+15       1.3841      0.01  Q         |         |         |         V
-----------------------------------------------------------------------
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       U n i t   H y d r o g r a p h   A n a l y s i s

       Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2014, Version 9.0
              Study date  07/23/19 File: DMAC100PROP24100.out


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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978


Program License Serial Number 6388

---------------------------------------------------------------------
 English (in-lb) Input Units Used
 English Rainfall Data (Inches) Input Values Used

 English Units used in output format



---------------------------------------------------------------------
KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
PROPOSED CONDITION, DMA C
100-YR 24-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019
--------------------------------------------------------------------
Drainage Area =       7.50(Ac.)  =      0.012 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =       7.50(Ac.)  =      0.012 Sq. Mi.
Length along longest watercourse =     860.00(Ft.)
Length along longest watercourse measured to centroid =     749.00(Ft.)
Length along longest watercourse =      0.163 Mi.
Length along longest watercourse measured to centroid =      0.142 Mi.
Difference in elevation =      21.50(Ft.)
Slope along watercourse =    132.0000 Ft./Mi.
Average Manning's 'N' = 0.015
Lag time =    0.034 Hr.
Lag time =     2.04 Min.
25% of lag time =     0.51 Min.
40% of lag time =     0.82 Min.
Unit time =    15.00 Min.
Duration of storm = 24 Hour(s)
User Entered Base Flow =     0.00(CFS)

2 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        7.50           2.05                 15.37

100 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        7.50           5.16                 38.70

STORM EVENT (YEAR) =  100.00
Area Averaged 2-Year Rainfall =    2.050(In)
Area Averaged 100-Year Rainfall =    5.160(In)

Point rain (area averaged) =    5.160(In)
Areal adjustment factor =  100.00 %
Adjusted average point rain =    5.160(In)

Sub-Area Data:
Area(Ac.)         Runoff Index   Impervious %
     7.500           56.00         0.760
 Total Area Entered =      7.50(Ac.)


RI    RI   Infil. Rate Impervious   Adj. Infil. Rate  Area%     F
AMC2 AMC-2     (In/Hr)    (Dec.%)      (In/Hr)      (Dec.)    (In/Hr)
56.0  56.0      0.511     0.760        0.161       1.000      0.161
                                                  Sum (F) =   0.161
Area averaged mean soil loss (F) (In/Hr) =  0.161
Minimum soil loss rate ((In/Hr)) =  0.081
```

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.290

U n i t H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.250	735.082	79.543	6.012
2	0.500	1470.164	20.457	1.546
			Sum = 100.000	Sum= 7.559

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Loss rate(In./Hr) Low	Effective (In/Hr)
1	0.25	0.20	0.041	(0.285)	0.012	0.029
2	0.50	0.30	0.062	(0.282)	0.018	0.044
3	0.75	0.30	0.062	(0.278)	0.018	0.044
4	1.00	0.40	0.083	(0.275)	0.024	0.059
5	1.25	0.30	0.062	(0.272)	0.018	0.044
6	1.50	0.30	0.062	(0.269)	0.018	0.044
7	1.75	0.30	0.062	(0.265)	0.018	0.044
8	2.00	0.40	0.083	(0.262)	0.024	0.059
9	2.25	0.40	0.083	(0.259)	0.024	0.059
10	2.50	0.40	0.083	(0.256)	0.024	0.059
11	2.75	0.50	0.103	(0.253)	0.030	0.073
12	3.00	0.50	0.103	(0.250)	0.030	0.073
13	3.25	0.50	0.103	(0.247)	0.030	0.073
14	3.50	0.50	0.103	(0.244)	0.030	0.073
15	3.75	0.50	0.103	(0.241)	0.030	0.073
16	4.00	0.60	0.124	(0.237)	0.036	0.088
17	4.25	0.60	0.124	(0.234)	0.036	0.088
18	4.50	0.70	0.144	(0.231)	0.042	0.103
19	4.75	0.70	0.144	(0.229)	0.042	0.103
20	5.00	0.80	0.165	(0.226)	0.048	0.117
21	5.25	0.60	0.124	(0.223)	0.036	0.088
22	5.50	0.70	0.144	(0.220)	0.042	0.103
23	5.75	0.80	0.165	(0.217)	0.048	0.117
24	6.00	0.80	0.165	(0.214)	0.048	0.117
25	6.25	0.90	0.186	(0.211)	0.054	0.132
26	6.50	0.90	0.186	(0.208)	0.054	0.132
27	6.75	1.00	0.206	(0.206)	0.060	0.147
28	7.00	1.00	0.206	(0.203)	0.060	0.147
29	7.25	1.00	0.206	(0.200)	0.060	0.147
30	7.50	1.10	0.227	(0.197)	0.066	0.161
31	7.75	1.20	0.248	(0.195)	0.072	0.176
32	8.00	1.30	0.268	(0.192)	0.078	0.191
33	8.25	1.50	0.310	(0.189)	0.090	0.220
34	8.50	1.50	0.310	(0.187)	0.090	0.220
35	8.75	1.60	0.330	(0.184)	0.096	0.234
36	9.00	1.70	0.351	(0.181)	0.102	0.249
37	9.25	1.90	0.392	(0.179)	0.114	0.278
38	9.50	2.00	0.413	(0.176)	0.120	0.293
39	9.75	2.10	0.433	(0.174)	0.126	0.308
40	10.00	2.20	0.454	(0.171)	0.132	0.322
41	10.25	1.50	0.310	(0.169)	0.090	0.220
42	10.50	1.50	0.310	(0.166)	0.090	0.220
43	10.75	2.00	0.413	(0.164)	0.120	0.293
44	11.00	2.00	0.413	(0.162)	0.120	0.293
45	11.25	1.90	0.392	(0.159)	0.114	0.278
46	11.50	1.90	0.392	(0.157)	0.114	0.278
47	11.75	1.70	0.351	(0.154)	0.102	0.249
48	12.00	1.80	0.372	(0.152)	0.108	0.264
49	12.25	2.50	0.516	(0.150)	0.150	0.366
50	12.50	2.60	0.537	0.148	(0.156)	0.389
51	12.75	2.80	0.578	0.145	(0.168)	0.432
52	13.00	2.90	0.599	0.143	(0.174)	0.455
53	13.25	3.40	0.702	0.141	(0.204)	0.561
54	13.50	3.40	0.702	0.139	(0.204)	0.563
55	13.75	2.30	0.475	0.137	(0.138)	0.338
56	14.00	2.30	0.475	0.135	(0.138)	0.340

```
57  14.25     2.70      0.557          0.133    (  0.162)        0.425
58  14.50     2.60      0.537          0.131    (  0.156)        0.406
59  14.75     2.60      0.537          0.129    (  0.156)        0.408
60  15.00     2.50      0.516          0.127    (  0.150)        0.389
61  15.25     2.40      0.495          0.125    (  0.144)        0.371
62  15.50     2.30      0.475          0.123    (  0.138)        0.352
63  15.75     1.90      0.392       (  0.121)       0.114        0.278
64  16.00     1.90      0.392       (  0.119)       0.114        0.278
65  16.25     0.40      0.083       (  0.117)       0.024        0.059
66  16.50     0.40      0.083       (  0.116)       0.024        0.059
67  16.75     0.30      0.062       (  0.114)       0.018        0.044
68  17.00     0.30      0.062       (  0.112)       0.018        0.044
69  17.25     0.50      0.103       (  0.110)       0.030        0.073
70  17.50     0.50      0.103       (  0.109)       0.030        0.073
71  17.75     0.50      0.103       (  0.107)       0.030        0.073
72  18.00     0.40      0.083       (  0.106)       0.024        0.059
73  18.25     0.40      0.083       (  0.104)       0.024        0.059
74  18.50     0.40      0.083       (  0.102)       0.024        0.059
75  18.75     0.30      0.062       (  0.101)       0.018        0.044
76  19.00     0.20      0.041       (  0.100)       0.012        0.029
77  19.25     0.30      0.062       (  0.098)       0.018        0.044
78  19.50     0.40      0.083       (  0.097)       0.024        0.059
79  19.75     0.30      0.062       (  0.095)       0.018        0.044
80  20.00     0.20      0.041       (  0.094)       0.012        0.029
81  20.25     0.30      0.062       (  0.093)       0.018        0.044
82  20.50     0.30      0.062       (  0.092)       0.018        0.044
83  20.75     0.30      0.062       (  0.091)       0.018        0.044
84  21.00     0.20      0.041       (  0.089)       0.012        0.029
85  21.25     0.30      0.062       (  0.088)       0.018        0.044
86  21.50     0.20      0.041       (  0.087)       0.012        0.029
87  21.75     0.30      0.062       (  0.086)       0.018        0.044
88  22.00     0.20      0.041       (  0.086)       0.012        0.029
89  22.25     0.30      0.062       (  0.085)       0.018        0.044
90  22.50     0.20      0.041       (  0.084)       0.012        0.029
91  22.75     0.20      0.041       (  0.083)       0.012        0.029
92  23.00     0.20      0.041       (  0.083)       0.012        0.029
93  23.25     0.20      0.041       (  0.082)       0.012        0.029
94  23.50     0.20      0.041       (  0.081)       0.012        0.029
95  23.75     0.20      0.041       (  0.081)       0.012        0.029
96  24.00     0.20      0.041       (  0.081)       0.012        0.029
              (Loss Rate Not Used)
   Sum =     100.0                                   Sum =    15.0
     Flood volume = Effective rainfall      3.75(In)
      times area        7.5(Ac.)/[(In)/(Ft.)] =       2.3(Ac.Ft)
     Total soil loss =       1.41(In)
     Total soil loss =      0.884(Ac.Ft)
     Total rainfall =      5.16(In)
     Flood volume =      101975.5 Cubic Feet
     Total soil loss =       38503.5 Cubic Feet
     --------------------------------------------------------------------
      Peak flow rate of this hydrograph =      4.253(CFS)
     --------------------------------------------------------------------
     ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                         24 - H O U R    S T O R M
                    R u n o f f      H y d r o g r a p h
     --------------------------------------------------------------------
                 Hydrograph in  15   Minute intervals ((CFS))

     --------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0        2.5       5.0       7.5      10.0
-----------------------------------------------------------------------
  0+15       0.0036      0.18  Q         |         |         |         |
  0+30       0.0100      0.31  VQ        |         |         |         |
  0+45       0.0169      0.33  VQ        |         |         |         |
  1+ 0       0.0256      0.42  VQ        |         |         |         |
  1+15       0.0329      0.36  VQ        |         |         |         |
  1+30       0.0398      0.33  VQ        |         |         |         |
  1+45       0.0467      0.33  VQ        |         |         |         |
  2+ 0       0.0554      0.42  VQ        |         |         |         |
  2+15       0.0645      0.44   Q        |         |         |         |
  2+30       0.0737      0.44  |Q        |         |         |         |
  2+45       0.0847      0.53  |VQ       |         |         |         |
  3+ 0       0.0961      0.55  |VQ       |         |         |         |
  3+15       0.1076      0.55  |VQ       |         |         |         |
  3+30       0.1190      0.55  | Q       |         |         |         |
  3+45       0.1305      0.55  | Q       |         |         |         |
  4+ 0       0.1437      0.64  | Q       |         |         |         |
  4+15       0.1575      0.66  | Q       |         |         |         |
  4+30       0.1730      0.75  | VQ      |         |         |         |
```

```
  4+45        0.1891       0.78  |  Q      |         |         |         |
  5+ 0        0.2069       0.86  |  Q      |         |         |         |
  5+15        0.2216       0.71  | QV      |         |         |         |
  5+30        0.2371       0.75  |  QV     |         |         |         |
  5+45        0.2550       0.86  |  QV     |         |         |         |
  6+ 0        0.2733       0.89  |  QV     |         |         |         |
  6+15        0.2934       0.97  |  Q V    |         |         |         |
  6+30        0.3141       1.00  |  Q V    |         |         |         |
  6+45        0.3365       1.09  |   QV    |         |         |         |
  7+ 0        0.3594       1.11  |   Q V   |         |         |         |
  7+15        0.3823       1.11  |   Q V   |         |         |         |
  7+30        0.4070       1.20  |   Q V   |         |         |         |
  7+45        0.4340       1.31  |    Q V  |         |         |         |
  8+ 0        0.4633       1.42  |    Q V  |         |         |         |
  8+15        0.4967       1.62  |     Q V |         |         |         |
  8+30        0.5311       1.66  |     Q  V|         |         |         |
  8+45        0.5672       1.75  |      Q V|         |         |         |
  9+ 0        0.6057       1.86  |      Q  V         |         |         |
  9+15        0.6482       2.06  |       Q |V        |         |         |
  9+30        0.6936       2.19  |       Q |V        |         |         |
  9+45        0.7412       2.30  |        Q| V       |         |         |
 10+ 0        0.7911       2.42  |        Q|  V      |         |         |
 10+15        0.8287       1.82  |      Q  |   V     |         |         |
 10+30        0.8631       1.66  |     Q   |   V     |         |         |
 10+45        0.9065       2.10  |       Q |    V    |         |         |
 11+ 0        0.9523       2.22  |       Q |     V   |         |         |
 11+15        0.9963       2.13  |       Q |      V  |         |         |
 11+30        1.0398       2.11  |       Q |      V  |         |         |
 11+45        1.0797       1.93  |      Q  |       V |         |         |
 12+ 0        1.1204       1.97  |      Q  |        V|         |         |
 12+15        1.1744       2.61  |         Q         V         |         |
 12+30        1.2344       2.91  |         |Q        |V        |         |
 12+45        1.3006       3.20  |         | Q       | V       |         |
 13+ 0        1.3710       3.41  |         |  Q      |  V      |         |
 13+15        1.4552       4.08  |         |     Q   |   V     |         |
 13+30        1.5431       4.25  |         |      Q  |     V   |         |
 13+45        1.6031       2.90  |         |Q        |      V  |         |
 14+ 0        1.6561       2.57  |         Q         |       V |         |
 14+15        1.7198       3.08  |         | Q       |        V|         |
 14+30        1.7838       3.10  |         | Q       |         V         |
 14+45        1.8475       3.08  |         | Q       |         |V        |
 15+ 0        1.9089       2.97  |         |Q        |         | V       |
 15+15        1.9674       2.83  |         |Q        |         |  V      |
 15+30        2.0230       2.69  |         Q         |         |   V     |
 15+45        2.0688       2.22  |       Q |         |         |    V    |
 16+ 0        2.1123       2.11  |       Q |         |         |     V   |
 16+15        2.1285       0.78  |  Q      |         |         |     V   |
 16+30        2.1377       0.44  |Q        |         |         |     V   |
 16+45        2.1450       0.36  |Q        |         |         |     V   |
 17+ 0        2.1519       0.33  |Q        |         |         |     V   |
 17+15        2.1624       0.51  | Q       |         |         |     V   |
 17+30        2.1738       0.55  | Q       |         |         |      V  |
 17+45        2.1853       0.55  | Q       |         |         |      V  |
 18+ 0        2.1949       0.47  |Q        |         |         |      V  |
 18+15        2.2041       0.44  |Q        |         |         |      V  |
 18+30        2.2132       0.44  |Q        |         |         |      V  |
 18+45        2.2206       0.36  |Q        |         |         |      V  |
 19+ 0        2.2256       0.24  Q         |         |         |       V |
 19+15        2.2320       0.31  |Q        |         |         |       V |
 19+30        2.2407       0.42  |Q        |         |         |       V |
 19+45        2.2480       0.36  |Q        |         |         |       V |
 20+ 0        2.2531       0.24  Q         |         |         |       V |
 20+15        2.2595       0.31  |Q        |         |         |       V |
 20+30        2.2664       0.33  |Q        |         |         |       V |
 20+45        2.2732       0.33  |Q        |         |         |       V |
 21+ 0        2.2783       0.24  Q         |         |         |       V |
 21+15        2.2847       0.31  |Q        |         |         |        V|
 21+30        2.2897       0.24  Q         |         |         |        V|
 21+45        2.2961       0.31  |Q        |         |         |        V|
 22+ 0        2.3012       0.24  Q         |         |         |        V|
 22+15        2.3076       0.31  |Q        |         |         |        V|
 22+30        2.3126       0.24  Q         |         |         |        V|
 22+45        2.3172       0.22  Q         |         |         |        V|
 23+ 0        2.3218       0.22  Q         |         |         |        V|
 23+15        2.3264       0.22  Q         |         |         |        V|
 23+30        2.3309       0.22  Q         |         |         |        V|
 23+45        2.3355       0.22  Q         |         |         |        V|
 24+ 0        2.3401       0.22  Q         |         |         |        V|
 24+15        2.3410       0.05  Q         |         |         |         V
```

APPENDIX B

EXISTING AND PROPOSED
UNIT HYDROGRAPH CALCULATIONS
DMA D

```
      U n i t   H y d r o g r a p h   A n a l y s i s

      Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2014, Version 9.0
             Study date  07/23/19 File: DMAD5EXIST15.out

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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978


Program License Serial Number 6388

---------------------------------------------------------------------
 English (in-lb) Input Units Used
 English Rainfall Data (Inches) Input Values Used

 English Units used in output format



---------------------------------------------------------------------
KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
EXISTING CONDITION, DMA D
5-YR 1-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019
--------------------------------------------------------------------
Drainage Area =       6.90(Ac.)  =      0.011 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =       6.90(Ac.)  =      0.011 Sq. Mi.
Length along longest watercourse =    1710.00(Ft.)
Length along longest watercourse measured to centroid =    1043.00(Ft.)
Length along longest watercourse =      0.324 Mi.
Length along longest watercourse measured to centroid =      0.198 Mi.
Difference in elevation =      40.00(Ft.)
Slope along watercourse =    123.5088 Ft./Mi.
Average Manning's 'N' = 0.025
Lag time =    0.085 Hr.
Lag time =     5.07 Min.
25% of lag time =     1.27 Min.
40% of lag time =     2.03 Min.
Unit time =     5.00 Min.
Duration of storm = 1 Hour(s)
User Entered Base Flow =     0.00(CFS)

2 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        6.90           0.49                  3.37

100 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        6.90           1.33                  9.18

STORM EVENT (YEAR) =    5.00
Area Averaged 2-Year Rainfall =    0.489(In)
Area Averaged 100-Year Rainfall =    1.330(In)

Point rain (area averaged) =    0.686(In)
Areal adjustment factor =   99.99 %
Adjusted average point rain =    0.686(In)

Sub-Area Data:
Area(Ac.)         Runoff Index   Impervious %
     6.900           56.00         0.150
 Total Area Entered =      6.90(Ac.)


RI    RI   Infil. Rate Impervious   Adj. Infil. Rate  Area%     F
AMC2 AMC-1     (In/Hr)    (Dec.%)      (In/Hr)      (Dec.)    (In/Hr)
56.0  36.0      0.706     0.150        0.611       1.000      0.611
                                                 Sum (F) =   0.611
Area averaged mean soil loss (F) (In/Hr) =  0.611
Minimum soil loss rate ((In/Hr)) =  0.305
```

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.780

Slope of intensity-duration curve for a 1 hour storm =0.5000

U n i t   H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.083	98.584	18.765	1.305
2	0.167	197.167	48.285	3.358
3	0.250	295.751	15.854	1.102
4	0.333	394.335	7.138	0.496
5	0.417	492.919	4.033	0.280
6	0.500	591.502	2.616	0.182
7	0.583	690.086	1.645	0.114
8	0.667	788.670	1.057	0.073
9	0.750	887.254	0.606	0.042
			Sum = 100.000	Sum= 6.954

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Low	Effective (In/Hr)
1	0.08	4.20	0.346	(0.611)	0.270	0.076
2	0.17	4.30	0.354	(0.611)	0.276	0.078
3	0.25	5.00	0.412	(0.611)	0.321	0.091
4	0.33	5.00	0.412	(0.611)	0.321	0.091
5	0.42	5.80	0.477	(0.611)	0.372	0.105
6	0.50	6.50	0.535	(0.611)	0.417	0.118
7	0.58	7.40	0.609	(0.611)	0.475	0.134
8	0.67	8.60	0.708	(0.611)	0.552	0.156
9	0.75	12.30	1.012	0.611	(0.790)	0.402
10	0.83	29.10	2.395	0.611	(1.868)	1.785
11	0.92	6.80	0.560	(0.611)	0.437	0.123
12	1.00	5.00	0.412	(0.611)	0.321	0.091
		(Loss Rate Not Used)				
Sum =		100.0			Sum =	3.2

Flood volume = Effective rainfall 0.27(In)
times area 6.9(Ac.)/[(In)/(Ft.)] = 0.2(Ac.Ft)
Total soil loss = 0.42(In)
Total soil loss = 0.239(Ac.Ft)
Total rainfall = 0.69(In)
Flood volume = 6778.4 Cubic Feet
Total soil loss = 10402.3 Cubic Feet

Peak flow rate of this hydrograph = 6.758(CFS)

++

1 - H O U R   S T O R M
R u n o f f   H y d r o g r a p h

Hydrograph in 5 Minute intervals ((CFS))

```
-------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0        2.5       5.0       7.5      10.0
-----------------------------------------------------------------------
  0+ 5       0.0007      0.10  Q         |         |         |         |
  0+10       0.0031      0.36  VQ        |         |         |         |
  0+15       0.0063      0.46  |Q        |         |         |         |
  0+20       0.0101      0.55  | Q       |         |         |         |
  0+25       0.0142      0.60  | QV      |         |         |         |
  0+30       0.0190      0.69  | Q V     |         |         |         |
  0+35       0.0243      0.78  |  Q  V   |         |         |         |
  0+40       0.0305      0.89  |  Q   V  |         |         |         |
  0+45       0.0396      1.32  |    Q    V         |         |         |
  0+50       0.0670      3.99  |         |    Q V  |         |         |
  0+55       0.1136      6.76  |         |         |      Q V|         |
  1+ 0       0.1328      2.79  |         |Q        |         |   V     |
  1+ 5       0.1431      1.50  |    Q    |         |         |     V   |
  1+10       0.1484      0.77  |  Q      |         |         |       V |
```

```
    1+15       0.1516      0.47  |Q        |         |         |        V |
    1+20       0.1536      0.29  |Q        |         |         |         V|
    1+25       0.1549      0.18  Q         |         |         |         V|
    1+30       0.1555      0.09  Q         |         |         |         V|
    1+35       0.1556      0.01  Q         |         |         |         V|
    1+40       0.1556      0.00  Q         |         |         |         V|
-----------------------------------------------------------------------
```

U n i t   H y d r o g r a p h   A n a l y s i s

Study date 07/23/19 File: DMAD5EXIST35.out

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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978

Program License Serial Number 6388

English (in-lb) Input Units Used
English Rainfall Data (Inches) Input Values Used

English Units used in output format

KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
EXISTING CONDITION, DMA D
5-YR 3-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019

Drainage Area = 6.90(Ac.) = 0.011 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment = 6.90(Ac.) = 0.011 Sq. Mi.
Length along longest watercourse = 1710.00(Ft.)
Length along longest watercourse measured to centroid = 1043.00(Ft.)
Length along longest watercourse = 0.324 Mi.
Length along longest watercourse measured to centroid = 0.198 Mi.
Difference in elevation = 40.00(Ft.)
Slope along watercourse = 123.5088 Ft./Mi.
Average Manning's 'N' = 0.025
Lag time = 0.085 Hr.
Lag time = 5.07 Min.
25% of lag time = 1.27 Min.
40% of lag time = 2.03 Min.
Unit time = 5.00 Min.
Duration of storm = 3 Hour(s)
User Entered Base Flow = 0.00(CFS)

2 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	Weighting[1*2]
6.90	0.87	5.98

100 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	Weighting[1*2]
6.90	2.09	14.42

STORM EVENT (YEAR) = 5.00
Area Averaged 2-Year Rainfall = 0.866(In)
Area Averaged 100-Year Rainfall = 2.090(In)

Point rain (area averaged) = 1.153(In)
Areal adjustment factor = 100.00 %
Adjusted average point rain = 1.153(In)

Sub-Area Data:

Area(Ac.)	Runoff Index	Impervious %
6.900	56.00	0.150

Total Area Entered = 6.90(Ac.)

RI AMC2	RI AMC-1	Infil. Rate (In/Hr)	Impervious (Dec.%)	Adj. Infil. Rate (In/Hr)	Area% (Dec.)	F (In/Hr)
56.0	36.0	0.706	0.150	0.611	1.000	0.611
					Sum (F) =	0.611

Area averaged mean soil loss (F) (In/Hr) = 0.611
Minimum soil loss rate ((In/Hr)) = 0.305

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.780

U n i t   H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.083	98.584	18.765	1.305
2	0.167	197.167	48.285	3.358
3	0.250	295.751	15.854	1.102
4	0.333	394.335	7.138	0.496
5	0.417	492.919	4.033	0.280
6	0.500	591.502	2.616	0.182
7	0.583	690.086	1.645	0.114
8	0.667	788.670	1.057	0.073
9	0.750	887.254	0.606	0.042
			Sum = 100.000	Sum= 6.954

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Loss rate(In./Hr) Low	Effective (In/Hr)
1	0.08	1.30	0.180	(0.611)	0.140	0.040
2	0.17	1.30	0.180	(0.611)	0.140	0.040
3	0.25	1.10	0.152	(0.611)	0.119	0.033
4	0.33	1.50	0.207	(0.611)	0.162	0.046
5	0.42	1.50	0.207	(0.611)	0.162	0.046
6	0.50	1.80	0.249	(0.611)	0.194	0.055
7	0.58	1.50	0.207	(0.611)	0.162	0.046
8	0.67	1.80	0.249	(0.611)	0.194	0.055
9	0.75	1.80	0.249	(0.611)	0.194	0.055
10	0.83	1.50	0.207	(0.611)	0.162	0.046
11	0.92	1.60	0.221	(0.611)	0.173	0.049
12	1.00	1.80	0.249	(0.611)	0.194	0.055
13	1.08	2.20	0.304	(0.611)	0.237	0.067
14	1.17	2.20	0.304	(0.611)	0.237	0.067
15	1.25	2.20	0.304	(0.611)	0.237	0.067
16	1.33	2.00	0.277	(0.611)	0.216	0.061
17	1.42	2.60	0.360	(0.611)	0.281	0.079
18	1.50	2.70	0.373	(0.611)	0.291	0.082
19	1.58	2.40	0.332	(0.611)	0.259	0.073
20	1.67	2.70	0.373	(0.611)	0.291	0.082
21	1.75	3.30	0.456	(0.611)	0.356	0.100
22	1.83	3.10	0.429	(0.611)	0.334	0.094
23	1.92	2.90	0.401	(0.611)	0.313	0.088
24	2.00	3.00	0.415	(0.611)	0.324	0.091
25	2.08	3.10	0.429	(0.611)	0.334	0.094
26	2.17	4.20	0.581	(0.611)	0.453	0.128
27	2.25	5.00	0.692	(0.611)	0.539	0.152
28	2.33	3.50	0.484	(0.611)	0.378	0.107
29	2.42	6.80	0.941	0.611	(0.734)	0.330
30	2.50	7.30	1.010	0.611	(0.788)	0.399
31	2.58	8.20	1.134	0.611	(0.885)	0.524
32	2.67	5.90	0.816	0.611	(0.637)	0.205
33	2.75	2.00	0.277	(0.611)	0.216	0.061
34	2.83	1.80	0.249	(0.611)	0.194	0.055
35	2.92	1.80	0.249	(0.611)	0.194	0.055
36	3.00	0.60	0.083	(0.611)	0.065	0.018

(Loss Rate Not Used)
Sum = 100.0 Sum = 3.6

Flood volume = Effective rainfall 0.30(In)
times area 6.9(Ac.)/[(In)/(Ft.)] = 0.2(Ac.Ft)
Total soil loss = 0.85(In)
Total soil loss = 0.488(Ac.Ft)
Total rainfall = 1.15(In)
Flood volume = 7603.2 Cubic Feet
Total soil loss = 21267.3 Cubic Feet

Peak flow rate of this hydrograph = 2.714(CFS)

+++

```
                            3 - H O U R   S T O R M
                       R u n o f f     H y d r o g r a p h
        --------------------------------------------------------------------
                   Hydrograph in   5   Minute intervals ((CFS))

        --------------------------------------------------------------------
  Time(h+m) Volume Ac.Ft   Q(CFS)  0        2.5       5.0       7.5      10.0
  -----------------------------------------------------------------------
    0+ 5       0.0004      0.05  Q         |         |         |         |
    0+10       0.0016      0.18  Q         |         |         |         |
    0+15       0.0031      0.22  Q         |         |         |         |
    0+20       0.0048      0.24  QV        |         |         |         |
    0+25       0.0067      0.28  |Q        |         |         |         |
    0+30       0.0088      0.31  |QV       |         |         |         |
    0+35       0.0112      0.34  |QV       |         |         |         |
    0+40       0.0135      0.33  |Q V      |         |         |         |
    0+45       0.0160      0.36  |Q V      |         |         |         |
    0+50       0.0184      0.36  |Q  V     |         |         |         |
    0+55       0.0208      0.34  |Q  V     |         |         |         |
    1+ 0       0.0232      0.35  |Q   V    |         |         |         |
    1+ 5       0.0258      0.38  |Q   V    |         |         |         |
    1+10       0.0288      0.43  |Q    V   |         |         |         |
    1+15       0.0319      0.45  |Q     V  |         |         |         |
    1+20       0.0349      0.45  |Q      V |         |         |         |
    1+25       0.0381      0.45  |Q      V |         |         |         |
    1+30       0.0416      0.52  | Q      V|         |         |         |
    1+35       0.0453      0.53  | Q       V         |         |         |
    1+40       0.0489      0.53  | Q       |V        |         |         |
    1+45       0.0529      0.58  | Q       | V       |         |         |
    1+50       0.0573      0.64  | Q       |  V      |         |         |
    1+55       0.0617      0.64  | Q       |   V     |         |         |
    2+ 0       0.0660      0.62  | Q       |    V    |         |         |
    2+ 5       0.0704      0.63  | Q       |     V   |         |         |
    2+10       0.0751      0.69  | Q       |      V  |         |         |
    2+15       0.0809      0.84  |  Q      |       V |         |         |
    2+20       0.0871      0.90  |  Q      |        V|         |         |
    2+25       0.0946      1.08  |   Q     |         |V        |         |
    2+30       0.1076      1.90  |      Q  |         |   V     |         |
    2+35       0.1250      2.53  |         Q         |       V |         |
    2+40       0.1437      2.71  |         Q         |         | V       |
    2+45       0.1554      1.69  |     Q   |         |         |    V    |
    2+50       0.1620      0.96  |  Q      |         |         |      V  |
    2+55       0.1668      0.70  | Q       |         |         |       V |
    3+ 0       0.1704      0.53  | Q       |         |         |        V|
    3+ 5       0.1725      0.31  |Q        |         |         |        V|
    3+10       0.1736      0.15  Q         |         |         |        V|
    3+15       0.1741      0.08  Q         |         |         |        V|
    3+20       0.1743      0.03  Q         |         |         |        V|
    3+25       0.1745      0.02  Q         |         |         |        V|
    3+30       0.1745      0.01  Q         |         |         |        V|
    3+35       0.1745      0.00  Q         |         |         |        V|
    3+40       0.1745      0.00  Q         |         |         |         V
-----------------------------------------------------------------------
```

```
      U n i t   H y d r o g r a p h   A n a l y s i s

      Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2014, Version 9.0
              Study date  07/23/19 File: DMAD5EXIST65.out


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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978


Program License Serial Number 6388

---------------------------------------------------------------------
 English (in-lb) Input Units Used
 English Rainfall Data (Inches) Input Values Used

 English Units used in output format



---------------------------------------------------------------------
KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
EXISTING CONDITION, DMA D
5-YR 6-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019
--------------------------------------------------------------------
Drainage Area =       6.90(Ac.)  =      0.011 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =       6.90(Ac.)  =      0.011 Sq. Mi.
Length along longest watercourse =    1710.00(Ft.)
Length along longest watercourse measured to centroid =    1043.00(Ft.)
Length along longest watercourse =      0.324 Mi.
Length along longest watercourse measured to centroid =      0.198 Mi.
Difference in elevation =      40.00(Ft.)
Slope along watercourse =    123.5088 Ft./Mi.
Average Manning's 'N' = 0.025
Lag time =    0.085 Hr.
Lag time =     5.07 Min.
25% of lag time =     1.27 Min.
40% of lag time =     2.03 Min.
Unit time =     5.00 Min.
Duration of storm = 6 Hour(s)
User Entered Base Flow =     0.00(CFS)

2 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        6.90           1.21                  8.35

100 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        6.90           2.86                 19.73

STORM EVENT (YEAR) =    5.00
Area Averaged 2-Year Rainfall =    1.210(In)
Area Averaged 100-Year Rainfall =    2.860(In)

Point rain (area averaged) =    1.596(In)
Areal adjustment factor =  100.00 %
Adjusted average point rain =    1.596(In)

Sub-Area Data:
Area(Ac.)         Runoff Index   Impervious %
     6.900           56.00         0.150
 Total Area Entered =      6.90(Ac.)


RI    RI   Infil. Rate Impervious   Adj. Infil. Rate  Area%     F
AMC2 AMC-1     (In/Hr)    (Dec.%)      (In/Hr)      (Dec.)    (In/Hr)
56.0  36.0      0.706     0.150        0.611       1.000      0.611
                                                  Sum (F) =   0.611
Area averaged mean soil loss (F) (In/Hr) =  0.611
Minimum soil loss rate ((In/Hr)) =  0.305
```

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.780

U n i t   H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %		Unit Hydrograph (CFS)
1	0.083	98.584	18.765		1.305
2	0.167	197.167	48.285		3.358
3	0.250	295.751	15.854		1.102
4	0.333	394.335	7.138		0.496
5	0.417	492.919	4.033		0.280
6	0.500	591.502	2.616		0.182
7	0.583	690.086	1.645		0.114
8	0.667	788.670	1.057		0.073
9	0.750	887.254	0.606		0.042
			Sum = 100.000	Sum=	6.954

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Low	Effective (In/Hr)
1	0.08	0.50	0.096	(0.611)	0.075	0.021
2	0.17	0.60	0.115	(0.611)	0.090	0.025
3	0.25	0.60	0.115	(0.611)	0.090	0.025
4	0.33	0.60	0.115	(0.611)	0.090	0.025
5	0.42	0.60	0.115	(0.611)	0.090	0.025
6	0.50	0.70	0.134	(0.611)	0.105	0.030
7	0.58	0.70	0.134	(0.611)	0.105	0.030
8	0.67	0.70	0.134	(0.611)	0.105	0.030
9	0.75	0.70	0.134	(0.611)	0.105	0.030
10	0.83	0.70	0.134	(0.611)	0.105	0.030
11	0.92	0.70	0.134	(0.611)	0.105	0.030
12	1.00	0.80	0.153	(0.611)	0.120	0.034
13	1.08	0.80	0.153	(0.611)	0.120	0.034
14	1.17	0.80	0.153	(0.611)	0.120	0.034
15	1.25	0.80	0.153	(0.611)	0.120	0.034
16	1.33	0.80	0.153	(0.611)	0.120	0.034
17	1.42	0.80	0.153	(0.611)	0.120	0.034
18	1.50	0.80	0.153	(0.611)	0.120	0.034
19	1.58	0.80	0.153	(0.611)	0.120	0.034
20	1.67	0.80	0.153	(0.611)	0.120	0.034
21	1.75	0.80	0.153	(0.611)	0.120	0.034
22	1.83	0.80	0.153	(0.611)	0.120	0.034
23	1.92	0.80	0.153	(0.611)	0.120	0.034
24	2.00	0.90	0.172	(0.611)	0.134	0.038
25	2.08	0.80	0.153	(0.611)	0.120	0.034
26	2.17	0.90	0.172	(0.611)	0.134	0.038
27	2.25	0.90	0.172	(0.611)	0.134	0.038
28	2.33	0.90	0.172	(0.611)	0.134	0.038
29	2.42	0.90	0.172	(0.611)	0.134	0.038
30	2.50	0.90	0.172	(0.611)	0.134	0.038
31	2.58	0.90	0.172	(0.611)	0.134	0.038
32	2.67	0.90	0.172	(0.611)	0.134	0.038
33	2.75	1.00	0.192	(0.611)	0.149	0.042
34	2.83	1.00	0.192	(0.611)	0.149	0.042
35	2.92	1.00	0.192	(0.611)	0.149	0.042
36	3.00	1.00	0.192	(0.611)	0.149	0.042
37	3.08	1.00	0.192	(0.611)	0.149	0.042
38	3.17	1.10	0.211	(0.611)	0.164	0.046
39	3.25	1.10	0.211	(0.611)	0.164	0.046
40	3.33	1.10	0.211	(0.611)	0.164	0.046
41	3.42	1.20	0.230	(0.611)	0.179	0.051
42	3.50	1.30	0.249	(0.611)	0.194	0.055
43	3.58	1.40	0.268	(0.611)	0.209	0.059
44	3.67	1.40	0.268	(0.611)	0.209	0.059
45	3.75	1.50	0.287	(0.611)	0.224	0.063
46	3.83	1.50	0.287	(0.611)	0.224	0.063
47	3.92	1.60	0.307	(0.611)	0.239	0.067
48	4.00	1.60	0.307	(0.611)	0.239	0.067
49	4.08	1.70	0.326	(0.611)	0.254	0.072

50	4.17	1.80	0.345	(0.611)	0.269	0.076
51	4.25	1.90	0.364	(0.611)	0.284	0.080
52	4.33	2.00	0.383	(0.611)	0.299	0.084
53	4.42	2.10	0.402	(0.611)	0.314	0.089
54	4.50	2.10	0.402	(0.611)	0.314	0.089
55	4.58	2.20	0.421	(0.611)	0.329	0.093
56	4.67	2.30	0.441	(0.611)	0.344	0.097
57	4.75	2.40	0.460	(0.611)	0.359	0.101
58	4.83	2.40	0.460	(0.611)	0.359	0.101
59	4.92	2.50	0.479	(0.611)	0.374	0.105
60	5.00	2.60	0.498	(0.611)	0.389	0.110
61	5.08	3.10	0.594	(0.611)	0.463	0.131
62	5.17	3.60	0.690	(0.611)	0.538	0.152
63	5.25	3.90	0.747	(0.611)	0.583	0.164
64	5.33	4.20	0.805	0.611	(0.628)	0.194
65	5.42	4.70	0.900	0.611	(0.702)	0.290
66	5.50	5.60	1.073	0.611	(0.837)	0.462
67	5.58	1.90	0.364	(0.611)	0.284	0.080
68	5.67	0.90	0.172	(0.611)	0.134	0.038
69	5.75	0.60	0.115	(0.611)	0.090	0.025
70	5.83	0.50	0.096	(0.611)	0.075	0.021
71	5.92	0.30	0.057	(0.611)	0.045	0.013
72	6.00	0.20	0.038	(0.611)	0.030	0.008

```
           (Loss Rate Not Used)
   Sum =     100.0                                Sum =     4.5
     Flood volume = Effective rainfall      0.38(In)
      times area       6.9(Ac.)/[(In)/(Ft.)] =       0.2(Ac.Ft)
     Total soil loss =      1.22(In)
     Total soil loss =     0.700(Ac.Ft)
     Total rainfall =      1.60(In)
     Flood volume =        9495.3 Cubic Feet
     Total soil loss =       30490.5 Cubic Feet
     --------------------------------------------------------------------
      Peak flow rate of this hydrograph =      2.174(CFS)
     --------------------------------------------------------------------
     ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                         6 - H O U R   S T O R M
                    R u n o f f     H y d r o g r a p h
     --------------------------------------------------------------------
                 Hydrograph in   5   Minute intervals ((CFS))

