Palmdale Water District

Stormwater Flood Management, Proposition 1E, Round 2

Littlerock Reservoir Sediment Removal Project

Prepared by:

RMC Water and Environment

February 1, 2013

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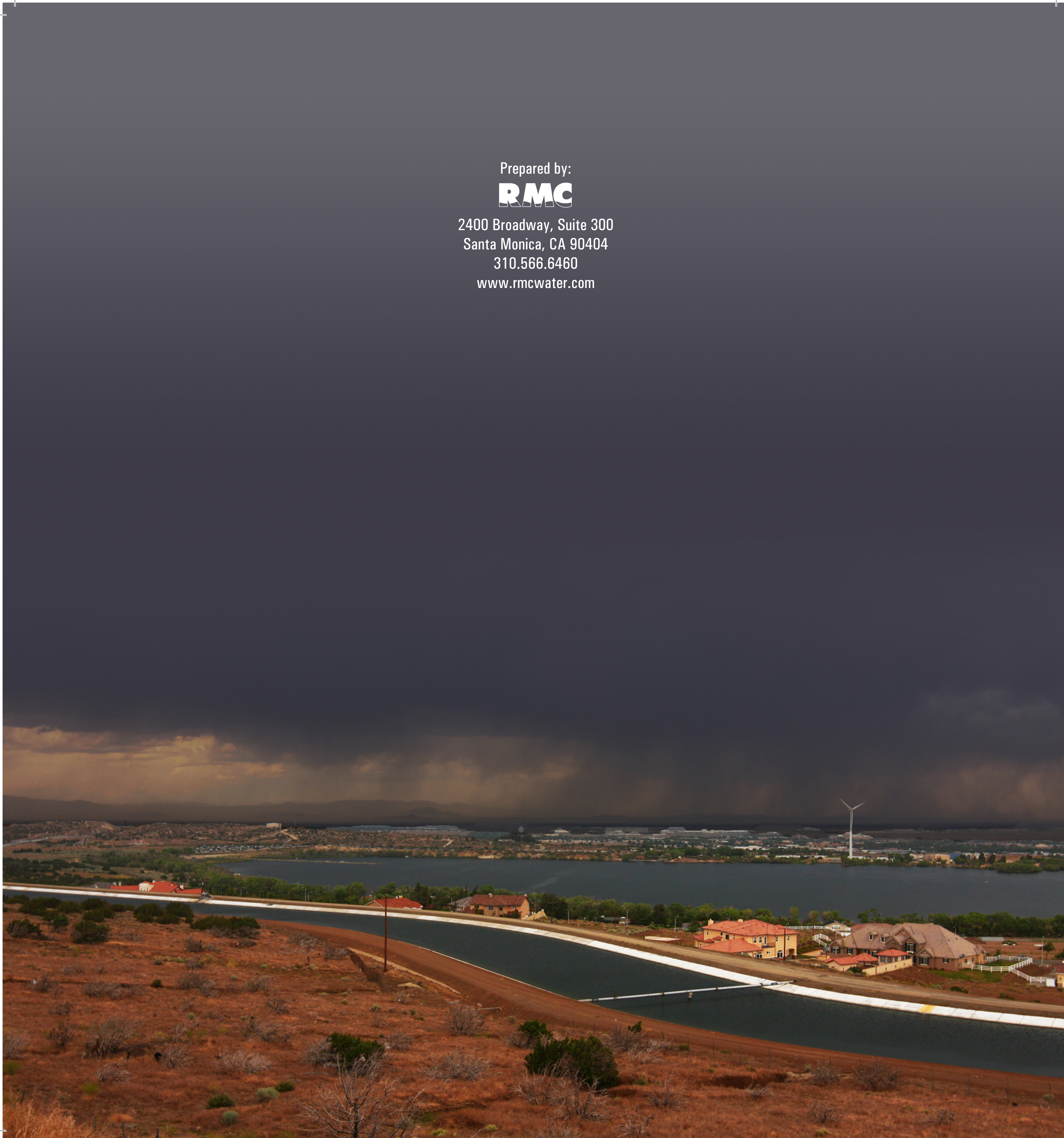


Attachment 1
Eligibility



Littlerock Reservoir Sediment Removal Project

Attachment 1

Stormwater Flood Management Grant Proposal Littlerock Reservoir Sediment Project Removal Authorization and Eligibility Requirements

Attachment 1 consists of the following items:

- ✓ **Authorization and Eligibility Requirements.** Attachment 1 contains Palmdale Water District's resolution and eligible documentation, Ground Water Management Compliance documentation, and information regarding the projects consistency with the adopted Antelope Valley Integrated Regional Water Management (IRWM) Plan.

Introduction

This attachment contains all authorization and eligibility documentation for the proposed Littlerock Reservoir Sedimentation Project (LRSR Project) as required under the IRWM Grant Program Guidelines for Stormwater Funding Management Grants (Proposition 1E).

Authorization Documentation

The Palmdale Water District (PWD) adopted Resolution No. 13-2 authorizing the execution of a master agreement to enter into an agreement with State of California on January 23, 2013. The adopted resolution is provided at the end of this attachment.

Eligible Application Documentation- Local Public Agency

Is the applicant a local agency as defined in Appendix B of the Guidelines?

Yes, PWD is a local agency as defined by Appendix B of the Guidelines. PWD is also a local agency as defined by the California Water Code 10701(a). That section defines a "local agency" as any city, county, district, or agency established for the performance of governmental or proprietary functions within limited boundaries. As set forth in no. 1 above, PWD is an irrigation district formed under the California Water Code and provides water to customers within a defined service area.

What is the statutory or other legal authority under which the applicant was formed and is authorized to operate?

PWD is an irrigation district duly organized and formed pursuant to Division 11 of the California Water Code (Cal. Water Code 20500 et seq.). More specifically, PWD was formed pursuant to formation statutes set forth in Part 2 of Division 11 of the Water Code, commencing at Section 20700.

Does the applicant have legal authority to enter into a grant agreement with the State of California?

PWD has full legal authority to enter into a grant agreement with the State of California. Pursuant to the powers granted to an irrigation district formed pursuant to Divission 11 of the California Water Code, PWD is expressly granted with the powers to make and perform any necessary contracts to carry out its purposes (Cal. Water Code 22230)

Describe any legal agreements among partner agencies and/or organizations that ensure performance of the Proposal and tracking of funds.

PWD is the lead agency submitting the Prop 1E Stormwater Flood Management Grant Application for the proposed LRSR Project. For the LRSR Project, PWD has a partnership with the, U.S. Department of Agriculture Forest Service (USFS) and Littlerock Creek Irrigation District (LCID). PWD and the USFS signed a Memorandum of Understanding (MOU) to collaborate on the LRSR project on July 26, 2012. A copy of the MOU is attached at the end of this attachment.

Since 1992, PWD has shared water from the Reservoir with LCID. PWD and LCID jointly hold long-standing water rights to divert 5,500 AFY from Littlerock Creek flows per an agreement between the two districts. LCID has not exercised its right to surface water diversions since 1994[1].

Groundwater Management Plan Compliance

The proposed LRSR project is not a groundwater project or project that will directly affect groundwater levels or quality.

PWD is a participant of the Antelope Valley Integrated Regional Water Management (IRWM) Plan that meets the requirements for an AB 3030 Plan. The Antelope Valley IRWMP serves as the Antelope Valley's groundwater management plan for the whole basin. The Antelope Valley IRWMP reference to the Groundwater Management Plan can be found in Section 1, Pg 1-24 to 1-25. A copy of the Section 1, Pg 1-24 to 1-25 is provided at the end of this attachment.

Consistency with an Adopted IRWM Plan

The LRSR Project is consistent with the Antelope Valley IRWM Plan. The LRSR project was vetted by the Antelope Valley IRWM Plan stakeholder and regional water management group (RWMG) before including the project in the 2007 Antelope Valley IRWM Plan. The LRSR was identified as a high priority project for the Antelope Valley IRWM Region. Documentation of the LRSR Project's consistency with the Antelope Valley IRWM Plan can be located in Section 7.3 of the Plan. A copy of this section is provided at the end of this attachment.

[1] Palmdale Water District (PWD). Aug 2012. Diversions from Littlerock Reservoir.

RESOLUTION NO. 13-2

RESOLUTION OF BOARD OF DIRECTORS OF PALMDALE WATER DISTRICT AUTHORIZING THE SUBMISSION OF AN APPLICATION TO THE CALIFORNIA DEPARTMENT OF WATER RESOURCES TO OBTAIN STORMWATER FLOOD MANAGEMENT GRANT FUNDING PURSUANT TO THE DISASTER PREPAREDNESS AND FLOOD PREVENTION BOND ACT OF 2006 (PUBLIC RESOURCE CODE SECTION 5096.800 ET. SEQ.) FOR THE LITTLEROCK RESERVOIR SEDIMENT REMOVAL PROJECT, AND TO ENTER INTO AN AGREEMENT WITH RESPECT THERETO

WHEREAS, Palmdale Water District ("District") is an irrigation district formed under Division 11 of the California Water Code; and

WHEREAS, the District is a "local agency" within the meaning of California Water Code §10701(a) and therefore is eligible to apply for a Stormwater Flood Management Grant administered by the California Department of Water Resources; and

WHEREAS, the District is in the process of developing a project known as the Littlerock Reservoir Sediment Removal Project, which will enable the District to more effectively and efficiently manage stormwater and its other resources for the benefit of its customers; and

WHEREAS, a grant from the California Department of Water Resources under the Local Groundwater Assistance Grant Program will be of significant benefit to the District and its customers in bringing the Littlerock Reservoir Sediment Removal Project to fruition.

NOW THEREFORE BE IT RESOLVED, that the Board of Directors of the Palmdale Water District hereby authorizes and directs that an application be made to the California Department of Water Resources to obtain a Stormwater Flood Management Grant (the "Grant") pursuant to the Disaster Preparedness and Flood Prevention Bond Act of 2006 (Public Resource Code §5096.800, et. seq.).

BE IT FURTHER RESOLVED, the District's Board of Directors authorizes the District's General Manager to enter into an agreement to receive the Grant for the Littlerock Reservoir Sediment Removal Project, and the General Manager, or his designee, is hereby authorized and directed to prepare the necessary data, conduct investigations, file such applications and execute such grant agreements with the California Department of Water Resources as may be appropriate in connection with the Grant.

BE IT FURTHER RESOLVED, that the General Manager and the staff of Palmdale Water District are hereby authorized and directed to take such other and further action that may be necessary or appropriate to carry out and further the purposes of this resolution.

PASSED AND ADOPTED at a meeting of the Board of Directors of Palmdale Water District on January 23, 2013.

[signature]	January 23, 2013
President	(date)
[signature] Robert E. Alvarado	January 23, 2013
Secretary	(date)

FS Agreement No. 12MU-1105-0100-014
Cooperator Agreement No.

MEMORANDUM OF UNDERSTANDING
Between The
PALMDALE WATER DISTRICT
And The
USDA, FOREST SERVICE
PACIFIC SOUTHWEST REGION, ANGELES NATIONAL FOREST

This MEMORANDUM OF UNDERSTANDING (MOU) is hereby made and entered into by and between the Palmdale Water District, hereinafter referred to as "PWD," and the USDA, Forest Service, Pacific Southwest Region, Angeles National Forest, hereinafter referred to as the "U.S. Forest Service."

Title: PWD Cooperative Work on the Angeles National Forest for the Littlerock Reservoir Sediment Project (Project).

I. **PURPOSE:** The purpose of this MOU is to document the cooperation between the parties to provide a framework for cooperation between the U.S. Forest Service and PWD to work together as joint lead agencies in preparing and completing a joint environmental analysis and document that is in compliance with NEPA, CEQA, and all applicable laws, executive orders, regulations, direction, and guidelines in accordance with the following provisions.

The PWD holds a Special Use Permit to operate and maintain the Littlerock Dam, Reservoir, and associated facilities as a local surface water impoundment. The Reservoir is a man-made feature formed by the impoundment of water on Littlerock Creek and is located within the boundaries of the Santa Clara/Mojave Rivers Ranger District of the Angeles National Forest. PWD proposes to excavate sediment from the Littlerock Reservoir and construct a grade control structure in order to remove excess reservoir sediment that has accumulated over time; restore and maintain the water storage capacity of the Reservoir; and prevent sediment loss and headcutting of the stream channel upstream of the Reservoir to prevent the incidental "take" of arroyo toad (*Anaxyrus californicus*), a federally endangered species.

The Forest Service, as joint lead agency under 40 CFR 1501.5(b), has determined that an Environmental Impact Statement (EIS) is required before a decision on the Project can be made. The EIS must comply with the National Environmental Policy Act of 1969, 42 U.S.C. 4371 et seq. (NEPA), and all other applicable laws, executive orders, regulations, and direction, including, but not limited to, the Council of Environmental Quality (CEQ) Regulations (40 CFR 1500-1508), the Endangered Species Act, the Angeles National Forest Land and Resources Management Plan, Forest Service Manual 1950, and Forest Service Handbook 1909.15.

The PWD, as the lead agency under the California Environmental Quality Act (CEQA) and as joint lead agency under 40 CFR 1501.5(b), has determined that an Environmental Impact Report (EIR) is required for the Project. The EIR must comply with CEQA and all other applicable laws and regulations.

II. STATEMENT OF MUTUAL BENEFIT AND INTERESTS:

CEQ regulations (40 CFR 1506.2) direct federal agencies to cooperate with State and local agencies to the fullest extent possible to reduce duplication between NEPA and State and local requirements, including joint planning processes, environmental research and studies, public hearings, and environmental impact statements. CEQA Guidelines Sections 15222 and 15226 encourage similar cooperation by State and local agencies with federal agencies when environmental review is required under both CEQA and NEPA. Under these conditions, the Parties shall be joint lead agencies developing one document that complies with all applicable laws.

In consideration of the above premises, the parties agree as follows:

III. PWD SHALL:

A. Serve as the CEQA lead agency throughout the CEQA process.

B. Comply with Federal Statutes relating to non-discrimination. This includes, but is not limited to: (a) Title VI of the Civil Rights Act of 1964 (P.L. 88-352), which prohibits discrimination on the basis of race, color, handicap, or national origin; (b) Title XI of the Education Amendments of 1972, as amended (20 U.S.C. 1681-1683 and 1685-1686) which prohibits discrimination on the basis of sex.

C. Require full cooperation of the Contractor.

D. As required, the PWD will be responsible for consulting with the California Department of Fish and Game.

E. Be responsible for conducting joint public meetings and/or hearings.

F. Coordinate with the Contractor and the Forest Service to develop and implement a Public and Agency Involvement Plan, which shall provide meaningful opportunities for public and agency notification, involvement, and participation during the environmental review of the Project. This Plan shall meet the legal/procedural requirements of CEQA and NEPA for public notification and involvement and provide additional items tailored to meet the specific needs of the Project. The Plan shall include, but not be limited to, the following: a Project telephone and fax hotline/email through which concerned citizens and organizations can contact the Project team and ask questions or submit comments; a Project database and document tracking; agency and stakeholder consultation;

preparation and distribution of the CEQA Notice of Preparation and the NEPA Notice of Intent; Project scoping, including a public scoping meeting and associated public notification; Draft EIR/EIS public involvement activities; post-Draft EIR/EIS support; and optional activities such as a Project website, electronic notification, and a Project newsletter.

G. Provide construction monitors.

H. Provide all graphic handouts and presentations for public meetings/hearings. Any such graphic presentations and/or handouts shall be submitted to the Forest Service for approval prior to distributing them at public meetings/hearings.

I. Be responsible for all stenographic, clerical, graphics, layout, printing, and like work.

J. Mail scoping letters and other correspondence, and arrange for publication of notices as required by the NEPA/CEQA processes.

K. Produce an internal administrative Draft EIR/EIS for review by the Forest Service prior to publication of the Draft EIR/EIS. The administrative draft shall include all text, maps, appendices, tables, charts, and other materials that will be incorporated in the Draft EIR/EIS for publication. As determined by the Forest Service, PWD shall provide a reasonable number of copies to meet internal review needs.

L. Include evaluation of potential alternatives and impacts in the Draft EIR/EIS. The Draft and Final EIR/EIS will apply whichever NEPA and CEQA requirement is more stringent in the analysis. The Draft and Final EIR/EIS will describe any inconsistencies between Federal plans or laws as they pertain to the proposed actions and describe the extent to which the Forest Service would reconcile the proposed action with the plan or law.

M. Have primary responsibility for writing and rewriting all sections, parts, and chapters of the EIR/EIS, subject to Forest Service comments during the environmental analysis and responses to the administrative Draft and Final EIR/EIS.

N. Coordinate with the Forest Service to develop standardized impact minimization measures for inclusion in the EIR/EIS and regulatory permit applications, as necessary. These measures shall be implemented during all construction and operations & maintenance (O&M) activities associated with the Project, as applicable. These measures shall include, but not be limited to, general Standard Operating Procedures and Best Management Practices as well as detailed mitigation measures for impacts to cultural and biological resources.

IV. THE U.S. FOREST SERVICE SHALL:

A. Serve as the NEPA lead agency throughout the NEPA process.

B. Provide updated mailing lists of stakeholders in affected National Forest or other Federal land to the PWD for soliciting input and distributing the scoping letter, Draft and Final EIR/EIS, and Record of Decision as required by law.

C. Review, and if acceptable, approve the draft Notice of Intent (NOI), public notices, and Notice of Availability of the document, before publication in appropriate periodicals.

D. Review, and if acceptable, approve draft scoping letter, before PWD sends the letter to stakeholders in mailing list provided by the Forest Service.

E. File Draft and Final EIR/EIS with the Environmental Protection Agency (EPA).

F. Be responsible for consulting with the United States Fish and Wildlife Service for a Section 7 Consultation and the California State Historic Preservation Officer for a Section 106 Consultation regarding proposed federal action; at the discretion of the Forest Service, PWD shall furnish such data or information required to accomplish such consultation.

G. Coordinate with the PWD to provide an approved set of Cultural Resources Mitigation Meausures.

H. Coordinate with the PWD to develop and implement a Public and Agency Involvement Plan, as described above under III.F above.

I. Coordinate with the PWD to develop and implement a Biological Resources Study Plan, which shall include, but not be limited to, the following: appropriate surveys and data collection to support preparation of the EIR/EIS and applicable regulatory compliance permits (including State and Federal Endangered Species Acts (ESA) compliance, California Department of Fish and Game Lake and Streambed Permitting Section 1602 and 1605, United States Army Corps of Engineers Clean Water Act Section 404, and Lahontan Regional Water Quality Control Board Section 401 Certification), preparation of Forest Service requirements (Biological Evaluation, Management Indicator Species Report, Weed Management Report, and Riparian Conservation Report), and plans related to biological resources (e.g., Water Management Plan, Habitat Compensation and Mitigation Plan, Operation and Maintenance Plan).

V. IT IS MUTUALLY UNDERSTOOD AND AGREED BY AND BETWEEN THE PARTIES THAT:

A. PRINCIPAL CONTACTS. Individuals listed below are authorized to act in their respective areas for matters related to this agreement.

Principal Cooperator Contacts:

Cooperator Program Contact	Cooperator Administrative Contact
Matt Knudson 2029 East Avenue Q Palmdale, CA 93550 (661) 947-4111 x118 (661) 947-8604 mknudson@palmdalewater.org	Matt Knudson 2029 East Avenue Q Palmdale, CA 93550 (661) 947-4111 x118 (661) 947-8604 mknudson@palmdalewater.org

Principal U.S. Forest Service Contacts:

U.S. Forest Service Program Manager Contact	U.S. Forest Service Administrative Contact
Wilburn Blount 33708 Crown Valley Road Acton, CA 93510 (661) 269-2808 FAX: (661) 269-2825 wmblount@fs.fed.us	Bonnie Harris 701 N. Santa Anita Ave. Arcadia, CA 91006 (626) 574-5246 (626) 574-5363 bharris@fs.fed.us

B. NON-LIABILITY. The U.S. Forest Service does not assume liability for any third party claims for damages arising out of this agreement.

C. NOTICES. Any communications affecting the operations covered by this agreement given by the U.S. Forest Service or PWD is sufficient only if in writing and delivered in person, mailed, or transmitted electronically by e-mail or fax, as follows:

To the U.S. Forest Service Program Manager, at the address specified in the MOU.

To PWD, at PWD's address shown in the MOU or such other address designated within the MOU.

Notices are effective when delivered in accordance with this provision, or on the effective date of the notice, whichever is later.

D. PARTICIPATION IN SIMILAR ACTIVITIES. This MOU in no way restricts the U.S. Forest Service or PWD from participating in similar activities with other public or private agencies, organizations, and individuals.

E. ENDORSEMENT. Any of PWD's contributions made under this MOU do not by direct reference or implication convey U.S. Forest Service endorsement of PWD's products or activities.

F. NONBINDING AGREEMENT. This MOU creates no right, benefit, or trust responsibility, substantive or procedural, enforceable at law or equity. The parties shall manage their respective resources and activities in a separate, coordinated and mutually beneficial manner to meet the purpose(s) of this MOU. Nothing in this MOU authorizes any of the parties to obligate or transfer anything of value.

Specific, prospective projects or activities that involve the transfer of funds, services, property, and/or anything of value to a party requires the execution of separate agreements and are contingent upon numerous factors, including, as applicable, but not limited to: agency availability of appropriated funds and other resources; cooperator availability of funds and other resources; agency and cooperator administrative and legal requirements (including agency authorization by statute); etc. This MOU neither provides, nor meets these criteria. If the parties elect to enter into an obligation agreement that involves the transfer of funds, services, property, and/or anything of value to a party, then the applicable criteria must be met. Additionally, under a prospective agreement, each party operates under its own laws, regulations, and/or policies, and any Forest Service obligation is subject to the availability of appropriated funds and other resources. The negotiation, execution, and administration of these prospective agreements must comply with all applicable law

Nothing in this MOU is intended to alter, limit, or expand the agencies' statutory and regulatory authority.

G. MEMBERS OF U.S. CONGRESS. Pursuant to 41 U.S.C. 22, no U.S. member of, or U.S. delegate to, Congress shall be admitted to any share or part of this agreement, or benefits that may arise therefrom, either directly or indirectly.

H. FREEDOM OF INFORMATION ACT (FOIA). Public access to MOU or agreement records must not be limited, except when such records must be kept confidential and would have been exempted from disclosure pursuant to Freedom of Information regulations (5 U.S.C. 552).

I. TEXT MESSAGING WHILE DRIVING. In accordance with Executive Order (EO) 13513, "Federal Leadership on Reducing Text Messaging While Driving," any and all text messaging by Federal employees is banned: a) while driving a Government owned vehicle (GOV) or driving a privately owned vehicle (POV) while on official Government business; or b) using any electronic equipment supplied by the Government when driving any vehicle at any time. All cooperators, their employees, volunteers, and contractors are encouraged to adopt and enforce policies that ban text messaging when driving company owned, leased or rented vehicles, POVs or GOVs when driving while on official Government business or when performing any work for or on behalf of the Government.

J. TERMINATION. Any of the parties, in writing, may terminate this MOU in whole, or in part, at any time before the date of expiration.

K. DEBARMENT AND SUSPENSION. PWD shall immediately inform the U.S. Forest Service if they or any of their principals are presently excluded, debarred, or suspended from entering into covered transactions with the federal government according to the terms of 2 CFR Part 180. Additionally, should PWD or any of their principals receive a transmittal letter or other official Federal notice of debarment or suspension, then they shall notify the U.S. Forest Service without undue delay. This applies whether the exclusion, debarment, or suspension is voluntary or involuntary.

L. CONSULTATION. The Agency Project Representatives shall keep each other advised of the developments affecting the preparation of the Draft EIR/EIS. The Forest Service will keep PWD informed of all discussions with Contractor and involve PWD when appropriate.

M. TIMELINE. Attached to this MOU is a draft detailed schedule, which Parties intend to serve as a template for the actual schedule of deadlines that they intend to adhere to in completing the environmental review that is subject to this MOU. The Parties agree to modify and reach final agreement on the details of this draft schedule, which will include specific dates establishing the deadlines for expected deliverables from the Contractor, as well as deadlines for the Forest Service and PWD to respond to all materials provided by the Contractor. Once the details of this schedule are agreed to, the Parties shall undertake their best efforts to comply with all deadlines set forth in said schedule.

N. MODIFICATIONS. Modifications within the scope of this MOU must be made by mutual consent of the parties, by the issuance of a written modification signed and dated by all properly authorized, signatory officials, prior to any changes being performed. Requests for modification should be made, in writing, at least 30 days prior to implementation of the requested change.

O. COMMENCEMENT/EXPIRATION DATE. This MOU is executed as of the date of the last signature and is effective through 12/31/2013 at which time it will expire, unless extended by an executed modification, signed and dated by all properly authorized, signatory officials.

P. AUTHORIZED REPRESENTATIVES. By signature below, each party certifies that the individuals listed in this document as representatives of the individual parties are authorized to act in their respective areas for matters related to this MOU. In witness whereof, the parties hereto have executed this MOU as of the last date written below.

7/26/12

MATTHEW KNUDSON, Engineering Manager — Date
Palmdale Water District

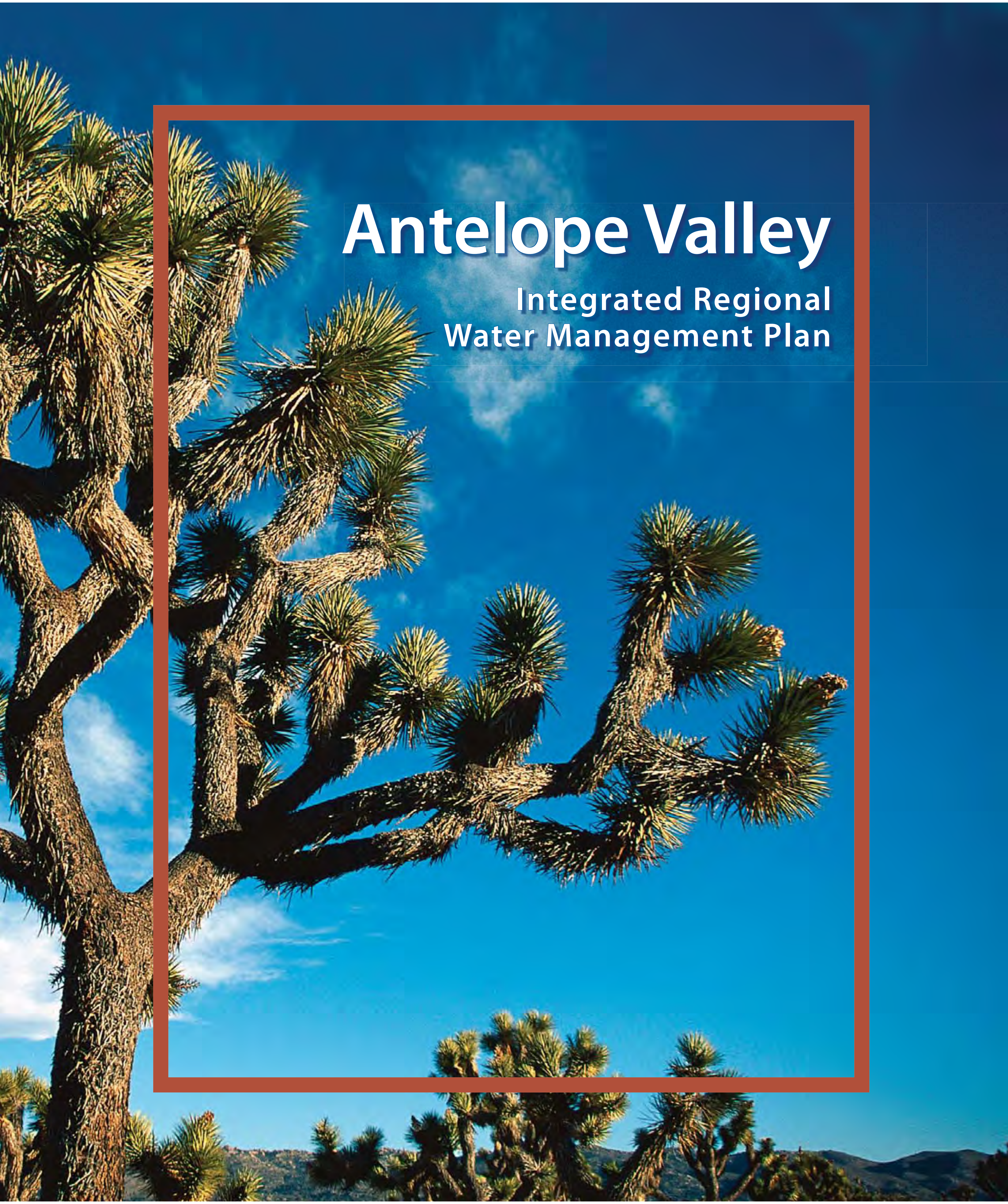
06/29/2012

MARTIN DUMPIS, Acting Forest Supervisor — Date
U.S. Forest Service, Angeles National Forest

The authority and format of this agreement have been reviewed and approved for signature.

6/29/12

BONNIE HARRIS — Date
U.S. Forest Service Grants & Agreements Specialist



Antelope Valley

Integrated Regional Water Management Plan

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When in bloom, the desert floor of the Antelope Valley can be seen bathed in the rich color of the prized California poppy.

Section 1: Introduction

This Integrated Regional Water Management Plan (IRWM Plan) defines a clear vision and direction for the sustainable management of water resources in the Antelope Valley Region through 2035. Although this IRWM Plan contains a viable action plan to provide a wide range of crucial water-related services necessary to support the well-being of people living in this unique and vibrant part of Southern California, this Plan is simply a planning and feasibility study and no implementation or any project is being approved or required through the adoption of this Plan. Implementation of this IRWM Plan will require further discretionary approvals either individually or jointly by the Group members. The IRWM Plan identifies existing key water-related challenges being faced by the residents of the Antelope Valley Region, along with projections of how these challenges will change by 2035. In response to current and expected challenges, this IRWM Plan provides a thorough inventory of possible actions to address the challenges, along with estimated costs and benefits of implementing each action. This IRWM Plan documents an extensive collaborative process that led to the selection of a robust combination of actions that may be implemented cooperatively by the stakeholders in the Antelope Valley Region.

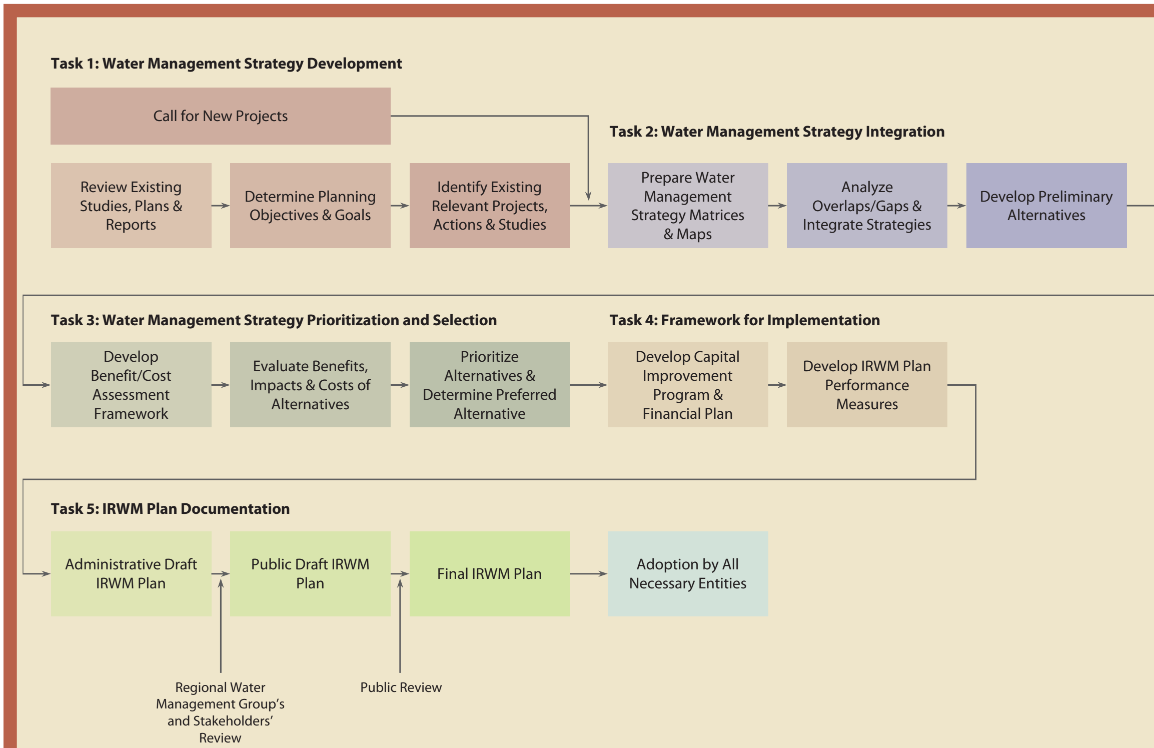

Figure 1-4 Antelope Valley Integrated Regional Water Management Planning Process

as well as Stakeholder comments on the Plan's content have been reviewed, evaluated, discussed amongst the Stakeholder group as necessary, and incorporated into the document as appropriate. These comments have been summarized into a comment response matrix and can be found in Appendix I.

1.3.3 Potential Obstacles to Plan Implementation

One potential obstacle to implementation of the IRWM Plan is the pending adjudication of the Antelope Valley Groundwater Basin. The IRWM Plan's water supply analysis is based on assumptions made regarding availability and reliability of the groundwater supply and was used to identify specific objectives and planning targets for the IRWM Plan. Thus it is possible that the outcome of the adjudication may require a change in the assumptions as well as the objectives and planning targets, which may delay implementation of the IRWM Plan. Additionally, the adjudication may place limitations not considered on the groundwater banking and recharge projects included for implementation. However, the IRWM Plan is meant to be a dynamic planning document and as such will be updated at a minimum of every two years with the project priority list being kept up-to-date as discussed in Section 8.6.2.

1.3.4 Groundwater Management Plan

This IRWM Plan defines a clear vision and direction for the sustainable management of water resources in the Antelope Valley Region through 2035. Inherent to this discussion is how groundwater will be managed to help meet the needs within the Antelope Valley Region now, and into the future. While a groundwater management plan currently does not exist for the Antelope Valley Groundwater Basin as a whole, one has been developed for the RCSD service area. There is the need, however, to develop a groundwater management plan for the Antelope Valley Region in order to provide a better understanding of the Antelope Valley Groundwater Basin and to recommend various strategies that result in a reliable water supply for all basin users and help meet increasing water demands. Therefore, the IRWM Plan will also meet the requirements for an AB 3030 Plan and establish a groundwater management plan for the whole basin.

The Groundwater Management Act (California Water Code Part 2.75 Section 10753), originally enacted as Assembly Bill (AB) 3030 (1992) and amended by Senate Bill (SB) 1938 (2002), provides the authority to prepare groundwater management plans. The intent of AB 3030 is to encourage local public agencies and water purveyors to adopt formal plans to manage groundwater resources within their jurisdiction.

Within the scope of Water Code Section 10753.8, a local groundwater management plan can potentially include up to twelve technical components, although this IRWM Plan need not be restricted to those specific components. This IRWM Plan addresses all the relevant components related to Groundwater Management Plans in the Water Code, as well as the components recommended by the California DWR in California's Groundwater, Bulletin 118 (DWR, 2004). Nothing in this IRWM Plan will supersede or interfere with the pending adjudication of the Antelope Valley Groundwater Basin. Table 1-3 provides a checklist at the end of this section to indicate where in this IRWM Plan specific Groundwater Management Plan components are located.

Table 1-3 Groundwater Management Plan Checklist According to Required Components

Required Components		
Items to Address	**Section of Law**	**Location in Plan**
Provide documentation that a written statement was provided to the public describing the manner in which interested parties may participate in developing the groundwater management plan.	10753.4(b)	Appendix C (Community Outreach Materials)
Provide basin management objectives for the groundwater basin that is subject to this IRWM Plan.	10753.7(a)(1)	Section 4
Describe components relating to the monitoring and management of groundwater levels, groundwater quality, inelastic land surface subsidence and changes in surface flow and surface water quality that directly affect groundwater levels or quality or are caused by pumping.	10753.7(a)(1)	Section 3
Describe plan to involve other agencies that enables the local agency to work cooperatively with other public entities whose service area or boundary overlies the groundwater basin .	10753.7 (a)(2)	Section 1 and Section 8
Adoption of monitoring protocols for the components in Water Code Section 10753.7(a)(1)	10753.7 (a)(4)	Table 8-8
Provide a map showing the area of the groundwater basin as defined by DWR Bulletin 118 with the area of the local agency subject to this IRWM Plan as well as the boundaries of other local agencies that overlie the basin in which the agency is developing a groundwater management plan.	10753.7 (a)(3)	Figure 2-10

With many residents relying on the California Aqueduct to supply their water, it is a lifeline to the Antelope Valley.

Section 7: IRWM Plan and Projects Evaluation and Prioritization

7.1 INTRODUCTION

This section presents a general discussion of the advantages of planning regionally for water resource management and evaluates the benefits of the Antelope Valley Integrated Regional Water Management (IRWM) Plan, including benefits to local and disadvantaged communities within the Antelope Valley Region, and positive impacts that this effort may have on other natural and community resources. Section 7 also describes the evaluation criteria and process that Stakeholders used to rank and prioritize IRWM projects, and presents those projects that Stakeholders have designated as high priority. High priority projects are those that the Stakeholders want to see implemented within the next two years; their implementation is discussed further in Section 8. Lastly, the benefit and costs of these high priority projects are provided in this section.

7.2.4.1 Impacts to Energy

The Antelope Valley Region has a variety of efforts planned or underway to both reduce water consumption with the corresponding reduction in energy use and to develop local energy supply. These efforts include water conservation, recycled water use, hydropower, and utilization of renewable resources, such as wastewater treatment plant digester gas recovery and solar power. As described in the IRWM Plan, the Antelope Valley Water Conservation Coalition is proposing the Comprehensive Water Conservation/ Water Use Efficiency Program and the Cities of Palmdale and Lancaster are both proposing recycled water projects. The water use efficiency effort, in particular, has a direct impact to reducing the energy used to pump water over the Tehachapis. Recycled waters derive similar benefit by reducing the quantity of potable water that needs to be pumped through the State Water Project system.

The projects included in the AV IRWM Plan also contribute to the production of local energy. The proposed Palmdale Power Project in the City of Palmdale, is a hybrid of natural gas-fired combined cycle generating equipment integrated with solar thermal generating equipment, and will have a net electrical output of 563 megawatts (MW). Critical process cooling water needs for the Plant will be met by the use of recycled water, as described in Section 3, thereby saving valuable potable water. Construction is planned to begin in 2008 and commercial operation planned in late 2010. The Palmdale Power Project is also designed to use solar photovoltaic technology to generate a portion of the project's output and thereby support the State of California's goal of increasing the percentage of renewable energy supplies.

Other examples of renewable energy in the region are the LACSD 14 and LACSD 20 projects. In 2003, the LACSD 14 entered into an agreement with Ingersoll-Rand (IR) to demonstrate their 250 kilowatt (kW) microturbine fueled by digester gas. At full power the microturbine will produce 250 kW of electricity and sufficient hot water to heat the water reclamation plant (WRP) digesters. The completed project will provide economical electricity and hot water to supply the plant's energy needs with a combined electrical and thermal efficiency of up to 51 percent. In the same time period as LACSD 14, LACSD 20 entered into an agreement with Quinn Power Systems to demonstrate a Fuel Cell Energy 250 kW fuel cell on digester gas. This program is the first digester gas application of the 250 kW unit. At full power the fuel cell will produce 250 kW of electricity and sufficient hot water to heat the WRP digesters. The completed project will provide economical electricity and hot water to supply the plant's energy needs with a combined electrical and thermal efficiency of up to 73 percent. Environmental benefits of these facilities include a reduction of greenhouse emissions, air emissions that are less than the gas flares, and the reduction of air emissions associated with less consumption of utility central generating plants. By generating power where it is needed there is also a reduced need for utility transmission and distribution facilities.

Through implementation of these projects and the AV IRWM Plan, there is the potential for an overall benefit to energy resources within the Antelope Valley Region.

7.3 IRWM PROJECTS EVALUATION AND RANKING

The following discussion focuses on the potential benefits associated with the individual projects proposed as part of the plan, as well as how effectively they will work towards plan objectives and the feasibility of their future implementation. The intent of the project evaluation and prioritization process is to identify those projects and management actions the stakeholders would like to pursue first to begin addressing the Antelope Valley Region's issues and needs and to meeting the identified AV IRWM Plan objectives.

As discussed in Section 5 and shown in Tables 6-1 and 6-5, there are a number of current strategies being used to address the Antelope Valley Region's water management issues. These include the development of plans and studies, investigations into groundwater recharge and groundwater banking programs, and others. Many of these current efforts provide the basis for the stakeholder-identified projects. For example, the City of Lancaster's Groundwater Recharge Feasibility Study provided the technical analysis for the development of Lancaster's Groundwater Recharge Using Recycled Water Pilot Project.

Plans and actions currently underway are assumed to continue for the purposes of this IRWM Plan. It is the projects that were submitted by the stakeholders during the Call for Projects that illustrate the breadth of the activities that would be needed for the Antelope Valley Region to meet its water management objectives. However, even if all of the projects proposed in this IRWM Plan were implemented in the Antelope Valley Region (discussed in Section 5 and shown in Table 6-2 and 6-6), there are still gaps that would need to be filled by alternative projects in order to meet the IRWM Plan objectives. Management actions suggested to fill these gaps were discussed in Section 6, and are also considered in the evaluation and prioritization exercise provided in this Section.

Therefore, the evaluation and ranking of the projects is focused mainly on those projects and management actions submitted by the stakeholders and the 'alternative gap' projects discussed in Section 6 that help fill the gaps between strategies. Through numerical ranking and qualitative assessment, each project was given a low, medium, or high priority ranking. Projects were evaluated and ranked according to the criteria listed below, and as shown in Table 7-1. Each evaluation criteria was assigned points, as described in more detail below. Initial scores provided an early indication of the potential final ranking of each project. Table 7-1 also allowed for stakeholder comments, which provided an additional method to evaluate the Projects.

CEQA Completed, or Not Required. Activities funded under Proposition 50 must be in compliance with the CEQA. Projects that have completed CEQA analyses or do not require CEQA review were given a point.

Cost Estimates Prepared (with some detail). As discussed in Section 5, the stakeholders were given the opportunity to directly submit their projects and project concepts for consideration through a "Call for Projects." The cost information provided herein represents the outcome of the initial step in a process of bringing individual projects into the collaborative process implied by this IRWM Plan. It should also be noted that stakeholders were encouraged to submit project concepts and thus the incompleteness of some cost information may be appropriate given that request. While many of the projects lack detailed supporting information, especially with regard to cost estimates, the Call for Projects process identified information that is readily available, needs to be identified, and provides a basis to move forward. Based on that process, a point was given to those projects that were farther along in their estimation of their project costs.

Table 7-1 also identifies the cost estimates if provided, and a description of the associated benefit if quantified. This allowed the Stakeholders to assess the projects cost/benefit ratio, even if just on a very preliminary level. Additionally, if the anticipated funding match source was known, that information was also identified in Table 7-1.

Schedule Prepared. Preference is given to those projects that demonstrate a 'readiness to proceed'. A point was given to those projects that had a schedule for implementation that was consistent with its project description and cost estimate.

The three evaluation criteria above: (1) CEQA, (2) Cost Estimation (including cost/benefit detail if available), and (3) Schedule, collectively gave the Stakeholders an indication of the readiness to proceed for a particular project.

Have Broad Support among AV IRWM Plan Stakeholders. It is ultimately up to the Antelope Valley Region Stakeholders to determine which water management projects and actions they wish to implement to address their issues and needs, and only those projects that are supported by the group are likely to move forward. Therefore, those projects that have broad support amongst the IRWM Plan stakeholders were given a point.

Integrates Easily with Other Projects. A key criterion for prioritization is the ability of a project to integrate with other projects and maximize linkages between projects. Those projects that could be integrated easily with other projects were given a point.

Number of IRWM Plan Objectives and Planning Targets Addressed. The IRWM Plan objectives and planning targets, identified in Section 4, were used to evaluate stakeholder-identified projects in Section 6. Priority was assumed to weigh more heavily on projects that meet more than one IRWM Plan objective. Therefore, for each project, the number of objectives that a project contributed to was tallied as its score for this criterion.

Six or More AB 3030 Elements Addressed. The Assembly Bill (AB) 3030 elements for a Groundwater Management Plan, identified in Section 3, were used to evaluate stakeholder-identified projects in Section 6. Those projects that contributed to six or more AB 3030 elements were given a point.

Six or More Water Management Strategies Addressed. The IRWM Plan water management strategies, identified and correlated with the California Water Plan strategies in Section 5, have been used to evaluate stakeholder-identified projects in Section 6. Those projects that contributed to six or more water management strategies were given a point.

Regional Priorities

Number of Regional Priorities Addressed. Regional priorities are intended to guide development of the IRWM Plan. Using the systemic approach of 'facilitated broad agreement' during one of the Stakeholder meetings, the following Regional priorities were developed. These priorities are inherently integrative to the objectives and planning targets identified in Section 4 that address the Antelope Valley Region's issues and needs. Based on discussions with the RWMG and the greater Stakeholder group,

Table 7-1 Project Evaluat ion Matrix (continued)

Planned Project/Program Types and Activities	Readiness to Proceed						Broad Support	Integration		No. of IRWM Plan Objectives & Targets Addressed	Six or more AB 3030 Elements Addressed	Six or More Water Mngt Strategies Addressed	No. of Regional Priorities Addressed	Four or more IRWM Plan Preferences Addressed	Five or more Statewide Priorities Addressed	Consistency w/ General Plans	Serves a DAC	Total Criteria Score	Stakeholder Comments/Discussion	Stakeholder's Priority (Low, Medium, High)
	CEQA Completed or Not Required	Cost Estimates Prepared (with some detail)	Cost/Benefit Detail			Schedule Prepared		Integrates Easily	Integration Detail											
			Cost Estimate	"Benefit Estimate (if quantifiable)"	Anticipated Funding Match Source															
Tropico Park Pipeline Project (RCSD)	0	0	$1M - $10M		Local + Gov't grants, loans	0	1	1	Will provide a way of using tertiary water to develop and water a regional park north to Tropico Hill	5	0	1	6	0	0	1	0	15	Provides a way of using tertiary treated water to develop a regional recreational park. Integrates with the recycled water projects.	Medium
Water Conservation Demonstration Garden (PWD)	1	1	$9M	~86,000 AF over 20 years	Not specified	1	1	1	Integrates with other conservation efforts proposed for the Region.	4	0	0	5	0	0	1	0	15	Addresses water quality problems.	High/to be included high priority coordi-nated conserva-tion program. Refer to Appendix E for Coordinated Conservation Program project template.
Water Conservation School Education Program (LACWWD40)	1	1	$1M		Not specified	1	1	1	Integrates with other conservation efforts proposed for the Region.	3	0	0	5	0	0	1	1	15	County recently issued a new contract for this project, to be awarded soon.	High/to be included high priority coordi-nated conserva-tion program. Refer to Appendix E for Coordinated Conservation Program project template.
42nd Street East, Sewer Installation (Palmdale)	0	0	$100K - $1M		Not specified	0	1	1		6	0	0	4	1	0	1	0	14	Would reduce groundwater pollution by eliminating septic tanks.	Low
Ultra Low Flush Toilet (ULFT) Change Out Program (LACWWD40)	1	1	$100K - $1M		Not specified	1	1	1	Integrates with other conservation efforts proposed for the Region.	2	0	0	5	0	0	1	1	14	Cost and schedule well defined, was included in a previous Proposition 50 Chapter 7 grant application.	High/to be included high priority coordi-nated conserva-tion program. Refer to Appendix E for Coordinated Conservation Program project template.
Water Waste Ordinance (LACWWD40)	1	0	Unknown		Not specified	0	1	1	Integrates with local city ordinances	4	0	0	5	0	0	1	1	14	Could integrate with local city ordinances and policies.	High/to be included high priority coordi-nated conserva-tion program. Refer to Appendix E for Coordinated Conservation Program project template.
Littlerock Dam Sediment Removal Project (PWD)	0	1	$4M		Not specified	1	1	1		3	0	0	5	0	0	1	0	13	CEQA almost complete, provides protection for the Arroyo Toad.	High
Place Valves and Turnouts on Reclaimed Water Pipeline (RCSD)	1	1	$900,000		Local + Gov't grants, loans	0	1	1	Will provide valving and controls to direct water to various pipelines for use by RCSD, AVEK, LA County, etc.	3	0	0	5	0	0	1	0	13	Facilitates water delivery to new facilities and will connect with Tropico Park Pipeline project.	Low
Avenue K Transmission Main, Phases I-IV (LACWWD40)	1	1	> $10M		Not specified	1	1	1		1	0	0	4	0	0	1	1	12	Provides multiple benefits, in-design.	High/linked to AVEK Westside project

Table 7-1A Regional Priorities Matrix

"Planned Project/Program Types and Activities"	Short-Term Regional Priorities						Long-Term Regional Priorities								
	Complete AV IRWM Plan by January 1, 2008	Identify Gap Projects	Maximize Funding For Project Implementation	Utilize Committee for Continued Development/ AV IRWM Plan Implementation	Develop Programs/ Policies to Increase Groundwater Recharge/ Manage Use	Encourage Cooperation in Developing Regional Groundwater Banking	Maintain Committee for Continued AV IRWM Plan Implementation/ Stakeholder Input	Optimize Use of Recycled Water, Conjunctive Management, Conservation, Stormwater	Provide Adequate Water/ Wastewater Services to Meet Projected Growth	Protect Groundwater Supplies	Provide More Efficient Storage for Imported Water Supply	Preserve Open Space, Ag Lands, Conserve Functional Habitats & Protect Species	Continue to Meet Applicable Water Quality Standards	Expand Recycled Water Distribution Systems to New Users	Expand Voluntary Water Conservation Programs for Res/CII/ Ag Users
WATER SUPPLY MANAGEMENT															
Groundwater Recharge/Banking															
Amargosa Creek Recharge and Channelization Project (Palmdale)				X	X	X	X	X	X	X	X	X			
Amargosa Water Banking and Storm Water Retention Project (No financial sponsor identified)				X	X	X	X	X	X	X	X	X			
Antelope Valley Water Bank (WDS)				X	X	X	X	X	X	X	X	X			
Aquifer Storage and Recovery Project: Injection Well Development (LACWWD40)				X	X	X	X	X	X	X	X				
Aquifer Storage and Recovery Project: Additional Storage Capacity (LACWWD40)				X	X	X	X	X	X	X	X				
Deep wells to Recapture Banked Water (RCSD)				X	X	X	X	X	X	X	X				
Gaskell Road Pipeline (RCSD)				X			X	X	X					X	
Groundwater Banking (LACWWD40)				X	X	X	X	X	X	X	X	X			
Purchasing Spreading Basin Land (RCSD)				X	X	X	X	X	X	X	X	X			
Water Supply Stabilization Project – Westside Project (AVEK, AVSWCA)				X	X	X	X	X	X	X	X	X			
Water Supply Stabilization Project – Eastside Project (AVEK, AVSWCA)				X	X	X	X	X	X	X	X	X			
Recycled Water															
Groundwater Recharge Using Recycled Water (GWR-RW) Pilot Project (Lancaster)				X	X	X	X	X	X	X	X			X	
Groundwater Recharge - Recycled Water Project (PWD)				X	X	X	X	X	X	X	X			X	
KC & LAC Interconnection Pipeline (RCSD)				X			X	X	X					X	
North Los Angeles/Kern County Regional Recycled Water System (LACWWD40)				X	X	X	X	X	X	X	X			X	
Tertiary Treated Water Conveyance & Incidental Groundwater Recharge of Amargosa Creek Avenue M to Avenue H (Lancaster)				X	X	X	X	X	X	X	X			X	
Water Conservation/Water Use Efficiency															
ET-Based Controller Program (PWD)				X			X	X	X						X
Implement Evapotranspiration (ET) Controller Program (LACWWD40)				X			X	X	X						X
Precision Irrigation Control System (Leona Valley Town Council)				X			X	X	X						X
Ultra Low Flush Toilet (ULFT) Change Out Program (LACWWD40)				X			X	X	X						X
Water Conservation Demonstration Garden (PWD)				X			X	X	X						X
Water Conservation School Education Program (LACWWD40)				X			X	X	X						X
Water Waste Ordinance (LACWWD40)				X			X	X	X						
Water Infrastructure Improvements															
Avenue K Transmission Main, Phases I-V (LACWWD40)				X			X	X	X						
Avenue M and 60th Street West Tanks (LACWWD40)				X			X	X	X		X				
Littlerock Dam Sediment Removal Project (PWD)				X			X	X	X		X				
Place Valves and Turnouts on Reclaimed Water Pipeline (RCSD)				X			X	X	X					X	
RCSD's Wastewater Pipeline (RCSD)				X			X	X	X					X	
WATER QUALITY MANAGEMENT															
Recycled Water															
42nd Street East, Sewer Installation (Palmdale)				X			X		X				X		
Lancaster WRP Stage V (LACSD)				X			X	X	X				X	X	
Lancaster WRP Stage VI (LACSD)				X			X	X	X				X	X	
Lancaster WRP Proposed Effluent Management Sites (LACSD)				X			X	X	X				X	X	
Palmdale Power Project (Palmdale)				X			X	X						X	
Palmdale WRP Existing Effluent Management Sites (LACSD)				X			X	X	X				X	X	
Palmdale WRP Stage V (LACSD)				X			X	X	X				X	X	
Palmdale WRP Stage VI (LACSD)				X			X	X	X				X	X	
Palmdale WRP Proposed Effluent Management Sites (LACSD)				X			X	X	X				X	X	
Water Infrastructure Improvements															
Partial Well Abandonment of Groundwater Wells for Arsenic Mitigation (LACWWD40)				X	X		X	X	X	X			X		

the following short-term (e.g., 3 to 5 years) and long-term (20 years) priorities have been identified for the Antelope Valley Region. For each project, the number of regional priorities that a project contributed to was tallied as its score for this criterion (refer to Table 7-1A).