     --------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0        2.5       5.0       7.5      10.0
-----------------------------------------------------------------------
  0+ 5      0.0002      0.03  Q          |         |         |         |
  0+10      0.0009      0.10  Q          |         |         |         |
  0+15      0.0019      0.14  Q          |         |         |         |
  0+20      0.0030      0.16  Q          |         |         |         |
  0+25      0.0041      0.16  Q          |         |         |         |
  0+30      0.0053      0.17  Q          |         |         |         |
  0+35      0.0066      0.19  QV         |         |         |         |
  0+40      0.0080      0.20  QV         |         |         |         |
  0+45      0.0094      0.20  QV         |         |         |         |
  0+50      0.0108      0.20  QV         |         |         |         |
  0+55      0.0122      0.20  Q V        |         |         |         |
  1+ 0      0.0136      0.21  Q V        |         |         |         |
  1+ 5      0.0152      0.22  Q V        |         |         |         |
  1+10      0.0168      0.23  Q  V       |         |         |         |
  1+15      0.0184      0.23  Q  V       |         |         |         |
  1+20      0.0200      0.23  Q  V       |         |         |         |
  1+25      0.0216      0.23  Q  V       |         |         |         |
  1+30      0.0232      0.23  Q   V      |         |         |         |
  1+35      0.0248      0.23  Q   V      |         |         |         |
  1+40      0.0264      0.23  Q   V      |         |         |         |
  1+45      0.0280      0.23  Q    V     |         |         |         |
  1+50      0.0296      0.23  Q    V     |         |         |         |
  1+55      0.0313      0.23  Q    V     |         |         |         |
  2+ 0      0.0329      0.24  Q     V    |         |         |         |
  2+ 5      0.0346      0.25  Q     V    |         |         |         |
  2+10      0.0363      0.24  Q     V    |         |         |         |
  2+15      0.0381      0.26  |Q    V    |         |         |         |
  2+20      0.0399      0.26  |Q     V   |         |         |         |
  2+25      0.0417      0.26  |Q     V   |         |         |         |
  2+30      0.0435      0.26  |Q     V   |         |         |         |
  2+35      0.0453      0.26  |Q      V  |         |         |         |
  2+40      0.0471      0.26  |Q      V  |         |         |         |
  2+45      0.0490      0.27  |Q      V  |         |         |         |
  2+50      0.0509      0.28  |Q       V|         |         |         |
  2+55      0.0529      0.29  |Q       V|         |         |         |
```

```
    3+ 0       0.0549      0.29  |Q        V         |         |         |
    3+ 5       0.0569      0.29  |Q        V         |         |         |
    3+10       0.0590      0.30  |Q        V         |         |         |
    3+15       0.0611      0.31  |Q        |V        |         |         |
    3+20       0.0633      0.32  |Q        |V        |         |         |
    3+25       0.0655      0.33  |Q        | V       |         |         |
    3+30       0.0679      0.35  |Q        | V       |         |         |
    3+35       0.0705      0.37  |Q        | V       |         |         |
    3+40       0.0732      0.39  |Q        |  V      |         |         |
    3+45       0.0760      0.41  |Q        |  V      |         |         |
    3+50       0.0789      0.42  |Q        |   V     |         |         |
    3+55       0.0819      0.44  |Q        |    V    |         |         |
    4+ 0       0.0850      0.45  |Q        |    V    |         |         |
    4+ 5       0.0883      0.47  |Q        |     V   |         |         |
    4+10       0.0916      0.49  |Q        |     V   |         |         |
    4+15       0.0952      0.52  | Q       |      V  |         |         |
    4+20       0.0989      0.54  | Q       |       V |         |         |
    4+25       0.1029      0.57  | Q       |       V |         |         |
    4+30       0.1070      0.60  | Q       |        V|         |         |
    4+35       0.1112      0.61  | Q       |         V         |         |
    4+40       0.1155      0.63  | Q       |         |V        |         |
    4+45       0.1201      0.66  | Q       |         | V       |         |
    4+50       0.1248      0.68  | Q       |         | V       |         |
    4+55       0.1296      0.70  | Q       |         |  V      |         |
    5+ 0       0.1346      0.72  | Q       |         |   V     |         |
    5+ 5       0.1399      0.77  |  Q      |         |    V    |         |
    5+10       0.1460      0.88  |  Q      |         |     V   |         |
    5+15       0.1528      0.99  |  Q      |         |       V |         |
    5+20       0.1605      1.11  |   Q     |         |        V|         |
    5+25       0.1699      1.37  |    Q    |         |         |V        |
    5+30       0.1834      1.96  |      Q  |         |         |  V      |
    5+35       0.1984      2.17  |       Q |         |         |     V   |
    5+40       0.2059      1.09  |   Q     |         |         |      V  |
    5+45       0.2102      0.63  | Q       |         |         |       V |
    5+50       0.2131      0.42  |Q        |         |         |        V|
    5+55       0.2151      0.29  |Q        |         |         |        V|
    6+ 0       0.2165      0.20  Q         |         |         |        V|
    6+ 5       0.2173      0.12  Q         |         |         |        V|
    6+10       0.2177      0.06  Q         |         |         |        V|
    6+15       0.2178      0.02  Q         |         |         |        V|
    6+20       0.2179      0.01  Q         |         |         |        V|
    6+25       0.2180      0.01  Q         |         |         |        V|
    6+30       0.2180      0.00  Q         |         |         |        V|
    6+35       0.2180      0.00  Q         |         |         |        V|
    6+40       0.2180      0.00  Q         |         |         |        V|
-----------------------------------------------------------------------
```

```
      U n i t   H y d r o g r a p h   A n a l y s i s

      Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2014, Version 9.0
              Study date  07/23/19 File: DMAD5EXIST245.out


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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978


Program License Serial Number 6388

---------------------------------------------------------------------
 English (in-lb) Input Units Used
 English Rainfall Data (Inches) Input Values Used

 English Units used in output format




---------------------------------------------------------------------
KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
EXISTING CONDITION, DMA D
5-YR 24-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019
--------------------------------------------------------------------
Drainage Area =       6.90(Ac.)  =      0.011 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =       6.90(Ac.)  =      0.011 Sq. Mi.
Length along longest watercourse =    1710.00(Ft.)
Length along longest watercourse measured to centroid =    1043.00(Ft.)
Length along longest watercourse =      0.324 Mi.
Length along longest watercourse measured to centroid =      0.198 Mi.
Difference in elevation =      40.00(Ft.)
Slope along watercourse =    123.5088 Ft./Mi.
Average Manning's 'N' = 0.025
Lag time =    0.085 Hr.
Lag time =     5.07 Min.
25% of lag time =     1.27 Min.
40% of lag time =     2.03 Min.
Unit time =    15.00 Min.
Duration of storm = 24 Hour(s)
User Entered Base Flow =     0.00(CFS)

2 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        6.90           2.05                 14.15

100 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        6.90           5.16                 35.60

STORM EVENT (YEAR) =    5.00
Area Averaged 2-Year Rainfall =    2.050(In)
Area Averaged 100-Year Rainfall =    5.160(In)

Point rain (area averaged) =    2.778(In)
Areal adjustment factor =  100.00 %
Adjusted average point rain =    2.778(In)

Sub-Area Data:
Area(Ac.)         Runoff Index   Impervious %
     6.900           56.00         0.150
 Total Area Entered =      6.90(Ac.)


RI    RI   Infil. Rate Impervious   Adj. Infil. Rate  Area%     F
AMC2 AMC-1     (In/Hr)    (Dec.%)      (In/Hr)      (Dec.)    (In/Hr)
56.0  36.0      0.706     0.150        0.611       1.000      0.611
                                                  Sum (F) =   0.611
Area averaged mean soil loss (F) (In/Hr) =  0.611
Minimum soil loss rate ((In/Hr)) =  0.305
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(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.780

U n i t   H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %		Unit Hydrograph (CFS)
1	0.250	295.751	56.239		3.911
2	0.500	591.502	37.364		2.598
3	0.750	887.254	6.397		0.445
			Sum = 100.000	Sum=	6.954

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Low	Effective (In/Hr)
1	0.25	0.20	0.022	(1.078)	0.017	0.005
2	0.50	0.30	0.033	(1.066)	0.026	0.007
3	0.75	0.30	0.033	(1.053)	0.026	0.007
4	1.00	0.40	0.044	(1.041)	0.035	0.010
5	1.25	0.30	0.033	(1.029)	0.026	0.007
6	1.50	0.30	0.033	(1.017)	0.026	0.007
7	1.75	0.30	0.033	(1.004)	0.026	0.007
8	2.00	0.40	0.044	(0.992)	0.035	0.010
9	2.25	0.40	0.044	(0.980)	0.035	0.010
10	2.50	0.40	0.044	(0.968)	0.035	0.010
11	2.75	0.50	0.056	(0.957)	0.043	0.012
12	3.00	0.50	0.056	(0.945)	0.043	0.012
13	3.25	0.50	0.056	(0.933)	0.043	0.012
14	3.50	0.50	0.056	(0.922)	0.043	0.012
15	3.75	0.50	0.056	(0.910)	0.043	0.012
16	4.00	0.60	0.067	(0.899)	0.052	0.015
17	4.25	0.60	0.067	(0.887)	0.052	0.015
18	4.50	0.70	0.078	(0.876)	0.061	0.017
19	4.75	0.70	0.078	(0.865)	0.061	0.017
20	5.00	0.80	0.089	(0.853)	0.069	0.020
21	5.25	0.60	0.067	(0.842)	0.052	0.015
22	5.50	0.70	0.078	(0.831)	0.061	0.017
23	5.75	0.80	0.089	(0.821)	0.069	0.020
24	6.00	0.80	0.089	(0.810)	0.069	0.020
25	6.25	0.90	0.100	(0.799)	0.078	0.022
26	6.50	0.90	0.100	(0.788)	0.078	0.022
27	6.75	1.00	0.111	(0.778)	0.087	0.024
28	7.00	1.00	0.111	(0.767)	0.087	0.024
29	7.25	1.00	0.111	(0.757)	0.087	0.024
30	7.50	1.10	0.122	(0.746)	0.095	0.027
31	7.75	1.20	0.133	(0.736)	0.104	0.029
32	8.00	1.30	0.144	(0.726)	0.113	0.032
33	8.25	1.50	0.167	(0.716)	0.130	0.037
34	8.50	1.50	0.167	(0.706)	0.130	0.037
35	8.75	1.60	0.178	(0.696)	0.139	0.039
36	9.00	1.70	0.189	(0.686)	0.147	0.042
37	9.25	1.90	0.211	(0.677)	0.165	0.046
38	9.50	2.00	0.222	(0.667)	0.173	0.049
39	9.75	2.10	0.233	(0.657)	0.182	0.051
40	10.00	2.20	0.244	(0.648)	0.191	0.054
41	10.25	1.50	0.167	(0.639)	0.130	0.037
42	10.50	1.50	0.167	(0.629)	0.130	0.037
43	10.75	2.00	0.222	(0.620)	0.173	0.049
44	11.00	2.00	0.222	(0.611)	0.173	0.049
45	11.25	1.90	0.211	(0.602)	0.165	0.046
46	11.50	1.90	0.211	(0.593)	0.165	0.046
47	11.75	1.70	0.189	(0.584)	0.147	0.042
48	12.00	1.80	0.200	(0.576)	0.156	0.044
49	12.25	2.50	0.278	(0.567)	0.217	0.061
50	12.50	2.60	0.289	(0.559)	0.225	0.064
51	12.75	2.80	0.311	(0.550)	0.243	0.068
52	13.00	2.90	0.322	(0.542)	0.251	0.071
53	13.25	3.40	0.378	(0.534)	0.295	0.083
54	13.50	3.40	0.378	(0.526)	0.295	0.083
55	13.75	2.30	0.256	(0.518)	0.199	0.056

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56  14.00     2.30      0.256       (  0.510)       0.199        0.056
57  14.25     2.70      0.300       (  0.502)       0.234        0.066
58  14.50     2.60      0.289       (  0.494)       0.225        0.064
59  14.75     2.60      0.289       (  0.487)       0.225        0.064
60  15.00     2.50      0.278       (  0.479)       0.217        0.061
61  15.25     2.40      0.267       (  0.472)       0.208        0.059
62  15.50     2.30      0.256       (  0.465)       0.199        0.056
63  15.75     1.90      0.211       (  0.458)       0.165        0.046
64  16.00     1.90      0.211       (  0.451)       0.165        0.046
65  16.25     0.40      0.044       (  0.444)       0.035        0.010
66  16.50     0.40      0.044       (  0.437)       0.035        0.010
67  16.75     0.30      0.033       (  0.430)       0.026        0.007
68  17.00     0.30      0.033       (  0.424)       0.026        0.007
69  17.25     0.50      0.056       (  0.418)       0.043        0.012
70  17.50     0.50      0.056       (  0.411)       0.043        0.012
71  17.75     0.50      0.056       (  0.405)       0.043        0.012
72  18.00     0.40      0.044       (  0.399)       0.035        0.010
73  18.25     0.40      0.044       (  0.393)       0.035        0.010
74  18.50     0.40      0.044       (  0.388)       0.035        0.010
75  18.75     0.30      0.033       (  0.382)       0.026        0.007
76  19.00     0.20      0.022       (  0.377)       0.017        0.005
77  19.25     0.30      0.033       (  0.371)       0.026        0.007
78  19.50     0.40      0.044       (  0.366)       0.035        0.010
79  19.75     0.30      0.033       (  0.361)       0.026        0.007
80  20.00     0.20      0.022       (  0.356)       0.017        0.005
81  20.25     0.30      0.033       (  0.351)       0.026        0.007
82  20.50     0.30      0.033       (  0.347)       0.026        0.007
83  20.75     0.30      0.033       (  0.343)       0.026        0.007
84  21.00     0.20      0.022       (  0.338)       0.017        0.005
85  21.25     0.30      0.033       (  0.334)       0.026        0.007
86  21.50     0.20      0.022       (  0.331)       0.017        0.005
87  21.75     0.30      0.033       (  0.327)       0.026        0.007
88  22.00     0.20      0.022       (  0.324)       0.017        0.005
89  22.25     0.30      0.033       (  0.320)       0.026        0.007
90  22.50     0.20      0.022       (  0.317)       0.017        0.005
91  22.75     0.20      0.022       (  0.315)       0.017        0.005
92  23.00     0.20      0.022       (  0.312)       0.017        0.005
93  23.25     0.20      0.022       (  0.310)       0.017        0.005
94  23.50     0.20      0.022       (  0.308)       0.017        0.005
95  23.75     0.20      0.022       (  0.307)       0.017        0.005
96  24.00     0.20      0.022       (  0.306)       0.017        0.005
              (Loss Rate Not Used)
   Sum =     100.0                                  Sum =     2.4
     Flood volume = Effective rainfall      0.61(In)
      times area       6.9(Ac.)/[(In)/(Ft.)] =       0.4(Ac.Ft)
     Total soil loss =      2.17(In)
     Total soil loss =     1.246(Ac.Ft)
     Total rainfall =      2.78(In)
     Flood volume =       15309.9 Cubic Feet
     Total soil loss =       54280.7 Cubic Feet
     --------------------------------------------------------------------
      Peak flow rate of this hydrograph =      0.573(CFS)
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     ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                         24 - H O U R   S T O R M
                    R u n o f f     H y d r o g r a p h
     --------------------------------------------------------------------
                 Hydrograph in  15   Minute intervals ((CFS))

     --------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0        2.5       5.0       7.5      10.0
-----------------------------------------------------------------------
  0+15       0.0004      0.02  Q          |         |         |         |
  0+30       0.0013      0.04  Q          |         |         |         |
  0+45       0.0023      0.05  Q          |         |         |         |
  1+ 0       0.0035      0.06  Q          |         |         |         |
  1+15       0.0047      0.06  Q          |         |         |         |
  1+30       0.0058      0.05  Q          |         |         |         |
  1+45       0.0069      0.05  Q          |         |         |         |
  2+ 0       0.0081      0.06  Q          |         |         |         |
  2+15       0.0095      0.07  QV         |         |         |         |
  2+30       0.0109      0.07  QV         |         |         |         |
  2+45       0.0125      0.08  QV         |         |         |         |
  3+ 0       0.0142      0.08  QV         |         |         |         |
  3+15       0.0160      0.09  QV         |         |         |         |
  3+30       0.0177      0.09  Q V        |         |         |         |
  3+45       0.0195      0.09  Q V        |         |         |         |
  4+ 0       0.0215      0.09  Q V        |         |         |         |
  4+15       0.0235      0.10  Q V        |         |         |         |
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 4+30       0.0259      0.11  Q V       |         |         |         |
 4+45       0.0283      0.12  Q  V      |         |         |         |
 5+ 0       0.0309      0.13  Q  V      |         |         |         |
 5+15       0.0333      0.12  Q  V      |         |         |         |
 5+30       0.0357      0.11  Q   V     |         |         |         |
 5+45       0.0383      0.13  Q   V     |         |         |         |
 6+ 0       0.0411      0.14  Q   V     |         |         |         |
 6+15       0.0441      0.15  Q    V    |         |         |         |
 6+30       0.0473      0.15  Q    V    |         |         |         |
 6+45       0.0506      0.16  Q    V    |         |         |         |
 7+ 0       0.0541      0.17  Q     V   |         |         |         |
 7+15       0.0576      0.17  Q     V   |         |         |         |
 7+30       0.0613      0.18  Q     V   |         |         |         |
 7+45       0.0654      0.20  Q      V  |         |         |         |
 8+ 0       0.0698      0.21  Q      V  |         |         |         |
 8+15       0.0747      0.24  Q       V |         |         |         |
 8+30       0.0800      0.25  |Q       V|         |         |         |
 8+45       0.0854      0.26  |Q       V|         |         |         |
 9+ 0       0.0912      0.28  |Q        V         |         |         |
 9+15       0.0976      0.31  |Q         V        |         |         |
 9+30       0.1044      0.33  |Q        |V        |         |         |
 9+45       0.1116      0.35  |Q        | V       |         |         |
10+ 0       0.1192      0.37  |Q        |  V      |         |         |
10+15       0.1255      0.31  |Q        |   V     |         |         |
10+30       0.1309      0.26  |Q        |   V     |         |         |
10+45       0.1372      0.30  |Q        |    V    |         |         |
11+ 0       0.1441      0.33  |Q        |     V   |         |         |
11+15       0.1509      0.33  |Q        |      V  |         |         |
11+30       0.1576      0.32  |Q        |      V  |         |         |
11+45       0.1639      0.30  |Q        |       V |         |         |
12+ 0       0.1701      0.30  |Q        |        V|         |         |
12+15       0.1778      0.37  |Q        |         V         |         |
12+30       0.1866      0.43  |Q        |          V        |         |
12+45       0.1961      0.46  |Q        |         | V       |         |
13+ 0       0.2061      0.48  |Q        |         |  V      |         |
13+15       0.2173      0.54  | Q       |         |   V     |         |
13+30       0.2291      0.57  | Q       |         |     V   |         |
13+45       0.2389      0.47  |Q        |         |      V  |         |
14+ 0       0.2472      0.40  |Q        |         |       V |         |
14+15       0.2561      0.43  |Q        |         |        V|         |
14+30       0.2653      0.45  |Q        |         |         V         |
14+45       0.2745      0.44  |Q        |         |          V        |
15+ 0       0.2834      0.43  |Q        |         |         | V       |
15+15       0.2920      0.42  |Q        |         |         |  V      |
15+30       0.3003      0.40  |Q        |         |         |   V     |
15+45       0.3076      0.35  |Q        |         |         |    V    |
16+ 0       0.3144      0.33  |Q        |         |         |    V    |
16+15       0.3181      0.18  Q         |         |         |     V   |
16+30       0.3198      0.08  Q         |         |         |     V   |
16+45       0.3210      0.06  Q         |         |         |     V   |
17+ 0       0.3221      0.05  Q         |         |         |     V   |
17+15       0.3236      0.07  Q         |         |         |     V   |
17+30       0.3253      0.08  Q         |         |         |      V  |
17+45       0.3270      0.09  Q         |         |         |      V  |
18+ 0       0.3286      0.08  Q         |         |         |      V  |
18+15       0.3300      0.07  Q         |         |         |      V  |
18+30       0.3314      0.07  Q         |         |         |      V  |
18+45       0.3326      0.06  Q         |         |         |      V  |
19+ 0       0.3335      0.04  Q         |         |         |      V  |
19+15       0.3344      0.04  Q         |         |         |       V |
19+30       0.3357      0.06  Q         |         |         |       V |
19+45       0.3369      0.06  Q         |         |         |       V |
20+ 0       0.3377      0.04  Q         |         |         |       V |
20+15       0.3387      0.04  Q         |         |         |       V |
20+30       0.3397      0.05  Q         |         |         |       V |
20+45       0.3407      0.05  Q         |         |         |       V |
21+ 0       0.3416      0.04  Q         |         |         |       V |
21+15       0.3425      0.04  Q         |         |         |       V |
21+30       0.3434      0.04  Q         |         |         |        V|
21+45       0.3443      0.04  Q         |         |         |        V|
22+ 0       0.3451      0.04  Q         |         |         |        V|
22+15       0.3460      0.04  Q         |         |         |        V|
22+30       0.3469      0.04  Q         |         |         |        V|
22+45       0.3476      0.04  Q         |         |         |        V|
23+ 0       0.3483      0.03  Q         |         |         |        V|
23+15       0.3490      0.03  Q         |         |         |        V|
23+30       0.3497      0.03  Q         |         |         |        V|
23+45       0.3504      0.03  Q         |         |         |        V|
24+ 0       0.3511      0.03  Q         |         |         |        V|
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  24+15       0.3514      0.01  Q         |         |         |        V|
  24+30       0.3515      0.00  Q         |         |         |         V
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      U n i t   H y d r o g r a p h   A n a l y s i s

      Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2014, Version 9.0
             Study date  07/23/19 File: DMAD5PROP15.out


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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978


Program License Serial Number 6388

---------------------------------------------------------------------
 English (in-lb) Input Units Used
 English Rainfall Data (Inches) Input Values Used

 English Units used in output format



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KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
PROPOSED CONDITION, DMA D
5-YR 1-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019
--------------------------------------------------------------------
Drainage Area =       6.90(Ac.)  =      0.011 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =       6.90(Ac.)  =      0.011 Sq. Mi.
Length along longest watercourse =    1710.00(Ft.)
Length along longest watercourse measured to centroid =    1043.00(Ft.)
Length along longest watercourse =      0.324 Mi.
Length along longest watercourse measured to centroid =      0.198 Mi.
Difference in elevation =      40.00(Ft.)
Slope along watercourse =    123.5088 Ft./Mi.
Average Manning's 'N' = 0.015
Lag time =    0.051 Hr.
Lag time =     3.04 Min.
25% of lag time =     0.76 Min.
40% of lag time =     1.22 Min.
Unit time =     5.00 Min.
Duration of storm = 1 Hour(s)
User Entered Base Flow =     0.00(CFS)

2 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        6.90           0.49                  3.37

100 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        6.90           1.33                  9.18

STORM EVENT (YEAR) =    5.00
Area Averaged 2-Year Rainfall =    0.489(In)
Area Averaged 100-Year Rainfall =    1.330(In)

Point rain (area averaged) =    0.686(In)
Areal adjustment factor =   99.99 %
Adjusted average point rain =    0.686(In)

Sub-Area Data:
Area(Ac.)         Runoff Index   Impervious %
     6.900           56.00         0.850
 Total Area Entered =      6.90(Ac.)


RI    RI   Infil. Rate Impervious   Adj. Infil. Rate  Area%     F
AMC2 AMC-1     (In/Hr)    (Dec.%)      (In/Hr)      (Dec.)    (In/Hr)
56.0  36.0      0.706     0.850        0.166       1.000      0.166
                                                  Sum (F) =   0.166
Area averaged mean soil loss (F) (In/Hr) =  0.166
Minimum soil loss rate ((In/Hr)) =  0.083
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(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.220

Slope of intensity-duration curve for a 1 hour storm =0.5000

U n i t H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.083	164.306	36.467	2.536
2	0.167	328.612	45.943	3.195
3	0.250	492.919	10.415	0.724
4	0.333	657.225	4.445	0.309
5	0.417	821.531	2.730	0.190
			Sum = 100.000	Sum= 6.954

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Loss rate(In./Hr) Low	Effective (In/Hr)
1	0.08	4.20	0.346	(0.166)	0.076	0.270
2	0.17	4.30	0.354	(0.166)	0.078	0.276
3	0.25	5.00	0.412	(0.166)	0.091	0.321
4	0.33	5.00	0.412	(0.166)	0.091	0.321
5	0.42	5.80	0.477	(0.166)	0.105	0.372
6	0.50	6.50	0.535	(0.166)	0.118	0.417
7	0.58	7.40	0.609	(0.166)	0.134	0.475
8	0.67	8.60	0.708	(0.166)	0.156	0.552
9	0.75	12.30	1.012	0.166	(0.223)	0.847
10	0.83	29.10	2.395	0.166	(0.527)	2.229
11	0.92	6.80	0.560	(0.166)	0.123	0.437
12	1.00	5.00	0.412	(0.166)	0.091	0.321

(Loss Rate Not Used)
Sum = 100.0 Sum = 6.8

Flood volume = Effective rainfall 0.57(In)
times area 6.9(Ac.)/[(In)/(Ft.)] = 0.3(Ac.Ft)
Total soil loss = 0.12(In)
Total soil loss = 0.067(Ac.Ft)
Total rainfall = 0.69(In)
Flood volume = 14273.2 Cubic Feet
Total soil loss = 2907.5 Cubic Feet

Peak flow rate of this hydrograph = 9.108(CFS)

+++

1 - H O U R   S T O R M
R u n o f f   H y d r o g r a p h

Hydrograph in 5 Minute intervals ((CFS))

```
------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0        2.5       5.0       7.5      10.0
-----------------------------------------------------------------------
  0+ 5      0.0047      0.68  V Q       |         |         |         |
  0+10      0.0155      1.56  |V    Q   |         |         |         |
  0+15      0.0285      1.89  |  V   Q  |         |         |         |
  0+20      0.0431      2.12  |    V  Q |         |         |         |
  0+25      0.0593      2.34  |      V Q|         |         |         |
  0+30      0.0774      2.63  |        VQ         |         |         |
  0+35      0.0978      2.97  |         |Q        |         |         |
  0+40      0.1212      3.40  |         |  QV     |         |         |
  0+45      0.1519      4.46  |         |      QV |         |         |
  0+50      0.2138      8.99  |         |         |    V    |    Q    |
  0+55      0.2766      9.11  |         |         |         | V  Q    |
  1+ 0      0.3054      4.19  |         |     Q   |         |     V   |
  1+ 5      0.3205      2.19  |       Q |         |         |        V|
  1+10      0.3260      0.79  |  Q      |         |         |        V|
  1+15      0.3272      0.18  Q         |         |         |        V|
  1+20      0.3277      0.06  Q         |         |         |         V
-----------------------------------------------------------------------
```

U n i t   H y d r o g r a p h   A n a l y s i s

Study date 07/23/19 File: DMAD5PROP35.out

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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978

Program License Serial Number 6388

English (in-lb) Input Units Used
English Rainfall Data (Inches) Input Values Used

English Units used in output format

KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
PROPOSED CONDITION, DMA D
5-YR 3-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019

Drainage Area = 6.90(Ac.) = 0.011 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment = 6.90(Ac.) = 0.011 Sq. Mi.
Length along longest watercourse = 1710.00(Ft.)
Length along longest watercourse measured to centroid = 1043.00(Ft.)
Length along longest watercourse = 0.324 Mi.
Length along longest watercourse measured to centroid = 0.198 Mi.
Difference in elevation = 40.00(Ft.)
Slope along watercourse = 123.5088 Ft./Mi.
Average Manning's 'N' = 0.015
Lag time = 0.051 Hr.
Lag time = 3.04 Min.
25% of lag time = 0.76 Min.
40% of lag time = 1.22 Min.
Unit time = 5.00 Min.
Duration of storm = 3 Hour(s)
User Entered Base Flow = 0.00(CFS)

2 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	Weighting[1*2]
6.90	0.87	5.98

100 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	Weighting[1*2]
6.90	2.09	14.42

STORM EVENT (YEAR) = 5.00
Area Averaged 2-Year Rainfall = 0.866(In)
Area Averaged 100-Year Rainfall = 2.090(In)

Point rain (area averaged) = 1.153(In)
Areal adjustment factor = 100.00 %
Adjusted average point rain = 1.153(In)

Sub-Area Data:

Area(Ac.)	Runoff Index	Impervious %
6.900	56.00	0.850

Total Area Entered = 6.90(Ac.)

RI AMC2	RI AMC-1	Infil. Rate (In/Hr)	Impervious (Dec.%)	Adj. Infil. Rate (In/Hr)	Area% (Dec.)	F (In/Hr)
56.0	36.0	0.706	0.850	0.166	1.000	0.166
					Sum (F) =	0.166

Area averaged mean soil loss (F) (In/Hr) = 0.166
Minimum soil loss rate ((In/Hr)) = 0.083

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.220

U n i t H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.083	164.306	36.467	2.536
2	0.167	328.612	45.943	3.195
3	0.250	492.919	10.415	0.724
4	0.333	657.225	4.445	0.309
5	0.417	821.531	2.730	0.190
			Sum = 100.000	Sum= 6.954

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Low	Effective (In/Hr)
1	0.08	1.30	0.180	(0.166)	0.040	0.140
2	0.17	1.30	0.180	(0.166)	0.040	0.140
3	0.25	1.10	0.152	(0.166)	0.033	0.119
4	0.33	1.50	0.207	(0.166)	0.046	0.162
5	0.42	1.50	0.207	(0.166)	0.046	0.162
6	0.50	1.80	0.249	(0.166)	0.055	0.194
7	0.58	1.50	0.207	(0.166)	0.046	0.162
8	0.67	1.80	0.249	(0.166)	0.055	0.194
9	0.75	1.80	0.249	(0.166)	0.055	0.194
10	0.83	1.50	0.207	(0.166)	0.046	0.162
11	0.92	1.60	0.221	(0.166)	0.049	0.173
12	1.00	1.80	0.249	(0.166)	0.055	0.194
13	1.08	2.20	0.304	(0.166)	0.067	0.237
14	1.17	2.20	0.304	(0.166)	0.067	0.237
15	1.25	2.20	0.304	(0.166)	0.067	0.237
16	1.33	2.00	0.277	(0.166)	0.061	0.216
17	1.42	2.60	0.360	(0.166)	0.079	0.281
18	1.50	2.70	0.373	(0.166)	0.082	0.291
19	1.58	2.40	0.332	(0.166)	0.073	0.259
20	1.67	2.70	0.373	(0.166)	0.082	0.291
21	1.75	3.30	0.456	(0.166)	0.100	0.356
22	1.83	3.10	0.429	(0.166)	0.094	0.334
23	1.92	2.90	0.401	(0.166)	0.088	0.313
24	2.00	3.00	0.415	(0.166)	0.091	0.324
25	2.08	3.10	0.429	(0.166)	0.094	0.334
26	2.17	4.20	0.581	(0.166)	0.128	0.453
27	2.25	5.00	0.692	(0.166)	0.152	0.539
28	2.33	3.50	0.484	(0.166)	0.107	0.378
29	2.42	6.80	0.941	0.166	(0.207)	0.775
30	2.50	7.30	1.010	0.166	(0.222)	0.844
31	2.58	8.20	1.134	0.166	(0.250)	0.968
32	2.67	5.90	0.816	0.166	(0.180)	0.650
33	2.75	2.00	0.277	(0.166)	0.061	0.216
34	2.83	1.80	0.249	(0.166)	0.055	0.194
35	2.92	1.80	0.249	(0.166)	0.055	0.194
36	3.00	0.60	0.083	(0.166)	0.018	0.065
		(Loss Rate Not Used)				
Sum =		100.0			Sum =	11.0

Flood volume = Effective rainfall 0.92(In)
times area 6.9(Ac.)/[(In)/(Ft.)] = 0.5(Ac.Ft)
Total soil loss = 0.24(In)
Total soil loss = 0.136(Ac.Ft)
Total rainfall = 1.15(In)
Flood volume = 22925.0 Cubic Feet
Total soil loss = 5945.6 Cubic Feet

Peak flow rate of this hydrograph = 5.935(CFS)

++

3 - H O U R   S T O R M
R u n o f f   H y d r o g r a p h

Hydrograph in 5 Minute intervals ((CFS))

```
        --------------------------------------------------------------------
  Time(h+m) Volume Ac.Ft   Q(CFS)   0        2.5       5.0       7.5       10.0
  -----------------------------------------------------------------------
    0+ 5       0.0025      0.36   VQ        |         |         |         |
    0+10       0.0080      0.80   V  Q      |         |         |         |
    0+15       0.0139      0.85   |V Q      |         |         |         |
    0+20       0.0203      0.93   |V Q      |         |         |         |
    0+25       0.0278      1.08   | V Q     |         |         |         |
    0+30       0.0360      1.19   | V Q     |         |         |         |
    0+35       0.0444      1.22   |  VQ     |         |         |         |
    0+40       0.0528      1.23   |   Q     |         |         |         |
    0+45       0.0619      1.32   |   VQ    |         |         |         |
    0+50       0.0706      1.26   |    Q    |         |         |         |
    0+55       0.0788      1.19   |   QV    |         |         |         |
    1+ 0       0.0875      1.26   |    QV   |         |         |         |
    1+ 5       0.0973      1.43   |    Q V  |         |         |         |
    1+10       0.1083      1.59   |     Q V |         |         |         |
    1+15       0.1195      1.63   |     Q  V|         |         |         |
    1+20       0.1304      1.59   |     Q  V|         |         |         |
    1+25       0.1421      1.69   |     Q   V         |         |         |
    1+30       0.1552      1.91   |      Q  |V        |         |         |
    1+35       0.1683      1.90   |      Q  | V       |         |         |
    1+40       0.1814      1.91   |      Q  |  V      |         |         |
    1+45       0.1964      2.17   |       Q |   V     |         |         |
    1+50       0.2124      2.33   |        Q|     V   |         |         |
    1+55       0.2280      2.26   |        Q|      V  |         |         |
    2+ 0       0.2433      2.23   |       Q |       V |         |         |
    2+ 5       0.2591      2.28   |        Q|        V|         |         |
    2+10       0.2771      2.61   |         Q         |V        |         |
    2+15       0.2992      3.22   |         | Q       | V       |         |
    2+20       0.3211      3.18   |         | Q       |   V     |         |
    2+25       0.3470      3.77   |         |    Q    |     V   |         |
    2+30       0.3825      5.14   |         |         Q        V|         |
    2+35       0.4233      5.93   |         |         |  Q      | V       |
    2+40       0.4624      5.67   |         |         | Q       |    V    |
    2+45       0.4881      3.74   |         |   Q     |         |      V  |
    2+50       0.5026      2.11   |       Q |         |         |       V |
    2+55       0.5140      1.65   |     Q   |         |         |        V|
    3+ 0       0.5217      1.12   |   Q     |         |         |        V|
    3+ 5       0.5248      0.45   |Q        |         |         |        V|
    3+10       0.5258      0.14   Q         |         |         |        V|
    3+15       0.5262      0.06   Q         |         |         |        V|
    3+20       0.5263      0.01   Q         |         |         |         V
-----------------------------------------------------------------------
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U n i t   H y d r o g r a p h   A n a l y s i s

Study date 07/23/19 File: DMAD5PROP65.out

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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978

Program License Serial Number 6388

English (in-lb) Input Units Used
English Rainfall Data (Inches) Input Values Used

English Units used in output format

KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
PROPOSED CONDITION, DMA D
5-YR 6-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019

Drainage Area = 6.90(Ac.) = 0.011 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment = 6.90(Ac.) = 0.011 Sq. Mi.
Length along longest watercourse = 1710.00(Ft.)
Length along longest watercourse measured to centroid = 1043.00(Ft.)
Length along longest watercourse = 0.324 Mi.
Length along longest watercourse measured to centroid = 0.198 Mi.
Difference in elevation = 40.00(Ft.)
Slope along watercourse = 123.5088 Ft./Mi.
Average Manning's 'N' = 0.015
Lag time = 0.051 Hr.
Lag time = 3.04 Min.
25% of lag time = 0.76 Min.
40% of lag time = 1.22 Min.
Unit time = 5.00 Min.
Duration of storm = 6 Hour(s)
User Entered Base Flow = 0.00(CFS)

2 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	Weighting[1*2]
6.90	1.21	8.35

100 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	Weighting[1*2]
6.90	2.86	19.73

STORM EVENT (YEAR) = 5.00
Area Averaged 2-Year Rainfall = 1.210(In)
Area Averaged 100-Year Rainfall = 2.860(In)

Point rain (area averaged) = 1.596(In)
Areal adjustment factor = 100.00 %
Adjusted average point rain = 1.596(In)

Sub-Area Data:

Area(Ac.)	Runoff Index	Impervious %
6.900	56.00	0.850

Total Area Entered = 6.90(Ac.)

RI AMC2	RI AMC-1	Infil. Rate (In/Hr)	Impervious (Dec.%)	Adj. Infil. Rate (In/Hr)	Area% (Dec.)	F (In/Hr)
56.0	36.0	0.706	0.850	0.166	1.000	0.166
					Sum (F) =	0.166

Area averaged mean soil loss (F) (In/Hr) = 0.166
Minimum soil loss rate ((In/Hr)) = 0.083

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.220

U n i t H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.083	164.306	36.467	2.536
2	0.167	328.612	45.943	3.195
3	0.250	492.919	10.415	0.724
4	0.333	657.225	4.445	0.309
5	0.417	821.531	2.730	0.190
			Sum = 100.000	Sum= 6.954

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Low	Effective (In/Hr)
1	0.08	0.50	0.096	(0.166)	0.021	0.075
2	0.17	0.60	0.115	(0.166)	0.025	0.090
3	0.25	0.60	0.115	(0.166)	0.025	0.090
4	0.33	0.60	0.115	(0.166)	0.025	0.090
5	0.42	0.60	0.115	(0.166)	0.025	0.090
6	0.50	0.70	0.134	(0.166)	0.030	0.105
7	0.58	0.70	0.134	(0.166)	0.030	0.105
8	0.67	0.70	0.134	(0.166)	0.030	0.105
9	0.75	0.70	0.134	(0.166)	0.030	0.105
10	0.83	0.70	0.134	(0.166)	0.030	0.105
11	0.92	0.70	0.134	(0.166)	0.030	0.105
12	1.00	0.80	0.153	(0.166)	0.034	0.120
13	1.08	0.80	0.153	(0.166)	0.034	0.120
14	1.17	0.80	0.153	(0.166)	0.034	0.120
15	1.25	0.80	0.153	(0.166)	0.034	0.120
16	1.33	0.80	0.153	(0.166)	0.034	0.120
17	1.42	0.80	0.153	(0.166)	0.034	0.120
18	1.50	0.80	0.153	(0.166)	0.034	0.120
19	1.58	0.80	0.153	(0.166)	0.034	0.120
20	1.67	0.80	0.153	(0.166)	0.034	0.120
21	1.75	0.80	0.153	(0.166)	0.034	0.120
22	1.83	0.80	0.153	(0.166)	0.034	0.120
23	1.92	0.80	0.153	(0.166)	0.034	0.120
24	2.00	0.90	0.172	(0.166)	0.038	0.134
25	2.08	0.80	0.153	(0.166)	0.034	0.120
26	2.17	0.90	0.172	(0.166)	0.038	0.134
27	2.25	0.90	0.172	(0.166)	0.038	0.134
28	2.33	0.90	0.172	(0.166)	0.038	0.134
29	2.42	0.90	0.172	(0.166)	0.038	0.134
30	2.50	0.90	0.172	(0.166)	0.038	0.134
31	2.58	0.90	0.172	(0.166)	0.038	0.134
32	2.67	0.90	0.172	(0.166)	0.038	0.134
33	2.75	1.00	0.192	(0.166)	0.042	0.149
34	2.83	1.00	0.192	(0.166)	0.042	0.149
35	2.92	1.00	0.192	(0.166)	0.042	0.149
36	3.00	1.00	0.192	(0.166)	0.042	0.149
37	3.08	1.00	0.192	(0.166)	0.042	0.149
38	3.17	1.10	0.211	(0.166)	0.046	0.164
39	3.25	1.10	0.211	(0.166)	0.046	0.164
40	3.33	1.10	0.211	(0.166)	0.046	0.164
41	3.42	1.20	0.230	(0.166)	0.051	0.179
42	3.50	1.30	0.249	(0.166)	0.055	0.194
43	3.58	1.40	0.268	(0.166)	0.059	0.209
44	3.67	1.40	0.268	(0.166)	0.059	0.209
45	3.75	1.50	0.287	(0.166)	0.063	0.224
46	3.83	1.50	0.287	(0.166)	0.063	0.224
47	3.92	1.60	0.307	(0.166)	0.067	0.239
48	4.00	1.60	0.307	(0.166)	0.067	0.239
49	4.08	1.70	0.326	(0.166)	0.072	0.254
50	4.17	1.80	0.345	(0.166)	0.076	0.269
51	4.25	1.90	0.364	(0.166)	0.080	0.284
52	4.33	2.00	0.383	(0.166)	0.084	0.299
53	4.42	2.10	0.402	(0.166)	0.089	0.314