Short-term Implementation Priorities (3-5-years)

- Complete the Antelope Valley IRWM Plan by January 1, 2008;
- Identify projects that will meet the gap between existing projects and the Regional planning targets;
- Maximize funding opportunities for project implementation from local, state, and federal funding sources;
- Utilize a committee structure for continued development and implementation of the IRWM Plan;
- Develop programs and policies to increase groundwater recharge or better manage groundwater use; and
- Encourage cooperation in the short-term to develop regional groundwater banking programs.

Long-term Implementation Priorities (20 years)

- Maintain a committee structure to oversee plan implementation and continued stakeholder input;
- Optimize use of recycled water, conjunctive management, conservation, and stormwater to enhance water supply reliability;
- Provide adequate water and wastewater services to meet projected growth
- Protect groundwater supplies;
- Provide more efficient storage for imported water supply to increase its reliability;
- Preserve open space, agricultural land uses, conserve functional habitats, and protect special-status species;
- Continue to meet applicable water quality standards;
- Expand distribution systems to provide recycled water to new users; and
- Expand voluntary water conservation programs for residential, commercial, industrial and agricultural uses.

Four or More IRWM Plan Preferences Addressed. The IRWM Plan preferences were identified and used to evaluate stakeholder-identified projects in Section 6. Those projects that contributed to four or more IRWM Plan preferences were given a point.

Five or More Statewide Priorities Addressed. The statewide priorities were used to evaluate stakeholder-identified projects in Section 6. Those projects that contributed to five or more statewide priorities were given a point.

Consistency with General Plans. The local and regional general plan policies related to water supply, water quality, flood management, environmental resource management, and land use management are identified in Section 8 (Table 8-2) and used to evaluate stakeholder-identified projects. Those projects that demonstrated consistency with these general plan policies were given a point.

Serves a Disadvantaged Community. A DAC was assumed to benefit from a particular project if the project increased the reliability of water supply for the Antelope Valley Region as a whole, enhanced water quality in the Antelope Valley Region, or if the DAC was located within the service area of a proposed project. In this manner, a project was given a point if it was determined to benefit a DAC.

Table 7-1 provides a preliminary evaluation and ranking of the stakeholder-identified proposed projects via a tally of the total number of criteria met by each project. The projects were then evaluated for how well they can be integrated with each other. Additionally, the projects were reviewed for geographic coverage while using a mix of plan objectives and water management strategies to provide multiple benefits, as shown in the "Additional Comments" column in Table 7-1.

Table 7-1 was presented to the RWMG/Stakeholder group for further evaluation and prioritization. Additionally, the Stakeholders were given the opportunity to present support for their projects, to discuss the merits of the projects with the group, and to discuss how their projects could potentially be combined to create more regional, comprehensive, and logistically beneficial and efficient projects. Additionally, at this particular Stakeholder meeting, a number of Stakeholders presented modified versions of their projects to the group that they felt better integrated with the goals and objectives of the Antelope Valley Region as well as other projects.

The Stakeholders were then broken up into groups and asked to give a preliminary "priority" ranking to each project based on the information in Table 7-1 and the discussions presented at the meeting. The group was asked to assign priority under the assumption that any particular project would be implemented with or without grant funding. Priority was given as follows:

- A 'high' priority was assigned to projects the group would take action on within the next two (2) years.
- A 'medium' priority was assigned to projects the group would take action on within the next five (5) years.
- A 'low' priority was assigned to projects the group would take action on within the next 5 to 10 years.

A facilitated discussion led the Stakeholders to identify their high, medium, and low projects, as shown below in Table 7-2. Appendix F provides a more detailed breakdown of the high priority project schedules.

Based on the stakeholders determinations of the ranking process above, the suite of projects and alternatives given 'high' priority, were selected for implementation and discussed below in Section 7.4.

Table 7-2 Prioritized Project List

Priority	Project	Responsible Entity	Project Status	Project Schedule
Water Supply Groundwater Recharge/Banking Infrastructure Projects				
High	Antelope Valley Water Bank	WDS	Design	2001 to 2008
	Aquifer Storage and Recovery Project - Injection Well Development	LACWWD 40	Planning	2007 to 2010
	Upper Amargosa Creek Recharge, Flood Control & Riparian Habitat Restoration Project	Palmdale, AVEK	Planning	2006 to 2010
	Water Supply Stabilization Project – Westside	AVEK/AVSWCA/ LACWWD 40	CEQA/ Permitting	2007 to 2009
Medium	Aquifer Storage and Recovery Project: Additional Storage Capacity	LACWWD 40	Planning	2010 to 2013
	Lower Amargosa Creek Recharge & Flood Control Project	J.Goit/Palmdale	Planning	2010 to 2013
	Water Supply Stabilization Project – Eastside Project	AVEK	Planning	2010 to 2013
Water Infrastructure Projects				
High	Avenue K Transmission Main, Phases I-IV	LACWWD 40	Planning	2008 to 2010
	Littlerock Dam Sediment Removal Project	PWD	Planning/ Design	2004 to 2009
	Waste Water Pipeline	RCSD	Planning	2008 to 2010
Low	Avenue M and 60th Street West Tanks	LACWWD 40	Conceptual	2013 to 2018
	Place Valves and Turnouts on Reclaimed Water Pipeline	RCSD	Conceptual	2013 to 2018
Recycled Water Projects				
High	Antelope Valley Recycled Water Project Phase 2	LACWWD 40/ Palmdale/LACSD	Planning	2007 to 2009
	Groundwater Recharge Using Recycled Water Project	Lancaster	Pilot Study	2006 to 2009
Medium	Groundwater Recharge – Recycled Water Project	PWD	Planning	2010 to 2013
	KC & LAC Interconnection Pipeline	RCSD	Planning	2010 to 2013
	Regional Recycled Water Project Phase 3	LACWWD 40/ Palmdale/LACSD	Planning	2010 to 2013
	Tertiary Treated Water Conveyance & Incidental Groundwater Recharge of Amargosa Creek Avenue M to Avenue H	Lancaster	Planning	2010 to 2013
Low	Regional Recycled Water Project Phase 4	LACWWD 40/ Palmdale/LACSD	Planning	2013 to 1018
Water Conservation/Water Use Efficiency				
High	Comprehensive Water Conservation/Efficient Water Use Program. This program would include the following: PWD's & LACWWD 40's "ET-Based Controller Program", Leona Valley's "Precision Irrigation Control System"; PWD's "Water Conservation Demonstration Garden"; LACWWD 40's "Water Conservation School Education Program", "Ultra Low Flush Toilet (ULFT) Change Out Program", and "Waste Water Ordinance." Additionally, this Program is envisioned to include a landscape/nuisance water ordinance.	AVWCC/ LACWWD/PWD	Planning	2007 to 2010

continual assessment of whether this IRWM Plan is meeting the issues and needs of the Antelope Valley Region will be conducted. Additionally, this IRWM Plan provides a mechanism for identifying new projects designed in accordance with the regional objectives, priorities, and management strategies. Therefore, a continual review of the prioritization is anticipated, and is described in more detail in Section 8, Implementation Framework. Table 7-2 is also included as Appendix E. In this way, the Appendix can be more easily evaluated and adjusted rather than having to make changes to the entire IRWM Plan if changes are necessitated more frequently than the scheduled updates as described in Section 8.6.

7.4 CURRENT HIGH PRIORITY PROJECTS

The following provides descriptions of the high priority projects from Table 7-2. During the process of evaluating and prioritizing the projects, the Stakeholders found that a number of their individually submitted projects could be integrated to form enhanced projects that could reach more beneficiaries, integrate geographically to extend to further reaches of the Antelope Valley Region, and take advantage of synergies not previously noticed. The process enabled the stakeholders to look more carefully at their projects and at what phases they may want to implement in the near term, potentially ranking that a higher priority than a later phase in the project. For example, the Regional Recycled Water Project, which is the regional recycled water backbone system project, includes a number of implementation phases. Phase 2, which includes the connection to the Palmdale Power Plant, was given a high priority. Later phases of the project, Phases 3 and 4, were given medium and low priorities, respectively. For a full description of each of the high priority projects, refer to their project templates, which are provided in Appendix F.

7.4.1 High Priority Projects Benefit/Cost Assessment

The IRWM Plan Guidelines require that an IRWM Plan demonstrate its economic and technical feasibility on a programmatic level (technical feasibility is discussed in Section 8). It is appropriate that both quantifiable and non-quantifiable benefits provided by projects be considered in relation to their costs. The potential benefit of each proposed project was initially identified in Section 5, and cumulatively considered in Section 6. It is likely, however, in this initial stage of Plan development, that a lack of detailed data regarding all benefits, especially costs, could preclude a rigorous quantitative comparison of all projects. Therefore, only those projects that have demonstrated priority status resultant from the analysis provided in Table 7-1 and with concurrence from the Stakeholders are assessed for their benefit to cost relationships. This analysis is presented in Table 7-3.

Upper Amargosa Creek Recharge, Flood Control and Riparian Habitat Restoration Project (WS-1)	
Project Sponsor:	City of Palmdale and Antelope Valley-East Kern Water Agency (AVEK)
Joint Agencies:	Antelope Valley State Water Contractors Association (AVSWCA), Los Angeles County Waterworks District No. 40 (LACWWD 40)
Project Description:	This project consists of the project previously entitled "Amargosa Creek Recharge and Channelization" with some modifications and additions included during the prioritization process. The project proposes the release of untreated aqueduct water into the Upper Amargosa Creek in order to recharge the most depressed and damage portion of the Antelope Valley Region's groundwater basin. Per the Stetson Report, the Amargosa ranks as one of the top locations in the Antelope Valley Region for groundwater recharge. Project goals include increasing the Antelope Valley Region's water supply and the amount of open space and protected natural habitat, and providing improved flood prevention within the Amargosa Creek watershed. Proposed project improvements include: expanding the size and capacity of the spreading ground of the natural recharge area; developing and preserving an ephemeral stream habitat; channelization of Amargosa Creek (soft bottom) and providing a grade separation of 20th Street West over Amargosa Creek.
Project Integration:	Possible integration with Water Supply Stabilization Project- Westside Project (WS-2).
Project Benefits:	5,000 – 10,000 AFY, 15 acres open space; 20 acres flood protection
Total Cost:	$13.5 Million

Comprehensive Water Conservation/Water Use Efficiency Program (WC-1)	
Project Sponsor:	Antelope Valley Water Conservation Coalition (AVWCC), LACWWD, PWD
Joint Agencies:	AVWCC includes the Cities of Lancaster and Palmdale, local mutual water districts, AVEK, Antelope Valley College, Building Industry Association (BIA), and local developers.
Project Description:	The Comprehensive Water Conservation/Water Use Efficiency Program would include a number of water conservation and water use efficiency projects previously discussed in Section 5 including: PWD's & LACWWD 40's "ET-Based Controller Program", Leona Valley's "Precision Irrigation Control System"; PWD's "Water Conservation Demonstration Garden"; LACWWD 40's "Water Conservation School Education Program", "Ultra Low Flush Toilet (ULFT) Change Out Program", and "Waste Water Ordinance." Additionally, WC-1 would include a landscape/nuisance water ordinance.
Project Integration:	Project integrates with all the water supply projects in reducing the expected mismatch of supply and demand in 2035.
Project Benefits:	3,500 AFY by 2010 and ultimately 28,000 to 42,000 AFY
Total Cost:	$900,000
Avenue K Transmission Main, Phases I-IV (WI-1)	
Project Sponsor:	LACWWD 40
Joint Agencies:	None
Project Description:	The Avenue K Transmission Main, Phases I-IV project consists of four phases for a total of approximately 32,000 linear feet of 30-inch and 36-inch diameter steel transmission main. The proposed transmission main will have interconnections to the existing distribution system and will increase the capacity of the water system to meet the existing domestic and fire protection requirements.
Project Integration:	Possibility to connect to WS-2
Project Benefits:	Firms up existing supply
Total Cost:	$10.0 Million
Littlerock Dam Sediment Removal Project (WI-2)	
Project Sponsor:	PWD
Joint Agencies:	None
Project Description	The Littlerock Dam Sediment Removal Project will remove up to 540,000 cubic yards of sediment that has accumulated from runoff in Littlerock Reservoir, and up to 40,000 cubic yards on an annual basis after the initial sediment is removed. The project may include a grade control structure that will protect the identified habitat of the arroyo toad. The project is expected to increase capacity and reliability of surface water storage in Littlerock Reservoir, and could eventually feed into other regional water banking projects such as AVEK's eastside project. CEQA for the project is almost complete.
Project Integration:	Project integrates with the other water supply projects in reducing the expected mismatch between supply and demand in 2035.
Project Benefits:	1,000 AFY
Total Cost:	$5.5 Million
RCSD's Waste Water Pipeline (WI-3)	
Project Sponsor:	RCSD
Joint Agencies:	None
Project Description:	This project would include placing a 36-inch wastewater pipeline from LACSD to RCSD's wastewater treatment plant. The total distance would be approximately 15 miles. This project would provide for a possible expansion of RCSD's recycled water services beyond the 0.5 mgd expansion in order to provide more recycled water in a quicker period of time.
Project Integration:	Integration with RW-1, WQ-1, WQ-2, and WQ-3, by connecting to their systems.
Project Benefits:	Adds additionally potential users of recycled water.
Total Cost:	$13.0 Million

Partial Well Abandonment of Groundwater Wells for Arsenic Mitigation (WQ-4)	
Project Sponsor:	LACWWD 40 and Quartz Hill Water District (QHWD)
Joint Agencies:	None
Project Description:	WQ-4 includes a combination of LACWWD 40's and QHWD's "Partial Well Abandonment of Groundwater Wells for Arsenic Mitigation" projects. WQ-4 proposes arsenic mitigation of six groundwater wells. The proposed method involves using grout with extremely small pour space to seal off localized regions of the well that contain higher levels of arsenic, resulting in an isolation of arsenic located in specific levels of strata and an overall decrease in contamination. This project will benefit several lower income areas that are served by these wells.
Project Integration:	Integrates with other water quality projects in protecting the Basin.
Project Benefits:	Preventing loss of groundwater pumping and supply.
Total Cost:	$1.5 Million

Ecosystem and Riparian Habitat Restoration of Amargosa Creek; Ave J to Ave H (EM-1)	
Project Sponsor:	City of Lancaster
Joint Agencies:	None
Project Description:	The Ecosystem and Riparian Habitat Restoration of Amargosa Creek; Ave J north to Ave H establishes riparian habitat along the eastern edge of the Amargosa Creek in elongated segments and sections resulting in a "Riparian Curtain" approximately extending from Ave J north to Ave H. This restoration project is holistic in that it serves to enhance the environment and improve water quality, and helps to offset impacts on the overall ecosystem of ephemeral and riparian habitat associated with Amargosa Creek. By establishing a riparian corridor, this project provides habitat connectivity and protection; creates acoustic and aesthetic buffers; improves the existing network of wetlands; and works towards overall ecosystem restoration. This project requires site reconnaissance, coordination with California Department of Fish and Game (CDFG), various bio-assessments and planting plans prior to implementation and creation.
Project Integration:	Integrates with WS-1 and LM-1
Project Benefits:	100 – 1,000 AFY
Total Cost:	$10.0 Million

Coordinated Flood Management Plan (FM-1)	
Project Sponsor:	Cities of Lancaster, Palmdale, LADPW, Kern County
Joint Agencies:	Edwards AFB would be an interested participant
Project Description:	The proposed project is the coordination of a flood management plan for the Antelope Valley Region by 2010. The Plan could include regional strategies to: improve and update flood management mapping and technology; coordinate mitigation efforts that address the level of risk associated with different areas and flood events; and direct the location, pattern and design of development in order to reduce flood damage, maximize groundwater recharge and meet other planning objectives throughout the Antelope Valley Region. A regional flood management plan could also include a regional communication and contingency plan, prepared so that regional and local authorities have the means to respond collaboratively to different flood events.
Project Integration:	Integrates with WS-1, EM-1, and LM-1
Project Benefits:	Improved flood management and protection for the Antelope Valley Region.
Total Cost:	To be provided once all project description components are more clearly defined.

Amargosa Creek Pathways Project (LM-1)	
Project Sponsor:	City of Lancaster
Joint Agencies:	None
Project Description:	The Amargosa Creek Pathways Project, proposed by the City of Lancaster, includes development of a top of bank trail or paseo along eastern side of Lake Lancaster, and construction of a foot-bridge structure crossing the lake and connecting under Hwy 14 to link to the existing trailhead at the Antelope Valley Region Fairgrounds. The project integrates stormwater/flood control with natural riparian habitat enhancement and preservation, open/recreational space and land use management. The goal is to construct a pathway in harmony with established riparian habitat, within a flood control management basin which captures stormwater and nuisance water runoff that, in turn, sustains riparian habitat. This project will additionally increase the amount of protected natural habitat and provide improved flood control within the Amargosa Creek watershed.
Project Integration:	Integrates with WS-1 and EM-1
Project Benefits:	1 – 100 AFY
Total Cost:	$1.3 Million
Coordinated Land Use Management Plan (LM-2)	
Project Sponsor:	Cities of Lancaster, Palmdale, LADPW, Kern County
Joint Agencies:	Antelope Valley Conservancy
Project Description:	The proposed project is the coordination of a land use management plan for the Antelope Valley Region. A regional land use plan that directs the Antelope Valley Region's growth towards existing urban centers will help protect agricultural lands, natural habitat and recreational open space, and will encourage the efficient use of water and economic resources dedicated to water utilities infrastructure improvements and expansions. It is likely that this effort will be combined with the "Antelope-Fremont Watershed Assessment and Plan" project described in Section 5. The watershed assessment project would fund the 606 Studio to work with regional stakeholders to coordinate a regional land use plan with emphasis on the preservation and restoration of sensitive natural systems of the Antelope Valley Region.
Project Integration:	Integrates with WS-1, WS-2, WS-4, RW-1, RW-2, WC-1, WQ-1, WQ-2, WQ-3, EM-1, and LM-1.
Project Benefits:	2,000 acres of habitat/conservation lands
Total Cost:	$45,000 to fund the development of the Antelope-Fremont Watershed Assessment and Plan portion of the Plan. Total cost of the Plan to be provided.

7.4.1.1 Integration of High Priority Projects

The combined implementation of these projects would provide multiple benefits to the Antelope Valley Region spanning a number of water management actions. All of the projects proposed for implementation are targeted at reducing the mismatch between supply and demand projected for the Region by 2035. The projects would facilitate the use of recycled water throughout the Region as well as improve water quality in the groundwater through interdependent recycled water projects, thereby providing a new water supply to the Region. Additionally, the suite of projects would reduce regional water demand by as much as 10 percent by 2035 through a regional water conservation program.

These priority projects work as an integrated package. Many of their components are dependant on each other, requiring continual coordination between agencies and Stakeholders. Implementation of these projects are discussion further in Section 8.

Table 7-3 Benefit/Cost for High Priority Projects

Project Code	Project	Quantified Water Supply Benefit	Other Benefits	Costs (in millions)
LM-1	Amargosa Creek Pathways Project	1 – 100 AFY		$1.3
RW-1	Antelope Valley Recycled Water Project Phase 2	8,400 AFY	Potential recharge and habitat restoration	$10.9
WS-4	Antelope Valley Water Bank	100,000 AFY	1,700 acres of agriculture	$170.0
WS-3	Aquifer Storage and Recovery Project: Injection Well Development	12,000 AFY		$10.0
WI-1	Avenue K Transmission Main, Phases I-IV	NA	Firms up supplies	$10.0
WC-1	Comprehensive Water Conservation/Water Use Efficiency Program	3,500 AFY	Ultimate benefit of 28,000 AFY to 42,000 AFY	$0.90
FM-1	Coordinated Flood Management Plan	NA	Would improve overall flood management and protection for the Antelope Valley Region	TBD
LM-2	Coordinated Land Use Management Plan	NA	2,000 acres open space	TBD
EM-1	Ecosystem & Riparian Habitat Restoration of Amargosa Creek; Ave J to Ave H	100 – 1,000 AFY		$10.0
RW-2	Groundwater Recharge Using Recycled Water (GWR-RW) Project	2,500 AFY	100 acres open space	$6.0
WQ-1	Lancaster WRP Stage V	See RW-1	48,000 AFY potential benefits when users identified	$74.8
WI-2	Littlerock Dam Sediment Removal Project	1,000 AFY		$5.5
WQ-2	Palmdale WRP Existing Effluent Management Sites	See RW-1	48,000 AFY potential benefits when users identified	$5.2
WQ-3	Palmdale WRP Stage V	See RW-1	48,000 AFY potential benefits when users identified	$94.6
WQ-4	Partial Well Abandonment of Groundwater Wells for Arsenic Mitigation	NA	Prevents loss of groundwater pumping and existing supply	$1.5
WI-3	RCSD's Waste Water Pipeline	NA	Provides potential future recycled water users	$13.0
WS-1	Upper Amargosa Creek Recharge, Flood Control & Riparian Habitat Restoration Project	5,000 – 10,000 AFY	15 acres open space; 20 acres flood protection	$13.5
WS-2	Water Supply Stabilization Project – Westside Project	40,400 to 42,600 AFY		$230.0

Attachment 2
Adopted Plan and Proof of Formal Adoption



Littlerock Reservoir Sediment Removal Project

Attachment 2

Stormwater Flood Management Grant Proposal
Littlerock Reservoir Sediment Removal Project
Proof of Formal Adoption

Attachment 2 consists of the following items:

✓ **Proof of Formal Adoption.** Attachment 2 contains the proof of formal adoption of the Antelope Valley Integrated Regional Water Management (IRWM) Plan.

Proof of Formal Adoption

The following resolutions were executed by the Regional Water Management Group (RWMG) as proof of formal adoption of the Antelope Valley IRWM Plan:

- Antelope Valley-East Kern Water Agency Resolution No. R-07-23
- Antelope Valley State Water Contractors Association Resolution No. 08-02 & 08-03
- City of Lancaster Resolution No. 07-221 & 08-02
- City of Palmdale Resolution No. 2008-007
- Los Angeles County Sanitation District Resolution No. 14
- Los Angeles County Sanitation District Resolution No. 20
- Littlerock Creek Irrigation District Resolution No. 08-02 & 08-03
- Los Angeles County Waterworks District No. 40
- Palmdale Water District Resolution No. 08-1 & 08-2
- Rosamond Community Services District Resolution No. 2008-10

Copies of these resolutions are provided at the end of this attachment.

RESOLUTION NO. R-07-23

A RESOLUTION OF THE ANTELOPE VALLEY-EAST KERN WATER AGENCY

APPROVING THE PROPOSAL AND DETERMINATION TO ADOPT AN INTEGRATED REGIONAL WATER MANAGEMENT

WHEREAS, the California Water Code Division 6, Part 2.2, known as the Integrated Regional Water Management Planning Act of 2002, hereinafter referred to as "ACT," provides the framework for preparation and adoption of integrated regional water management plans; and

WHEREAS, the Antelope Valley-East Kern Water Agency; Palmdale Water District; Quartz Hill Water District; Littlerock Creek Irrigation District; Antelope Valley State Water Contractors Association; City of Palmdale; City of Lancaster; County Sanitation District No. 14 of Los Angeles County; County Sanitation District No. 20 of Los Angeles County; Rosamond Community Services District; and Los Angeles County Waterworks District No. 40; Antelope Valley, have established a Regional Water Management Group by means of a Memorandum of Understanding in accordance with the ACT; and

WHEREAS, the Regional Water Management Group collaboratively prepared an Integrated Regional Water Management Plan, hereinafter referred to as "PLAN," that meets the requirements of the ACT; and

WHEREAS, the Regional Water Management Group solicited and incorporated input from all interested stakeholders in preparation of the PLAN; and

WHEREAS, the adoption of the PLAN is intended to improve the Antelope Valley's competitiveness for State and Federal funding, including grants from Propositions 50, 84, and 1E for all members of the Regional Water Management Group.

NOW, THEREFORE, BE IT RESOLVED, that the Board of Directors acting as the governing body of the Antelope Valley-East Kern Water Agency, does hereby:

1. Propose to adopt an Integrated Regional Water Management Plan for the Antelope Valley as a member of the Regional Water Management Group; and

2. Determine to adopt and adopt an Integrated Regional Water Management Plan for the Antelope Valley as a member of the Regional Water Management Group.

The foregoing Resolution was adopted on the 8th day of January, 2008, by the **BOARD OF DIRECTORS, as the governing body of the** ANTELOPE VALLEY-EAST KERN WATER AGENCY:

By ____________________
BOARD PRESIDENT

APPROVED AS TO FORM:

By ____________________
Legal Counsel

ANTELOPE VALLEY STATE WATER CONTRACTORS ASSOCIATION
RESOLUTION 08-02

RESOLUTION OF THE GOVERNING BOARD OF THE ANTELOPE VALLEY STATE WATER CONTRACTORS ASSOCIATION APPROVING THE PROPOSAL AND DETERMINATION TO ADOPT AN INTEGRATED REGIONAL WATER MANAGEMENT PLAN FOR THE ANTELOPE VALLEY

WHEREAS, the California Water Code Division 6, Part 2.2, known as the Integrated Regional Water Management Planning Act of 2002, hereinafter referred to as "ACT," provides the framework for preparation and adoption of integrated regional water management plans; and

WHEREAS, the Antelope Valley-East Kern Water Agency; Palmdale Water District; Quartz Hill Water District; Littlerock Creek Irrigation District; Antelope Valley State Water Contractors Association; City of Palmdale; City of Lancaster; County Sanitation District No. 14 of Los Angeles County; County Sanitation District No. 20 of Los Angeles County; Rosamond Community Services District; and Los Angeles County Waterworks District No. 40; Antelope Valley, have established a Regional Water Management Group by means of a Memorandum of Understanding in accordance with the ACT; and

WHEREAS, the Regional Water Management Group collaboratively prepared an Integrated Regional Water Management Plan, hereinafter referred to as "PLAN," that meets the requirements of the ACT; and

WHEREAS, the Regional Water Management Group solicited and incorporated input from all interested stakeholders in preparation of the PLAN; and

WHEREAS, the adoption of the PLAN is intended to improve the Antelope Valley's competitiveness for State and Federal funding, including grants from Propositions 50, 84, and 1E for all members of the Regional Water Management Group.

NOW, THEREFORE, BE IT RESOLVED, that the Board of Commissioners of the Antelope Valley State Water Contractors Association does hereby:

1. Propose to adopt an Integrated Regional Water Management Plan for the Antelope Valley as a member of the Regional Water Management Group; and

2. Determine to adopt and adopt an Integrated Regional Water Management Plan for the Antelope Valley as a member of the Regional Water Management Group.

PASSED AND ADOPTED on this 17th day of January, 2008, by the Board of Commissioners, the governing body of the Antelope Valley State Water Contractors Association.

ANTELOPE VALLEY STATE WATER CONTRACTORS ASSOCIATION

Barbara Hogan,
Chair

ATTEST: ANDY RUTLEDGE
Secretary: ______________

ANTELOPE VALLEY STATE WATER CONTRACTORS ASSOCIATION RESOLUTION 08-03

RESOLUTION OF THE GOVERNING BOARD OF THE ANTELOPE VALLEY STATE WATER CONTRACTORS ASSOCIATION APPROVING THE PROPOSAL AND DETERMINATION TO ADOPT A GROUNDWATER MANAGEMENT PLAN FOR THE ANTELOPE VALLEY

WHEREAS, the California Water Code Division 6, Part 2.75, known as the Groundwater Management Planning Act, hereinafter referred to as "ACT," provides the framework for preparation and adoption of groundwater management plans in the State; and

WHEREAS, the Antelope Valley-East Kern Water Agency; Palmdale Water District; Quartz Hill Water District; Littlerock Creek Irrigation District; Antelope Valley State Water Contractors Association; City of Palmdale; City of Lancaster; County Sanitation District No. 14 of Los Angeles County; County Sanitation District No. 20 of Los Angeles County; Rosamond Community Services District; and Los Angeles County Waterworks District No. 40; Antelope Valley, have established a Regional Water Management Group by means of a Memorandum of Understanding in accordance with the ACT; and

WHEREAS, the Regional Water Management Group collaboratively prepared a Groundwater Management Plan for the Antelope Valley, hereinafter referred to as "PLAN," that meets the requirements of the ACT; and

WHEREAS, the Regional Water Management Group solicited and incorporated input from all interested stakeholders in preparation of the PLAN; and

WHEREAS, the adoption of the PLAN is intended to improve the Antelope Valley's competitiveness for State and Federal funding, including grants from Propositions 50, 84, and 1E for all members of the Regional Water Management Group.

NOW, THEREFORE, BE IT RESOLVED, that the Board of Commissioners of the Antelope Valley State Water Contractors Association does hereby:

1. Determine to adopt and adopt a Groundwater Management Plan for the Antelope Valley as a member of the Regional Water Management Group.

PASSED AND ADOPTED on this 17th day of January, 2008, by the Board of Commissioners, the governing body of the Antelope Valley State Water Contractors Association.

ANTELOPE VALLEY STATE WATER
CONTRACTORS ASSOCIATION

Barbara Hogan

Barbara Hogan,

Chair

ATTEST: ANDY RUTLEDGE

Secretary: Andy Rutledge

RESOLUTION NO. 07-221

A RESOLUTION OF THE CITY COUNCIL OF THE
CITY OF LANCASTER, CALIFORNIA,
APPROVING THE PROPOSAL AND DETERMINATION
TO ADOPT AN INTEGRATED REGIONAL WATER MANAGEMENT PLAN.

WHEREAS, the California Water Code Division 6, Part 2.2, known as the Integrated Regional Water Management Planning Act of 2002, hereinafter referred to as "ACT," provides the framework for preparation and adoption of integrated regional water management plans; and

WHEREAS, the Antelope Valley-East Kern Water Agency; Palmdale Water District; Quartz Hill Water District; Littlerock Creek Irrigation District; Antelope Valley State Water Contractors Association; City of Palmdale; City of Lancaster; County Sanitation District No. 14 of Los Angeles County; County Sanitation District No. 20 of Los Angeles County; Rosamond Community Services District; and Los Angeles County Waterworks District No. 40; Antelope Valley, have established a Regional Water Management Group by means of a Memorandum of Understanding in accordance with the ACT; and

WHEREAS, the Regional Water Management Group collaboratively prepared an Integrated Regional Water Management Plan, hereinafter referred to as "PLAN," that meets the requirements of the ACT; and

WHEREAS, the Regional Water Management Group solicited and incorporated input from all interested stakeholders in preparation of the PLAN; and

WHEREAS, the adoption of the PLAN is intended to improve the Antelope Valley's competitiveness for State and Federal funding, including grants from Propositions 50, 84, and 1E for all members of the Regional Water Management Group.

NOW, THEREFORE, BE IT RESOLVED AND ORDERED BY THE CITY COUNCIL OF THE CITY OF LANCASTER, STATE OF CALIFORNIA, THAT:

Section 1. Propose to adopt an Integrated Regional Water Management Plan for the Antelope Valley as a member of the Regional Water Management Group; and

Section 2. Determine to adopt and adopt an Integrated Regional Water Management Plan for the Antelope Valley as a member of the Regional Water Management Group.

PASSED, APPROVED, and ADOPTED this 11th day of December, 2007, by the following vote:

AYES: Council Members: Jeffra, Sileo, Smith, Vice Mayor Visokey, Mayor Hearns

NOES: None

ABSTAIN: None

ABSENT: None

ATTEST:

GERI K. BRYAN, CMC
City Clerk
City of Lancaster

APPROVED:

HENRY W. HEARNS
Mayor
City of Lancaster

STATE OF CALIFORNIA)
COUNTY OF LOS ANGELES) ss
CITY OF LANCASTER)

CERTIFICATION OF RESOLUTION
CITY COUNCIL

I, ____________________, ____________________ City of Lancaster, CA, do hereby certify that this is a true and correct copy of the original Resolution No. 07-221, for which the original is on file in my office.

WITNESS MY HAND AND THE SEAL OF THE CITY OF LANCASTER, on this ________ day of ______________, ________.

(seal)

____

RESOLUTION NO. 08-02

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF LANCASTER, CALIFORNIA, ADOPTING A GROUNDWATER MANAGEMENT PLAN FOR THE ANTELOPE VALLEY

WHEREAS, California Water Code Division 6, Part 2.2, known as the *Integrated Regional Water Management Planning Act of 2002,* and Division 6, Part 2.75, known as the *Groundwater Management Planning Act,* hereinafter collectively referred to as "ACTS", provide the framework for preparation of integrated regional water management plans and groundwater management plans in the State; and

WHEREAS, the Antelope Valley-East Kern Water Agency, Palmdale Water District, Quartz Hill Water District, Littlerock Creek Irrigation District, Antelope Valley State Water Contractors Association, City of Palmdale, City of Lancaster, County Sanitation District No. 14 of Los Angeles County, County Sanitation District No. 20 of Los Angeles County, Rosamond Community Services District, and Los Angeles County Waterworks District No. 40, Antelope Valley have established a Regional Water Management Group by means of a Memorandum of Understanding in accordance with the ACTS; and

WHEREAS, the Regional Water Management Group collaboratively prepared an Integrated Regional Water Management Plan/Groundwater Management Plan for the Antelope Valley, hereinafter referred to as "PLAN", that meets the requirements of the ACTS ; and

WHEREAS, the Regional Water Management Group solicited and incorporated input from all interested stakeholders; and

WHEREAS, the adoption of the PLAN will improve the Antelope Valley's competitiveness for State and Federal funding including grants from Propositions 50, 84, and 1E.

WHEREAS, the City Council adopted the Integrated Regional Water Management Plan by Resolution No. 07-221 on December 11, 2007; and

WHEREAS, the Groundwater Management Plan requires that two (2) public hearings be held; one indicating intention to prepare the PLAN and the second taking testimony and determining if a majority protest exists; and

WHEREAS, said public hearings were noticed and held in accordance with the ACTS; and

WHEREAS, there was no majority protest.

NOW, THEREFORE, BE IT RESOLVED AND ORDERED BY THE CITY COUNCIL OF THE CITY OF LANCASTER, STATE OF CALIFORNIA, THAT:

Section 1. This City Council hereby adopts the Groundwater Management Plan as a member of the Regional Water Management Group.

PASSED, APPROVED, and ADOPTED this 8th day of January, 2008, by the following vote:

AYES: Council Members: Sileo, Smith, Vice Mayor Visokey, Mayor Hearns

NOES: None

ABSTAIN: None

ABSENT: Council Member: Jeffra

ATTEST:

GERI K. BRYAN, CMC
City Clerk
City of Lancaster

APPROVED:

HENRY W. HEARNS
Mayor
City of Lancaster

STATE OF CALIFORNIA)
COUNTY OF LOS ANGELES) ss
CITY OF LANCASTER)

CERTIFICATION OF RESOLUTION
CITY COUNCIL

I, Britt Avrit, Deputy City Clerk City of Lancaster, CA, do hereby certify that this is a true and correct copy of the original Resolution No. 08-02, for which the original is on file in my office.

WITNESS MY HAND AND THE SEAL OF THE CITY OF LANCASTER, on this 9th day of January, 2008.

(seal)

CITY OF PALMDALE
LOS ANGELES COUNTY, CALIFORNIA

RESOLUTION NO. CC 2008-007

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF PALMDALE, CALIFORNIA APPROVING THE PROPOSAL AND DETERMINATION TO ADOPT AN INTEGRATED REGIONAL WATER MANAGEMENT PLAN AND A GROUNDWATER MANAGEMENT PLAN FOR THE ANTELOPE VALLEY

RECITALS

WHEREAS, California Water Code Division 6, Part 2.2, known as the Integrated Regional Water Management Planning Act of 2002, and Division 6, Part 2.75, known as the Groundwater Management Planning Act, hereinafter collectively referred to as "ACTS", provide the framework for preparation and adoption of Integrated Regional Water Management Plans and Groundwater Management Plans in the state; and

WHEREAS, the Antelope Valley-East Kern Water Agency; Palmdale Water District; Quartz Hill Water District; Littlerock Creek Irrigation District; Antelope Valley State Water Contractors Association; City of Palmdale; City of Lancaster; County Sanitation District No. 14 of Los Angeles County; County Sanitation District No. 20 of Los Angeles County; Rosamond Community Services District; and Los Angeles County Waterworks District No. 40; Antelope Valley, have established a Regional Water Management Group by means of a Memorandum of Understanding in accordance with the ACTS; and

WHEREAS, the Regional Water Management Group collaboratively prepared an Integrated Regional Water Management/Groundwater Management Plan for the Antelope Valley, hereinafter referred to as "PLAN", that collectively meet the requirements of the ACTS; and

WHEREAS, the Regional Water Management Group solicited and incorporated input from all interested stakeholders in preparation of the PLAN; and

WHEREAS, regional collaboration can promote a more efficient, comprehensive, and effective approach to water resource management while being responsive within a regional context to the needs of individual communities and jurisdictions; and

WHEREAS, the PLAN is to prepare to meet the Antelope Valley's future regional need for water supply reliability by evaluating opportunities for water recycling, water conservation, groundwater management, conjunctive use, water transfers, water quality improvement, storm water capture and management, flood management, recreation and public access, and environmental and habitat protection and improvement; and

WHEREAS, the PLAN will foster coordination, collaboration and communication among public agencies in the Antelope Valley and other interested stakeholders to achieve greater water-use efficiencies, enhance public services, and build public support for vital projects; and

WHEREAS, the adoption of the PLAN will improve the Antelope Valley's competitiveness for State and Federal funding including grants from Propositions 50, 84, and 1E for all members of the Regional Water Management Group; and

WHEREAS, the PLAN is a feasibility and planning study for possible future action and no implementation or project is being adopted, approved, required or funded through the adoption of the PLAN; and

WHEREAS, implementation of the PLAN may not proceed without further discretionary approvals either by the individual public agency or jointly by the group members; and

WHEREAS, adoption of the PLAN, does not legally bind the City of Palmdale to approve or perform any implementation or project.. Furthermore, any approval of any project suggested in this PLAN, including, but not limited to the use of recycled water for direct groundwater recharge, will require full environmental and public review.

NOW, THEREFORE, the City Council hereby finds, determines, and resolves as follows:

SECTION 1: The City Council hereby specifically finds that all of the facts set forth in the Recitals and true and correct and constitute the findings of the City Council in this matter.

SECTION 2: The City Council adopts the Final Integrated Regional Water Management/Groundwater Management Plan for the Antelope Valley as a member of the Regional Water Management Group.

SECTION 3: The City Council hereby finds as follows with respect to the Notice of Exemption prepared in connection with Final Integrated Regional Water Management/ Groundwater Management Plan for the Antelope Valley:

(a) Pursuant to the California Environmental Quality Act ("CEQA") and the City's local CEQA Guidelines, City staff determined the project to be exempt from environmental review pursuant to Section 15262 of the California Environmental Quality Act (CEQA) Guidelines, Feasibility and Planning Studies for possible future actions for which no implementation or project has been approved or funded. Thereafter, the City staff provided public notice of the determination and of the intent to find the project exempt from environmental review pursuant to Section 15272 of the CEQA Guidelines.

(b) The City Council has reviewed the Notice of Exemption and, based on the whole record before it, finds that the Notice of Exemption was prepared in compliance with CEQA. The City Council further finds that the Notice of Exemption reflects the independent judgment and analysis of the City Council. Based on these findings, the City Council hereby adopts the Notice of Exemption.

(c) The custodian of records for the Notice of Exemption, and all other materials which constitute the record of proceedings upon which the City Council's decision is based, is the Director of Planning of the City of Palmdale. Those documents are available for public review in the Planning Department of the City of Palmdale located at 38250 Sierra Highway, Palmdale, California 93550, telephone (661) 267-5200.

SECTION 4: City staff is authorized and directed to file a Notice of Exemption under Section 15262 of the California Environmental Quality Act (CEQA) guidelines on behalf of the Regional Water Management Group.

SECTION 5: The City Clerk shall certify to the adoption of this resolution.

PASSED, APPROVED and ADOPTED this 16th day of January, 2008, by the following vote:

AYES: Mayor Ledford and Councilmembers Lackey, Knight, Hofbauer, and Dispenza

NOES: None

ABSENT: None ABSTAIN: None

James C. Ledford, Jr., Mayor

Attest:

Becky Smith, Deputy City Clerk
for Victoria L. Hancock, CMC
City Clerk

Approve as to form:

for Wm. Matthew Ditzhazy
City Attorney

PALMDALE

a place to call home

JAMES C. LEDFORD, JR.
Mayor

MIKE DISPENZA
Mayor Pro Tem

STEVEN D. HOFBAUER
Councilmember

STEPHEN KNIGHT
Councilmember

TOM LACKEY
Councilmember

38300 Sierra Highway

Palmdale, CA 93550-4798

Tel: 661/267-5100

Fax: 661/267-5122

TDD: 661/267-5167

Auxiliary aids provided for communication accessibility [upon] 72 hours' notice and request.

CITY COUNCIL

CLERK'S CERTIFICATE

I, Victoria L. Hancock, CMC, City Clerk of the City of Palmdale, State of California, do hereby certify as follows:

The attached is a full, true and correct copy of Resolution No. CC 2008-007 adopted at the Regular Meeting of the City Council of the City of Palmdale duly held at the regular meeting place thereof, on January 16, 2008, at which meeting all of the members of said City Council had due notice and at which a majority thereof was present.

I further certify that I have carefully compared the same with the original Resolution No. CC 2008-007 on file and of record in my office and that said Resolution CC 2008-007 is a full, true, and correct copy of the original Resolution No. CC 2008-007 adopted at said meeting.

At said meeting, Resolution No. CC 2008-007 was adopted by the following vote:

AYES: Mayor Ledford and Councilmembers Lackey, Knight, Hofbauer, and Dispenza

NOES: None

ABSTAIN: None

ABSENT: None

WITNESS my hand and the seal of the City of Palmdale this 22nd day of January 2008.

Becky Smith, Deputy City Clerk
for Victoria L. Hancock, CMC
City Clerk

RESOLUTION OF THE BOARD OF DIRECTORS OF COUNTY SANITATION DISTRICT NO. 14 OF LOS ANGELES COUNTY TO ADOPT AN INTEGRATED REGIONAL WATER MANAGEMENT PLAN FOR THE ANTELOPE VALLEY

WHEREAS, California Water Code Division 6, Part 2.2, known as the *Integrated Regional Water Management Planning Act of 2002* (ACT), provides the framework for preparation of integrated regional water management plans in the State; and

WHEREAS, the Antelope Valley-East Kern Water Agency, Palmdale Water District, Quartz Hill Water District, Littlerock Creek Irrigation District, Antelope Valley State Water Contractors Association, City of Palmdale, City of Lancaster, County Sanitation District No. 14 of Los Angeles County, County Sanitation District No. 20 of Los Angeles County, Rosamond Community Services District, and Los Angeles County Waterworks District No. 40, Antelope Valley have established a Regional Water Management Group by means of a Memorandum of Understanding in accordance with the ACT; and

WHEREAS, the Regional Water Management Group solicited and incorporated input from all interested stakeholders in preparation of the PLAN; and

WHEREAS, the Regional Water Management Group collaboratively prepared an Integrated Regional Water Management Plan for the Antelope Valley (PLAN) that meets the requirements of the ACT; and

WHEREAS, the adoption of the PLAN is intended to improve the Antelope Valley's competitiveness for State and Federal funding including grants from Propositions 50, 84, and 1E.

NOW, THEREFORE, BE IT RESOLVED, that the Board of Directors of County Sanitation District No. 14 of Los Angeles County hereby adopts the Integrated Regional Water Management Plan for the Antelope Valley.

The foregoing Resolution was adopted on the 23rd day of January, 2008, by the Board of Directors as the governing body of County Sanitation District No. 14 of Los Angeles County.

By ______________________
Chairperson, County Sanitation District No. 14 of Los Angeles County

JAN 2 3 2008

ATTEST:

By: ______________________
Secretary to the Boards

APPROVED AS TO FORM:

By ______________________
Legal Counsel

RESOLUTION OF THE BOARD OF DIRECTORS OF COUNTY SANITATION DISTRICT NO. 20 OF LOS ANGELES COUNTY TO ADOPT AN INTEGRATED REGIONAL WATER MANAGEMENT PLAN FOR THE ANTELOPE VALLEY

WHEREAS, California Water Code Division 6, Part 2.2, known as the *Integrated Regional Water Management Planning Act of 2002* (ACT), provides the framework for preparation of integrated regional water management plans in the State; and

WHEREAS, the Antelope Valley-East Kern Water Agency, Palmdale Water District, Quartz Hill Water District, Littlerock Creek Irrigation District, Antelope Valley State Water Contractors Association, City of Palmdale, City of Lancaster, County Sanitation District No. 14 of Los Angeles County, County Sanitation District No. 20 of Los Angeles County, Rosamond Community Services District, and Los Angeles County Waterworks District No. 40, Antelope Valley have established a Regional Water Management Group by means of a Memorandum of Understanding in accordance with the ACT; and

WHEREAS, the Regional Water Management Group solicited and incorporated input from all interested stakeholders in preparation of the PLAN; and

WHEREAS, the Regional Water Management Group collaboratively prepared an Integrated Regional Water Management Plan for the Antelope Valley (PLAN) that meets the requirements of the ACT; and

WHEREAS, the adoption of the PLAN is intended to improve the Antelope Valley's competitiveness for State and Federal funding including grants from Propositions 50, 84, and 1E.

NOW, THEREFORE, BE IT RESOLVED, that the Board of Directors of County Sanitation District No. 20 of Los Angeles County hereby adopts the Integrated Regional Water Management Plan for the Antelope Valley.

The foregoing Resolution was adopted on the 23rd day of January, 2008, by the Board of Directors as the governing body of County Sanitation District No. 20 of Los Angeles County.

By: ______________________
Chairperson, County Sanitation District No. 20 of Los Angeles County

JAN 2 3 2008

ATTEST:

By: ______________________
Secretary to the Boards

APPROVED AS TO FORM:

By: ______________________
Legal Counsel

RECEIVED

JAN 23 2008

KENNEDY JENKS CONSULTANTS
VENTURA, CA

RESOLUTION NO. 08-02

A RESOLUTION OF THE BOARD OF DIRECTORS OF LITTLEROCK CREEK IRRIGATION DISTRICT APPROVING THE PROPOSAL AND DETERMINATION TO ADOPT AN INTEGRATED REGIONAL WATER MANAGEMENT PLAN FOR THE ANTELOPE VALLEY

WHEREAS, the California Water Code Division 6, Part 2.75, known as the Groundwater Management Planning Act, hereinafter referred to as "ACT," provides the framework for preparation and adoption of integrated regional water management plans; and

WHEREAS, the Antelope Valley-East Kern Water Agency; Palmdale Water District; Quartz Hill Water District; Littlerock Creek Irrigation District; Antelope Valley State Water Contractors Association; City of Palmdale; City of Lancaster; County Sanitation District No. 14 of Los Angeles County; County Sanitation District No. 20 of Los Angeles County; Rosamond Community Services District; and Los Angeles County Waterworks District No. 40; Antelope Valley, have established a Regional Water Management Group by means of a Memorandum of Understanding in accordance with the ACT; and

WHEREAS, The Regional Water Management Group collaboratively prepared an Integrated Regional Water Management Plan for the Antelope Valley, hereinafter referred to as "PLAN," that meets the requirements of the ACT; and

WHEREAS, The Regional Water Management Group solicited and incorporated input from all interested stakeholders in preparation of the PLAN; and

WHEREAS, the adoption of the PLAN is intended to improve the Antelope Valley's competitiveness for State and Federal funding, including grants from Proposition 50, 84, and 1E for all members of the Regional Water Management Group.

NOW, THEREFORE, BE IT RESOLVED, that the Board of Directors for the Littlerock Creek Irrigation District, acting as the governing body, does hereby:

1. Propose to adopt an Integrated Regional Water Management Plan for the Antelope Valley as a member of the Regional Water Management Group; and

2. Determine to adopt and adopt an Integrated Regional Water Management Plan for the Antelope Valley as a member of the Regional Water Management Group.

PASSED, APPROVED AND ADOPTED on January 16, 2008.

Leo Thibault
President

ATTEST:

Frances Young
Secretary

(SEAL)

RESOLUTION NO. 08-03

A RESOLUTION OF THE BOARD OF DIRECTORS OF LITTLEROCK CREEK IRRIGATION DISTRICT APPROVING THE PROPOSAL AND DETERMINATION TO ADOPT A GROUNDWATER MANAGEMENT PLAN FOR THE ANTELOPE VALLEY

WHEREAS, the California Water Code Division 6, Part 2.75, known as the Groundwater Management Planning Act, hereinafter referred to as "ACT," provides the framework for preparation and adoption of groundwater management plans in the Sate; and

WHEREAS, the Antelope Valley-East Kern Water Agency; Palmdale Water District; Quartz Hill Water District; Littlerock Creek Irrigation District; Antelope Valley State Water Contractors Association; City of Palmdale; City of Lancaster; County Sanitation District No. 14 of Los Angeles County; County Sanitation District No. 20 of Los Angeles County; Rosamond Community Services District; and Los Angeles County Waterworks District No. 40; Antelope Valley, have established a Regional Water Management Group by means of a Memorandum of Understanding in accordance with the ACT; and

WHEREAS, The Regional Water Management Group collaboratively prepared a Groundwater Management Plan for the Antelope Valley, hereinafter referred to as "PLAN," that meets the requirements of the ACT; and

WHEREAS, The Regional Water Management Group solicited and incorporated input from all interested stakeholders in preparation of the PLAN; and

WHEREAS, the adoption of the PLAN is intended to improve the Antelope Valley's competitiveness for State and Federal funding, including grants from Proposition 50, 84, and 1E for all members of the Regional Water Management Group.

NOW, THEREFORE, BE IT RESOLVED, that the Board of Directors for the Littlerock Creek Irrigation District, acting as the governing body, does hereby:

1. Determine to adopt and adopt a Groundwater Management Plan for the Antelope Valley as a member of the Regional Water Management Group.

PASSED, APPROVED AND ADOPTED on Janaury 16, 2008.

[signature]
President

ATTEST:

[signature]
Secretary

(SEAL)

MINUTES OF THE BOARD OF SUPERVISORS
COUNTY OF LOS ANGELES, STATE OF CALIFORNIA

Sachi A. Hamai, Executive Officer
Clerk of the Board of Supervisors
383 Kenneth Hahn Hall of Administration
Los Angeles, California 90012

At its meeting held December 4, 2007 the Board acting as the Governing Body of the Los Angeles County Waterworks District No. 40, Antelope Valley, took the following action:

63

At the time and place regularly set, notice having been duly given, the following item was called up:

> Hearing on proposal and determination to adopt an Integrated Regional Water Management Plan and Groundwater Management Plan for the Antelope Valley (5), to provide the framework for local agencies to coordinate programs and projects intended to address regional water supply needs, protect and improve water quality, provide flood management, protect the environment, and establish a data management system to monitor the progress of these objectives; and find that the project is exempt from the California Environmental Quality Act, as further described in the attached letter dated December 4, 2007 from the Chief Executive Officer.

Opportunity was given for interested persons to address the Board. No interested persons addressed the Board. No correspondence was presented.

On motion of Supervisor Knabe, seconded by Supervisor Antonovich, unanimously carried, the hearing was closed and the Board acting as the Governing Body of the Los Angeles County Waterworks District No. 40, Antelope Valley, took the following actions:

1. Made a finding that said action is exempt from the California Environmental Quality Act; and

(Continued on Page 2)

63 (Continued)

2. Determined that no majority protest exists against the adoption of the Groundwater Management Plan; and

3. Adopted the attached resolutions approving the proposal and determination to adopt an Integrated Regional Water Management Plan and the Groundwater Management Plan for the Antelope Valley.

03120407_63

Attachments

Copies distributed:
Each Supervisor
Auditor-Controller
Chief Executive Officer
County Counsel
Director of Public Works

County of Los Angeles
CHIEF EXECUTIVE OFFICE
713 KENNETH HAHN HALL OF ADMINISTRATION
LOS ANGELES, CALIFORNIA 90012
(213) 974-1101
http://ceo.lacounty.gov

WILLIAM T FUJIOKA
Chief Executive Officer

December 4, 2007

The Honorable Board of Supervisors
County of Los Angeles
383 Kenneth Hahn Hall of Administration
500 West Temple Street
Los Angeles, CA 90012

Dear Supervisors:

DEPARTMENT OF PUBLIC WORKS: LOS ANGELES COUNTY WATERWORKS DISTRICT NO. 40, ANTELOPE VALLEY PUBLIC HEARING FOR ADOPTION OF RESOLUTIONS FOR THE PROPOSAL AND DETERMINATION TO ADOPT AN INTEGRATED REGIONAL WATER MANAGEMENT PLAN AND A GROUNDWATER MANAGEMENT PLAN FOR THE ANTELOPE VALLEY (SUPERVISORIAL DISTRICT 5) (3 VOTES)

IT IS RECOMMENDED THAT YOUR BOARD AFTER THE PUBLIC HEARING ACTING AS THE GOVERNING BODY OF THE LOS ANGELES COUNTY WATERWORKS DISTRICT NO. 40, ANTELOPE VALLEY:

1. Find that the proposed action is exempt from the provisions of the California Environmental Quality Act for the reasons cited in this letter.

2. Consider protests to the adoption of the Groundwater Management Plan and determine whether a majority protest exists. If your Board finds that the protests filed represent more than 50 percent of the assessed value of land within the Los Angeles County Waterworks District No. 40, Antelope Valley, deny adoption of the Groundwater Management Plan and refer the matter back to the Department of Public Works. If there is no majority protest, adopt the resolution for the determination to adopt a Groundwater Management Plan for the Antelope Valley.

3. Adopt the resolution for the proposal and determination to adopt an Integrated Regional Water Management Plan.

PURPOSE/JUSTIFICATION OF RECOMMENDED ACTION

The purpose of these actions is to adopt an Integrated Regional Water Management Plan and a Groundwater Management Plan (Plans) for the Antelope Valley.

The Plans were collaboratively prepared by 11 public agencies, including the Los Angeles County Waterworks District No. 40, Antelope Valley (District) in accordance with State guidelines to address regional water supply needs, protect and improve water quality, provide flood management, protect the environment, and establish a data management system to monitor the progress of these objectives. The adoption of the Plans will improve the Antelope Valley's competitiveness for State and Federal grant funds, including those authorized under Propositions 50, 84, and 1E.

Implementation of Strategic Plan Goals

The Countywide Strategic Plan directs that we provide Fiscal Responsibility (Goal 4) and Community Services (Goal 6) by improving the District's competitiveness for State and Federal grant funds and enhancing the reliability of water supply for the District's customers.

FISCAL IMPACT/FINANCING

There will be no impact to the County General Fund.

FACTS AND PROVISIONS/LEGAL REQUIREMENTS

The Integrated Regional Water Management Planning Act of 2002, as codified in California Water Code §10530 through §10546, provides the framework for preparation and adoption of Integrated Regional Water Management Plans in the State. California Water Code §10541(c) requires publication of a notice of intention to adopt an Integrated Regional Water Management Plan (IRWMP) in accordance with Government Code §6066 if three or more participants in the group propose to adopt the IRWMP. Additionally, California Water Code §10541(d) requires a determination to adopt the IRWMP after holding a public hearing.

The Groundwater Management Act, as codified in California Water Code §10750 through §10756, provides the framework for preparation and adoption of Groundwater Management Plan in the State. California Water Code §10753.5(a) requires that a local agency hold a public hearing to determine to adopt the Groundwater Management Plan. After the public hearing, the local agency shall consider protests to the adoption of the plan and determine whether a majority protest exists. Pursuant to California Water

Code §10753.6(b), the local agency must compare the names and property descriptions on the protests against the property ownership records of the County Assessors. If your Board finds that the protests filed represent more than 50 percent of the assessed value of land within the District, deny adoption of the Groundwater Management Plan and refer the matter back to Public Works. If there is no majority protest, adopt the resolution for the determination to adopt a Groundwater Management Plan for the Antelope Valley.

ENVIRONMENTAL DOCUMENTATION

The proposed action is to adopt plans collaboratively prepared by 11 public agencies including the District, in accordance with State guidelines to address regional water supply needs, protect and improve water quality, provide flood management, protect the environment, and establish a data management system to monitor the progress of these objectives. It involves only feasibility or planning studies for possible future actions, which your Board has not approved, adopted, or funded. The Plans will not have a legally binding effect on later activities and, therefore, their adoption is exempt from the California Environmental Quality Act pursuant to Section 15262 of the California Environmental Quality Act Guidelines.

IMPACT ON CURRENT SERVICES (OR PROJECTS)

The adoption of the Plans will improve the District's competitiveness for State and Federal grant funds to improve the reliability of water supply for the District's customers.

There will be no impact on current County services or projects as a result of this action.

CONCLUSION

Upon approval, please return one adopted copy of this letter and the attached resolutions to the Department of Public Works, Waterworks Division.

Respectfully submitted,

WILLIAM T FUJIOKA
Chief Executive Officer

WTF:DLW
AA:cr

Attachments (2)

c: County Counsel

A RESOLUTION OF THE BOARD OF SUPERVISORS OF THE COUNTY OF LOS ANGELES, CALIFORNIA, ACTING AS THE GOVERNING BODY OF THE LOS ANGELES COUNTY WATERWORKS DISTRICT NO. 40, ANTELOPE VALLEY, APPROVING THE PROPOSAL AND DETERMINATION TO ADOPT A GROUNDWATER MANAGEMENT PLAN FOR THE ANTELOPE VALLEY

WHEREAS, the California Water Code Division 6, Part 2.75, known as the Groundwater Management Planning Act, hereinafter referred to as "ACT," provides the framework for preparation and adoption of groundwater management plans in the State; and

WHEREAS, the Antelope Valley-East Kern Water Agency; Palmdale Water District; Quartz Hill Water District; Littlerock Creek Irrigation District; Antelope Valley State Water Contractors Association; City of Palmdale; City of Lancaster; County Sanitation District No. 14 of Los Angeles County; County Sanitation District No. 20 of Los Angeles County; Rosamond Community Services District; and Los Angeles County Waterworks District No. 40; Antelope Valley, have established a Regional Water Management Group by means of a Memorandum of Understanding in accordance with the ACT; and

WHEREAS, the Regional Water Management Group collaboratively prepared a Groundwater Management Plan for the Antelope Valley, hereinafter referred to as "PLAN," that meets the requirements of the ACT; and

WHEREAS, the Regional Water Management Group solicited and incorporated input from all interested stakeholders in preparation of the PLAN; and

WHEREAS, the adoption of the PLAN is intended to improve the Antelope Valley's competitiveness for State and Federal funding, including grants from Propositions 50, 84, and 1E for all members of the Regional Water Management Group.

NOW, THEREFORE, BE IT RESOLVED, that the Board of Supervisors of the County of Los Angeles, acting as the governing body of Los Angeles County Waterworks District No. 40, Antelope Valley, does hereby:

1. Determine to adopt and adopt a Groundwater Management Plan for the Antelope Valley as a member of the Regional Water Management Group.

The foregoing Resolution was adopted on the 4th day of December, 2007, by the Board of Supervisors of the County of Los Angeles acting as the governing body of the Los Angeles County Waterworks District No. 40, Antelope Valley.

SACHI A. HAMAI
Executive Officer of the
Board of Supervisors of the
County of Los Angeles

By ____________________
Deputy

APPROVED AS TO FORM:

RAYMOND G. FORTNER, JR.
County Counsel

By ____________________
Deputy
Frederick W. Pfaeffle

A RESOLUTION OF THE BOARD OF SUPERVISORS OF THE COUNTY OF LOS ANGELES, CALIFORNIA, ACTING AS THE GOVERNING BODY OF THE LOS ANGELES COUNTY WATERWORKS DISTRICT NO. 40, ANTELOPE VALLEY, APPROVING THE PROPOSAL AND DETERMINATION TO ADOPT AN INTEGRATED REGIONAL WATER MANAGEMENT PLAN FOR THE ANTELOPE VALLEY

WHEREAS, the California Water Code Division 6, Part 2.2, known as the Integrated Regional Water Management Planning Act of 2002, hereinafter referred to as "ACT," provides the framework for preparation and adoption of integrated regional water management plans; and

WHEREAS, the Antelope Valley-East Kern Water Agency; Palmdale Water District; Quartz Hill Water District; Littlerock Creek Irrigation District; Antelope Valley State Water Contractors Association; City of Palmdale; City of Lancaster; County Sanitation District No. 14 of Los Angeles County; County Sanitation District No. 20 of Los Angeles County; Rosamond Community Services District; and Los Angeles County Waterworks District No. 40; Antelope Valley, have established a Regional Water Management Group by means of a Memorandum of Understanding in accordance with the ACT; and

WHEREAS, the Regional Water Management Group collaboratively prepared an Integrated Regional Water Management Plan, hereinafter referred to as "PLAN," that meets the requirements of the ACT; and

WHEREAS, the Regional Water Management Group solicited and incorporated input from all interested stakeholders in preparation of the PLAN; and

WHEREAS, the adoption of the PLAN is intended to improve the Antelope Valley's competitiveness for State and Federal funding, including grants from Propositions 50, 84, and 1E for all members of the Regional Water Management Group.

NOW, THEREFORE, BE IT RESOLVED, that the Board of Supervisors of the County of Los Angeles, acting as the governing body of Los Angeles County Waterworks District No. 40, Antelope Valley, does hereby:

1. Propose to adopt an Integrated Regional Water Management Plan for the Antelope Valley as a member of the Regional Water Management Group; and

2. Determine to adopt and adopt an Integrated Regional Water Management Plan for the Antelope Valley as a member of the Regional Water Management Group.

The foregoing Resolution was adopted on the 4TH day of December, 2007, by the Board of Supervisors of the County of Los Angeles acting as the governing body of the Los Angeles County Waterworks District No. 40, Antelope Valley.

SACHI A. HAMAI
Executive Officer of the
Board of Supervisors of the
County of Los Angeles

By ______________________
Deputy

APPROVED AS TO FORM:

RAYMOND G. FORTNER, JR.
County Counsel

By ______________________
Deputy
Frederick W. Pfaeffle

PALMDALE WATER DISTRICT
RESOLUTION 08-1

RESOLUTION OF THE GOVERNING BOARD OF THE PALMDALE WATER DISTRICT APPROVING THE PREPARATION OF AND ADOPTING AN INTEGRATED REGIONAL WATER MANAGEMENT PLAN FOR THE ANTELOPE VALLEY

WHEREAS, the California Water Code Division 6, Part 2.2, known as the Integrated Regional Water Management Planning Act of 2002, hereinafter referred to as "ACT," provides the framework for preparation and adoption of integrated regional water management plans; and

WHEREAS, the Antelope Valley-East Kern Water Agency; Palmdale Water District; Quartz Hill Water District; Littlerock Creek Irrigation District; Antelope Valley State Water Contractors Association; City of Palmdale; City of Lancaster; County Sanitation District No. 14 of Los Angeles County; County Sanitation District No. 20 of Los Angeles County; Rosamond Community Services District; and Los Angeles County Waterworks District No. 40; Antelope Valley, have established a Regional Water Management Group by means of a Memorandum of Understanding in accordance with the ACT; and

WHEREAS, the Regional Water Management Group collaboratively prepared an Integrated Regional Water Management Plan, hereinafter referred to as "PLAN," that meets the requirements of the ACT; and

WHEREAS, the Regional Water Management Group solicited and incorporated input from all interested stakeholders in preparation of the PLAN; and

WHEREAS, the adoption of the PLAN is intended to improve the Antelope Valley's competitiveness for State and Federal funding, including grants from Propositions 50, 84, and 1E for all members of the Regional Water Management Group; and

WHEREAS, the adoption of the PLAN is exempt from the California Environmental Quality Act under section 15262 of the guidelines as a project involving only feasibility or planning studies for possible future actions; and

NOW, THEREFORE, BE IT RESOLVED, that the Board of Directors of the Palmdale Water District does hereby:

1. Propose to adopt an Integrated Regional Water Management Plan for the Antelope Valley as a member of the Regional Water Management Group; and

2. Determine to adopt and adopt an Integrated Regional Water Management Plan for the Antelope Valley as a member of the Regional Water Management Group.

PASSED AND ADOPTED on this 23rd day of January, 2008, by the Board of Directors, the governing body of the Palmdale Water District.

PALMDALE WATER DISTRICT

____

Richard D. Wells,

President

ATTEST: JEFF A. STORM

Assistant Secretary: ____________________

PALMDALE WATER DISTRICT
RESOLUTION 08-2

RESOLUTION OF THE GOVERNING BOARD OF THE PALMDALE WATER DISTRICT APPROVING THE PREPARATION OF AND ADOPTING A GROUNDWATER MANAGEMENT PLAN FOR THE ANTELOPE VALLEY

WHEREAS, the California Water Code Division 6, Part 2.75, known as the Groundwater Management Planning Act, hereinafter referred to as "ACT," provides the framework for preparation and adoption of groundwater management plans in the State; and

WHEREAS, the Antelope Valley-East Kern Water Agency; Palmdale Water District; Quartz Hill Water District; Littlerock Creek Irrigation District; Antelope Valley State Water Contractors Association; City of Palmdale; City of Lancaster; County Sanitation District No. 14 of Los Angeles County; County Sanitation District No. 20 of Los Angeles County; Rosamond Community Services District; and Los Angeles County Waterworks District No. 40; Antelope Valley, have established a Regional Water Management Group by means of a Memorandum of Understanding in accordance with the ACT; and

WHEREAS, the Regional Water Management Group collaboratively prepared a Groundwater Management Plan for the Antelope Valley, hereinafter referred to as "PLAN," that meets the requirements of the ACT; and

WHEREAS, the Regional Water Management Group solicited and incorporated input from all interested stakeholders in preparation of the PLAN; and

WHEREAS, the adoption of the PLAN is intended to improve the Antelope Valley's competitiveness for State and Federal funding, including grants from Propositions 50, 84, and 1E for all members of the Regional Water Management Group; and

WHEREAS, the adoption of the PLAN is exempt from the California Environmental Quality Act under section 15262 of the guidelines as a project involving only feasibility or planning studies for possible future actions; and

NOW, THEREFORE, BE IT RESOLVED, that the Board of Directors of the Palmdale Water District does hereby:

1. Determine to adopt and adopt a Groundwater Management Plan for the Antelope Valley as a member of the Regional Water Management Group.

PASSED AND ADOPTED on this 23rd day of January, 2008, by the Board of Directors, the governing body of the Palmdale Water District.

PALMDALE WATER DISTRICT

Richard D. Wells,
President

ATTEST: JEFF A. STORM

Assistant Secretary: ____________________

ROSAMOND COMMUNITY SERVICES DISTRICT
RESOLUTION NO. 2008-10

A RESOLUTION OF THE BOARD OF DIRECTORS OF THE ROSAMOND COMMUNITY SERVICES DISTRICT APPROVING THE PROPOSAL AND DETERMINATION TO ADOPT AN INTEGRATED REGIONAL WATER MANAGEMENT PLAN

WHEREAS, the California Water Code Division 6, Part 2.2, known as the Integrated Regional Water Management Planning Act of 2002, hereinafter referred to as "ACT," provides the framework for preparation and adoption of integrated regional water management plans; and

WHEREAS, the Antelope Valley-East Kern Water Agency; Palmdale Water District; Quartz Hill Water District; Littlerock Creek Irrigation District; Antelope Valley State Water Contractors Association; City of Palmdale; City of Lancaster; County Sanitation District No. 14 of Los Angeles County; County Sanitation District No. 20 of Los Angeles County; Rosamond Community Services District; and Los Angeles County Waterworks District No. 40; Antelope Valley, have established a Regional Water Management Group by means of a Memorandum of Understanding in accordance with the ACT; and

WHEREAS, the Regional Water Management Group collaboratively prepared an Integrated Regional Water Management Plan, hereinafter referred to as "PLAN," that meets the requirements of the ACT; and

WHEREAS, the Regional Water Management Group solicited and incorporated input from all interested stakeholders in preparation of the PLAN; and

WHEREAS, the adoption of the PLAN is intended to improve the Antelope Valley's competitiveness for State and Federal funding, including grants from Propositions 50, 84, and 1E for all members of the Regional Water Management Group.

NOW, THEREFORE, BE IT RESOLVED, Board of Directors of the Rosamond Community Services District , **does hereby:**

1. Propose to adopt an Integrated Regional Water Management Plan for the Antelope Valley as a member of the Regional Water Management Group; and

2. Determine to adopt and adopt an Integrated Regional Water Management Plan for the Antelope Valley as a member of the Regional Water Management Group.

PASSED AND ADOPTED at the regular meeting of the Board of Directors of the Rosamond Community Services District held this 9th day of January, 2008.

By: ______________________________
President, Board of Directors
Rosamond Community Services District

ATTEST:

By: ______________________________
Secretary, Board of Directors
Rosamond Community Services District

Attachment 3
Work Plan

Littlerock Reservoir Sediment Removal Project

Attachment 3

Stormwater Flood Management Grant Proposal
Littlerock Reservoir Sediment Removal Project
Work Plan

Attachment 3 consists of the following items:

- ✓ **Work Plan.** Attachment 3 contains detailed information regarding the tasks that were and will be performed for the proposed project.

Introduction

Background

The Littlerock Reservoir Sediment Removal (LRSR) Project is proposed by Palmdale Water District (PWD) in partnership with the Angeles National Forest (ANF), U.S. Department of Agriculture Forest Service (USFS) and Littlerock Creek Irrigation District (LCID). Since 1922, PWD has shared water from the Littlerock Reservoir (Reservoir) with LCID. PWD and LCID jointly hold long-standing water rights to divert 5,500 AFY from Littlerock Creek flows per an agreement between the two districts. LCID has not exercised its right to surface water diversions since 1994.[1]

The Reservoir is a man-made feature formed by the impoundment of water by the Littlerock Dam, constructed in 1924. The Reservoir serves as a source of water supply storage, provides flood protection and debris control for downstream areas, provides habitat for endangered species, and serves as a recreational use area. Littlerock Creek, which supplies water to the Reservoir, is a perennial stream supported by annual rainfall and snowmelt from the nearby slope of Mount Williamson. Inflow to Littlerock Reservoir is seasonal and varies widely from year to year depending on stream flows and snow melt from the ANF. An average dry year can yield approximately 3,500 acre-feet per year (AFY) of water supply from the Reservoir. Currently, PWD is authorized to divert approximately 5,500 AFY of water.

The initial design capacity[2] of the Reservoir was 4,300 acre-feet (AF); however, this capacity has been substantially reduced over time by the deposition of sediment behind Littlerock Dam. By 1991, the capacity of the Reservoir had been reduced to approximately 1,600 AF. As a result, in 1992 the height of Littlerock Dam was raised to increase the Reservoir capacity by approximately 1,723 AF. The current Reservoir storage capacity is estimated at 2,765 AF (see Attachment 7). As average seasonal inflow to the Reservoir is approximately 3,500 AFY, flows during winter rainy seasons quickly fill the Reservoir and overtop Littlerock Dam. Calculations conducted by PWD indicate the Reservoir capacity is further reduced by siltation at an annual rate of approximately 54,000 cubic yards of sediment amounting to a loss of approximately 35 AFY of water[3].

[1] *Diversions from Littlerock Reservoir*, PWD, August 2012.
[2] Woodward-Clyde, 1992. *Littlerock Dam and Reservoir Restoration Project Feasibility Report*. September 1992.
[3] Aspen Environmental Group. 2012. *DRAFT Littlerock Reservoir Sediment Removal Project Description of Proposed Action*. June 2012.

Description

The LRSR Project proposes to restore the capacity of the reservoir to 3,325 AF through removal of 900,000 net cubic yards (equivalent to 560 AF) of accumulated sediment behind the Littlerock Dam. In addition, the LRSR Project proposes to construct a grade control structure that will prevent sediment loss and headcutting upstream of the Reservoir beyond Rocky Point to protect and preserve habitat for the federally endangered arroyo toad.

PWD intends to partner with the USFS to ensure that the proposed LRSR Project considers downstream stakeholders and focuses on developing methods to ensure that the National Forest System Lands within the Antelope Valley Watershed are sustainably maintained and continue to provide high quality water for all beneficial uses. These factors illustrate the forests' vital significance to the overall health of the water resources within the watershed. The LRSR Project would contribute to the overall health and sustainability of the Antelope Valley Watershed by increasing water supply capacity, reducing sediment accumulation, reducing flood damages, preserving endangered species habitat, and ensuring a potable water source with optimum water quality. PWD and the USFS have entered into a Memorandum of Understanding that is the first step in integrating forest management practices with interests of downstream water users (a copy of the MOU is included at the end of this attachment).

Water Supply

Littlerock Reservoir is a critical water supply asset for PWD. Approximately 60 percent of potable water supply for PWD's customers comes from imported and local surface water. Surface water supplies are primarily made up of State Water Project (SWP) and supplemented with local surface water from the Reservoir. Surface water from the Reservoir is conveyed through an 8.5-mile ditch to Palmdale Lake and eventually treated at PWD's 35-mgd water treatment plant for potable use. However, with the increasing variability of SWP deliveries, PWD has been relying more on the Reservoir to supplement water demands. This Project will offset imported water supplies from the SWP, improve local surface water quality, and reduce treatment needs for water supply. The removal of 900,000 net cubic yards of sediment (as described under the **Flood Control** section below) would increase the Reservoir capacity to a minimum total of 3,325 AF and provide an additional 560 AF of storage capacity that could be delivered as potable supply to customers each year.

Flood Control

The Project will restore debris control and flood peak attenuation capability provided by Littlerock Dam and Reservoir (shown in Figure 3-1) by removing 900,000 net cubic yards of sediment to achieve a capacity of 3,325 AF. Estimates show that approximately 54,000 cubic yards of sediment are deposited into the Reservoir annually from seasonal inflow. The project would remove a minimum of 900,000 net cubic yards of sediment during a 5-year closure of the Reservoir. The LRSR Project would increase the flood control capacity at the Reservoir by a minimum of 560 AF.

Figure 3-1: Littlerock Dam

Source: http://www.littlerockdam.org/

Flood Insurance Rate Maps (FIRM)[4] for the community of Palmdale indicate that downstream communities are situated on the alluvial floodplain of the Antelope Valley. Consequently, the type of flooding experienced is typical of that experienced by communities developed on alluvial fans. Flood flows discharge from the mountainous canyons onto the desert floor, where, due to the lack of well-incised streambeds, it spreads out in uncontrolled patterns. Flood discharges have overflowed in normally dry streambeds, resulting in heavy damage as floodwaters pass through developed areas. During the period of comparatively recent record, floods of major proportions have occurred. The office of the Los Angeles County Engineer has identified the areas in which moderate to severe flooding was observed during the heavy storms of 1938, 1965, 1969, 1978, 1980, 1983, 1994 on flood overflow maps. Flooding from Little Rock Creek was experienced in the eastern portion of the city. During these floods, widespread damage to orchards, irrigation systems, buildings, and roads occurred.[5]

Water Quality

State Water Project (SWP) water supplies used by PWD contain total dissolved solids (TDS) or salts. When imported water is used in the Antelope Valley watershed, those salts, nutrients, and other constituents remain in the watershed. By avoiding SWP water imports, the use of Littlerock Creek water effectively avoids importing salts to the Antelope Valley. This is a key concern in the ongoing development of a Salt and Nutrient Management Plan for the Valley.

[4] Flood Insurance Rate Maps (FIRM), Community: Palmdale, City/Los Angeles CO, Panel #'s: 06037C0694F, 06037C0711F, 06037C0442F, and 06037C0450F. Effective Date: September 26, 2008.

[5] Flood Insurance Rate Maps (FIRM), Community: Palmdale, City/Los Angeles CO, Panel #'s: 06037C0694F, 06037C0711F, 06037C0442F, and 06037C0450F. Effective Date: September 26, 2008.

SWP water also contains higher levels of bromide, both of which are of concern in drinking water. Bromide combines with chemicals used in the water treatment process to form disinfection byproducts (DBPs) such as trihalomethanes (THMs) that are strictly regulated under the Federal Safe Drinking Water Act. PWD treats all its water to meet stringent state and federal drinking water standards before delivering it to its customers. However, source water of lower quality will make it increasingly expensive and difficult to meet such standards. Increased levels of constituents that could aid in the formation of THMs can mean more time spent monitoring treated water in the distribution systems and may lead to the use of increased proportions of blend water supplies in order to control THMs. The LRSR Project would offset the demand for SWP Imported water with local surface water supply that contains less bromide.

Protection of Local Habitat and Wildlife

Littlerock Creek, which feeds the Reservoir, provides habitat for the federally endangered arroyo toad (*Bufo californicus*), shown in Figure 3-2. Previous plans for sediment removal from the Reservoir posed potential risks for “take” of arroyo toad and degradation of arroyo toad habitat upstream of the Reservoir beyond the Rocky Point area. The LRSR project proposes to construct a soil cement grade control structure at Rocky Point to prevent sediment loss and headcutting of the stream channel upstream of Rocky Point. This grade control structure will minimize the degradation of critical habitat for and incidental “take” of the federally-endangered arroyo toad. In addition, the grade control structure would act as a barrier between human activities (i.e., recreation activities, sediment removal activities, etc.) within the Reservoir and the arroyo toad’s habitat upstream of Rocky Point. Protection of the arroyo toad is also consistent with USFS Strategy WL 1 (Threatened, Endangered, Proposed, Candidate, and Sensitive Species Management) which is a standard practice advocated by USFS.

Figure 3-2: Arroyo Toad (*Bufo californicus*)

Source: Chris Brown

The grade control structure design would consist of a permanent structure of soil cement and would be constructed as a cascading (i.e., stair-step) structure with a series of steep drops of approximately 4-feet each with 15-foot horizontal aprons downstream of each drop, extending to a total depth of up to 70 feet below the existing ground surface. The structure would be constructed below grade, and once backfilled, only the top or upper lip of the structure would be visible when the Reservoir water level is lowered. When the Reservoir is full it would contain water beyond the Rocky Point area and any portion of the grade control structure at the Reservoir bottom grade would be submerged and not visible.

Energy and Greenhouse Gas Emissions

By offsetting imported water demands with local surface water, the proposed Project would reduce energy consumption and greenhouse gas (GHG) emissions generated by transporting and treating imported SWP water to southern California. The long-distance transport of water in conveyance systems consumes a significant portion of California's total electricity demand. The SWP, is the largest consumer of electrical energy in the California, requiring an average of 5 billion kWh per year (2 to 3 percent of all electricity consumed in California)[6], and contributes 0.6% of California's total GHG emissions. [7] By offsetting the demand of 560 AF of imported SWP water, the proposed Project will reduce energy consumption and reduce emissions of CO_2 equivalents.

Project Partners

The PWD is the lead implementing agency and CEQA agency for the LRSR Project. In addition, the following partners are participating in the Project:

- USFS, ANF – is an agency of the U.S. Department of Agriculture and manages public lands in national forests and grasslands; serves as the land manager, the NEPA lead agency, and the agency responsible for issuing a Special Use Authorization for the LRSR Project.

- LCID – LCID's service area comprises of approximately 17 square miles within the southeastern region of the Antelope Valley. LCID receives raw water from SWP, local surface water from Littlerock Reservoir and pumps groundwater. LCID participates in a joint use agreement with PWD for shared use of the Littlerock Dam for treated water (copy of LCID support letter is included at the end of this attachment).

Goals and Objectives

The goals of the Project are to (1) restore the ability of PWD to store potable water supply in the Reservoir, (2) offset less reliable imported water supplies with more reliable local water supplies to help reduce reliance through Delta water transfers from the SWP, (3) provide debris control and peak flood attenuation at Littlerock Dam, (4) preserve habitat for federally endangered species, (5) improve water quality for PWD customers, (6) decrease the introduction of imported salts into the Antelope Valley, (7) reduce energy consumption, (8) reduce greenhouse gas emissions.

The specific objectives the Project seeks to achieve are:

- Restore the ability of PWD to store potable supply water in the Reservoir and offset imported supplies by removing 900,000 net cubic yards (560 AF) of accumulated silt starting in the year 2019.
- Maintain the level of debris control and flood peak attenuation provided by Littlerock Dam and Reservoir by removing 900,000 net cubic yards (560 AF) of accumulated silt starting in the year 2019.

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[6] Natural Resources Defenses Council (NRDC). 2004. Energy Down The Drain – The Hidden Costs of California's Water Supply. August 2004. Available: http://www.circleofblue.org/waternews/wp-content/uploads/2010/08/energy_down_the_drain.pdf

[7] Snow, Lester A. Department of Water Resources addressed to Senator Don Perata. April 2007.

- Preserve habitat for the federally endangered arroyo toad, and incidental "take" of the arroyo toad, by constructing a grade control structure to prevent sediment loss and headcutting of the stream channel upstream of Rocky Point starting in the year 2016.
- Decrease the amount of imported Total Dissolved Solids (TDS) introduced into the Antelope Valley by offsetting 560 AFY of imported water (contains a TDS loading that did not originate in the Antelope Valley) starting in the year 2019.
- Improve water quality for the constituent bromide (which contributes to the creation of DBPs) by replacing lower quality imported water with higher quality local surface water starting in the year 2019.
- Reduce energy consumption by offsetting 560 AFY of water imported from the SWP.
- Reduce greenhouse gas emissions by offsetting 560 AFY of water imported from the SWP.

IRWM Plan Consistency

PWD adopted the Antelope Valley 2007 IRWM Plan in 2007 and is an active participant in the Antelope Valley 2013 IRWM Plan update. The LRSR Project is one of the identified high priority projects in the Antelope Valley 2007 IRWM Plan, Section 7 that will aid in meeting the IRWM Region's goals and objectives. Table 3-1 highlights the Antelope Valley's 2007 IRWM Plan goals along with the respective objectives designed to achieve these goals.

Table 3-1: Antelope Valley IRWM Plan Goals and Objectives

IRWM Plan Objective		Primary IRWM Plan Goals Implemented by Objective		
		Goal 1: Municipal and industrial (M&I) purveyors reliably provide the quantity and the quality of water that will be demanded by a growing population	Goal 2: Satisfy agricultural users' demand for reliable irrigation water supplies at a reasonable cost	Goal 3: Protect and enhance current water resources (including groundwater) and the other environmental resources within the Antelope Valley Region
A	Provide reliable water supply to meet the Antelope Valley Region's expected demand between now and 2035	●	●	
B	Establish a contingency plan to meet water supply needs of the Antelope Valley Region during a plausible disruption of SWP water deliveries	●	●	
C	Stabilize groundwater levels at current conditions		●	●
D	Provide drinking water that meets customer expectations	●		
E	Protect aquifer from contamination	●		●
F	Protect natural streams and recharge areas from contamination	●		●
G	Maximize beneficial use of recycled water	●		
H	Reduce negative impacts of stormwater, urban runoff, and nuisance water			●
I	Preserve open space and natural habitats that protect and enhance water resources and species in the Antelope Valley Region			●
J	Maintain agricultural land use within the Antelope Valley Region		●	●
K	Meet growing demand for recreational space			●
L	Improve integrated land use planning to support water management	●		●

● IRWM Plan goal targeted by Plan objective

The LRSR Project will be consistent with six of twelve Antelope Valley IRWM Plan objectives. Table 3-2 below provides an overview of the Antelope Valley IRWM Plan objectives that are expected to be directly (●) achieved through implementation of the project.

Table 3-2: Contribution to IRWM Plan Objectives

Proposal Projects	Contribution to IRWM Plan Objectives											
	A	B	C	D	E	F	G	H	I	J	K	L
Littlerock Reservoir Sediment Removal Project	●	●		●		●		●	●			

● achieved through implementation of the Project

This project contributes to the Antelope Valley IRWM Plan objectives in the following ways:

- **Objective A** – *Provide a reliable water supply to meet the Antelope Valley Region's expected demand between now and 2035*: by sediment removal behind Littlerock Dam which would increase the local surface water storage capacity at the Reservoir aiding the region in meeting its water supply needs.
- **Objective B** – *Establish a contingency plan to meet water supply needs of the Antelope Valley Region during a plausible disruption of SWP water deliveries*: by restoring the water storage capacity of the Reservoir and continue providing a reliable stream of water supply if future SWP disruptions occur.
- **Objective D** – *Provide drinking water that meets customer expectations*: by offsetting imported water supplies with local water supplies. SWP imported water contains a higher concentration of bromide, a disinfection byproduct (DBP) precursor, compared to local surface water.
- **Objective F** – *Protection of natural streams and recharge areas from contamination*: by constructing a grade control structure to minimize sediment loss and headcutting of the Littlerock Creek stream channel.
- **Objective H** – *Reduce negative impacts of stormwater, urban runoff, and nuisance water*: by restoring the capacity for flood control at the Reservoir to prevent downstream flooding.
- **Objective I** – *Preserve open space and natural habitats that protect and enhance water resources and species in the Antelope Valley Region*: by constructing a grade control structure to prevent headcutting and sediment removal in the upstream channel helping to preserve critical habitat for the federally endangered arroyo toad.

Purpose and Need

The LRSR Project is needed to help the Region offset SWP water with local water supplies. Restoring water storage capacity of the Reservoir by removing accumulated sediment would allow PWD to increase water storage capacity while maintaining flood protection.

The purpose of the LRSR Project is to restore surface water storage capacity at Littlerock Reservoir through sediment removal, restore flood control capacity, prevent degradation of the federally endangered arroyo toad critical habitat and incidental "take" of the arroyo toad, improve water quality of drinking water for PWD customers, and reduce energy consumption and GHG emissions.

Project Specifics

Table 3-3 provides an abstract of the proposed project, the current status of the project, implementing agency, the site specific geographic location, and the project's stormwater component, and its relation to the State Plan Flood Control.

Table 3-3: LRSR Project Specifics

Project	Description	
Littlerock Reservoir Sedimentation Removal Project	*Abstract:*	The Littlerock Reservoir Sediment Removal Project will remove 900,000 net cubic yards of sediment that has accumulated from runoff behind Littlerock Dam. The Project will also include a grade control structure that will protect the identified critical habitat of the federally-endangered arroyo toad. The project is expected to increase the flood control and water storage capacity, and reliability of surface water storage in Littlerock Reservoir.
	Status:	Pre-Design Phase
	Implementing Agency:	Palmdale Water District
	Location:	The project is located ten miles southeast of the City of Palmdale and four miles south of the Littlerock Community within the Antelope Valley IRWM boundary.
	Storm water Conveyance:	The project will increase capacity for flood control at the Reservoir through the removal of sediment behind the Littlerock Dam.
	State Plan for Flood Control:	The project is not part of the State-federal flood protection system (SPFC) in the Central Valley.

Integrated Elements of Project

This Project will be integrated with two other planned projects in the Littlerock Creek floodplain:

- *Littlerock Creek In-River Spreading Grounds* - Led by the Los Angeles County Department of Public Works and County Supervisorial District 5, this project proposes to develop a spreading ground facility in Littlerock Creek near the San Gabriel Mountain foothills in order to increase groundwater recharge. The facility will include earthen levees in and adjacent to the creek to capture and recharge stormwater from the creek into the groundwater basin. The design phase and environmental documents could be completed in approximately 16 months and the construction phase would follow in approximately 12 months. The preliminary cost estimate is $4 million and the County is seeking partnerships with local agencies. This project would be located downstream from the LRSR Project and is integrated with the LRSR Project due to the shared objectives of increasing local surface water supplies, water supply reliability, flood protection, and water quality in the Region.

- *Littlerock Creek Groundwater Recharge and Recovery Project (LCGRRP)* - Led by PWD, the LCGRRP is the largest of four recharge projects included in PWD's 2010 Strategic Water Resources Plan. It proposes to construct off-channel basins and in-stream recharge facilities to recharge approximately 43,000 AFY; it also includes an adjacent wellfield to recover approximately 14,000 AFY. Sources of recharge water include imported, stormwater, and eventually recycled water. Imported water would be conveyed from the California Aqueduct for recharge when available. This project would be located downstream from the LRSR Project and is integrated with the LRSR Project due to the shared objectives of increasing local surface water supplies, water supply reliability, flood protection, and water quality in the Region.
- *USFS Forest Management Program* – Though not included in the LRSR Project at this time, PWD intends to partner with the USFS in the future to implement forest management practices that consider downstream stakeholders and focus on developing methods to ensure that the National Forest System Lands within Antelope Valley Watershed are sustainably maintained and continue to provide high quality water for all beneficial uses. These factors illustrate the forests' vital significance to the overall health of the water resources within the watershed. The LRSR Project would contribute to the overall health and sustainability of the Antelope Valley Watershed by increasing water supply capacity, reducing sediment accumulation, reducing flood damages, preserving endangered species habitat, and ensuring a potable water source with optimum water quality. PWD and the USFS have entered into a Memorandum of Understanding that is the first step in integrating forest management practices with interests of downstream water users.

Completed Work

Work that has not yet been completed but is expected to be completed prior to the grant award date includes:

- CEQA Notice of Preparation (NOP) of an EIR
- NEPA Notice of Intent (NOI) to prepare an EIS
- Excavation Plans
- Conceptual Design Plans

Existing Data and Studies

Several studies have been prepared in support of this project's site location, feasibility and technical methods. These include:

- *DRAFT Littlerock Reservoir Sediment Removal Project Biological Resources Technical Report* was prepared by Aspen Environmental Group in October 2012. The Biological Technical Report serves as the basis for: the environmental analysis of biological resources in the EIR/EIS; and the federally required Biological Assessment and subsequent Biological Opinion of the U.S. Fish and Wildlife Service (see Appendix A).

- *DRAFT Littlerock Reservoir Sediment Removal Project 1st Administrative Environmental Impact Report/Environmental Impact Statement (EIR/EIS)* was prepared by Aspen Environmental Group in April 2007. The finalized EIR will be available by June 2014.

- *Geotechnical Investigation, Data Collection, and Survey Memoranda* was prepared by Aspen Environmental Group in July 2007. The memorandum addresses the proposed grade control structure and the following components: geotechnical investigation, survey and topography, excavation grading plan, grade control materials and location, and grade control concept details (see Appendix B).

- *Preliminary Dredging/Slurry Feasibility Analysis for Excavation of Littlerock Reservoir* was prepared by Aspen Environmental Group in September 2007. The study presents a preliminary dredging/slurry feasibility analysis to provide a brief overview of the general feasibility and cost of excavating the Littlerock Reservoir using a dredge and slurry operation. This preliminary evaluation was done as an early decision-making tool for slurry excavation versus truck excavation.

- *Littlerock Reservoir Hydrologic and Sediment Transport Analysis Technical Report* was prepared by Aspen Environmental Group in June 2005. The Hydrologic and Sediment Transport Analysis Technical Report establishes the need for the project by describing the rate of sediment accumulation at the reservoir and the need for its removal to restore capacity (see Appendix C).

Project Timing and Phasing

The LRSR Project is not part of a multi-phased project. The LRSR Project will commence Project Administration tasks once the grant funding agreement between PWD and the State of California, DWR has been signed. Project construction is scheduled to begin in the 4th quarter of 2015 (October 2015) and end by the 4th quarter of 2019 (October 2019). See Attachment 5 Schedule for a detailed project schedule.

Project Maps

The Littlerock Reservoir is located on Littlerock Creek in the northeastern foothills of the San Gabriel Mountains on the western edge of the Mojave Desert, within the boundaries of the Santa Clara Mojave Rivers Ranger District of the ANF of the City of Palmdale and four miles south of the community of Littlerock in the northern Los Angeles County area. Figure 3-3 illustrates the regional vicinity and the project site location. Figure 3-4 provides a closer look at the project site. Figure 3-5 provides an illustration of the proposed grade control structure. Figure 3-6 is a side profile illustration of the grade control structure. Figure 3-7 provides a visual simulation of the surface grade control structure. Figure 3-8 highlights the project construction zones at and around Littlerock Reservoir. Figure 3-9 outlines the canyon boundary that will be used to dispose of the sediment removed from Littlerock Creek Reservoir.