```
54   4.50     2.10      0.402       (  0.166)       0.089        0.314
55   4.58     2.20      0.421       (  0.166)       0.093        0.329
56   4.67     2.30      0.441       (  0.166)       0.097        0.344
57   4.75     2.40      0.460       (  0.166)       0.101        0.359
58   4.83     2.40      0.460       (  0.166)       0.101        0.359
59   4.92     2.50      0.479       (  0.166)       0.105        0.374
60   5.00     2.60      0.498       (  0.166)       0.110        0.389
61   5.08     3.10      0.594       (  0.166)       0.131        0.463
62   5.17     3.60      0.690       (  0.166)       0.152        0.538
63   5.25     3.90      0.747       (  0.166)       0.164        0.583
64   5.33     4.20      0.805          0.166    (  0.177)        0.639
65   5.42     4.70      0.900          0.166    (  0.198)        0.734
66   5.50     5.60      1.073          0.166    (  0.236)        0.907
67   5.58     1.90      0.364       (  0.166)       0.080        0.284
68   5.67     0.90      0.172       (  0.166)       0.038        0.134
69   5.75     0.60      0.115       (  0.166)       0.025        0.090
70   5.83     0.50      0.096       (  0.166)       0.021        0.075
71   5.92     0.30      0.057       (  0.166)       0.013        0.045
72   6.00     0.20      0.038       (  0.166)       0.008        0.030
              (Loss Rate Not Used)
   Sum =     100.0                                 Sum =    15.1
     Flood volume = Effective rainfall      1.25(In)
      times area       6.9(Ac.)/[(In)/(Ft.)] =       0.7(Ac.Ft)
     Total soil loss =      0.34(In)
     Total soil loss =     0.197(Ac.Ft)
     Total rainfall =      1.60(In)
     Flood volume =      31425.6 Cubic Feet
     Total soil loss =       8560.2 Cubic Feet
     --------------------------------------------------------------------
      Peak flow rate of this hydrograph =      5.394(CFS)
     --------------------------------------------------------------------
     ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                         6 - H O U R   S T O R M
                    R u n o f f     H y d r o g r a p h
     --------------------------------------------------------------------
                Hydrograph in   5   Minute intervals ((CFS))

     --------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0        2.5       5.0       7.5      10.0
-----------------------------------------------------------------------
  0+ 5       0.0013      0.19  Q         |         |         |         |
  0+10       0.0045      0.47  VQ        |         |         |         |
  0+15       0.0084      0.57  V Q       |         |         |         |
  0+20       0.0126      0.60  V Q       |         |         |         |
  0+25       0.0169      0.62  V Q       |         |         |         |
  0+30       0.0214      0.66  |VQ       |         |         |         |
  0+35       0.0263      0.71  |VQ       |         |         |         |
  0+40       0.0313      0.72  |VQ       |         |         |         |
  0+45       0.0362      0.72  | Q       |         |         |         |
  0+50       0.0413      0.73  | Q       |         |         |         |
  0+55       0.0463      0.73  | Q       |         |         |         |
  1+ 0       0.0515      0.77  | VQ      |         |         |         |
  1+ 5       0.0571      0.81  |  Q      |         |         |         |
  1+10       0.0628      0.82  |  Q      |         |         |         |
  1+15       0.0685      0.83  |  Q      |         |         |         |
  1+20       0.0743      0.83  |  QV     |         |         |         |
  1+25       0.0800      0.83  |  QV     |         |         |         |
  1+30       0.0857      0.83  |  QV     |         |         |         |
  1+35       0.0914      0.83  |  Q V    |         |         |         |
  1+40       0.0972      0.83  |  Q V    |         |         |         |
  1+45       0.1029      0.83  |  Q V    |         |         |         |
  1+50       0.1086      0.83  |  Q  V   |         |         |         |
  1+55       0.1144      0.83  |  Q  V   |         |         |         |
  2+ 0       0.1203      0.87  |  Q  V   |         |         |         |
  2+ 5       0.1264      0.88  |  Q   V  |         |         |         |
  2+10       0.1325      0.88  |  Q   V  |         |         |         |
  2+15       0.1388      0.92  |  Q   V  |         |         |         |
  2+20       0.1452      0.93  |  Q    V |         |         |         |
  2+25       0.1517      0.93  |  Q    V |         |         |         |
  2+30       0.1581      0.94  |  Q    V |         |         |         |
  2+35       0.1645      0.94  |  Q     V|         |         |         |
  2+40       0.1710      0.94  |  Q     V|         |         |         |
  2+45       0.1777      0.97  |  Q     V|         |         |         |
  2+50       0.1847      1.02  |   Q     V         |         |         |
  2+55       0.1918      1.03  |   Q     V         |         |         |
  3+ 0       0.1990      1.04  |   Q     |V        |         |         |
  3+ 5       0.2061      1.04  |   Q     |V        |         |         |
  3+10       0.2136      1.08  |   Q     |V        |         |         |
  3+15       0.2213      1.13  |   Q     | V       |         |         |
```

```
    3+20       0.2291      1.14  |   Q     | V       |         |         |
    3+25       0.2372      1.18  |   Q     |  V      |         |         |
    3+30       0.2460      1.27  |    Q    |  V      |         |         |
    3+35       0.2554      1.36  |    Q    |   V     |         |         |
    3+40       0.2652      1.43  |    Q    |   V     |         |         |
    3+45       0.2754      1.48  |    Q    |    V    |         |         |
    3+50       0.2860      1.54  |     Q   |    V    |         |         |
    3+55       0.2970      1.59  |     Q   |     V   |         |         |
    4+ 0       0.3083      1.64  |     Q   |      V  |         |         |
    4+ 5       0.3199      1.69  |     Q   |      V  |         |         |
    4+10       0.3322      1.78  |      Q  |       V |         |         |
    4+15       0.3452      1.88  |      Q  |        V|         |         |
    4+20       0.3589      1.98  |      Q  |        V|         |         |
    4+25       0.3732      2.09  |       Q |         V         |         |
    4+30       0.3881      2.15  |       Q |         |V        |         |
    4+35       0.4033      2.21  |       Q |         | V       |         |
    4+40       0.4192      2.30  |        Q|         |  V      |         |
    4+45       0.4357      2.40  |        Q|         |   V     |         |
    4+50       0.4527      2.47  |        Q|         |    V    |         |
    4+55       0.4701      2.52  |         Q         |     V   |         |
    5+ 0       0.4881      2.62  |         Q         |      V  |         |
    5+ 5       0.5078      2.87  |         |Q        |       V |         |
    5+10       0.5306      3.31  |         |  Q      |        V|         |
    5+15       0.5563      3.72  |         |   Q     |         V         |
    5+20       0.5845      4.09  |         |     Q   |         | V       |
    5+25       0.6160      4.58  |         |       Q |         |   V     |
    5+30       0.6532      5.39  |         |         |Q        |     V   |
    5+35       0.6839      4.46  |         |      Q  |         |      V  |
    5+40       0.6994      2.25  |        Q|         |         |       V |
    5+45       0.7082      1.28  |    Q    |         |         |        V|
    5+50       0.7140      0.83  |  Q      |         |         |        V|
    5+55       0.7175      0.51  | Q       |         |         |        V|
    6+ 0       0.7198      0.33  |Q        |         |         |        V|
    6+ 5       0.7209      0.17  Q         |         |         |        V|
    6+10       0.7213      0.05  Q         |         |         |        V|
    6+15       0.7214      0.02  Q         |         |         |        V|
    6+20       0.7214      0.01  Q         |         |         |         V
-----------------------------------------------------------------------
```

```
       U n i t   H y d r o g r a p h   A n a l y s i s

       Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2014, Version 9.0
               Study date  07/23/19 File: DMAD5PROP245.out

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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978


Program License Serial Number 6388

---------------------------------------------------------------------
 English (in-lb) Input Units Used
 English Rainfall Data (Inches) Input Values Used

 English Units used in output format



---------------------------------------------------------------------
KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
PROPOSED CONDITION, DMA D
5-YR 24-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019
--------------------------------------------------------------------
Drainage Area =       6.90(Ac.)  =      0.011 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =       6.90(Ac.)  =      0.011 Sq. Mi.
Length along longest watercourse =    1710.00(Ft.)
Length along longest watercourse measured to centroid =    1043.00(Ft.)
Length along longest watercourse =      0.324 Mi.
Length along longest watercourse measured to centroid =      0.198 Mi.
Difference in elevation =      40.00(Ft.)
Slope along watercourse =    123.5088 Ft./Mi.
Average Manning's 'N' = 0.015
Lag time =    0.051 Hr.
Lag time =     3.04 Min.
25% of lag time =     0.76 Min.
40% of lag time =     1.22 Min.
Unit time =    15.00 Min.
Duration of storm = 24 Hour(s)
User Entered Base Flow =     0.00(CFS)

2 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        6.90           2.05                 14.15

100 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        6.90           5.16                 35.60

STORM EVENT (YEAR) =    5.00
Area Averaged 2-Year Rainfall =    2.050(In)
Area Averaged 100-Year Rainfall =    5.160(In)

Point rain (area averaged) =    2.778(In)
Areal adjustment factor =  100.00 %
Adjusted average point rain =    2.778(In)

Sub-Area Data:
Area(Ac.)         Runoff Index   Impervious %
     6.900           56.00         0.850
 Total Area Entered =      6.90(Ac.)


RI    RI   Infil. Rate Impervious   Adj. Infil. Rate  Area%     F
AMC2 AMC-1     (In/Hr)    (Dec.%)      (In/Hr)      (Dec.)    (In/Hr)
56.0  36.0      0.706     0.850        0.166       1.000      0.166
                                                    Sum (F) =   0.166
Area averaged mean soil loss (F) (In/Hr) =  0.166
Minimum soil loss rate ((In/Hr)) =  0.083
```

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.220

U n i t H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %		Unit Hydrograph (CFS)
1	0.250	492.919	70.567		4.907
2	0.500	985.837	29.433		2.047
			Sum = 100.000	Sum=	6.954

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Loss rate(In./Hr) Low	Effective (In/Hr)
1	0.25	0.20	0.022	(0.293)	0.005	0.017
2	0.50	0.30	0.033	(0.290)	0.007	0.026
3	0.75	0.30	0.033	(0.286)	0.007	0.026
4	1.00	0.40	0.044	(0.283)	0.010	0.035
5	1.25	0.30	0.033	(0.279)	0.007	0.026
6	1.50	0.30	0.033	(0.276)	0.007	0.026
7	1.75	0.30	0.033	(0.273)	0.007	0.026
8	2.00	0.40	0.044	(0.270)	0.010	0.035
9	2.25	0.40	0.044	(0.266)	0.010	0.035
10	2.50	0.40	0.044	(0.263)	0.010	0.035
11	2.75	0.50	0.056	(0.260)	0.012	0.043
12	3.00	0.50	0.056	(0.257)	0.012	0.043
13	3.25	0.50	0.056	(0.254)	0.012	0.043
14	3.50	0.50	0.056	(0.250)	0.012	0.043
15	3.75	0.50	0.056	(0.247)	0.012	0.043
16	4.00	0.60	0.067	(0.244)	0.015	0.052
17	4.25	0.60	0.067	(0.241)	0.015	0.052
18	4.50	0.70	0.078	(0.238)	0.017	0.061
19	4.75	0.70	0.078	(0.235)	0.017	0.061
20	5.00	0.80	0.089	(0.232)	0.020	0.069
21	5.25	0.60	0.067	(0.229)	0.015	0.052
22	5.50	0.70	0.078	(0.226)	0.017	0.061
23	5.75	0.80	0.089	(0.223)	0.020	0.069
24	6.00	0.80	0.089	(0.220)	0.020	0.069
25	6.25	0.90	0.100	(0.217)	0.022	0.078
26	6.50	0.90	0.100	(0.214)	0.022	0.078
27	6.75	1.00	0.111	(0.211)	0.024	0.087
28	7.00	1.00	0.111	(0.208)	0.024	0.087
29	7.25	1.00	0.111	(0.206)	0.024	0.087
30	7.50	1.10	0.122	(0.203)	0.027	0.095
31	7.75	1.20	0.133	(0.200)	0.029	0.104
32	8.00	1.30	0.144	(0.197)	0.032	0.113
33	8.25	1.50	0.167	(0.195)	0.037	0.130
34	8.50	1.50	0.167	(0.192)	0.037	0.130
35	8.75	1.60	0.178	(0.189)	0.039	0.139
36	9.00	1.70	0.189	(0.186)	0.042	0.147
37	9.25	1.90	0.211	(0.184)	0.046	0.165
38	9.50	2.00	0.222	(0.181)	0.049	0.173
39	9.75	2.10	0.233	(0.179)	0.051	0.182
40	10.00	2.20	0.244	(0.176)	0.054	0.191
41	10.25	1.50	0.167	(0.174)	0.037	0.130
42	10.50	1.50	0.167	(0.171)	0.037	0.130
43	10.75	2.00	0.222	(0.169)	0.049	0.173
44	11.00	2.00	0.222	(0.166)	0.049	0.173
45	11.25	1.90	0.211	(0.164)	0.046	0.165
46	11.50	1.90	0.211	(0.161)	0.046	0.165
47	11.75	1.70	0.189	(0.159)	0.042	0.147
48	12.00	1.80	0.200	(0.156)	0.044	0.156
49	12.25	2.50	0.278	(0.154)	0.061	0.217
50	12.50	2.60	0.289	(0.152)	0.064	0.225
51	12.75	2.80	0.311	(0.150)	0.068	0.243
52	13.00	2.90	0.322	(0.147)	0.071	0.251
53	13.25	3.40	0.378	(0.145)	0.083	0.295
54	13.50	3.40	0.378	(0.143)	0.083	0.295
55	13.75	2.30	0.256	(0.141)	0.056	0.199
56	14.00	2.30	0.256	(0.139)	0.056	0.199

57	14.25	2.70	0.300	(0.136)	0.066	0.234
58	14.50	2.60	0.289	(0.134)	0.064	0.225
59	14.75	2.60	0.289	(0.132)	0.064	0.225
60	15.00	2.50	0.278	(0.130)	0.061	0.217
61	15.25	2.40	0.267	(0.128)	0.059	0.208
62	15.50	2.30	0.256	(0.126)	0.056	0.199
63	15.75	1.90	0.211	(0.124)	0.046	0.165
64	16.00	1.90	0.211	(0.122)	0.046	0.165
65	16.25	0.40	0.044	(0.121)	0.010	0.035
66	16.50	0.40	0.044	(0.119)	0.010	0.035
67	16.75	0.30	0.033	(0.117)	0.007	0.026
68	17.00	0.30	0.033	(0.115)	0.007	0.026
69	17.25	0.50	0.056	(0.113)	0.012	0.043
70	17.50	0.50	0.056	(0.112)	0.012	0.043
71	17.75	0.50	0.056	(0.110)	0.012	0.043
72	18.00	0.40	0.044	(0.108)	0.010	0.035
73	18.25	0.40	0.044	(0.107)	0.010	0.035
74	18.50	0.40	0.044	(0.105)	0.010	0.035
75	18.75	0.30	0.033	(0.104)	0.007	0.026
76	19.00	0.20	0.022	(0.102)	0.005	0.017
77	19.25	0.30	0.033	(0.101)	0.007	0.026
78	19.50	0.40	0.044	(0.099)	0.010	0.035
79	19.75	0.30	0.033	(0.098)	0.007	0.026
80	20.00	0.20	0.022	(0.097)	0.005	0.017
81	20.25	0.30	0.033	(0.095)	0.007	0.026
82	20.50	0.30	0.033	(0.094)	0.007	0.026
83	20.75	0.30	0.033	(0.093)	0.007	0.026
84	21.00	0.20	0.022	(0.092)	0.005	0.017
85	21.25	0.30	0.033	(0.091)	0.007	0.026
86	21.50	0.20	0.022	(0.090)	0.005	0.017
87	21.75	0.30	0.033	(0.089)	0.007	0.026
88	22.00	0.20	0.022	(0.088)	0.005	0.017
89	22.25	0.30	0.033	(0.087)	0.007	0.026
90	22.50	0.20	0.022	(0.086)	0.005	0.017
91	22.75	0.20	0.022	(0.085)	0.005	0.017
92	23.00	0.20	0.022	(0.085)	0.005	0.017
93	23.25	0.20	0.022	(0.084)	0.005	0.017
94	23.50	0.20	0.022	(0.084)	0.005	0.017
95	23.75	0.20	0.022	(0.083)	0.005	0.017
96	24.00	0.20	0.022	(0.083)	0.005	0.017

```
             (Loss Rate Not Used)
   Sum =     100.0                                  Sum =     8.7
     Flood volume = Effective rainfall      2.17(In)
      times area       6.9(Ac.)/[(In)/(Ft.)] =       1.2(Ac.Ft)
     Total soil loss =      0.61(In)
     Total soil loss =     0.351(Ac.Ft)
     Total rainfall =      2.78(In)
     Flood volume =      54280.7 Cubic Feet
     Total soil loss =      15309.9 Cubic Feet
     --------------------------------------------------------------------
      Peak flow rate of this hydrograph =      2.051(CFS)
     --------------------------------------------------------------------
     ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                         24 - H O U R   S T O R M
                    R u n o f f     H y d r o g r a p h
     --------------------------------------------------------------------
                Hydrograph in  15   Minute intervals ((CFS))

     --------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0        2.5       5.0       7.5      10.0
-----------------------------------------------------------------------
  0+15       0.0018      0.09  Q         |         |         |         |
  0+30       0.0051      0.16  Q         |         |         |         |
  0+45       0.0089      0.18  Q         |         |         |         |
  1+ 0       0.0135      0.22  Q         |         |         |         |
  1+15       0.0176      0.20  Q         |         |         |         |
  1+30       0.0213      0.18  Q         |         |         |         |
  1+45       0.0251      0.18  Q         |         |         |         |
  2+ 0       0.0297      0.22  Q         |         |         |         |
  2+15       0.0347      0.24  QV        |         |         |         |
  2+30       0.0397      0.24  QV        |         |         |         |
  2+45       0.0455      0.28  |Q        |         |         |         |
  3+ 0       0.0517      0.30  |Q        |         |         |         |
  3+15       0.0580      0.30  |Q        |         |         |         |
  3+30       0.0642      0.30  |QV       |         |         |         |
  3+45       0.0704      0.30  |QV       |         |         |         |
  4+ 0       0.0776      0.34  |QV       |         |         |         |
  4+15       0.0850      0.36  |QV       |         |         |         |
  4+30       0.0934      0.40  |QV       |         |         |         |
```

```
 4+45       0.1021      0.42  |Q V      |         |         |         |
 5+ 0       0.1117      0.46  |Q V      |         |         |         |
 5+15       0.1199      0.40  |Q V      |         |         |         |
 5+30       0.1283      0.40  |Q  V     |         |         |         |
 5+45       0.1379      0.46  |Q  V     |         |         |         |
 6+ 0       0.1478      0.48  |Q  V     |         |         |         |
 6+15       0.1587      0.53  | Q  V    |         |         |         |
 6+30       0.1699      0.54  | Q  V    |         |         |         |
 6+45       0.1820      0.59  | Q  V    |         |         |         |
 7+ 0       0.1945      0.60  | Q   V   |         |         |         |
 7+15       0.2069      0.60  | Q   V   |         |         |         |
 7+30       0.2203      0.65  | Q    V  |         |         |         |
 7+45       0.2349      0.71  | Q    V  |         |         |         |
 8+ 0       0.2507      0.77  |  Q    V |         |         |         |
 8+15       0.2686      0.87  |  Q    V |         |         |         |
 8+30       0.2873      0.90  |  Q     V|         |         |         |
 8+45       0.3069      0.95  |  Q     V|         |         |         |
 9+ 0       0.3277      1.01  |   Q     V         |         |         |
 9+15       0.3507      1.11  |   Q      V        |         |         |
 9+30       0.3752      1.19  |   Q     | V       |         |         |
 9+45       0.4010      1.25  |   Q     | V       |         |         |
10+ 0       0.4281      1.31  |    Q    |  V      |         |         |
10+15       0.4493      1.03  |   Q     |   V     |         |         |
10+30       0.4680      0.90  |  Q      |    V    |         |         |
10+45       0.4911      1.12  |   Q     |    V    |         |         |
11+ 0       0.5160      1.21  |   Q     |     V   |         |         |
11+15       0.5401      1.16  |   Q     |      V  |         |         |
11+30       0.5638      1.15  |   Q     |       V |         |         |
11+45       0.5857      1.06  |   Q     |       V |         |         |
12+ 0       0.6077      1.07  |   Q     |        V|         |         |
12+15       0.6363      1.38  |    Q    |         V         |         |
12+30       0.6683      1.55  |     Q   |          V        |         |
12+45       0.7025      1.65  |     Q   |         | V       |         |
13+ 0       0.7383      1.73  |     Q   |         |  V      |         |
13+15       0.7788      1.96  |      Q  |         |   V     |         |
13+30       0.8212      2.05  |       Q |         |     V   |         |
13+45       0.8539      1.58  |     Q   |         |      V  |         |
14+ 0       0.8825      1.39  |    Q    |         |       V |         |
14+15       0.9147      1.56  |     Q   |         |        V|         |
14+30       0.9475      1.59  |     Q   |         |         V         |
14+45       0.9799      1.57  |     Q   |         |          V        |
15+ 0       1.0114      1.53  |     Q   |         |         | V       |
15+15       1.0417      1.47  |    Q    |         |         |  V      |
15+30       1.0707      1.40  |    Q    |         |         |   V     |
15+45       1.0958      1.22  |   Q     |         |         |    V    |
16+ 0       1.1195      1.15  |   Q     |         |         |    V    |
16+15       1.1300      0.51  | Q       |         |         |     V   |
16+30       1.1350      0.24  Q         |         |         |     V   |
16+45       1.1391      0.20  Q         |         |         |     V   |
17+ 0       1.1428      0.18  Q         |         |         |     V   |
17+15       1.1483      0.27  |Q        |         |         |     V   |
17+30       1.1546      0.30  |Q        |         |         |      V  |
17+45       1.1608      0.30  |Q        |         |         |      V  |
18+ 0       1.1661      0.26  |Q        |         |         |      V  |
18+15       1.1711      0.24  Q         |         |         |      V  |
18+30       1.1761      0.24  Q         |         |         |      V  |
18+45       1.1802      0.20  Q         |         |         |      V  |
19+ 0       1.1831      0.14  Q         |         |         |      V  |
19+15       1.1864      0.16  Q         |         |         |       V |
19+30       1.1911      0.22  Q         |         |         |       V |
19+45       1.1952      0.20  Q         |         |         |       V |
20+ 0       1.1980      0.14  Q         |         |         |       V |
20+15       1.2014      0.16  Q         |         |         |       V |
20+30       1.2051      0.18  Q         |         |         |       V |
20+45       1.2089      0.18  Q         |         |         |       V |
21+ 0       1.2117      0.14  Q         |         |         |       V |
21+15       1.2151      0.16  Q         |         |         |        V|
21+30       1.2180      0.14  Q         |         |         |        V|
21+45       1.2213      0.16  Q         |         |         |        V|
22+ 0       1.2242      0.14  Q         |         |         |        V|
22+15       1.2276      0.16  Q         |         |         |        V|
22+30       1.2304      0.14  Q         |         |         |        V|
22+45       1.2329      0.12  Q         |         |         |        V|
23+ 0       1.2354      0.12  Q         |         |         |        V|
23+15       1.2379      0.12  Q         |         |         |        V|
23+30       1.2404      0.12  Q         |         |         |        V|
23+45       1.2429      0.12  Q         |         |         |        V|
24+ 0       1.2454      0.12  Q         |         |         |        V|
24+15       1.2461      0.04  Q         |         |         |        V|
```

U n i t   H y d r o g r a p h   A n a l y s i s

Study date 07/23/19 File: DMAD10EXIST110.out

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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978

Program License Serial Number 6388

English (in-lb) Input Units Used
English Rainfall Data (Inches) Input Values Used

English Units used in output format

KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
EXISTING CONDITION, DMA D
10-YR 1-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019

```
Drainage Area =       6.90(Ac.)  =      0.011 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =       6.90(Ac.)  =      0.011 Sq. Mi.
Length along longest watercourse =    1710.00(Ft.)
Length along longest watercourse measured to centroid =    1043.00(Ft.)
Length along longest watercourse =      0.324 Mi.
Length along longest watercourse measured to centroid =      0.198 Mi.
Difference in elevation =      40.00(Ft.)
Slope along watercourse =    123.5088 Ft./Mi.
Average Manning's 'N' = 0.025
Lag time =    0.085 Hr.
Lag time =     5.07 Min.
25% of lag time =     1.27 Min.
40% of lag time =     2.03 Min.
Unit time =     5.00 Min.
Duration of storm = 1 Hour(s)
User Entered Base Flow =     0.00(CFS)
```

2 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	Weighting[1*2]
6.90	0.49	3.37

100 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	Weighting[1*2]
6.90	1.33	9.18

```
STORM EVENT (YEAR) =   10.00
Area Averaged 2-Year Rainfall =    0.489(In)
Area Averaged 100-Year Rainfall =    1.330(In)

Point rain (area averaged) =    0.835(In)
Areal adjustment factor =   99.99 %
Adjusted average point rain =    0.835(In)
```

Sub-Area Data:

Area(Ac.)	Runoff Index	Impervious %
6.900	56.00	0.150

Total Area Entered =   6.90(Ac.)

RI AMC2	RI AMC-2	Infil. Rate (In/Hr)	Impervious (Dec.%)	Adj. Infil. Rate (In/Hr)	Area% (Dec.)	F (In/Hr)
56.0	56.0	0.511	0.150	0.442	1.000	0.442
					Sum (F) =	0.442

Area averaged mean soil loss (F) (In/Hr) = 0.442
Minimum soil loss rate ((In/Hr)) = 0.221

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.780

Slope of intensity-duration curve for a 1 hour storm =0.5000

U n i t   H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.083	98.584	18.765	1.305
2	0.167	197.167	48.285	3.358
3	0.250	295.751	15.854	1.102
4	0.333	394.335	7.138	0.496
5	0.417	492.919	4.033	0.280
6	0.500	591.502	2.616	0.182
7	0.583	690.086	1.645	0.114
8	0.667	788.670	1.057	0.073
9	0.750	887.254	0.606	0.042
			Sum = 100.000	Sum= 6.954

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Low	Effective (In/Hr)
1	0.08	4.20	0.421	(0.442)	0.328	0.093
2	0.17	4.30	0.431	(0.442)	0.336	0.095
3	0.25	5.00	0.501	(0.442)	0.391	0.110
4	0.33	5.00	0.501	(0.442)	0.391	0.110
5	0.42	5.80	0.581	0.442	(0.453)	0.139
6	0.50	6.50	0.651	0.442	(0.508)	0.209
7	0.58	7.40	0.741	0.442	(0.578)	0.300
8	0.67	8.60	0.862	0.442	(0.672)	0.420
9	0.75	12.30	1.232	0.442	(0.961)	0.791
10	0.83	29.10	2.916	0.442	(2.274)	2.474
11	0.92	6.80	0.681	0.442	(0.531)	0.239
12	1.00	5.00	0.501	(0.442)	0.391	0.110

(Loss Rate Not Used)
Sum = 100.0 Sum = 5.1

```
Flood volume = Effective rainfall      0.42(In)
 times area       6.9(Ac.)/[(In)/(Ft.)] =       0.2(Ac.Ft)
Total soil loss =      0.41(In)
Total soil loss =     0.236(Ac.Ft)
Total rainfall =      0.83(In)
Flood volume =       10623.8 Cubic Feet
Total soil loss =       10289.0 Cubic Feet
--------------------------------------------------------------------
 Peak flow rate of this hydrograph =      9.854(CFS)
--------------------------------------------------------------------
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                   1 - H O U R   S T O R M
              R u n o f f     H y d r o g r a p h
--------------------------------------------------------------------
            Hydrograph in   5   Minute intervals ((CFS))

--------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0        2.5       5.0       7.5      10.0
-----------------------------------------------------------------------
  0+ 5      0.0008      0.12  Q          |         |         |         |
  0+10      0.0038      0.43  VQ         |         |         |         |
  0+15      0.0077      0.56  |VQ        |         |         |         |
  0+20      0.0123      0.66  | Q        |         |         |         |
  0+25      0.0174      0.75  | Q        |         |         |         |
  0+30      0.0241      0.96  |  Q       |         |         |         |
  0+35      0.0334      1.36  |    Q     |         |         |         |
  0+40      0.0467      1.92  |      Q   |         |         |         |
  0+45      0.0671      2.96  |         VQ         |         |         |
  0+50      0.1126      6.61  |          |      V  |      Q  |         |
  0+55      0.1804      9.85  |          |         |        V|        Q|
  1+ 0      0.2099      4.28  |          |     Q   |         |    V    |
  1+ 5      0.2252      2.22  |        Q |         |         |      V  |
  1+10      0.2331      1.16  |   Q      |         |         |        V|
```

```
    1+15        0.2380       0.71  | Q       |         |         |        V|
    1+20        0.2410       0.43  |Q        |         |         |        V|
    1+25        0.2428       0.26  |Q        |         |         |        V|
    1+30        0.2437       0.13  Q         |         |         |        V|
    1+35        0.2439       0.02  Q         |         |         |        V|
    1+40        0.2439       0.00  Q         |         |         |        V|
-----------------------------------------------------------------------
```

```
      U n i t   H y d r o g r a p h   A n a l y s i s

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               Study date  07/23/19 File: DMAD10EXIST310.out


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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978


Program License Serial Number 6388

---------------------------------------------------------------------
 English (in-lb) Input Units Used
 English Rainfall Data (Inches) Input Values Used

 English Units used in output format



---------------------------------------------------------------------
KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
EXISTING CONDITION, DMA D
10-YR 3-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019
--------------------------------------------------------------------
Drainage Area =       6.90(Ac.)  =      0.011 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =       6.90(Ac.)  =      0.011 Sq. Mi.
Length along longest watercourse =    1710.00(Ft.)
Length along longest watercourse measured to centroid =    1043.00(Ft.)
Length along longest watercourse =      0.324 Mi.
Length along longest watercourse measured to centroid =      0.198 Mi.
Difference in elevation =      40.00(Ft.)
Slope along watercourse =    123.5088 Ft./Mi.
Average Manning's 'N' = 0.025
Lag time =    0.085 Hr.
Lag time =     5.07 Min.
25% of lag time =     1.27 Min.
40% of lag time =     2.03 Min.
Unit time =     5.00 Min.
Duration of storm = 3 Hour(s)
User Entered Base Flow =     0.00(CFS)

2 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        6.90           0.87                  5.98

100 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        6.90           2.09                 14.42

STORM EVENT (YEAR) =   10.00
Area Averaged 2-Year Rainfall =    0.866(In)
Area Averaged 100-Year Rainfall =    2.090(In)

Point rain (area averaged) =    1.370(In)
Areal adjustment factor =  100.00 %
Adjusted average point rain =    1.370(In)

Sub-Area Data:
Area(Ac.)         Runoff Index   Impervious %
     6.900           56.00         0.150
 Total Area Entered =      6.90(Ac.)


RI    RI   Infil. Rate Impervious   Adj. Infil. Rate  Area%     F
AMC2 AMC-2     (In/Hr)    (Dec.%)      (In/Hr)      (Dec.)    (In/Hr)
56.0  56.0      0.511     0.150        0.442       1.000      0.442
                                                  Sum (F) =   0.442
Area averaged mean soil loss (F) (In/Hr) =  0.442
Minimum soil loss rate ((In/Hr)) =  0.221
```

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.780

U n i t H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.083	98.584	18.765	1.305
2	0.167	197.167	48.285	3.358
3	0.250	295.751	15.854	1.102
4	0.333	394.335	7.138	0.496
5	0.417	492.919	4.033	0.280
6	0.500	591.502	2.616	0.182
7	0.583	690.086	1.645	0.114
8	0.667	788.670	1.057	0.073
9	0.750	887.254	0.606	0.042
			Sum = 100.000	Sum= 6.954

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Low	Effective (In/Hr)
1	0.08	1.30	0.214	(0.442)	0.167	0.047
2	0.17	1.30	0.214	(0.442)	0.167	0.047
3	0.25	1.10	0.181	(0.442)	0.141	0.040
4	0.33	1.50	0.247	(0.442)	0.192	0.054
5	0.42	1.50	0.247	(0.442)	0.192	0.054
6	0.50	1.80	0.296	(0.442)	0.231	0.065
7	0.58	1.50	0.247	(0.442)	0.192	0.054
8	0.67	1.80	0.296	(0.442)	0.231	0.065
9	0.75	1.80	0.296	(0.442)	0.231	0.065
10	0.83	1.50	0.247	(0.442)	0.192	0.054
11	0.92	1.60	0.263	(0.442)	0.205	0.058
12	1.00	1.80	0.296	(0.442)	0.231	0.065
13	1.08	2.20	0.362	(0.442)	0.282	0.080
14	1.17	2.20	0.362	(0.442)	0.282	0.080
15	1.25	2.20	0.362	(0.442)	0.282	0.080
16	1.33	2.00	0.329	(0.442)	0.256	0.072
17	1.42	2.60	0.427	(0.442)	0.333	0.094
18	1.50	2.70	0.444	(0.442)	0.346	0.098
19	1.58	2.40	0.394	(0.442)	0.308	0.087
20	1.67	2.70	0.444	(0.442)	0.346	0.098
21	1.75	3.30	0.542	(0.442)	0.423	0.119
22	1.83	3.10	0.509	(0.442)	0.397	0.112
23	1.92	2.90	0.477	(0.442)	0.372	0.105
24	2.00	3.00	0.493	(0.442)	0.385	0.108
25	2.08	3.10	0.509	(0.442)	0.397	0.112
26	2.17	4.20	0.690	0.442	(0.538)	0.248
27	2.25	5.00	0.822	0.442	(0.641)	0.380
28	2.33	3.50	0.575	0.442	(0.449)	0.133
29	2.42	6.80	1.118	0.442	(0.872)	0.676
30	2.50	7.30	1.200	0.442	(0.936)	0.758
31	2.58	8.20	1.348	0.442	(1.051)	0.906
32	2.67	5.90	0.970	0.442	(0.756)	0.528
33	2.75	2.00	0.329	(0.442)	0.256	0.072
34	2.83	1.80	0.296	(0.442)	0.231	0.065
35	2.92	1.80	0.296	(0.442)	0.231	0.065
36	3.00	0.60	0.099	(0.442)	0.077	0.022

(Loss Rate Not Used)
Sum = 100.0 Sum = 5.8

Flood volume = Effective rainfall 0.48(In)
times area 6.9(Ac.)/[(In)/(Ft.)] = 0.3(Ac.Ft)
Total soil loss = 0.89(In)
Total soil loss = 0.511(Ac.Ft)
Total rainfall = 1.37(In)
Flood volume = 12034.0 Cubic Feet
Total soil loss = 22268.4 Cubic Feet

Peak flow rate of this hydrograph = 5.051(CFS)

+++

```
                                  3 - H O U R   S T O R M
                             R u n o f f     H y d r o g r a p h
       --------------------------------------------------------------------
                          Hydrograph in   5   Minute intervals ((CFS))

       --------------------------------------------------------------------
  Time(h+m) Volume Ac.Ft   Q(CFS)  0         2.5       5.0       7.5      10.0
  -----------------------------------------------------------------------
    0+ 5       0.0004     0.06  Q         |         |         |         |
    0+10       0.0019     0.22  Q         |         |         |         |
    0+15       0.0037     0.26  VQ        |         |         |         |
    0+20       0.0057     0.28  VQ        |         |         |         |
    0+25       0.0080     0.33  |Q        |         |         |         |
    0+30       0.0105     0.37  |Q        |         |         |         |
    0+35       0.0133     0.40  |Q        |         |         |         |
    0+40       0.0160     0.40  |QV       |         |         |         |
    0+45       0.0190     0.43  |QV       |         |         |         |
    0+50       0.0219     0.43  |Q V      |         |         |         |
    0+55       0.0247     0.40  |Q V      |         |         |         |
    1+ 0       0.0275     0.41  |Q V      |         |         |         |
    1+ 5       0.0307     0.46  |Q  V     |         |         |         |
    1+10       0.0342     0.51  | Q V     |         |         |         |
    1+15       0.0378     0.53  | Q  V    |         |         |         |
    1+20       0.0415     0.53  | Q   V   |         |         |         |
    1+25       0.0452     0.54  | Q   V   |         |         |         |
    1+30       0.0495     0.61  | Q    V  |         |         |         |
    1+35       0.0538     0.63  | Q    V  |         |         |         |
    1+40       0.0581     0.63  | Q     V |         |         |         |
    1+45       0.0629     0.69  | Q      V|         |         |         |
    1+50       0.0681     0.76  |  Q     V|         |         |         |
    1+55       0.0733     0.76  |  Q      V         |         |         |
    2+ 0       0.0784     0.74  | Q       |V        |         |         |
    2+ 5       0.0836     0.75  |  Q      | V       |         |         |
    2+10       0.0901     0.95  |  Q      |  V      |         |         |
    2+15       0.1010     1.58  |     Q   |   V     |         |         |
    2+20       0.1138     1.86  |      Q  |     V   |         |         |
    2+25       0.1272     1.95  |      Q  |       V |         |         |
    2+30       0.1528     3.71  |         |   Q     | V       |         |
    2+35       0.1852     4.72  |         |       Q |     V   |         |
    2+40       0.2200     5.05  |         |         Q         |V        |
    2+45       0.2443     3.52  |         |   Q     |         |    V    |
    2+50       0.2563     1.75  |     Q   |         |         |      V  |
    2+55       0.2642     1.14  |   Q     |         |         |       V |
    3+ 0       0.2698     0.81  |  Q      |         |         |        V|
    3+ 5       0.2731     0.48  |Q        |         |         |        V|
    3+10       0.2748     0.25  Q         |         |         |        V|
    3+15       0.2757     0.13  Q         |         |         |        V|
    3+20       0.2760     0.05  Q         |         |         |        V|
    3+25       0.2762     0.02  Q         |         |         |        V|
    3+30       0.2762     0.01  Q         |         |         |        V|
    3+35       0.2763     0.00  Q         |         |         |        V|
    3+40       0.2763     0.00  Q         |         |         |         V
-----------------------------------------------------------------------
```

```
      U n i t   H y d r o g r a p h   A n a l y s i s

       Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2014, Version 9.0
               Study date  07/23/19 File: DMAD10EXIST610.out

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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978


Program License Serial Number 6388

---------------------------------------------------------------------
 English (in-lb) Input Units Used
 English Rainfall Data (Inches) Input Values Used

 English Units used in output format



---------------------------------------------------------------------
KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
EXISTING CONDITION, DMA D
10-YR 6-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019
--------------------------------------------------------------------
Drainage Area =       6.90(Ac.)  =      0.011 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =       6.90(Ac.)  =      0.011 Sq. Mi.
Length along longest watercourse =    1710.00(Ft.)
Length along longest watercourse measured to centroid =    1043.00(Ft.)
Length along longest watercourse =      0.324 Mi.
Length along longest watercourse measured to centroid =      0.198 Mi.
Difference in elevation =      40.00(Ft.)
Slope along watercourse =    123.5088 Ft./Mi.
Average Manning's 'N' = 0.025
Lag time =    0.085 Hr.
Lag time =     5.07 Min.
25% of lag time =     1.27 Min.
40% of lag time =     2.03 Min.
Unit time =     5.00 Min.
Duration of storm = 6 Hour(s)
User Entered Base Flow =     0.00(CFS)

2 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        6.90           1.21                  8.35

100 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        6.90           2.86                 19.73

STORM EVENT (YEAR) =   10.00
Area Averaged 2-Year Rainfall =    1.210(In)
Area Averaged 100-Year Rainfall =    2.860(In)

Point rain (area averaged) =    1.889(In)
Areal adjustment factor =  100.00 %
Adjusted average point rain =    1.889(In)

Sub-Area Data:
Area(Ac.)         Runoff Index   Impervious %
     6.900           56.00         0.150
 Total Area Entered =      6.90(Ac.)