Figure 3-3: Project Location Map

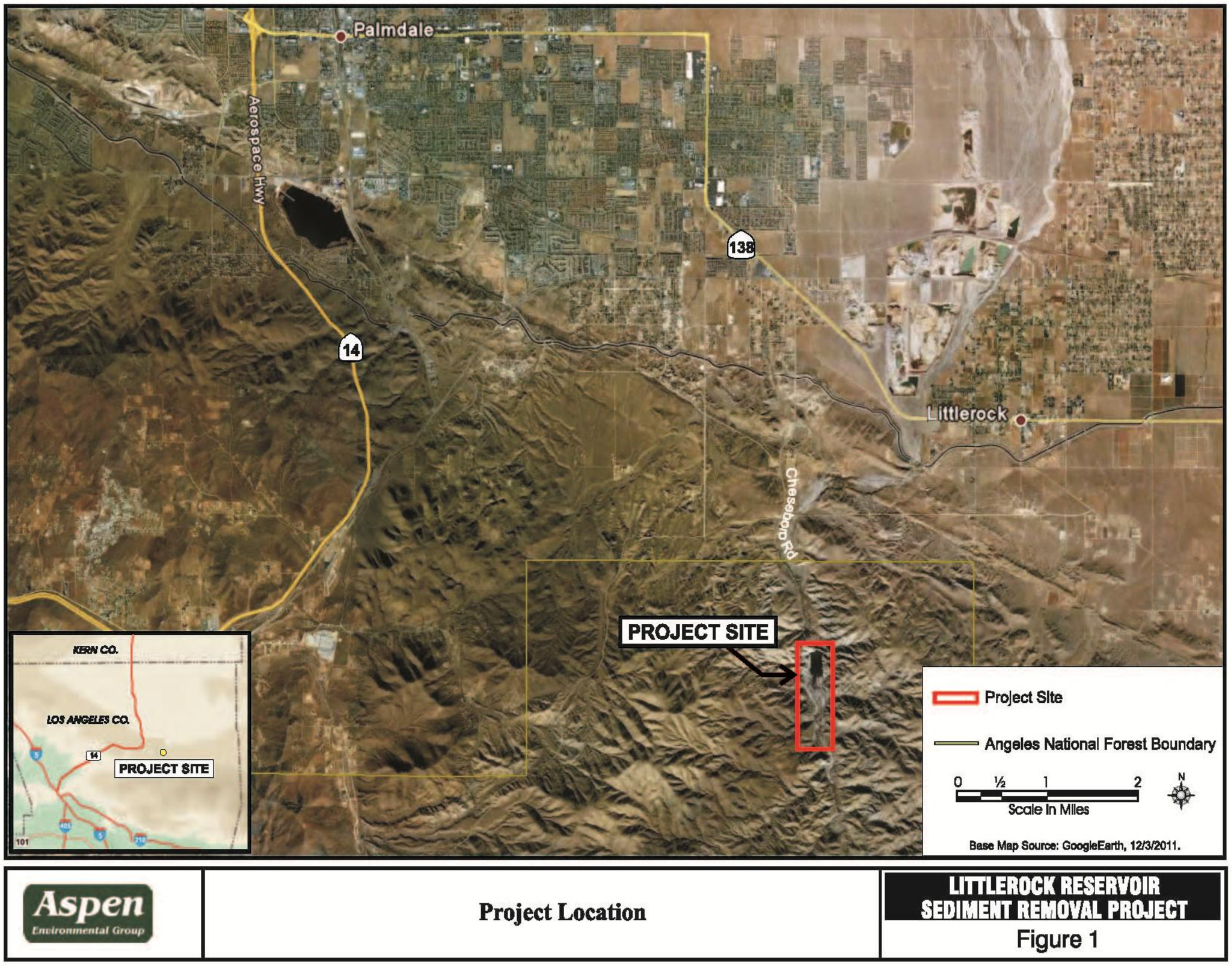


Figure 3-4: Project Site Map

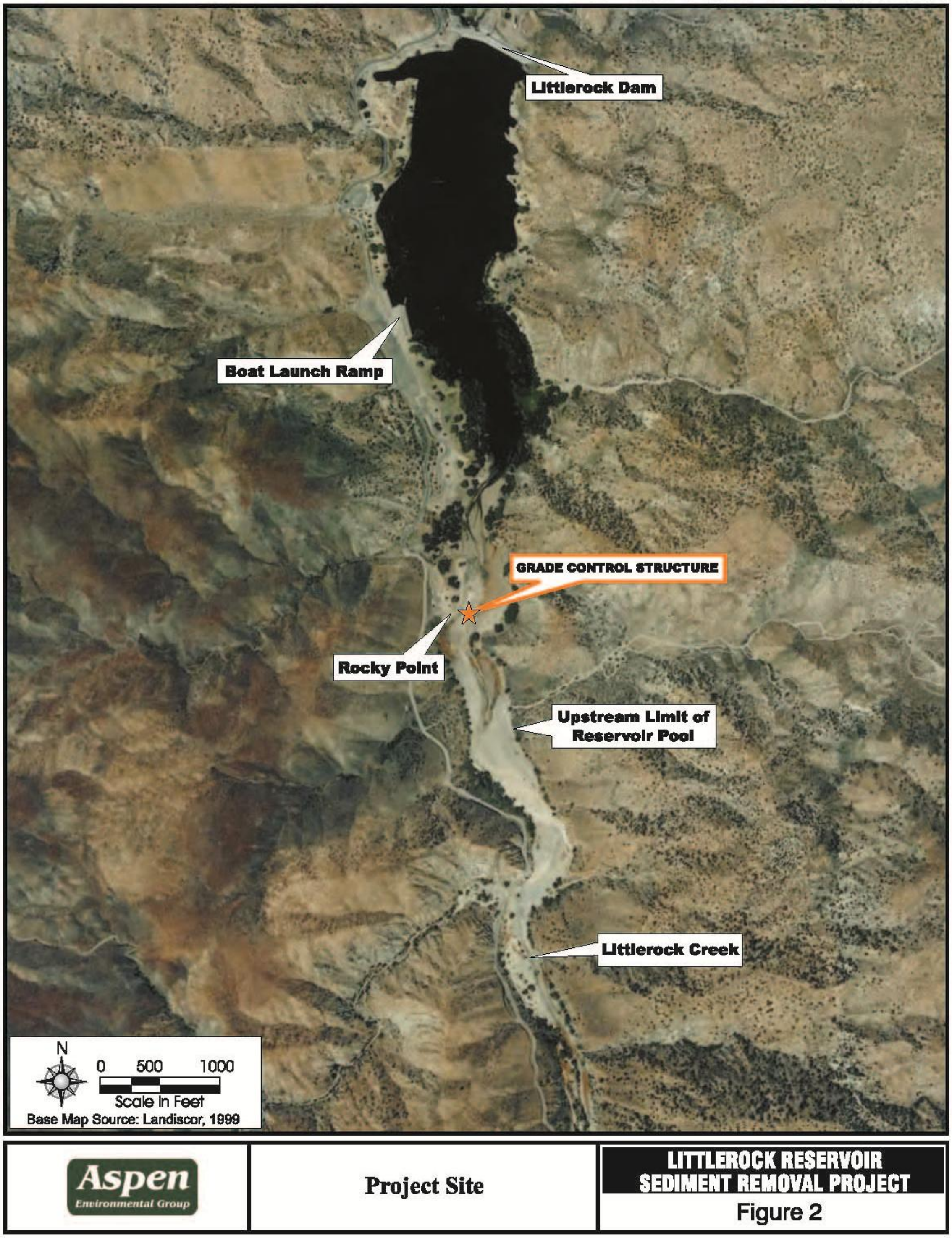


Figure 3-5: Grade Control Structure Plan

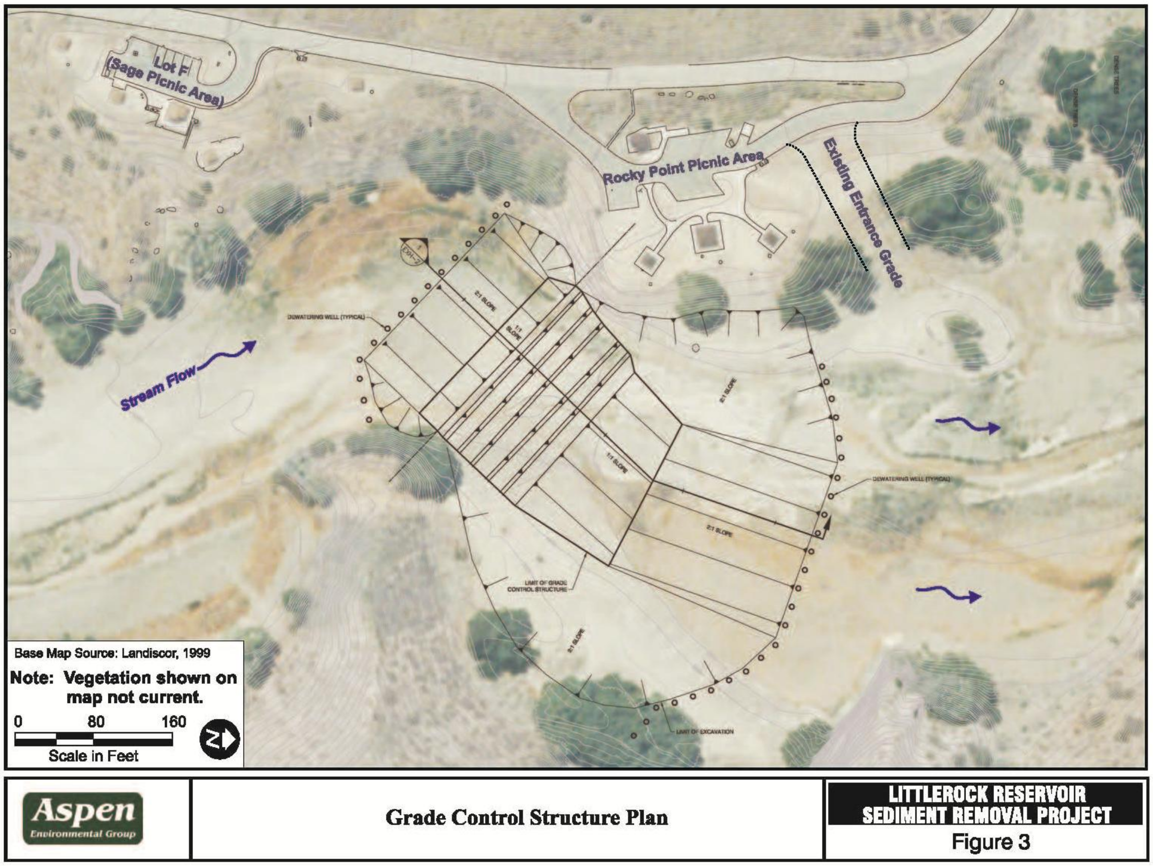


Figure 3-6: Grade Control Structure Profile

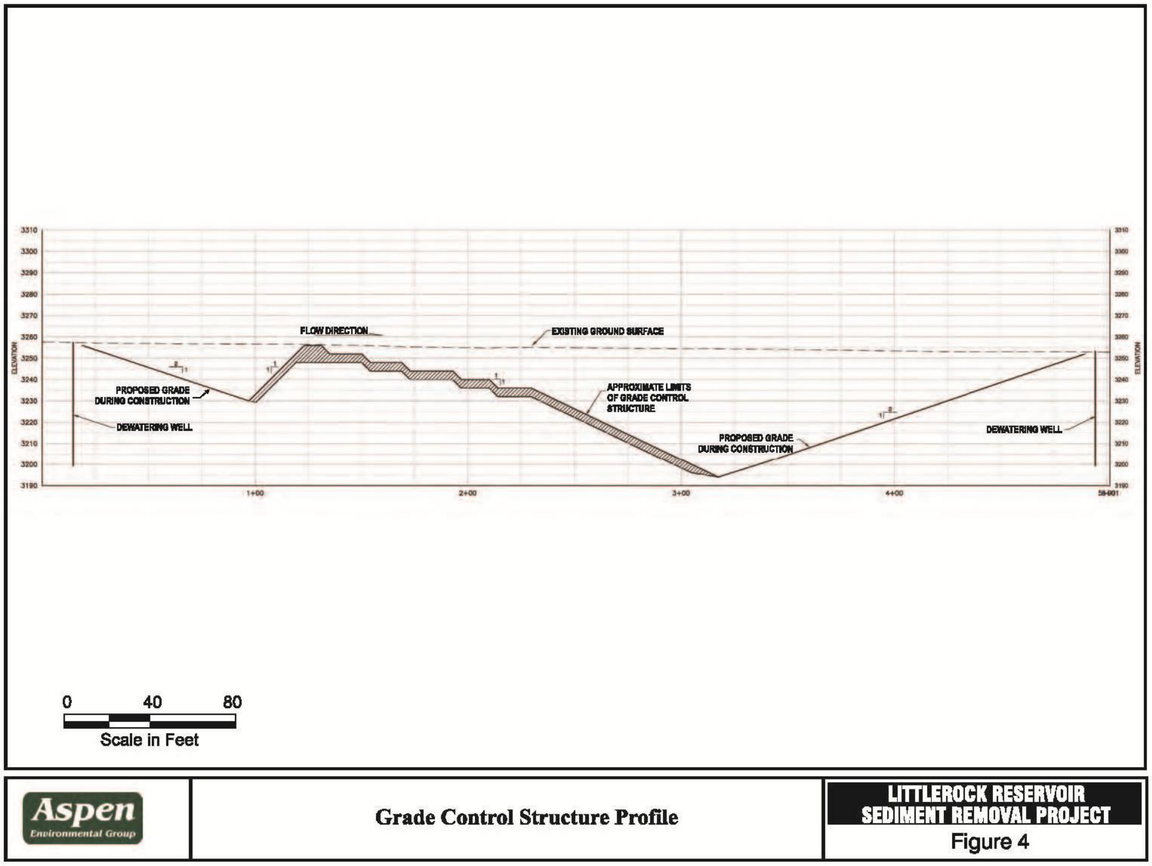
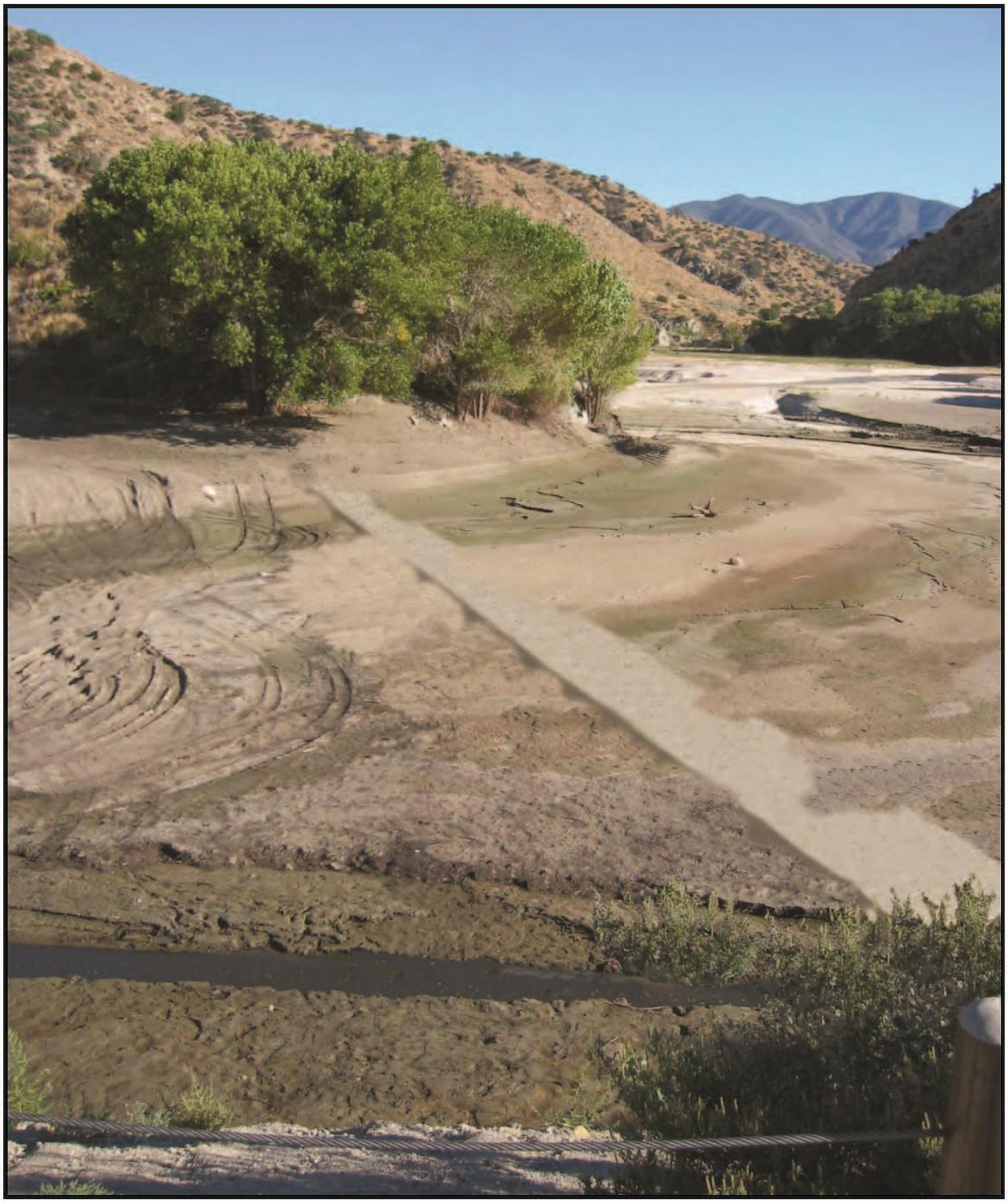


Figure 3-7: Grade Control Structure Surface Visual Simulation



Aspen Environmental Group	Grade Control Structure Surface Visual Simulation	LITTLEROCK RESERVOIR SEDIMENT REMOVAL PROJECT Figure 5

Figure 3-8: Project Construction Areas

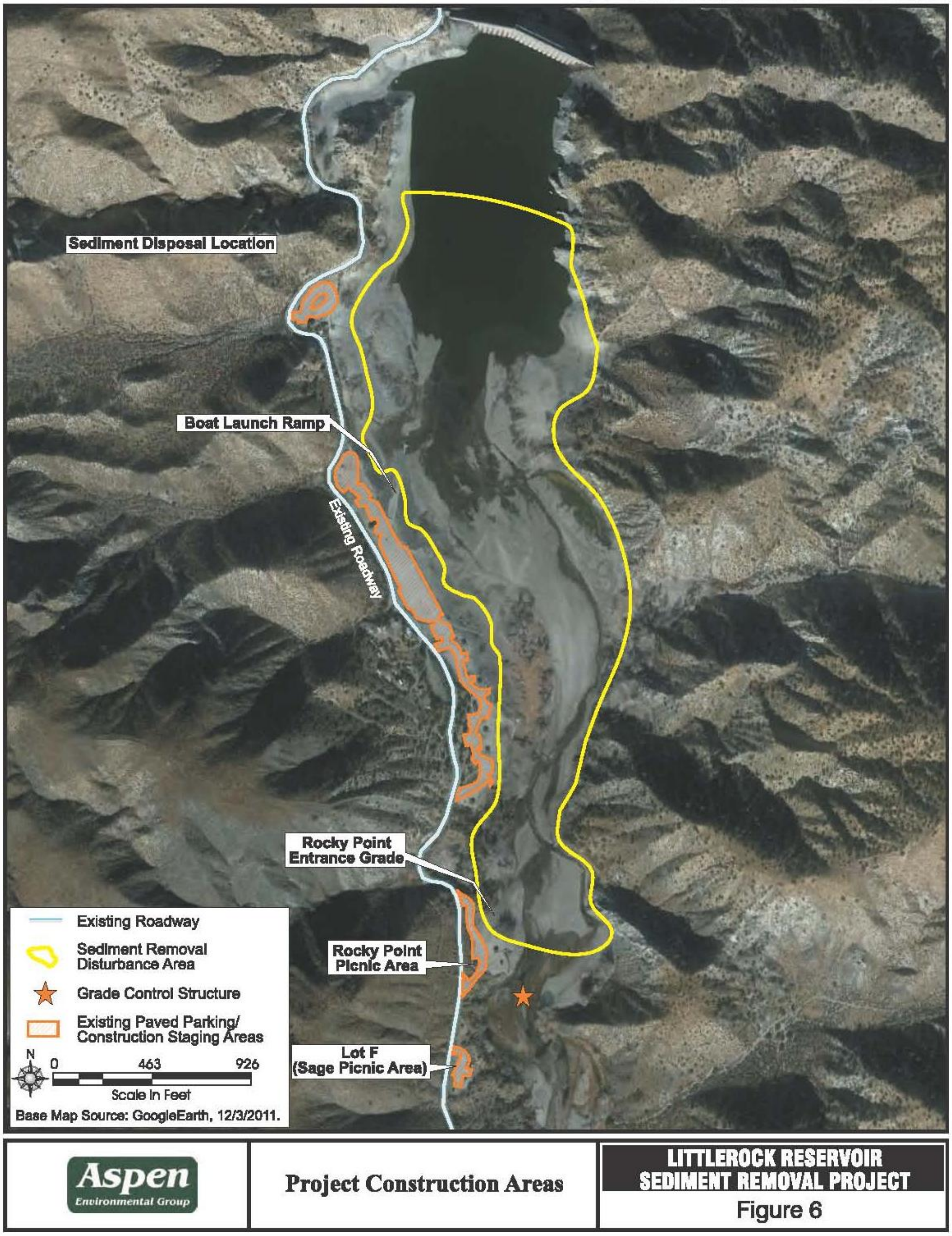


Figure 3-9: Sediment Disposal Location

Proposed Work

The following sections discuss work items necessary for implementation of the project. The work items are divided into each of the six primary budget categories and associated tasks as shown on Table 4, page 29, of the Proposition 1E, Round 2 Stormwater Flood Management Grant PSP. Work is divided into tasks completed before the grant award date (before August 15, 2013) and after the grant award date (after August 15, 2013).

(a) Direct Project Administration Costs

Task 1: Project Administration

Work to be completed under this task will be performed by a PWD project manager, engineering manager, engineering technician, and construction inspector. The project administration tasks will consist of a development of project management plan, administration of grant and construction contracts, preparation of invoices, reports, and plans, coordination of design contract, and other administrative activities required manage the project. The project manager will also be responsible for managing all project related financing to ensure all grant contract requirements are met.

PWD and the USFS finalized on December 15, 2011 a Category 6 major Cost Recovery Agreement (CRA). The CRA provides the terms and dollar amount through which PWD would pay monies to the USFS to reimburse them for processing the LRSR Project Special Use Authorization application. This was followed by a Memorandum of Understanding (MOU) between PWD and the USFS, Pacific Southwest Region, ANF executed on July 26, 2012 to collaborate on the LRSR project. Copies of the CRA and MOU are included at the end of this attachment.

Project Administration Activities or Deliverables	Completion Schedule	Status	Completion	
			Before Aug 2013	After Aug 2013
Cost Recovery Agreement (CRA)	December 2011	Completed	✓	
Memorandum of Understanding (MOU)	July 2012	Completed	✓	
Project Administration	Quarterly after Aug 15, 2013	Not yet begun		✓
Development of Financing	August 2013 – February 2015	Not yet begun		✓
Development of a Project Management Plan	August 2013 – October 2013	Not yet begun		✓

Task 2: Labor Compliance Program

PWD will hire Golden State Labor Compliance, LLC or a similar approved third party labor compliance program provider by the California Department of Industrial Relations throughout the project implementation. Upon grant award notification PWD will register with the Department of Industrial Relations Compliance Monitoring Unit as required by AB 436 to monitor and enforce prevailing wage requirements for this public works project.

Labor Compliance Program Activities or Deliverables	Completion Schedule	Status	Completion	
			Before Aug 2013	After Aug 2013
Labor Compliance Program	August 2013 – October 2019	Not yet begun	✓	
Compliance Monitoring Unit Registration	August 2013	Not yet begun		✓

Task 3: Reporting

The PWD project manager and supporting staff will prepare and submit quarterly progress reports and invoices to the granting agency (DWR). The progress reports will describe activities undertaken and accomplishments of each task when milestones are achieved and when any problems are encountered in the performance of the work. A final project report will be prepared per grant requirements and submitted to the granting agency within ninety calendar days of the project completion. Post-completion reports will be submitted to the state within ninety calendar days after the first operations year of the project for a total of 10 years after the project has been completed.

Upon grant award notification, PWD will enter into a contract agreement regarding compliance with Stormwater Flood Management Grant Program requirements and terms of reimbursement payments with the State of California. The contract agreement between PWD and the State of California is anticipated to be finalized by August 15 2013. The table below contains a detailed list of all the reporting submittals PWD will make to the granting agency (State of California).

Reporting Activities or Deliverables	Schedule	Status	Completion	
			Before Aug 2013	After Aug 2013
Contract Agreement between PWD and the State of California	August 2013 – November 2013	Not yet begun		✓
Quarterly Invoices and Progress Reports	Quarterly after August 15, 2013	Not yet begun		✓
Final Project Report	Completed by February 2020	Not yet begun		✓
Post-Completion Reports	Annually for 10 yrs from project construction completion date, starting October 2020	Not yet begun		✓

(b) Land Purchase/Easement

The LRSR Project will not require purchase of land or acquisition of right-of-ways. PWD has received a special use permit from the USFS authorizing PWD to use National Forest System lands to operate the dam. A copy of the most recent special use permit dated December 1997 is included in Appendix D.

(c) Planning/Design/Engineering/Environmental Documentation

Task 4: Assessment and Evaluation

Assessment and evaluation activities have already been completed (see Existing Data and Studies for detailed information), and include:

- *DRAFT Littlerock Reservoir Sediment Removal Project Biological Resources Technical Report* was prepared by Aspen Environmental Group in October 2012.
- *Geotechnical Investigation, Data Collection, and Survey Memoranda* was prepared by Aspen Environmental Group in July 2007.
- *Feasibility Study* was prepared by Aspen Environmental Group in September 2007.
- *DRAFT Littlerock Reservoir Hydrologic and Sediment Transport Analysis Technical Report* was prepared by Aspen Environmental Group in June 2005

Assessment and evaluation activities that will be completed for the project include:

- A final biological technical report will be completed in September 2013. The report will serve as the basis for the environmental analysis of biological resources in the EIR/EIS and the federally required biological assessment and subsequent biological opinion of the U.S. Fish and Wildlife Service for the project.
- An updated hydrological and sediment transport analysis technical report, from the one completed in June 2005, will be done by September 2013.
- Updated Topographic Mapping will be completed by September 2013.

Assessment and Evaluation Activities or Deliverables	Schedule	Status	Completion	
			Before Aug 2013	After Aug 2013
DRAFT Littlerock Reservoir Sediment Removal Project Biological Resources Technical Report	October 2012	Completed	✓	
Geotechnical Investigation, Data Collection, and Survey Memoranda	July 2007	Completed	✓	
Feasibility Study	September 2007	Completed	✓	
DRAFT Littlerock Reservoir Hydrologic and Sediment Transport Analysis Technical Report	June 2005	Completed	✓	
Final Biological Technical Report	July 2012 - September 2013	Underway		✓
Final Hydrological and Sediment Transport Analysis Technical Report	July 2005 - September 2013	Underway		✓
Updated Topographic Mapping	July 2012 - September 2013	Underway		✓

Task 5: Project Design

A final excavation plan will be completed by May 2013 to document the rate of siltation and the sediment removal locations based on updated topographical mapping. A conceptual design plan will be completed by April 2013 for the grade control structure, which will include a finalized list of the construction materials needed and location specifications. The conceptual design plan will use information from the excavation plan to finalize the grade control structure general design specifications. The final design plan is scheduled to be completed by January 2014.

Project Design Activities or Deliverables	Schedule	Status	Completion	
			Before Aug 2013	After Aug 2013
Excavation Plan	March- May 2013	Not yet started	✓	
Conceptual Design Plan	February – April 2013	Not yet started	✓	
30% Design	May – July 2013	Not yet started		✓
60% Design	July – September 2013	Not yet started		✓
90% Design	September – November 2013	Not yet started		✓
Final (100%) Design Plans	November –January 2014	Not yet started		✓

Task 6: Environmental Documentation

The LRSR Project requires compliance with the California Environmental Quality Act (CEQA) as part of the environmental review process. A Notice of Preparation (NOP) - EIR/EIS will be sent out to interested agencies, organizations and individuals to notify the preparation of environmental documents in accordance with the CEQA for the LRSR project in February 2013. Preparation of the Draft EIR /EID will begin in October 2013, followed by the preparation of a final EIR/EIS to be completed by June 2014.

Environmental Documentation Activity or Deliverable	Schedule	Status	Completion	
			Before Aug 2013	After Aug 2013
NOP – EIR/EIS	February 2013	Not yet begun	✓	
Draft EIR/EIS	October – December 2013	Not yet begun		✓
Final EIR/EIS	April – June 2014	Not yet begun		✓

Task 7: Permitting

The following permits will be required for the LRSR project:

- *USDA Forest Service Special Use Authorization (SUA)*: A Standard Form 299 (Application for Transportation and Utility Systems and Facilities on Federal Lands) has been filed with the USFS to officially start the SUA process. The application information is needed by the USFS to evaluate the request to use National Forest System lands and manage those lands to protect natural resources, administer the use, and ensure public health and safety. The authority for the requirement is provided by the Organic Act of 1897 and the Federal Land Policy and Management Act of 1976, which authorize the secretary of Agriculture to promulgate rules and regulations for authorizing and managing National Forest System lands. A new SUA is needed to construct and operate LRSR project on National Forest System Lands.

- *Clean Water Act (CWA) Section 404 Permit (and Water Management Plan (WMP))*: Construction and maintenance of the project, within portions of Littlerock Creek and/or Reservoir, would result in activities that involve a discharge of material to presumed "waters of the State." Therefore, a Section 401 Water Quality Certification from the State Water Resources Control Board would be required to comply with the applicable provisions under the Federal Clean Water Act.
- *CWA Section 401 Certification*: Section 401 of the Clean Water Act (CWA) regulates the discharge of dredged material, placement of fill material, or certain types of excavation within "waters of the U.S." Construction and maintenance of the project, within portions of Littlerock Creek and/or Reservoir, would result in activities that would discharge or place fill material into presumed "waters of the U.S." and/or wetlands. These types of activities would require a permit or authorization from the United States Army Corps of Engineers.
- *National Pollutant Discharge Elimination System (NPDES) Permit and NPDES Associated Storm Water Pollution Prevention Plan*: To control the types of pollutants/wastes to be discharged and how the pollutants/waste are treated or contained, Regional Water Boards issue NPDES permits. Construction and maintenance of the project within portions of Littlerock Creek and Reservoir may result in the discharge of pollutants into "waters of the U.S." from point sources such as pipes or man-made ditches. Therefore an individual NPDES permit is required.
- *Endangered Species Action (ESA) Section 7 Biological Opinion*: Federally listed wildlife species are known to occur within and adjacent to the project site. Arroyo toad (Anaryxus (Bufo) californicus [Federally Endangered]) has been recently documented within the southern extent of the project site. The Federally Endangered least bell's vireo (Vireo bellii pusillus) has been detected within the riparian habitat immediately below the dam. Direct and indirect impacts to these species may occur during construction and maintenance of the project. Under Section 7, Federal agencies must consult with the U.S. Fish and Wildlife Service (Service) when any action the agency carries out, funds, or authorizes (such as through a permit) may affect a listed endangered or threatened species.
- *Section 2081 Incidental Take Permit (ITP)*: The state endangered least bell's vireo has recently been documented within the riparian habitat immediately below the dam. Direct and indirect impacts to this species could occur as a result of the construction and maintenance of the project. Sections 2081(b) and (c) of the California Endangered Species Act allow the California Department of Fish and Wildlife (CDFW) to issue an incidental take permit for a State listed threatened and endangered species if specific criteria are met.
- *Lake or Streambed Alteration Agreement (Section 1602 and 1605 Permits)*: Because construction and maintenance of the project would potentially divert and/or obstruct the natural flow of Littlerock Creek and substantially change the bed, channel, and bank of Littlerock Creek and/or Reservoir a Lake or Streambed Alteration Agreement may be required from the CDFW.

Permit applications have not been submitted as of the date of this application package.

Permitting Activities or Deliverables	Schedule	Status	Completion	
			Before Aug 2013	After Aug 2013
USFS SUA	October 2012 – October 2015	Underway		✓
CWA Section 404 Permit and WMP	July 2013 – May 2014	Not yet begun		✓
CWA Section 401 Certification (WMP included in 404 permit)	July 2013 – August 2014	Not yet begun		✓
NPDES and associated SWPPP	July 2013 – June 2014	Not yet begun		✓
ESA BO	July 2013 – March 2014	Not yet begun		✓
Section 2081 ITP	July 2013 – March 2014	Not yet begun		✓
Section 1602 and 1605 Permits	January 2015 – May 2015	Not yet begun		✓

(d) Construction/Implementation

Task 8: Construction Contracting

The construction contracting for the project will be handled by PWD. Tasks to secure the Contract award include: advertisement for bids, a pre-bid contractors meeting, bid opening, bid evaluation and selection of contractor with lowest responsive bid. PWD will review bids for completeness, and award the project to the responsible bidder with the lowest bid in accordance with the Public Contract code. Once the project has been bid and awarded, the selected contractor will construct the project in accordance with the final plans and specification.

Construction Contracting Activities or Deliverables	Schedule	Status	Completion	
			Before Aug 2013	After Aug 2013
Preparation of Bid Packages	June 2015	Not yet begun		✓
Advertisement of bids	June – August 2015	Not yet begun		✓
Pre-bid contractors Meeting	August 2015	Not yet begun		✓
Evaluation of bids	August – September 2015	Not yet begun		✓
Bid award	September 2015	Not yet begun		✓
Notice to Proceed	October 2015	Not yet begun		✓

Task 9: Construction

The LRSR Project consists of two construction components: the Grade Control Structure and Sediment Removal. Both of these activities are described in detail below:

Grade Control Structure

The grade control structure will be constructed just downstream of the Rocky Point area. Figure 3-4 shows the location of the grade control structure within the Littlerock Reservoir. This location has been selected to allow construction of a minimum sized grade control structure that can prevent upstream head cutting and preserve critical habitat for the arroyo toad. To protect arroyo toad from sediment removal activities, the grade control structure will be constructed prior to sediment removal.

The conceptual grade control structure design consists of a permanent structure constructed of soil cement as a cascading (stair-step) structure with a series of steep drops of approximately 4 feet each, with 15-foot horizontal aprons downstream of each drop, extending to a total depth of up to 70 feet below the existing ground surface. Figures 3-5 and 3-6 provide an overview and profile image of the conceptual grade control structure design and dimensions. The grade control structure would span approximately 260 feet of channel (bank to bank) at the Rocky point area, with construction activities temporarily disturbing a section of Reservoir channel and adjacent bank approximately 300 feet wide in a direction perpendicular to the flow, and 500 feet long (include the total length of the structure) with the flow of the creek. The temporary disturbance during construction (including dewatering wells) would be approximately four acres for the grade control structure.

Because the grade control structure would be constructed below grade, only the top or upper lip of the structure would be visible when the Reservoir water level is lowered. Figure 3-7 shows a visual simulation of the completed grade control structure under lowered reservoir conditions. As shown in Figure 3-6, permanent disturbance at the end of construction would consist of the top of the grade control structure that remains visible above grade (approximately 8 feet by 238 feet, or 0.4 acre). As drop forms downstream of this structure, the visible portion of the structure could expand to a maximum of approximately 68 feet by 238 feet (0.37 acre) should sediment transport expose additional downstream areas of the grade control structure. The total drop height of the exposed upper lip would vary from zero up to a maximum of approximately 13 feet, depending upon reservoir inflows and sediment levels. When the Reservoir is full the grade control structure would be completely submerged and not visible.

Sediment Removal

Sediment removal would begin immediately subsequent to construction of the grade control structure during a proposed 5-year closure of the Reservoir. A total of 900,000 cubic yards of sediment are required to achieve the desired Reservoir capacity. The 5-year closure period ensures that 900,000 cubic yards of sediment can be removed when accounting for seasonal rainfall and other potential disruptions to sediment removal activities. Preliminary estimates indicate that an excess of 1,100,000 cubic yards of sediment would likely need to be removed to account for ongoing annual sediment deposition of 54,000 cubic yards per year. Therefore, sediment removal activities would achieve or exceed the optimal desired Reservoir capacity of 3,560 AF.

Figure 3-8 shows the Reservoir area designated for sediment removal and the adjacent canyon where sediment will be disposed. When the Reservoir is full, the area proposed for sediment removal is covered by water. The Reservoir will be lowered and maintained to a minimum dead pool level during the 5-year closure period. When feasible, sediment removal would occur evenly to preserve the existing slope of the Reservoir bottom. Ground disturbance associated with sediment removal activities would include up to 100 acres. As discussed later, egress and ingress of equipment and trucks into the Reservoir will occur from either the existing access ramp slope at Rocky Point or the boat landing ramp. Permanent disturbance outside of the Reservoir bed is not expected to occur with the sediment removal portion of the proposed action.

Subtask Descriptions:

Subtask 9.1 Special Conditions:

Mobilization
Closure of the Reservoir facility is necessary to facilitate construction of the grade control structure and removal of sediment thereafter. Therefore, the proposed action includes a 5-year closure of the Reservoir to the public. Signage indicating the duration of Reservoir closure would be posted on Cheseboro Road between Mt. Emma Road and the entrance to the Reservoir. A gate would be installed at the existing guard shack location eliminating public vehicular access during the 5-year closure of the Reservoir to the public. Additionally, signage or a temporary kiosk would be installed at the closure point informing the public of the LRSR project and other recreational and OHV areas in the area.

Local vehicle access to the Reservoir is provided via Cheseboro Road, where it leads into the Littlerock Recreational Area, which contains three parking lots and an internal roadway providing circulation throughout the Reservoir area (refer to Figures 3-4 and 3-8). Once the Reservoir level is lowered, vehicle egress/ingress to the Reservoir bed would occur from the existing boat ramp located on the west side of the Reservoir and from an existing Reservoir access slope at the Rocky Point Picnic Area parking lot. The current boat landing ramp on the west side of the Reservoir is paved with an acceptable grade for vehicle and equipment access. However, the existing access ramp from the Rocky Point Picnic Area parking lot may require a decrease in grade to allow construction vehicle and equipment egress/ingress. Additional material to decrease slope will come from within the Reservoir bed sediment removal area, resulting in minimal increase to temporary disturbance. The use of these existing access ramps and internal roadway system connecting all parking areas will allow project related vehicles to travel throughout the Reservoir utilizing the existing transportation/circulation system.

Temporary Electric Power - Dewatering
Dewatering activities conducted under Subtask 9.2 will require access to electric power for the duration of construction to power dewatering wells. See discussion below. These wells, and the connection to the electric power supply, will be temporary, removed after construction, and the ground restored to the pre-construction condition upon completion of the grade control structure.

Asphalt Paving
At the completion of sediment removal activities, PWD’s contractor would repair any damage to existing paved parking areas, access roads, and travel paths demonstrable to sediment removal activities. It is assumed roadway and paved parking area restoration activities would include, but not be limited to, surface replacement, repair and fill of any potholes or surface scrapes, as well

as slurry sealing of any new significant surface crack damage demonstrable to sediment removal activities.

Lawns and Grasses
Disturbed channel areas would be returned to pre-construction conditions or better after construction. Native, locally collected seed mixtures and container plant material would be planted in areas that previously contained vegetation disturbed during construction of the grade control structure activities. Site restoration efforts are expected to begin immediately following the cessation of construction activities concurrent with appropriate planting conditions and permit requirements.

Subtask 9.2 Grade Control Structure:

It is expected that the grade control structure would begin in October 2015 and be finished approximately 4-6 months after initiation of construction. Construction of the grade control structure would occur 5-days a week from 7 a.m. to 7 p.m. Should night construction be required (daylight savings period), it would only occur with prior authorization from the USFS and would not be conducted near habitat that supports arroyo toads to avoid interference with breeding calls from construction noise. Also, any construction activities during a Red Flag warning event would be coordinated with the USFS prior to daily start-up.

Water Truck
The construction team will utilize a water truck to provide dust suppression during construction of the grade control structure.

Site Clearing
All vegetation, soil, and rock material will be cleared as necessary to prepare the site for construction work. All equipment staging and maintenance, temporary employee parking, and imported material storage would occur on 4.94 acres of existing paved parking areas located adjacent to the Reservoir (refer to Figure 3-8). No fuel storage or vehicle staging would occur within the Reservoir.

Dewatering
Construction of the grade control structure would require diversion of subsurface water around the construction area. Subsurface flows will be collected by installing a series of dewatering wells to a maximum depth of approximately 70 feet in the reservoir bed along the upstream and downstream limits of construction. These wells will pump subsurface water into a temporary pipeline that will convey the water around the construction site to be discharged into the reservoir bed downstream of the construction. Wells are expected to be approximately 4 to 6 inches in diameter and spaced in a line at 3- to 10-foot intervals of the grade control excavation location. These wells are expected to be located near the excavation perimeter. Intermediate wells may be necessary along the cut slope between the primary wells and the bottom of the excavation, and it is possible additional wells may be required at a distance of 100-200 feet upstream of the upstream excavation edge, as well as at the downstream edge of construction. These wells will be temporary, removed after construction, and the ground restored to the pre-construction condition upon completion of the grade control structure.

Surface flows from Littlerock Creek, if present, will be collected using a temporary coffer dam and sump. Depending on the amount of water flow, coffer dam size would vary but is assumed to be limited to less than grade control structure construction area width (approximately 300 feet). Water collected in the sump will be pumped around the construction site and discharged into the downstream Reservoir bed.

Excavation Support and Protection

Construction of the grade control structure will employ the use of all necessary shoring techniques to maintain excavation sites in a workable and safe manner.

Earthwork

Excavation for placement of the grade control structure would require the movement of approximately 130,000 cubic yards of material. This material would not be transported off-site, but would be stockpiled within the empty Reservoir bed downstream of Rocky Point, where it will be used as material for soil cement and for backfill as the grade control structure is built. It is anticipated that excavation would require four bulldozers.

Construction of the grade control structure would require approximately 12,000 cubic yards of soil cement. Sandy soil for the soil cement would come from the excavated material, which would be fed through a portable rock screener for sorting, then transported to and fed into a portable pug mill or soil cement batch plant where it would be mixed with water and Portland cement. These facilities would be located within 4.94 acres of existing paved parking areas. Portland cement would be obtained from off-site commercial sources and trucked to the staging area. Cementitious materials would be stored on-site at existing paved parking areas at portable batch plant locations. Required water for soil cement would be obtained from the remaining Reservoir pool and transported by truck or temporary pipeline.

Soil Stabilization

Soil cement mixture would then be transported in trucks to the grade control site and spread and compacted in lifts, and in a stair-step fashion, to form the grade-control structure. The excavation would be backfilled as the structure is built up. Construction access to the grade control structure site from the 4.94 acres of existing paved parking areas to be used for staging can occur from either the existing access ramp slope at Rocky Point or the boat landing ramp.

Transmission Pipelines

Transmission pipelines will be constructed to maintain water diversions during construction.

Water Supply and Intake Structures

Water supply and treatment pumps will be employed during construction to maintain water diversions. Water supply, intake structure, and water diversion valves will be accessible and operational during construction to maintain water supply to Lake Palmdale and to stay in compliance with Division Safety Dams.

Subtask 9.3: Sediment Removal

As discussed earlier, sediment removal would occur when the Reservoir was lowered and maintained to a minimum dead pool level. During the winter and spring months of the 5-year closure period, PWD will regularly (as needed) drain the Reservoir pool as it is filled by Littlerock Creek (via stormwater and annual snow melt) to maximize sediment removal operations. Because the grade control structure would be in place prior to sediment excavation, stream flows would be minimized or eliminated into the Reservoir bed during sediment removal periods. However, should stream flow be present, water would be diverted around the extraction site via a temporary coffer dam and sump, with water transferred via a temporary pipeline into the dead pool. Should groundwater occur, temporary pumps and pipelines would transfer water from the removal area into the remaining water pool. As these circumstances would vary from season to season, exact specifications of these temporary features are not available but should be assumed to be a maximum width of the affected sediment removal work area.

Sediment removed from the Reservoir is expected to consist of a combination of fine sediments, sand, course gravels, and cobble. Given that Littlerock Reservoir is a naturally fed water storage facility, it is unlikely that any sediment removed would be contaminated. However, prior to disposal of excavated materials, a sediment testing program would be implemented to identify any potential contaminants. If contaminated material is identified, the PWD, in consultation with the USFS, would transport this material to an approved hazardous material storage facility, such as the Lancaster Landfill and Recycling Center, for disposal. Clean sediment would be hauled to an adjacent 25-acre canyon on USFS lands for placement and spreading. The sediment disposal location is shown on Figure 3-8. Access roads would be graded within the canyon for dump truck access. The haul route for trucks transporting sediment would occur between the canyon and both Reservoir access points (boat ramp and Rocky Point). Sediment would be dumped and spread at the lowest elevations first, with the canyon then filled and re-contoured to match adjacent slopes. Additionally, due to removed sediment consisting of primarily fine sediments, minimal change to existing hydrology would occur within the canyon.

A Sediment Removal Summary is provided below with an overview of sediment removal activities.

Component	Details
Work Schedule	Mon-Fri, 7am-7pm
Sediment Removal [1]	Minimum net total of 900,000 Cubic Yards
Number of 12-Cubic Yard Dump Trucks	12
Truck Trips (Round Trip) [1]	108 Daily 19,440 Annual

[1] Assumptions:

- Each truck conducts one round trip per hour between the Reservoir and disposal location;
- Annual average of 9 hours of daily operation per truck; and
- Annual average of 36 weeks operating 5 days per week (180 days per year)

Construction Activities or Deliverables	Schedule	Status	Completion	
			Before Aug 2013	After Aug 2013
Subtask 9.1 Special Conditions	October 2015 - December 2019	Not yet begun		✓
Subtask 9.2 Grade Control Structure	December 2015 - May 2016	Not yet begun		✓
Subtask 9.3 Sediment Removal	June 2016 - December 2019	Not yet begun		✓

(e) Environmental Compliance/Mitigation/Enhancement

Task 10: Environmental Compliance/Mitigation/Enhancement

PWD will prepare a Mitigation Monitoring Compliance and Reporting Program (MMCRP) after the completion of all environmental clearance documents, acquisition of permits, issuance of PWD and USFS decisions, and after the USFS SUA is obtained. PWD will incorporate all required actions as specified in the acquired documents and permits into the MMCRP.

Environmental Compliance / Mitigation / Enhancement Activities or Deliverables	Schedule	Status	Completion	
			Before Aug 2013	After Aug 2013
Mitigation Monitoring Compliance and Reporting Program (MMCRP)	October 2015-December 2019	Not yet begun		✓

(f) Construction Administration

Task 11: Construction Administration

PWD will hire a qualified engineering consulting firm for construction management services to serve as the representative at the construction site to provide daily on-site observation, coordinate with contractors, review schedules and invoices, and provide inspection services to ensure construction is in compliance with PWD standards and other governing standards. PWD will compile the major items in the monthly progress reports into quarterly reports to accompany invoices to the grantee agency.

Construction Contracting Activity or Deliverable	Schedule	Status	Completion	
			Before Aug 2013	After Aug 2013
Construction Administration	October 2015-December 2019	Not yet begun		✓
Quarterly Construction Reports	October 2015-December 2019	Not yet begun		✓

(g) Other Costs

PWD will develop a data management plan and system to process, store and share all the data collected during after completion of the proposed project. The data management plan and system will be developed alongside the performance measures and monitoring plan. This is to ensure the data collected is used to ensure the project is meeting its objectives.

PWD will develop an operations and maintenance plan for the proposed project. The plan will address all operation and maintenance components of the sediment removal activities, including, but not limited to, management of vegetation, sensitive species, sediment, and water as well as issues such as agreements with on-site concessionaire (if necessary), restoration methods, and timing.

Other Activity or Deliverable	Schedule	Status	Completion	
			Before Oct 2013	After Oct 2013
Development of Data Management	June - December 2019	Not yet begun		✓
Development of Performance Measures and Monitoring Plan	June - December 2019	Not yet begun		✓
Development of Operations and Maintenance Plan	June - December 2019	Not yet begun		✓

Discussion of Standards

This Project will meet all the following construction standards, health and safety standards, laboratory analysis, and classification methods:

- Standard specification of Public Works Construction 2009
- Standard Plans of the Los Angeles County Department of Public Works; 3080-2, 3090-1, 3091.1, 3093-1, and 6002-1.
- Occupational safety and health administration
- American Society for Testing and Materials
- Uniform Building Code
- California Administrative Code Title 24, Energy Conservation Standards
- American National Standard Institute
- State Water Resources Control Board
- Construction Site Best Management Practices Manual
- American Water Works Association
- PWD Specifications for Water Distribution System Construction

- Detailed specifications developed by project engineer that will be made part of the contract documents

FOUNDED 1892

LITTLEROCK CREEK
·IRRIGATION DISTRICT·

January 30, 2013

Mr. Zaffar Eusuff, Program Manager
Department of Water Resources
Division of Financial Assistance
P.O. Box 942836
Sacramento, CA 94236

Dear Mr. Eusuff:

LITTLEROCK CREEK IRRIGATION DISTRICT
LETTER OF SUPPORT

We are pleased to provide this Letter of Support for the Palmdale Water District Littlerock Reservoir Sediment Removal Project being submitted for the Stormwater Flood Management Grant Proposal, Proposition 1E funding.

Littlerock Creek Irrigation District supports the Littlerock Reservoir Sediment Removal Project and recognizes the valuable benefits it will provide to the Region. These benefits include water supply, debris control and flood protection, habitat preservation for federally endangered species, water quality improvements, energy conservation, reduced greenhouse gas emissions, and the continuance of open space and recreation for the surrounding community.

Thank you for your consideration of this valuable project for funding.

Sincerely,

BJ Bones

BRAD BONES

General Manager

35141 87TH STREET EAST LITTLEROCK, CALIFORNIA 93543
(661) 944-2015 · FAX (661) 944-3668

FS Agreement No. 12MU-1105-0100-014
Cooperator Agreement No.

MEMORANDUM OF UNDERSTANDING
Between The
PALMDALE WATER DISTRICT
And The
USDA, FOREST SERVICE
PACIFIC SOUTHWEST REGION, ANGELES NATIONAL FOREST

This MEMORANDUM OF UNDERSTANDING (MOU) is hereby made and entered into by and between the Palmdale Water District, hereinafter referred to as "PWD," and the USDA, Forest Service, Pacific Southwest Region, Angeles National Forest, hereinafter referred to as the "U.S. Forest Service."

Title: PWD Cooperative Work on the Angeles National Forest for the Littlerock Reservoir Sediment Project (Project).

I. **PURPOSE:** The purpose of this MOU is to document the cooperation between the parties to provide a framework for cooperation between the U.S. Forest Service and PWD to work together as joint lead agencies in preparing and completing a joint environmental analysis and document that is in compliance with NEPA, CEQA, and all applicable laws, executive orders, regulations, direction, and guidelines in accordance with the following provisions.

The PWD holds a Special Use Permit to operate and maintain the Littlerock Dam, Reservoir, and associated facilities as a local surface water impoundment. The Reservoir is a man-made feature formed by the impoundment of water on Littlerock Creek and is located within the boundaries of the Santa Clara/Mojave Rivers Ranger District of the Angeles National Forest. PWD proposes to excavate sediment from the Littlerock Reservoir and construct a grade control structure in order to remove excess reservoir sediment that has accumulated over time; restore and maintain the water storage capacity of the Reservoir; and prevent sediment loss and headcutting of the stream channel upstream of the Reservoir to prevent the incidental "take" of arroyo toad (*Anaxyrus californicus*), a federally endangered species.

The Forest Service, as joint lead agency under 40 CFR 1501.5(b), has determined that an Environmental Impact Statement (EIS) is required before a decision on the Project can be made. The EIS must comply with the National Environmental Policy Act of 1969, 42 U.S.C. 4371 et seq. (NEPA), and all other applicable laws, executive orders, regulations, and direction, including, but not limited to, the Council of Environmental Quality (CEQ) Regulations (40 CFR 1500-1508), the Endangered Species Act, the Angeles National Forest Land and Resources Management Plan, Forest Service Manual 1950, and Forest Service Handbook 1909.15.

The PWD, as the lead agency under the California Environmental Quality Act (CEQA) and as joint lead agency under 40 CFR 1501.5(b), has determined that an Environmental Impact Report (EIR) is required for the Project. The EIR must comply with CEQA and all other applicable laws and regulations.

II. STATEMENT OF MUTUAL BENEFIT AND INTERESTS:

CEQ regulations (40 CFR 1506.2) direct federal agencies to cooperate with State and local agencies to the fullest extent possible to reduce duplication between NEPA and State and local requirements, including joint planning processes, environmental research and studies, public hearings, and environmental impact statements. CEQA Guidelines Sections 15222 and 15226 encourage similar cooperation by State and local agencies with federal agencies when environmental review is required under both CEQA and NEPA. Under these conditions, the Parties shall be joint lead agencies developing one document that complies with all applicable laws.

In consideration of the above premises, the parties agree as follows:

III. PWD SHALL:

A. Serve as the CEQA lead agency throughout the CEQA process.

B. Comply with Federal Statutes relating to non-discrimination. This includes, but is not limited to: (a) Title VI of the Civil Rights Act of 1964 (P.L. 88-352), which prohibits discrimination on the basis of race, color, handicap, or national origin; (b) Title XI of the Education Amendments of 1972, as amended (20 U.S.C. 1681-1683 and 1685-1686) which prohibits discrimination on the basis of sex.

C. Require full cooperation of the Contractor.

D. As required, the PWD will be responsible for consulting with the California Department of Fish and Game.

E. Be responsible for conducting joint public meetings and/or hearings.

F. Coordinate with the Contractor and the Forest Service to develop and implement a Public and Agency Involvement Plan, which shall provide meaningful opportunities for public and agency notification, involvement, and participation during the environmental review of the Project. This Plan shall meet the legal/procedural requirements of CEQA and NEPA for public notification and involvement and provide additional items tailored to meet the specific needs of the Project. The Plan shall include, but not be limited to, the following: a Project telephone and fax hotline/email through which concerned citizens and organizations can contact the Project team and ask questions or submit comments; a Project database and document tracking; agency and stakeholder consultation;

preparation and distribution of the CEQA Notice of Preparation and the NEPA Notice of Intent; Project scoping, including a public scoping meeting and associated public notification; Draft EIR/EIS public involvement activities; post-Draft EIR/EIS support; and optional activities such as a Project website, electronic notification, and a Project newsletter.