RI    RI   Infil. Rate Impervious   Adj. Infil. Rate  Area%     F
AMC2 AMC-2     (In/Hr)    (Dec.%)      (In/Hr)      (Dec.)    (In/Hr)
56.0  56.0      0.511     0.150        0.442       1.000      0.442
                                                   Sum (F) =   0.442
Area averaged mean soil loss (F) (In/Hr) =  0.442
Minimum soil loss rate ((In/Hr)) =  0.221
```

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.780

U n i t H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.083	98.584	18.765	1.305
2	0.167	197.167	48.285	3.358
3	0.250	295.751	15.854	1.102
4	0.333	394.335	7.138	0.496
5	0.417	492.919	4.033	0.280
6	0.500	591.502	2.616	0.182
7	0.583	690.086	1.645	0.114
8	0.667	788.670	1.057	0.073
9	0.750	887.254	0.606	0.042
			Sum = 100.000	Sum= 6.954

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Loss rate(In./Hr) Low	Effective (In/Hr)
1	0.08	0.50	0.113	(0.442)	0.088	0.025
2	0.17	0.60	0.136	(0.442)	0.106	0.030
3	0.25	0.60	0.136	(0.442)	0.106	0.030
4	0.33	0.60	0.136	(0.442)	0.106	0.030
5	0.42	0.60	0.136	(0.442)	0.106	0.030
6	0.50	0.70	0.159	(0.442)	0.124	0.035
7	0.58	0.70	0.159	(0.442)	0.124	0.035
8	0.67	0.70	0.159	(0.442)	0.124	0.035
9	0.75	0.70	0.159	(0.442)	0.124	0.035
10	0.83	0.70	0.159	(0.442)	0.124	0.035
11	0.92	0.70	0.159	(0.442)	0.124	0.035
12	1.00	0.80	0.181	(0.442)	0.141	0.040
13	1.08	0.80	0.181	(0.442)	0.141	0.040
14	1.17	0.80	0.181	(0.442)	0.141	0.040
15	1.25	0.80	0.181	(0.442)	0.141	0.040
16	1.33	0.80	0.181	(0.442)	0.141	0.040
17	1.42	0.80	0.181	(0.442)	0.141	0.040
18	1.50	0.80	0.181	(0.442)	0.141	0.040
19	1.58	0.80	0.181	(0.442)	0.141	0.040
20	1.67	0.80	0.181	(0.442)	0.141	0.040
21	1.75	0.80	0.181	(0.442)	0.141	0.040
22	1.83	0.80	0.181	(0.442)	0.141	0.040
23	1.92	0.80	0.181	(0.442)	0.141	0.040
24	2.00	0.90	0.204	(0.442)	0.159	0.045
25	2.08	0.80	0.181	(0.442)	0.141	0.040
26	2.17	0.90	0.204	(0.442)	0.159	0.045
27	2.25	0.90	0.204	(0.442)	0.159	0.045
28	2.33	0.90	0.204	(0.442)	0.159	0.045
29	2.42	0.90	0.204	(0.442)	0.159	0.045
30	2.50	0.90	0.204	(0.442)	0.159	0.045
31	2.58	0.90	0.204	(0.442)	0.159	0.045
32	2.67	0.90	0.204	(0.442)	0.159	0.045
33	2.75	1.00	0.227	(0.442)	0.177	0.050
34	2.83	1.00	0.227	(0.442)	0.177	0.050
35	2.92	1.00	0.227	(0.442)	0.177	0.050
36	3.00	1.00	0.227	(0.442)	0.177	0.050
37	3.08	1.00	0.227	(0.442)	0.177	0.050
38	3.17	1.10	0.249	(0.442)	0.194	0.055
39	3.25	1.10	0.249	(0.442)	0.194	0.055
40	3.33	1.10	0.249	(0.442)	0.194	0.055
41	3.42	1.20	0.272	(0.442)	0.212	0.060
42	3.50	1.30	0.295	(0.442)	0.230	0.065
43	3.58	1.40	0.317	(0.442)	0.248	0.070
44	3.67	1.40	0.317	(0.442)	0.248	0.070
45	3.75	1.50	0.340	(0.442)	0.265	0.075
46	3.83	1.50	0.340	(0.442)	0.265	0.075
47	3.92	1.60	0.363	(0.442)	0.283	0.080
48	4.00	1.60	0.363	(0.442)	0.283	0.080
49	4.08	1.70	0.385	(0.442)	0.301	0.085

```
50   4.17     1.80      0.408       (  0.442)       0.318        0.090
51   4.25     1.90      0.431       (  0.442)       0.336        0.095
52   4.33     2.00      0.453       (  0.442)       0.354        0.100
53   4.42     2.10      0.476       (  0.442)       0.371        0.105
54   4.50     2.10      0.476       (  0.442)       0.371        0.105
55   4.58     2.20      0.499       (  0.442)       0.389        0.110
56   4.67     2.30      0.521       (  0.442)       0.407        0.115
57   4.75     2.40      0.544       (  0.442)       0.424        0.120
58   4.83     2.40      0.544       (  0.442)       0.424        0.120
59   4.92     2.50      0.567          0.442    (  0.442)        0.125
60   5.00     2.60      0.589          0.442    (  0.460)        0.147
61   5.08     3.10      0.703          0.442    (  0.548)        0.261
62   5.17     3.60      0.816          0.442    (  0.636)        0.374
63   5.25     3.90      0.884          0.442    (  0.689)        0.442
64   5.33     4.20      0.952          0.442    (  0.743)        0.510
65   5.42     4.70      1.065          0.442    (  0.831)        0.623
66   5.50     5.60      1.269          0.442    (  0.990)        0.827
67   5.58     1.90      0.431       (  0.442)       0.336        0.095
68   5.67     0.90      0.204       (  0.442)       0.159        0.045
69   5.75     0.60      0.136       (  0.442)       0.106        0.030
70   5.83     0.50      0.113       (  0.442)       0.088        0.025
71   5.92     0.30      0.068       (  0.442)       0.053        0.015
72   6.00     0.20      0.045       (  0.442)       0.035        0.010
              (Loss Rate Not Used)
   Sum =     100.0                                 Sum =     6.8
     Flood volume = Effective rainfall      0.57(In)
      times area       6.9(Ac.)/[(In)/(Ft.)] =       0.3(Ac.Ft)
     Total soil loss =      1.32(In)
     Total soil loss =     0.761(Ac.Ft)
     Total rainfall =      1.89(In)
     Flood volume =       14173.9 Cubic Feet
     Total soil loss =       33134.4 Cubic Feet
     --------------------------------------------------------------------
      Peak flow rate of this hydrograph =      4.140(CFS)
     --------------------------------------------------------------------
     ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                         6 - H O U R   S T O R M
                    R u n o f f     H y d r o g r a p h
     --------------------------------------------------------------------
                 Hydrograph in   5   Minute intervals ((CFS))

     --------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0        2.5       5.0       7.5      10.0
-----------------------------------------------------------------------
  0+ 5       0.0002      0.03  Q          |         |         |         |
  0+10       0.0011      0.12  Q          |         |         |         |
  0+15       0.0022      0.17  Q          |         |         |         |
  0+20       0.0035      0.18  Q          |         |         |         |
  0+25       0.0048      0.19  Q          |         |         |         |
  0+30       0.0063      0.21  Q          |         |         |         |
  0+35       0.0078      0.23  Q          |         |         |         |
  0+40       0.0094      0.24  QV         |         |         |         |
  0+45       0.0111      0.24  QV         |         |         |         |
  0+50       0.0128      0.24  QV         |         |         |         |
  0+55       0.0144      0.24  QV         |         |         |         |
  1+ 0       0.0161      0.25  QV         |         |         |         |
  1+ 5       0.0180      0.27  |QV        |         |         |         |
  1+10       0.0198      0.27  |QV        |         |         |         |
  1+15       0.0217      0.27  |QV        |         |         |         |
  1+20       0.0236      0.28  |QV        |         |         |         |
  1+25       0.0255      0.28  |Q V       |         |         |         |
  1+30       0.0274      0.28  |Q V       |         |         |         |
  1+35       0.0293      0.28  |Q V       |         |         |         |
  1+40       0.0312      0.28  |Q V       |         |         |         |
  1+45       0.0332      0.28  |Q  V      |         |         |         |
  1+50       0.0351      0.28  |Q  V      |         |         |         |
  1+55       0.0370      0.28  |Q  V      |         |         |         |
  2+ 0       0.0389      0.28  |Q  V      |         |         |         |
  2+ 5       0.0410      0.29  |Q   V     |         |         |         |
  2+10       0.0430      0.29  |Q   V     |         |         |         |
  2+15       0.0450      0.30  |Q   V     |         |         |         |
  2+20       0.0472      0.31  |Q   V     |         |         |         |
  2+25       0.0493      0.31  |Q    V    |         |         |         |
  2+30       0.0514      0.31  |Q    V    |         |         |         |
  2+35       0.0536      0.31  |Q    V    |         |         |         |
  2+40       0.0557      0.31  |Q    V    |         |         |         |
  2+45       0.0579      0.32  |Q     V   |         |         |         |
  2+50       0.0602      0.34  |Q     V   |         |         |         |
  2+55       0.0626      0.34  |Q     V   |         |         |         |
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    3+ 0       0.0650      0.34  |Q     V  |         |         |         |
    3+ 5       0.0673      0.34  |Q      V |         |         |         |
    3+10       0.0698      0.35  |Q      V |         |         |         |
    3+15       0.0723      0.37  |Q      V |         |         |         |
    3+20       0.0749      0.38  |Q       V|         |         |         |
    3+25       0.0775      0.38  |Q       V|         |         |         |
    3+30       0.0804      0.41  |Q       V|         |         |         |
    3+35       0.0834      0.44  |Q        V         |         |         |
    3+40       0.0866      0.46  |Q        V         |         |         |
    3+45       0.0899      0.48  |Q        |V        |         |         |
    3+50       0.0933      0.50  | Q       |V        |         |         |
    3+55       0.0969      0.52  | Q       |V        |         |         |
    4+ 0       0.1006      0.54  | Q       | V       |         |         |
    4+ 5       0.1044      0.55  | Q       | V       |         |         |
    4+10       0.1084      0.58  | Q       |  V      |         |         |
    4+15       0.1126      0.61  | Q       |  V      |         |         |
    4+20       0.1171      0.64  | Q       |   V     |         |         |
    4+25       0.1217      0.68  | Q       |   V     |         |         |
    4+30       0.1266      0.70  | Q       |    V    |         |         |
    4+35       0.1315      0.72  | Q       |     V   |         |         |
    4+40       0.1367      0.75  |  Q      |     V   |         |         |
    4+45       0.1421      0.78  |  Q      |      V  |         |         |
    4+50       0.1477      0.81  |  Q      |       V |         |         |
    4+55       0.1534      0.83  |  Q      |       V |         |         |
    5+ 0       0.1594      0.88  |  Q      |        V|         |         |
    5+ 5       0.1671      1.11  |   Q     |         V         |         |
    5+10       0.1786      1.67  |     Q   |         |V        |         |
    5+15       0.1943      2.28  |        Q|         |  V      |         |
    5+20       0.2135      2.78  |         |Q        |     V   |         |
    5+25       0.2364      3.33  |         |  Q      |        V|         |
    5+30       0.2649      4.14  |         |     Q   |         | V       |
    5+35       0.2930      4.08  |         |     Q   |         |     V   |
    5+40       0.3060      1.89  |      Q  |         |         |      V  |
    5+45       0.3134      1.06  |   Q     |         |         |       V |
    5+50       0.3181      0.68  | Q       |         |         |        V|
    5+55       0.3212      0.46  |Q        |         |         |        V|
    6+ 0       0.3233      0.30  |Q        |         |         |        V|
    6+ 5       0.3245      0.18  Q         |         |         |        V|
    6+10       0.3251      0.08  Q         |         |         |        V|
    6+15       0.3252      0.02  Q         |         |         |        V|
    6+20       0.3253      0.01  Q         |         |         |        V|
    6+25       0.3254      0.01  Q         |         |         |        V|
    6+30       0.3254      0.00  Q         |         |         |        V|
    6+35       0.3254      0.00  Q         |         |         |        V|
    6+40       0.3254      0.00  Q         |         |         |        V|
-----------------------------------------------------------------------
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U n i t   H y d r o g r a p h   A n a l y s i s

Study date 07/23/19 File: DMAD10EXIST2410.out

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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978

Program License Serial Number 6388

English (in-lb) Input Units Used
English Rainfall Data (Inches) Input Values Used

English Units used in output format

KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
EXISTING CONDITION, DMA D
10-YR 24-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019

Drainage Area =   6.90(Ac.) =   0.011 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =   6.90(Ac.) =   0.011 Sq. Mi.
Length along longest watercourse =   1710.00(Ft.)
Length along longest watercourse measured to centroid =   1043.00(Ft.)
Length along longest watercourse =   0.324 Mi.
Length along longest watercourse measured to centroid =   0.198 Mi.
Difference in elevation =   40.00(Ft.)
Slope along watercourse =   123.5088 Ft./Mi.
Average Manning's 'N' = 0.025
Lag time =   0.085 Hr.
Lag time =   5.07 Min.
25% of lag time =   1.27 Min.
40% of lag time =   2.03 Min.
Unit time =   15.00 Min.
Duration of storm = 24 Hour(s)
User Entered Base Flow =   0.00(CFS)

2 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	Weighting[1*2]
6.90	2.05	14.15

100 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	Weighting[1*2]
6.90	5.16	35.60

STORM EVENT (YEAR) =   10.00
Area Averaged 2-Year Rainfall =   2.050(In)
Area Averaged 100-Year Rainfall =   5.160(In)

Point rain (area averaged) =   3.329(In)
Areal adjustment factor = 100.00 %
Adjusted average point rain =   3.329(In)

Sub-Area Data:

Area(Ac.)	Runoff Index	Impervious %
6.900	56.00	0.150

Total Area Entered =   6.90(Ac.)

RI AMC2	RI AMC-2	Infil. Rate (In/Hr)	Impervious (Dec.%)	Adj. Infil. Rate (In/Hr)	Area% (Dec.)	F (In/Hr)
56.0	56.0	0.511	0.150	0.442	1.000	0.442
					Sum (F) =	0.442

Area averaged mean soil loss (F) (In/Hr) = 0.442
Minimum soil loss rate ((In/Hr)) = 0.221

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.780

U n i t H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.250	295.751	56.239	3.911
2	0.500	591.502	37.364	2.598
3	0.750	887.254	6.397	0.445
			Sum = 100.000	Sum= 6.954

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Loss rate(In./Hr) Low	Effective (In/Hr)
1	0.25	0.20	0.027	(0.780)	0.021	0.006
2	0.50	0.30	0.040	(0.771)	0.031	0.009
3	0.75	0.30	0.040	(0.762)	0.031	0.009
4	1.00	0.40	0.053	(0.753)	0.042	0.012
5	1.25	0.30	0.040	(0.744)	0.031	0.009
6	1.50	0.30	0.040	(0.736)	0.031	0.009
7	1.75	0.30	0.040	(0.727)	0.031	0.009
8	2.00	0.40	0.053	(0.718)	0.042	0.012
9	2.25	0.40	0.053	(0.709)	0.042	0.012
10	2.50	0.40	0.053	(0.701)	0.042	0.012
11	2.75	0.50	0.067	(0.692)	0.052	0.015
12	3.00	0.50	0.067	(0.684)	0.052	0.015
13	3.25	0.50	0.067	(0.675)	0.052	0.015
14	3.50	0.50	0.067	(0.667)	0.052	0.015
15	3.75	0.50	0.067	(0.658)	0.052	0.015
16	4.00	0.60	0.080	(0.650)	0.062	0.018
17	4.25	0.60	0.080	(0.642)	0.062	0.018
18	4.50	0.70	0.093	(0.634)	0.073	0.021
19	4.75	0.70	0.093	(0.626)	0.073	0.021
20	5.00	0.80	0.107	(0.617)	0.083	0.023
21	5.25	0.60	0.080	(0.609)	0.062	0.018
22	5.50	0.70	0.093	(0.602)	0.073	0.021
23	5.75	0.80	0.107	(0.594)	0.083	0.023
24	6.00	0.80	0.107	(0.586)	0.083	0.023
25	6.25	0.90	0.120	(0.578)	0.093	0.026
26	6.50	0.90	0.120	(0.570)	0.093	0.026
27	6.75	1.00	0.133	(0.563)	0.104	0.029
28	7.00	1.00	0.133	(0.555)	0.104	0.029
29	7.25	1.00	0.133	(0.548)	0.104	0.029
30	7.50	1.10	0.146	(0.540)	0.114	0.032
31	7.75	1.20	0.160	(0.533)	0.125	0.035
32	8.00	1.30	0.173	(0.525)	0.135	0.038
33	8.25	1.50	0.200	(0.518)	0.156	0.044
34	8.50	1.50	0.200	(0.511)	0.156	0.044
35	8.75	1.60	0.213	(0.504)	0.166	0.047
36	9.00	1.70	0.226	(0.497)	0.177	0.050
37	9.25	1.90	0.253	(0.490)	0.197	0.056
38	9.50	2.00	0.266	(0.483)	0.208	0.059
39	9.75	2.10	0.280	(0.476)	0.218	0.062
40	10.00	2.20	0.293	(0.469)	0.229	0.064
41	10.25	1.50	0.200	(0.462)	0.156	0.044
42	10.50	1.50	0.200	(0.455)	0.156	0.044
43	10.75	2.00	0.266	(0.449)	0.208	0.059
44	11.00	2.00	0.266	(0.442)	0.208	0.059
45	11.25	1.90	0.253	(0.436)	0.197	0.056
46	11.50	1.90	0.253	(0.429)	0.197	0.056
47	11.75	1.70	0.226	(0.423)	0.177	0.050
48	12.00	1.80	0.240	(0.417)	0.187	0.053
49	12.25	2.50	0.333	(0.410)	0.260	0.073
50	12.50	2.60	0.346	(0.404)	0.270	0.076
51	12.75	2.80	0.373	(0.398)	0.291	0.082
52	13.00	2.90	0.386	(0.392)	0.301	0.085
53	13.25	3.40	0.453	(0.386)	0.353	0.100
54	13.50	3.40	0.453	(0.380)	0.353	0.100
55	13.75	2.30	0.306	(0.375)	0.239	0.067

56	14.00	2.30	0.306	(0.369)	0.239	0.067
57	14.25	2.70	0.360	(0.363)	0.280	0.079
58	14.50	2.60	0.346	(0.358)	0.270	0.076
59	14.75	2.60	0.346	(0.352)	0.270	0.076
60	15.00	2.50	0.333	(0.347)	0.260	0.073
61	15.25	2.40	0.320	(0.342)	0.249	0.070
62	15.50	2.30	0.306	(0.336)	0.239	0.067
63	15.75	1.90	0.253	(0.331)	0.197	0.056
64	16.00	1.90	0.253	(0.326)	0.197	0.056
65	16.25	0.40	0.053	(0.321)	0.042	0.012
66	16.50	0.40	0.053	(0.316)	0.042	0.012
67	16.75	0.30	0.040	(0.311)	0.031	0.009
68	17.00	0.30	0.040	(0.307)	0.031	0.009
69	17.25	0.50	0.067	(0.302)	0.052	0.015
70	17.50	0.50	0.067	(0.298)	0.052	0.015
71	17.75	0.50	0.067	(0.293)	0.052	0.015
72	18.00	0.40	0.053	(0.289)	0.042	0.012
73	18.25	0.40	0.053	(0.285)	0.042	0.012
74	18.50	0.40	0.053	(0.280)	0.042	0.012
75	18.75	0.30	0.040	(0.276)	0.031	0.009
76	19.00	0.20	0.027	(0.272)	0.021	0.006
77	19.25	0.30	0.040	(0.269)	0.031	0.009
78	19.50	0.40	0.053	(0.265)	0.042	0.012
79	19.75	0.30	0.040	(0.261)	0.031	0.009
80	20.00	0.20	0.027	(0.258)	0.021	0.006
81	20.25	0.30	0.040	(0.254)	0.031	0.009
82	20.50	0.30	0.040	(0.251)	0.031	0.009
83	20.75	0.30	0.040	(0.248)	0.031	0.009
84	21.00	0.20	0.027	(0.245)	0.021	0.006
85	21.25	0.30	0.040	(0.242)	0.031	0.009
86	21.50	0.20	0.027	(0.239)	0.021	0.006
87	21.75	0.30	0.040	(0.237)	0.031	0.009
88	22.00	0.20	0.027	(0.234)	0.021	0.006
89	22.25	0.30	0.040	(0.232)	0.031	0.009
90	22.50	0.20	0.027	(0.230)	0.021	0.006
91	22.75	0.20	0.027	(0.228)	0.021	0.006
92	23.00	0.20	0.027	(0.226)	0.021	0.006
93	23.25	0.20	0.027	(0.224)	0.021	0.006
94	23.50	0.20	0.027	(0.223)	0.021	0.006
95	23.75	0.20	0.027	(0.222)	0.021	0.006
96	24.00	0.20	0.027	(0.221)	0.021	0.006
			(Loss Rate Not Used)			
	Sum =	100.0			Sum =	2.9

Flood volume = Effective rainfall 0.73(In)
times area 6.9(Ac.)/[(In)/(Ft.)] = 0.4(Ac.Ft)
Total soil loss = 2.60(In)
Total soil loss = 1.493(Ac.Ft)
Total rainfall = 3.33(In)
Flood volume = 18346.3 Cubic Feet
Total soil loss = 65046.0 Cubic Feet

Peak flow rate of this hydrograph = 0.687(CFS)

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+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                    24 - H O U R   S T O R M
               R u n o f f     H y d r o g r a p h
---------------------------------------------------------------------
            Hydrograph in  15   Minute intervals ((CFS))

---------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0        2.5       5.0       7.5      10.0
-----------------------------------------------------------------------
  0+15       0.0005      0.02  Q          |         |         |         |
  0+30       0.0015      0.05  Q          |         |         |         |
  0+45       0.0027      0.06  Q          |         |         |         |
  1+ 0       0.0042      0.07  Q          |         |         |         |
  1+15       0.0057      0.07  Q          |         |         |         |
  1+30       0.0069      0.06  Q          |         |         |         |
  1+45       0.0082      0.06  Q          |         |         |         |
  2+ 0       0.0097      0.07  Q          |         |         |         |
  2+15       0.0114      0.08  QV         |         |         |         |
  2+30       0.0131      0.08  QV         |         |         |         |
  2+45       0.0150      0.09  QV         |         |         |         |
  3+ 0       0.0171      0.10  QV         |         |         |         |
  3+15       0.0192      0.10  QV         |         |         |         |
  3+30       0.0213      0.10  Q V        |         |         |         |
  3+45       0.0234      0.10  Q V        |         |         |         |
  4+ 0       0.0257      0.11  Q V        |         |         |         |
  4+15       0.0282      0.12  Q V        |         |         |         |
```

```
 4+30       0.0310      0.13  Q V       |         |         |         |
 4+45       0.0339      0.14  Q  V      |         |         |         |
 5+ 0       0.0371      0.15  Q  V      |         |         |         |
 5+15       0.0400      0.14  Q  V      |         |         |         |
 5+30       0.0428      0.14  Q   V     |         |         |         |
 5+45       0.0459      0.15  Q   V     |         |         |         |
 6+ 0       0.0493      0.16  Q   V     |         |         |         |
 6+15       0.0529      0.17  Q    V    |         |         |         |
 6+30       0.0566      0.18  Q    V    |         |         |         |
 6+45       0.0607      0.19  Q    V    |         |         |         |
 7+ 0       0.0649      0.20  Q     V   |         |         |         |
 7+15       0.0691      0.20  Q     V   |         |         |         |
 7+30       0.0735      0.22  Q     V   |         |         |         |
 7+45       0.0784      0.23  Q      V  |         |         |         |
 8+ 0       0.0836      0.25  |Q     V  |         |         |         |
 8+15       0.0895      0.29  |Q      V |         |         |         |
 8+30       0.0958      0.30  |Q       V|         |         |         |
 8+45       0.1024      0.32  |Q       V|         |         |         |
 9+ 0       0.1093      0.34  |Q        V         |         |         |
 9+15       0.1169      0.37  |Q         V        |         |         |
 9+30       0.1251      0.40  |Q        |V        |         |         |
 9+45       0.1337      0.42  |Q        | V       |         |         |
10+ 0       0.1428      0.44  |Q        |  V      |         |         |
10+15       0.1504      0.37  |Q        |   V     |         |         |
10+30       0.1569      0.31  |Q        |   V     |         |         |
10+45       0.1644      0.36  |Q        |    V    |         |         |
11+ 0       0.1727      0.40  |Q        |     V   |         |         |
11+15       0.1809      0.40  |Q        |      V  |         |         |
11+30       0.1889      0.39  |Q        |      V  |         |         |
11+45       0.1964      0.36  |Q        |       V |         |         |
12+ 0       0.2039      0.36  |Q        |        V|         |         |
12+15       0.2131      0.45  |Q        |         V         |         |
12+30       0.2237      0.51  | Q       |          V        |         |
12+45       0.2351      0.55  | Q       |         | V       |         |
13+ 0       0.2470      0.58  | Q       |         |  V      |         |
13+15       0.2604      0.65  | Q       |         |   V     |         |
13+30       0.2746      0.69  | Q       |         |     V   |         |
13+45       0.2863      0.57  | Q       |         |      V  |         |
14+ 0       0.2963      0.48  |Q        |         |       V |         |
14+15       0.3069      0.51  | Q       |         |        V|         |
14+30       0.3179      0.53  | Q       |         |         V         |
14+45       0.3289      0.53  | Q       |         |          V        |
15+ 0       0.3396      0.52  | Q       |         |         | V       |
15+15       0.3500      0.50  |Q        |         |         |  V      |
15+30       0.3599      0.48  |Q        |         |         |   V     |
15+45       0.3686      0.42  |Q        |         |         |    V    |
16+ 0       0.3767      0.39  |Q        |         |         |    V    |
16+15       0.3812      0.22  Q         |         |         |     V   |
16+30       0.3833      0.10  Q         |         |         |     V   |
16+45       0.3847      0.07  Q         |         |         |     V   |
17+ 0       0.3860      0.06  Q         |         |         |     V   |
17+15       0.3877      0.08  Q         |         |         |     V   |
17+30       0.3898      0.10  Q         |         |         |      V  |
17+45       0.3919      0.10  Q         |         |         |      V  |
18+ 0       0.3938      0.09  Q         |         |         |      V  |
18+15       0.3955      0.08  Q         |         |         |      V  |
18+30       0.3972      0.08  Q         |         |         |      V  |
18+45       0.3986      0.07  Q         |         |         |      V  |
19+ 0       0.3997      0.05  Q         |         |         |      V  |
19+15       0.4008      0.05  Q         |         |         |       V |
19+30       0.4022      0.07  Q         |         |         |       V |
19+45       0.4037      0.07  Q         |         |         |       V |
20+ 0       0.4047      0.05  Q         |         |         |       V |
20+15       0.4058      0.05  Q         |         |         |       V |
20+30       0.4071      0.06  Q         |         |         |       V |
20+45       0.4083      0.06  Q         |         |         |       V |
21+ 0       0.4094      0.05  Q         |         |         |       V |
21+15       0.4105      0.05  Q         |         |         |       V |
21+30       0.4115      0.05  Q         |         |         |        V|
21+45       0.4126      0.05  Q         |         |         |        V|
22+ 0       0.4136      0.05  Q         |         |         |        V|
22+15       0.4147      0.05  Q         |         |         |        V|
22+30       0.4157      0.05  Q         |         |         |        V|
22+45       0.4165      0.04  Q         |         |         |        V|
23+ 0       0.4174      0.04  Q         |         |         |        V|
23+15       0.4182      0.04  Q         |         |         |        V|
23+30       0.4191      0.04  Q         |         |         |        V|
23+45       0.4199      0.04  Q         |         |         |        V|
24+ 0       0.4208      0.04  Q         |         |         |        V|
```

```
  24+15       0.4211      0.02  Q         |         |         |        V|
  24+30       0.4212      0.00  Q         |         |         |        V|
-----------------------------------------------------------------------
```

```
      U n i t   H y d r o g r a p h   A n a l y s i s

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             Study date  07/23/19 File: DMAD10PROP110.out

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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978


Program License Serial Number 6388

---------------------------------------------------------------------
 English (in-lb) Input Units Used
 English Rainfall Data (Inches) Input Values Used

 English Units used in output format



---------------------------------------------------------------------
KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
PROPOSED CONDITION, DMA D
10-YR 1-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019
--------------------------------------------------------------------
Drainage Area =       6.90(Ac.)  =      0.011 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =       6.90(Ac.)  =      0.011 Sq. Mi.
Length along longest watercourse =    1710.00(Ft.)
Length along longest watercourse measured to centroid =    1043.00(Ft.)
Length along longest watercourse =      0.324 Mi.
Length along longest watercourse measured to centroid =      0.198 Mi.
Difference in elevation =      40.00(Ft.)
Slope along watercourse =    123.5088 Ft./Mi.
Average Manning's 'N' = 0.015
Lag time =    0.051 Hr.
Lag time =     3.04 Min.
25% of lag time =     0.76 Min.
40% of lag time =     1.22 Min.
Unit time =     5.00 Min.
Duration of storm = 1 Hour(s)
User Entered Base Flow =     0.00(CFS)

2 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        6.90           0.49                  3.37

100 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        6.90           1.33                  9.18

STORM EVENT (YEAR) =   10.00
Area Averaged 2-Year Rainfall =    0.489(In)
Area Averaged 100-Year Rainfall =    1.330(In)

Point rain (area averaged) =    0.835(In)
Areal adjustment factor =   99.99 %
Adjusted average point rain =    0.835(In)

Sub-Area Data:
Area(Ac.)         Runoff Index   Impervious %
     6.900           56.00         0.850
 Total Area Entered =      6.90(Ac.)


RI    RI   Infil. Rate Impervious   Adj. Infil. Rate  Area%     F
AMC2 AMC-2     (In/Hr)    (Dec.%)      (In/Hr)      (Dec.)    (In/Hr)
56.0  56.0      0.511     0.850        0.120       1.000      0.120
                                                  Sum (F) =   0.120
Area averaged mean soil loss (F) (In/Hr) =  0.120
Minimum soil loss rate ((In/Hr)) =  0.060
```

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.220

Slope of intensity-duration curve for a 1 hour storm =0.5000

U n i t   H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

	Unit time period (hrs)	Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.083	164.306	36.467	2.536
2	0.167	328.612	45.943	3.195
3	0.250	492.919	10.415	0.724
4	0.333	657.225	4.445	0.309
5	0.417	821.531	2.730	0.190
			Sum = 100.000	Sum= 6.954

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Loss rate(In./Hr) Low	Effective (In/Hr)
1	0.08	4.20	0.421	(0.120)	0.093	0.328
2	0.17	4.30	0.431	(0.120)	0.095	0.336
3	0.25	5.00	0.501	(0.120)	0.110	0.391
4	0.33	5.00	0.501	(0.120)	0.110	0.391
5	0.42	5.80	0.581	0.120	(0.128)	0.461
6	0.50	6.50	0.651	0.120	(0.143)	0.531
7	0.58	7.40	0.741	0.120	(0.163)	0.621
8	0.67	8.60	0.862	0.120	(0.190)	0.742
9	0.75	12.30	1.232	0.120	(0.271)	1.112
10	0.83	29.10	2.916	0.120	(0.641)	2.796
11	0.92	6.80	0.681	0.120	(0.150)	0.561
12	1.00	5.00	0.501	(0.120)	0.110	0.391

(Loss Rate Not Used)
Sum = 100.0 Sum = 8.7

Flood volume = Effective rainfall 0.72(In)
times area 6.9(Ac.)/[(In)/(Ft.)] = 0.4(Ac.Ft)
Total soil loss = 0.11(In)
Total soil loss = 0.065(Ac.Ft)
Total rainfall = 0.83(In)
Flood volume = 18077.8 Cubic Feet
Total soil loss = 2835.0 Cubic Feet

Peak flow rate of this hydrograph = 11.514(CFS)

+++

1 - H O U R   S T O R M
R u n o f f   H y d r o g r a p h

Hydrograph in 5 Minute intervals ((CFS))

```
-------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0        5.0      10.0      15.0      20.0
------------------------------------------------------------------
  0+ 5      0.0057      0.83  VQ        |         |         |         |
  0+10      0.0188      1.90  |V Q      |         |         |         |
  0+15      0.0347      2.30  |  VQ     |         |         |         |
  0+20      0.0525      2.59  |    Q    |         |         |         |
  0+25      0.0723      2.87  |    QV   |         |         |         |
  0+30      0.0949      3.29  |     Q  V|         |         |         |
  0+35      0.1211      3.80  |      Q  |V        |         |         |
  0+40      0.1519      4.47  |       Q |   V    |         |         |
  0+45      0.1925      5.89  |         |Q      V|         |         |
  0+50      0.2715     11.48  |         |         | Q   V   |         |
  0+55      0.3508     11.51  |         |         |  Q      |  V      |
  1+ 0      0.3873      5.30  |         Q         |         |      V  |
  1+ 5      0.4061      2.73  |    Q    |         |         |        V|
  1+10      0.4129      0.99  |Q        |         |         |        V|
  1+15      0.4145      0.23  Q         |         |         |        V|
  1+20      0.4150      0.07  Q         |         |         |         V
-----------------------------------------------------------------------
```

```
      U n i t   H y d r o g r a p h   A n a l y s i s

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             Study date  07/23/19 File: DMAD10PROP310.out


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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978


Program License Serial Number 6388

---------------------------------------------------------------------
 English (in-lb) Input Units Used
 English Rainfall Data (Inches) Input Values Used

 English Units used in output format




---------------------------------------------------------------------
KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
PROPOSED CONDITION, DMA D
10-YR 3-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019
--------------------------------------------------------------------
Drainage Area =       6.90(Ac.)  =      0.011 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =       6.90(Ac.)  =      0.011 Sq. Mi.
Length along longest watercourse =    1710.00(Ft.)
Length along longest watercourse measured to centroid =    1043.00(Ft.)
Length along longest watercourse =      0.324 Mi.
Length along longest watercourse measured to centroid =      0.198 Mi.
Difference in elevation =      40.00(Ft.)
Slope along watercourse =    123.5088 Ft./Mi.
Average Manning's 'N' = 0.015
Lag time =    0.051 Hr.
Lag time =     3.04 Min.
25% of lag time =     0.76 Min.
40% of lag time =     1.22 Min.
Unit time =     5.00 Min.
Duration of storm = 3 Hour(s)
User Entered Base Flow =     0.00(CFS)

2 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        6.90           0.87                  5.98

100 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        6.90           2.09                 14.42

STORM EVENT (YEAR) =   10.00
Area Averaged 2-Year Rainfall =    0.866(In)
Area Averaged 100-Year Rainfall =    2.090(In)

Point rain (area averaged) =    1.370(In)
Areal adjustment factor =  100.00 %
Adjusted average point rain =    1.370(In)

Sub-Area Data:
Area(Ac.)         Runoff Index   Impervious %
     6.900           56.00         0.850
 Total Area Entered =      6.90(Ac.)


RI    RI   Infil. Rate Impervious   Adj. Infil. Rate  Area%     F
AMC2 AMC-2     (In/Hr)    (Dec.%)      (In/Hr)      (Dec.)    (In/Hr)
56.0  56.0      0.511     0.850        0.120       1.000      0.120
                                                  Sum (F) =   0.120
Area averaged mean soil loss (F) (In/Hr) =  0.120
Minimum soil loss rate ((In/Hr)) =  0.060
```

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.220

U n i t H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.083	164.306	36.467	2.536
2	0.167	328.612	45.943	3.195
3	0.250	492.919	10.415	0.724
4	0.333	657.225	4.445	0.309
5	0.417	821.531	2.730	0.190
			Sum = 100.000	Sum= 6.954

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Loss rate(In./Hr) Low	Effective (In/Hr)
1	0.08	1.30	0.214	(0.120)	0.047	0.167
2	0.17	1.30	0.214	(0.120)	0.047	0.167
3	0.25	1.10	0.181	(0.120)	0.040	0.141
4	0.33	1.50	0.247	(0.120)	0.054	0.192
5	0.42	1.50	0.247	(0.120)	0.054	0.192
6	0.50	1.80	0.296	(0.120)	0.065	0.231
7	0.58	1.50	0.247	(0.120)	0.054	0.192
8	0.67	1.80	0.296	(0.120)	0.065	0.231
9	0.75	1.80	0.296	(0.120)	0.065	0.231
10	0.83	1.50	0.247	(0.120)	0.054	0.192
11	0.92	1.60	0.263	(0.120)	0.058	0.205
12	1.00	1.80	0.296	(0.120)	0.065	0.231
13	1.08	2.20	0.362	(0.120)	0.080	0.282
14	1.17	2.20	0.362	(0.120)	0.080	0.282
15	1.25	2.20	0.362	(0.120)	0.080	0.282
16	1.33	2.00	0.329	(0.120)	0.072	0.256
17	1.42	2.60	0.427	(0.120)	0.094	0.333
18	1.50	2.70	0.444	(0.120)	0.098	0.346
19	1.58	2.40	0.394	(0.120)	0.087	0.308
20	1.67	2.70	0.444	(0.120)	0.098	0.346
21	1.75	3.30	0.542	(0.120)	0.119	0.423
22	1.83	3.10	0.509	(0.120)	0.112	0.397
23	1.92	2.90	0.477	(0.120)	0.105	0.372
24	2.00	3.00	0.493	(0.120)	0.108	0.385
25	2.08	3.10	0.509	(0.120)	0.112	0.397
26	2.17	4.20	0.690	0.120	(0.152)	0.570
27	2.25	5.00	0.822	0.120	(0.181)	0.702
28	2.33	3.50	0.575	0.120	(0.127)	0.455
29	2.42	6.80	1.118	0.120	(0.246)	0.997
30	2.50	7.30	1.200	0.120	(0.264)	1.080
31	2.58	8.20	1.348	0.120	(0.296)	1.228
32	2.67	5.90	0.970	0.120	(0.213)	0.850
33	2.75	2.00	0.329	(0.120)	0.072	0.256
34	2.83	1.80	0.296	(0.120)	0.065	0.231
35	2.92	1.80	0.296	(0.120)	0.065	0.231
36	3.00	0.60	0.099	(0.120)	0.022	0.077

(Loss Rate Not Used)
Sum = 100.0 Sum = 13.5

Flood volume = Effective rainfall 1.12(In)
times area 6.9(Ac.)/[(In)/(Ft.)] = 0.6(Ac.Ft)
Total soil loss = 0.25(In)
Total soil loss = 0.143(Ac.Ft)
Total rainfall = 1.37(In)
Flood volume = 28088.6 Cubic Feet
Total soil loss = 6213.8 Cubic Feet

Peak flow rate of this hydrograph = 7.563(CFS)

+++

3 - H O U R S T O R M
R u n o f f H y d r o g r a p h

Hydrograph in 5 Minute intervals ((CFS))

```
      -------------------------------------------------------------------
 Time(h+m) Volume Ac.Ft   Q(CFS)  0         2.5       5.0       7.5      10.0
 -----------------------------------------------------------------------
   0+ 5       0.0029       0.42  VQ        |         |         |         |
   0+10       0.0095       0.96  V  Q      |         |         |         |
   0+15       0.0165       1.01  |V  Q     |         |         |         |
   0+20       0.0241       1.11  |V  Q     |         |         |         |
   0+25       0.0330       1.29  | V  Q    |         |         |         |
   0+30       0.0427       1.41  | V  Q    |         |         |         |
   0+35       0.0527       1.45  |  V Q    |         |         |         |
   0+40       0.0628       1.46  |  V Q    |         |         |         |
   0+45       0.0736       1.57  |   V Q   |         |         |         |
   0+50       0.0839       1.50  |    Q    |         |         |         |
   0+55       0.0936       1.41  |    Q    |         |         |         |
   1+ 0       0.1039       1.50  |    QV   |         |         |         |
   1+ 5       0.1157       1.70  |     QV  |         |         |         |
   1+10       0.1286       1.88  |      Q  |         |         |         |
   1+15       0.1419       1.93  |      QV |         |         |         |
   1+20       0.1549       1.89  |      Q V|         |         |         |
   1+25       0.1688       2.01  |       Q V         |         |         |
   1+30       0.1844       2.27  |        Q|V        |         |         |
   1+35       0.2000       2.26  |        Q| V       |         |         |
   1+40       0.2156       2.26  |        Q|  V      |         |         |
   1+45       0.2333       2.57  |         Q   V     |         |         |
   1+50       0.2524       2.77  |         |Q   V    |         |         |
   1+55       0.2709       2.69  |         Q     V   |         |         |
   2+ 0       0.2891       2.65  |         Q      V  |         |         |
   2+ 5       0.3078       2.71  |         Q        V|         |         |
   2+10       0.3297       3.19  |         | Q       V         |         |
   2+15       0.3578       4.08  |         |     Q   | V       |         |
   2+20       0.3854       4.01  |         |     Q   |  V      |         |
   2+25       0.4181       4.75  |         |       Q |    V    |         |
   2+30       0.4635       6.58  |         |         |     Q V |         |
   2+35       0.5155       7.56  |         |         |         QV        |
   2+40       0.5655       7.26  |         |         |        Q|    V    |
   2+45       0.5984       4.78  |         |        Q|         |      V  |
   2+50       0.6164       2.61  |         Q         |         |       V |
   2+55       0.6302       2.00  |       Q |         |         |        V|
   3+ 0       0.6394       1.34  |    Q    |         |         |        V|
   3+ 5       0.6431       0.53  | Q       |         |         |        V|
   3+10       0.6443       0.17  Q         |         |         |        V|
   3+15       0.6447       0.07  Q         |         |         |        V|
   3+20       0.6448       0.01  Q         |         |         |         V
-----------------------------------------------------------------------
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      U n i t   H y d r o g r a p h   A n a l y s i s

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              Study date  07/23/19 File: DMAD10PROP610.out

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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978


Program License Serial Number 6388

---------------------------------------------------------------------
 English (in-lb) Input Units Used
 English Rainfall Data (Inches) Input Values Used

 English Units used in output format



---------------------------------------------------------------------
KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
PROPOSED CONDITION, DMA D
10-YR 6-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019
--------------------------------------------------------------------
Drainage Area =       6.90(Ac.)  =      0.011 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =       6.90(Ac.)  =      0.011 Sq. Mi.
Length along longest watercourse =    1710.00(Ft.)
Length along longest watercourse measured to centroid =    1043.00(Ft.)
Length along longest watercourse =      0.324 Mi.
Length along longest watercourse measured to centroid =      0.198 Mi.
Difference in elevation =      40.00(Ft.)
Slope along watercourse =    123.5088 Ft./Mi.
Average Manning's 'N' = 0.015
Lag time =    0.051 Hr.
Lag time =     3.04 Min.
25% of lag time =     0.76 Min.
40% of lag time =     1.22 Min.
Unit time =     5.00 Min.
Duration of storm = 6 Hour(s)
User Entered Base Flow =     0.00(CFS)

2 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        6.90           1.21                  8.35

100 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        6.90           2.86                 19.73

STORM EVENT (YEAR) =   10.00
Area Averaged 2-Year Rainfall =    1.210(In)
Area Averaged 100-Year Rainfall =    2.860(In)

Point rain (area averaged) =    1.889(In)
Areal adjustment factor =  100.00 %
Adjusted average point rain =    1.889(In)

Sub-Area Data:
Area(Ac.)         Runoff Index   Impervious %
     6.900           56.00         0.850
 Total Area Entered =      6.90(Ac.)