G. Provide construction monitors.

H. Provide all graphic handouts and presentations for public meetings/hearings. Any such graphic presentations and/or handouts shall be submitted to the Forest Service for approval prior to distributing them at public meetings/hearings.

I. Be responsible for all stenographic, clerical, graphics, layout, printing, and like work.

J. Mail scoping letters and other correspondence, and arrange for publication of notices as required by the NEPA/CEQA processes.

K. Produce an internal administrative Draft EIR/EIS for review by the Forest Service prior to publication of the Draft EIR/EIS. The administrative draft shall include all text, maps, appendices, tables, charts, and other materials that will be incorporated in the Draft EIR/EIS for publication. As determined by the Forest Service, PWD shall provide a reasonable number of copies to meet internal review needs.

L. Include evaluation of potential alternatives and impacts in the Draft EIR/EIS. The Draft and Final EIR/EIS will apply whichever NEPA and CEQA requirement is more stringent in the analysis. The Draft and Final EIR/EIS will describe any inconsistencies between Federal plans or laws as they pertain to the proposed actions and describe the extent to which the Forest Service would reconcile the proposed action with the plan or law.

M. Have primary responsibility for writing and rewriting all sections, parts, and chapters of the EIR/EIS, subject to Forest Service comments during the environmental analysis and responses to the administrative Draft and Final EIR/EIS.

N. Coordinate with the Forest Service to develop standardized impact minimization measures for inclusion in the EIR/EIS and regulatory permit applications, as necessary. These measures shall be implemented during all construction and operations & maintenance (O&M) activities associated with the Project, as applicable. These measures shall include, but not be limited to, general Standard Operating Procedures and Best Management Practices as well as detailed mitigation measures for impacts to cultural and biological resources.

IV. THE U.S. FOREST SERVICE SHALL:

A. Serve as the NEPA lead agency throughout the NEPA process.

B. Provide updated mailing lists of stakeholders in affected National Forest or other Federal land to the PWD for soliciting input and distributing the scoping letter, Draft and Final EIR/EIS, and Record of Decision as required by law.

C. Review, and if acceptable, approve the draft Notice of Intent (NOI), public notices, and Notice of Availability of the document, before publication in appropriate periodicals.

D. Review, and if acceptable, approve draft scoping letter, before PWD sends the letter to stakeholders in mailing list provided by the Forest Service.

E. File Draft and Final EIR/EIS with the Environmental Protection Agency (EPA).

F. Be responsible for consulting with the United States Fish and Wildlife Service for a Section 7 Consultation and the California State Historic Preservation Officer for a Section 106 Consultation regarding proposed federal action; at the discretion of the Forest Service, PWD shall furnish such data or information required to accomplish such consultation.

G. Coordinate with the PWD to provide an approved set of Cultural Resources Mitigation Meausures.

H. Coordinate with the PWD to develop and implement a Public and Agency Involvement Plan, as described above under III.F above.

I. Coordinate with the PWD to develop and implement a Biological Resources Study Plan, which shall include, but not be limited to, the following: appropriate surveys and data collection to support preparation of the EIR/EIS and applicable regulatory compliance permits (including State and Federal Endangered Species Acts (ESA) compliance, California Department of Fish and Game Lake and Streambed Permitting Section 1602 and 1605, United States Army Corps of Engineers Clean Water Act Section 404, and Lahontan Regional Water Quality Control Board Section 401 Certification), preparation of Forest Service requirements (Biological Evaluation, Management Indicator Species Report, Weed Management Report, and Riparian Conservation Report), and plans related to biological resources (e.g., Water Management Plan, Habitat Compensation and Mitigation Plan, Operation and Maintenance Plan).

V. IT IS MUTUALLY UNDERSTOOD AND AGREED BY AND BETWEEN THE PARTIES THAT:

A. <u>PRINCIPAL CONTACTS</u>. Individuals listed below are authorized to act in their respective areas for matters related to this agreement.

Principal Cooperator Contacts:

Cooperator Program Contact	Cooperator Administrative Contact
Matt Knudson 2029 East Avenue Q Palmdale, CA 93550 (661) 947-4111 x118 (661) 947-8604 mknudson@palmdalewater.org	Matt Knudson 2029 East Avenue Q Palmdale, CA 93550 (661) 947-4111 x118 (661) 947-8604 mknudson@palmdalewater.org

Principal U.S. Forest Service Contacts:

U.S. Forest Service Program Manager Contact	U.S. Forest Service Administrative Contact
Wilburn Blount 33708 Crown Valley Road Acton, CA 93510 (661) 269-2808 FAX: (661) 269-2825 wmblount@fs.fed.us	Bonnie Harris 701 N. Santa Anita Ave. Arcadia, CA 91006 (626) 574-5246 (626) 574-5363 bharris@fs.fed.us

B. NON-LIABILITY. The U.S. Forest Service does not assume liability for any third party claims for damages arising out of this agreement.

C. NOTICES. Any communications affecting the operations covered by this agreement given by the U.S. Forest Service or PWD is sufficient only if in writing and delivered in person, mailed, or transmitted electronically by e-mail or fax, as follows:

To the U.S. Forest Service Program Manager, at the address specified in the MOU.

To PWD, at PWD's address shown in the MOU or such other address designated within the MOU.

Notices are effective when delivered in accordance with this provision, or on the effective date of the notice, whichever is later.

D. PARTICIPATION IN SIMILAR ACTIVITIES. This MOU in no way restricts the U.S. Forest Service or PWD from participating in similar activities with other public or private agencies, organizations, and individuals.

E. ENDORSEMENT. Any of PWD's contributions made under this MOU do not by direct reference or implication convey U.S. Forest Service endorsement of PWD's products or activities.

F. NONBINDING AGREEMENT. This MOU creates no right, benefit, or trust responsibility, substantive or procedural, enforceable at law or equity. The parties shall manage their respective resources and activities in a separate, coordinated and mutually beneficial manner to meet the purpose(s) of this MOU. Nothing in this MOU authorizes any of the parties to obligate or transfer anything of value.

Specific, prospective projects or activities that involve the transfer of funds, services, property, and/or anything of value to a party requires the execution of separate agreements and are contingent upon numerous factors, including, as applicable, but not limited to: agency availability of appropriated funds and other resources; cooperator availability of funds and other resources; agency and cooperator administrative and legal requirements (including agency authorization by statute); etc. This MOU neither provides, nor meets these criteria. If the parties elect to enter into an obligation agreement that involves the transfer of funds, services, property, and/or anything of value to a party, then the applicable criteria must be met. Additionally, under a prospective agreement, each party operates under its own laws, regulations, and/or policies, and any Forest Service obligation is subject to the availability of appropriated funds and other resources. The negotiation, execution, and administration of these prospective agreements must comply with all applicable law

Nothing in this MOU is intended to alter, limit, or expand the agencies' statutory and regulatory authority.

G. MEMBERS OF U.S. CONGRESS. Pursuant to 41 U.S.C. 22, no U.S. member of, or U.S. delegate to, Congress shall be admitted to any share or part of this agreement, or benefits that may arise therefrom, either directly or indirectly.

H. FREEDOM OF INFORMATION ACT (FOIA). Public access to MOU or agreement records must not be limited, except when such records must be kept confidential and would have been exempted from disclosure pursuant to Freedom of Information regulations (5 U.S.C. 552).

I. TEXT MESSAGING WHILE DRIVING. In accordance with Executive Order (EO) 13513, "Federal Leadership on Reducing Text Messaging While Driving," any and all text messaging by Federal employees is banned: a) while driving a Government owned vehicle (GOV) or driving a privately owned vehicle (POV) while on official Government business; or b) using any electronic equipment supplied by the Government when driving any vehicle at any time. All cooperators, their employees, volunteers, and contractors are encouraged to adopt and enforce policies that ban text messaging when driving company owned, leased or rented vehicles, POVs or GOVs when driving while on official Government business or when performing any work for or on behalf of the Government.

J. TERMINATION. Any of the parties, in writing, may terminate this MOU in whole, or in part, at any time before the date of expiration.

K. DEBARMENT AND SUSPENSION. PWD shall immediately inform the U.S. Forest Service if they or any of their principals are presently excluded, debarred, or suspended from entering into covered transactions with the federal government according to the terms of 2 CFR Part 180. Additionally, should PWD or any of their principals receive a transmittal letter or other official Federal notice of debarment or suspension, then they shall notify the U.S. Forest Service without undue delay. This applies whether the exclusion, debarment, or suspension is voluntary or involuntary.

L. CONSULTATION. The Agency Project Representatives shall keep each other advised of the developments affecting the preparation of the Draft EIR/EIS. The Forest Service will keep PWD informed of all discussions with Contractor and involve PWD when appropriate.

M. TIMELINE. Attached to this MOU is a draft detailed schedule, which Parties intend to serve as a template for the actual schedule of deadlines that they intend to adhere to in completing the environmental review that is subject to this MOU. The Parties agree to modify and reach final agreement on the details of this draft schedule, which will include specific dates establishing the deadlines for expected deliverables from the Contractor, as well as deadlines for the Forest Service and PWD to respond to all materials provided by the Contractor. Once the details of this schedule are agreed to, the Parties shall undertake their best efforts to comply with all deadlines set forth in said schedule.

N. MODIFICATIONS. Modifications within the scope of this MOU must be made by mutual consent of the parties, by the issuance of a written modification signed and dated by all properly authorized, signatory officials, prior to any changes being performed. Requests for modification should be made, in writing, at least 30 days prior to implementation of the requested change.

O. COMMENCEMENT/EXPIRATION DATE. This MOU is executed as of the date of the last signature and is effective through 12/31/2013 at which time it will expire, unless extended by an executed modification, signed and dated by all properly authorized, signatory officials.

P. AUTHORIZED REPRESENTATIVES. By signature below, each party certifies that the individuals listed in this document as representatives of the individual parties are authorized to act in their respective areas for matters related to this MOU. In witness whereof, the parties hereto have executed this MOU as of the last date written below.

7/26/12

MATTHEW KNUDSON, Engineering Manager — Date
Palmdale Water District

06/29/2012

MARTIN DUMPIS, Acting Forest Supervisor — Date
U.S. Forest Service, Angeles National Forest

The authority and format of this agreement have been reviewed and approved for signature.

6/29/12

BONNIE HARRIS — Date
U.S. Forest Service Grants & Agreements Specialist

USDA United States Department of Agriculture
Forest Service
Angeles National Forest
Santa Clara/Mojave Rivers Ranger District
33708 Crown Valley Road
Acton, CA 93510
661-296-9710 Voice
626-447-8992 TTY

File Code: 2720-2
Date: December 12, 2011

Matthew R. Knudson
Engineering Manager
Palmdale Water District
2029 East Avenue Q
Palmdale, CA 93550

DEC 15 2011

Dear Mr. Knudson:

Enclosed is the fully executed cost recovery agreement. Our Albuquerque office will send you a bill for collection within two weeks. As we discussed, the cost recovery agreement will pay for the Forest Service's review and potential issuance of an amendment for the removal of accumulated sediment from the reservoir and construction of a grade control structure. The estimated processing fee for these actions is $119,415.70. Appendix D of the Major Cost Recovery Agreement (enclosed) breaks down the scope of work showing the hours and costs for processing your application.

The estimated costs as shown in Appendix D are anticipated to cover progress on the processing of the application for amendment, up to and including the release of a Draft EIR/EIS to the public. The parties agree to review the status of funds and progress on processing the application approximately 6 months after the cost recovery bill is paid. The purpose of this joint review will be to determine additional funding necessary to complete the processing of the application and issuing the amendment.

When your payment is received, we will contact you and begin the review process. If you have any questions or if I can be of further assistance, please contact Joe Holzinger, Permit Administrator at (661) 296-9710 extension 249.

Sincerely,

WILBURN M. BLOUNT
District Ranger

CR Agreement #
12MJ-11050153981

FS-2700-26 (05/09)
USDA Forest Service
OMB No. 0596-0082

CATEGORY 6 MAJOR COST RECOVERY AGREEMENT

Between

USDA, FOREST SERVICE, Angeles National Forest,

DEC 1 5 2011

and the Palmdale Water District

This agreement is entered into between the UNITED STATES DEPARTMENT OF AGRICULTURE, FOREST SERVICE, Angeles National Forest (the Forest Service), and the Palmdale Water District (the applicant), under 36 CFR 251.58.

A. RECITALS

1. On 10/27/2011, the Forest Service accepted the applicant's application for use and occupancy of National Forest System lands (hereinafter "the application"), which is enumerated in Appendix A. The Forest Service shall assess the applicant a cost recovery fee for the agency's costs to process the application.

2. The Forest Service has determined that the fee for processing the application falls within category 6 under the applicable Forest Service processing fee schedule and/or that the fee for monitoring the applicant's special use authorization falls within category 6 under the applicable Forest Service processing fee schedule.

3. The geographic area to be covered by this agreement is Little Rock Reservoir (NE¼NW¼ of Sec. 3, T.4 N., R.11 W.; W½ of Sec. 34, T.5 N., R. 11 W.; SW¼SW¼ and SE¼SW¼ of Sec. 27, T.5 N., R.11 W., SBBM). See Appendix B.

4. The application has been submitted or the applicant's special use authorization is being issued under an authority other than the Mineral Leasing Act, and the applicant has not waived payment of reasonable costs. Therefore, the Forest Service is entitled to recover its full reasonable costs incurred in processing the application.

5. Payment of a processing fee by the applicant does not obligate the Forest Service to authorize the applicant's proposed use and occupancy. If the application is denied or withdrawn in writing, the applicant is responsible for costs incurred by the Forest Service in processing the application up to and including the date the agency denies the application or receives written notice of the applicant's withdrawal. If the applicant withdraws the application, the applicant also is responsible for any costs subsequently incurred by the Forest Service in terminating consideration of the application.

6. The Forest Service shall determine the appropriate level of environmental analysis for the application and inform the applicant prior to initiating the environmental analysis.

7. Information associated with this agreement may be released to the public in accordance with the provisions of the Freedom of Information Act and Privacy Act.

PART I PROCESSING FEES

B. BASIS FOR PROCESSING FEES

Processing fees for the application are based upon the direct and indirect costs that the Forest Service incurs in reviewing the application, conducting environmental analyses of the effects of the proposed use, reviewing any applicant-generated environmental documents and studies, conducting site visits, evaluating the applicant's technical and financial qualifications, making a decision on whether to issue the authorization, and preparing documentation of analyses, decisions, and authorizations for the application. The processing fee for the application shall be based only on costs that are necessary for processing the application. "Necessary for" means that but for the application, the costs would not have been incurred. The processing fee shall not include costs for studies for programmatic planning or analysis or other agency management objectives, unless they are necessary for processing the application. Proportional costs for analyses, such as capacity studies, that are necessary for the application may be included in the processing fee.

C. AGREEMENT

In consideration of the foregoing, the parties agree as follows:

1. Scope of Work. The Forest Service shall develop a scope of work for processing the application and an estimate of the agency's costs to process the application, which will be incorporated into this agreement as Appendix C. This scope of work shall report direct costs in categories that correspond to those in the agency's accounting system, e.g., job code, personnel compensation based upon the cost to the government (salary and benefits), travel, and other direct services, materials, and supplies. In addition, the estimate of the agency's processing costs shall include the agency's indirect costs based upon the approved annual indirect cost rate. Classification of costs as direct or indirect shall be in accordance with the published Forest Service budget for the applicable fiscal year.

2. Environmental Analysis. The Forest Service shall supervise the preparation of the environmental analysis associated with the application in compliance with applicable legal requirements, including public review of the analysis, analysis of public comments, and decision documentation. In exercising this responsibility, the Forest Service shall endeavor to foster cooperation among other agencies involved in the process, and to integrate National Environmental Policy Act requirements and other environmental review and consultation requirements to avoid, to the fullest extent possible, duplication of efforts by those agencies. However, the Forest Service shall not delegate to any other agency its authority over the scope and content of the environmental analysis, or approval or denial of the application.

3. Billing. The Forest Service shall bill the applicant prior to commencement of work. The applicant agrees to pay the estimated processing fee of $119,415.70. The bill for the estimated processing fee will be issued from the Forest Service Albuquerque Service Center once this agreement is executed.

4. Payment. The applicant shall pay the estimated processing fee within 30 days of the date the bill for the fee is issued. The Forest Service shall not initiate processing the application until the estimated processing fee is paid. If the applicant fails to pay the estimated processing fee or the fee is late, the Forest Service shall cease processing the application until the fee is paid.

5. Statement of Costs. The Forest Service shall annually report costs incurred for processing the application by providing a financial statement from the agency's accounting system to the applicant.

6. Underpayment. When the estimated processing fee is lower than the full actual costs of processing an application submitted under the Mineral Leasing Act, or lower than the full reasonable costs (when the applicant has not waived payment of reasonable costs) of processing an application submitted under other authorities, the applicant shall pay the difference between the estimated and full actual or reasonable processing costs within 30 days of billing.

7. Overpayment. If payment of the processing fee exceeds the full actual costs of processing an application submitted under the Mineral Leasing Act, or the full reasonable costs (when the applicant has not waived payment of reasonable costs) of processing an application submitted under other authorities, the Forest Service shall either (a) refund the excess payment to the applicant or (b) at the applicant's request, credit it towards monitoring fees due.

8. Disputes

a. If the applicant disagrees with the estimated dollar amount of the processing costs, the applicant may submit a written request before the disputed fee is due for substitution of alternative estimated costs to the immediate supervisor of the authorized officer who determined the estimated costs. The written request must include supporting documentation.

b. If the applicant pays the full disputed processing fee, the Forest Service shall continue to process the application during the supervisory officer's review of the disputed fee, unless the applicant requests that the application processing cease.

c. If the applicant fails to pay the full disputed processing fee, the Forest Service shall suspend further processing of the application pending the supervisory officer's determination of an appropriate processing fee and the applicant's payment of that fee.

d. The authorized officer's immediate supervisor shall render a decision on a disputed processing fee within 30 calendar days of receipt of the written request from the applicant. The supervisory officer's decision is the final level of administrative review. The dispute shall be decided in favor of the applicant if the supervisory officer does not respond to the written request within 30 days of receipt.

9. Lack of Administrative Appeal. A decision by an authorized officer to assess a processing fee or to determine the estimated costs is not subject to administrative appeal. A decision by an authorized officer's immediate supervisor in response to a request for substitution of alternative estimated costs likewise is not subject to administrative appeal.

10. Amendment. Modifications to this agreement shall be made in writing and shall be signed and dated by both parties.

11. Expiration and Termination. This agreement expires on 12/31/2013. Either party, in writing, may terminate this agreement in whole or in part at any time before it expires. The applicant is responsible for all Forest Service costs covered by this agreement that are incurred up to the date of expiration or termination.

12. Principal Point of Contact. The Forest Service and the applicant shall each establish a principal point of contact for purposes of this agreement.

The Forest Service's contact is Joe Holzinger, Project Manager, (661) 296-9710 x249.

The applicant's contact is Matthew R. Knudson, Engineering Manager, 661-456-1018.

This agreement is accepted subject to all terms and conditions.

DENNIS D.LAMOREAUX
GENERAL MANAGER
PALMDALE WATER DISTRICT

12/8/11
Date

WILBURN M. BLOUNT
DISTRICT RANGER
USDA, FOREST SERVICE

12/12/11
Date

According to the Paperwork Reduction Act of 1995, an agency may not conduct or sponsor, and a person is not required to respond to a collection of information unless it displays a valid OMB control number. The valid OMB control number for this information collection is 0596-0082. The time required to complete this information collection is estimated to average 4 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, gender, religion, age, disability, political beliefs, sexual orientation, and marital or family status. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at 202-720-2600 (voice and TDD).

To file a complaint of discrimination, write USDA, Director, Office of Civil Rights, 1400 Independence Avenue, SW, Washington, DC 20250-9410 or call toll free (866) 632-9992 (voice). TDD users can contact USDA through local relay or the Federal relay at (800) 877-8339 (TDD) or (866) 377-8642 (relay voice). USDA is an equal opportunity provider and employer.

The Privacy Act of 1974 (5 U.S.C. 552a) and the Freedom of Information Act (5 U.S.C. 552) govern the confidentiality to be provided for information received by the Forest Service.

APPENDIX A

Applications and Authorizations Subject to this Agreement

Applications

SF 299, Application for Transportation and Utility Systems and Facilities on Federal Lands, on file at the Santa Clara/Mojave Rivers Ranger District Office, 33708 Crown Valley Road, Acton, CA 93510.

Authorizations

Upon completion of the review of Palmdale Water District's environmental documents, the Forest will be prepared to issue an Amendment, FS-2700-23, to Palmdale Water District's Special Use Permit, dated December 05, 1997, for the removal of accumulated sediment from the reservoir and construction of a grade control structure, or any alternatives to the project as determined through the NEPA process. The amendment will be issued under the authority of the Federal Land & Policy Management Act, as amended.

APPENDIX B

Description and Map of the Geographic Area

This project is located in the NE¼NW¼ of Sec. 3, T.4 N., R.11 W.; W½ of Sec. 34, T.5 N., R. 11 W.; SW¼SW¼ and SE¼SW¼ of Sec. 27, T.5 N., R.11 W., SBBM.

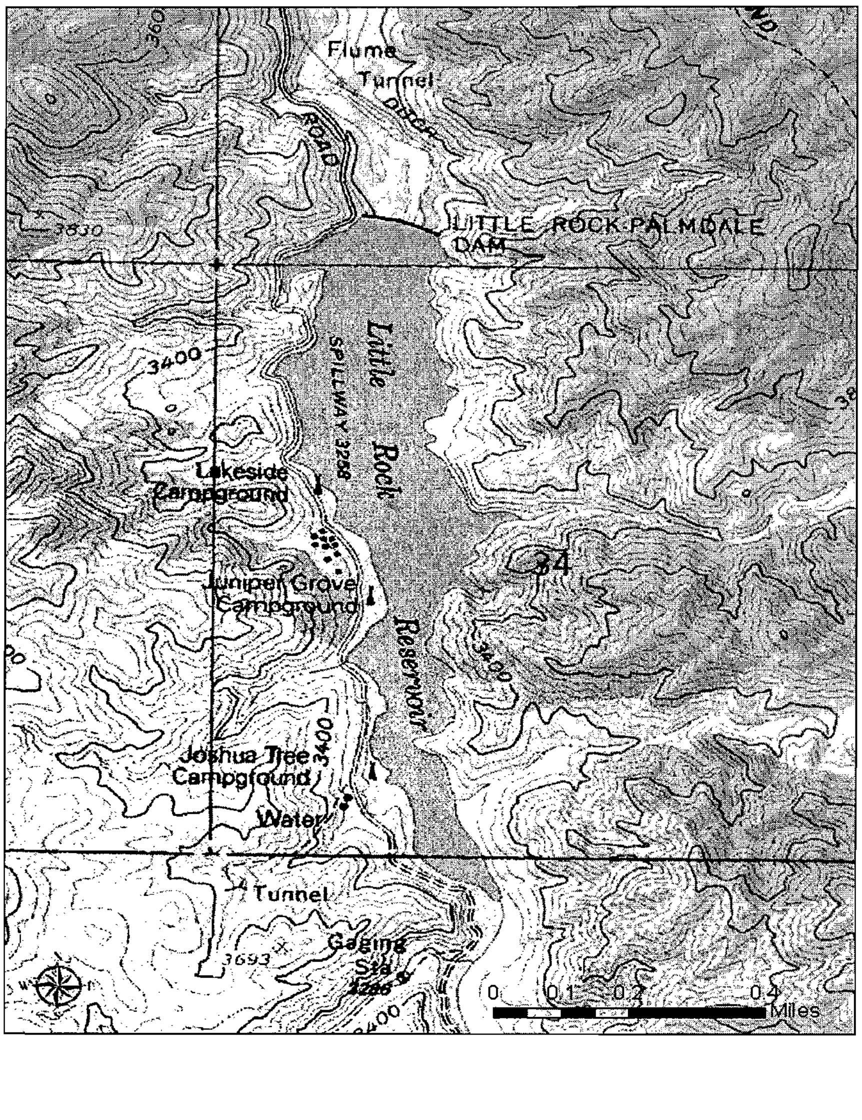


Figure 1: Little Rock Reservoir. Angeles National Forest.

APPENDIX C

Scope of Work

The study area is located at the Little Rock Reservoir within the Santa Clara/Mojave Rivers Ranger District of the Angeles National Forest. The reservoir is located on Little Rock Creek in the northeastern foothills of the San Gabriel Mountains on the western edge of the Mojave Desert. The purpose of the project is to remove accumulated sediment from the Little Rock Reservoir to provide greater water storage for the Palmdale Water District (PWD).

The reservoir, supplied by Little Rock Creek, was constructed in 1924 with an initial design capacity of 4,300 acre-feet. The capacity has been substantially reduced over time by the deposition of sediment behind the dam. By 1991, the capacity of the reservoir had been reduced by sediment deposition to approximately 1,600 acre-feet. As a result of the 1992 Little Rock Dam and Reservoir Restoration Project, the height of the dam was raised to increase the reservoir capacity by approximately 1,723 acre-feet with a surface area of nearly 100 acres. The current reservoir storage capacity is approximately 3,000 acre-feet. Preliminary calculations indicate that the reservoir capacity is further reduced at a rate of approximately 30 to 40 acre-feet per year.

Palmdale Water District proposes to remove approximately 540,000 cubic yards of sediment from the reservoir over a two year period. After the initial sediment removal phase, annual or semi-annual sediment removal of approximately 54,000 cubic yards would be required as ongoing maintenance depending on the mean annual sediment load that is carried into the reservoir during winter storms. In order to remove sediment without compromising upstream habitat for the arroyo toad and other aquatic organisms, the construction of a grade control structure is also proposed at Rocky Point, an area annually submerged below the typical high water mark of the reservoir. This structure would be at or below grade and would prevent head-cutting and the loss or modification of sediment levels in upstream areas. This would allow for continued use and operation of the Little Rock Reservoir.

In order for work to proceed, an Amendment to PWD's Special Use Permit must be issued to PWD for the removal of accumulated sediment from the reservoir and construction of a grade control structure. Before an Amendment can be issued, certifications from Forest biologists, botanists, hydrologists, and archeology staff must be in place before a Decision Memo can be signed by the Forest Supervisor, which in effect, becomes the foundation document for the issuance of the Amendment and authorizes the action to take place.

The Forest Service is the lead agency responsible for compliance with NEPA regulations. The proponent (PWD) is responsible for the preparation of the environmental impact statement (EIS), thereby converting PWD and USF&WS documents into the Forest Service format, updating species information, and addressing Management Indicator Species (MIS).

Outcomes:

- Compliance with NEPA regulations and agency policy.
- Compliance with the Forest's Land Management Plan.
- Compliance with Section 106 of the National Historic Preservation Act.

- Compliance with the Endangered Species Act.
- Amendment authorizing the removal of accumulated sediment from the reservoir and construction of a grade control structure, or other alternatives as determined through the NEPA process.

This information will be used to estimate the costs associated with the time needed to process the Amendment in accordance with Cost Recovery legislation.

The estimated costs as shown in Appendix D are anticipated to cover progress on the processing of the application for amendment, up to and including the release of a Draft EIR/EIS to the public. This was revised from the original estimate which included full processing of the application up to and including issuance of the permit amendment. The revision was made at the request of the Palmdale Water Company to lessen the amount of advance payment needed to proceed with processing the amendment. The parties agree to review status of funds and progress on processing the application approximately 6 months after cost recovery bill is paid. The purpose of this joint review will be to determine additional funding necessary to complete the processing of the application and issuing the amendment.

APPENDIX D

Cost Estimate

Attached

Processing	Amendment# : 2	Type of NEPA : EIS	
Item	**Item Description**	**Est. Hours**	
ARCHAEOLOGIST/CULTURAL RESOURCES	Review, consultation, inspection	280	
CASE MANAGER	Project Manager	500	
WILDLIFE BIOLOGIST	Review, consultation, inspection	280	
BOTANIST	Review, consultation, inspection	200	
ENGINEER/ENGINEERING TECH	Review, consultation, inspection	160	
HYDROLOGIST	Review, consultation, inspection	160	
LANDSCAPE ARCHITECT	Review, consultation, inspection	160	
RECREATION SPEC/TECH	Review, consultation, inspection	100	
NEPA COORDINATOR	Review, consultation, coordination	80	
RESOURCE CLERK/ASST/SPEC	Review, consultation, inspection	20	
OTHER SPECIALIST	Air Quality Specialist; Review, consultation	160	
	Total Hours :	**2100**	**Category :** 6

For Categories 5 or 6 Determine Estimated and Actual Costs:

Item	Item Description	Hourly Rate	Estimated Hours	Estimated Cost	Actual Hours	Actual Cost	Comments
ARCHAEOLOGIST/CULTURAL RESOURCES	Review, consultation, inspection	$53.83	280	$15,072.40		$0.00	
BOTANIST	Review, consultation, inspection	$43.88	200	$8,776.00		$0.00	
CASE MANAGER	Project Manager	$34.32	500	$17,160.00			
ENGINEER/ENGINEERING TECH	Review, consultation, inspection	$58	160	$9,280.00		$0.00	
HYDROLOGIST	Review, consultation, inspection	$59.22	160	$9,475.20		$0.00	
LANDSCAPE ARCHITECT	Review, consultation, inspection	$52	160	$8,320.00		$0.00	
NEPA COORDINATOR	Review, consultation, coordination	$53	80	$4,240.00		$0.00	
OTHER SPECIALIST	Air Quality Specialist; Review, consultation	$63.78	160	$10,204.80		$0.00	
RECREATION SPEC/TECH	Review, consultation, inspection	$44	100	$4,400.00		$0.00	
RESOURCE CLERK/ASST/SPEC	Review, consultation, inspection	$39.47	20	$789.40		$0.00	
WILDLIFE BIOLOGIST	Review, consultation, inspection	$44	280	$12,320.00		$0.00	
	Sub - Totals :		**2,100**	**$100,037.80**		**$0.00**	

Other Expenses	Item Description	Estimated Cost	Actual Cost	Comments

OTHER EXPENSE	OVERTIME	$9,600.00		**20 days @ $60.00 per hour**
VEHICLE	SITE VISITS, SURVEYS, MEETINGS	$1,550.00		**5000 miles @ $0.31 per mile**
	Sub - Totals :	**$11,150.00**		
	Totals :	**$111,187.80**	**$0.00**	
	Add Burden Rate : 7.4 %	**$8,227.90**	**$0.00**	
	Grand Totals :	**$119,415.70**	**$0.00**	

Report Name: SPUCR10L

Report Title: **Estimation Sheet for Cost Recovery and/or Fee**

Run by: **JSEASTRAND**

Instance ID: **10602**

Instance Name: **Server**

Selected By

CN: 12511679010602

Sorted By

Note Table Used: II_SU_CR_FEES, II_SUF_CRS

End of Report

USDA

COPY

US FOREST SERVICE
BILL FOR COLLECTION

BILL DATE: 01/23/12 PAGE: 01

ENCLOSE A COPY OF THIS BILL WITH YOUR CHECK OR MONEY ORDER. DO NOT SEND CASH. PLEASE INCLUDE BILL NO. AND PAYER CODE ON YOUR CHECK.
MAKE CHECK PAYABLE TO:
US FOREST SERVICE

MAIL PAYMENT TO:
US FOREST SERVICE
C/O CITIBANK
P.O. BOX 301550
LOS ANGELES, CA 90030-1550

TO:

PALMDALE WATER DISTRICT
2029 EASST AVE Q

PALMDALE CA 93550

PAYER INDICATE AMOUNT ENCLOSED:

NET AMOUNT DUE: $ 119,415.70

DUE DATE: 02/22/12

BILL NUMBER: BA RACA2A00263

PAYER CODE: 956004540 A

AGREEMENT NO: 0501-12-MJ-981 CONTRACT NO:

DESCRIPTION: SCM101101; PALMDALE WATER DIST

REMARKS:
RE: PAYER CODE: 956004540 A BILL NO: BA RACA2A00263

NOTE:
PLEASE SEND ALL CORRESPONDENCE, INQUIRIES, AND CHANGE OF ADDRESS TO:

US FOREST SERVICE, ABQ SRV CTR
101B SUN AVE NE - RACA
ALBUQUERQUE, NM 87109
877-372-7248 BUDGET & FINANCE

PRINCIPAL:	$	119,415.70
INTEREST:		
ADMINISTRATIVE COSTS:		
PENALTY:		
AMOUNT DUE:	$	119,415.70
AMOUNT CREDITED:		
NET AMOUNT DUE:	$	119,415.70

FAILURE TO MAKE PAYMENT BY THE DUE DATE WILL RESULT IN THE ASSESSMENT OF LATE PAYMENT CHARGES (INTEREST, ADMINISTRATIVE COST, AND/OR PENALTY CHARGES) IN ACCORDANCE WITH YOUR CONTRACT, PERMIT, OR THE DEBT COLLECTION ACT OF 1982, AS AMENDED. POSTMARKS ARE NOT HONORED. LATE FEES DO NOT APPLY FOR BILLINGS IN ADVANCE OF RECEIPT OF GOODS OR SERVICES

LINE: 001 ORG: 0501 JOB: MJ298112

SCM101101; FS AGREEMENT NO.: 12-MJ-11050153-981
PRC: HOLZINGER, JOE 661 296-9710 JHOLZINGER@FS.FED.US
FS BILLING POC: ASC RACA 877-372-7248, #1
CR AGREEMENT / PALMDALE WATER DISTRICT

MJ2981
MJL
SPECIAL BILLING REQUEST C12: ALSO EMAILPRC JHOLZINGER@FS.FED.US

LINE	ORG	JOB	AMOUNT	LINE	ORG	JOB	AMOUNT	LINE	ORG	JOB	AMOUNT
001	0501	MJ298112	$ 119,415.70								

Attachment 4
Budget



Littlerock Reservoir Sediment Removal Project

Attachment 4

Stormwater Flood Management Grant Proposal Littlerock Reservoir Sediment Removal Project Budget

Attachment 4 consists of the following items:

✓ **Budget.** Attachment 4 provides a budget estimate for each budget category row of the proposed project.

Introduction

This attachment presents detailed budget information and supporting documentation for the Littlerock Reservoir Sediment Removal Project (LRSR Project). The project proposal offers tremendous investment value to the State for a number of reasons including:

- The proposal provides 54.0 percent of funding from non-State sources, demonstrating there is a strong commitment from PWD to the implementation of this project.
- 100 percent of the grant funding request will be used directly for construction or construction-related activities.

A summary budget for the LRSR Project is provided in Table 4-1 while Table 4-2 provides a cost breakdown by Work Plan task and sub-task. Tables 4-3 through 4-13 provide detailed budget breakdowns for each of the budget categories. The cost breakdown for each budget is provided for each of the budget categories included in the sample budget provided in Exhibit B of the Proposition 1E IRWM Proposal Solicitation Package and are consistent with the categories included in the Work Plan (provided in Attachment 3) and Schedule (provided in Attachment 5).

Table 4-1: Total Project Budget[1]

		(a)	(b)	(c)	(d)	(e)
Budget Category		Requested Grant Amount	Cost Share: Non-State Fund Source* (Funding Match)	Cost Share: Other State Fund Source*	Total	% Funding Match
(a)	Direct Project Administration		$68,728		$68,728	100%
(b)	Land Purchase/Easement		$0		$0	N/A
(c)	Planning/Design/Engineering/ Environmental Documentation		$1,198,550		$1,198,550	100%
(d)	Construction/Implementation	$5,500,000	$2,742,723		$8,242,723	33.3%
(e)	Environmental Compliance/ Mitigation/Enhancement		$81,650		$81,650	100%
(f)	Construction Administration		$192,900		$192,900	100%
(g)	Other Costs (Including Legal Costs, Permitting and		$118,000		$118,000	100%

	Licenses)					
(h)	Construction/Implementation Contingency		$2,060,682		$2,060,682	100%
(i)	**Grand Total (Sum rows (a) through (h) for each column)**	**$5,500,000**	**$6,463,233**		**$11,963,233**	**54.0%**
*Sources of Funding: *PWD funds*						

Table 4-2: Cost Breakdown by Work Plan Task and Subtask

Row/Task	Category	Total
Row (a)	Direct Project Administration	**$68,728**
Task 1	*Project Administration*	*$31,900*
Task 2	*Labor Compliance Program*	*$26,928*
Task 3	*Reporting*	*$9,900*
Row (b)	Land Purchase Easement	***$0***
Row (c)	Planning/Design/Engineering/Environmental Documentation	**$1,198,550**
Task 4	*Assessment and Evaluation*	*$206,600*
Task 5	*Project Design*	*$635,900*
Task 6	*Environmental Documentation*	*$258,550*
Task 7	*Permitting*	*$97,500*
Row (d)	Construction	**$8,242,723**
Task 8	*Construction Contracting*	*$8,100*
Task 9	*Construction*	*$8,234,623*
Row (e)	Environmental Compliance/Mitigation/Enhancement	**$81,650**
Task 10	*Environmental Compliance/Mitigation/Enhancement*	*$81,650*
Row (f)	Construction Administration	**$192,900**
Task 11	*Construction Administration*	*$192,900*
Row (g)	Other Costs	**$118,000**
Row (h)	Construction Contingency	**$2,060,682**
Row (i)	Grand Total	**$11,963,233**

Row (a) Direct Project Administration

Task 1 – Project Administration:

The Project Administration cost estimate of $31,900 was calculated based on labor costs shown in Table 4-3. Project Administration includes the following activities; completed tasks are not included in the cost estimate:

- Cost Recovery Agreement (completed)
- Memorandum of Understanding (completed)
- Project Administration
- Development of Financing
- Development of a Project Management Plan

Table 4-3: Project Administration Budget

Discipline	Hourly Wage ($/hr)	Number of Hours	Total
Engineering Manager	$150.00	50	$7,500
Project Manager	$145.00	100	$14,500
Engineering Technician	$110.00	40	$4,400
Construction Inspector	$110.00	50	$5,500
		Total	**$31,900**

Task 2 – Labor Compliance Program:

The Labor Compliance Program (LCP) cost estimate of $26,928 as presented in Table 4-4 was calculated based on an estimated 0.30 percent fee of the project construction costs (Tasks 8 and 9 below) for the actual LCP plus minor costs for compliance monitoring. These allocated costs will be used to contract Golden State Labor Compliance, LLC or a similar company to implement the LCP.

Upon grant award notification, PWD will register with the Department of Industrial Relations Compliance Monitoring Unit as required by AB 436 to monitor and enforce prevailing ware requirements for this public works project. Labor for this effort is included in Table 4-4. The Labor Compliance Program includes the following activities; completed tasks are not included in the cost estimate:

- Labor Compliance Program
- Compliance Monitoring Unit Registration

Table 4-4: Labor Compliance Program Budget

Subtask	Discipline	Hourly Wage ($/hr)	Number of Hours	Total
Labor Compliance Program	Third Party Compliance Program	Lump Sum	N/A	$24,728
Compliance Monitoring Unit Registration	Engineering Technician	$110.00	20	$2,200
			Total	**$26,928**

Task 3 – Reporting:

The Reporting cost estimate of $9,900 was calculated based on labor costs shown in Table 4-5. Reporting includes the following activities; completed tasks are not included in the cost estimate:

- Contract Agreement between PWD and the State of California
- Quarterly Invoices and Progress Reports
- Final Project Report
- Post-Completion Report

Table 4-5: Reporting Budget

Discipline	Hourly Wage ($/hr)	Number of Hours	Total
Engineering Manager	$150.00	10	$1,500
Project Manager	$145.00	20	$2,900
Engineering Technician	$110.00	50	$5,500
		Total	**$9,900**

Row (b) Land Purchase/Easement

The LRSR Project will not require purchase of land or acquisition of right-of-ways. PWD has received a special use permit from the USFS authorizing PWD to use National Forest System lands to operate the dam and will obtain an additional Special Use Authorization to construct and operate the Project.

Row (c) Planning/Design/Engineering/Environmental Documentation

Task 4 – Assessment and Evaluation:

The Assessment and Evaluation cost estimate of $206,600 was calculated based on labor costs shown in Table 4-6. Assessment and Evaluation includes the following activities; completed tasks are not included in the cost estimate:

- DRAFT Littlerock Reservoir Sediment Removal Project Biological Resources Technical Report (completed draft)
- Geotechnical Investigation, Data Collection, and Survey Memoranda (completed)
- Feasibility Study (completed)
- DRAFT Littlerock Reservoir Hydrologic and Sediment Transport Analysis Technical Report
- Final Biological Technical Report
- Final Hydrological and Sediment Transport Analysis Technical Report
- Updated Topographic Mapping

Table 4-6: Assessment and Evaluation Budget

Discipline	Hourly Wage ($/hr)	Number of Hours	Total
Engineering Manager	$150.00	10	$1,500
Project Manager	$145.00	20	$2,900
Engineering Technician	$110.00	20	$2,200
Engineering/Planning Consultants	$200.00	1,000	$200,000
		Total	**$206,600**

Task 5 – Project Design:

The Project Design cost estimate of $635,900 was calculated based on labor costs shown in Table 4-7. These design costs represent approximately 8 percent of total construction costs. Project Design includes the following activities:

- Excavation Plan

- Conceptual Design Plan
- 30% Design
- 60% Design
- 90% Design
- Final (100%) Design

Table 4-7: Project Design Budget

Discipline	Hourly Wage ($/hr)	Number of Hours	Total
Engineering Manager	$150.00	40	$6,000
Project Manager	$145.00	100	$14,500
Engineering Technician	$110.00	100	$11,000
Construction Inspector	$110.00	40	$4,400
Engineering/Design Consultants	$200.00	3000	$600,000
		Total	**$635,900**

Task 6 – Environmental Documentation:

The Environmental Documentation cost estimate of $258,550 was calculated based on labor costs shown in Table 4-8. Environmental Documentation includes the following activities:

- Notice of Preparation - EIR/EIS
- Draft EIR/EIS
- Final EIR/EIS

Table 4-8: Environmental Documentation Budget

Discipline	Hourly Wage ($/hr)	Number of Hours	Total
Engineering Manager	$150.00	40	$6,000
Project Manager	$145.00	10	$1,450
Engineering Technician	$110.00	10	$1,100
Engineering/Design Consultants	$200.00	1250	$250,000
		Total	**$258,550**

Task 7 – Permitting:

The Permitting cost estimate of $97,500 was calculated based on labor costs shown in Table 4-9. Permitting includes the following activities that will be completed by a consultant:

- USDA Forest Service SUA
- CWA Section 404 Permit (and WMP)
- CWA Section 402 Certification
- NPDES (and SWPPP)
- ESA BO
- Section 2081 ITP

- Section 1602 and 1605 Permits

Table 4-9: Permitting Budget

Discipline	Discipline	Hourly Wage ($/hr)	Number of Hours	Total
USDA Forest Service SUA	Staff	$150.00	60	$9,000
CWA Section 404 Permit (and WMP)	Staff	$150.00	80	$12,000
CWA Section 402 Certification	Staff	$150.00	60	$9,000
NPDES (and SWPPP)	Staff	$150.00	80	$12,000
ESA BO	Staff	$150.00	250	$37,500
Section 2081 ITP	Staff	$150.00	40	$6,000
Section 1602 and 1605 Permits	Staff	$150.00	80	$12,000
			Total	**$97,500**

Row (d) Construction

Task 8 – Construction Contracting:

The Construction Contracting cost estimate of $8,100 was calculated based on labor costs shown in Table 4-8. Construction Contracting includes the following activities; completed tasks are not included in the cost estimate:

- Preparation of Bid Packages
- Advertisement of Bids
- Pre-Bid Contractors Meeting
- Evaluation of Bids
- Bid Award
- Notice to Proceed

Table 4-8: Construction Contracting Budget

Discipline	Hourly Wage ($/hr)	Number of Hours	Total
Engineering Manager	$150.00	20	$3,000
Project Manager	$145.00	20	$2,900
Engineering Technician	$110.00	10	$1,100
Construction Inspector	$110.00	10	$1,100
		Total	**$8,100**

Task 9– Construction:

The Construction cost estimate of $8,234,623 was calculated based on the activities and labor costs shown in Table 4-9.

Table 4-9: Construction Budget

Activity	Labor Hrs	Labor Amount	Material Amount	Equip Amount	Sub Amount	Other Amount	Total Amount
Subtask 9.1 Special Conditions[1]							
Mobilization	-	-	-	$61,000	$64,095	$15,000	$140,095
Temporary Electric Power – Dewatering	1,152	$90,769	$50,600	$75,373	-	$223,600	$440,342
Asphalt Paving	-	-	-	-	$100,000	-	$100,000
Lawns & Grasses	-	-	-	-	$171,968	-	$171,968
						Sub total	**$852,405**
Subtask 9.2 Grade Control Structure[1]							
Water Truck	-	-	-	$25,200	-	-	$25,200
Site Clearing	788	$42,659	-	$12,662	-	-	$55,321
Dewatering	5,146	$334,476	$144,979	$39,318	$23,000	-	$541,773
Excavation Support & Protection	163	$9,893	$43	$58,253	$19,271	-	$87,460
Earthwork	5,197	$339,795	-	$509,154	-	-	$848,949
Soil Stabilization	2,600	$167,252	$120,000	$180,188	$10,000	-	$477,440
Transmission Pipelines	936	$53,109	$86,236	$25,400	-	$4,470	$169,215
Water Supply & Treatment Pumps	356	$33,014	$4,200	$4,166	$37,820	-	$79,200
						Sub Total	**$2,284,558**
Subtask 9.3 Sediment Removal[2]							
Sediment Excavation and Disposal	-	-	-	-	-	$5,097,660	$5,097,660
						Sub Total	**$5,097,660**
						Total	**$8,234,623**

Notes:

1. Based on *Palmdale Water District Littlerock Reservoir Sediment Removal Project Concept - Opinion of Construction Cost,* CDM-Smith, 2013.
2. Based on *Littlerock Reservoir Approximate Costs*, Aspen Environmental, January 2007 (costs for sediment removal have been adjusted to 2012 dollars using CCI and are prorated for a net volume of 900,000 cubic yards).

Row (e) Environmental Compliance/Mitigation/Enhancement

Task 10- Environmental Compliance/Mitigation/Enhancement:

The Environmental Compliance/Mitigation/Enhancement cost estimate of $81,650 was calculated based on labor costs shown in Table 4-10. Environmental Compliance/Mitigation/Enhancement includes the following activities:

- Mitigation Monitoring Compliance and Reporting Program

Table 4-10: Environmental Compliance/Mitigation/Enhancement Budget

Discipline	Hourly Wage ($/hr)	Number of Hours	Total
Engineering Manager	$150.00	200	$30,000
Project Manager	$145.00	250	$36,250
Engineering Technician	$110.00	100	$11,000
Construction Inspector	$110.00	40	$4,400
		Total	**$81,650**

Row (f) Construction Administration

Task 11- Construction Administration:

The Construction Administration cost estimate of $192,900 was calculated based on labor costs shown in Table 4-11. Construction Administration includes the following activities:

- Construction Administration
- Quarterly Construction Reports

Table 4-11: Construction Administration Budget

Discipline	Hourly Wage ($/hr)	Number of Hours	Total
Engineering Manager	$150.00	200	$30,000
Project Manager	$145.00	380	$55,100
Engineering Technician	$110.00	80	$8,800
Construction Inspector	$110.00	900	$99,000
		Total	**$192,900**

Row (g) Other Costs

Other Costs are estimated at $118,000 and are based on labor costs shown in Table 4-12. Other Costs include the following activities; completed tasks are not included in the cost estimate:

- Development of Data Management
- Development of Performance Measures and Monitoring Plan
- Development of Operations and Maintenance Plan

Table 4-12: Other Costs Budget

Discipline	Hourly Wage ($/hr)	Number of Hours	Total
Engineering Manager	$150.00	80	$12,000
Project Manager	$145.00	200	$29,000
Engineering Technician	$110.00	320	$35,200
Construction Inspector	$110.00	380	$41,800
		Total	**$118,000**

Row (h) Construction Contingency

A contingency of 25 percent is added to the construction costs listed in Tasks 8 and 9 to account for unknown conditions encountered during construction or implementation of the Project. The 25 percent value is consistent with a "budget level estimate" as defined by the American National Standards Institute (ANSI) for projects that are at a level of project definition that is 15 to 45 percent complete. PWD has selected this number as appropriate for the LRSR. The contingency costs are $2,060,682.

Row (i) Grand Total

The grand total of rows (a) through (h) is $11,963,233 as shown in Table 4-13.

Table 4-13: Row (i) Grand Total Costs

Row	Budget Category	Total Costs
(a)	Direct Project Administration Costs	$68,728
(b)	Land Purchase/Easement	$0
(c)	Planning/Design/Engineering/ Environmental Documentation	$1,198,550
(d)	Construction/Implementation	$8,242,723
(e)	Environmental Compliance/ Mitigation/Enhancement	$81,650
(f)	Construction Administration	$192,900
(g)	Other Costs (Includes Permitting)	$118,000
(h)	Construction/Implementation Contingency	$2,060,682
(i)	**Grand Total**	**$11,963,233**

ATTACHMENT 5
SCHEDULE



LITTLEROCK RESERVOIR SEDIMENT REMOVAL PROJECT

Attachment 5

Stormwater Flood Management Grant Proposal Littlerock Reservoir Sediment Removal Project Schedule

Attachment 5 consists of the following items:

✓ **Work Plan.** Attachment 5 provides a detailed schedule of the proposed project.

Introduction

The proposed project schedule is provided in the following page. The schedule indicates start and end dates along with milestones for each of the tasks and linkages/dependencies between tasks. In accordance with the PSP, the schedule items align with the work tasks described in Attachment 3 Work Plan and Attachment 4 Budget, and include the following items:

- Development of financing
- Development of environmental documentation (CEQA)
- Project design and bid solicitation process
- Acquisition of rights-of- way (Not applicable for this project)
- Identification and acquisition of all necessary permits
- Development of a project management plan
- Construction start and end dates including significant milestones
- Implementation of any environmental mitigation or enhancement efforts
- Construction administration
- Project administration
- Progress reports and final report submittals

The schedule presented in this attachment assumes the proposed project is funded, with a grant effective award date of August 15, 2013.

Task 1: Project Administration

This task will extend throughout the implementation of the project.

Task 2: Labor Compliance Program

Palmdale Water District (PWD) will have a labor compliance program in place throughout the implementation of the project. Registration with the Department of Industrial Relations – Compliance Monitoring Unit is expected to be completed soon after PWD receives its grant award notification.

Task 3: Reporting

Quarterly reports will be submitted to DWR by the last day of the following months: March, June, September, and December. The final project report will be submitted to DWR within ninety (90) calendar days of DWR verification that all task associate with the Prop 1E Grant Program have been completed. The post completion reports will be submitted to DWR within ninety (90) calendar days after the first operation year of the project annually for a total of 10 years. Note the attached Gantt Schedule only shows the first post completion report.

Task 4: Assessment and Evaluation

All reports and topographical mapping will be completed by September 2013.

Task 5: Final Design

The final design of the project is scheduled to be completed by January 2014.

Task 6: Environmental Documentation

The draft public EIR/EIS is scheduled to be ready for review by December 2013. The final EIR/EIS is schedule to complete by June 2014.

Task 7: Permitting

Securing necessary permits began in October 2012 and is scheduled to be completed by October 2015.

Task 8: Construction Contracting

Construction contracting is scheduled to be completed by October 2015. Please refer to the Gantt schedule for details.

Task 9: Construction

Construction will commence October 2015 scheduled for completion December 2019. See the attached Gantt schedule for details.

Task 10: Environmental Compliance/Mitigation/Enhancement

The mitigation monitoring compliance and reporting program will be in place during construction activities starting October 2015 through December 2019.

Task 11: Construction Administration

Construction administration will begin October 2015 and will continue until the completion of the last quarterly construction report in January 2020. Quarterly construction reports will be submitted by the contractor to PWD. PWD will incorporate quarterly updates on construction along with the overall project quarterly reports that will be submitted to DWR.

Development of Performance Measures and Monitoring Plan

Post-project monitoring based on the monitoring, assessment and performance measures developed in Attachment 6 of this proposal will be used to ensure the project is meeting objectives. The development of the performance measures and monitoring plan is scheduled to commence June 2019 and completed by December 2019.

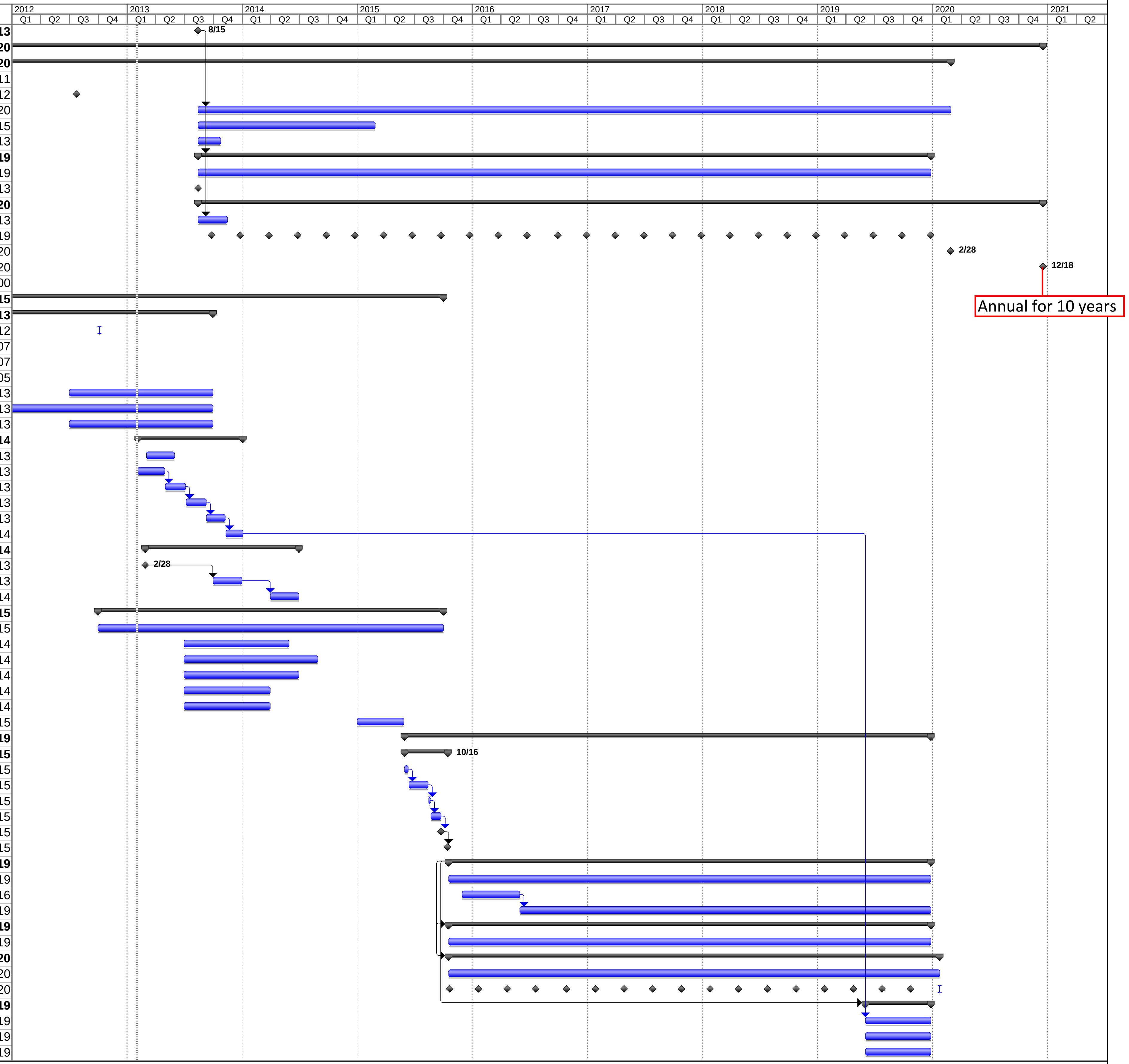
Development of Data Management

Along with the performances measures and monitoring plan, a data management system/plan will be developed to collect, store, and share data collected from the project. The development of the data management system/plan is scheduled to commence June 2019 and completed by December 2019.

Development of Operations and Maintenance Plan

PWD will develop an operations and maintenance plan during construction of the project. The development of the operations and maintenance plan is schedules to commence June 2019 and completed by December 2019.

Task Name	Start	Finish
Grant Award Date	**Thu 8/15/13**	**Thu 8/15/13**
Row (a) Direct Project Administration	**Thu 12/15/11**	**Fri 12/18/20**
Task 1: Administration	**Thu 12/15/11**	**Fri 2/28/20**
Cost Recovery Agreement (CRA)	Thu 12/15/11	Thu 12/15/11
Memorandum of Understanding (MOU)	Thu 7/26/12	Thu 7/26/12
Project Administration	Thu 8/15/13	Fri 2/28/20
Development of Financing	Thu 8/15/13	Fri 2/27/15
Development of Project Management Plan	Thu 8/15/13	Fri 10/25/13
Task 2: Labor Compliance Program	**Thu 8/15/13**	**Fri 12/27/19**
Labor Compliance Program	Thu 8/15/13	Fri 12/27/19
Compliance Monitoring Unit Registration	Thu 8/15/13	Fri 8/30/13
Task 3: Reporting	**Thu 8/15/13**	**Fri 12/18/20**
Contract Agreement with PWD and DWR	Thu 8/15/13	Fri 11/15/13
Quarterly Invoices and Progress Reports	Fri 9/27/13	Fri 12/27/19
Final Report	Fri 2/28/20	Fri 2/28/20
Post Completion Report	Fri 12/18/20	Fri 12/18/20
Row (b) Land Purchase / Easement (N/A)	**Sat 1/1/00**	**Sat 1/1/00**
Row (c) Planning / Design / Engineering / Environmental Documentation	**Fri 6/17/05**	**Fri 10/2/15**
Task 4: Assessment and Evaluation	**Fri 6/17/05**	**Mon 9/30/13**
Draft Littlerock Reservoir Sediment Removal Project Biological Resources Technical Report	Fri 10/5/12	Fri 10/5/12
Geotechnical Investigation, Data Collection, and Survey Memoranda	Tue 7/31/07	Tue 7/31/07
Feasibility Study	Fri 9/28/07	Fri 9/28/07
Draft Littlerock Reservoir Hydrologic and Sediment Transport Analysis Technical Report	Fri 6/17/05	Fri 6/17/05
Final Biological Technical Report	Mon 7/2/12	Mon 9/30/13
Final Hydrological and Sediment Transport Analysis Technical Report	Fri 7/1/05	Mon 9/30/13
Updated Topographic Mapping	Mon 7/2/12	Mon 9/30/13
Task 5: Final Design	**Mon 2/4/13**	**Fri 1/3/14**
Excavation Plan	Mon 3/4/13	Fri 5/31/13
Conceptual Design Plan	Mon 2/4/13	Tue 4/30/13
30% Design	Fri 5/3/13	Fri 7/5/13
60% Design	Mon 7/8/13	Mon 9/9/13
90% Design	Tue 9/10/13	Fri 11/8/13
100% Design (Final)	Mon 11/11/13	Fri 1/3/14
Task 6: Environmental Documentation	**Thu 2/28/13**	**Mon 6/30/14**
NOP - EIR/EIS	Thu 2/28/13	Thu 2/28/13
Draft Final EIR/EIS	Tue 10/1/13	Tue 12/31/13
Final EIR/EIS	Tue 4/1/14	Mon 6/30/14
Task 7: Permitting	**Mon 10/1/12**	**Fri 10/2/15**
USFS SUA	Mon 10/1/12	Fri 10/2/15
CWA Section 404 Permit and WMP	Mon 7/1/13	Fri 5/30/14
CWA Section 401 Certification	Mon 7/1/13	Fri 8/29/14
NPDES and Associated SWPPP	Mon 7/1/13	Mon 6/30/14
ESO BO	Mon 7/1/13	Mon 3/31/14
Section 2081 ITP	Mon 7/1/13	Mon 3/31/14
Section 1602 and 1605 Permits	Fri 1/2/15	Fri 5/29/15
Row (d) Construction / Implementation	**Mon 6/1/15**	**Fri 12/27/19**
Task 8: Construction Contracting	**Mon 6/1/15**	**Fri 10/16/15**
Preparation of Bid Packages	Mon 6/1/15	Fri 6/12/15
Advertisement for bids	Mon 6/15/15	Fri 8/14/15
Pre-bid Contractors Meeting	Mon 8/17/15	Fri 8/21/15
Evaluation of Bids	Mon 8/24/15	Thu 9/24/15
Bid Award	Fri 9/25/15	Fri 9/25/15
Notice to Proceed	Fri 10/16/15	Fri 10/16/15
Task 9: Construction	**Mon 10/19/15**	**Fri 12/27/19**
Subtask 9.1: Special Conditions	Mon 10/19/15	Fri 12/27/19
Subtask 9.2: Grade Control Structure	Tue 12/1/15	Tue 5/31/16
Subtask 9.3: Sediment Removal	Wed 6/1/16	Fri 12/27/19
Row (e) Environmental Compliance/ Mitigation/ Enhancement	**Mon 10/19/15**	**Fri 12/27/19**
Mitigation Monitoring Compliance and Reporting Program	Mon 10/19/15	Fri 12/27/19
Row (f) Construction Administration	**Mon 10/19/15**	**Fri 1/24/20**
Construction Administration	Mon 10/19/15	Fri 1/24/20
Quarterly Construction Reports	Fri 10/23/15	Fri 1/24/20
Row (g) Other	**Mon 6/3/19**	**Fri 12/27/19**
Development of Data Management	Mon 6/3/19	Fri 12/27/19
Development of Performance Measures and Monitoring Plan	Mon 6/3/19	Fri 12/27/19
Development of Operations and Maintenance Plan	Mon 6/3/19	Fri 12/27/19



Task | Milestone | Summary

Attachment 6
Monitoring, Assessment, and Performance Measures



Littlerock Reservoir Sediment Removal Project

Attachment 6

Stormwater Flood Management Grant Proposal
Littlerock Reservoir Sediment Removal Project
Monitoring, Assessment, and Performance Measures

Attachment 6 consists of the following items:

- ✓ Monitoring, Assessment, and Performance Measures. The purpose of this attachment is to describe the monitoring, assessment, and performance measures that will be used to evaluate the proposed project. These measures will ensure that this proposal meets its intended goals, achieves measurable outcomes, and provides value to the Region and the State of California.

The purpose of this attachment is to provide a discussion of the monitoring system to be used to verify project performance with respect to the project benefits or objectives identified. This attachment will identify data collection and analysis to be used by the proposed Project.

This attachment will also discuss how monitoring data will be used to measure the performance in meeting the overall goals and objectives of the Antelope Valley IRWM Plan. The Project applicant has prepared a Project Performance Measures Table (included in this attachment) that includes the following:

- Project goals
- Desired outcomes
- Targets – measurable targets that are feasible to meet during the life of the Project(s)
- Performance indicators – measures to evaluate change that is a direct result of the Project being built
- Measurement tools and methods – to effectively track performance

The project performance measures will continue to be refined as the Project continues to be developed. Upon receipt of grant award funding, the Project Performance Measures Table (Table 6-1) will be utilized to develop a project monitoring plan. Project benefits are discussed in more detail in Attachments 7 and 8.

Project:
Littlerock Reservoir Sediment Removal Project

The Littlerock Reservoir Sediment Removal Project (LRSR Project) will consist of a suite of activities designed to reduce dependence on imported water and improve water supply reliability, increase flood protection, protect environmental habitat, improve water quality, reduce energy consumption and reduce GHG emissions. These activities will be executed in order to meet the Project goals (listed below). Project goals will each have performance measures that will be used to quantify and verify project performance. The performance measures used to quantify and verify project performance are described in the Project Goals and Performance Measures section below and are summarized in Table 6-1.

Table 6-1: Performance Measures Table
Littlerock Reservoir Sediment Removal Project

Project Goals	Desired Outcomes	Targets	Performance Indicators	Measurement Tools and Methods
Water Supply - Increase capacity storage of local surface water supply in Littlerock Reservoir (Reservoir)	Increase water supply storage capacity of Reservoir	Removal of 900,000 net cubic yards of sediment to provide 560 AF of added storage capacity in the Reservoir	Quantification of increased surface water storage capacity at the Reservoir compared to baseline	Record of net cubic yards of sediment removed from Reservoir
Water Supply - Offset less reliable imported water supplies with more reliable local water supplies	Reduce dependence on less reliable imported water supplies	Increased use of local surface water supplies by 560 AFY and decreased use of SWP imported supplies by 560 AFY, on average	Quantification of local surface water and imported water use compared to baseline	Record of local surface water deliveries and imported water deliveries as measured by PWD influent flow meters for each source at the water treatment plant
Flood Protection - Provide debris control and peak flood attenuation at Littlerock Dam	Increase stormwater runoff storage capacity	Removal of 900,000 net cubic yards of sediment to provide 560 AF of added storage capacity in the Reservoir	Quantification of increased stormwater storage capacity at the Reservoir compared to baseline	Record of net cubic yards of sediment removed from Reservoir
Water Quality - Decrease the amount of TDS imported into the Antelope Valley	Reduce amount of TDS imported into the Antelope Valley Region	Avoid the import of 97 metric tons per year of TDS imported from outside the Region	Quantification of imported water use compared to baseline Quantification of the concentration of TDS in the imported water source	Record of local surface water deliveries and imported water deliveries as measured by PWD influent flow meters for each source at the water treatment plant Record of TDS concentrations in SWP imported water. PWD will collect, record, and report this data.
Water Quality - Decrease the amount of bromide imported into the Antelope Valley	Reduce import of bromide imported into the Antelope Valley Region	Avoid the import of 289 pounds per year of bromide imported from outside the Region	Quantification of imported water use compared to baseline Quantification of the concentration of bromide in the imported water source	Record of local surface water deliveries and imported water deliveries as measured by PWD influent flow meters for each source at the water treatment plant

Project Goals	Desired Outcomes	Targets	Performance Indicators	Measurement Tools and Methods
				Record of bromide concentrations in SWP imported water. PWD will collect, record, and report this data.
Habitat Protection - Preserve habitat for federally endangered species	Protection of habitat for the arroyo toad	To be defined once the Littlerock Reservoir Sediment Removal Project Biological Resources Report is finalized (September 2013)	Quantification of acres of habitat protected compared to baseline	Botanical and wildlife surveys of actual acres of habitat protected
Energy Conservation - Reduce energy consumption	Reduce energy consumption from conveyance of imported water	Conserve 1,640,000 kWh per year of energy	Quantification of imported water use compared to baseline Quantification of the kWh per AF required to pump/convey SWP imported water to PWD	Record of local surface water deliveries and imported water deliveries as measured by PWD influent flow meters for each source at the water treatment plant Record of SWP energy demand requirements as reported by SWP
Greenhouse Gass Reduction - Reduce greenhouse gas (GHG) emissions	Reduce emissions of CO_2 equivalents from conveyance of imported water	Avoid 552 metric tons of CO_2 equivalents per year emitted	Quantification of kWh of energy conserved by the offset of SWP imported water Quantification of CO_2 equivalents per kWh of energy	Record of local surface water deliveries and imported water deliveries as measured by PWD influent flow meters for each source at the water treatment plant Climate Action Registry, General Reporting Protocol

Project Goals and Performance Measures

This section provides a discussion on the LRSR Project goals and how the monitoring systems used to verify each performance measure (summarized in Table 6-1) is consist with the Antelope Valley Integrated Regional Water Management (IRWM) Plan and project objectives (see Attachment 3 – Work Plan).

Water Supply – Increase capacity storage of local surface water supply in the Reservoir

The LRSR Project will remove 900,000 net cubic yards of accumulated sediment in the Reservoir to provide 560 AF of additional local water storage capacity. The increase of local surface water storage capacity will be recorded by measuring the net cubic yards of sediment removed behind Littlerock Dam during construction activities. This performance measure is consisted with the Antelope Valley IRWM Plan objective of *providing reliable water supply to meet the Antelope Valley Region's expected demand between now and 2035*. This performance measure additionally helps meet the LRSR Project objective of removing 900,000 net cubic yards (560 AFY) of accumulated sediment behind the Reservoir to restore the ability of PWD to store potable water supply starting in the year 2019.

Water Supply - Offset less reliable imported water supplies with more reliable local water supplies

The LRSR Project will reduce dependence on imported water by maximizing local surface water usage in the Antelope Valley IRWM Region that would be used in lieu of imported State Water Project (SWP) water. The LRSR Project will increase the use of local water supplies by 560 AFY and decrease the use of SWP imported supplies by 560 AFY, on average. The volume of imported water avoided as a result of the LRSR Project will be quantified by recording local surface water deliveries and imported water deliveries as measured by PWD influent flow meters for each source at the PWD water treatment plant. This performance measure is consistent with the Antelope Valley IRWM Plan objective of *providing reliable water supply to meet the Antelope Valley Region's expected demand between now and 2035*. This performance measure additionally helps meet the LRSR Project objective of offsetting imported water supplies by removing 900,000 net cubic yards (560 AFY) of accumulated sediment behind the Reservoir starting in the year 2019.

Flood Protection - Provide debris control and peak flood attenuation at Littlerock Dam

The LRSR Project will increase stormwater runoff storage capacity by removing 900,000 net cubic yards of sediment behind the Reservoir to provide 560 AFY of added storage capacity in the Reservoir. The increase of stormwater runoff capacity at the Reservoir will be recorded by measuring the net cubic yards of sediment removed from behind Littlerock Dam during construction activities. The performance measure identified for this project goal is consistent with the Antelope Valley IRWM Plan objective of *reducing negative impacts of stormwater, urban runoff, and nuisance water*. This performance measure will additionally help meet the LRSR Project objective of maintaining the level of debris control and flood peak attenuation provided by Littlerock Dam and Reservoir by removing 900,000 net cubic yards (560 AYF) of accumulated sediment starting in the year 2019.

Water Quality - Decrease the amount of TDS in the Antelope Valley

The LRSR Project will improve water quality by avoiding the import of 97 metric tons per year of Total Dissolved Solids (TDS), or salts, from outside the Antelope Valley Region. The reduction in TDS into the Antelope Valley as a result of the LRSR Project will be quantified by recording local surface water deliveries and SWP imported water deliveries as measured by PWD influent flow meters for each source at the PWD water treatment plant; TDS concentrations in SWP imported water will also be collected and recorded by PWD. This performance measure is consistent with the AV IRWM Plan objective of *providing drinking water that meets customer expectations*. This performance measure will additionally help meet the LRSR Project objective of decreasing the amount of imported TDS introduced into the Antelope Valley by offsetting 560 AFY of SWP imported water starting in the year 2019.

Water Quality – Decrease the amount of bromide imported into the Antelope Valley

The LRSR Project will improve water quality by contributing to the reduction of 289 pounds per year of bromide, a disinfection byproduct (DBP) precursor, imported into Antelope Valley Region. Reduction of imported bromide into the Antelope Valley Region as a result of the LRSR Project will be quantified by recording local surface water deliveries and imported water deliveries as measured by PWD influent flow meters for each source at the PWD water treatment plant; Bromide concentration data in SWP imported water will also be collected and recorded by PWD. This performance measure is consistent with the Antelope Valley IRWM Plan objective of *providing drinking water that meets customer expectations*. This performance measure will additionally help meet the LRSR Project objective of improving water quality for bromide (which contributes to the creation of DBPs) by replacing lower quality imported water with higher quality local surface water starting in the year 2019.

Habitat Protection - Preserve habitat for a federally endangered species

The LRSR Project will protect existing habitat for the federally endangered arroyo toad (*Bufo californicus*) during and after the construction of an in-stream grade control structure. The target for this project goal will be defined once the Littlerock Reservoir Sediment Removal Project Biological Resources Report is finalized in September 2013. The target is expected to consist of a quantification of acres of habitat protected compared to the baseline. Once the target is defined, the acres of habitat protected will be measured via botanical and wildlife surveys of actual acres of habitat protected. This performance measure is consistent with the Antelope Valley IRWM Plan objective of *preserving open space and natural habitats that protect and enhance water resources and species in the Antelope Valley Region*. This performance measure will additionally help meet the LRSR Project objective of preserving habitat for the federally endangered arroyo toad, and incidental "take" of the arroyo toad, by constructing a grade control structure to prevent sediment loss and headcutting of the stream channel upstream of Rocky Point starting in the year 2016.

Energy Conservation - Reduce energy consumption

The LRSR Project will reduce energy consumption from conveyance of SWP imported water by offsetting imported water with local water supplies. The LRSR Project will conserve 1,640,000 kWh per year of energy. Reduction of energy consumption as a result of the LRSR Project will be quantified by recording local surface water deliveries and SWP imported water deliveries as measured by PWD influent flow meters for each source at the PWD water treatment plant. Additionally, PWD will keep records of SWP energy demand requirements by SWP to quantify energy conservation. This performance measure will help meet the newly drafted climate change objective of *mitigate against climate change* for the Antelope Valley Integrated Regional Water Management (IWRM) Plan 2013 Update. The 2013 Antelope Valley IRWM Plan is currently in the process of being updated, including Regional objectives, and is expected to be complete by September 2013[1]. This performance measure will additionally help meet the LRSR Project objective of reducing energy consumption by offsetting 560 AFY of SWP imported water.

Greenhouse Gas Reduction - Reduce greenhouse gas (GHG) emissions

The LRSR Project will offset imported water demands with local surface water supplies by avoiding 552 metric tons of CO_2 (a GHG) equivalents per year generated by transporting imported SWP water to the Antelope Valley Region. Reduction of CO_2 emissions as a result of the LRSR Project will be quantified by recording local surface water deliveries and SWP imported water deliveries as measured by PWD influent flow meters for each source at the PWD water treatment plant. PWD will also utilize the Climate Action Registry, General Reporting Protocol standards to document reduction of CO_2 emissions. This performance measure will help meet the newly drafted climate change objective of *mitigate against climate change* for the Antelope Valley Integrated Regional Water Management (IWRM) Plan Update. The Antelope Valley IRWM Plan is currently in the process of being updated, including Regional objectives, and is expected to be complete by September 2013.This performance measure will additionally help meet the LRSR Project objective of reducing GHG emissions by offsetting 560 AFY of SWP imported water.

[1] Revised objectives for the Antelope Valley IRWM Plan 2013 Update are currently in draft form and will not be finalized until September 2013. Some of these draft objectives do not appear in the 2007 Antelope Valley IRWM Plan.

Attachment 7
Technical Justification of Project Physical Benefits

Littlerock Reservoir Sediment Removal Project

Attachment 7

Stormwater Flood Management Grant Proposal Littlerock Reservoir Sediment Removal Project Technical Justification

Attachment 7 consists of the following items:

- ✓ **Technical Justification.** Attachment 7 provides the technical justification for the proposed project.
- ✓ **Supporting Documentation.** Technical reports, feasibility studies, and other documents justifying the claimed physical benefits are included in this attachment.

Project Overview

The LRSR Project proposes to restore the capacity of the reservoir to 3,325 AF through removal of 900,000 net cubic yards (equivalent to 560 AF) of accumulated sediment behind the Littlerock Dam. In addition, the LRSR Project proposes to construct a grade control structure that will prevent sediment loss and headcutting upstream of the Reservoir beyond Rocky Point to protect and preserve habitat for the federally endangered arroyo toad. Water quality, energy, and climate change benefits are also provided by the Project.

Project Physical Benefits

The following physical benefits are claimed for the LRSR Project. These physical benefits are further summarized in Table 7-1.

- Water Supply
  - Increased Reservoir volume of 900,000 net cubic yards enables PWD to provide an additional 560 AF of local surface water supply to customers each year; the total cumulative volume is 28,000 AF over the 50-year lifespan of the Project
  - Increased water supply reliability for PWD during times of drought experienced by the SWP by offsetting less reliable imported water with more reliable local surface water
- Reduced Delta demands to help address Bay-Delta environmental goals
- Flood Protection
  - Increased Reservoir volume of 900,000 net cubic yards enables PWD to provide an additional 560 AF of flood protection each year
- Habitat Protection (included in non-monetized benefits discussion)
  - Avoidance of “take” of federally endangered species
  - Preservation of habitat acres for federally endangered species
- Water Quality
  - Avoidance of 4,835 metric tons of salts imported from outside the Region over the 50-year lifespan of the Project
  - Avoidance of 14,450 pounds of bromide imported from outside the Region over the 50-year lifespan of the Project
  - Reduced disinfection byproducts (DBPs) in product water
- Energy Conservation
  - Reduction of 84 million kWh over the 50-year lifespan of the Project

- Greenhouse Gas Reduction
    - Avoidance of 27,600 metric tons of CO_2 equivalents emitted over the 50-year lifespan of the Project

Table 7-1: Summary of Physical Benefits

Physical Benefit	Unit	Technical Justification
Water Supply - increased Reservoir volume	cubic yards (and acre-feet)	*Littlerock Reservoir Hydrologic and Sediment Transport Analysis Technical Report*, June 2005. Note: Excavated volume of 540,000 cubic yards in report was increased to approximately 900,000 net cubic yards based on seven additional years of sedimentation at 54,000 cubic yards per year on average. See Appendix A.
Water Supply - increased reliability	Qualitative	California Department of Water Resources (DWR). *The 2011 State Water Project Final Delivery Reliability Report.* Bay-Delta Office. June 2012.
Delta Demands - decreased	Qualitative	California Department of Water Resources (DWR). *The 2011 State Water Project Final Delivery Reliability Report.* Bay-Delta Office. June 2012.
Flood Protection - reduced flow over Littlerock Dam during storm events	cubic yards (and acre-feet)	*Littlerock Reservoir Hydrologic and Sediment Transport Analysis Technical Report*, June 2005. See Appendix A. Flood Insurance Rate Maps (FIRM), Community: Palmdale, City/Los Angeles CO, Panel #'s: 06037C0694F, 06037C0711F, 06037C0442F, and 06037C0450F. Effective Date: September 26, 2008. See Appendix E. Aerial photos – GoogleEarth – 8/25/2012 Flood Insurance Study – Los Angeles County, CA. September 26, 2008. See Appendix E. USDA/NRCS - National Geospatial Management Center. National Elevation Data 10 meter or better. Process Date: 09/2011. Hydrologic Units (USGS HUCS/Watersheds) - USDA/NRCS - National Geospatial Management Center. 10 Digit Watershed Boundary Dataset in HUC8. Publication Date: 2012. (Shapefiles not included) Anaverde Flood Hydrograph – Upper Anaverde Watershed Detention Storage Alternatives, City of Palmdale, prepared by URS, 2002 Summary of LACDPW Observed Flooding Location in the Antelope Valley, compiled by LACDPW, January 2013. Placed at the end of Attachment 7.

Physical Benefit	Unit	Technical Justification
Habitat Protection	qualitative	*Littlerock Reservoir Sediment Removal Project Draft Biological Resources Technical Report,* October 2012. Qualitative - see discussion
Water Quality - avoidance of salts imported from outside Region	AFY of supply milligrams per liter of (mg/L) of TDS	AVEK 2011 Annual Water Quality Report - Los Angeles County System; average TDS for Acton, Eastside, Quartz Hill, and Raw Influent sources. Water Quality Table. See Appendix F. http://www.avek.org/2011%20LA%20County%20AWQR.pdf
Water Quality - reduced bromide concentrations:	AFY of supply mg/L of bromide	Tech. Memo No. 1 - *Development, Evaluation, and Selection of Treatment Train Alternatives for the Eastside Water Treatment Plant*, Carollo Engineers, February 2007. See Appendix G.
Energy Conservation - reduced energy from offset of SWP water	kWh	*Analysis of the Energy Intensity of Water Supplies for West Basin Municipal Water District*, WBMWD, March 2007, p. 4. See Appendix H. http://www.westbasin.org/files/general-pdfs/Energy--UCSB-energy-study.pdf
Greenhouse Gas Reduction - reduced emissions	Tons of CO_2 equivalents	Climate Action Registry, General Reporting Protocol http://www.climateregistry.org/tools/protocols/general-reporting-protocol.html

Narrative Description of Without-Project Baseline

Sediment is expected to accumulate at an average rate of 34 AF/year. If the LRSR Project is not implemented, the Reservoir will continue to lose water supply storage capability from the current capacity of roughly 2,765 AF. In addition to diminishing water supply for consumption, the reduced capacity of the reservoir will result in continuing vulnerability of downstream areas to flooding. Finally, without the grade control structure included in the LRSR project, sediment loss will result in degradation of the natural habitat for the arroyo toad.

Lost water supply capability due to increasing sediment deposits will have additional damages related to alternative water options. By not increasing the supply of water, PWD will have to rely on additional SWP imports, which are less reliable compared to local water from Littlerock Creek. SWP imports include TDS and bromide loadings, and will require additional monitoring and treatment. SWP imports to the region will also continue to increase energy consumptions and carbon dioxide emissions.

Narrative Description of Physical Benefits (with Project)

A. Water Supply

Increase Use of Local Surface Water

Littlerock Reservoir is a critical water supply asset for PWD. Approximately 60 percent of potable water supply for PWD's customers comes from imported and local surface water. These supplies are primarily made up of State Water Project (SWP) and are supplemented with local surface water from the Reservoir. Surface water from the Reservoir is conveyed through an 8.5-mile ditch to Palmdale Lake and eventually treated at PWD's 15-mgd water treatment plant for potable use. However, with the increasing variability of SWP deliveries, PWD has been relying more on the Reservoir to supplement water demands. This Project will offset imported water supplies from the SWP.

The water supply benefit claimed is for 560 additional AFY of local surface water supply that will replace 560 AFY of water imported from the SWP. The LRSR Project removes approximately 900,000 net cubic yards of sediment. This volume is based on the 2005 *Littlerock Reservoir Hydrologic and Sediment Transport Analysis Technical Report*[1] which developed an alternative proposing to remove 540,000 cubic yards of sediment, followed by removal of an additional 270,000 cubic yards every five years thereafter. The alternative developed in the 2005 report assumed that 540,000 cubic yards represented a 10-year period of sediment deposition from 1995 to 2005, based on a 1991 sediment flow analysis[2] that estimated 54,000 cubic yards of deposition per year, on average.

The Project submitted in this application builds upon that 2005 project alternative and assumes that 54,000 cubic yards of sediment deposition has continued to occur for each of the seven years between 2005 and 2012. This accumulated sediment amounts to approximately 900,000 net cubic yards for the full seventeen-year period from 1995 to 2012. Once the sediment is removed, this volume would allow for approximately 560 AF of additional Reservoir capacity.

In the 2005 Report, the Reservoir storage capacity was reported as 3,000 AF. Assuming the ongoing deposition mentioned above, the 2012 capacity of the Reservoir may be approximated by subtracting the volume of the additional seven years of sediment, 378,000 cubic yards (235 AF), from the 2005 Reservoir volume. Using this method, the 2012 Reservoir capacity is estimated as 2,765 AF. The Project would increase the total storage capacity of the Reservoir from 2,765 AF to 3,325 AF; therefore these volumes represent the with- and without-Project conditions, respectively.

The 2005 Report estimated the time to fill the Reservoir, assuming full capacity was available at the beginning of the runoff season and that the 1995 topography was adjusted for 10 years of sediment deposition to represent 2005 conditions. Using historical runoff data, it was estimated that the median year inflow would fill the Reservoir by March 2. The 2005 Report also described USGS records indicating that the annual runoff volume exceeds 2005 Reservoir capacity 80 percent of the time. Using these estimates, and with the understanding that even less storage volume is available in 2012 after seven additional years of sediment deposition, this Project assumes that the Reservoir, under typical operating conditions, is filled to capacity early in the

[1] Aspen Environmental Group, 2005. *Littlerock Reservoir Hydrologic and Sediment Transport Analysis Technical Report.* June 2005.
[2] Woodward-Clyde Consultants, 1991. *Littlerock Dam Reservoir Restoration Project. Evaluation of Aggregates for RCC Construction*.

year. Thus, additional storage capacity in the Reservoir will capture additional stormwater runoff during the rainy season months of December through May; and depending on water use patterns by PWD, could capture additional surface runoff that occurs outside the rainy season months if the Reservoir is drawn down prior to storm events. These high-inflow years would be offset occasionally by dry years where the total additional captured flow would be less than the total storage capacity of the Reservoir.

Once sediment removal takes place, no additional facilities are needed to provide water supply benefits since Littlerock Dam and the associated water conveyance system already has capacity to store and deliver the additional 560 AFY.

The documented information described above validates the water supply benefit claim that the Project will provide an additional 560 AFY of local surface water supply to the Region.

Increase Supply Reliability

The reliability of a water supply refers to the ability to consistently meet water demands, even in times of drought or other constraints on source water availability. The Project would help increase the reliability of water use by PWD by substituting local surface water from Littlerock Reservoir for SWP supplies. The SWP Delivery Reliability Report for 2011[3] shows that the long-term reliability of SWP supplies is 60% of the total demand for SWP Table A water, with deliveries during multiple dry year periods averaging 32% to 38% of total demand. In comparison, PWD's 2010 Strategic Water Resources Plan[4] includes a record of Littlerock Creek runoff by year that indicates a reliability of 100% of PWD's 5,500 AFY diversion right during an average year.

Reduce Demands on California Delta

The Antelope Valley Region has made it a priority to reduce dependence on imported water supplies received from the Sacramento-San Joaquin Delta (Delta), a priority that is reflected in the Region's 2007 IRWMP Plan. Diversion of water from the Delta to southern California has caused damage to the Bay Delta's ecosystem due to SWP and Central Valley Project operations. In particular, infrastructure used to divert water to southern California directly impacts species (such as the entrainment of aquatic species in pumps) and damages habitats, while operations that reverse river flows impact ecosystems activity. By reducing the Region's reliance on the Bay Delta, diversions will be reduced, thus reducing operations that impact native species and habitats. This reduction in operations will help to meet Bay Delta environmental goals to restore tidal marshes and floodplains, and restore fish and wildlife species.

B. Flood Protection

The Project will restore the level of debris control and flood peak attenuation provided by Littlerock Dam and Reservoir by removing 900,000 net cubic yards of sediment to achieve a capacity of 3,325 AF, as established in the Water Supply section above. Estimates show that approximately 54,000 cubic yards of sediment are deposited into the Reservoir annually from seasonal inflow. The project would remove a

[3] California Department of Water Resources (DWR). *The 2011 State Water Project Final Delivery Reliability Report.* Bay-Delta Office. June 2012.

[4] 2010 Palmdale Water District Strategic Water Resources Program: Options Report, RMC, March 2010.

minimum of 900,000 cubic yards of sediment during a 5-year closure of the Reservoir. The LRSR Project would increase the flood control capacity at the Reservoir by a minimum of 560 AF on average.

Flood damage from Little Rock Creek downstream of Little Rock Dam occurs primarily through flooding of roadway crossings and potential flooding of homes and other structures in the floodplain. The proposed excavation will create additional storage within the reservoir such that the magnitude and frequency of floods exiting the reservoir are potentially reduced.

The purpose of this analysis is to provide a rough characterization of potential flood damages prevented by the LRSR Project.

Reservoir Operations and Hydrology

Under current conditions Littlerock reservoir has a storage capacity of 2,765 acre feet. After project implementation, the capacity will be approximately 3,345 acre feet. The excavation of an additional 560 acre feet of volume within the reservoir will provide additional capacity for attenuating flood flows.

Flows entering Littlerock Reservoir during the annual winter flood season, which extends roughly from November to May, are held in the reservoir until the reservoir water level reaches the spillway crest. Before the water level reaches the dam spillway crest, all flood flows entering the reservoir are attenuated completely. No discharges except for water supply withdrawals by PWD are allowed to exit the reservoir. Project-related attenuation of flows will not occur at water levels exceeding the spillway crest.

PWD currently has the right to withdraw up to 5,500 acre feet of water per year from Littlerock Reservoir. The reservoir is normally drained by the end of December. Withdrawals can occur after the fall runoff inflow and occur throughout the year. Assuming a 10-month withdrawal period (i.e., end of November to end of September), average water supply withdrawal discharge is 9.1 cfs.

An estimate of the time to fill for the Littlerock Reservoir to the level of the spillway crest was made by subtracting the average supply withdrawal of 9.1 cfs from average inflows recorded by the United States Geological Survey (USGS).[5] Withdrawals were assumed to begin December 13, which is the day average inflow begins to exceed 9.1 cfs. This analysis showed that net inflow volume reaches 2,765 acre feet on February 4 each year, on average. After February 4, inflows pass over the spillway crest and are not attenuated. The same analysis showed that with the with-project volume of 3,325 acre feet, net inflow would be reached on February 11, providing an average of seven additional days per year when no flood flows would pass over Littlerock Dam. In other words, without the excavation project, Littlerock Reservoir has the potential for attenuation of floods that occur before February 4 each year on average. With the project the potential for attenuation is extended to February 11. After those dates no flood attenuation can be expected.

A review of USGS annual peak flow records[6] over a period of 51 years shows the following frequency of flood occurrences by month:

[5] Hydrologic Units (USGS HUCS/Watersheds) - USDA/NRCS - National Geospatial Management Center. 10 Digit Watershed Boundary Dataset in HUC8. Publication Date: 2012.

[6] Hydrologic Units (USGS HUCS/Watersheds) - USDA/NRCS - National Geospatial Management Center. 10 Digit Watershed Boundary Dataset in HUC8. Publication Date: 2012.

Month	Number of Annual Peak Flow Occurrences
September	1
October	0
November	5
December	7
January	10
February	15
March	5
April	6
May	2
Total	51

The table above shows that roughly half of the peak flows on Littlerock Creek occur in or before February and have the potential to be attenuated by Littlerock Reservoir.

According to the FEMA flood insurance study for Littlerock Creek[7], the 100-year discharge at Littlerock Dam is 20,000 cfs. A 100-year flood hydrograph was developed for Littlerock Creek using the hydrograph shape from the nearby Anaverde Creek adjusted to conform to the peak discharge of Littlerock Creek.[8] This hydrograph gave a 100-year, 24-hour volume of 5,500 acre feet. An approximation of the potential of Littlerock Reservoir to attenuate this peak was made using the following assumptions:

- The flood occurs when the reservoir is initially empty.
- Reservoir storage volume is equal to cumulative hydrograph inflow minus cumulative reservoir outflow.
- Reservoir outflow is 9.1 cfs (same as the average PWD maximum delivery allocation).
- No flood attenuation occurs after the maximum reservoir volume below the spillway crest is reached.

The analysis showed that under current conditions the maximum reservoir capacity of 2,675 acre feet would be reached before the peak inflow occurs, resulting in no attenuation of the 100-year peak. Under with-project conditions the peak inflow at the time maximum capacity is reached would be approximately 19,625 cfs, meaning the 100-year peak would be reduced by approximately 2%. If the flood occurs after the end of November, with associated previous inflow to the reservoir, there would be no reduction in the flood peak. Therefore, for the excavation project to have an effect on the 100-year flood, the flood must occur in or before the month of November. Based on the flood peak frequency table above, roughly one in ten floods occur in or before November.

[7] Floodplain information - Flood Insurance Rate Maps (FIRM), Community: Palmdale, City/Los Angeles CO, Panel #'s: 06037C0694F, 06037C0711F, 06037C0442F, and 06037C0450F. Effective Date: September 26, 2008.

[8] Anaverde Flood Hydrograph – Upper Anaverde Watershed Detention Storage Alternatives, City of Palmdale, prepared by URS, 2002

A 50-year flood analysis showed that if the flood occurs before the end of November, there is a potential for a reduction in flood peak of approximately 4,400 cfs, but if the flood occurs after the end of December the project-related flood peak reduction is extremely low. Based on the seasonal frequency of flood peaks given above, the chance a 50-year flood will occur before the end of November is approximately 12%. Approximately one in eight 50-year floods that enter Littlerock Reservoir have the potential to be reduced by Project-related excavation.

The 25-year flood exhibits shows that if the flood occurs when the reservoir is initially empty, the reservoir has capacity for the entire flood under existing and with-Project conditions, meaning there would be no project-related flood-control benefit. If the flood occurs at the end of November, the Project-related reduction in flood peak would be approximately 1,800 cfs. If the flood occurs at the end of December, the Project-related reduction in flood peak would be approximately 4,600 cfs. Based on the seasonal frequency of flood peaks given above, the chance a 25-year flood will occur during the month of December, the window of primary opportunity for 25-year flood-control benefit, is approximately 14%. Approximately one in seven 25-year floods that enter Littlerock Reservoir have the potential to be reduced by Project-related excavation.

Summary of Approximate Potential Flood Peak Reductions by Little Rock Dam

Flood Return Period	Discharge in cfs[1]	Project-related peak reduction, in cfs[2]	With Project peak flow, in cfs	With Project peak percent of without Project peak	Seasonal window of opportunity for this peak reduction[3]	Likelihood the peak will be reduced in a given flood season[4]
100 Year	20,000	0	20,000	100%	Not applicable. no peak reduction.	0
50 Year	13,000	4,400	8,600	66%	September to end of November	12%
25 Year	9,000	4,600	4,400	49%	December	14%

1 100-Year is from the FEMA study. The others are by ratio from the Anaverde Wash study.
2 Computed by approximate routing analysis described in the text.
3 Due to annual filling of the reservoir, the flood must occur within this period for any flood peak reduction to occur.
4 Based on observed distribution of annual peak flow events from USGS records.

Roadway Damages Prevented

Based on information from the Los Angeles County Department of Public Works,[9] roadway flooding has occurred at the following roadways:

- 70th Street East
- Avenue N
- Avenue I
- Avenue H
- 50th Street East
- Avenue G

70th Street, at a distance of approximately 10 miles downstream of Little Rock Reservoir, is the nearest crossing.

Benefits of the Littlerock Reservoir excavation project to the roadway crossings would be:

- 5 additional days per year when there is no flow over Littlerock Dam.
- Reduced frequency and magnitude of flood peaks for floods of 50-year magnitude or smaller from Littlerock Dam, if the floods occur early in the flood season.

These benefits should be considered in the context of the overall watershed. The figure below shows the watersheds contributing runoff at the approximate location of the road crossings listed above. In addition to the Littlerock Creek watershed, there is a substantial watershed referred to as Town of Pearblossom, entering between the dam and the road crossings. At Avenue K, which is at approximately the midpoint of these road crossings, the total watershed area is 184 square miles, compared to 64 square miles at Littlerock Dam. With 120 square miles of watershed area contributing downstream of the dam, nearly twice the watershed of the dam, the effect of the dam on flood peaks and duration at the location of the road crossings will be substantially reduced. A rough approximation of flood depth reductions at the road crossings can be found in the analysis described below.

Structure Damages Prevented

A review of aerial photographs indicates 77 structures in the FEMA floodplain. Based on our interpretation of aerial photographs there are 40 residential structures, 20 warehouse structures, 9 commercial outbuildings, 6 industrial buildings, and 2 garages. The watershed figure above shows the location of these structures. All but 2 are more than 15 miles downstream of the dam.

According to FEMA maps, all but two of the 77 structures referred to above are in a Zone A, defined as having undetermined 100-year flow depths. The FEMA study has no discharges for Littlerock Wash at the location of the flooded structures (approximately at Avenue K). The floodplain in this area is delineated by approximate methods. For purposes of this analysis, the peak 100-year discharge at that location is estimated at 57,500 cfs by area ratio using the following method:

- Watershed area at Littlerock Dam = 64 Square Miles
- Watershed Area at Avenue K = 184 Square Miles

[9] *Summary of LACDPW Observed Flooding Location in the Antelope Valley*, compiled by LACDPW, January 2013.

- 100-Year Peak Flow at Littlerock Dam = 20,000 cfs
- 20,000 cfs/64 Square Miles * 184 Square Miles = 57,500 cfs

Without-project 50-year and 25-year discharges are estimated by ratio as 37,375 cfs and 25,875 cfs, respectively. With-project 50-year and 25-year discharges are estimated by subtracting the with-project peak reductions given above and are 32,975 cfs and 21,275 cfs, respectively.

Flow depths at the location of the flooded structures are approximated by normal depth calculations using the assumption of a flat-bottomed cross section:

- Floodplain Width = 2 miles (measured as typical at most floodplain structures)
- Ground Slope = 0.004 Feet per Foot
- Roughness Coefficient = 0.05 (for cultivated areas)

Without and with-project flow depths in the Zone A structures affected by flooding are as shown in the following table:

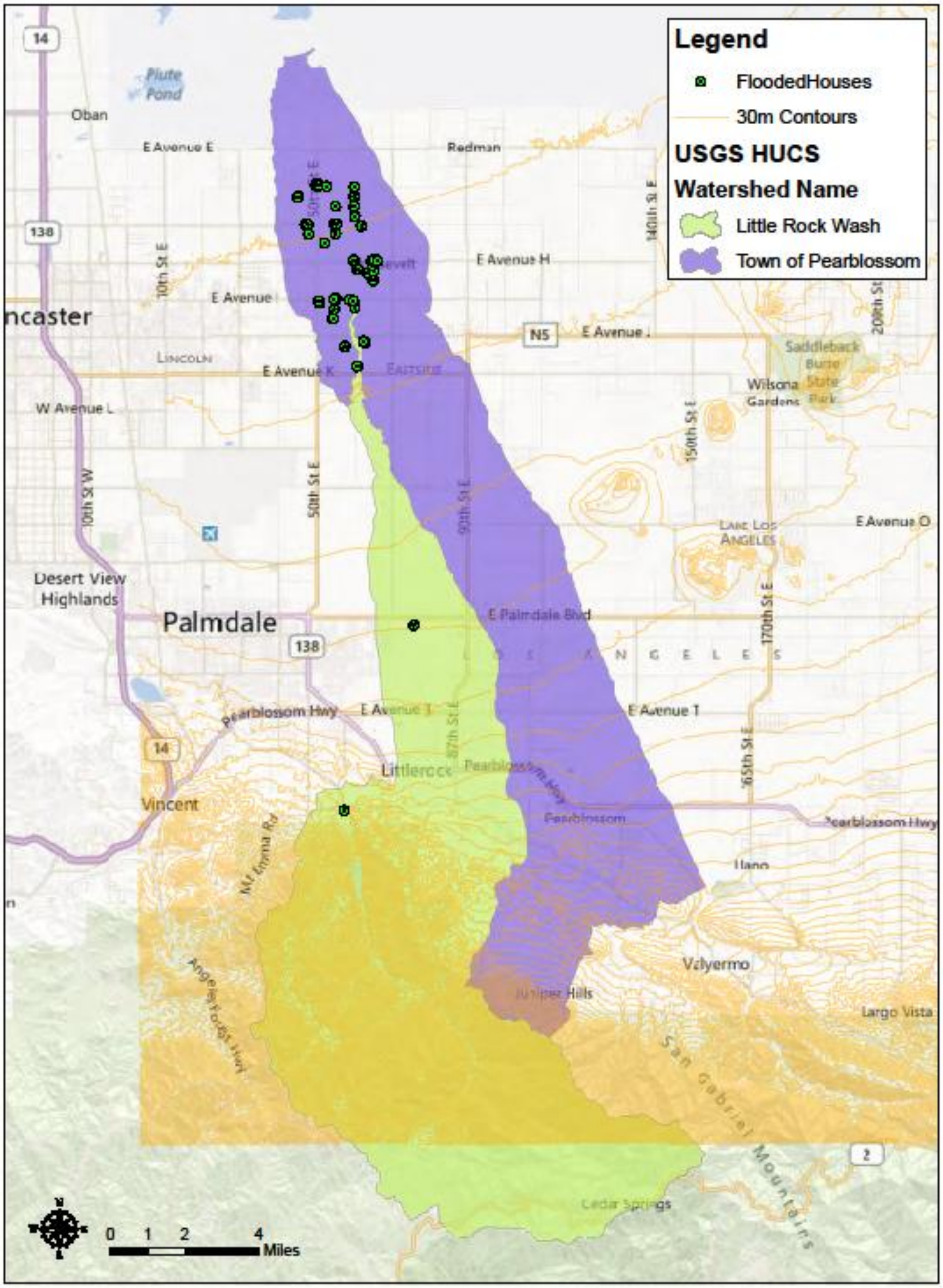
Approximate With and Without Project Flood Depths at Zone A Flooded Structures in Littlerock Wash Floodplain		
Flood Return Period	Without-Project Flood Depth, in Feet	With-Project Flood Depth, in Feet
100-Years	1.89	1.89
50 Years	1.46	1.36
25-Years	1.17	1.04

No information is available on finished floor elevations. In the absence of this information an assumption of 6 inches above surrounding grade is used. The table below gives flood depths above and below finished floors at the floodplain structures.