RI    RI   Infil. Rate Impervious   Adj. Infil. Rate  Area%     F
AMC2 AMC-2     (In/Hr)    (Dec.%)      (In/Hr)      (Dec.)    (In/Hr)
56.0  56.0      0.511     0.850        0.120       1.000      0.120
                                                  Sum (F) =   0.120
Area averaged mean soil loss (F) (In/Hr) =  0.120
Minimum soil loss rate ((In/Hr)) =  0.060
```

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.220

U n i t   H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.083	164.306	36.467	2.536
2	0.167	328.612	45.943	3.195
3	0.250	492.919	10.415	0.724
4	0.333	657.225	4.445	0.309
5	0.417	821.531	2.730	0.190
			Sum = 100.000	Sum= 6.954

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Low	Effective (In/Hr)
1	0.08	0.50	0.113	(0.120)	0.025	0.088
2	0.17	0.60	0.136	(0.120)	0.030	0.106
3	0.25	0.60	0.136	(0.120)	0.030	0.106
4	0.33	0.60	0.136	(0.120)	0.030	0.106
5	0.42	0.60	0.136	(0.120)	0.030	0.106
6	0.50	0.70	0.159	(0.120)	0.035	0.124
7	0.58	0.70	0.159	(0.120)	0.035	0.124
8	0.67	0.70	0.159	(0.120)	0.035	0.124
9	0.75	0.70	0.159	(0.120)	0.035	0.124
10	0.83	0.70	0.159	(0.120)	0.035	0.124
11	0.92	0.70	0.159	(0.120)	0.035	0.124
12	1.00	0.80	0.181	(0.120)	0.040	0.141
13	1.08	0.80	0.181	(0.120)	0.040	0.141
14	1.17	0.80	0.181	(0.120)	0.040	0.141
15	1.25	0.80	0.181	(0.120)	0.040	0.141
16	1.33	0.80	0.181	(0.120)	0.040	0.141
17	1.42	0.80	0.181	(0.120)	0.040	0.141
18	1.50	0.80	0.181	(0.120)	0.040	0.141
19	1.58	0.80	0.181	(0.120)	0.040	0.141
20	1.67	0.80	0.181	(0.120)	0.040	0.141
21	1.75	0.80	0.181	(0.120)	0.040	0.141
22	1.83	0.80	0.181	(0.120)	0.040	0.141
23	1.92	0.80	0.181	(0.120)	0.040	0.141
24	2.00	0.90	0.204	(0.120)	0.045	0.159
25	2.08	0.80	0.181	(0.120)	0.040	0.141
26	2.17	0.90	0.204	(0.120)	0.045	0.159
27	2.25	0.90	0.204	(0.120)	0.045	0.159
28	2.33	0.90	0.204	(0.120)	0.045	0.159
29	2.42	0.90	0.204	(0.120)	0.045	0.159
30	2.50	0.90	0.204	(0.120)	0.045	0.159
31	2.58	0.90	0.204	(0.120)	0.045	0.159
32	2.67	0.90	0.204	(0.120)	0.045	0.159
33	2.75	1.00	0.227	(0.120)	0.050	0.177
34	2.83	1.00	0.227	(0.120)	0.050	0.177
35	2.92	1.00	0.227	(0.120)	0.050	0.177
36	3.00	1.00	0.227	(0.120)	0.050	0.177
37	3.08	1.00	0.227	(0.120)	0.050	0.177
38	3.17	1.10	0.249	(0.120)	0.055	0.194
39	3.25	1.10	0.249	(0.120)	0.055	0.194
40	3.33	1.10	0.249	(0.120)	0.055	0.194
41	3.42	1.20	0.272	(0.120)	0.060	0.212
42	3.50	1.30	0.295	(0.120)	0.065	0.230
43	3.58	1.40	0.317	(0.120)	0.070	0.248
44	3.67	1.40	0.317	(0.120)	0.070	0.248
45	3.75	1.50	0.340	(0.120)	0.075	0.265
46	3.83	1.50	0.340	(0.120)	0.075	0.265
47	3.92	1.60	0.363	(0.120)	0.080	0.283
48	4.00	1.60	0.363	(0.120)	0.080	0.283
49	4.08	1.70	0.385	(0.120)	0.085	0.301
50	4.17	1.80	0.408	(0.120)	0.090	0.318
51	4.25	1.90	0.431	(0.120)	0.095	0.336
52	4.33	2.00	0.453	(0.120)	0.100	0.354
53	4.42	2.10	0.476	(0.120)	0.105	0.371

```
54   4.50     2.10      0.476       (  0.120)       0.105        0.371
55   4.58     2.20      0.499       (  0.120)       0.110        0.389
56   4.67     2.30      0.521       (  0.120)       0.115        0.407
57   4.75     2.40      0.544       (  0.120)       0.120        0.424
58   4.83     2.40      0.544       (  0.120)       0.120        0.424
59   4.92     2.50      0.567          0.120    (  0.125)        0.447
60   5.00     2.60      0.589          0.120    (  0.130)        0.469
61   5.08     3.10      0.703          0.120    (  0.155)        0.583
62   5.17     3.60      0.816          0.120    (  0.180)        0.696
63   5.25     3.90      0.884          0.120    (  0.194)        0.764
64   5.33     4.20      0.952          0.120    (  0.209)        0.832
65   5.42     4.70      1.065          0.120    (  0.234)        0.945
66   5.50     5.60      1.269          0.120    (  0.279)        1.149
67   5.58     1.90      0.431       (  0.120)       0.095        0.336
68   5.67     0.90      0.204       (  0.120)       0.045        0.159
69   5.75     0.60      0.136       (  0.120)       0.030        0.106
70   5.83     0.50      0.113       (  0.120)       0.025        0.088
71   5.92     0.30      0.068       (  0.120)       0.015        0.053
72   6.00     0.20      0.045       (  0.120)       0.010        0.035
              (Loss Rate Not Used)
   Sum =     100.0                                  Sum =    18.2
     Flood volume = Effective rainfall      1.52(In)
      times area       6.9(Ac.)/[(In)/(Ft.)] =       0.9(Ac.Ft)
     Total soil loss =      0.37(In)
     Total soil loss =     0.213(Ac.Ft)
     Total rainfall =      1.89(In)
     Flood volume =       38039.2 Cubic Feet
     Total soil loss =        9269.0 Cubic Feet
     --------------------------------------------------------------------
      Peak flow rate of this hydrograph =      6.908(CFS)
     --------------------------------------------------------------------
     ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                         6 - H O U R   S T O R M
                    R u n o f f     H y d r o g r a p h
     --------------------------------------------------------------------
                 Hydrograph in   5   Minute intervals ((CFS))

     --------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0        2.5       5.0       7.5      10.0
-----------------------------------------------------------------------
  0+ 5       0.0015      0.22  Q         |         |         |         |
  0+10       0.0053      0.55  V Q       |         |         |         |
  0+15       0.0100      0.67  V Q       |         |         |         |
  0+20       0.0149      0.71  V Q       |         |         |         |
  0+25       0.0199      0.73  V Q       |         |         |         |
  0+30       0.0253      0.78  |V Q      |         |         |         |
  0+35       0.0311      0.84  |V Q      |         |         |         |
  0+40       0.0370      0.85  |V Q      |         |         |         |
  0+45       0.0429      0.86  |V Q      |         |         |         |
  0+50       0.0488      0.86  | VQ      |         |         |         |
  0+55       0.0547      0.86  | VQ      |         |         |         |
  1+ 0       0.0610      0.91  | VQ      |         |         |         |
  1+ 5       0.0676      0.96  |  Q      |         |         |         |
  1+10       0.0743      0.98  |  Q      |         |         |         |
  1+15       0.0811      0.98  |  Q      |         |         |         |
  1+20       0.0879      0.98  |  QV     |         |         |         |
  1+25       0.0946      0.98  |  QV     |         |         |         |
  1+30       0.1014      0.98  |  QV     |         |         |         |
  1+35       0.1082      0.98  |  QV     |         |         |         |
  1+40       0.1150      0.98  |  Q V    |         |         |         |
  1+45       0.1217      0.98  |  Q V    |         |         |         |
  1+50       0.1285      0.98  |  Q V    |         |         |         |
  1+55       0.1353      0.98  |  Q  V   |         |         |         |
  2+ 0       0.1424      1.03  |   Q V   |         |         |         |
  2+ 5       0.1496      1.04  |   Q V   |         |         |         |
  2+10       0.1567      1.04  |   Q  V  |         |         |         |
  2+15       0.1642      1.09  |   Q  V  |         |         |         |
  2+20       0.1718      1.10  |   Q  V  |         |         |         |
  2+25       0.1794      1.10  |   Q   V |         |         |         |
  2+30       0.1870      1.11  |   Q   V |         |         |         |
  2+35       0.1947      1.11  |   Q   V |         |         |         |
  2+40       0.2023      1.11  |   Q    V|         |         |         |
  2+45       0.2102      1.15  |   Q    V|         |         |         |
  2+50       0.2186      1.21  |   Q     V         |         |         |
  2+55       0.2270      1.22  |   Q     V         |         |         |
  3+ 0       0.2354      1.23  |   Q     V         |         |         |
  3+ 5       0.2439      1.23  |   Q     |V        |         |         |
  3+10       0.2527      1.27  |    Q    |V        |         |         |
  3+15       0.2618      1.33  |    Q    |V        |         |         |
```

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    3+20       0.2711      1.34  |    Q    | V       |         |         |
    3+25       0.2807      1.39  |    Q    | V       |         |         |
    3+30       0.2910      1.50  |    Q    |  V      |         |         |
    3+35       0.3021      1.61  |     Q   |  V      |         |         |
    3+40       0.3138      1.69  |     Q   |   V     |         |         |
    3+45       0.3258      1.75  |      Q  |   V     |         |         |
    3+50       0.3384      1.82  |      Q  |    V    |         |         |
    3+55       0.3513      1.88  |      Q  |     V   |         |         |
    4+ 0       0.3647      1.94  |      Q  |     V   |         |         |
    4+ 5       0.3785      2.00  |       Q |      V  |         |         |
    4+10       0.3931      2.11  |       Q |       V |         |         |
    4+15       0.4084      2.23  |       Q |       V |         |         |
    4+20       0.4246      2.35  |        Q|        V|         |         |
    4+25       0.4416      2.47  |        Q|         V         |         |
    4+30       0.4591      2.55  |         Q         |V        |         |
    4+35       0.4772      2.62  |         Q         |V        |         |
    4+40       0.4959      2.73  |         Q         | V       |         |
    4+45       0.5155      2.84  |         |Q        |  V      |         |
    4+50       0.5356      2.92  |         |Q        |   V     |         |
    4+55       0.5563      3.00  |         |Q        |    V    |         |
    5+ 0       0.5778      3.13  |         | Q       |     V   |         |
    5+ 5       0.6020      3.51  |         |   Q     |      V  |         |
    5+10       0.6309      4.19  |         |     Q   |       V |         |
    5+15       0.6640      4.81  |         |        Q|         V         |
    5+20       0.7007      5.33  |         |         |Q        | V       |
    5+25       0.7416      5.94  |         |         |  Q      |  V      |
    5+30       0.7892      6.91  |         |         |      Q  |     V   |
    5+35       0.8278      5.61  |         |         | Q       |      V  |
    5+40       0.8468      2.76  |         |Q        |         |       V |
    5+45       0.8576      1.56  |     Q   |         |         |        V|
    5+50       0.8645      1.00  |   Q     |         |         |        V|
    5+55       0.8686      0.61  | Q       |         |         |        V|
    6+ 0       0.8713      0.39  |Q        |         |         |        V|
    6+ 5       0.8727      0.20  Q         |         |         |        V|
    6+10       0.8731      0.06  Q         |         |         |        V|
    6+15       0.8732      0.02  Q         |         |         |        V|
    6+20       0.8733      0.01  Q         |         |         |        V|
-----------------------------------------------------------------------
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      U n i t   H y d r o g r a p h   A n a l y s i s

      Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2014, Version 9.0
             Study date  07/23/19 File: DMAD10PROP2410.out


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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978


Program License Serial Number 6388

---------------------------------------------------------------------
 English (in-lb) Input Units Used
 English Rainfall Data (Inches) Input Values Used

 English Units used in output format



---------------------------------------------------------------------
KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
PROPOSED CONDITION, DMA D
10-YR 24-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019
--------------------------------------------------------------------
Drainage Area =       6.90(Ac.)  =      0.011 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =       6.90(Ac.)  =      0.011 Sq. Mi.
Length along longest watercourse =    1710.00(Ft.)
Length along longest watercourse measured to centroid =    1043.00(Ft.)
Length along longest watercourse =      0.324 Mi.
Length along longest watercourse measured to centroid =      0.198 Mi.
Difference in elevation =      40.00(Ft.)
Slope along watercourse =    123.5088 Ft./Mi.
Average Manning's 'N' = 0.015
Lag time =    0.051 Hr.
Lag time =     3.04 Min.
25% of lag time =     0.76 Min.
40% of lag time =     1.22 Min.
Unit time =    15.00 Min.
Duration of storm = 24 Hour(s)
User Entered Base Flow =     0.00(CFS)

2 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        6.90           2.05                 14.15

100 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        6.90           5.16                 35.60

STORM EVENT (YEAR) =   10.00
Area Averaged 2-Year Rainfall =    2.050(In)
Area Averaged 100-Year Rainfall =    5.160(In)

Point rain (area averaged) =    3.329(In)
Areal adjustment factor =  100.00 %
Adjusted average point rain =    3.329(In)

Sub-Area Data:
Area(Ac.)         Runoff Index   Impervious %
     6.900           56.00         0.850
 Total Area Entered =      6.90(Ac.)


RI    RI   Infil. Rate Impervious   Adj. Infil. Rate  Area%     F
AMC2 AMC-2     (In/Hr)    (Dec.%)      (In/Hr)      (Dec.)    (In/Hr)
56.0  56.0      0.511     0.850        0.120       1.000      0.120
                                                  Sum (F) =   0.120
Area averaged mean soil loss (F) (In/Hr) =  0.120
Minimum soil loss rate ((In/Hr)) =  0.060
```

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.220

U n i t H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.250	492.919	70.567	4.907
2	0.500	985.837	29.433	2.047
			Sum = 100.000	Sum= 6.954

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Low	Effective (In/Hr)
1	0.25	0.20	0.027	(0.212)	0.006	0.021
2	0.50	0.30	0.040	(0.210)	0.009	0.031
3	0.75	0.30	0.040	(0.207)	0.009	0.031
4	1.00	0.40	0.053	(0.205)	0.012	0.042
5	1.25	0.30	0.040	(0.202)	0.009	0.031
6	1.50	0.30	0.040	(0.200)	0.009	0.031
7	1.75	0.30	0.040	(0.197)	0.009	0.031
8	2.00	0.40	0.053	(0.195)	0.012	0.042
9	2.25	0.40	0.053	(0.193)	0.012	0.042
10	2.50	0.40	0.053	(0.190)	0.012	0.042
11	2.75	0.50	0.067	(0.188)	0.015	0.052
12	3.00	0.50	0.067	(0.186)	0.015	0.052
13	3.25	0.50	0.067	(0.183)	0.015	0.052
14	3.50	0.50	0.067	(0.181)	0.015	0.052
15	3.75	0.50	0.067	(0.179)	0.015	0.052
16	4.00	0.60	0.080	(0.177)	0.018	0.062
17	4.25	0.60	0.080	(0.174)	0.018	0.062
18	4.50	0.70	0.093	(0.172)	0.021	0.073
19	4.75	0.70	0.093	(0.170)	0.021	0.073
20	5.00	0.80	0.107	(0.168)	0.023	0.083
21	5.25	0.60	0.080	(0.166)	0.018	0.062
22	5.50	0.70	0.093	(0.163)	0.021	0.073
23	5.75	0.80	0.107	(0.161)	0.023	0.083
24	6.00	0.80	0.107	(0.159)	0.023	0.083
25	6.25	0.90	0.120	(0.157)	0.026	0.093
26	6.50	0.90	0.120	(0.155)	0.026	0.093
27	6.75	1.00	0.133	(0.153)	0.029	0.104
28	7.00	1.00	0.133	(0.151)	0.029	0.104
29	7.25	1.00	0.133	(0.149)	0.029	0.104
30	7.50	1.10	0.146	(0.147)	0.032	0.114
31	7.75	1.20	0.160	(0.145)	0.035	0.125
32	8.00	1.30	0.173	(0.143)	0.038	0.135
33	8.25	1.50	0.200	(0.141)	0.044	0.156
34	8.50	1.50	0.200	(0.139)	0.044	0.156
35	8.75	1.60	0.213	(0.137)	0.047	0.166
36	9.00	1.70	0.226	(0.135)	0.050	0.177
37	9.25	1.90	0.253	(0.133)	0.056	0.197
38	9.50	2.00	0.266	(0.131)	0.059	0.208
39	9.75	2.10	0.280	(0.129)	0.062	0.218
40	10.00	2.20	0.293	(0.127)	0.064	0.229
41	10.25	1.50	0.200	(0.126)	0.044	0.156
42	10.50	1.50	0.200	(0.124)	0.044	0.156
43	10.75	2.00	0.266	(0.122)	0.059	0.208
44	11.00	2.00	0.266	(0.120)	0.059	0.208
45	11.25	1.90	0.253	(0.118)	0.056	0.197
46	11.50	1.90	0.253	(0.117)	0.056	0.197
47	11.75	1.70	0.226	(0.115)	0.050	0.177
48	12.00	1.80	0.240	(0.113)	0.053	0.187
49	12.25	2.50	0.333	(0.111)	0.073	0.260
50	12.50	2.60	0.346	(0.110)	0.076	0.270
51	12.75	2.80	0.373	(0.108)	0.082	0.291
52	13.00	2.90	0.386	(0.107)	0.085	0.301
53	13.25	3.40	0.453	(0.105)	0.100	0.353
54	13.50	3.40	0.453	(0.103)	0.100	0.353
55	13.75	2.30	0.306	(0.102)	0.067	0.239
56	14.00	2.30	0.306	(0.100)	0.067	0.239

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57  14.25     2.70      0.360       (  0.099)       0.079        0.280
58  14.50     2.60      0.346       (  0.097)       0.076        0.270
59  14.75     2.60      0.346       (  0.096)       0.076        0.270
60  15.00     2.50      0.333       (  0.094)       0.073        0.260
61  15.25     2.40      0.320       (  0.093)       0.070        0.249
62  15.50     2.30      0.306       (  0.091)       0.067        0.239
63  15.75     1.90      0.253       (  0.090)       0.056        0.197
64  16.00     1.90      0.253       (  0.089)       0.056        0.197
65  16.25     0.40      0.053       (  0.087)       0.012        0.042
66  16.50     0.40      0.053       (  0.086)       0.012        0.042
67  16.75     0.30      0.040       (  0.085)       0.009        0.031
68  17.00     0.30      0.040       (  0.083)       0.009        0.031
69  17.25     0.50      0.067       (  0.082)       0.015        0.052
70  17.50     0.50      0.067       (  0.081)       0.015        0.052
71  17.75     0.50      0.067       (  0.080)       0.015        0.052
72  18.00     0.40      0.053       (  0.078)       0.012        0.042
73  18.25     0.40      0.053       (  0.077)       0.012        0.042
74  18.50     0.40      0.053       (  0.076)       0.012        0.042
75  18.75     0.30      0.040       (  0.075)       0.009        0.031
76  19.00     0.20      0.027       (  0.074)       0.006        0.021
77  19.25     0.30      0.040       (  0.073)       0.009        0.031
78  19.50     0.40      0.053       (  0.072)       0.012        0.042
79  19.75     0.30      0.040       (  0.071)       0.009        0.031
80  20.00     0.20      0.027       (  0.070)       0.006        0.021
81  20.25     0.30      0.040       (  0.069)       0.009        0.031
82  20.50     0.30      0.040       (  0.068)       0.009        0.031
83  20.75     0.30      0.040       (  0.067)       0.009        0.031
84  21.00     0.20      0.027       (  0.067)       0.006        0.021
85  21.25     0.30      0.040       (  0.066)       0.009        0.031
86  21.50     0.20      0.027       (  0.065)       0.006        0.021
87  21.75     0.30      0.040       (  0.064)       0.009        0.031
88  22.00     0.20      0.027       (  0.064)       0.006        0.021
89  22.25     0.30      0.040       (  0.063)       0.009        0.031
90  22.50     0.20      0.027       (  0.062)       0.006        0.021
91  22.75     0.20      0.027       (  0.062)       0.006        0.021
92  23.00     0.20      0.027       (  0.061)       0.006        0.021
93  23.25     0.20      0.027       (  0.061)       0.006        0.021
94  23.50     0.20      0.027       (  0.061)       0.006        0.021
95  23.75     0.20      0.027       (  0.060)       0.006        0.021
96  24.00     0.20      0.027       (  0.060)       0.006        0.021
              (Loss Rate Not Used)
   Sum =     100.0                                   Sum =    10.4
     Flood volume = Effective rainfall      2.60(In)
      times area       6.9(Ac.)/[(In)/(Ft.)] =       1.5(Ac.Ft)
     Total soil loss =      0.73(In)
     Total soil loss =     0.421(Ac.Ft)
     Total rainfall =      3.33(In)
     Flood volume =       65046.0 Cubic Feet
     Total soil loss =       18346.3 Cubic Feet
     --------------------------------------------------------------------
      Peak flow rate of this hydrograph =      2.457(CFS)
     --------------------------------------------------------------------
     ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                         24 - H O U R   S T O R M
                    R u n o f f     H y d r o g r a p h
     --------------------------------------------------------------------
                Hydrograph in  15   Minute intervals ((CFS))

     --------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0        2.5       5.0       7.5      10.0
-----------------------------------------------------------------------
  0+15       0.0021      0.10  Q         |         |         |         |
  0+30       0.0061      0.20  Q         |         |         |         |
  0+45       0.0106      0.22  Q         |         |         |         |
  1+ 0       0.0162      0.27  VQ        |         |         |         |
  1+15       0.0211      0.24  Q         |         |         |         |
  1+30       0.0256      0.22  Q         |         |         |         |
  1+45       0.0300      0.22  Q         |         |         |         |
  2+ 0       0.0356      0.27  VQ        |         |         |         |
  2+15       0.0415      0.29  |Q        |         |         |         |
  2+30       0.0475      0.29  |Q        |         |         |         |
  2+45       0.0545      0.34  |Q        |         |         |         |
  3+ 0       0.0620      0.36  |Q        |         |         |         |
  3+15       0.0695      0.36  |Q        |         |         |         |
  3+30       0.0769      0.36  |QV       |         |         |         |
  3+45       0.0844      0.36  |QV       |         |         |         |
  4+ 0       0.0929      0.41  |QV       |         |         |         |
  4+15       0.1019      0.43  |QV       |         |         |         |
  4+30       0.1119      0.48  |QV       |         |         |         |
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 4+45      0.1224     0.51  | QV      |         |         |         |
 5+ 0      0.1339     0.56  | QV      |         |         |         |
 5+15      0.1437     0.48  |Q V      |         |         |         |
 5+30      0.1537     0.48  |Q  V     |         |         |         |
 5+45      0.1652     0.56  | Q V     |         |         |         |
 6+ 0      0.1772     0.58  | Q V     |         |         |         |
 6+15      0.1902     0.63  | Q  V    |         |         |         |
 6+30      0.2036     0.65  | Q  V    |         |         |         |
 6+45      0.2181     0.70  | Q  V    |         |         |         |
 7+ 0      0.2330     0.72  | Q   V   |         |         |         |
 7+15      0.2480     0.72  | Q   V   |         |         |         |
 7+30      0.2640     0.77  |  Q   V  |         |         |         |
 7+45      0.2814     0.85  |  Q   V  |         |         |         |
 8+ 0      0.3004     0.92  |  Q    V |         |         |         |
 8+15      0.3219     1.04  |   Q   V |         |         |         |
 8+30      0.3443     1.08  |   Q    V|         |         |         |
 8+45      0.3678     1.14  |   Q    V|         |         |         |
 9+ 0      0.3927     1.21  |   Q     V         |         |         |
 9+15      0.4202     1.33  |    Q     V        |         |         |
 9+30      0.4496     1.42  |    Q    | V       |         |         |
 9+45      0.4806     1.50  |    Q    | V       |         |         |
10+ 0      0.5130     1.57  |     Q   |  V      |         |         |
10+15      0.5384     1.23  |   Q     |   V     |         |         |
10+30      0.5608     1.08  |   Q     |    V    |         |         |
10+45      0.5885     1.34  |    Q    |    V    |         |         |
11+ 0      0.6184     1.45  |    Q    |     V   |         |         |
11+15      0.6472     1.39  |    Q    |      V  |         |         |
11+30      0.6756     1.37  |    Q    |       V |         |         |
11+45      0.7018     1.27  |    Q    |       V |         |         |
12+ 0      0.7283     1.28  |    Q    |        V|         |         |
12+15      0.7625     1.66  |     Q   |         V         |         |
12+30      0.8009     1.86  |      Q  |          V        |         |
12+45      0.8418     1.98  |      Q  |         | V       |         |
13+ 0      0.8847     2.07  |       Q |         |  V      |         |
13+15      0.9333     2.35  |        Q|         |   V     |         |
13+30      0.9840     2.46  |        Q|         |     V   |         |
13+45      1.0232     1.90  |      Q  |         |      V  |         |
14+ 0      1.0576     1.66  |     Q   |         |       V |         |
14+15      1.0961     1.87  |      Q  |         |        V|         |
14+30      1.1354     1.90  |      Q  |         |         V         |
14+45      1.1742     1.88  |      Q  |         |          V        |
15+ 0      1.2120     1.83  |      Q  |         |         | V       |
15+15      1.2483     1.76  |      Q  |         |         |  V      |
15+30      1.2830     1.68  |     Q   |         |         |   V     |
15+45      1.3132     1.46  |    Q    |         |         |    V    |
16+ 0      1.3415     1.37  |    Q    |         |         |    V    |
16+15      1.3541     0.61  | Q       |         |         |     V   |
16+30      1.3601     0.29  |Q        |         |         |     V   |
16+45      1.3650     0.24  Q         |         |         |     V   |
17+ 0      1.3695     0.22  Q         |         |         |     V   |
17+15      1.3761     0.32  |Q        |         |         |     V   |
17+30      1.3835     0.36  |Q        |         |         |      V  |
17+45      1.3910     0.36  |Q        |         |         |      V  |
18+ 0      1.3974     0.31  |Q        |         |         |      V  |
18+15      1.4034     0.29  |Q        |         |         |      V  |
18+30      1.4094     0.29  |Q        |         |         |      V  |
18+45      1.4143     0.24  Q         |         |         |      V  |
19+ 0      1.4177     0.17  Q         |         |         |      V  |
19+15      1.4217     0.20  Q         |         |         |       V |
19+30      1.4273     0.27  |Q        |         |         |       V |
19+45      1.4322     0.24  Q         |         |         |       V |
20+ 0      1.4356     0.17  Q         |         |         |       V |
20+15      1.4397     0.20  Q         |         |         |       V |
20+30      1.4441     0.22  Q         |         |         |       V |
20+45      1.4486     0.22  Q         |         |         |       V |
21+ 0      1.4521     0.17  Q         |         |         |       V |
21+15      1.4561     0.20  Q         |         |         |        V|
21+30      1.4595     0.17  Q         |         |         |        V|
21+45      1.4636     0.20  Q         |         |         |        V|
22+ 0      1.4670     0.17  Q         |         |         |        V|
22+15      1.4710     0.20  Q         |         |         |        V|
22+30      1.4745     0.17  Q         |         |         |        V|
22+45      1.4774     0.14  Q         |         |         |        V|
23+ 0      1.4804     0.14  Q         |         |         |        V|
23+15      1.4834     0.14  Q         |         |         |        V|
23+30      1.4864     0.14  Q         |         |         |        V|
23+45      1.4894     0.14  Q         |         |         |        V|
24+ 0      1.4924     0.14  Q         |         |         |        V|
24+15      1.4933     0.04  Q         |         |         |        V|
```

U n i t   H y d r o g r a p h   A n a l y s i s

Study date 07/23/19 File: DMAD100EXIST1100.out

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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978

Program License Serial Number 6388

English (in-lb) Input Units Used
English Rainfall Data (Inches) Input Values Used

English Units used in output format

KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
EXISTING CONDITION, DMA D
100-YR 1-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019

Drainage Area = 6.90(Ac.) = 0.011 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment = 6.90(Ac.) = 0.011 Sq. Mi.
Length along longest watercourse = 1710.00(Ft.)
Length along longest watercourse measured to centroid = 1043.00(Ft.)
Length along longest watercourse = 0.324 Mi.
Length along longest watercourse measured to centroid = 0.198 Mi.
Difference in elevation = 40.00(Ft.)
Slope along watercourse = 123.5088 Ft./Mi.
Average Manning's 'N' = 0.025
Lag time = 0.085 Hr.
Lag time = 5.07 Min.
25% of lag time = 1.27 Min.
40% of lag time = 2.03 Min.
Unit time = 5.00 Min.
Duration of storm = 1 Hour(s)
User Entered Base Flow = 0.00(CFS)

2 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	Weighting[1*2]
6.90	0.49	3.37

100 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	Weighting[1*2]
6.90	1.33	9.18

STORM EVENT (YEAR) = 100.00
Area Averaged 2-Year Rainfall = 0.489(In)
Area Averaged 100-Year Rainfall = 1.330(In)

Point rain (area averaged) = 1.330(In)
Areal adjustment factor = 99.99 %
Adjusted average point rain = 1.330(In)

Sub-Area Data:

Area(Ac.)	Runoff Index	Impervious %
6.900	56.00	0.150

Total Area Entered = 6.90(Ac.)

RI AMC2	RI AMC-2	Infil. Rate (In/Hr)	Impervious (Dec.%)	Adj. Infil. Rate (In/Hr)	Area% (Dec.)	F (In/Hr)
56.0	56.0	0.511	0.150	0.442	1.000	0.442
					Sum (F) =	0.442

Area averaged mean soil loss (F) (In/Hr) = 0.442
Minimum soil loss rate ((In/Hr)) = 0.221

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.780

Slope of intensity-duration curve for a 1 hour storm =0.5000

U n i t   H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.083	98.584	18.765	1.305
2	0.167	197.167	48.285	3.358
3	0.250	295.751	15.854	1.102
4	0.333	394.335	7.138	0.496
5	0.417	492.919	4.033	0.280
6	0.500	591.502	2.616	0.182
7	0.583	690.086	1.645	0.114
8	0.667	788.670	1.057	0.073
9	0.750	887.254	0.606	0.042
			Sum = 100.000	Sum= 6.954

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Low	Effective (In/Hr)
1	0.08	4.20	0.670	0.442	(0.523)	0.228
2	0.17	4.30	0.686	0.442	(0.535)	0.244
3	0.25	5.00	0.798	0.442	(0.622)	0.356
4	0.33	5.00	0.798	0.442	(0.622)	0.356
5	0.42	5.80	0.926	0.442	(0.722)	0.484
6	0.50	6.50	1.037	0.442	(0.809)	0.595
7	0.58	7.40	1.181	0.442	(0.921)	0.739
8	0.67	8.60	1.372	0.442	(1.071)	0.931
9	0.75	12.30	1.963	0.442	(1.531)	1.521
10	0.83	29.10	4.644	0.442	(3.622)	4.202
11	0.92	6.80	1.085	0.442	(0.846)	0.643
12	1.00	5.00	0.798	0.442	(0.622)	0.356
		(Loss Rate Not Used)				
Sum =		100.0				Sum = 10.7

Flood volume = Effective rainfall 0.89(In)
times area 6.9(Ac.)/[(In)/(Ft.)] = 0.5(Ac.Ft)
Total soil loss = 0.44(In)
Total soil loss = 0.254(Ac.Ft)
Total rainfall = 1.33(In)
Flood volume = 22243.6 Cubic Feet
Total soil loss = 11066.8 Cubic Feet

Peak flow rate of this hydrograph = 17.509(CFS)

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1 - H O U R   S T O R M
R u n o f f   H y d r o g r a p h

Hydrograph in 5 Minute intervals ((CFS))

```
Time(h+m) Volume Ac.Ft    Q(CFS)  0        5.0       10.0      15.0      20.0
-----------------------------------------------------------------------
  0+ 5       0.0021      0.30  Q         |         |         |         |
  0+10       0.0095      1.09  V Q       |         |         |         |
  0+15       0.0201      1.54  |V Q      |         |         |         |
  0+20       0.0342      2.04  | V Q     |         |         |         |
  0+25       0.0508      2.41  |  VQ     |         |         |         |
  0+30       0.0720      3.08  |    VQ   |         |         |         |
  0+35       0.0985      3.85  |      Q  |         |         |         |
  0+40       0.1316      4.80  |        QV         |         |         |
  0+45       0.1763      6.49  |         | QV      |         |         |
  0+50       0.2612     12.32  |         |         V   Q     |         |
  0+55       0.3818     17.51  |         |         |        V|     Q   |
  1+ 0       0.4405      8.53  |         |      Q  |         |   V     |
  1+ 5       0.4731      4.74  |        Q|         |         |      V  |
  1+10       0.4894      2.35  |   Q     |         |         |       V |
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   1+15       0.4990      1.40  | Q       |         |         |        V|
   1+20       0.5048      0.85  |Q        |         |         |        V|
   1+25       0.5083      0.51  |Q        |         |         |        V|
   1+30       0.5102      0.27  Q         |         |         |        V|
   1+35       0.5105      0.05  Q         |         |         |        V|
   1+40       0.5106      0.02  Q         |         |         |         V
-----------------------------------------------------------------------
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U n i t   H y d r o g r a p h   A n a l y s i s

Study date 07/23/19 File: DMAD100EXIST3100.out

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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978

Program License Serial Number 6388

English (in-lb) Input Units Used
English Rainfall Data (Inches) Input Values Used

English Units used in output format

KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
EXISTING CONDITION, DMA D
100-YR 3-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019

Drainage Area = 6.90(Ac.) = 0.011 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment = 6.90(Ac.) = 0.011 Sq. Mi.
Length along longest watercourse = 1710.00(Ft.)
Length along longest watercourse measured to centroid = 1043.00(Ft.)
Length along longest watercourse = 0.324 Mi.
Length along longest watercourse measured to centroid = 0.198 Mi.
Difference in elevation = 40.00(Ft.)
Slope along watercourse = 123.5088 Ft./Mi.
Average Manning's 'N' = 0.025
Lag time = 0.085 Hr.
Lag time = 5.07 Min.
25% of lag time = 1.27 Min.
40% of lag time = 2.03 Min.
Unit time = 5.00 Min.
Duration of storm = 3 Hour(s)
User Entered Base Flow = 0.00(CFS)

2 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	Weighting[1*2]
6.90	0.87	5.98

100 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	Weighting[1*2]
6.90	2.09	14.42

STORM EVENT (YEAR) = 100.00
Area Averaged 2-Year Rainfall = 0.866(In)
Area Averaged 100-Year Rainfall = 2.090(In)

Point rain (area averaged) = 2.090(In)
Areal adjustment factor = 100.00 %
Adjusted average point rain = 2.090(In)

Sub-Area Data:

Area(Ac.)	Runoff Index	Impervious %
6.900	56.00	0.150

Total Area Entered = 6.90(Ac.)