Flood Depths Above and Below Finished Floors at the Floodplain Structures		
Flood Return Period	Without Project Flood Depth, in Inches	With Project Flood Depth, in Inches
100-Years	16.7	16.7
50 Years	11.5	10.3
25-Years	8.0	6.5

Miles of Inundated Roads, With and Without Project, by Road Category and Return Period (i.e., Flood Frequency)			
	Major Roads (mi)		
	With Project	Without Project	Change
25-Year	0.54	0.65	0.11
50-Year	0.8	0.9	0.1
100-Year	1.5	1.5	0

Source: CDM-Smith modeling analysis


Legend
FloodedHouses
30m Contours
USGS HUCS
Watershed Name
Little Rock Wash
Town of Pearblossom
Palmdale
Littlerock
Pearblossom
Vincent
Valyermo
Juniper Hills
Largo Vista
Cedar Springs
San Gabriel Mountains
Desert View Highlands
Wilsona Gardens
Saddleback Butte State Park
Lake Los Angeles
Oban
Redman
Plute Pond
E Avenue E
E Avenue H
E Avenue J
E Avenue K
W Avenue L
E Avenue O
E Avenue T
E Palmdale Blvd
Pearblossom Hwy
Angeles Forest Hwy
Mt Emma Rd
10th St E
10th St W
50th St E
90th St E
87th St E
140th St E
150th St E
170th St E
165th St E
200th St
0 1 2 4
Miles

Summary and Conclusion

This analysis shows that the flood-control benefit of the sediment removal project is likely to occur in the early stages of the flood season when the reservoir is empty or near empty. The potential for flood benefits is reduced substantially as the runoff season progresses. No benefit is expected for floods that occur after mid-February. Benefits are negligible for the 100-year flood. Nearly all potential benefits are 15 miles or more downstream of the dam and for the 50-year and smaller discharges. Because of the complexities involved, it is possible a more detailed analysis would show benefits to be less than those presented here.

Limitations

The analysis presented here is an approximate analysis using simplifying assumptions that could have implications regarding the accuracy of the results. The primary intent is to determine whether it is possible there be flood benefits from the excavation at Littlerock Reservoir, and to make an approximation of the probable magnitude of these benefits in terms of flood frequency and flood depth at flood-prone structures. Major limitations to this study are listed below:

- The flood hydrograph used was based on the shape of a hydrograph developed by another study for a nearby watercourse (Anaverde Creek), with ordinates adjusted by ratio of the Littlerock 100-year peak to the Anaverde 100-year peak. It is likely a detailed analysis of Littlerock hydrology will result in a different hydrograph with larger runoff volumes at Littlerock Dam, resulting less flood peak attenuation than presented here. Peak discharge rates at the location of the flooded homes are likely less than represented here due to channel attenuation, area rainfall reduction, timing of converging peaks, and watershed topography.

- The reservoir routing analysis used an approximation rather than the standard storage indication method normally used in reservoir routing.

- The reservoir inflow scenario and assumption of available reservoir storage capacity at the initiation of the flood season is simplified and should be revisited with more inflow scenarios in a more detailed analysis.

- Flood depths at the location of the flooded properties are assumed by normal depth calculations, not by step backwater analysis.

- Finished floor elevations are assumed to be 6 inches. No on-site information is available.

C. Habitat Protection (also discussed in Attachment 8)

Littlerock Creek, which feeds the Reservoir, provides habitat for the federally endangered arroyo toad (*Bufo californicus*). Previous plans for sediment removal from the Reservoir posed potential risks for "take" of arroyo toad and degradation of arroyo toad habitat upstream of the Reservoir beyond the Rocky Point area. The LRSR project proposes to construct a soil cement grade control structure at Rocky Point to prevent sediment loss and headcutting of the stream channel upstream of Rocky Point. This grade control structure will minimize the degradation of critical habitat for and incidental "take" of the federally-endangered arroyo toad. In addition, the grade control structure would act as a barrier between human activities (i.e., recreation activities, sediment removal activities, etc.) within the Reservoir and the arroyo toad's habitat upstream of Rocky Point. Protection of the arroyo toad is consistent with USFS Strategy WL 1 (Threatened, Endangered, Proposed, Candidate, and Sensitive Species Management).

The grade control structure design would consist of a permanent structure of soil cement and would be constructed as a cascading (i.e., stair-step) structure with a series of steep drops of approximately 4-feet each with 15-foot horizontal aprons downstream of each drop, extending to a total depth of up to 70 feet below the existing ground surface. The structure would be constructed below grade, and once backfilled, only the top or upper lip of the structure would be visible when the Reservoir water level is lowered. When the Reservoir is full it would contain water beyond the Rocky Point area and any portion of the grade control structure at the Reservoir bottom grade would be submerged and not visible.

The number of federally endangered species and acres of protected habitat will be further evaluated and determined in subsequent phases of the *Littlerock Reservoir Sediment Removal Project Biological Resources Technical Report* that will be completed in a final version in late 2013.

D. Water Quality

Total Dissolved Solids

State Water Project (SWP) water contains total dissolved solids (TDS) or salts. A typical value for TDS in SWP water is 140 mg/l, based on the Antelope Valley East Kern Water Agency 2011 Annual Water Quality Report.[10] Since this water is imported from outside of the Antelope Valley basin, it represents a net increase in loading of salts to the basin. Efforts such as the ongoing Antelope Valley Salt and Nutrient Management Plan have increased awareness of salt balance in the Region and have increased concern for identifying and reducing salt inflows. SWP water is the largest inflow of TDS to the Region and this is of particular concern in the Antelope Valley because the groundwater basin and subbasins are closed (i.e., no outlet to the ocean).

Assuming an average SWP TDS concentration of 140 mg/L, and assuming that TDS loadings that originate from local surface water are already contained within the Antelope Valley Region (and therefore do not represent salt inflows), 560 AFY of offset imported SWP water represents approximately 97 metric tons per year of salts that would no longer be imported. Over the lifespan of the Project, this amounts to approximately 4,835 metric tons of TDS that will not be introduced to the Antelope Valley as a salt input.

Bromide

SWP water supplies also contain higher levels of bromide, which is a concern in drinking water. Bromide combines with chemicals used in the water treatment process to form disinfection byproducts (DBPs) such as trihalomethanes (THMs) that are strictly regulated under the Federal Safe Drinking Water Act. PWD treats all water to meet stringent state and federal drinking water standards before delivering it to customers. However, source water of poorer quality will make it increasingly expensive and difficult to meet such standards. Increased levels of constituents that could aid in the formation of THMs can mean more time spent monitoring treated water in the distribution systems and may lead to the use of increased proportions of groundwater in the blend water supplies in order to control THMs. The LRSR Project would offset the need for SWP Imported water with local surface water supply that contains less bromide and has less propensity to form DBPs.

[10] AVEK 2011 Annual Water Quality Report - Los Angeles County System; average TDS for Acton, Eastside, Quartz Hill, and Raw Influent sources.

A 2007 water quality report for AVEK[11] reported an average bromide value of 0.19 mg/L for SWP water and a value of “non-detect” for surface water in the Littlerock Reservoir. Assuming this average concentration of 0.19 mg/L, 560 AFY of offset imported SWP water represents approximately 289 pounds per year of bromide that would no longer be imported. Over the lifespan of the Project, this amounts to approximately 14,450 pounds of bromide that will not be introduced to the Antelope Valley; moreover, this reduced bromide will reduce the propensity for DBP formation in potable drinking supplies.

E. Energy Conservation

The long-distance transport of water in conveyance systems consumes a significant portion of California’s total electricity demand. The SWP, is the largest consumer of electrical energy in the California, requiring an average of 5,000 GWh per year, and contributes 0.6% of California’s total GHG emissions.

The energy required to convey surface water from the Reservoir to PWD’s 35-mgd water treatment plant is essentially zero. For imported supplies, West Basin Municipal Water District (WBMWD) has estimated that approximately 3,000 kilowatt-hours (kWh) per AF of energy is required for conveyance and pumping to Southern California SWP contracting agencies.[12] Assuming 3,000 kWh/AF and an average annual imported water offset of 560 AF, approximately 1,680,000 kWh per year of energy will be saved by implementing the Project. Over the 50-year lifespan of the Project, this totals 84 million kWh of conserved energy.

F. Greenhouse Gas Reduction

The proposed project would avoid greenhouse gas (GHG) emissions generated by the additional energy needed to transport imported SWP water for the Region. This value may be calculated by applying a factor of 0.724 lbs. of CO_2 equivalents per kWh and converting to total tons of CO_2 equivalents, based on the California Action Registry, General Reporting Protocol.[13] By offsetting the demand of 560 AF of imported SWP water, the proposed Project will avoid GHG emissions of 552 metric tons per year of CO_2 equivalents per year. Over the 50-year lifespan of the Project, this totals 27,600 metric tons of avoided carbon emissions.

[11] Tech. Memo No. 1 - *Development, Evaluation, and Selection of Treatment Train Alternatives for the Eastside Water Treatment Plant*, Carollo Engineers, February 2007.
[12] *Analysis of the Energy Intensity of Water Supplies for West Basin Municipal Water District*, WBMWD, March 2007.
[13] Climate Action Registry, General Reporting Protocol http://www.climateregistry.org/tools/protocols/general-reporting-protocol.html

Annual Project Physical Benefits

The following tables present the physically quantifiable benefits for the project. One table is completed for each physically quantifiable benefit.

Benefit #1 - Water Supply

The table below provides information regarding Reservoir capacity for local surface water, with and without the Project.

Littlerock Reservoir Sediment Removal Project			
Physical Benefit: increased Reservoir capacity for local surface water supply			
Measure of Benefit Claimed (Name of Units): AF			
Additional Information about this Measure:			
Year	**Physical Benefits**		
	Without Project	**With Project**	**Change Resulting from Project**
2012	2,765	2,765	0
2013	2,765	2,765	0
2014	2,765	2,765	0
2015	2,765	2,765	0
2016	2,765	2,765	0
2017	2,765	2,765	0
2018	2,765	2,765	0
2019	2,765	2,765	0
2020	2,765	3,325	560
2021	2,765	3,325	560
2022	2,765	3,325	560
2023-2069	2,765	3,325	560
References: *Littlerock Reservoir Hydrologic and Sediment Transport Analysis Technical Report*, June 2005. Note: Excavated volume of 540,000 cubic yards in report was increased to approximately 900,000 net cubic yards based on seven additional years of sedimentation at 54,000 cubic yards per year on average.			

Benefit #2 - Flood Protection

The table below provides information regarding the degree of flood protection, with and without the Project.

Littlerock Reservoir Sediment Removal Project			
Physical Benefit: increased Reservoir capacity for flood protection			
Measure of Benefit Claimed (Name of Units): AF			
Additional Information about this Measure:			
Year	**Physical Benefits**		
	Without Project	**With Project**	**Change Resulting from Project**
2012	2,765	2,765	0
2013	2,765	2,765	0
2014	2,765	2,765	0
2015	2,765	2,765	0
2016	2,765	2,765	0
2017	2,765	2,765	0
2018	2,765	2,765	0
2019	2,765	2,765	0
2020	2,765	3,325	560
2021	2,765	3,325	560
2022	2,765	3,325	560
2023-2069	2,765	3,325	560
References: *Littlerock Reservoir Hydrologic and Sediment Transport Analysis Technical Report,* June 2005. Note: Excavated volume of 540,000 cubic yards in report was increased to approximately 900,000 cubic yards based on seven additional years of sedimentation at 54,000 cubic yards per year on average.			

Benefit #3 - Water Quality, Total Dissolved Solids (TDS)

The table below provides information regarding the amount of TDS imported to the Region, with and without the Project.

Littlerock Reservoir Sediment Removal Project			
Physical Benefit: avoided imported TDS			
Measure of Benefit Claimed (Name of Units): metric tons			
Additional Information about this Measure:			
Year	**Physical Benefits**		
	Without Project	**With Project**	**Change Resulting from Project**
2012	97	97	0
2013	97	97	0
2014	97	97	0
2015	97	97	0
2016	97	97	0
2017	97	97	0
2018	97	97	0
2019	97	97	0
2020	97	0	-97
2021	97	0	-97
2022	97	0	-97
2023-2069	97	0	-97
References: AVEK 2011 Annual Water Quality Report - Los Angeles County System; average TDS for Acton, Eastside, Quartz Hill, and Raw Influent sources. Water Quality Table.			

Benefit #4 - Water Quality, bromide

The table below provides information regarding the amount of bromide imported to the Region, with and without the Project.

Littlerock Reservoir Sediment Removal Project			
Physical Benefit: avoided imported bromide			
Measure of Benefit Claimed (Name of Units): pounds			
Additional Information about this Measure:			
Year	**Physical Benefits**		
	Without Project	**With Project**	**Change Resulting from Project**
2012	289	289	0
2013	289	289	0
2014	289	289	0
2015	289	289	0
2016	289	289	0
2017	289	289	0
2018	289	289	0
2019	289	289	0
2020	289	0	-289
2021	289	0	-289
2022	289	0	-289
2023-2069	289	0	-289
References: Tech. Memo No. 1 - *Development, Evaluation, and Selection of Treatment Train Alternatives for the Eastside Water Treatment Plant*, Carollo Engineers, February 2007.			

Benefit #5 - Energy Conservation

The table below provides information regarding energy consumption for conveyance of SWP imported water, with and without the Project.

Littlerock Reservoir Sediment Removal Project			
Physical Benefit: energy consumed			
Measure of Benefit Claimed (Name of Units): kilowatt-hours (kWh)			
Additional Information about this Measure:			
Year	**Physical Benefits**		
	Without Project	**With Project**	**Change Resulting from Project**
2012	1,680,000	1,680,000	0
2013	1,680,000	1,680,000	0
2014	1,680,000	1,680,000	0
2015	1,680,000	1,680,000	0
2016	1,680,000	1,680,000	0
2017	1,680,000	1,680,000	0
2018	1,680,000	1,680,000	0
2019	1,680,000	1,680,000	0
2020	1,680,000	0	-1,680,000
2021	1,680,000	0	-1,680,000
2022	1,680,000	0	-1,680,000
2023-2069	1,680,000	0	-1,680,000
References: *Analysis of the Energy Intensity of Water Supplies for West Basin Municipal Water District*, WBMWD, March 2007, p. 4.			

Benefit #6 - Greenhouse Gas (GHG) Emissions

The table below provides information regarding GHG emissions for conveyance of SWP imported water, with and without the Project.

Littlerock Reservoir Sediment Removal Project			
Physical Benefit: CO_2 equivalents emitted			
Measure of Benefit Claimed (Name of Units): metric tons			
Additional Information about this Measure:			
Year	**Physical Benefits**		
	Without Project	**With Project**	**Change Resulting from Project**
2012	552	552	0
2013	552	552	0
2014	552	552	0
2015	552	552	0
2016	552	552	0
2017	552	552	0
2018	552	552	0
2019	552	552	0
2020	552	0	-582
2021	552	0	-582
2022	552	0	-582
2023-2069	552	0	-582
References: Climate Action Registry, General Reporting Protocol http://www.climateregistry.org/tools/protocols/general-reporting-protocol.html			

Strategic Water Resources Program: Options Report

Prepared by:

RMC Water and Environment

In Association with:

A&N Technical Services

Wildermuth Environmental

March 2010

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Appendices

3.7 Littlerock Reservoir

PWD uses Littlerock Creek as a local surface water supply source. The watershed is approximately a 90 square mile area and has tributary flows that feed Littlerock Reservoir from Littlerock Creek and Santiago Creek. From Littlerock Reservoir, the Palmdale Ditch flows to Lake Palmdale prior to treatment and distribution. The current Littlerock Reservoir capacity is 3,000 af. In normal years, Littlerock Reservoir overflows its capacity in wet months and water is released to Littlerock Creek.

The original design of Littlerock Reservoir allowed for a maximum storage capacity of 4,300 af. Due to sediment build-up, the storage capacity was substantially reduced to 1,600 af by 1991. In 1992, PWD raised the height of the dam and the storage capacity increased to 3,300 af but did not remove any sediment. If all sediment were removed given the current dam height, the maximum storage capacity of Littlerock Reservoir could be 6,000 af.

In preparing this section, the following materials were reviewed:

- *Alternatives for Proposed Rocky Point Grade Control Structure*, URS Corporation. June 2008.
- *Preliminary Dredging/Slurry Feasibility Analysis for Excavation of Littlerock Reservoir*, Aspen Consulting Engineers, September 2007.
- *Environmental Impact Report/Environmental Impact Statement, Littlerock Reservoir Sediment Removal Project*, Aspen Environmental Group. April 2007.
- *Hydropower Program: Hydrofacts*, Idaho National Laboratory. July 2005.
- *Estimation of Economic Parameters of U.S. Hydropower Resources*, Idaho National Laboratory and Environmental Laboratory. June 2003.
- *Hydropower Resource Economics Database*, Idaho National Laboratory. April 2003.

3.7.1 Existing Supply

In a normal year, PWD takes about 4,400 af from Littlerock Reservoir, as shown in **Table 3-27**, from January through June – which is about 150% of the storage capacity of 3,000 af. **Figure 3-35** provides a graphic summary of the annual deliveries to Littlerock Reservoir from Littlerock Creek. As shown in **Table 3-28** the average yearly supply from Littlerock Creek is 18,950 afy and that supplies are almost non-existent in summer months. At present, Littlerock Reservoir is losing roughly 30-40 af of storage capacity each year due to ongoing sediment build-up. PWD is not currently removing sediment from Littlerock Reservoir to maintain its storage capacity and so it is anticipated that potential supplies will continue to decrease over time. **Figure 3-36** provides this rate of storage capacity loss. Assuming the current trend of storage capacity being lost and PWD's current use of about 150% of storage capacity, **Figure 3-37** shows graphically the cumulative costs PWD will incur to purchase imported water to counterbalance storage losses at Littlerock Reservoir.

Table 3-27: PWD Historical Production from Littlerock Reservoir

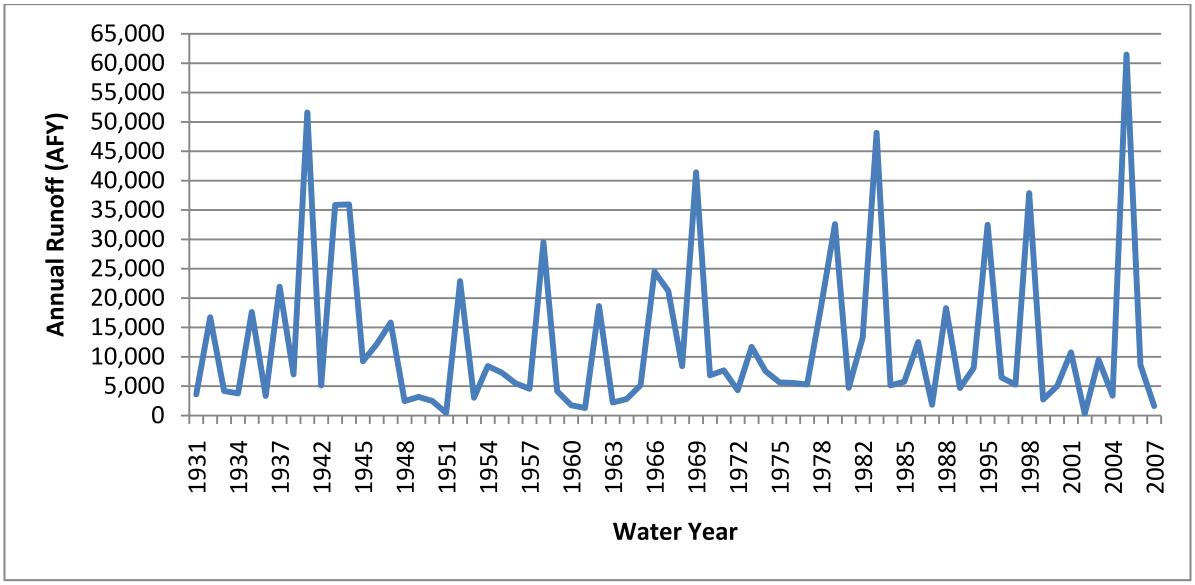
Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Average
PWD Take (AFY)	3,771	2,409	3,595	5,040	3,050	6,501	6,852	-	3,499	3,660	6,900	4,173	-	3,045	4,400

Table 3-28: Littlerock Creek Runoff by Monthly Average

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOTAL
Mean (CFS)	113.61	59.51	49.42	38.71	31.62	7.46	2.19	1.10	0.94	3.63	1.68	8.60	318.47
Mean (AF/month)	6,760	3,541	2,941	2,303	1,882	444	130	65	56	216	100	512	18,950

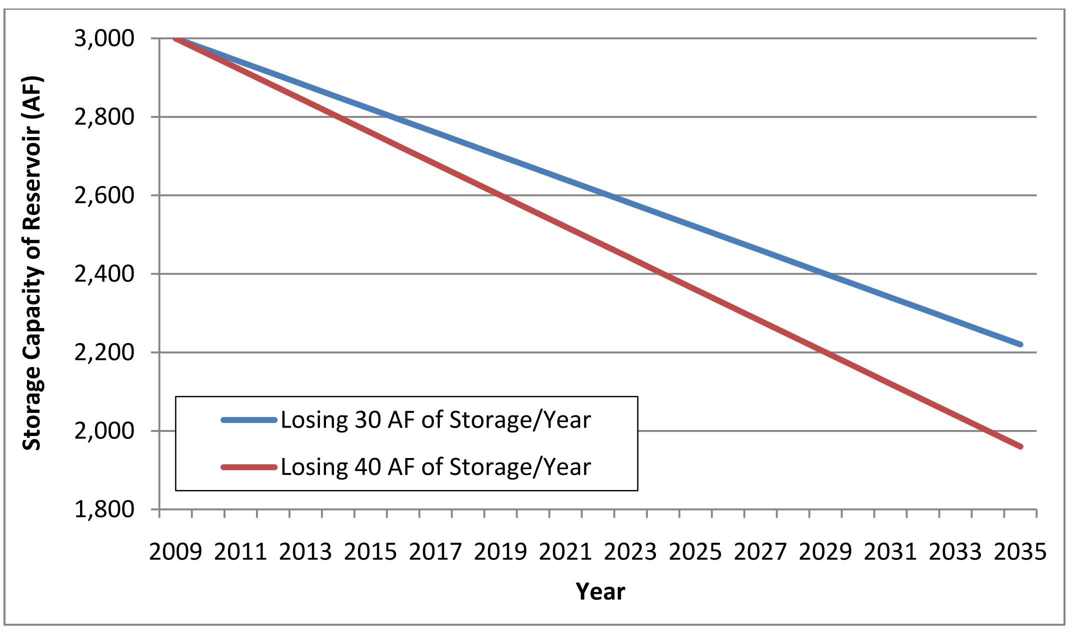
Source: http://www.ladpw.org/wrd/report/0607/runoff/discharge.cfm

Figure 3-35: Littlerock Creek Runoff by Year



Source: http://www.ladpw.org/wrd/report/0607/runoff/discharge.cfm

Figure 3-36: Littlerock Reservoir Projected Loss of Storage Capacity



Summary of LACDPW Observed Flooding Locations in the Antelope Valley

Information provided by: Youssef Chebabi, Dale Brown, Bob Holmes, and Thomas Ashton, LA County Department of Public Works

Summarized by: Brian Dietrick, P.E., RMC Water and Environment

Date: 1/26/2013

1. **<u>Flood Frequency - all storms</u>**:
    a. 240th St. East at Avenue P
    b. Avenue O west of 240th St. East
    c. 180th St. East at Avenue O
    d. Avenue P at 170th St. East
    e. Avenue Q4 at 160th St. East
    f. Avenue Q4 at 155th St. East
    g. Avenue L8 at 170th ST. East
    h. Avenue M8 at 155th St. East
    i. Avenue M12 at 155th St. East
    j. 165th St. East at Avenue N
    k. Cool Water St. at 167th St. East
    l. Avenue N at 160th St. East
    m. Avenue N at 155th St. East
    n. 50th St. East and Avenue J (south side is City)
    o. Avenue H east of Division St.
    p. Avenue P8 at 90th St. East
    q. Avenue M east of 150th St. East
    r. Avenue G east of Division St.
    s. Avenue F east of 10th St. East
    t. Avenue G6 at Division St.
    u. Avenue M12 at 157th St. East
    v. Frontier Circus St. from Stagecoach to Avenue P8
    w. Avenue J at 100th St. East
2. **<u>Flood Frequency - medium and high storm events:</u>**
   Big Rock Creek
    a. Avenue Q at 145th St. East
    b. Avenue Q west of 140th St. East
    c. 140th St. East south of Avenue Q
    d. 145th St. East north of Avenue Q
    e. 150th St. East at Palmdale Blvd. to Avenue Q4 (very high storm events)
    f. Avenue O at 140th St. East
    g. 150th St. East at Avenue M8
    h. 150th St. East at Avenue M4

i. 110^{th} St. East from Avenue K8 to Avenue I (down middle of street for 2 miles)
j. Avenue I west of 110^{th} St. East
k. Avenue H at 100^{th} to 105^{th} St. East

Littlerock Creek

a. 70^{th} St. East +/- Avenue M
b. Avenue N west of 70^{th} St. East
c. Avenue I west of 60^{th} St. East
d. Avenue H at 55^{th} St. East
e. Avenue H (3/4 of the water travels west on Avenue H to 50^{th} St. East)
f. 50^{th} St. East (3/4 of water flows down from Avenue H to Avenue D (to AF Base), water travels down street for 4 miles)
g. Avenue G at 55^{th} St. East (1/4 of water flows down on Avenue G)

3. Other Areas

a. Hasley Canyon Road and Del Valle Road: Hasley Cyn area
b. Lincoln approximately 200 feet south of Chiquito Canyon Road: Val Verde area
c. Lincoln and Taylor: Val Verde area
d. Kenningston Road at Arlington St.: Val Verde area
e. 20^{th} St. West from Ave. E to Ave. F
f. 60^{th} St. West from Ave. A to Ave. E
g. 70^{th} St. West from Ave. A to Ave. E
h. 90^{th} St. West from Ave. A to Ave. G8
i. 110^{th} St. West from Ave. A to Ave. K
j. Lancaster Road from 70^{th} St. West to 245^{th} St. West
k. La Petite Ave. from Ave. B8 to Ave. D
l. Ave. A from 100^{th} St. West to 170^{th} St. West
m. 170^{th} St. West from Ave. A to Lancaster Road
n. 190^{th} St. West from Ave. B to Ave. D
o. Elizabeth Lake Road from Godde Hill Road and Lake Hughes Road
p. Bouquet Canyon Road from Elizabeth Lake Road to M.M. 8.01 (end of district)
q. San Francisquito Canyon Rd. from Elizabeth Lake Road and Pelton Road (end of district)
r. Johnson Hill Road from 110^{th} St. West to Elizabeth Lake Road
s. Munz Ranch Road from Lancaster Road to Elizabeth Lake Road
t. 45^{th} St. West from Quartz Hill Road to Ave. M4
u. Ave. N west of 50^{th} St. West - for dip
v. Ave. M east and west of 51^{st} St. West
w. Ave. L east and west of 52^{nd} St. West
x. Ave. L8 from 42^{nd} to 45^{th} St. West - at dip
y. Ave. K east of 45^{th} St. West on south side - where water comes from field
z. Ave. K east and west of 52^{nd} St. West
aa. Quartz Hill Road and Ave. M from 40^{th} St. West to 50^{th} St. West

Attachment 8
Benefits and Cost Analysis



Littlerock Reservoir Sediment Removal Project

Attachment 8

Stormwater Flood Management Grant Proposal Littlerock Reservoir Sediment Removal Project Flood Damage Reduction Costs and Benefits

Attachment 8 consists of the following items:

- ✓ **Flood Damage Reduction Costs and Benefits.** Attachment 8 describes and quantifies the benefits and costs of each project in the proposal.

Introduction

This attachment presents the economic analysis for the Littlerock Reservoir Sediment Removal Project (LRSR). A project abstract and of project benefit summary table are followed by the sections as outlined in the PSP: Flood Damage Reduction Benefit Analysis (Section D1), Non-Monetized Benefits Analysis (Section D2), Monetized Benefit Analysis (Section D3), and Project Benefits and Costs Summary (Section D4).

Project Abstract

The LRSR Project proposes to restore the capacity of the reservoir to 3,325 AF through removal of 900,000 net cubic yards (equivalent to 560 AF) of accumulated sediment behind the Littlerock Dam. In addition, the LRSR Project proposes to construct a grade control structure that will prevent sediment loss and headcutting upstream of the Reservoir beyond Rocky Point to protect and preserve habitat for the federally endangered arroyo toad. Water quality, energy, and climate change benefits are also provided by the Project.

Summary Distribution of Project Benefits and Identification of Beneficiaries

The LRSR Project provides multiple benefits to a wide range of beneficiaries. As is shown in Table 8-1 local, regional and statewide benefits come from avoided flood damage, increased water supply, avoided GHG emissions, improved habitat for the endangered Arroyo Toad, improved water quality, increased water supply reliability, and avoided increases in demands on the Delta.

Table 8-1: Project Benefits and Beneficiaries

Project Benefits	Project Beneficiaries
Increased water supplies through restored reservoir capacity	Palmdale Water District and customers
Increased water supply reliability	Palmdale Water District and customers
Avoided increase in demands on the Delta	Statewide residents
Avoided flood damage	Downstream residents and businesses
Improved habitat for endangered Arroyo Toad	General public
Improved water quality	Palmdale Water District and customers

Project Benefits	Project Beneficiaries
Reduced energy consumption	General public
Avoided GHG emissions	General public

Flood Damage Reduction Benefit Analysis (Section D1)

Flooding downstream of the Littlerock Reservoir as a result of water overtopping the Littlerock Dam could cause damage to existing residential structures, warehouses, commercial outbuildings, and garages. By increasing flood protection, this project will reduce the costs of repairing injured buildings and their contents, as well as costs to public areas (e.g., roads).

Hydrologic modeling of flood damages downstream of Littlerock Dam was performed for this analysis by CDM, as detailed in Attachment 7. Downstream flood damages are shown to affect residential, commercial, and industrial structures, as well as roads. Flood damage reduction benefits were estimated with DWR's F-RAM model. Estimated physical flood protection benefits were input (i.e., flood depth in affected structures and miles of inundated road) into F-RAM to estimate the average annual value of flood protection benefits with and without the Project. F-RAM results indicate that without the Project, average annual damages associated with flooding would amount to $57,171. With the Project, average annual damages would be approximately $53,687. Of this $3,484 annual difference, structural damage accounts for $2,892 and road damages account for $592.

Flood damages were estimated for the without- and with-Project conditions for the following categories:

- Residential structure damage
- Commercial structure damage
- Industrial structure damage
- Road damage

Estimates of probability of a storm with a particular return period overtopping Littlerock Dam are shown in Table 8-2, along with the average flood depth above ground level calculated in the CDM analysis. A ratio of depreciated value to replacement value of 60% was assumed based generally on the older age of the structures that will be flooded downstream.

Table 8-2 Average Flood Depths
Littlerock Reservoir Sediment Removal Project
F-RAM Model Inputs:

Hydrologic Event	10-Yr	25-Yr	50-Yr	100-Yr
Exceedance Probability				
Without Project		0.66	1.00	1.00
With Project		0.50	0.88	1.00
Average Flood Depth Above Finished Floors (ft)				
Without Project		0.67	0.96	1.39
With Project		0.54	0.86	1.39

Without- and With-Project Flood Damage Estimates

F-RAM flood damage estimates for the without- and with-project conditions are summarized in Table 8-3. All dollar amounts are in 2012 dollars. Expected Annual Damages (EAD) calculated with F-RAM are shown at the bottom of the table.

Table 8-3 (PSP Table 11)
Littlerock Reservoir Sediment Removal Project
F-RAM Flood Damage Estimates
(2012 Dollars)

Hydrologic Event	10-Yr	25-Yr	50-Yr	100-Yr
Exceedance Probability		0.04	0.02	0.01
Annual Damage to Residential Structures				
Without Project		$561,386	$850,585	$2,251,724
With Project		$425,292	$748,514	$2,251,724
Annual Damage to Commercial Structures				
Without Project		$0	$0	$42
With Project		$0	$0	$42
Annual Damage to Industrial Structures				
Without Project		$80	$122	$122
With Project		$61	$107	$122
Annual Damage to Roads				
Without Project		$53,625	$117,500	$181,250
With Project		$33,750	$91,300	$181,250
Expected Annual Damages				
Without Project				$57,171
With Project				$53,687
Annual Flood Damage Reduction Benefit				$3,484
Notes				

Present Value of Expected Annual Damages

The present value of flood damage reduction benefits are summarized in Table 8-4 (which corresponds to PSP Table 12).Benefits are assumed to commence in 2020 and have useful life of 50 years. Future benefits are discounted using a 6% discount rate.

Table 8-4 (PSP Table 12) Littlerock Reservoir Sediment Removal Project Present Value of Expected Annual Damages (2012 Dollars)			
(a)	Expected Annual Damage Without Project		**$57,171**
(b)	Expected Annual Damage With Project		**$53,687**
(c)	Expected Annual Benefit	(a) – (b)	**$3,484**
(d)	Present Value Coefficient		**15.76**
(e)	**Present Value of Future Benefits** **Transfer to Table 17, column (d).**	**(c) x (d)**	**$54,917**

Non-Monetized Benefits Analysis (Section D2)

Table 8-5 shows the non-monetized benefits checklist for the project. Narrative descriptions of the benefit categories marked "Yes" are provide following the table.

Table 8-5 (PSP Table 13) Littlerock Reservoir Sediment Removal Project Non-monetized Benefits Checklist		
No.	Question	Enter "Yes", "No" or "Neg"
	Community/Social Benefits **Will the proposal**	
1	**Provide education or technology benefits?**	No
	Examples are not limited to, but may include: - Include educational features that should result in water supply, water quality, or flood damage reduction benefits? - Develop, test or document a new technology for water supply, water quality, or flood damage reduction management? - Provide some other education or technological benefit?	
2	**Provide social recreation or access benefits?**	No
	Examples are not limited to, but may include: - Provide new or improved outdoor recreation opportunities? - Provide more access to open space? - Provide some other recreation or public access benefit?	
3	**Help avoid, reduce or resolve various public water resources conflicts?**	Yes[2]
	Examples are not limited to, but may include: - Provide more opportunities for public involvement in water management? - Help avoid or resolve an existing conflict as evidenced by recurring fines or litigation?	

Table 8-5 (PSP Table 13) Littlerock Reservoir Sediment Removal Project Non-monetized Benefits Checklist		
No.	Question	Enter "Yes", "No" or "Neg"
	- Help meet an existing state mandate (e.g., water quality, water conservation, flood control)?	
4	**Promote social health and safety?**	No[1]
	Examples are not limited to, but may include: - Increase urban water supply reliability for fire-fighting and critical services following seismic events? - Reduce risk to life from dam failure or flooding? - Reduce exposure to water-related hazards?	
5	**Have other social benefits?**	No
	Examples are not limited to, but may include: - Redress or increase inequitable distribution of environmental burdens? - Have disproportionate beneficial or adverse effects on disadvantaged communities, Native Americans, or other distinct cultural groups?	
	Environmental Stewardship Benefits: **Will the proposal**	
6	**Benefit wildlife or habitat in ways that were not quantified in Attachment 7?**	Yes
	Examples are not limited to, but may include: - Cause an increase in the amount or quality of terrestrial, aquatic, riparian or wetland habitat? - Contribute to an existing biological opinion or recovery plan for a listed special status species? - Preserve or restore designated critical habitat of a listed species? - Enhance wildlife protection or habitat?	
7	**Improve water quality in ways that were not quantified in Attachment 7?**	No[1]
	Examples are not limited to, but may include: - Cause an improvement in water quality in an impaired water body or sensitive habitat? - Prevent water quality degradation? - Cause some other improvement in water quality?	
8	**Reduce net emissions in ways that were not quantified in Attachment 7?**	No[1]
	Examples are not limited to, but may include: - Reduce net production of greenhouse gasses? - Reduce net emissions of other harmful chemicals into the air or water?	
9	**Provide other environmental stewardship benefits, other than those claimed in Sections D1, D3 or D4?**	No
	Sustainability Benefits: **Will the proposal**	
10	**Improve the overall, long-term management of California groundwater resources?**	No

Table 8-5 (PSP Table 13) Littlerock Reservoir Sediment Removal Project Non-monetized Benefits Checklist		
No.	Question	Enter "Yes", "No" or "Neg"
	Examples are not limited to, but may include: - Reduce extraction of non-renewable groundwater? - Promote aquifer storage or recharge?	
11	**Reduce demand for net diversions for the regions from the Delta?**	Yes
12	**Provide a long-term solution in place of a short-term one?**	No
	Examples are not limited to, but may include: - Replace a temporary water supply with a more permanent supply? - Replace a temporary water quality solution with a more permanent solution? - Replace temporary flood control management with a more permanent solution? - Replace temporary habitat with a more permanent solution?	
13	**Reduce water consumption on a permanent basis?**	No
14	**Promote energy savings or replace fossil fuel based energy sources with renewable energy and resources?**	No[1]
	Examples are not limited to, but may include: - Reduce net energy use on a permanent basis? - Increase renewable energy production? - Include new buildings or modify buildings to include certified LEED features? - Provide a net increase in recycling or reuse of materials? - Replace unsustainable practices with recognized sustainable practices?	
15	**Improve water supply reliability in ways not quantified in Attachment 7?**	No[1]
	Examples are not limited to, but may include: - Provide a more flexible mix of water sources? - Reduce likelihood of catastrophic supply outages? - Reduce supply uncertainty? - Reduce supply variability?	
16	**Other (If the above listed categories do not apply, provide non-monetized benefit description)?**	No

[1] This benefit was already addressed as a physical benefit discussed in Attachment 7.
[2] This benefit is described in more detail in Attachment 9.

Narrative Description of Qualitative Benefits

Benefit wildlife or habitat in ways that were not quantified in Attachment 7

Littlerock Creek, which feeds the Reservoir, provides habitat for the federally endangered arroyo toad (Bufo californicus). Previous plans for sediment removal from the Reservoir posed potential risks for “take” of arroyo toad and degradation of arroyo toad habitat upstream of the Reservoir beyond the Rocky Point area. The LRSR project proposes to construct a soil cement grade control structure at Rocky Point to prevent sediment loss and headcutting of the stream channel upstream of Rocky Point. This grade control structure will minimize the degradation of critical habitat for and incidental “take” of the federally-endangered arroyo toad. In addition, the grade control structure would act as a barrier between human activities (i.e., recreation activities, sediment removal activities, etc.) within the Reservoir and the arroyo toad’s habitat upstream of Rocky Point. Protection of the arroyo toad is consistent with USFS Strategy WL 1 (Threatened, Endangered, Proposed, Candidate, and Sensitive Species Management).

Reduce demand for net diversions for the regions from the Delta

Abating SWP imports has additional benefits from reducing dependence on the Sacramento-San Joaquin Delta, which has competing demands for water supply, habitat, and recreation value. The Delta’s ability to provide reliable potable water is affected by variable inflows, competing beneficial uses and water rights, water quality standards, regulatory requirements, pumping operations, and other physical factors[1]. By increasing water supply capacity at the Littlerock Reservoir, PWD is avoiding costs associated with the many factors of providing potable water via diversions of the Delta. Additionally, reducing Delta diversions allays the physical damage to species and habitat caused directly or indirectly by water supply infrastructure. This reduction in operations will help to meet Bay Delta environmental goals to restore fish and wildlife species, as well as tidal marshes and flood plains.

The Antelope Valley Region has made it a priority to reduce dependence on imported water supplies received from the Sacramento-San Joaquin Delta (Delta), a priority that is reflected in the Region’s 2007 IRWMP Plan. Diversion of water from the Delta to southern California has caused damage to the Bay Delta’s ecosystem due to SWP and Central Valley Project operations. In particular, infrastructure used to divert water to southern California directly impacts species (such as the entrainment of aquatic species in pumps) and damages habitats, while operations that reverse river flows impact ecosystems activity. By reducing the Region’s reliance on the Bay Delta, diversions will be reduced, thus reducing operations that impact native species and habitats. This reduction in operations will help to meet Bay Delta environmental goals to restore tidal marshes and floodplains, and restore fish and wildlife species.

Improve water supply reliability in ways not quantified in Attachment 7

The reliability of a water supply refers to the ability to consistently meet water demands, even in times of drought or other constraints on source water availability. The Project would help increase the reliability of water use by PWD by substituting local surface water from Littlerock Reservoir for SWP supplies. The SWP Delivery Reliability Report for 2011[2] shows that the long-term reliability of SWP supplies is 60% of the total demand for SWP Table A water, with deliveries during multiple dry year periods averaging 32% to 38% of total demand. In comparison, PWD’s 2010 Strategic Water Resources Plan[3] includes a record of Littlerock Creek runoff by year that indicates a reliability of 100% for PWD’s 5,500 AFY diversion right during an average year.

Monetized Benefit Analysis (Section D3)

Water supply benefits from increased storage Littlerock Creek runoff in Littlerock Reservoir and avoided social cost of carbon due to avoided imports of SWP water are claimed as monetized benefits in this section.

[1] California Department of Water Resources (DWR). *The 2011 State Water Project Final Delivery Reliability Report.* Bay-Delta Office. June 2012.
[2] California Department of Water Resources (DWR). *The 2011 State Water Project Final Delivery Reliability Report.* Bay-Delta Office. June 2012.
[3] 2010 Palmdale Water District Strategic Water Resources Program: Options Report, RMC, March 2010.

Increased local water supply

PWD's local surface water supply is from Littlerock Dam Reservoir. This water is transferred from the reservoir to Lake Palmdale for treatment and distribution. PWD's imported water is provided by the SWP and is conveyed to Lake Palmdale which acts as a forebay for the District's 35 million gallon per day (mgd) water treatment plant. Lake Palmdale can store approximately 4,250 AF of SWP and Littlerock Dam Reservoir water.

The sediment removal associated with this project will add 560 AF per year of storage space to Littlerock Reservoir. At described in Attachment 7, without this project PWD would need to meet that amount of demand with increased imports of SWP water. PWD has an allocation of SWP Table A water that it is expected to fully utilize before 2015, given the average reliability of SWP water of 60% in a normal year[4]. Permanent exchanges are currently being priced at approximately $7,500/AF, or a 30 year amortized cost of approximately $550/AF[5]. Losses in the Palmdale Ditch between Littlerock Reservoir and Lake Palmdale reach 33%, and so the cost per AF was adjusted to $825 per AF in 2012 dollars.

The cost of imported water has increased in nominal terms anywhere between 5% and 10% annually in recent years, and we use the midpoint of that range escalate annually at 7.5% into the future.[6] Assuming a long term average inflation rate of 2.5% results in a real escalation rate of approximately 5%. Based on these assumptions, we estimate that the project will provide a present benefit of approximately $17.1 million in avoided water import costs over the next 50 years, assuming a 6% discount rate.

Avoided greenhouse gas emissions

Avoidance of purchase and use of additional imported water to meet PWD demands also avoids energy use associated with delivering imported water. The energy required to convey surface water from the Reservoir to PWD's 15-mgd water treatment plant is essentially zero. For imported supplies, West Basin Municipal Water District (WBMWD) has estimated that approximately 3,000 kilowatt-hours (kWh) per AF of energy is required for conveyance and pumping to Southern California SWP contracting agencies. Greenhouse gas (GHG) emissions generated by the energy needed to transport imported SWP water for the Region can be calculated by applying a factor of 0.724 lbs. of CO_2 equivalents per kWh and converting to total tons of CO_2 equivalents, based on the California Action Registry, General Reporting Protocol.[7] By offsetting the demand of 560 AF of imported SWP water, the proposed Project will avoid GHG emissions of 552 metric tons per year of CO_2 equivalents per year.

Avoided energy use can be valued according to environmental impacts due to carbon emissions. The federal Interagency Working Group on Social Cost of Carbon has developed a value for the global damages contributed by each metric ton of CO_2 equivalent emitted. The social cost of carbon is "intended to include (but is not limited to) changes in net agricultural productivity, human health, property damages from increased flood risk, and the value of ecosystem services" (See Appendix I).[8] The working group value is $21.83/MT, with a range from $4.79/MT to $66.20/MT. When the $21.83/MT value is applied to the avoided emissions from imported water through the end of the useful life of the project, the total present value of the avoided cost of CO2 emissions is $126,316.

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[4] Palmdale Water District. 2011. Urban Water Management Plan 2010.

[5] RMC, 2010. PWD's *Strategic Water Resources Program: Options Report, RMC, March 2010.*

[6] Palmdale Water District, 2012. Strategic Water Resources Plan. RMC, March 2010.

[7] Climate Action Registry, General Reporting Protocol http://www.climateregistry.org/tools/protocols/general-reporting-protocol.html

[8] Interagency Working Group on Social Cost of Carbon. 2010. Technical Support Document: Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866. United States Government. February. Available: www.epa.gov/oms/climate/regulations/scc-tsd.pdf. Accessed January 2013.

Summary

The monetized benefits in this section are calculated from avoided imported water purchase costs and avoided social costs of carbon associated with avoided energy use to transport SWP water from the Delta. As is shown in Table 8-6, the present value of monetized benefits from this section is $17.26 million.

Table 8-6 (PSP Table 14)
Littlerock Reservoir Sediment Removal Project
Other Annual Project Benefits
(2012 Dollars)

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	Type of Benefit	Measure of Benefit (Units)	Without Project	With Project	Change Resulting from Project (e) – (d)	Unit $ Value	Annual $ Value (f) x (g)	Discount Factor	Discounted Benefits (h) x (i)
2012						$825		1.000	
2013						$866		1.000	
2014						$910		0.890	
2015						$955		0.840	
2016						$1,003		0.792	
2017						$1,053		0.747	
2018						$1,106		0.705	
2019						$1,161		0.665	
2020	avoided reservoir capacity loss	acre-feet	560	0	560	1,219	$682,584	0.627	**$ 428,262**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.627	**$ 7,560**
2021	avoided reservoir capacity loss	acre-feet	560	0	560	$1,280	$716,714	0.592	**$ 424,222**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.592	**$ 7,132**
2022	avoided reservoir capacity loss	acre-feet	560	0	560	$1,344	$752,549	0.558	**$ 420,220**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.558	**$ 6,729**
2023	avoided reservoir capacity loss	acre-feet	560	0	560	$1,411	$790,177	0.527	**$ 416,255**

	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,0506	0.527	**$ 6,348**
2024	avoided reservoir capacity loss	acre-feet	560	0	560	$1,482	$829,686	0.497	**$ 412,328**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.497	**$ 5,989**
2025	avoided reservoir capacity loss	acre-feet	560	0	560	$1,556	$871,170	0.469	**$ 408,438**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.469	**$ 5,650**
2026	avoided reservoir capacity loss	acre-feet	560	0	560	$1,633	$914,728	0.442	**$ 404,585**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.442	**$ 5,330**
2027	avoided reservoir capacity loss	acre-feet	560	0	560	$1,715	$960,465	0.417	**$ 400,768**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.417	**$ 5,028**
2028	avoided reservoir capacity loss	acre-feet	560	0	560	$1,801	$1,008,488	0.394	**$ 396,988**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.394	**$ 4,744**
2029	avoided reservoir capacity loss	acre-feet	560	0	560	$1,891	$1,058,912	0.371	**$ 393,242**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.371	**$ 4,475**
2030	avoided reservoir capacity loss	acre-feet	560	0	560	$1,985	$1,111,858	0.350	**$ 389,533**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.350	**$ 4,222**
2031	avoided reservoir capacity loss	acre-feet	560	0	560	$2,085	$1,167,451	0.331	**$ 385,858**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.331	**$ 3,983**
2032	avoided reservoir capacity	acre-feet	560	0	560	$2,189	$1,225,824	0.312	**$ 382,218**

	loss								
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.312	**$ 3,757**
2033	avoided reservoir capacity loss	acre-feet	560	0	560	$2,298	$1,287,115	0.294	**$ 378,612**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.294	**$ 3,545**
2034	avoided reservoir capacity loss	acre-feet	560	0	560	$2,413	$1,351,470	0.278	**$ 375,040**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.278	**$ 3,344**
2035	avoided reservoir capacity loss	acre-feet	560	0	560	$2,534	$1,419,044	0.262	**$ 371,502**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.262	**$ 3,155**
2036	avoided reservoir capacity loss	acre-feet	560	0	560	$2,661	$1,489,996	0.247	**$ 367,997**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.247	**$ 2,976**
2037	avoided reservoir capacity loss	acre-feet	560	0	560	$2,794	$1,564,496	0.233	**$ 364,525**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.233	**$ 2,808**
2038	avoided reservoir capacity loss	acre-feet	560	0	560	$2,933	$1,642,721	0.220	**$ 361,087**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.220	**$ 2,649**
2039	avoided reservoir capacity loss	acre-feet	560	0	560	$3,080	$1,724,857	0.207	**$ 357,680**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.207	**$ 2,499**
2040	avoided reservoir capacity loss	acre-feet	560	0	560	$3,234	$1,811,100	0.196	**$ 354,306**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.196	**$ 2,357**
2041	avoided reservoir	acre-feet	560	0	560	$3,396	$1,901,655	0.185	**$ 350,963**

	capacity loss								
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.185	**$ 2,224**
2042	avoided reservoir capacity loss	acre-feet	560	0	560	$3,566	$1,996,737	0.174	**$ 347,652**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.174	**$ 2,098**
2043	avoided reservoir capacity loss	acre-feet	560	0	560	$3,744	$2,096,574	0.164	**$ 344,372**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.164	**$ 1,979**
2044	avoided reservoir capacity loss	acre-feet	560	0	560	$3,931	$2,201,403	0.155	**$ 341,124**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.155	**$ 1,867**
2045	avoided reservoir capacity loss	acre-feet	560	0	560	$4,128	$2,311,473	0.146	**$ 337,906**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.146	**$ 1,762**
2046	avoided reservoir capacity loss	acre-feet	560	0	560	$4,334	$2,427,047	0.138	**$ 334,718**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.138	**$ 1,662**
2047	avoided reservoir capacity loss	acre-feet	560	0	560	$4,551	$2,548,399	0.130	**$ 331,560**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.130	**$ 1,568**
2048	avoided reservoir capacity loss	acre-feet	560	0	560	$4,778	$2,675,819	0.123	**$ 328,432**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.123	**$ 1,479**
2049	avoided reservoir capacity loss	acre-feet	560	0	560	$5,017	$2,809,610	0.116	**$ 325,334**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.116	**$ 1,395**
2050	avoided	acre-	560	0	560	$5,268	$2,950,091	0.109	**$ 322,264**

	reservoir capacity loss	feet							
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.109	**$ 1,316**
2051	avoided reservoir capacity loss	acre-feet	560	0	560	$5,531	$3,097,595	0.103	**$ 319,224**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.103	**$ 1,242**
2052	avoided reservoir capacity loss	acre-feet	560	0	560	$5,808	$3,252,475	0.097	**$ 316,213**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.097	**$ 1,172**
2053	avoided reservoir capacity loss	acre-feet	560	0	560	$6,098	$3,415,099	0.092	**$ 313,230**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.092	**$ 1,105**
2054	avoided reservoir capacity loss	acre-feet	560	0	560	$6,403	$3,585,853	0.087	**$ 310,275**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.087	**$ 1,043**
2055	avoided reservoir capacity loss	acre-feet	560	0	560	$6,723	$3,765,146	0.082	**$ 307,347**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.082	**$ 984**
2056	avoided reservoir capacity loss	acre-feet	560	0	560	$7,060	$3,953,403	0.077	**$ 304,448**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.077	**$ 928**
2057	avoided reservoir capacity loss	acre-feet	560	0	560	$7,413	$4,151,074	0.073	**$ 301,576**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.073	**$ 875**
2058	avoided reservoir capacity loss	acre-feet	560	0	560	$7,783	$4,358,627	0.069	**$ 298,731**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.069	**$ 826**

2059	avoided reservoir capacity loss	acre-feet	560	0	560	$8,172	$4,576,559	0.065	**$ 295,913**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.065	**$ 779**
2060	avoided reservoir capacity loss	acre-feet	560	0	560	$8,581	$4,805,387	0.061	**$ 293,121**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.061	**$ 735**
2061	avoided reservoir capacity loss	acre-feet	560	0	560	$9,010	$5,045,656	0.058	**$ 290,356**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.058	**$ 693**
2062	avoided reservoir capacity loss	acre-feet	560	0	560	$9,461	$5,297,939	0.054	**$ 287,616**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.054	**$ 654**
2063	avoided reservoir capacity loss	acre-feet	560	0	560	$9,934	$5,562,836	0.051	**$ 284,903**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.051	**$ 617**
2064	avoided reservoir capacity loss	acre-feet	560	0	560	$10,430	$5,840,977	0.048	**$ 282,215**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.048	**$ 582**
2065	avoided reservoir capacity loss	acre-feet	560	0	560	$10,952	$6,133,026	0.046	**$ 279,553**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.046	**$ 549**
2066	avoided reservoir capacity loss	acre-feet	560	0	560	$11,499	$6,439,678	0.043	**$ 276,916**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.043	**$ 518**
2067	avoided reservoir capacity loss	acre-feet	560	0	560	$12,074	$6,761,661	0.041	**$ 274,303**
	avoided CO_2	tons	552	0	552	$21.83	$12,050	0.041	**$ 489**

	emissions								
2068	avoided reservoir capacity loss	acre-feet	560	0	560	$12,678	$7,099,745	0.038	**$ 271,715**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.038	**$ 461**
2069	avoided reservoir capacity loss	acre-feet	560	0	560	$13,312	$7,454,732	0.036	**$ 269,152**
	avoided CO_2 emissions	tons	552	0	552	$21.83	$12,050	0.036	**$ 435**
Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table)									**$17,260,677**
Comments:									

Project Benefits and Costs Summary (Section D4)

Project Economic Costs

Project economic costs are summarized in Table 8-7. Initial costs for sediment removal total $11,963,233. Direct construction and implementation costs account for $8,242,723 (about 69%) of total capital costs. Project administration, planning, design, environmental documentation and compliance, permitting and legal fees, and contingency costs account for the remainder of the capital budget.