RI AMC2	RI AMC-2	Infil. Rate (In/Hr)	Impervious (Dec.%)	Adj. Infil. Rate (In/Hr)	Area% (Dec.)	F (In/Hr)
56.0	56.0	0.511	0.150	0.442	1.000	0.442
					Sum (F) =	0.442

Area averaged mean soil loss (F) (In/Hr) = 0.442
Minimum soil loss rate ((In/Hr)) = 0.221

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.780

U n i t   H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.083	98.584	18.765	1.305
2	0.167	197.167	48.285	3.358
3	0.250	295.751	15.854	1.102
4	0.333	394.335	7.138	0.496
5	0.417	492.919	4.033	0.280
6	0.500	591.502	2.616	0.182
7	0.583	690.086	1.645	0.114
8	0.667	788.670	1.057	0.073
9	0.750	887.254	0.606	0.042
			Sum = 100.000	Sum= 6.954

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Loss rate(In./Hr) Low	Effective (In/Hr)
1	0.08	1.30	0.326	(0.442)	0.254	0.072
2	0.17	1.30	0.326	(0.442)	0.254	0.072
3	0.25	1.10	0.276	(0.442)	0.215	0.061
4	0.33	1.50	0.376	(0.442)	0.293	0.083
5	0.42	1.50	0.376	(0.442)	0.293	0.083
6	0.50	1.80	0.451	(0.442)	0.352	0.099
7	0.58	1.50	0.376	(0.442)	0.293	0.083
8	0.67	1.80	0.451	(0.442)	0.352	0.099
9	0.75	1.80	0.451	(0.442)	0.352	0.099
10	0.83	1.50	0.376	(0.442)	0.293	0.083
11	0.92	1.60	0.401	(0.442)	0.313	0.088
12	1.00	1.80	0.451	(0.442)	0.352	0.099
13	1.08	2.20	0.552	(0.442)	0.430	0.121
14	1.17	2.20	0.552	(0.442)	0.430	0.121
15	1.25	2.20	0.552	(0.442)	0.430	0.121
16	1.33	2.00	0.502	(0.442)	0.391	0.110
17	1.42	2.60	0.652	0.442	(0.509)	0.210
18	1.50	2.70	0.677	0.442	(0.528)	0.235
19	1.58	2.40	0.602	0.442	(0.469)	0.160
20	1.67	2.70	0.677	0.442	(0.528)	0.235
21	1.75	3.30	0.828	0.442	(0.646)	0.386
22	1.83	3.10	0.777	0.442	(0.606)	0.336
23	1.92	2.90	0.727	0.442	(0.567)	0.285
24	2.00	3.00	0.752	0.442	(0.587)	0.311
25	2.08	3.10	0.777	0.442	(0.606)	0.336
26	2.17	4.20	1.053	0.442	(0.822)	0.611
27	2.25	5.00	1.254	0.442	(0.978)	0.812
28	2.33	3.50	0.878	0.442	(0.685)	0.436
29	2.42	6.80	1.705	0.442	(1.330)	1.264
30	2.50	7.30	1.831	0.442	(1.428)	1.389
31	2.58	8.20	2.056	0.442	(1.604)	1.615
32	2.67	5.90	1.480	0.442	(1.154)	1.038
33	2.75	2.00	0.502	(0.442)	0.391	0.110
34	2.83	1.80	0.451	(0.442)	0.352	0.099
35	2.92	1.80	0.451	(0.442)	0.352	0.099
36	3.00	0.60	0.150	(0.442)	0.117	0.033
		(Loss Rate Not Used)				
Sum =		100.0			Sum =	11.5

Flood volume = Effective rainfall 0.96(In)
times area 6.9(Ac.)/[(In)/(Ft.)] = 0.6(Ac.Ft)
Total soil loss = 1.13(In)
Total soil loss = 0.651(Ac.Ft)
Total rainfall = 2.09(In)
Flood volume = 23994.4 Cubic Feet
Total soil loss = 28352.3 Cubic Feet

Peak flow rate of this hydrograph = 9.317(CFS)

+++

```
                         3 - H O U R    S T O R M
                      R u n o f f      H y d r o g r a p h
       --------------------------------------------------------------------
                   Hydrograph in   5   Minute intervals ((CFS))

       --------------------------------------------------------------------
  Time(h+m) Volume Ac.Ft   Q(CFS)  0         2.5       5.0       7.5      10.0
  -----------------------------------------------------------------------
    0+ 5       0.0006      0.09  Q         |         |         |         |
    0+10       0.0029      0.33  VQ        |         |         |         |
    0+15       0.0057      0.40  VQ        |         |         |         |
    0+20       0.0086      0.43  VQ        |         |         |         |
    0+25       0.0121      0.51  V Q       |         |         |         |
    0+30       0.0160      0.56  |VQ       |         |         |         |
    0+35       0.0202      0.61  |VQ       |         |         |         |
    0+40       0.0244      0.61  |VQ       |         |         |         |
    0+45       0.0289      0.66  | Q       |         |         |         |
    0+50       0.0334      0.65  | Q       |         |         |         |
    0+55       0.0376      0.61  | Q       |         |         |         |
    1+ 0       0.0420      0.63  | QV      |         |         |         |
    1+ 5       0.0468      0.70  | QV      |         |         |         |
    1+10       0.0522      0.78  |  Q      |         |         |         |
    1+15       0.0578      0.81  |  QV     |         |         |         |
    1+20       0.0633      0.81  |  QV     |         |         |         |
    1+25       0.0696      0.91  |  Q V    |         |         |         |
    1+30       0.0784      1.27  |    Q    |         |         |         |
    1+35       0.0878      1.37  |    QV   |         |         |         |
    1+40       0.0967      1.29  |    Q V  |         |         |         |
    1+45       0.1084      1.69  |     QV  |         |         |         |
    1+50       0.1235      2.20  |       Q |         |         |         |
    1+55       0.1385      2.17  |       Q V         |         |         |
    2+ 0       0.1527      2.07  |       Q |V        |         |         |
    2+ 5       0.1676      2.16  |       Q | V       |         |         |
    2+10       0.1856      2.62  |         Q  V      |         |         |
    2+15       0.2121      3.85  |         |    Q    |         |         |
    2+20       0.2421      4.35  |         |      Q  |         |         |
    2+25       0.2734      4.54  |         |       QV|         |         |
    2+30       0.3233      7.25  |         |         |  V    Q |         |
    2+35       0.3839      8.80  |         |         |      V  |    Q    |
    2+40       0.4480      9.32  |         |         |         | V    Q  |
    2+45       0.4941      6.69  |         |         |     Q   |    V    |
    2+50       0.5161      3.20  |         | Q       |         |      V  |
    2+55       0.5300      2.02  |       Q |         |         |       V |
    3+ 0       0.5397      1.40  |    Q    |         |         |        V|
    3+ 5       0.5454      0.83  |  Q      |         |         |        V|
    3+10       0.5483      0.43  |Q        |         |         |        V|
    3+15       0.5498      0.22  Q         |         |         |        V|
    3+20       0.5505      0.09  Q         |         |         |        V|
    3+25       0.5507      0.03  Q         |         |         |        V|
    3+30       0.5508      0.02  Q         |         |         |        V|
    3+35       0.5508      0.01  Q         |         |         |        V|
    3+40       0.5508      0.00  Q         |         |         |         V
-----------------------------------------------------------------------
```

```
       U n i t   H y d r o g r a p h   A n a l y s i s

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               Study date  07/23/19 File: DMAD100EXIST6100.out

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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978


Program License Serial Number 6388

---------------------------------------------------------------------
 English (in-lb) Input Units Used
 English Rainfall Data (Inches) Input Values Used

 English Units used in output format



---------------------------------------------------------------------
KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
EXISTING CONDITION, DMA D
100-YR 6-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019
--------------------------------------------------------------------
Drainage Area =       6.90(Ac.)  =      0.011 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =       6.90(Ac.)  =      0.011 Sq. Mi.
Length along longest watercourse =    1710.00(Ft.)
Length along longest watercourse measured to centroid =    1043.00(Ft.)
Length along longest watercourse =      0.324 Mi.
Length along longest watercourse measured to centroid =      0.198 Mi.
Difference in elevation =      40.00(Ft.)
Slope along watercourse =    123.5088 Ft./Mi.
Average Manning's 'N' = 0.025
Lag time =    0.085 Hr.
Lag time =     5.07 Min.
25% of lag time =     1.27 Min.
40% of lag time =     2.03 Min.
Unit time =     5.00 Min.
Duration of storm = 6 Hour(s)
User Entered Base Flow =     0.00(CFS)

2 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        6.90           1.21                  8.35

100 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        6.90           2.86                 19.73

STORM EVENT (YEAR) =  100.00
Area Averaged 2-Year Rainfall =    1.210(In)
Area Averaged 100-Year Rainfall =    2.860(In)

Point rain (area averaged) =    2.860(In)
Areal adjustment factor =  100.00 %
Adjusted average point rain =    2.860(In)

Sub-Area Data:
Area(Ac.)         Runoff Index   Impervious %
     6.900           56.00         0.150
 Total Area Entered =      6.90(Ac.)


RI    RI   Infil. Rate Impervious   Adj. Infil. Rate  Area%     F
AMC2 AMC-2     (In/Hr)    (Dec.%)      (In/Hr)      (Dec.)    (In/Hr)
56.0  56.0      0.511     0.150        0.442       1.000      0.442
                                                   Sum (F) =   0.442
Area averaged mean soil loss (F) (In/Hr) =  0.442
Minimum soil loss rate ((In/Hr)) =  0.221
```

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.780

Unit Hydrograph
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.083	98.584	18.765	1.305
2	0.167	197.167	48.285	3.358
3	0.250	295.751	15.854	1.102
4	0.333	394.335	7.138	0.496
5	0.417	492.919	4.033	0.280
6	0.500	591.502	2.616	0.182
7	0.583	690.086	1.645	0.114
8	0.667	788.670	1.057	0.073
9	0.750	887.254	0.606	0.042
			Sum = 100.000	Sum= 6.954

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Loss rate(In./Hr) Low	Effective (In/Hr)
1	0.08	0.50	0.172	(0.442)	0.134	0.038
2	0.17	0.60	0.206	(0.442)	0.161	0.045
3	0.25	0.60	0.206	(0.442)	0.161	0.045
4	0.33	0.60	0.206	(0.442)	0.161	0.045
5	0.42	0.60	0.206	(0.442)	0.161	0.045
6	0.50	0.70	0.240	(0.442)	0.187	0.053
7	0.58	0.70	0.240	(0.442)	0.187	0.053
8	0.67	0.70	0.240	(0.442)	0.187	0.053
9	0.75	0.70	0.240	(0.442)	0.187	0.053
10	0.83	0.70	0.240	(0.442)	0.187	0.053
11	0.92	0.70	0.240	(0.442)	0.187	0.053
12	1.00	0.80	0.275	(0.442)	0.214	0.060
13	1.08	0.80	0.275	(0.442)	0.214	0.060
14	1.17	0.80	0.275	(0.442)	0.214	0.060
15	1.25	0.80	0.275	(0.442)	0.214	0.060
16	1.33	0.80	0.275	(0.442)	0.214	0.060
17	1.42	0.80	0.275	(0.442)	0.214	0.060
18	1.50	0.80	0.275	(0.442)	0.214	0.060
19	1.58	0.80	0.275	(0.442)	0.214	0.060
20	1.67	0.80	0.275	(0.442)	0.214	0.060
21	1.75	0.80	0.275	(0.442)	0.214	0.060
22	1.83	0.80	0.275	(0.442)	0.214	0.060
23	1.92	0.80	0.275	(0.442)	0.214	0.060
24	2.00	0.90	0.309	(0.442)	0.241	0.068
25	2.08	0.80	0.275	(0.442)	0.214	0.060
26	2.17	0.90	0.309	(0.442)	0.241	0.068
27	2.25	0.90	0.309	(0.442)	0.241	0.068
28	2.33	0.90	0.309	(0.442)	0.241	0.068
29	2.42	0.90	0.309	(0.442)	0.241	0.068
30	2.50	0.90	0.309	(0.442)	0.241	0.068
31	2.58	0.90	0.309	(0.442)	0.241	0.068
32	2.67	0.90	0.309	(0.442)	0.241	0.068
33	2.75	1.00	0.343	(0.442)	0.268	0.076
34	2.83	1.00	0.343	(0.442)	0.268	0.076
35	2.92	1.00	0.343	(0.442)	0.268	0.076
36	3.00	1.00	0.343	(0.442)	0.268	0.076
37	3.08	1.00	0.343	(0.442)	0.268	0.076
38	3.17	1.10	0.378	(0.442)	0.294	0.083
39	3.25	1.10	0.378	(0.442)	0.294	0.083
40	3.33	1.10	0.378	(0.442)	0.294	0.083
41	3.42	1.20	0.412	(0.442)	0.321	0.091
42	3.50	1.30	0.446	(0.442)	0.348	0.098
43	3.58	1.40	0.480	(0.442)	0.375	0.106
44	3.67	1.40	0.480	(0.442)	0.375	0.106
45	3.75	1.50	0.515	(0.442)	0.402	0.113
46	3.83	1.50	0.515	(0.442)	0.402	0.113
47	3.92	1.60	0.549	(0.442)	0.428	0.121
48	4.00	1.60	0.549	(0.442)	0.428	0.121
49	4.08	1.70	0.583	0.442	(0.455)	0.142

```
50   4.17     1.80      0.618          0.442     (  0.482)        0.176
51   4.25     1.90      0.652          0.442     (  0.509)        0.210
52   4.33     2.00      0.686          0.442     (  0.535)        0.245
53   4.42     2.10      0.721          0.442     (  0.562)        0.279
54   4.50     2.10      0.721          0.442     (  0.562)        0.279
55   4.58     2.20      0.755          0.442     (  0.589)        0.313
56   4.67     2.30      0.789          0.442     (  0.616)        0.347
57   4.75     2.40      0.824          0.442     (  0.642)        0.382
58   4.83     2.40      0.824          0.442     (  0.642)        0.382
59   4.92     2.50      0.858          0.442     (  0.669)        0.416
60   5.00     2.60      0.892          0.442     (  0.696)        0.450
61   5.08     3.10      1.064          0.442     (  0.830)        0.622
62   5.17     3.60      1.235          0.442     (  0.964)        0.794
63   5.25     3.90      1.338          0.442     (  1.044)        0.897
64   5.33     4.20      1.441          0.442     (  1.124)        1.000
65   5.42     4.70      1.613          0.442     (  1.258)        1.171
66   5.50     5.60      1.922          0.442     (  1.499)        1.480
67   5.58     1.90      0.652          0.442     (  0.509)        0.210
68   5.67     0.90      0.309       (  0.442)       0.241         0.068
69   5.75     0.60      0.206       (  0.442)       0.161         0.045
70   5.83     0.50      0.172       (  0.442)       0.134         0.038
71   5.92     0.30      0.103       (  0.442)       0.080         0.023
72   6.00     0.20      0.069       (  0.442)       0.054         0.015
              (Loss Rate Not Used)
   Sum =     100.0                                  Sum =    13.3
     Flood volume = Effective rainfall      1.11(In)
      times area       6.9(Ac.)/[(In)/(Ft.)] =       0.6(Ac.Ft)
     Total soil loss =      1.75(In)
     Total soil loss =     1.005(Ac.Ft)
     Total rainfall =      2.86(In)
     Flood volume =       27849.7 Cubic Feet
     Total soil loss =       43783.0 Cubic Feet
     --------------------------------------------------------------------
      Peak flow rate of this hydrograph =      7.849(CFS)
     --------------------------------------------------------------------
     ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                         6 - H O U R    S T O R M
                    R u n o f f     H y d r o g r a p h
     --------------------------------------------------------------------
                 Hydrograph in   5   Minute intervals ((CFS))

     --------------------------------------------------------------------
Time(h+m) Volume Ac.Ft    Q(CFS)  0        2.5       5.0       7.5      10.0
-----------------------------------------------------------------------
  0+ 5       0.0003      0.05  Q         |         |         |         |
  0+10       0.0016      0.19  Q         |         |         |         |
  0+15       0.0034      0.25  VQ        |         |         |         |
  0+20       0.0053      0.28  VQ        |         |         |         |
  0+25       0.0073      0.29  VQ        |         |         |         |
  0+30       0.0095      0.31  VQ        |         |         |         |
  0+35       0.0118      0.34  VQ        |         |         |         |
  0+40       0.0143      0.36  VQ        |         |         |         |
  0+45       0.0168      0.36  |Q        |         |         |         |
  0+50       0.0193      0.36  |Q        |         |         |         |
  0+55       0.0218      0.37  |Q        |         |         |         |
  1+ 0       0.0244      0.38  |Q        |         |         |         |
  1+ 5       0.0272      0.40  |Q        |         |         |         |
  1+10       0.0300      0.41  |Q        |         |         |         |
  1+15       0.0329      0.42  |QV       |         |         |         |
  1+20       0.0358      0.42  |QV       |         |         |         |
  1+25       0.0386      0.42  |QV       |         |         |         |
  1+30       0.0415      0.42  |QV       |         |         |         |
  1+35       0.0444      0.42  |QV       |         |         |         |
  1+40       0.0473      0.42  |QV       |         |         |         |
  1+45       0.0502      0.42  |Q V      |         |         |         |
  1+50       0.0531      0.42  |Q V      |         |         |         |
  1+55       0.0560      0.42  |Q V      |         |         |         |
  2+ 0       0.0590      0.43  |Q V      |         |         |         |
  2+ 5       0.0620      0.45  |Q V      |         |         |         |
  2+10       0.0650      0.44  |Q  V     |         |         |         |
  2+15       0.0682      0.46  |Q  V     |         |         |         |
  2+20       0.0714      0.47  |Q  V     |         |         |         |
  2+25       0.0746      0.47  |Q  V     |         |         |         |
  2+30       0.0779      0.47  |Q  V     |         |         |         |
  2+35       0.0811      0.47  |Q   V    |         |         |         |
  2+40       0.0844      0.47  |Q   V    |         |         |         |
  2+45       0.0877      0.48  |Q   V    |         |         |         |
  2+50       0.0912      0.51  | Q  V    |         |         |         |
  2+55       0.0948      0.52  | Q  V    |         |         |         |
```

```
    3+ 0      0.0983      0.52  | Q   V   |         |         |         |
    3+ 5      0.1019      0.52  | Q   V   |         |         |         |
    3+10      0.1056      0.53  | Q   V   |         |         |         |
    3+15      0.1095      0.56  | Q   V   |         |         |         |
    3+20      0.1134      0.57  | Q    V  |         |         |         |
    3+25      0.1174      0.58  | Q    V  |         |         |         |
    3+30      0.1217      0.62  | Q    V  |         |         |         |
    3+35      0.1262      0.66  | Q    V  |         |         |         |
    3+40      0.1311      0.70  | Q     V |         |         |         |
    3+45      0.1361      0.73  | Q     V |         |         |         |
    3+50      0.1413      0.76  |  Q    V |         |         |         |
    3+55      0.1467      0.78  |  Q     V|         |         |         |
    4+ 0      0.1523      0.82  |  Q     V|         |         |         |
    4+ 5      0.1582      0.85  |  Q     V|         |         |         |
    4+10      0.1649      0.97  |  Q      V         |         |         |
    4+15      0.1729      1.16  |   Q     V         |         |         |
    4+20      0.1824      1.37  |    Q    |V        |         |         |
    4+25      0.1934      1.59  |     Q   | V       |         |         |
    4+30      0.2056      1.78  |      Q  | V       |         |         |
    4+35      0.2187      1.90  |      Q  |  V      |         |         |
    4+40      0.2331      2.09  |       Q |   V     |         |         |
    4+45      0.2490      2.32  |        Q|    V    |         |         |
    4+50      0.2662      2.50  |        Q|     V   |         |         |
    4+55      0.2843      2.62  |         Q      V  |         |         |
    5+ 0      0.3037      2.81  |         |Q      V |         |         |
    5+ 5      0.3258      3.21  |         | Q      V         |         |
    5+10      0.3539      4.08  |         |     Q   | V       |         |
    5+15      0.3884      5.02  |         |         Q   V     |         |
    5+20      0.4283      5.79  |         |         |  Q  V   |         |
    5+25      0.4739      6.62  |         |         |     Q  V|         |
    5+30      0.5279      7.85  |         |         |         |Q V      |
    5+35      0.5800      7.55  |         |         |         Q     V   |
    5+40      0.6048      3.61  |         |   Q     |         |      V  |
    5+45      0.6182      1.95  |      Q  |         |         |       V |
    5+50      0.6267      1.22  |   Q     |         |         |        V|
    5+55      0.6323      0.81  |  Q      |         |         |        V|
    6+ 0      0.6358      0.51  | Q       |         |         |        V|
    6+ 5      0.6379      0.30  |Q        |         |         |        V|
    6+10      0.6388      0.13  Q         |         |         |        V|
    6+15      0.6391      0.04  Q         |         |         |        V|
    6+20      0.6392      0.02  Q         |         |         |        V|
    6+25      0.6393      0.01  Q         |         |         |        V|
    6+30      0.6393      0.00  Q         |         |         |        V|
    6+35      0.6393      0.00  Q         |         |         |        V|
    6+40      0.6393      0.00  Q         |         |         |         V
-----------------------------------------------------------------------
```

```
       U n i t   H y d r o g r a p h   A n a l y s i s

       Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2014, Version 9.0
              Study date  07/23/19 File: DMAD100EXIST24100.out


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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978


Program License Serial Number 6388

---------------------------------------------------------------------
 English (in-lb) Input Units Used
 English Rainfall Data (Inches) Input Values Used

 English Units used in output format



---------------------------------------------------------------------
KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
EXISTING CONDITION, DMA D
100-YR 24-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019
--------------------------------------------------------------------
Drainage Area =       6.90(Ac.)  =      0.011 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =       6.90(Ac.)  =      0.011 Sq. Mi.
Length along longest watercourse =    1710.00(Ft.)
Length along longest watercourse measured to centroid =    1043.00(Ft.)
Length along longest watercourse =      0.324 Mi.
Length along longest watercourse measured to centroid =      0.198 Mi.
Difference in elevation =      40.00(Ft.)
Slope along watercourse =    123.5088 Ft./Mi.
Average Manning's 'N' = 0.025
Lag time =    0.085 Hr.
Lag time =     5.07 Min.
25% of lag time =     1.27 Min.
40% of lag time =     2.03 Min.
Unit time =    15.00 Min.
Duration of storm = 24 Hour(s)
User Entered Base Flow =     0.00(CFS)

2 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        6.90           2.05                 14.15

100 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        6.90           5.16                 35.60

STORM EVENT (YEAR) =  100.00
Area Averaged 2-Year Rainfall =    2.050(In)
Area Averaged 100-Year Rainfall =    5.160(In)

Point rain (area averaged) =    5.160(In)
Areal adjustment factor =  100.00 %
Adjusted average point rain =    5.160(In)

Sub-Area Data:
Area(Ac.)         Runoff Index   Impervious %
     6.900           56.00         0.150
 Total Area Entered =      6.90(Ac.)


RI    RI   Infil. Rate Impervious   Adj. Infil. Rate  Area%     F
AMC2 AMC-2     (In/Hr)    (Dec.%)      (In/Hr)      (Dec.)    (In/Hr)
56.0  56.0      0.511     0.150        0.442       1.000      0.442
                                                   Sum (F) =   0.442
Area averaged mean soil loss (F) (In/Hr) =  0.442
Minimum soil loss rate ((In/Hr)) =  0.221
```

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.780

U n i t   H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.250	295.751	56.239	3.911
2	0.500	591.502	37.364	2.598
3	0.750	887.254	6.397	0.445
			Sum = 100.000	Sum= 6.954

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Loss rate(In./Hr) Low	Effective (In/Hr)
1	0.25	0.20	0.041	(0.780)	0.032	0.009
2	0.50	0.30	0.062	(0.771)	0.048	0.014
3	0.75	0.30	0.062	(0.762)	0.048	0.014
4	1.00	0.40	0.083	(0.753)	0.064	0.018
5	1.25	0.30	0.062	(0.744)	0.048	0.014
6	1.50	0.30	0.062	(0.736)	0.048	0.014
7	1.75	0.30	0.062	(0.727)	0.048	0.014
8	2.00	0.40	0.083	(0.718)	0.064	0.018
9	2.25	0.40	0.083	(0.709)	0.064	0.018
10	2.50	0.40	0.083	(0.701)	0.064	0.018
11	2.75	0.50	0.103	(0.692)	0.080	0.023
12	3.00	0.50	0.103	(0.684)	0.080	0.023
13	3.25	0.50	0.103	(0.675)	0.080	0.023
14	3.50	0.50	0.103	(0.667)	0.080	0.023
15	3.75	0.50	0.103	(0.658)	0.080	0.023
16	4.00	0.60	0.124	(0.650)	0.097	0.027
17	4.25	0.60	0.124	(0.642)	0.097	0.027
18	4.50	0.70	0.144	(0.634)	0.113	0.032
19	4.75	0.70	0.144	(0.626)	0.113	0.032
20	5.00	0.80	0.165	(0.617)	0.129	0.036
21	5.25	0.60	0.124	(0.609)	0.097	0.027
22	5.50	0.70	0.144	(0.602)	0.113	0.032
23	5.75	0.80	0.165	(0.594)	0.129	0.036
24	6.00	0.80	0.165	(0.586)	0.129	0.036
25	6.25	0.90	0.186	(0.578)	0.145	0.041
26	6.50	0.90	0.186	(0.570)	0.145	0.041
27	6.75	1.00	0.206	(0.563)	0.161	0.045
28	7.00	1.00	0.206	(0.555)	0.161	0.045
29	7.25	1.00	0.206	(0.548)	0.161	0.045
30	7.50	1.10	0.227	(0.540)	0.177	0.050
31	7.75	1.20	0.248	(0.533)	0.193	0.054
32	8.00	1.30	0.268	(0.525)	0.209	0.059
33	8.25	1.50	0.310	(0.518)	0.241	0.068
34	8.50	1.50	0.310	(0.511)	0.241	0.068
35	8.75	1.60	0.330	(0.504)	0.258	0.073
36	9.00	1.70	0.351	(0.497)	0.274	0.077
37	9.25	1.90	0.392	(0.490)	0.306	0.086
38	9.50	2.00	0.413	(0.483)	0.322	0.091
39	9.75	2.10	0.433	(0.476)	0.338	0.095
40	10.00	2.20	0.454	(0.469)	0.354	0.100
41	10.25	1.50	0.310	(0.462)	0.241	0.068
42	10.50	1.50	0.310	(0.455)	0.241	0.068
43	10.75	2.00	0.413	(0.449)	0.322	0.091
44	11.00	2.00	0.413	(0.442)	0.322	0.091
45	11.25	1.90	0.392	(0.436)	0.306	0.086
46	11.50	1.90	0.392	(0.429)	0.306	0.086
47	11.75	1.70	0.351	(0.423)	0.274	0.077
48	12.00	1.80	0.372	(0.417)	0.290	0.082
49	12.25	2.50	0.516	(0.410)	0.402	0.114
50	12.50	2.60	0.537	0.404	(0.419)	0.132
51	12.75	2.80	0.578	0.398	(0.451)	0.180
52	13.00	2.90	0.599	0.392	(0.467)	0.206
53	13.25	3.40	0.702	0.386	(0.547)	0.316
54	13.50	3.40	0.702	0.380	(0.547)	0.321
55	13.75	2.30	0.475	(0.375)	0.370	0.104

56	14.00	2.30	0.475	0.369	(0.370)	0.106
57	14.25	2.70	0.557	0.363	(0.435)	0.194
58	14.50	2.60	0.537	0.358	(0.419)	0.179
59	14.75	2.60	0.537	0.352	(0.419)	0.184
60	15.00	2.50	0.516	0.347	(0.402)	0.169
61	15.25	2.40	0.495	0.342	(0.386)	0.154
62	15.50	2.30	0.475	0.336	(0.370)	0.138
63	15.75	1.90	0.392	(0.331)	0.306	0.086
64	16.00	1.90	0.392	(0.326)	0.306	0.086
65	16.25	0.40	0.083	(0.321)	0.064	0.018
66	16.50	0.40	0.083	(0.316)	0.064	0.018
67	16.75	0.30	0.062	(0.311)	0.048	0.014
68	17.00	0.30	0.062	(0.307)	0.048	0.014
69	17.25	0.50	0.103	(0.302)	0.080	0.023
70	17.50	0.50	0.103	(0.298)	0.080	0.023
71	17.75	0.50	0.103	(0.293)	0.080	0.023
72	18.00	0.40	0.083	(0.289)	0.064	0.018
73	18.25	0.40	0.083	(0.285)	0.064	0.018
74	18.50	0.40	0.083	(0.280)	0.064	0.018
75	18.75	0.30	0.062	(0.276)	0.048	0.014
76	19.00	0.20	0.041	(0.272)	0.032	0.009
77	19.25	0.30	0.062	(0.269)	0.048	0.014
78	19.50	0.40	0.083	(0.265)	0.064	0.018
79	19.75	0.30	0.062	(0.261)	0.048	0.014
80	20.00	0.20	0.041	(0.258)	0.032	0.009
81	20.25	0.30	0.062	(0.254)	0.048	0.014
82	20.50	0.30	0.062	(0.251)	0.048	0.014
83	20.75	0.30	0.062	(0.248)	0.048	0.014
84	21.00	0.20	0.041	(0.245)	0.032	0.009
85	21.25	0.30	0.062	(0.242)	0.048	0.014
86	21.50	0.20	0.041	(0.239)	0.032	0.009
87	21.75	0.30	0.062	(0.237)	0.048	0.014
88	22.00	0.20	0.041	(0.234)	0.032	0.009
89	22.25	0.30	0.062	(0.232)	0.048	0.014
90	22.50	0.20	0.041	(0.230)	0.032	0.009
91	22.75	0.20	0.041	(0.228)	0.032	0.009
92	23.00	0.20	0.041	(0.226)	0.032	0.009
93	23.25	0.20	0.041	(0.224)	0.032	0.009
94	23.50	0.20	0.041	(0.223)	0.032	0.009
95	23.75	0.20	0.041	(0.222)	0.032	0.009
96	24.00	0.20	0.041	(0.221)	0.032	0.009

```
                (Loss Rate Not Used)
   Sum =     100.0                                  Sum =     5.3
     Flood volume = Effective rainfall      1.34(In)
      times area        6.9(Ac.)/[(In)/(Ft.)] =       0.8(Ac.Ft)
     Total soil loss =       3.82(In)
     Total soil loss =      2.199(Ac.Ft)
     Total rainfall =      5.16(In)
     Flood volume =       33467.7 Cubic Feet
     Total soil loss =       95773.1 Cubic Feet
     --------------------------------------------------------------------
      Peak flow rate of this hydrograph =       2.170(CFS)
     --------------------------------------------------------------------
     ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                        24 - H O U R    S T O R M
                  R u n o f f      H y d r o g r a p h
     --------------------------------------------------------------------
               Hydrograph in  15   Minute intervals ((CFS))

     --------------------------------------------------------------------
Time(h+m) Volume Ac.Ft    Q(CFS)  0        2.5       5.0       7.5      10.0
-----------------------------------------------------------------------
  0+15       0.0007       0.04  Q          |         |         |         |
  0+30       0.0023       0.08  Q          |         |         |         |
  0+45       0.0042       0.09  Q          |         |         |         |
  1+ 0       0.0066       0.11  Q          |         |         |         |
  1+15       0.0088       0.11  Q          |         |         |         |
  1+30       0.0108       0.10  Q          |         |         |         |
  1+45       0.0127       0.09  Q          |         |         |         |
  2+ 0       0.0151       0.11  Q          |         |         |         |
  2+15       0.0176       0.12  Q          |         |         |         |
  2+30       0.0202       0.13  QV         |         |         |         |
  2+45       0.0232       0.14  QV         |         |         |         |
  3+ 0       0.0264       0.16  QV         |         |         |         |
  3+15       0.0297       0.16  QV         |         |         |         |
  3+30       0.0330       0.16  QV         |         |         |         |
  3+45       0.0362       0.16  QV         |         |         |         |
  4+ 0       0.0399       0.18  Q V        |         |         |         |
  4+15       0.0437       0.19  Q V        |         |         |         |
```

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 4+30       0.0480      0.21  Q V       |         |         |         |
 4+45       0.0525      0.22  Q V       |         |         |         |
 5+ 0       0.0575      0.24  Q V       |         |         |         |
 5+15       0.0619      0.22  Q  V      |         |         |         |
 5+30       0.0663      0.21  Q  V      |         |         |         |
 5+45       0.0712      0.24  Q  V      |         |         |         |
 6+ 0       0.0764      0.25  |Q V      |         |         |         |
 6+15       0.0820      0.27  |Q  V     |         |         |         |
 6+30       0.0878      0.28  |Q  V     |         |         |         |
 6+45       0.0940      0.30  |Q  V     |         |         |         |
 7+ 0       0.1005      0.31  |Q   V    |         |         |         |
 7+15       0.1070      0.32  |Q   V    |         |         |         |
 7+30       0.1139      0.33  |Q   V    |         |         |         |
 7+45       0.1214      0.36  |Q    V   |         |         |         |
 8+ 0       0.1296      0.39  |Q    V   |         |         |         |
 8+15       0.1388      0.44  |Q     V  |         |         |         |
 8+30       0.1485      0.47  |Q     V  |         |         |         |
 8+45       0.1586      0.49  |Q      V |         |         |         |
 9+ 0       0.1694      0.52  | Q     V |         |         |         |
 9+15       0.1812      0.57  | Q      V|         |         |         |
 9+30       0.1939      0.61  | Q       V         |         |         |
 9+45       0.2073      0.65  | Q       V         |         |         |
10+ 0       0.2213      0.68  | Q       |V        |         |         |
10+15       0.2330      0.57  | Q       | V       |         |         |
10+30       0.2431      0.49  |Q        | V       |         |         |
10+45       0.2548      0.56  | Q       |  V      |         |         |
11+ 0       0.2676      0.62  | Q       |  V      |         |         |
11+15       0.2803      0.61  | Q       |   V     |         |         |
11+30       0.2927      0.60  | Q       |    V    |         |         |
11+45       0.3044      0.56  | Q       |    V    |         |         |
12+ 0       0.3159      0.56  | Q       |     V   |         |         |
12+15       0.3302      0.69  | Q       |      V  |         |         |
12+30       0.3478      0.85  |  Q      |       V |         |         |
12+45       0.3705      1.10  |   Q     |        V|         |         |
13+ 0       0.3980      1.33  |    Q    |         V         |         |
13+15       0.4363      1.85  |      Q  |         | V       |         |
13+30       0.4811      2.17  |       Q |         |    V    |         |
13+45       0.5097      1.38  |    Q    |         |     V   |         |
14+ 0       0.5268      0.83  |  Q      |         |      V  |         |
14+15       0.5491      1.08  |   Q     |         |       V |         |
14+30       0.5750      1.25  |    Q    |         |        V|         |
14+45       0.6013      1.27  |    Q    |         |         V         |
15+ 0       0.6265      1.22  |   Q     |         |         | V       |
15+15       0.6497      1.12  |   Q     |         |         |  V      |
15+30       0.6707      1.02  |   Q     |         |         |   V     |
15+45       0.6865      0.77  |  Q      |         |         |    V    |
16+ 0       0.6994      0.62  | Q       |         |         |     V   |
16+15       0.7063      0.33  |Q        |         |         |     V   |
16+30       0.7096      0.16  Q         |         |         |     V   |
16+45       0.7118      0.11  Q         |         |         |      V  |
17+ 0       0.7138      0.10  Q         |         |         |      V  |
17+15       0.7165      0.13  Q         |         |         |      V  |
17+30       0.7197      0.15  Q         |         |         |      V  |
17+45       0.7229      0.16  Q         |         |         |      V  |
18+ 0       0.7258      0.14  Q         |         |         |      V  |
18+15       0.7285      0.13  Q         |         |         |      V  |
18+30       0.7311      0.13  Q         |         |         |       V |
18+45       0.7333      0.11  Q         |         |         |       V |
19+ 0       0.7350      0.08  Q         |         |         |       V |
19+15       0.7367      0.08  Q         |         |         |       V |
19+30       0.7390      0.11  Q         |         |         |       V |
19+45       0.7412      0.11  Q         |         |         |       V |
20+ 0       0.7428      0.08  Q         |         |         |       V |
20+15       0.7445      0.08  Q         |         |         |       V |
20+30       0.7464      0.09  Q         |         |         |       V |
20+45       0.7484      0.09  Q         |         |         |       V |
21+ 0       0.7500      0.08  Q         |         |         |        V|
21+15       0.7517      0.08  Q         |         |         |        V|
21+30       0.7533      0.07  Q         |         |         |        V|
21+45       0.7550      0.08  Q         |         |         |        V|
22+ 0       0.7565      0.07  Q         |         |         |        V|
22+15       0.7582      0.08  Q         |         |         |        V|
22+30       0.7598      0.07  Q         |         |         |        V|
22+45       0.7611      0.07  Q         |         |         |        V|
23+ 0       0.7624      0.06  Q         |         |         |        V|
23+15       0.7637      0.06  Q         |         |         |        V|
23+30       0.7650      0.06  Q         |         |         |        V|
23+45       0.7664      0.06  Q         |         |         |        V|
24+ 0       0.7677      0.06  Q         |         |         |        V|
```

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  24+15        0.7682      0.03  Q          |         |         |        V|
  24+30        0.7683      0.00  Q          |         |         |        V|
-----------------------------------------------------------------------
```

```
       U n i t   H y d r o g r a p h   A n a l y s i s

       Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2014, Version 9.0
               Study date  07/23/19 File: DMAD100PROP1100.out


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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978


Program License Serial Number 6388

---------------------------------------------------------------------
 English (in-lb) Input Units Used
 English Rainfall Data (Inches) Input Values Used

 English Units used in output format




---------------------------------------------------------------------
KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
PROPOSED CONDITION, DMA D
100-YR 1-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019
--------------------------------------------------------------------
Drainage Area =       6.90(Ac.)  =      0.011 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =       6.90(Ac.)  =      0.011 Sq. Mi.
Length along longest watercourse =    1710.00(Ft.)
Length along longest watercourse measured to centroid =    1043.00(Ft.)
Length along longest watercourse =      0.324 Mi.
Length along longest watercourse measured to centroid =      0.198 Mi.
Difference in elevation =      40.00(Ft.)
Slope along watercourse =    123.5088 Ft./Mi.
Average Manning's 'N' = 0.015
Lag time =    0.051 Hr.
Lag time =     3.04 Min.
25% of lag time =     0.76 Min.
40% of lag time =     1.22 Min.
Unit time =     5.00 Min.
Duration of storm = 1 Hour(s)
User Entered Base Flow =     0.00(CFS)

2 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        6.90           0.49                  3.37

100 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        6.90           1.33                  9.18

STORM EVENT (YEAR) =  100.00
Area Averaged 2-Year Rainfall =    0.489(In)
Area Averaged 100-Year Rainfall =    1.330(In)

Point rain (area averaged) =    1.330(In)
Areal adjustment factor =   99.99 %
Adjusted average point rain =    1.330(In)

Sub-Area Data:
Area(Ac.)         Runoff Index   Impervious %
     6.900           56.00         0.850
 Total Area Entered =      6.90(Ac.)


RI    RI   Infil. Rate Impervious   Adj. Infil. Rate  Area%     F
AMC2 AMC-2     (In/Hr)    (Dec.%)      (In/Hr)      (Dec.)    (In/Hr)
56.0  56.0      0.511     0.850        0.120       1.000      0.120
                                                    Sum (F) =   0.120
Area averaged mean soil loss (F) (In/Hr) =  0.120
Minimum soil loss rate ((In/Hr)) =  0.060
```

```
(for 24 hour storm duration)
Soil low loss rate (decimal) =   0.220
----------------------------------------------------------------------
Slope of intensity-duration curve for a 1 hour storm =0.5000
-----------------------------------------------------------------------

               U n i t   H y d r o g r a p h
                      VALLEY S-Curve
----------------------------------------------------------------------
               Unit Hydrograph Data
----------------------------------------------------------------------
Unit time period   Time % of lag   Distribution   Unit Hydrograph
    (hrs)                           Graph %          (CFS)
----------------------------------------------------------------------
    1   0.083         164.306         36.467             2.536
    2   0.167         328.612         45.943             3.195
    3   0.250         492.919         10.415             0.724
    4   0.333         657.225          4.445             0.309
    5   0.417         821.531          2.730             0.190
                               Sum = 100.000    Sum=       6.954
```

```
 The following loss rate calculations reflect use of the minimum calculated loss
 rate subtracted from the Storm Rain to produce the maximum Effective Rain value

  Unit Time   Pattern   Storm Rain     Loss rate(In./Hr)     Effective
       (Hr.)  Percent   (In/Hr)         Max   |   Low         (In/Hr)
   1   0.08     4.20      0.670          0.120    (  0.147)        0.550
   2   0.17     4.30      0.686          0.120    (  0.151)        0.566
   3   0.25     5.00      0.798          0.120    (  0.176)        0.678
   4   0.33     5.00      0.798          0.120    (  0.176)        0.678
   5   0.42     5.80      0.926          0.120    (  0.204)        0.806
   6   0.50     6.50      1.037          0.120    (  0.228)        0.917
   7   0.58     7.40      1.181          0.120    (  0.260)        1.061
   8   0.67     8.60      1.372          0.120    (  0.302)        1.252
   9   0.75    12.30      1.963          0.120    (  0.432)        1.843
  10   0.83    29.10      4.644          0.120    (  1.022)        4.524
  11   0.92     6.80      1.085          0.120    (  0.239)        0.965
  12   1.00     5.00      0.798          0.120    (  0.176)        0.678
               (Loss Rate Not Used)
     Sum =     100.0                                    Sum =    14.5
       Flood volume = Effective rainfall      1.21(In)
        times area       6.9(Ac.)/[(In)/(Ft.)] =       0.7(Ac.Ft)
       Total soil loss =       0.12(In)
       Total soil loss =      0.069(Ac.Ft)
       Total rainfall =      1.33(In)
       Flood volume =      30303.8 Cubic Feet
       Total soil loss =        3006.6 Cubic Feet
       ---------------------------------------------------------------------
        Peak flow rate of this hydrograph =     18.834(CFS)
       ---------------------------------------------------------------------
       +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                          1 - H O U R     S T O R M
                    R u n o f f      H y d r o g r a p h
       ---------------------------------------------------------------------
                 Hydrograph in   5   Minute intervals ((CFS))

       ---------------------------------------------------------------------
  Time(h+m) Volume Ac.Ft    Q(CFS)  0         5.0       10.0      15.0      20.0
  -----------------------------------------------------------------------
    0+ 5       0.0096       1.40  V Q       |         |         |         |
    0+10       0.0316       3.20  |V    Q   |         |         |         |
    0+15       0.0587       3.93  |  V   Q  |         |         |         |
    0+20       0.0894       4.47  |    V  Q |         |         |         |
    0+25       0.1238       4.98  |      V Q|         |         |         |
    0+30       0.1631       5.71  |        V|Q        |         |         |
    0+35       0.2082       6.55  |         |V Q      |         |         |
    0+40       0.2606       7.61  |         |    VQ   |         |         |
    0+45       0.3287       9.88  |         |        VQ|        |         |
    0+50       0.4580      18.78  |         |         |      V  |      Q  |
    0+55       0.5877      18.83  |         |         |         |  V   Q  |
    1+ 0       0.6489       8.89  |         |       Q |         |      V  |
    1+ 5       0.6807       4.62  |        Q|         |         |        V|
    1+10       0.6921       1.65  | Q       |         |         |        V|
    1+15       0.6948       0.39  Q         |         |         |        V|
    1+20       0.6957       0.13  Q         |         |         |         V
```

```
      U n i t   H y d r o g r a p h   A n a l y s i s

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              Study date  07/23/19 File: DMAD100PROP3100.out


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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978


Program License Serial Number 6388

---------------------------------------------------------------------
 English (in-lb) Input Units Used
 English Rainfall Data (Inches) Input Values Used

 English Units used in output format



---------------------------------------------------------------------
KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
PROPOSED CONDITION, DMA D
100-YR 3-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019
--------------------------------------------------------------------
Drainage Area =       6.90(Ac.)  =      0.011 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =       6.90(Ac.)  =      0.011 Sq. Mi.
Length along longest watercourse =    1710.00(Ft.)
Length along longest watercourse measured to centroid =    1043.00(Ft.)
Length along longest watercourse =      0.324 Mi.
Length along longest watercourse measured to centroid =      0.198 Mi.
Difference in elevation =      40.00(Ft.)
Slope along watercourse =    123.5088 Ft./Mi.
Average Manning's 'N' = 0.015
Lag time =    0.051 Hr.
Lag time =     3.04 Min.
25% of lag time =     0.76 Min.
40% of lag time =     1.22 Min.
Unit time =     5.00 Min.
Duration of storm = 3 Hour(s)
User Entered Base Flow =     0.00(CFS)

2 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        6.90           0.87                  5.98

100 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        6.90           2.09                 14.42

STORM EVENT (YEAR) =  100.00
Area Averaged 2-Year Rainfall =    0.866(In)
Area Averaged 100-Year Rainfall =    2.090(In)

Point rain (area averaged) =    2.090(In)
Areal adjustment factor =  100.00 %
Adjusted average point rain =    2.090(In)

Sub-Area Data:
Area(Ac.)         Runoff Index   Impervious %
     6.900           56.00         0.850
 Total Area Entered =      6.90(Ac.)


RI    RI   Infil. Rate Impervious   Adj. Infil. Rate  Area%     F
AMC2 AMC-2     (In/Hr)    (Dec.%)      (In/Hr)      (Dec.)    (In/Hr)
56.0  56.0      0.511     0.850        0.120       1.000      0.120
                                                  Sum (F) =   0.120
Area averaged mean soil loss (F) (In/Hr) =  0.120
Minimum soil loss rate ((In/Hr)) =  0.060
```

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.220

U n i t   H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.083	164.306	36.467	2.536
2	0.167	328.612	45.943	3.195
3	0.250	492.919	10.415	0.724
4	0.333	657.225	4.445	0.309
5	0.417	821.531	2.730	0.190
			Sum = 100.000	Sum= 6.954

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Low	Effective (In/Hr)
1	0.08	1.30	0.326	(0.120)	0.072	0.254
2	0.17	1.30	0.326	(0.120)	0.072	0.254
3	0.25	1.10	0.276	(0.120)	0.061	0.215
4	0.33	1.50	0.376	(0.120)	0.083	0.293
5	0.42	1.50	0.376	(0.120)	0.083	0.293
6	0.50	1.80	0.451	(0.120)	0.099	0.352
7	0.58	1.50	0.376	(0.120)	0.083	0.293
8	0.67	1.80	0.451	(0.120)	0.099	0.352
9	0.75	1.80	0.451	(0.120)	0.099	0.352
10	0.83	1.50	0.376	(0.120)	0.083	0.293
11	0.92	1.60	0.401	(0.120)	0.088	0.313
12	1.00	1.80	0.451	(0.120)	0.099	0.352
13	1.08	2.20	0.552	0.120	(0.121)	0.432
14	1.17	2.20	0.552	0.120	(0.121)	0.432
15	1.25	2.20	0.552	0.120	(0.121)	0.432
16	1.33	2.00	0.502	(0.120)	0.110	0.391
17	1.42	2.60	0.652	0.120	(0.143)	0.532
18	1.50	2.70	0.677	0.120	(0.149)	0.557
19	1.58	2.40	0.602	0.120	(0.132)	0.482
20	1.67	2.70	0.677	0.120	(0.149)	0.557
21	1.75	3.30	0.828	0.120	(0.182)	0.708
22	1.83	3.10	0.777	0.120	(0.171)	0.657
23	1.92	2.90	0.727	0.120	(0.160)	0.607
24	2.00	3.00	0.752	0.120	(0.166)	0.632
25	2.08	3.10	0.777	0.120	(0.171)	0.657
26	2.17	4.20	1.053	0.120	(0.232)	0.933
27	2.25	5.00	1.254	0.120	(0.276)	1.134
28	2.33	3.50	0.878	0.120	(0.193)	0.758
29	2.42	6.80	1.705	0.120	(0.375)	1.585
30	2.50	7.30	1.831	0.120	(0.403)	1.711
31	2.58	8.20	2.056	0.120	(0.452)	1.936
32	2.67	5.90	1.480	0.120	(0.326)	1.360
33	2.75	2.00	0.502	(0.120)	0.110	0.391
34	2.83	1.80	0.451	(0.120)	0.099	0.352
35	2.92	1.80	0.451	(0.120)	0.099	0.352
36	3.00	0.60	0.150	(0.120)	0.033	0.117
		(Loss Rate Not Used)				
Sum =		100.0			Sum =	21.3

Flood volume = Effective rainfall 1.78(In)
times area 6.9(Ac.)/[(In)/(Ft.)] = 1.0(Ac.Ft)
Total soil loss = 0.31(In)
Total soil loss = 0.180(Ac.Ft)
Total rainfall = 2.09(In)
Flood volume = 44511.4 Cubic Feet
Total soil loss = 7835.3 Cubic Feet

Peak flow rate of this hydrograph = 11.980(CFS)

++

3 - H O U R   S T O R M
R u n o f f   H y d r o g r a p h

Hydrograph in 5 Minute intervals ((CFS))

```
     --------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0         5.0       10.0      15.0      20.0
-----------------------------------------------------------------------
  0+ 5       0.0044      0.65  VQ        |         |         |         |
  0+10       0.0145      1.46  V Q       |         |         |         |
  0+15       0.0251      1.54  V  Q      |         |         |         |
  0+20       0.0368      1.70  |V Q      |         |         |         |
  0+25       0.0503      1.97  |V Q      |         |         |         |
  0+30       0.0652      2.16  | V Q     |         |         |         |
  0+35       0.0804      2.21  |  VQ     |         |         |         |
  0+40       0.0958      2.23  |  VQ     |         |         |         |
  0+45       0.1123      2.40  |   Q     |         |         |         |
  0+50       0.1280      2.28  |   QV    |         |         |         |
  0+55       0.1429      2.15  |   QV    |         |         |         |
  1+ 0       0.1586      2.28  |   Q V   |         |         |         |
  1+ 5       0.1765      2.61  |    QV   |         |         |         |
  1+10       0.1964      2.88  |    Q V  |         |         |         |
  1+15       0.2167      2.96  |    Q  V |         |         |         |
  1+20       0.2366      2.89  |    Q   V|         |         |         |
  1+25       0.2582      3.13  |     Q   V         |         |         |
  1+30       0.2830      3.61  |      Q  |V        |         |         |
  1+35       0.3078      3.59  |      Q  | V       |         |         |
  1+40       0.3325      3.60  |      Q  |  V      |         |         |
  1+45       0.3615      4.20  |       Q |   V     |         |         |
  1+50       0.3931      4.59  |        Q|    V    |         |         |
  1+55       0.4235      4.42  |       Q |     V   |         |         |
  2+ 0       0.4534      4.35  |       Q |      V  |         |         |
  2+ 5       0.4842      4.47  |       Q |       V |         |         |
  2+10       0.5203      5.24  |         Q         V         |         |
  2+15       0.5661      6.65  |         |  Q      | V       |         |
  2+20       0.6112      6.55  |         |  Q      |  V      |         |
  2+25       0.6640      7.68  |         |    Q    |    V    |         |
  2+30       0.7363     10.49  |         |         Q       V |         |
  2+35       0.8188     11.98  |         |         |  Q      | V       |
  2+40       0.8981     11.51  |         |         |  Q      |    V    |
  2+45       0.9502      7.57  |         |    Q    |         |      V  |
  2+50       0.9781      4.05  |       Q |         |         |       V |
  2+55       0.9994      3.09  |     Q   |         |         |        V|
  3+ 0       1.0136      2.06  |   Q     |         |         |        V|
  3+ 5       1.0192      0.81  |Q        |         |         |        V|
  3+10       1.0210      0.26  Q         |         |         |        V|
  3+15       1.0217      0.10  Q         |         |         |        V|
  3+20       1.0218      0.02  Q         |         |         |         V
-----------------------------------------------------------------------
```

```
       U n i t   H y d r o g r a p h   A n a l y s i s

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               Study date  07/23/19 File: DMAD100PROP6100.out


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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978


Program License Serial Number 6388

---------------------------------------------------------------------
 English (in-lb) Input Units Used
 English Rainfall Data (Inches) Input Values Used

 English Units used in output format



---------------------------------------------------------------------
KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
PROPOSED CONDITION, DMA D
100-YR 6-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019
--------------------------------------------------------------------
Drainage Area =       6.90(Ac.)  =      0.011 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =       6.90(Ac.)  =      0.011 Sq. Mi.
Length along longest watercourse =    1710.00(Ft.)
Length along longest watercourse measured to centroid =    1043.00(Ft.)
Length along longest watercourse =      0.324 Mi.
Length along longest watercourse measured to centroid =      0.198 Mi.
Difference in elevation =      40.00(Ft.)
Slope along watercourse =    123.5088 Ft./Mi.
Average Manning's 'N' = 0.015
Lag time =    0.051 Hr.
Lag time =     3.04 Min.
25% of lag time =     0.76 Min.
40% of lag time =     1.22 Min.
Unit time =     5.00 Min.
Duration of storm = 6 Hour(s)
User Entered Base Flow =     0.00(CFS)

2 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        6.90           1.21                  8.35

100 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        6.90           2.86                 19.73

STORM EVENT (YEAR) =  100.00
Area Averaged 2-Year Rainfall =    1.210(In)
Area Averaged 100-Year Rainfall =    2.860(In)

Point rain (area averaged) =    2.860(In)
Areal adjustment factor =  100.00 %
Adjusted average point rain =    2.860(In)

Sub-Area Data:
Area(Ac.)         Runoff Index   Impervious %
     6.900           56.00          0.850
 Total Area Entered =      6.90(Ac.)


RI    RI   Infil. Rate Impervious   Adj. Infil. Rate  Area%     F
AMC2 AMC-2     (In/Hr)    (Dec.%)      (In/Hr)      (Dec.)    (In/Hr)
56.0  56.0      0.511     0.850        0.120       1.000      0.120
                                                  Sum (F) =   0.120
Area averaged mean soil loss (F) (In/Hr) =  0.120
Minimum soil loss rate ((In/Hr)) =  0.060
```

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.220

U n i t H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.083	164.306	36.467	2.536
2	0.167	328.612	45.943	3.195
3	0.250	492.919	10.415	0.724
4	0.333	657.225	4.445	0.309
5	0.417	821.531	2.730	0.190
			Sum = 100.000	Sum= 6.954

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Loss rate(In./Hr) Low	Effective (In/Hr)
1	0.08	0.50	0.172	(0.120)	0.038	0.134
2	0.17	0.60	0.206	(0.120)	0.045	0.161
3	0.25	0.60	0.206	(0.120)	0.045	0.161
4	0.33	0.60	0.206	(0.120)	0.045	0.161
5	0.42	0.60	0.206	(0.120)	0.045	0.161
6	0.50	0.70	0.240	(0.120)	0.053	0.187
7	0.58	0.70	0.240	(0.120)	0.053	0.187
8	0.67	0.70	0.240	(0.120)	0.053	0.187
9	0.75	0.70	0.240	(0.120)	0.053	0.187
10	0.83	0.70	0.240	(0.120)	0.053	0.187
11	0.92	0.70	0.240	(0.120)	0.053	0.187
12	1.00	0.80	0.275	(0.120)	0.060	0.214
13	1.08	0.80	0.275	(0.120)	0.060	0.214
14	1.17	0.80	0.275	(0.120)	0.060	0.214
15	1.25	0.80	0.275	(0.120)	0.060	0.214
16	1.33	0.80	0.275	(0.120)	0.060	0.214
17	1.42	0.80	0.275	(0.120)	0.060	0.214
18	1.50	0.80	0.275	(0.120)	0.060	0.214
19	1.58	0.80	0.275	(0.120)	0.060	0.214
20	1.67	0.80	0.275	(0.120)	0.060	0.214
21	1.75	0.80	0.275	(0.120)	0.060	0.214
22	1.83	0.80	0.275	(0.120)	0.060	0.214
23	1.92	0.80	0.275	(0.120)	0.060	0.214
24	2.00	0.90	0.309	(0.120)	0.068	0.241
25	2.08	0.80	0.275	(0.120)	0.060	0.214
26	2.17	0.90	0.309	(0.120)	0.068	0.241
27	2.25	0.90	0.309	(0.120)	0.068	0.241
28	2.33	0.90	0.309	(0.120)	0.068	0.241
29	2.42	0.90	0.309	(0.120)	0.068	0.241
30	2.50	0.90	0.309	(0.120)	0.068	0.241
31	2.58	0.90	0.309	(0.120)	0.068	0.241
32	2.67	0.90	0.309	(0.120)	0.068	0.241
33	2.75	1.00	0.343	(0.120)	0.076	0.268
34	2.83	1.00	0.343	(0.120)	0.076	0.268
35	2.92	1.00	0.343	(0.120)	0.076	0.268
36	3.00	1.00	0.343	(0.120)	0.076	0.268
37	3.08	1.00	0.343	(0.120)	0.076	0.268
38	3.17	1.10	0.378	(0.120)	0.083	0.294
39	3.25	1.10	0.378	(0.120)	0.083	0.294
40	3.33	1.10	0.378	(0.120)	0.083	0.294
41	3.42	1.20	0.412	(0.120)	0.091	0.321
42	3.50	1.30	0.446	(0.120)	0.098	0.348
43	3.58	1.40	0.480	(0.120)	0.106	0.375
44	3.67	1.40	0.480	(0.120)	0.106	0.375
45	3.75	1.50	0.515	(0.120)	0.113	0.402
46	3.83	1.50	0.515	(0.120)	0.113	0.402
47	3.92	1.60	0.549	0.120	(0.121)	0.429
48	4.00	1.60	0.549	0.120	(0.121)	0.429
49	4.08	1.70	0.583	0.120	(0.128)	0.463
50	4.17	1.80	0.618	0.120	(0.136)	0.498
51	4.25	1.90	0.652	0.120	(0.143)	0.532
52	4.33	2.00	0.686	0.120	(0.151)	0.566
53	4.42	2.10	0.721	0.120	(0.159)	0.601

```
54   4.50      2.10      0.721           0.120     (  0.159)        0.601
55   4.58      2.20      0.755           0.120     (  0.166)        0.635
56   4.67      2.30      0.789           0.120     (  0.174)        0.669
57   4.75      2.40      0.824           0.120     (  0.181)        0.704
58   4.83      2.40      0.824           0.120     (  0.181)        0.704
59   4.92      2.50      0.858           0.120     (  0.189)        0.738
60   5.00      2.60      0.892           0.120     (  0.196)        0.772
61   5.08      3.10      1.064           0.120     (  0.234)        0.944
62   5.17      3.60      1.235           0.120     (  0.272)        1.115
63   5.25      3.90      1.338           0.120     (  0.294)        1.218
64   5.33      4.20      1.441           0.120     (  0.317)        1.321
65   5.42      4.70      1.613           0.120     (  0.355)        1.493
66   5.50      5.60      1.922           0.120     (  0.423)        1.802
67   5.58      1.90      0.652           0.120     (  0.143)        0.532
68   5.67      0.90      0.309       (  0.120)        0.068         0.241
69   5.75      0.60      0.206       (  0.120)        0.045         0.161
70   5.83      0.50      0.172       (  0.120)        0.038         0.134
71   5.92      0.30      0.103       (  0.120)        0.023         0.080
72   6.00      0.20      0.069       (  0.120)        0.015         0.054
              (Loss Rate Not Used)
   Sum =     100.0                                   Sum =     28.5
     Flood volume = Effective rainfall      2.37(In)
      times area       6.9(Ac.)/[(In)/(Ft.)] =       1.4(Ac.Ft)
     Total soil loss =      0.49(In)
     Total soil loss =     0.279(Ac.Ft)
     Total rainfall =      2.86(In)
     Flood volume =      59468.7 Cubic Feet
     Total soil loss =       12164.1 Cubic Feet
     --------------------------------------------------------------------
      Peak flow rate of this hydrograph =     10.890(CFS)
     --------------------------------------------------------------------
     ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                         6 - H O U R    S T O R M
                    R u n o f f      H y d r o g r a p h
     --------------------------------------------------------------------
                 Hydrograph in   5   Minute intervals ((CFS))

     --------------------------------------------------------------------
Time(h+m) Volume Ac.Ft    Q(CFS)   0        5.0       10.0      15.0      20.0
-----------------------------------------------------------------------
  0+ 5       0.0023       0.34  Q         |         |         |         |
  0+10       0.0081       0.84  VQ        |         |         |         |
  0+15       0.0151       1.02  V Q       |         |         |         |
  0+20       0.0225       1.08  V Q       |         |         |         |
  0+25       0.0302       1.11  V Q       |         |         |         |
  0+30       0.0384       1.19  |VQ       |         |         |         |
  0+35       0.0471       1.27  |VQ       |         |         |         |
  0+40       0.0560       1.29  |VQ       |         |         |         |
  0+45       0.0649       1.30  |VQ       |         |         |         |
  0+50       0.0739       1.30  | Q       |         |         |         |
  0+55       0.0829       1.30  | Q       |         |         |         |
  1+ 0       0.0923       1.37  | Q       |         |         |         |
  1+ 5       0.1024       1.46  | Q       |         |         |         |
  1+10       0.1125       1.48  | QV      |         |         |         |
  1+15       0.1228       1.48  | QV      |         |         |         |
  1+20       0.1330       1.49  | QV      |         |         |         |
  1+25       0.1433       1.49  | Q V     |         |         |         |
  1+30       0.1536       1.49  | Q V     |         |         |         |
  1+35       0.1638       1.49  | Q V     |         |         |         |
  1+40       0.1741       1.49  | Q  V    |         |         |         |
  1+45       0.1843       1.49  | Q  V    |         |         |         |
  1+50       0.1946       1.49  | Q  V    |         |         |         |
  1+55       0.2049       1.49  | Q   V   |         |         |         |
  2+ 0       0.2156       1.56  |  Q  V   |         |         |         |
  2+ 5       0.2264       1.58  |  Q  V   |         |         |         |
  2+10       0.2373       1.58  |  Q  V   |         |         |         |
  2+15       0.2487       1.65  |  Q   V  |         |         |         |
  2+20       0.2602       1.67  |  Q   V  |         |         |         |
  2+25       0.2717       1.67  |  Q   V  |         |         |         |
  2+30       0.2832       1.68  |  Q    V |         |         |         |
  2+35       0.2948       1.68  |  Q    V |         |         |         |
  2+40       0.3063       1.68  |  Q    V |         |         |         |
  2+45       0.3183       1.74  |  Q     V|         |         |         |
  2+50       0.3309       1.83  |  Q     V|         |         |         |
  2+55       0.3437       1.85  |  Q      V         |         |         |
  3+ 0       0.3565       1.86  |  Q      V         |         |         |
  3+ 5       0.3693       1.86  |  Q      V         |         |         |
  3+10       0.3826       1.93  |  Q      |V        |         |         |
  3+15       0.3965       2.02  |   Q     |V        |         |         |
```

```
    3+20       0.4105      2.04  |   Q     | V       |         |         |
    3+25       0.4250      2.11  |   Q     | V       |         |         |
    3+30       0.4407      2.27  |   Q     | V       |         |         |
    3+35       0.4575      2.44  |   Q     |  V      |         |         |
    3+40       0.4751      2.56  |    Q    |  V      |         |         |
    3+45       0.4934      2.66  |    Q    |   V     |         |         |
    3+50       0.5124      2.76  |    Q    |    V    |         |         |
    3+55       0.5320      2.85  |    Q    |    V    |         |         |
    4+ 0       0.5523      2.95  |    Q    |     V   |         |         |
    4+ 5       0.5733      3.06  |     Q   |     V   |         |         |
    4+10       0.5958      3.26  |     Q   |      V  |         |         |
    4+15       0.6199      3.49  |     Q   |       V |         |         |
    4+20       0.6455      3.72  |      Q  |       V |         |         |
    4+25       0.6728      3.96  |      Q  |        V|         |         |
    4+30       0.7011      4.11  |       Q |         V         |         |
    4+35       0.7303      4.24  |       Q |         |V        |         |
    4+40       0.7610      4.46  |       Q |         | V       |         |
    4+45       0.7933      4.68  |        Q|         |  V      |         |
    4+50       0.8266      4.83  |        Q|         |   V     |         |
    4+55       0.8607      4.96  |        Q|         |    V    |         |
    5+ 0       0.8963      5.17  |         Q         |     V   |         |
    5+ 5       0.9359      5.75  |         |Q        |      V  |         |
    5+10       0.9825      6.77  |         |  Q      |       V |         |
    5+15       1.0357      7.72  |         |    Q    |         V         |
    5+20       1.0942      8.49  |         |     Q   |         | V       |
    5+25       1.1591      9.42  |         |       Q |         |  V      |
    5+30       1.2341     10.89  |         |         |Q        |     V   |
    5+35       1.2949      8.83  |         |      Q  |         |      V  |
    5+40       1.3247      4.33  |       Q |         |         |       V |
    5+45       1.3413      2.40  |   Q     |         |         |        V|
    5+50       1.3518      1.53  |  Q      |         |         |        V|
    5+55       1.3582      0.92  |Q        |         |         |        V|
    6+ 0       1.3622      0.58  |Q        |         |         |        V|
    6+ 5       1.3643      0.30  Q         |         |         |        V|
    6+10       1.3649      0.09  Q         |         |         |        V|
    6+15       1.3651      0.03  Q         |         |         |        V|
    6+20       1.3652      0.01  Q         |         |         |        V|
-----------------------------------------------------------------------
```

```
U n i t   H y d r o g r a p h   A n a l y s i s

Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2014, Version 9.0
        Study date  07/23/19 File: DMAD100PROP24100.out

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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978


Program License Serial Number 6388

---------------------------------------------------------------------
 English (in-lb) Input Units Used
 English Rainfall Data (Inches) Input Values Used

 English Units used in output format



---------------------------------------------------------------------
KPMV PROJECT UNIT HYDROGRAPH ANALYSIS
PROPOSED CONDITION, DMA D
100-YR 24-HR DESIGN STORM
BY PRASAD KASTURI, JULY 2019
--------------------------------------------------------------------
Drainage Area =       6.90(Ac.)  =      0.011 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =       6.90(Ac.)  =      0.011 Sq. Mi.
Length along longest watercourse =    1710.00(Ft.)
Length along longest watercourse measured to centroid =    1043.00(Ft.)
Length along longest watercourse =      0.324 Mi.
Length along longest watercourse measured to centroid =      0.198 Mi.
Difference in elevation =      40.00(Ft.)
Slope along watercourse =    123.5088 Ft./Mi.
Average Manning's 'N' = 0.015
Lag time =    0.051 Hr.
Lag time =     3.04 Min.
25% of lag time =     0.76 Min.
40% of lag time =     1.22 Min.
Unit time =    15.00 Min.
Duration of storm = 24 Hour(s)
User Entered Base Flow =     0.00(CFS)

2 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        6.90           2.05                 14.15

100 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        6.90           5.16                 35.60

STORM EVENT (YEAR) =  100.00
Area Averaged 2-Year Rainfall =    2.050(In)
Area Averaged 100-Year Rainfall =    5.160(In)

Point rain (area averaged) =    5.160(In)
Areal adjustment factor =  100.00 %
Adjusted average point rain =    5.160(In)

Sub-Area Data:
Area(Ac.)         Runoff Index   Impervious %
     6.900           56.00         0.850
 Total Area Entered =      6.90(Ac.)


RI    RI   Infil. Rate Impervious   Adj. Infil. Rate  Area%     F
AMC2 AMC-2     (In/Hr)    (Dec.%)      (In/Hr)      (Dec.)    (In/Hr)
56.0  56.0      0.511     0.850        0.120       1.000      0.120
                                                  Sum (F) =   0.120
Area averaged mean soil loss (F) (In/Hr) =  0.120
Minimum soil loss rate ((In/Hr)) =  0.060
```

(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.220

U n i t   H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.250	492.919	70.567	4.907
2	0.500	985.837	29.433	2.047
			Sum = 100.000	Sum= 6.954

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Low	Effective (In/Hr)
1	0.25	0.20	0.041	(0.212)	0.009	0.032
2	0.50	0.30	0.062	(0.210)	0.014	0.048
3	0.75	0.30	0.062	(0.207)	0.014	0.048
4	1.00	0.40	0.083	(0.205)	0.018	0.064
5	1.25	0.30	0.062	(0.202)	0.014	0.048
6	1.50	0.30	0.062	(0.200)	0.014	0.048
7	1.75	0.30	0.062	(0.197)	0.014	0.048
8	2.00	0.40	0.083	(0.195)	0.018	0.064
9	2.25	0.40	0.083	(0.193)	0.018	0.064
10	2.50	0.40	0.083	(0.190)	0.018	0.064
11	2.75	0.50	0.103	(0.188)	0.023	0.080
12	3.00	0.50	0.103	(0.186)	0.023	0.080
13	3.25	0.50	0.103	(0.183)	0.023	0.080
14	3.50	0.50	0.103	(0.181)	0.023	0.080
15	3.75	0.50	0.103	(0.179)	0.023	0.080
16	4.00	0.60	0.124	(0.177)	0.027	0.097
17	4.25	0.60	0.124	(0.174)	0.027	0.097
18	4.50	0.70	0.144	(0.172)	0.032	0.113
19	4.75	0.70	0.144	(0.170)	0.032	0.113
20	5.00	0.80	0.165	(0.168)	0.036	0.129
21	5.25	0.60	0.124	(0.166)	0.027	0.097
22	5.50	0.70	0.144	(0.163)	0.032	0.113
23	5.75	0.80	0.165	(0.161)	0.036	0.129
24	6.00	0.80	0.165	(0.159)	0.036	0.129
25	6.25	0.90	0.186	(0.157)	0.041	0.145
26	6.50	0.90	0.186	(0.155)	0.041	0.145
27	6.75	1.00	0.206	(0.153)	0.045	0.161
28	7.00	1.00	0.206	(0.151)	0.045	0.161
29	7.25	1.00	0.206	(0.149)	0.045	0.161
30	7.50	1.10	0.227	(0.147)	0.050	0.177
31	7.75	1.20	0.248	(0.145)	0.054	0.193
32	8.00	1.30	0.268	(0.143)	0.059	0.209
33	8.25	1.50	0.310	(0.141)	0.068	0.241
34	8.50	1.50	0.310	(0.139)	0.068	0.241
35	8.75	1.60	0.330	(0.137)	0.073	0.258
36	9.00	1.70	0.351	(0.135)	0.077	0.274
37	9.25	1.90	0.392	(0.133)	0.086	0.306
38	9.50	2.00	0.413	(0.131)	0.091	0.322
39	9.75	2.10	0.433	(0.129)	0.095	0.338
40	10.00	2.20	0.454	(0.127)	0.100	0.354
41	10.25	1.50	0.310	(0.126)	0.068	0.241
42	10.50	1.50	0.310	(0.124)	0.068	0.241
43	10.75	2.00	0.413	(0.122)	0.091	0.322
44	11.00	2.00	0.413	(0.120)	0.091	0.322
45	11.25	1.90	0.392	(0.118)	0.086	0.306
46	11.50	1.90	0.392	(0.117)	0.086	0.306
47	11.75	1.70	0.351	(0.115)	0.077	0.274
48	12.00	1.80	0.372	(0.113)	0.082	0.290
49	12.25	2.50	0.516	0.111	(0.114)	0.405
50	12.50	2.60	0.537	0.110	(0.118)	0.427
51	12.75	2.80	0.578	0.108	(0.127)	0.470
52	13.00	2.90	0.599	0.107	(0.132)	0.492
53	13.25	3.40	0.702	0.105	(0.154)	0.597
54	13.50	3.40	0.702	0.103	(0.154)	0.598
55	13.75	2.30	0.475	0.102	(0.104)	0.373
56	14.00	2.30	0.475	0.100	(0.104)	0.374

```
57  14.25     2.70      0.557          0.099    (  0.123)        0.459
58  14.50     2.60      0.537          0.097    (  0.118)        0.439
59  14.75     2.60      0.537          0.096    (  0.118)        0.441
60  15.00     2.50      0.516          0.094    (  0.114)        0.422
61  15.25     2.40      0.495          0.093    (  0.109)        0.403
62  15.50     2.30      0.475          0.091    (  0.104)        0.383
63  15.75     1.90      0.392      (  0.090)        0.086        0.306
64  16.00     1.90      0.392      (  0.089)        0.086        0.306
65  16.25     0.40      0.083      (  0.087)        0.018        0.064
66  16.50     0.40      0.083      (  0.086)        0.018        0.064
67  16.75     0.30      0.062      (  0.085)        0.014        0.048
68  17.00     0.30      0.062      (  0.083)        0.014        0.048
69  17.25     0.50      0.103      (  0.082)        0.023        0.080
70  17.50     0.50      0.103      (  0.081)        0.023        0.080
71  17.75     0.50      0.103      (  0.080)        0.023        0.080
72  18.00     0.40      0.083      (  0.078)        0.018        0.064
73  18.25     0.40      0.083      (  0.077)        0.018        0.064
74  18.50     0.40      0.083      (  0.076)        0.018        0.064
75  18.75     0.30      0.062      (  0.075)        0.014        0.048
76  19.00     0.20      0.041      (  0.074)        0.009        0.032
77  19.25     0.30      0.062      (  0.073)        0.014        0.048
78  19.50     0.40      0.083      (  0.072)        0.018        0.064
79  19.75     0.30      0.062      (  0.071)        0.014        0.048
80  20.00     0.20      0.041      (  0.070)        0.009        0.032
81  20.25     0.30      0.062      (  0.069)        0.014        0.048
82  20.50     0.30      0.062      (  0.068)        0.014        0.048
83  20.75     0.30      0.062      (  0.067)        0.014        0.048
84  21.00     0.20      0.041      (  0.067)        0.009        0.032
85  21.25     0.30      0.062      (  0.066)        0.014        0.048
86  21.50     0.20      0.041      (  0.065)        0.009        0.032
87  21.75     0.30      0.062      (  0.064)        0.014        0.048
88  22.00     0.20      0.041      (  0.064)        0.009        0.032
89  22.25     0.30      0.062      (  0.063)        0.014        0.048
90  22.50     0.20      0.041      (  0.062)        0.009        0.032
91  22.75     0.20      0.041      (  0.062)        0.009        0.032
92  23.00     0.20      0.041      (  0.061)        0.009        0.032
93  23.25     0.20      0.041      (  0.061)        0.009        0.032
94  23.50     0.20      0.041      (  0.061)        0.009        0.032
95  23.75     0.20      0.041      (  0.060)        0.009        0.032
96  24.00     0.20      0.041      (  0.060)        0.009        0.032
              (Loss Rate Not Used)
   Sum =     100.0                                  Sum =    16.4
     Flood volume = Effective rainfall      4.09(In)
      times area        6.9(Ac.)/[(In)/(Ft.)] =       2.4(Ac.Ft)
     Total soil loss =       1.07(In)
     Total soil loss =      0.613(Ac.Ft)
     Total rainfall =      5.16(In)
     Flood volume =      102544.9 Cubic Feet
     Total soil loss =       26695.9 Cubic Feet
     --------------------------------------------------------------------
      Peak flow rate of this hydrograph =       4.160(CFS)
     --------------------------------------------------------------------
     ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                         24 - H O U R    S T O R M
                    R u n o f f     H y d r o g r a p h
     --------------------------------------------------------------------
                 Hydrograph in  15   Minute intervals ((CFS))

     --------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0        2.5       5.0       7.5      10.0
-----------------------------------------------------------------------
  0+15      0.0033      0.16  Q          |         |         |         |
  0+30      0.0095      0.30  VQ         |         |         |         |
  0+45      0.0165      0.34  VQ         |         |         |         |
  1+ 0      0.0250      0.42  VQ         |         |         |         |
  1+15      0.0327      0.37  VQ         |         |         |         |
  1+30      0.0396      0.34  VQ         |         |         |         |
  1+45      0.0466      0.34  VQ         |         |         |         |
  2+ 0      0.0551      0.42  VQ         |         |         |         |
  2+15      0.0644      0.45   Q         |         |         |         |
  2+30      0.0736      0.45  |Q         |         |         |         |
  2+45      0.0845      0.53  |VQ        |         |         |         |
  3+ 0      0.0961      0.56  |VQ        |         |         |         |
  3+15      0.1077      0.56  |VQ        |         |         |         |
  3+30      0.1192      0.56  | Q        |         |         |         |
  3+45      0.1308      0.56  | Q        |         |         |         |
  4+ 0      0.1440      0.64  | Q        |         |         |         |
  4+15      0.1579      0.67  | Q        |         |         |         |
  4+30      0.1734      0.75  | VQ       |         |         |         |
```

```
 4+45       0.1896      0.78  |  Q      |         |         |         |
 5+ 0       0.2075      0.86  |  Q      |         |         |         |
 5+15       0.2227      0.74  | QV      |         |         |         |
 5+30       0.2382      0.75  |  QV     |         |         |         |
 5+45       0.2561      0.86  |  QV     |         |         |         |
 6+ 0       0.2746      0.90  |  QV     |         |         |         |
 6+15       0.2947      0.98  |  Q V    |         |         |         |
 6+30       0.3155      1.01  |   QV    |         |         |         |
 6+45       0.3380      1.09  |   QV    |         |         |         |
 7+ 0       0.3612      1.12  |   Q V   |         |         |         |
 7+15       0.3843      1.12  |   Q V   |         |         |         |
 7+30       0.4091      1.20  |   Q V   |         |         |         |
 7+45       0.4362      1.31  |    Q V  |         |         |         |
 8+ 0       0.4656      1.42  |    Q V  |         |         |         |
 8+15       0.4989      1.61  |     Q V |         |         |         |
 8+30       0.5336      1.68  |     Q  V|         |         |         |
 8+45       0.5700      1.76  |      Q V|         |         |         |
 9+ 0       0.6086      1.87  |      Q  V         |         |         |
 9+15       0.6512      2.06  |       Q |V        |         |         |
 9+30       0.6968      2.21  |       Q |V        |         |         |
 9+45       0.7448      2.32  |        Q| V       |         |         |
10+ 0       0.7950      2.43  |        Q|  V      |         |         |
10+15       0.8345      1.91  |      Q  |   V     |         |         |
10+30       0.8692      1.68  |     Q   |   V     |         |         |
10+45       0.9121      2.08  |       Q |    V    |         |         |
11+ 0       0.9584      2.24  |       Q |     V   |         |         |
11+15       1.0030      2.16  |       Q |      V  |         |         |
11+30       1.0470      2.13  |       Q |      V  |         |         |
11+45       1.0877      1.97  |      Q  |       V |         |         |
12+ 0       1.1287      1.98  |      Q  |        V|         |         |
12+15       1.1819      2.58  |         Q         V         |         |
12+30       1.2424      2.92  |         |Q        |V        |         |
12+45       1.3081      3.18  |         | Q       | V       |         |
13+ 0       1.3779      3.38  |         |  Q      |  V      |         |
13+15       1.4592      3.94  |         |    Q    |   V     |         |
13+30       1.5452      4.16  |         |     Q   |     V   |         |
13+45       1.6083      3.06  |         | Q       |      V  |         |
14+ 0       1.6621      2.60  |         Q         |       V |         |
14+15       1.7244      3.02  |         | Q       |        V|         |
14+30       1.7884      3.10  |         | Q       |         V         |
14+45       1.8517      3.06  |         | Q       |         |V        |
15+ 0       1.9132      2.97  |         |Q        |         | V       |
15+15       1.9719      2.84  |         |Q        |         |  V      |
15+30       2.0278      2.71  |         Q         |         |   V     |
15+45       2.0750      2.29  |        Q|         |         |    V    |
16+ 0       2.1190      2.13  |       Q |         |         |     V   |
16+15       2.1385      0.94  |  Q      |         |         |     V   |
16+30       2.1477      0.45  |Q        |         |         |     V   |
16+45       2.1554      0.37  |Q        |         |         |     V   |
17+ 0       2.1623      0.34  |Q        |         |         |     V   |
17+15       2.1725      0.49  |Q        |         |         |     V   |
17+30       2.1841      0.56  | Q       |         |         |      V  |
17+45       2.1956      0.56  | Q       |         |         |      V  |
18+ 0       2.2056      0.48  |Q        |         |         |      V  |
18+15       2.2148      0.45  |Q        |         |         |      V  |
18+30       2.2241      0.45  |Q        |         |         |      V  |
18+45       2.2317      0.37  |Q        |         |         |      V  |
19+ 0       2.2370      0.26  |Q        |         |         |       V |
19+15       2.2433      0.30  |Q        |         |         |       V |
19+30       2.2519      0.42  |Q        |         |         |       V |
19+45       2.2595      0.37  |Q        |         |         |       V |
20+ 0       2.2648      0.26  |Q        |         |         |       V |
20+15       2.2711      0.30  |Q        |         |         |       V |
20+30       2.2780      0.34  |Q        |         |         |       V |
20+45       2.2850      0.34  |Q        |         |         |       V |
21+ 0       2.2903      0.26  |Q        |         |         |       V |
21+15       2.2965      0.30  |Q        |         |         |        V|
21+30       2.3018      0.26  |Q        |         |         |        V|
21+45       2.3081      0.30  |Q        |         |         |        V|
22+ 0       2.3134      0.26  |Q        |         |         |        V|
22+15       2.3197      0.30  |Q        |         |         |        V|
22+30       2.3250      0.26  |Q        |         |         |        V|
22+45       2.3296      0.22  Q         |         |         |        V|
23+ 0       2.3342      0.22  Q         |         |         |        V|
23+15       2.3389      0.22  Q         |         |         |        V|
23+30       2.3435      0.22  Q         |         |         |        V|
23+45       2.3481      0.22  Q         |         |         |        V|
24+ 0       2.3527      0.22  Q         |         |         |        V|
24+15       2.3541      0.07  Q         |         |         |        V|
```

APPENDIX C

RCFC&WCD Reference Material

RUNOFF INDEX NUMBERS OF HYDROLOGIC SOIL-COVER COMPLEXES FOR PERVIOUS AREAS-AMC II

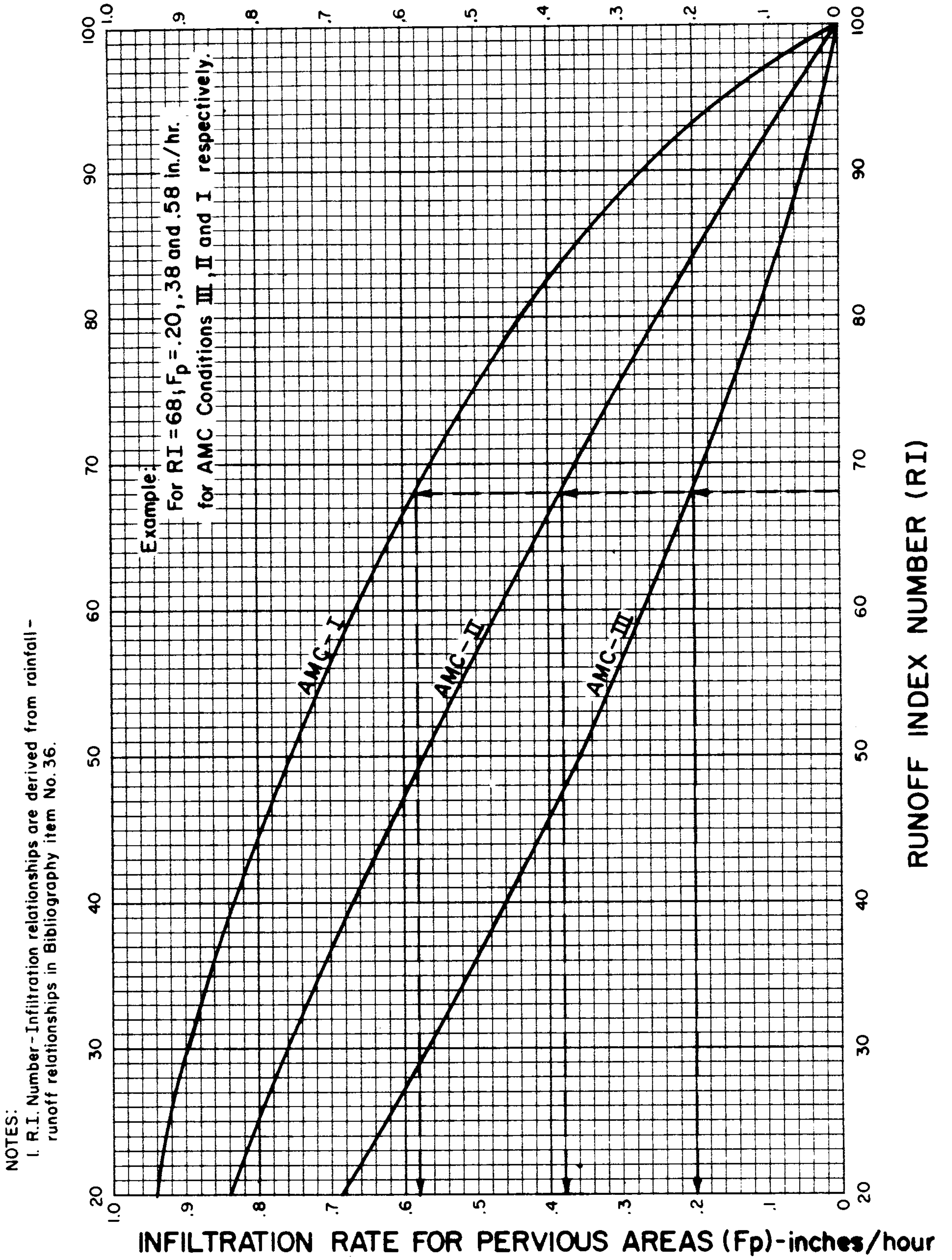
Cover Type (3)	Quality of Cover (2)	Soil Group A	B	C	D
NATURAL COVERS -					
Barren (Rockland, eroded and graded land)		78	86	91	93
Chaparrel, Broadleaf (Manzonita, ceanothus and scrub oak)	Poor	53	70	80	85
	Fair	40	63	75	81
	Good	31	57	71	78
Chaparrel, Narrowleaf (Chamise and redshank)	Poor	71	82	88	91
	Fair	55	72	81	86
Grass, Annual or Perennial	Poor	67	78	86	89
	Fair	50	69	79	84
	Good	38	61	74	80
Meadows or Cienegas (Areas with seasonally high water table, principal vegetation is sod forming grass)	Poor	63	77	85	88
	Fair	51	70	80	84
	Good	30	58	72	78
Open Brush (Soft wood shrubs - buckwheat, sage, etc.)	Poor	62	76	84	88
	Fair	46	66	77	83
	Good	41	63	75	81
Woodland (Coniferous or broadleaf trees predominate. Canopy density is at least 50 percent)	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	28	55	70	77
Woodland, Grass (Coniferous or broadleaf trees with canopy density from 20 to 50 percent)	Poor	57	73	82	86
	Fair	44	65	77	82
	Good	33	58	72	79
URBAN COVERS -					
Residential or Commercial Landscaping (Lawn, shrubs, etc.)	Good	32	56	69	75
Turf (Irrigated and mowed grass)	Poor	58	74	83	87
	Fair	44	65	77	82
	Good	33	58	72	79
AGRICULTURAL COVERS -					
Fallow (Land plowed but not tilled or seeded)		76	85	90	92

RUNOFF INDEX NUMBERS OF HYDROLOGIC SOIL-COVER COMPLEXES FOR PERVIOUS AREAS-AMC II

Cover Type (3)	Quality of Cover (2)	Soil Group A	B	C	D
AGRICULTURAL COVERS (cont.) -					
Legumes, Close Seeded (Alfalfa, sweetclover, timothy, etc.)	Poor	66	77	85	89
	Good	58	72	81	85
Orchards, Deciduous (Apples, apricots, pears, walnuts, etc.)		See Note 4			
Orchards, Evergreen (Citrus, avocados, etc.)	Poor	57	73	82	86
	Fair	44	65	77	82
	Good	33	58	72	79
Pasture, Dryland (Annual grasses)	Poor	67	78	86	89
	Fair	50	69	79	84
	Good	38	61	74	80
Pasture, Irrigated (Legumes and perennial grass)	Poor	58	74	83	87
	Fair	44	65	77	82
	Good	33	58	72	79
Row Crops (Field crops - tomatoes, sugar beets, etc.)	Poor	72	81	88	91
	Good	67	78	85	89
Small Grain (Wheat, oats, barley, etc.)	Poor	65	76	84	88
	Good	63	75	83	87
Vineyard		See Note 4			

Notes:

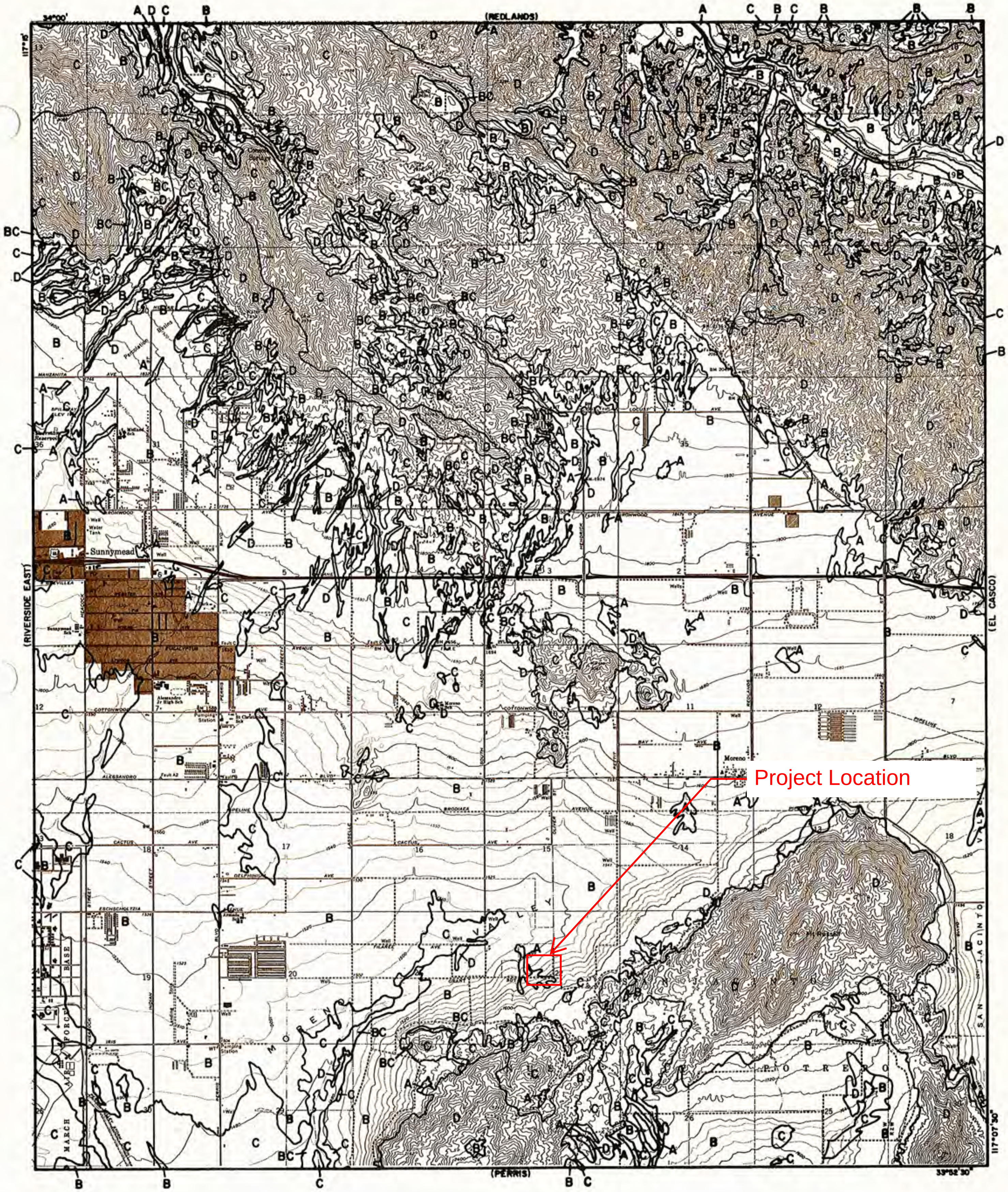
1. All runoff index (RI) numbers are for Antecedent Moisture Condition (AMC) II.
2. Quality of cover definitions:
   Poor-Heavily grazed or regularly burned areas. Less than 50 percent of the ground surface is protected by plant cover or brush and tree canopy.
   Fair-Moderate cover with 50 percent to 75 percent of the ground surface protected.
   Good-Heavy or dense cover with more than 75 percent of the ground surface protected.
3. See Plate C-2 for a detailed description of cover types.
4. Use runoff index numbers based on ground cover type. See discussion under "Cover Type Descriptions" on Plate C-2.
5. Reference Bibliography item 17.



RCFC & WCD

HYDROLOGY MANUAL

INFILTRATION RATE FOR PERVIOUS AREAS VERSUS RUNOFF INDEX NUMBERS



LEGEND

—— SOILS GROUP BOUNDARY

A SOILS GROUP DESIGNATION

RCFC & WCD

HYDROLOGY MANUAL

0 FEET 5000

HYDROLOGIC SOILS GROUP MAP FOR SUNNYMEAD

PLATE C-1.17

RAINFALL INTENSITY—INCHES PER HOUR

SUNNYMEAD - MORENO			WOODCREST		
DURATION MINUTES	FREQUENCY		DURATION MINUTES	FREQUENCY	
	10 YEAR	100 YEAR		10 YEAR	100 YEAR
5	2.84	4.16	5	3.37	5.30
6	2.59	3.79	6	3.05	4.79
7	2.40	3.51	7	2.80	4.40
8	2.25	3.29	8	2.60	4.09
9	2.12	3.10	9	2.44	3.83
10	2.01	2.94	10	2.30	3.62
11	1.92	2.80	11	2.19	3.43
12	1.83	2.68	12	2.08	3.27
13	1.76	2.58	13	1.99	3.13
14	1.70	2.48	14	1.91	3.01
15	1.64	2.40	15	1.84	2.89
16	1.59	2.32	16	1.78	2.79
17	1.54	2.25	17	1.72	2.70
18	1.50	2.19	18	1.67	2.62
19	1.46	2.13	19	1.62	2.54
20	1.42	2.08	20	1.57	2.47
22	1.35	1.98	22	1.49	2.34
24	1.30	1.90	24	1.42	2.23
26	1.25	1.82	26	1.36	2.14
28	1.20	1.76	28	1.31	2.05
30	1.16	1.70	30	1.26	1.98
32	1.12	1.64	32	1.22	1.91
34	1.09	1.59	34	1.18	1.85
36	1.06	1.55	36	1.14	1.79
38	1.03	1.51	38	1.11	1.74
40	1.00	1.47	40	1.07	1.69
45	.95	1.39	45	1.01	1.58
50	.90	1.31	50	.95	1.49
55	.86	1.25	55	.90	1.42
60	.82	1.20	60	.86	1.35
65	.79	1.15	65	.82	1.29
70	.76	1.11	70	.79	1.24
75	.73	1.07	75	.76	1.19
80	.71	1.04	80	.73	1.15
85	.69	1.01	85	.71	1.11

SLOPE = .500 (Sunnymead - Moreno)

SLOPE = .550 (Woodcrest)

STANDARD INTENSITY—DURATION CURVES DATA

APPENDIX D

HYDRAULIC CALCULATIONS

Michael Baker
INTERNATIONAL
9755 Clairemont Mesa Blvd., San Diego, CA 92124
Phone: (858) 614-5000 · MBAKERINTL.COM

STORM DRAIN NETWORK

KAISER MEDICAL MORENO VALLEY

WEST NODE 101 TO 102

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.27000	ft/ft
Diameter	1.00	ft
Discharge	3.89	ft³/s

Results

Normal Depth	0.31	ft
Flow Area	0.21	ft²
Wetted Perimeter	1.18	ft
Hydraulic Radius	0.18	ft
Top Width	0.93	ft
Critical Depth	0.84	ft
Percent Full	31.1	%
Critical Slope	0.01148	ft/ft
Velocity	18.66	ft/s
Velocity Head	5.41	ft
Specific Energy	5.72	ft
Froude Number	6.93	
Maximum Discharge	19.91	ft³/s
Discharge Full	18.51	ft³/s
Slope Full	0.01192	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	31.11	%
Downstream Velocity	Infinity	ft/s

WEST NODE 101 TO 102

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.31	ft
Critical Depth	0.84	ft
Channel Slope	0.27000	ft/ft
Critical Slope	0.01148	ft/ft

WEST NODE 104 TO 102

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.04000	ft/ft
Diameter	1.00	ft
Discharge	2.71	ft³/s

Results

Normal Depth	0.43	ft
Flow Area	0.32	ft²
Wetted Perimeter	1.43	ft
Hydraulic Radius	0.22	ft
Top Width	0.99	ft
Critical Depth	0.71	ft
Percent Full	42.7	%
Critical Slope	0.00808	ft/ft
Velocity	8.46	ft/s
Velocity Head	1.11	ft
Specific Energy	1.54	ft
Froude Number	2.62	
Maximum Discharge	7.66	ft³/s
Discharge Full	7.13	ft³/s
Slope Full	0.00579	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	42.75	%
Downstream Velocity	Infinity	ft/s

WEST NODE 104 TO 102

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.43	ft
Critical Depth	0.71	ft
Channel Slope	0.04000	ft/ft
Critical Slope	0.00808	ft/ft

WEST NODE 102 TO 105

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00570	ft/ft
Diameter	2.00	ft
Discharge	9.70	ft³/s

Results

Normal Depth	1.08	ft
Flow Area	1.73	ft²
Wetted Perimeter	3.30	ft
Hydraulic Radius	0.52	ft
Top Width	1.99	ft
Critical Depth	1.11	ft
Percent Full	54.0	%
Critical Slope	0.00515	ft/ft
Velocity	5.61	ft/s
Velocity Head	0.49	ft
Specific Energy	1.57	ft
Froude Number	1.06	
Maximum Discharge	18.37	ft³/s
Discharge Full	17.08	ft³/s
Slope Full	0.00184	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	53.96	%
Downstream Velocity	Infinity	ft/s

WEST NODE 102 TO 105

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	1.08	ft
Critical Depth	1.11	ft
Channel Slope	0.00570	ft/ft
Critical Slope	0.00515	ft/ft

WEST NODE 105 TO 106

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.03100	ft/ft
Diameter	1.50	ft
Discharge	11.49	ft³/s

Results

Normal Depth	0.86	ft
Flow Area	1.04	ft²
Wetted Perimeter	2.57	ft
Hydraulic Radius	0.41	ft
Top Width	1.48	ft
Critical Depth	1.29	ft
Percent Full	57.1	%
Critical Slope	0.01105	ft/ft
Velocity	11.03	ft/s
Velocity Head	1.89	ft
Specific Energy	2.75	ft
Froude Number	2.32	
Maximum Discharge	19.89	ft³/s
Discharge Full	18.49	ft³/s
Slope Full	0.01197	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	57.06	%
Downstream Velocity	Infinity	ft/s

WEST NODE 105 TO 106

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.86	ft
Critical Depth	1.29	ft
Channel Slope	0.03100	ft/ft
Critical Slope	0.01105	ft/ft

WEST NODE 201 TO 106

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.06300	ft/ft
Diameter	1.00	ft
Discharge	5.82	ft³/s

Results

Normal Depth	0.59	ft
Flow Area	0.48	ft²
Wetted Perimeter	1.75	ft
Hydraulic Radius	0.27	ft
Top Width	0.98	ft
Critical Depth	0.95	ft
Percent Full	58.8	%
Critical Slope	0.02312	ft/ft
Velocity	12.12	ft/s
Velocity Head	2.28	ft
Specific Energy	2.87	ft
Froude Number	3.06	
Maximum Discharge	9.62	ft³/s
Discharge Full	8.94	ft³/s
Slope Full	0.02669	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	58.78	%
Downstream Velocity	Infinity	ft/s

WEST NODE 201 TO 106

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.59	ft
Critical Depth	0.95	ft
Channel Slope	0.06300	ft/ft
Critical Slope	0.02312	ft/ft

WEST NODE 301 TO 106

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.03200	ft/ft
Diameter	1.00	ft
Discharge	0.76	ft³/s

Results

Normal Depth	0.23	ft
Flow Area	0.14	ft²
Wetted Perimeter	1.01	ft
Hydraulic Radius	0.14	ft
Top Width	0.85	ft
Critical Depth	0.36	ft
Percent Full	23.3	%
Critical Slope	0.00569	ft/ft
Velocity	5.47	ft/s
Velocity Head	0.46	ft
Specific Energy	0.70	ft
Froude Number	2.38	
Maximum Discharge	6.86	ft³/s
Discharge Full	6.37	ft³/s
Slope Full	0.00046	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	23.31	%
Downstream Velocity	Infinity	ft/s

WEST NODE 301 TO 106

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.23	ft
Critical Depth	0.36	ft
Channel Slope	0.03200	ft/ft
Critical Slope	0.00569	ft/ft

WEST NODE 106 TO 107

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01100	ft/ft
Diameter	2.00	ft
Discharge	20.33	ft³/s

Results

Normal Depth	1.43	ft
Flow Area	2.40	ft²
Wetted Perimeter	4.02	ft
Hydraulic Radius	0.60	ft
Top Width	1.81	ft
Critical Depth	1.62	ft
Percent Full	71.3	%
Critical Slope	0.00827	ft/ft
Velocity	8.49	ft/s
Velocity Head	1.12	ft
Specific Energy	2.54	ft
Froude Number	1.30	
Maximum Discharge	25.52	ft³/s
Discharge Full	23.73	ft³/s
Slope Full	0.00808	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	71.27	%
Downstream Velocity	Infinity	ft/s

WEST NODE 106 TO 107

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	1.43	ft
Critical Depth	1.62	ft
Channel Slope	0.01100	ft/ft
Critical Slope	0.00827	ft/ft

WEST NODE 107 TO 108

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.04400	ft/ft
Diameter	2.00	ft
Discharge	22.26	ft³/s

Results

Normal Depth	0.96	ft
Flow Area	1.50	ft²
Wetted Perimeter	3.07	ft
Hydraulic Radius	0.49	ft
Top Width	2.00	ft
Critical Depth	1.68	ft
Percent Full	48.2	%
Critical Slope	0.00926	ft/ft
Velocity	14.86	ft/s
Velocity Head	3.43	ft
Specific Energy	4.39	ft
Froude Number	3.03	
Maximum Discharge	51.04	ft³/s
Discharge Full	47.45	ft³/s
Slope Full	0.00968	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	48.18	%
Downstream Velocity	Infinity	ft/s

WEST NODE 107 TO 108

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.96	ft
Critical Depth	1.68	ft
Channel Slope	0.04400	ft/ft
Critical Slope	0.00926	ft/ft

WEST NODE 401 TO 402

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01500	ft/ft
Diameter	1.00	ft
Discharge	1.03	ft³/s

Results

Normal Depth	0.33	ft
Flow Area	0.23	ft²
Wetted Perimeter	1.23	ft
Hydraulic Radius	0.18	ft
Top Width	0.94	ft
Critical Depth	0.43	ft
Percent Full	33.1	%
Critical Slope	0.00583	ft/ft
Velocity	4.55	ft/s
Velocity Head	0.32	ft
Specific Energy	0.65	ft
Froude Number	1.63	
Maximum Discharge	4.69	ft³/s
Discharge Full	4.36	ft³/s
Slope Full	0.00084	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	33.05	%
Downstream Velocity	Infinity	ft/s

WEST NODE 401 TO 402

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.33	ft
Critical Depth	0.43	ft
Channel Slope	0.01500	ft/ft
Critical Slope	0.00583	ft/ft

WEST NODE 402 TO 403

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00600	ft/ft
Diameter	1.50	ft
Discharge	4.96	ft³/s

Results

Normal Depth	0.85	ft
Flow Area	1.03	ft²
Wetted Perimeter	2.55	ft
Hydraulic Radius	0.40	ft
Top Width	1.49	ft
Critical Depth	0.86	ft
Percent Full	56.4	%
Critical Slope	0.00576	ft/ft
Velocity	4.83	ft/s
Velocity Head	0.36	ft
Specific Energy	1.21	ft
Froude Number	1.02	
Maximum Discharge	8.75	ft³/s
Discharge Full	8.14	ft³/s
Slope Full	0.00223	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	56.39	%
Downstream Velocity	Infinity	ft/s

WEST NODE 402 TO 403

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.85	ft
Critical Depth	0.86	ft
Channel Slope	0.00600	ft/ft
Critical Slope	0.00576	ft/ft

WEST NODE 403 TO 108

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.10000	ft/ft
Diameter	1.50	ft
Discharge	5.76	ft³/s

Results

Normal Depth	0.42	ft
Flow Area	0.41	ft²
Wetted Perimeter	1.68	ft
Hydraulic Radius	0.24	ft
Top Width	1.35	ft
Critical Depth	0.93	ft
Percent Full	28.2	%
Critical Slope	0.00611	ft/ft
Velocity	14.09	ft/s
Velocity Head	3.09	ft
Specific Energy	3.51	ft
Froude Number	4.52	
Maximum Discharge	35.73	ft³/s
Discharge Full	33.22	ft³/s
Slope Full	0.00301	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	28.18	%
Downstream Velocity	Infinity	ft/s

WEST NODE 403 TO 108

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.42	ft
Critical Depth	0.93	ft
Channel Slope	0.10000	ft/ft
Critical Slope	0.00611	ft/ft

WEST NODE 108 TO 500

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.02900	ft/ft
Diameter	2.00	ft
Discharge	28.01	ft³/s

Results

Normal Depth	1.26	ft
Flow Area	2.09	ft²
Wetted Perimeter	3.68	ft
Hydraulic Radius	0.57	ft
Top Width	1.93	ft
Critical Depth	1.83	ft
Percent Full	63.2	%
Critical Slope	0.01335	ft/ft
Velocity	13.37	ft/s
Velocity Head	2.78	ft
Specific Energy	4.04	ft
Froude Number	2.26	
Maximum Discharge	41.44	ft³/s
Discharge Full	38.52	ft³/s
Slope Full	0.01533	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	63.24	%
Downstream Velocity	Infinity	ft/s

WEST NODE 108 TO 500

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	1.26	ft
Critical Depth	1.83	ft
Channel Slope	0.02900	ft/ft
Critical Slope	0.01335	ft/ft

EAST NODE 101 TO 102

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.06250	ft/ft
Diameter	1.50	ft
Discharge	10.59	ft³/s

Results

Normal Depth	0.66	ft
Flow Area	0.75	ft²
Wetted Perimeter	2.18	ft
Hydraulic Radius	0.35	ft
Top Width	1.49	ft
Critical Depth	1.25	ft
Percent Full	44.2	%
Critical Slope	0.00988	ft/ft
Velocity	14.06	ft/s
Velocity Head	3.07	ft
Specific Energy	3.73	ft
Froude Number	3.49	
Maximum Discharge	28.25	ft³/s
Discharge Full	26.26	ft³/s
Slope Full	0.01016	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	44.19	%
Downstream Velocity	Infinity	ft/s

EAST NODE 101 TO 102

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.66	ft
Critical Depth	1.25	ft
Channel Slope	0.06250	ft/ft
Critical Slope	0.00988	ft/ft

EAST NODE 103 TO 105

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00690	ft/ft
Diameter	1.00	ft
Discharge	1.35	ft³/s

Results

Normal Depth	0.47	ft
Flow Area	0.37	ft²
Wetted Perimeter	1.52	ft
Hydraulic Radius	0.24	ft
Top Width	1.00	ft
Critical Depth	0.49	ft
Percent Full	47.4	%
Critical Slope	0.00610	ft/ft
Velocity	3.68	ft/s
Velocity Head	0.21	ft
Specific Energy	0.68	ft
Froude Number	1.07	
Maximum Discharge	3.18	ft³/s
Discharge Full	2.96	ft³/s
Slope Full	0.00144	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	47.39	%
Downstream Velocity	Infinity	ft/s

EAST NODE 103 TO 105

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.47	ft
Critical Depth	0.49	ft
Channel Slope	0.00690	ft/ft
Critical Slope	0.00610	ft/ft

EAST NODE 105 TO 102

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00714	ft/ft
Diameter	1.50	ft
Discharge	4.69	ft³/s

Results

Normal Depth	0.78	ft
Flow Area	0.92	ft²
Wetted Perimeter	2.41	ft
Hydraulic Radius	0.38	ft
Top Width	1.50	ft
Critical Depth	0.83	ft
Percent Full	51.7	%
Critical Slope	0.00566	ft/ft
Velocity	5.09	ft/s
Velocity Head	0.40	ft
Specific Energy	1.18	ft
Froude Number	1.15	
Maximum Discharge	9.55	ft³/s
Discharge Full	8.88	ft³/s
Slope Full	0.00199	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	51.67	%
Downstream Velocity	Infinity	ft/s

EAST NODE 105 TO 102

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.78	ft
Critical Depth	0.83	ft
Channel Slope	0.00714	ft/ft
Critical Slope	0.00566	ft/ft

EAST NODE 102 TO 106

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.15000	ft/ft
Diameter	1.50	ft
Discharge	16.00	ft³/s

Results

Normal Depth	0.65	ft
Flow Area	0.74	ft²
Wetted Perimeter	2.16	ft
Hydraulic Radius	0.34	ft
Top Width	1.49	ft
Critical Depth	1.42	ft
Percent Full	43.6	%
Critical Slope	0.02010	ft/ft
Velocity	21.64	ft/s
Velocity Head	7.27	ft
Specific Energy	7.93	ft
Froude Number	5.41	
Maximum Discharge	43.76	ft³/s
Discharge Full	40.68	ft³/s
Slope Full	0.02320	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	43.58	%
Downstream Velocity	Infinity	ft/s

EAST NODE 102 TO 106

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.65	ft
Critical Depth	1.42	ft
Channel Slope	0.15000	ft/ft
Critical Slope	0.02010	ft/ft

EAST NODE 106 TO 107

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01800	ft/ft
Diameter	2.00	ft
Discharge	16.00	ft³/s

Results

Normal Depth	1.03	ft
Flow Area	1.63	ft²
Wetted Perimeter	3.21	ft
Hydraulic Radius	0.51	ft
Top Width	2.00	ft
Critical Depth	1.44	ft
Percent Full	51.6	%
Critical Slope	0.00661	ft/ft
Velocity	9.79	ft/s
Velocity Head	1.49	ft
Specific Energy	2.52	ft
Froude Number	1.91	
Maximum Discharge	32.65	ft³/s
Discharge Full	30.35	ft³/s
Slope Full	0.00500	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	51.59	%
Downstream Velocity	Infinity	ft/s

EAST NODE 106 TO 107

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	1.03	ft
Critical Depth	1.44	ft
Channel Slope	0.01800	ft/ft
Critical Slope	0.00661	ft/ft

EAST NODE 108 TO 109

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01200	ft/ft
Diameter	1.50	ft
Discharge	5.89	ft³/s

Results

Normal Depth	0.76	ft
Flow Area	0.90	ft²
Wetted Perimeter	2.38	ft
Hydraulic Radius	0.38	ft
Top Width	1.50	ft
Critical Depth	0.94	ft
Percent Full	50.7	%
Critical Slope	0.00617	ft/ft
Velocity	6.55	ft/s
Velocity Head	0.67	ft
Specific Energy	1.43	ft
Froude Number	1.49	
Maximum Discharge	12.38	ft³/s
Discharge Full	11.51	ft³/s
Slope Full	0.00314	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	50.69	%
Downstream Velocity	Infinity	ft/s

EAST NODE 108 TO 109

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.76	ft
Critical Depth	0.94	ft
Channel Slope	0.01200	ft/ft
Critical Slope	0.00617	ft/ft

EAST NODE 109 TO 111

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.02400	ft/ft
Diameter	1.50	ft
Discharge	6.48	ft³/s

Results

Normal Depth	0.66	ft
Flow Area	0.75	ft²
Wetted Perimeter	2.17	ft
Hydraulic Radius	0.34	ft
Top Width	1.49	ft
Critical Depth	0.98	ft
Percent Full	43.9	%
Critical Slope	0.00647	ft/ft
Velocity	8.68	ft/s
Velocity Head	1.17	ft
Specific Energy	1.83	ft
Froude Number	2.16	
Maximum Discharge	17.50	ft³/s
Discharge Full	16.27	ft³/s
Slope Full	0.00381	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	43.88	%
Downstream Velocity	Infinity	ft/s

EAST NODE 109 TO 111

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.66	ft
Critical Depth	0.98	ft
Channel Slope	0.02400	ft/ft
Critical Slope	0.00647	ft/ft

EAST NODE 110 TO 111

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01110	ft/ft
Diameter	2.00	ft
Discharge	14.43	ft³/s

Results

Normal Depth	1.12	ft
Flow Area	1.82	ft²
Wetted Perimeter	3.39	ft
Hydraulic Radius	0.54	ft
Top Width	1.98	ft
Critical Depth	1.37	ft
Percent Full	56.1	%
Critical Slope	0.00616	ft/ft
Velocity	7.95	ft/s
Velocity Head	0.98	ft
Specific Energy	2.10	ft
Froude Number	1.46	
Maximum Discharge	25.64	ft³/s
Discharge Full	23.83	ft³/s
Slope Full	0.00407	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	56.14	%
Downstream Velocity	Infinity	ft/s

EAST NODE 110 TO 111

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	1.12	ft
Critical Depth	1.37	ft
Channel Slope	0.01110	ft/ft
Critical Slope	0.00616	ft/ft

EAST NODE 111 TO 112

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01500	ft/ft
Diameter	2.00	ft
Discharge	20.58	ft³/s

Results

Normal Depth	1.28	ft
Flow Area	2.13	ft²
Wetted Perimeter	3.72	ft
Hydraulic Radius	0.57	ft
Top Width	1.92	ft
Critical Depth	1.63	ft
Percent Full	64.2	%
Critical Slope	0.00839	ft/ft
Velocity	9.66	ft/s
Velocity Head	1.45	ft
Specific Energy	2.73	ft
Froude Number	1.62	
Maximum Discharge	29.80	ft³/s
Discharge Full	27.71	ft³/s
Slope Full	0.00828	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	64.18	%
Downstream Velocity	Infinity	ft/s

EAST NODE 111 TO 112

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	1.28	ft
Critical Depth	1.63	ft
Channel Slope	0.01500	ft/ft
Critical Slope	0.00839	ft/ft

EAST NODE 112 TO 117

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.05000	ft/ft
Diameter	2.00	ft
Discharge	20.58	ft³/s

Results

Normal Depth	0.89	ft
Flow Area	1.35	ft²
Wetted Perimeter	2.92	ft
Hydraulic Radius	0.46	ft
Top Width	1.99	ft
Critical Depth	1.63	ft
Percent Full	44.4	%
Critical Slope	0.00839	ft/ft
Velocity	15.27	ft/s
Velocity Head	3.62	ft
Specific Energy	4.51	ft
Froude Number	3.27	
Maximum Discharge	54.41	ft³/s
Discharge Full	50.58	ft³/s
Slope Full	0.00828	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	44.41	%
Downstream Velocity	Infinity	ft/s

EAST NODE 112 TO 117

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.89	ft
Critical Depth	1.63	ft
Channel Slope	0.05000	ft/ft
Critical Slope	0.00839	ft/ft

EAST NODE 107 TO 113

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00940	ft/ft
Diameter	2.50	ft
Discharge	35.50	ft³/s

Results

Normal Depth	1.84	ft
Flow Area	3.88	ft²
Wetted Perimeter	5.16	ft
Hydraulic Radius	0.75	ft
Top Width	2.20	ft
Critical Depth	2.02	ft
Percent Full	73.7	%
Critical Slope	0.00768	ft/ft
Velocity	9.16	ft/s
Velocity Head	1.30	ft
Specific Energy	3.15	ft
Froude Number	1.22	
Maximum Discharge	42.78	ft³/s
Discharge Full	39.77	ft³/s
Slope Full	0.00749	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	73.67	%
Downstream Velocity	Infinity	ft/s

EAST NODE 107 TO 113

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	1.84	ft
Critical Depth	2.02	ft
Channel Slope	0.00940	ft/ft
Critical Slope	0.00768	ft/ft

EAST NODE 201 TO 202

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01500	ft/ft
Diameter	1.00	ft
Discharge	0.53	ft³/s

Results

Normal Depth	0.24	ft
Flow Area	0.14	ft²
Wetted Perimeter	1.01	ft
Hydraulic Radius	0.14	ft
Top Width	0.85	ft
Critical Depth	0.30	ft
Percent Full	23.5	%
Critical Slope	0.00561	ft/ft
Velocity	3.76	ft/s
Velocity Head	0.22	ft
Specific Energy	0.46	ft
Froude Number	1.63	
Maximum Discharge	4.69	ft³/s
Discharge Full	4.36	ft³/s
Slope Full	0.00022	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	23.53	%
Downstream Velocity	Infinity	ft/s

EAST NODE 201 TO 202

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.24	ft
Critical Depth	0.30	ft
Channel Slope	0.01500	ft/ft
Critical Slope	0.00561	ft/ft

EAST NODE 202 TO 203

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.03100	ft/ft
Diameter	1.00	ft
Discharge	3.66	ft³/s

Results

Normal Depth	0.55	ft
Flow Area	0.44	ft²
Wetted Perimeter	1.67	ft
Hydraulic Radius	0.26	ft
Top Width	1.00	ft
Critical Depth	0.82	ft
Percent Full	54.9	%
Critical Slope	0.01064	ft/ft
Velocity	8.29	ft/s
Velocity Head	1.07	ft
Specific Energy	1.62	ft
Froude Number	2.20	
Maximum Discharge	6.75	ft³/s
Discharge Full	6.27	ft³/s
Slope Full	0.01055	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	54.87	%
Downstream Velocity	Infinity	ft/s

EAST NODE 202 TO 203

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.55	ft
Critical Depth	0.82	ft
Channel Slope	0.03100	ft/ft
Critical Slope	0.01064	ft/ft

EAST NODE 203 TO 204

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01700	ft/ft
Diameter	1.50	ft
Discharge	10.11	ft³/s

Results

Normal Depth	0.96	ft
Flow Area	1.19	ft²
Wetted Perimeter	2.78	ft
Hydraulic Radius	0.43	ft
Top Width	1.44	ft
Critical Depth	1.23	ft
Percent Full	63.9	%
Critical Slope	0.00932	ft/ft
Velocity	8.48	ft/s
Velocity Head	1.12	ft
Specific Energy	2.08	ft
Froude Number	1.64	
Maximum Discharge	14.73	ft³/s
Discharge Full	13.70	ft³/s
Slope Full	0.00926	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	63.90	%
Downstream Velocity	Infinity	ft/s

EAST NODE 203 TO 204

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.96	ft
Critical Depth	1.23	ft
Channel Slope	0.01700	ft/ft
Critical Slope	0.00932	ft/ft

EAST NODE 301 TO 204

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00590	ft/ft
Diameter	1.50	ft
Discharge	4.08	ft³/s

Results

Normal Depth	0.75	ft
Flow Area	0.89	ft²
Wetted Perimeter	2.37	ft
Hydraulic Radius	0.38	ft
Top Width	1.50	ft
Critical Depth	0.77	ft
Percent Full	50.3	%
Critical Slope	0.00543	ft/ft
Velocity	4.58	ft/s
Velocity Head	0.33	ft
Specific Energy	1.08	ft
Froude Number	1.05	
Maximum Discharge	8.68	ft³/s
Discharge Full	8.07	ft³/s
Slope Full	0.00151	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	50.32	%
Downstream Velocity	Infinity	ft/s

EAST NODE 301 TO 204

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.75	ft
Critical Depth	0.77	ft
Channel Slope	0.00590	ft/ft
Critical Slope	0.00543	ft/ft

EAST NODE 204 TO 205

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01100	ft/ft
Diameter	2.00	ft
Discharge	15.62	ft³/s

Results

Normal Depth	1.18	ft
Flow Area	1.94	ft²
Wetted Perimeter	3.51	ft
Hydraulic Radius	0.55	ft
Top Width	1.97	ft
Critical Depth	1.43	ft
Percent Full	59.2	%
Critical Slope	0.00650	ft/ft
Velocity	8.06	ft/s
Velocity Head	1.01	ft
Specific Energy	2.19	ft
Froude Number	1.43	
Maximum Discharge	25.52	ft³/s
Discharge Full	23.73	ft³/s
Slope Full	0.00477	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	59.22	%
Downstream Velocity	Infinity	ft/s

EAST NODE 204 TO 205

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	1.18	ft
Critical Depth	1.43	ft
Channel Slope	0.01100	ft/ft
Critical Slope	0.00650	ft/ft

EAST NODE 205 TO 208

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00770	ft/ft
Diameter	2.00	ft
Discharge	19.55	ft³/s

Results

Normal Depth	1.61	ft
Flow Area	2.71	ft²
Wetted Perimeter	4.46	ft
Hydraulic Radius	0.61	ft
Top Width	1.58	ft
Critical Depth	1.59	ft
Percent Full	80.6	%
Critical Slope	0.00792	ft/ft
Velocity	7.20	ft/s
Velocity Head	0.81	ft
Specific Energy	2.42	ft
Froude Number	0.97	
Maximum Discharge	21.35	ft³/s
Discharge Full	19.85	ft³/s
Slope Full	0.00747	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	80.63	%
Downstream Velocity	Infinity	ft/s

EAST NODE 205 TO 208

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	1.61	ft
Critical Depth	1.59	ft
Channel Slope	0.00770	ft/ft
Critical Slope	0.00792	ft/ft

EAST NODE 207 TO 208

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00560	ft/ft
Diameter	1.00	ft
Discharge	0.79	ft³/s

Results

Normal Depth	0.37	ft
Flow Area	0.27	ft²
Wetted Perimeter	1.31	ft
Hydraulic Radius	0.20	ft
Top Width	0.97	ft
Critical Depth	0.37	ft
Percent Full	37.3	%
Critical Slope	0.00569	ft/ft
Velocity	2.96	ft/s
Velocity Head	0.14	ft
Specific Energy	0.51	ft
Froude Number	0.99	
Maximum Discharge	2.87	ft³/s
Discharge Full	2.67	ft³/s
Slope Full	0.00049	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	37.30	%
Downstream Velocity	Infinity	ft/s

EAST NODE 207 TO 208

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.37	ft
Critical Depth	0.37	ft
Channel Slope	0.00560	ft/ft
Critical Slope	0.00569	ft/ft

EAST NODE 208 TO 209

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01000	ft/ft
Diameter	2.50	ft
Discharge	20.26	ft³/s

Results

Normal Depth	1.24	ft
Flow Area	2.43	ft²
Wetted Perimeter	3.91	ft
Hydraulic Radius	0.62	ft
Top Width	2.50	ft
Critical Depth	1.53	ft
Percent Full	49.6	%
Critical Slope	0.00511	ft/ft
Velocity	8.33	ft/s
Velocity Head	1.08	ft
Specific Energy	2.32	ft
Froude Number	1.49	
Maximum Discharge	44.12	ft³/s
Discharge Full	41.01	ft³/s
Slope Full	0.00244	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	49.65	%
Downstream Velocity	Infinity	ft/s

EAST NODE 208 TO 209

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	1.24	ft
Critical Depth	1.53	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.00511	ft/ft

EAST NODE 209 TO 113

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01000	ft/ft
Diameter	2.50	ft
Discharge	20.26	ft³/s

Results

Normal Depth	1.24	ft
Flow Area	2.43	ft²
Wetted Perimeter	3.91	ft
Hydraulic Radius	0.62	ft
Top Width	2.50	ft
Critical Depth	1.53	ft
Percent Full	49.6	%
Critical Slope	0.00511	ft/ft
Velocity	8.33	ft/s
Velocity Head	1.08	ft
Specific Energy	2.32	ft
Froude Number	1.49	
Maximum Discharge	44.12	ft³/s
Discharge Full	41.01	ft³/s
Slope Full	0.00244	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	49.65	%
Downstream Velocity	Infinity	ft/s

EAST NODE 209 TO 113

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	1.24	ft
Critical Depth	1.53	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.00511	ft/ft

EAST NODE 113 TO 400

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00560	ft/ft
Diameter	3.50	ft
Discharge	54.83	ft³/s

Results

Normal Depth	2.22	ft
Flow Area	6.42	ft²
Wetted Perimeter	6.44	ft
Hydraulic Radius	1.00	ft
Top Width	3.37	ft
Critical Depth	2.32	ft
Percent Full	63.3	%
Critical Slope	0.00492	ft/ft
Velocity	8.54	ft/s
Velocity Head	1.13	ft
Specific Energy	3.35	ft
Froude Number	1.09	
Maximum Discharge	80.98	ft³/s
Discharge Full	75.29	ft³/s
Slope Full	0.00297	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	63.32	%
Downstream Velocity	Infinity	ft/s

EAST NODE 113 TO 400

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	2.22	ft
Critical Depth	2.32	ft
Channel Slope	0.00560	ft/ft
Critical Slope	0.00492	ft/ft