In addition to the 5-year sediment removal period, maintaining the water supply and flood protection capacity will require removing approximately 54,000 cubic yards of sediment annually. At a cost of $15/CY, this amounts to O&M costs of the project of about $810,000 per year. In total, the present value capital and O&M costs associated with the project amount to $17,688,105 over the 50-year project life (the 50-year project period runs from 2020, the first year following the end of sediment removal, through 2069).

Table 8-7 (PSP Table 16) Littlerock Reservoir Sediment Removal Project Project Annual Costs (2012 Dollars)										
	Initial Costs Grand Total Cost from Table 6 (row (i), column (d))	Adjusted Grand Total Cost	Annual Costs						Discounting Calculations	
			Admin	Operation	Maintenance	Replace-ment	Other	Total Costs (a) +…+ (g)	Discount Factor (Capital) Present Value Coeff (O&M)	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2012	$ 399,517							$399,517	1.000	**$399,517**
2013	$ 409,335							$409,335	0.943	**$386,003**
2014	$ 409,335							$409,335	0.890	**$364,308**
2015	$ 2,125,409							$2,125,409	0.840	**$1,785,344**
2016	$ 2,125,409							$2,125,409	0.792	**$1,683,523**
2017	$ 2,125,409							$2,125,409	0.747	**$1,588,229**
2018	$ 2,125,409							$2,125,409	0.705	**$1,498,330**
2019	$ 2,243,409							$2,243,409	0.665	**$1,491,995**
2020					$810,000			$810,000	0.627	**$508,204**
2021					$810,000			$810,000	0.592	**$479,438**
2022					$810,000			$810,000	0.558	**$452,300**
2023					$810,000			$810,000	0.527	**$426,698**
2024					$810,000			$810,000	0.497	**$402,545**
2025					$810,000			$810,000	0.469	**$379,760**
2026					$810,000			$810,000	0.442	**$358,264**
2027					$810,000			$810,000	0.417	**$337,985**
2028					$810,000			$810,000	0.394	**$318,853**
2029					$810,000			$810,000	0.371	**$300,805**

2030					$810,000			$810,000	0.350	**$283,778**
2031					$810,000			$810,000	0.331	**$267,716**
2032					$810,000			$810,000	0.312	**$252,562**
2033					$810,000			$810,000	0.294	**$238,266**
2034					$810,000			$810,000	0.278	**$224,779**
2035					$810,000			$810,000	0.262	**$212,056**
2036					$810,000			$810,000	0.247	**$200,053**
2037					$810,000			$810,000	0.233	**$188,729**
2038					$810,000			$810,000	0.220	**$178,046**
2039					$810,000			$810,000	0.207	**$167,968**
2040					$810,000			$810,000	0.196	**$158,460**
2041					$810,000			$810,000	0.185	**$149,491**
2042					$810,000			$810,000	0.174	**$141,029**
2043					$810,000			$810,000	0.164	**$133,046**
2044					$810,000			$810,000	0.155	**$125,515**
2045					$810,000			$810,000	0.146	**$118,411**
2046					$810,000			$810,000	0.138	**$111,708**
2047					$810,000			$810,000	0.130	**$105,385**
2048					$810,000			$810,000	0.123	**$99,420**
2049					$810,000			$810,000	0.116	**$93,792**
2050					$810,000			$810,000	0.109	**$88,483**
2051					$810,000			$810,000	0.103	**$83,475**
2052					$810,000			$810,000	0.097	**$78,750**
2053					$810,000			$810,000	0.092	**$74,292**
2054					$810,000			$810,000	0.087	**$70,087**
2055					$810,000			$810,000	0.082	**$66,120**
2056					$810,000			$810,000	0.077	**$62,377**
2057					$810,000			$810,000	0.073	**$58,847**
2058					$810,000			$810,000	0.069	**$55,516**

2059					$810,000			$810,000	0.065	**$52,373**
2060					$810,000			$810,000	0.061	**$49,409**
2061					$810,000			$810,000	0.058	**$46,612**
2062					$810,000			$810,000	0.054	**$43,974**
2063					$810,000			$810,000	0.051	**$41,485**
2064					$810,000			$810,000	0.048	**$39,136**
2065					$810,000			$810,000	0.046	**$36,921**
2066					$810,000			$810,000	0.043	**$34,831**
2067					$810,000			$810,000	0.041	**$32,860**
2068					$810,000			$810,000	0.038	**$31,000**
2069					$810,000			$810,000	0.036	**$29,245**
Total Present Value of Discounted Costs (Sum of Column (j)) Transfer to Table 17, column (c), Proposal Benefits and Costs Summaries										**$17,688,105**
Comments:										

Proposal Benefits and Costs Summary

Project benefits and costs are summarized in Table 8-8.

Table 8-8 (PSP Table 17)
Littlerock Reservoir Sediment Removal Project
Proposal Benefits and Costs Summary
(2012 Dollars)

Project	Project Proponent	Total Present Value Project Costs	Total Present Value Project Benefits			From Section D2 – Briefly describe the main Non-monetized benefits
			From Section D2 – Flood Damage Reduction	From Section D3 – Monetized	Total	
(a)	(b)	(c)	(d)	(e)	(f) = (d) + (e)	(g)
Littlerock Dam and Sediment Removal Project	Palmdale Water District	$ 17,688,105	$54,917	$17,260,677	$17,315,594	Benefit to endangered Arroyo Toad, increased water supply reliability, improved water quality through avoided SWP water imports, avoided increase in demands on the Delta, reduced energy consumption

Strategic Water Resources Program: Options Report

Prepared by:

RMC

Water and Environment

In Association with:

A&N Technical Services

Wildermuth Environmental

March 2010

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Cost for Delivering Water

The recent cost for delivering SWP water to PWD is summarized below in **Table 3-12**. The cost of pumping SWP water is subsidized by DWR. However, if non-SWP water is moved through the system, a non-subsidized power rate may apply.

Table 3-12: Cost to Transport SWP Water to PWD

Charge Description	2007 Charge (per af)
Transportation Charges	
Capital Cost Component	$51
Minimum OMP&R Component	$47
Off-Aqueduct Component	$36
Variable IMP&R Component	$109
Delta Water Charge	$42
Water System Revenue Bond Surcharge	$9
Total Equivalent Unit Charge	**$295**

(DWR Bulletin 132-06, Table B-24)

In addition to the cost of delivering imported water from its source to PWD, PWD will also need to consider supply storage (such as water banking) that will smooth out deliveries and provide supplies during dry years. In general, the cost associated with banking water may range from $200/af to $400/af. Water banking is addressed in further detail in Section 5.5.

Cost and Terms for Obtaining Water

There are various sources of water that might be available to PWD for purchase or lease including:

- Table A allocations from other SWP contractors
- Allocations from Central Valley Project (CVP) contractors
- Other non-SWP or CVP water rights (pre- and post-1914 water rights)
- New developed water (or water rights) including new diversions/capture, conservation (i.e. agricultural savings, canal lining, etc.), and creation of new supplies (e.g. recycled water or desalination)

Table 3-13 summarizes the various sources and types of water available, general duration of availability, and the typical purpose for that type. DWR allows non-SWP water to be conveyed through the California Aqueduct as long as that water meets water quality requirements and capacity is available. Obtaining non-SWP water may require arrangement for additional aqueduct capacity in addition to paying the cost of moving water at non-subsidized power rates.

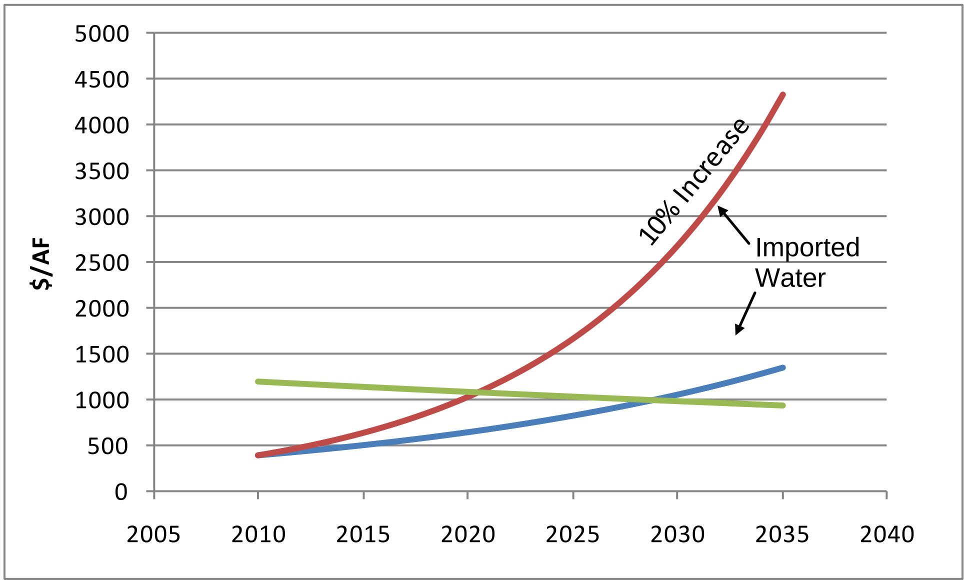
Table 3-13: Description of Exchanges/Transfers Types

Type	Duration	Purpose
Short-Term	1-2 years	Obtain emergency supply or excess wet year water
Long-Term Lease	5-15 years	Fill both normal and dry year needs until permanent supplies can be developed or obtained
Permanent	Permanent	Fill what is expected to be a permanent demand
Wet-year	1 year	Obtain excess water at generally lower cost and stored for future use
Dry-year	1-2 years	Meet short term supply deficit
Table A SWP Water	Short-term to permanent	Priority delivery through the SWP system and cost subsidized by DWR. However, delivery is subject to allocation by DWR
CVP Water	Short-term to permanent	If CVP water is available, may be exchanged through certain SWP contractors who have allocations for both (Subject to allocation by USBR)
Non-SWP Water	Short-term to permanent	Not subject to allocation by DWR, but may be subject to market power cost to transport through SWP - also, delivery priority is lower than SWP water
Pre-1914 water rights	Short-term to permanent	Does not require a permit from the SWRCB which provides for greater flexibility in use and/or sale
Development	Permanent	PWD shares in the cost to develop (or expand) a project elsewhere (e.g. recycled water or desalination) in exchange for imported supply and possibly delivery capacity through the Aqueduct

The costs to acquire imported supplies can vary substantially depending upon supply conditions, demand for supplies, and timing. Recently, supplies for dry-year water and long-term lease water have been priced at approximately $250/af (not including delivery losses). Assuming 1/3 of supply may be lost in transport, the true cost of the supply would be $400/af. Meanwhile, wet-year supplies have historically cost on the order of $50/af. Permanent exchanges are currently being priced at approximately $7,500/af (or a 30 year amortized cost of approximately $550/af assuming 100 percent delivery).

In the future, costs are projected to increase faster than the historical rate of inflation (3 percent) because of the increasing scarcity of readily available supplies (i.e. those now available on the market) and the costs associated with developing new supplies. The cost of these new development projects is expected to range from $400/af for agricultural conservation projects and new diversion/storage projects to as much as $1,000/af and more for desalination and recycled water projects. As such, the anticipated annual increase in the cost of new supplies is expected to increase at between 5 and 10 percent. Curves showing projected costs are shown in **Figure 3-27**. Given the expected price increase, the cost for which PWD could pay to acquire new supplies could match that of ocean desalination sometime between 2020 and 2030.

Figure 3-27: Imported Water and Ocean Desalination Cost Projections



3.4.3 Imported Water Options

Based on the analysis of the opportunities and constraints previously detailed, the following assumptions have been made in developing imported water supply options:

- PWD will acquire non-SWP water on either a long-term or permanent basis up to their current Table A delivery capacity of 21,300 afy. To meet projected demands, this supply will need to be acquired and delivered beginning within the next 2-5 years.
- For future supplies above PWD's current delivery capacity of 21,300 afy, PWD will need to consider different options in order to address the aqueduct capacity issue. These options include:
  - Acquiring either non-SWP water or Table A water from providers upstream of PWD's service area and leasing delivery capacity from one or more SWP contractors south of PWD. This could include either long-term supplies or short-term wet year supplies.
  - Acquiring Table A (and aqueduct capacity) from one or more SWP contractors south of PWD.

From a strategic standpoint, fundamental questions that PWD must answer through the strategic plan include how much water should PWD seek to acquire and when. Based on the opportunities and constraints of importing new supplies to PWD, two general strategic options are available for how PWD may proceed with meeting both its short term needs. These options are:

1. Acquire permanent supply: Acquire up to 35,000 afy (average yield) of imported supply in the short term (<5 years) to meet both short and long term needs. This could be achieved by a combination of permanent transfer as well as multi-year leases.
2. Acquire and bank wet weather water: Acquire approximately 10,000 afy (average yield) now and, in the future, acquire approximately 100,000 af wet year water on the short-term market on average every 5 years. Combined, this would produce 35,000 afy of average yield by 2035.

Attachment 9
Program Preferences

Littlerock Reservoir Sediment Removal Project

Attachment 9

Stormwater Flood Management Grant Proposal
Littlerock Reservoir Sediment Removal Project
Program Preferences

Attachment 9 consists of the following items:

✓ Program Preferences. Attachment 9 contains detailed information on how the proposal will meet the program preferences described in the IRWM Guidelines.

Program Preferences Met by Proposal

The Littlerock Reservoir Sediment Removal Project (LRSR Project) meets eight out of eight Program Preferences identified in the Proposition 84 & Proposition 1E IRWM Guidelines. This attachment details the specific Program Preferences that are met by the LRSR Project, the certainty that the Proposal will meet the Program Preferences, and the breadth and magnitude to which the Program Preferences will be met. Table 9-1, below identifies the Program Preferences which the LRSR Project will assist in meeting.

Table 9-1: Program Preferences Met by Proposal

Project	Program Preferences							
	(1) Includes Regional Projects or Programs	(2) Integrates Projects within a Hydrologic Region	(3) Resolves Significant Water-Related Conflicts Within Region	(4) Contribute to Attainment of one or more CALFED objectives	(5) Addresses Critical Water Supply or Quality Needs of DAC	(6) Integrates Water Manage-ment with Land Use Planning	(7) Eligible for SWFM funding	(8) Addresses Statewide Priorities
Littlerock Reservoir Sediment Removal Project	✓	✓	✓	✓	✓	✓	✓	✓

Description of the how the LRSR Project Meets Program Preferences:

(1) Includes regional projects and programs:

- Project was identified as a high priority project that helps to meet multiple regional objectives developed through a stakeholder process in the Antelope Valley IRWM Plan (see Attachment 3 - Work Plan)
- Project provides regional water supply benefits by offsetting the use of imported SWP water that could be used for other beneficial purposes in the Region

(2) Integrates programs and projects within a hydrologic region:

- Project provides water supply benefits to the Lahontan Hydrologic Region by offsetting the use of imported SWP water that could be used for other beneficial purposes in the Lahontan Hydrologic Region
- Project integrates with other projects that seek such as the Littlerock Creek In-River Spreading Grounds and the Littlerock Creek Groundwater Recharge and Recovery Project (see Attachment 3 – Work Plan)

(3) Resolves significant water-related conflicts within the Antelope Valley IRWM region

- Project will help to support the outcome of the ongoing groundwater adjudication effort in the Antelope Valley by offsetting imported water demands and making that imported water available for other beneficial purposes such as groundwater recharge. The availability of additional groundwater recharge supplies makes the success of Regional groundwater management more likely.

(4) Contribute to the attainment of CALFED objectives:

- Project increases the flexibility of water systems at the state, federal, and local level through improvements in local water supply storage and management
- Project decreases demand for SWP water supplies and potentially leaves the offset of demands as in stream flows in the Bay-Delta

(5) Addresses critical water supply or water quality needs of DAC:

- Project addresses critical water supply needs of DAC areas located north of Lake Palmdale and eastern most portion of the PWD service area by providing more reliability through the use of local supplies (see Figure 9-1).
- Project addresses critical water quality needs of DAC areas located within the service area of PWD by reducing constituent concentrations influent to the Leslie O. Carter water treatment plant (capacity of 35 million gallons per day), which serves the DAC areas listed above.

(6) Integrates water management with land use planning:

- Project reduces the impacts of downstream flooding on various land uses (e.g., residential, transportation, and agriculture) by implementing sediment removal in combination with forest management practices in a partnership between PWD and the USDA Forest Service, ANF together to collaborate on the LRSR Project which combines a water supply project with flood protection, habitat protection, and water quality improvements.

(7) The Project is eligible for Stormwater Flood Management (SWFM) funding because:

- The project is not part of the State Plan Flood Control (SPFC);
- The project will help manage stormwater runoff to reduce flood damage;
- The project yields multiple benefits including water supply, water quality, ecosystem protection, GHG emission reduction and flood control benefits; and
- The project is consistent with the applicable Regional Water Quality Control Plan[1] to manage stormwater runoff to reduce flood damages.

[1] Water Quality Control Plan for the Lahontan Region (Basin Plan); http://www.waterboards.ca.gov/rwqcb6/water_issues/programs/basin_plan/references.shtml

(8) The Project addresses Statewide Priorities as detailed in Table 9-2 below.

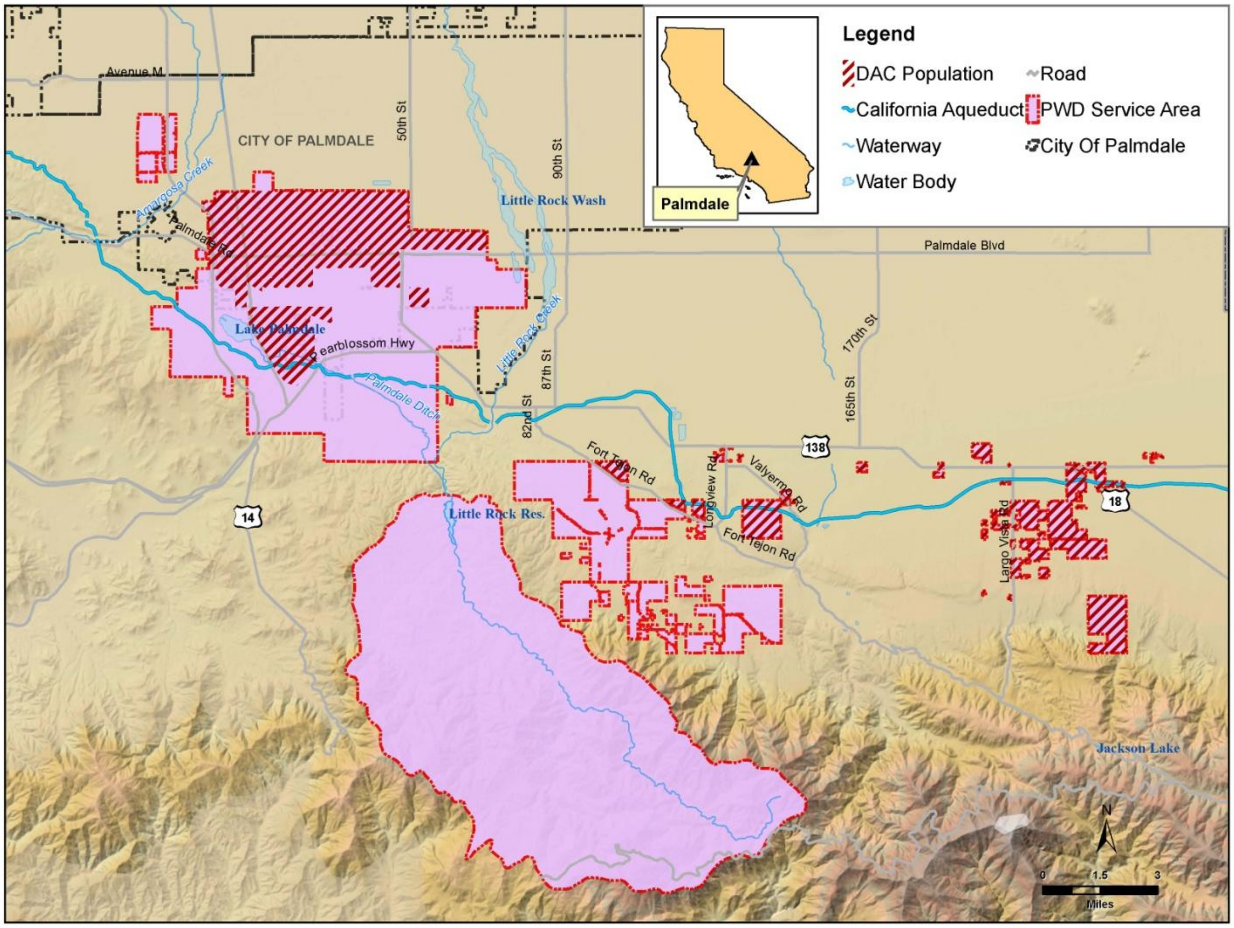
Table 9-2: Address Statewide Priorities

Project	Assist in Meeting Statewide Priorities							
	Drought Prepared-ness	Use and Reuse Water More Efficiently	Climate Change Response Actions	Expand Environ-mental Steward-ship	Practice Integrated Flood Manage-ment	Protect Surface Water Quality and Ground-water Quality	Improve Tribal Water and Natural Resources	Ensure Equitable Distribu-tion of Benefits
Littlerock Reservoir Sediment Removal Project	✓	✓	✓	✓	✓	✓		✓

The LRSR Project addresses seven Statewide Priorities:

- **Drought Preparedness -** by storing additional supply water in the Reservoir for drought years that impact the Bay-Delta, when the SWP cannot provide quantities required for the Region
- **Use and Reuse Water More Efficiently -** by storing additional water in the Reservoir and increasing water supply reliability through the use of additional local water supplies in place of imported SWP supply
- **Climate Change Response Actions** – by reducing green house gas (GHG) emissions through the offset of higher-energy demand imported water with lower-energy demand local surface water
- **Expand Environmental Stewardship** – by constructing an in stream grade control structure upstream of the Littlerock Reservoir to prevent sediment loss and head cutting of the Littlerock Stream Channel which is vital habitat for the federally endangered arroyo toad (*Bufo californicus*)
- **Practice Integrated Flood Management** – by restoring and maintaining water supply and flood storage capacity at Littlerock Reservoir
- **Protect Surface Water Quality and Groundwater Quality** - by offsetting imported water which reduces the loading of salts/nutrients imported from outside the Antelope Valley Region
- **Ensure Equitable Distribution of Benefits** - by providing water supply, flood protection, water quality, habitat protection, and other benefits to customers inside the PWD service area, these benefits will be distributed to over 195,000 people after the project startup date (2019); approximately 20% of PWD's service area is composed of disadvantaged communities (DACs), mainly in the eastern portions and north of Lake Palmdale (See Figure 9-1).

Figure 9-1: DACs within the PWD Service Area



Certainty that the Proposal will meet Program Preferences

The LRSR Project has undergone extreme scrutiny during the IRWMP stakeholder-led process and therefore, there is great certainty the project selected for this proposal will meet the Program Preferences. The project will meet criteria designed to address Proposition 1E requirements and achieve multiple IRWM Plan objectives (See Attachment 3 - Work Plan). The project has the ability to achieve its required benefits, is technically feasible, has secured 50% of matching funds, and is implementable within a reasonable length of time after the grant award date (see Attachment 5 - Schedule). Additionally, the Angeles National Forest (ANF), U.S. Department of Agriculture Forest Service (USFS) and Littlerock Creek Irrigation District (LCID) have given their full support and have expressed their willingness to cooperated with the LRSR project to ensure the project meets the Program Preferences.

The existing data and studies that demonstrate the project is technically sound and likely to be implemented are listed below in Table 9-3.

Table 9-3: Existing Data and Studies

Project	Existing Data and Studies
Littlerock Reservoir Sediment Removal Project	• Littlerock Reservoir Hydrologic and Sediment Transport Analysis Technical Report, June 2005 • Flood Insurance Rate Maps (FIRM), Community: Palmdale, City/Los Angeles CO, Panel #'s: 06037C0694F, 06037C0711F, 06037C0442F, and 06037C0450F. Effective Date: September 26, 2008. • Flood Insurance Study – Los Angeles County, CA. September 26,2008 • USDA/NRCS - National Geospatial Management Center. National Elevation Data 10 meter or better. Process Date: 09/2011. • Anaverde Flood Hydrograph – Upper Anaverde Watershed Detention Storage Alternatives, City of Palmdale, prepared by URS, 2002 • Summary of LACDPW Observed Flooding Location in the Antelope Valley, compiled by LACDPW, January 2013 • Littlerock Reservoir Sediment Removal Project Draft Biological Resources Technical Report, October 2012. • DRAFT Littlerock Reservoir Sediment Removal Project Biological Resources Technical Report, October 2012 • DRAFT Littlerock Reservoir Sediment Removal Project 1st Administrative Environmental Impact Report/Environmental Impact Statement (EIR/EIS), April 2007 • Geotechnical Investigation, Data Collection, and Survey Memoranda was prepared, July 2007 • Preliminary Dredging/Slurry Feasibility Analysis for Excavation of Littlerock Reservoir, September 2007 • Littlerock Reservoir Hydrologic and Sediment Transport Analysis Technical Report, June 2005

Breadth and Magnitude that Project will meet Program Preferences

The breadth and magnitude to which the Program Preferences will be met by the Project are described in detail in *Attachment 3 - Work Plan*. The Antelope Valley IRWM Plan articulated three goals, all of which the LRSR Project will meet. The goals in the Antelope Valley IRWM Plan the LRSR Project will help meet are as follows:

- Municipal and Industrial (M&I) purveyors reliably provide the quantity and the quality of water that will be demanded by a growing population
- Satisfy agricultural users' demand for reliable irrigation water supplies at a reasonable cost
- Protect and enhance current water resources (including groundwater) and the other environmental resources within the Antelope Valley Region

Table 9-4 provides both quantitative and qualitative data on the breadth and magnitude to which the LRSR Project will meet Program Preferences.

Table 9-4: Breadth/Magnitude to which Program Preferences will be Met

Project	Breadth/Magnitude to Which Program Preferences Will Be Met
Littlerock Reservoir Sediment Removal Project	• Project will restore 560 AFY of local surface water supply storage and flood control capacity. Over the 50 year life span of the project it will provide a total cumulative volume of 28,000 AF of local water supplies to PWD customers. • Project will provide debris and sediment control measures • Project will avoid 4,835 metric tons of salts imported from outside the Region over the 50-year lifespan of the project • Project will reduce energy use by 84 million kWh over the 50-year life span of the project • Project will avoid 27,600 metric tons of CO_2 equivalents emitted over the 50-year life span of the project

Attachment 10
UWMP, GWMP, AB 1420, and Water Meter Compliance Information



Littlerock Reservoir Sediment Removal Project

Attachment 10

Stormwater Flood Management Grant Proposal
Littlerock Reservoir Sediment Removal Project
UWMP, GWMP, AB1420 and Water Meter Compliance Information

Attachment 10 consists of the following items:

✓ **UWMP, GWMP, AB1420 and Water Meter Compliance Form.**

Introduction

Palmdale Water District (PWD) has attached the following documents as required per Attachment 10:

- AB 1420 Self Certification
- Water Meter Compliance

PWD's 2010 Urban Water Management Plan (UWMP) has been submitted to the Department of Water Resources (DWR) and was adopted by the PWD board in July 2011.

The proposed Littlerock Reservoir Sediment Removal Project is not a groundwater project or project that will directly affect groundwater levels or quality, therefore the GWMP self certification document has not been submitted as instructed by the Prop 1E PSP Guidelines.

AB 1420 Self- Certification Statement Table 1

Note: Table 1 documents Status of Past and Current BMP implementation.

Self-Certification Statement: The Urban Water Supplier and its authorized representative certifies, under penalty of perjury, that all information and claims, stated in this table, regarding compliance and implementation of the BMPs, including alternative conservation approaches, are true and accurate. This signed AB 1420 Self-Certification Statement Table 1, and Table 2 are the basis for granting funds by the Funding Agency. Falsification and/or inaccuracies in AB 1420 Self Certification Statement Table 1, and Table 2 and in any supporting documents substantiating such claims may, at the discretion of the funding agency, result in loss of all State funds to the applicant. Additionally, the Funding Agency, in its sole discretion, may halt disbursement of grant or loan funds, not pay pending invoices, and/or pursue any other applicable legal remedy and refer the matter to the Attorney General's Office.

Name of Signatory DENNIS D. LaMOREAUX Title of Signatory GENERAL MANAGER Signature of signatory [signature] Date 1/14/13

Application Date:

Proposal Identification Number: CUWCC Member? Yes/No YES

Has Urban Water Supplier submitted a 2005 Urban Water Management Plan? Yes/No YES Is the UWM Plan Deemed Complete by DWR? Yes/No YES

Applicant Name: PALMDALE WATER DISTRICT

Project Title: LITTLEROCK DAM SEDIMENTATION REMOVAL

Applicant's Contact Information: Name: MATTHEW KNUDSON Phone: (661) 456-1018 E-mail: mknudson@palmdalewater.org

Participants:

Retailer (List Below)	Wholesaler (List Below)
PALMDALE WATER DISTRICT	

C1

C2	C3	C4	C5	*C6	C7	**C8	**C9	**C10	C11	C12	C13	C14	C15	C16	C17	C18
			BMP Implemented by Retailers and/or Wholesalers / *BMP*			Compliance Options/Alternative Conservation Approaches (1)			BMP Is Exempt (2)			BMP Implementation Requirements Met				
BMPs required for Wholesale Supplier	BMPs required for Retail Supplier	BMPs	Retailer *Yes/No*	Wholesaler *Yes/No*	Regional *Yes/No*	BMP Checklist	Flex Track	Gallons Per Capita Per Day GPCD	Not Cost Effective	Lack of Funding	Lack of Legal Authority	CUWCC MOU Requirement Met: Retailer *Yes/No*	CUWCC MOU Requirement Met: Wholesaler *Yes/No*	Date of BMP Report Submitted to CUWCC for (2007-2008) (MOU Signatories)	Date BMP Implementation Data Submitted to DWR in CUWCC Format (Non MOU Signatories) (3)	All Supporting Documents have been Submitted Yes/No
	✓	BMP 1 Water Survey for Single/Multi-Family Residential Customers	YES					✓				YES		8/14/2008		YES
	✓	BMP 2 Residential Plumbing Retrofit	YES					✓				YES		8/14/2008		YES
✓	✓	BMP 3 System Water Audits, Leak Detection	YES					✓				YES		8/14/2008		YES
✓	✓	BMP 3 Leak Repairs	YES					✓				YES		8/14/2008		YES
	✓	BMP 4 Metering with Commodity Rates for All New connections	YES					✓				YES		8/14/2008		YES

C1

C2	C3	C4	C5	*C6	C7	**C8	**C9	**C10	C11	C12	C13	C14	C15	C16	C17	C18
			BMP Implemented by Retailers and/or Wholesalers / *BMP*			Compliance Options/Alternative Conservation Approaches (1)			BMP Is Exempt (2)			BMP Implementation Requirements Met				
BMPs required for Wholesale Supplier	BMPs required for Retail Supplier	BMPs	Retailer *Yes/No*	Wholesaler *Yes/No*	Regional *Yes/No*	BMP Checklist	Flex Track	Gallons Per Capita Per Day GPCD	Not Cost Effective	Lack of Funding	Lack of Legal Authority	CUWCC MOU Requirement Met: Retailer *Yes/No*	CUWCC MOU Requirement Met: Wholesaler *Yes/No*	Date of BMP Report Submitted to CUWCC for (2007-2008) (MOU Signatories)	Date BMP Implementation Data Submitted to DWR in CUWCC Format (Non MOU Signatories) (3)	All Supporting Documents have been Submitted Yes/No
	✓	BMP 4 Retrofit of Existing Connections	YES					✓				YES		8/14/2008		YES
	✓	BMP 5 Large Landscape Conservation Programs and Incentives	YES					✓				YES		8/14/2008		YES
	✓	BMP 6 High-Efficiency Washing Machine Rebate Programs	YES					✓				YES		8/14/2008		YES
✓	✓	BMP 7 Public Information	YES					✓				YES		8/14/2008		YES
✓	✓	BMP 8 School Education	YES					✓				YES		8/14/2008		YES
	✓	BMP 9 Conservation programs for Commercial, Industrial, and Institutional (CII) Accounts	YES					✓				YES		8/14/2008		YES
✓		BMP 10 Wholesale Agency Assistance Programs	N/A					N/A				N/A		N/A		N/A
	✓	BMP 11 Conservation Pricing	YES					✓				YES		8/14/2008		YES
✓	✓	BMP 12 Conservation Coordinator	YES					✓				YES		8/14/2008		YES
	✓	BMP 13 Water Waste Prohibitions	YES					✓				YES		8/14/2008		YES
	✓	BMP 14 Residential ULFT Replacement Programs	YES					✓				YES		8/14/2008		YES

***C6:** Wholesaler may also be a retailer (supplying water to end water users)
****C8, **C9, **, and C10:** Agencies choosing an alternative conservation approach are responsible for achieving water savings equal or greater than that which they would have achieved using only BMP list

(1) For details, please see: http://www.cuwcc.org/mou/exhibit-1-bmp-definitions-schedules-requirements.aspx
(2) BMP is exempt based on cost-effectiveness, lack of funding, and lack of legal authority criteria as detailed in the CUWCC MOU
(3) Non MOU signatories must submit to DWR reports and supporting documents in the same format as CUWCC

AB 1420 Self- Certification Statement Table 2

Provide Schedule, Budget, and Finance Plan to Demonstrate Commitment to Implement All BMP's to Become in Compliance with BMP Implementation - Commencing Within 1st Year of Agreement for Which Applicant Receives Funds.

Self-Certification Statement: The Urban Water Supplier and its authorized representative certifies, under penalty of perjury, that all information and claims, stated in this table, regarding compliance and implementation of the BMPs, including alternative conservation approaches, are true and accurate. This signed AB 1420 Self-Certification Statement Table 1 and Table 2 are the basis for granting funds by the Funding Agency. Falsification and/or inaccuracies in AB 1420 Self Certification Statement Table 1 and Table 2, and in any supporting documents substantiating such claims may, at the discretion of the funding agency, result in loss of all State funds to the applicant. Additionally, the Funding Agency, in its sole discretion, may halt disbursement of grant or loan funds, not pay pending invoices, and/or pursue any other applicable legal remedy and refer the matter to the Attorney General's Office.

Name of Signatory DENNIS D. LaMOREAUX Title of Signatory GENERAL MANANGER Signature of signatory Dennis D. LaMoreaux Date 1/14/13

Application Date:

Proposal Identification Number: ______ CUWCC Member? Yes/No: YES

Applicant Name: PALMDALE WATER DISTRICT — Is the UWM Plan Deemed Complete by DWR? Yes/No: YES

Project Title: LITTLEROCK DAM SEDIMENTATION REMOVAL

Applicant's Contact Information: Name MATTHEW KNUDSON

	Retailer (List Below)		
Participants:	PALMDALE WATER DISTRICT		

C1	C2	C3	C4	C5	*C6	C7	C8	**C9	**C10	**C11	C12			C13	C14	C15	C16	C17	C18	C19
				BMP Implemented by Retailers and/or Wholesalers				Compliance Options / Alternative Conservation Approaches (1)			BMP is Exempt (2)			Implementation Scheduled to Commence within 1st Year of Agreement						
CUWCC 2010 Flex Track BMPs	BMPs required for Wholesale Supplier	BMPs required for Retail Supplier	BMPs	Retailer Yes/No	Wholesaler Yes/No	Regional Yes/No	Alternative Conservation Approaches Yes/No	BMP Checklist	Flex Track	Gallons Per Capita Per Day GPCD	Not Cost Effective	Lack of Funding	Lack of Legal Authority	Start Date (MM/YR)	Completion Level (%)	BMP Completion Date (MM/YR)	Budget (Dollars)	Funding Source & Finance Plan to Implement BMPs	Meets CUWCC Coverage Yes/No	Funds Requested, if Available. (See AB 1420 Compliance Table 3) Yes/No
1. Utility Operations Programs																				
1.11	✓	✓	BMP 12 Conservation Coordinator	YES			YES			✓				1992	100%	ONGOING	ONGOING	NO	YES	
1.12		✓	BMP 13 Water Waste Prohibitions	YES			YES			✓				JAN '09	100%	ONGOING	ONGOING	NO	YES	
1.13	✓	✓	BMP 10 Wholesale Agency Assistance Programs	N/A			N/A							N/A	N/A	N/A	N/A	N/A	N/A	
1.20	✓	✓	BMP 3 System Water Audits, Leak Detection/Repair	YES			YES			✓				1989	ONGOING	ONGOING	ONGOING	NO	YES	
1.30		✓	BMP 4 Metering with Commodity Rates for All New/Retrofit of Existing connections	YES			YES			✓				1992	85%	ONGOING	ONGOING	NO	YES	
1.40		✓	BMP 11 Conservation Pricing	YES			YES			✓				MAY '09	100%	ONGOING	ONGOING	NO	YES	
2. Educational Programs																				
2.10	✓	✓	BMP 7 Public Information	YES			YES			✓				1995	100%	ONGOING	ONGOING	NO	YES	
2.20	✓	✓	BMP 8 School Education	YES			YES			✓				1995	100%	ONGOING	ONGOING	NO	YES	
3. Residential																				
3.11		✓	BMP 1 Indoor Water Survey for Single/Multi-Family Residential Customers	YES			YES							2002	ONGOING	ONGOING	ONGOING	NO	YES	

CUWCC 2010 Flex Track BMPs	BMPs required for Wholesale Supplier	BMPs required for Retail Supplier	BMPs	BMP Implemented by Retailers and/or Wholesalers				Compliance Options / Alternative Conservation Approaches (1)			BMP is Exempt (2)			Implementation Scheduled to Commence within 1st Year of Agreement						
				Retailer Yes/No	Wholesaler Yes/No	Regional Yes/No	Alternative Conservation Approaches Yes/No	BMP Checklist	Flex Track	Gallons Per Capita Per Day GPCD	Not Cost Effective	Lack of Funding	Lack of Legal Authority	Start Date (MM/YR)	Completion Level (%)	BMP Completion Date (MM/YR)	Budget (Dollars)	Funding Source & Finance Plan to Implement BMPs	Meets CUWCC Coverage Yes/No	Funds Requested, if Available. (See AB 1420 Compliance Table 3) Yes/No
3.12			BMP 1 **Outdoor** Water Survey for Single/Multi-Family Residential Customers	YES			YES							2002	ONGOING	ONGOING	ONGOING	NO	YES	
3.20		✓	BMP 2 Residential Plumbing Retrofit	YES			YES							1985	100%	ONGOING	ONGOING	NO	YES	
3.30		✓	BMP 6 High-Efficiency Washing Machine Rebate Programs	YES			YES			✓				2009	100%	ONGOING	ONGOING	NO	YES	
3.40		✓	BMP 14 Residential ULFT Replacement Programs	YES			YES			✓				2009	100%	ONGOING	ONGOING	NO	YES	
	[redacted]ustrial, Institutional																			
4.00		✓	BMP 9 Conservation programs for Commercial, Industrial, and Institutional (CII) Accounts	YES			YES			✓				2009	100%	ONGOING	ONGOING	NO	YES	
	5. Landscape																			
5.00		✓	BMP 5 Large Landscape Conservation Programs and Incentives	YES			YES			✓				2002	100%	ONGOING	ONGOING	NO	YES	

*C6: Wholesaler may also be a retailer (supplying water to end water users)
**C9, ** C10, and **C11: Agencies choosing an alternative conservation approach are responsible for achieving water savings equal or greater than that which they would have achieved using only BMP list.
(1) For details, please see http://www.cuwcc org/mou/exhibit-1-bmp-definitions-schedules-requirements.aspx.
(2) BMP is exempt based on cost-effectiveness, lack of funding, or lack of legal authority, as detailed in the CUWCC MOU.

California State Water Resources Control Board
California Department of Water Resources
California Department of Public Health

CERTIFICATION FOR COMPLIANCE WITH WATER METERING REQUIREMENTS FOR FUNDING APPLICATIONS

In 2004, Assembly Bill 2572 added section 529.5 to the Water Code, providing that, commencing January 1, 2010, urban water suppliers must meet certain volumetric pricing and water metering requirements in order to apply for permits for new or expanded water supply, or state financial assistance for the following types of projects:

1. wastewater treatment projects
2. water use efficiency projects (including water recycling projects)
3. drinking water treatment projects

For the purposes of compliance with Section 529.5, a "water use efficiency project" means an action or series of actions that ensure or enhance the efficient use of water or result in the conservation of water supplies.

Please consult with your legal counsel and review sections 525 through 529.7 of the Water Code before completing this certification.

Applicants Affected
This requirement applies to urban water suppliers.

"Urban water supplier" means a supplier, either publicly or privately owned, providing water for municipal purposes either directly or indirectly to more than 3,000 customers or supplying more than 3,000 acre-feet of water annually. An urban water supplier includes a supplier or contractor for water, regardless of the basis of right, which distributes or sells for ultimate resale to customers.

When Certification is Required
State Water Resources Control Board (SWRCB): The application for financial assistance must include a completed and signed certification form demonstrating compliance with the water metering requirements.

Department of Water Resources (DWR) funding applications: This certification must be completed and submitted with the funding application. Check the specific proposal solicitation package for directions on applicability and submittal instructions.

Department of Public Health (DPH) Safe Drinking Water State Revolving Fund Program: This certification must be completed and submitted with the executed Notice of Acceptance of Application (NOAA).

California State Water Resources Control Board
California Department of Water Resources
California Department of Public Health

**CERTIFICATION FOR
COMPLIANCE WITH WATER METERING REQUIREMENTS
FOR FUNDING APPLICATIONS**

Funding Agency name: DEPARTMENT OF WATER RESOURCES

Funding Program name: PROPOSITION 1E

Applicant (Agency name): PALMDALE WATER DISTRICT

Project Title (as shown on application form): LITTLEROCK SEDIMENTATION REMOVAL

Please check one of the boxes below and sign and date this form.

☐ As the authorized representative for the applicant agency, I certify under penalty of perjury under the laws of the State of California, that the agency is not an urban water supplier, as that term is understood pursuant to the provisions of section 529.5 of the Water Code.

☐ As the authorized representative for the applicant agency, I certify under penalty of perjury under the laws of the State of California, that the applicant agency has fully complied with the provisions of Division 1, Chapter 8, Article 3.5 of the California Water Code (sections 525 through 529.7 inclusive) and that ordinances, rules, or regulations have been duly adopted and are in effect as of this date.

I understand that the Funding Agency will rely on this signed certification in order to approve funding and that false and/or inaccurate representations in this Certification Statement may result in loss of all funds awarded to the applicant for its project. Additionally, for the aforementioned reasons, the Funding Agency may withhold disbursement of project funds, and/or pursue any other applicable legal remedy.

DENNIS D. LaMOREAUX
Name of Authorized Representative
(Please print)

Dennis D. LaMoreaux
Signature

GENERAL MANAGER
Title

1/14/13
Date

Recycled Paper

Appendices

Littlerock Reservoir Sediment Removal Project

Appendices

Table of Contents

The appendices are located in the enclosed CD.

The appendices consist of the following items:

- **Appendix A**: *DRAFT Littlerock Reservoir Sediment Removal Project Biological Resources Technical Report*
- **Appendix B**: *Geotechnical Investigation, Data Collection, and Survey Memoranda*
- **Appendix C**: *Littlerock Reservoir Hydrologic and Sediment Transport Analysis Technical Report*
- **Appendix D**: *Special Use Permit*
- **Appendix E:** *Flood Analysis References include: Flood Insurance Rate Maps and Flood Insurance Study*
- **Appendix F:** *AVEK 2011 Annual Water Quality Report*
- **Appendix G**: *Tech Memo No. 1 Development, Evaluation, and Selection of Treatment Alternatives for the Eastside Water Treatment Plant*
- **Appendix H**: *Analysis of the Energy Intensity of Water Supplies for West*
- **Appendix I**: *Technical Support Document*
- **Appendix J**: *Long Range Finance Plan Update*

Appendix A

DRAFT Littlerock Reservoir Sediment Removal Project
Biological Resources Report

Draft
Biological Resources Technical Report

Littlerock Reservoir Sediment Removal Project

Prepared for:
Palmdale Water District

Prepared by:
Aspen Environmental Group

October 2012

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Executive Summary

This report provides a summary of the biological resources known or expected to occur at the Littlerock Reservoir (Reservoir). Biological information was collected through field investigations (i.e., reconnaissance, protocol, and focused surveys); review of existing on-line and published literature; consultation with local biologists and regional experts; and coordination with regulatory staff including the United States Fish and Wildlife Service (USFWS), California Department of Fish and Game (CDFG), and USDA Forest Service (Forest Service). Field surveys were conducted between 2007 and 2012 and augment existing surveys conducted by the Forest Service to monitor the metapopulation of the Federally Endangered arroyo toad (*Anaryxus* (*Bufo*) *californicus*), which breeds immediately upstream of the Reservoir.

Special status species including federally or State endangered, threatened, State Species of Special Concern, or Forest Service Sensitive are known to occur in the region and were identified during surveys of the Reservoir. Some of the sensitive species detected at or near the Reservoir include:

- Short-joint beavertail cactus, a CRPR List 1B.1/FSS;
- Johnston's monkeyflower, a CRPR List 4.3;
- Lemmon's syntrichopappus, a CRPR List 4.3/FSW;
- Arroyo toad, Federally Endangered), and State Species of Special Concern;
- Least Bell's vireo, a State and Federal Endangered Species;
- Bald eagle, a State Endangered and fully Protected Species and FSS;
- Silvery legless lizard, a State Species of Special Concern and FSS;
- San Diego coast horned lizard, a State Species of Special Concern and FSS;
- Southwestern pond turtle, a State Species of Special Concern and FSS; and
- Two-striped garter snake, a State Species of Special Concern and FSS.

Most of these species were observed in areas adjacent to or near the Reservoir such as above Rocky Point or below the dam. However, some species including the arroyo toad, southwestern pond turtle, and two-striped garter snakes were observed within the Reservoir. Table 4-1 (Known and Potential Occurrence of Special-Status Plant Taxa within the Study Area) and Table 4-2 (Known and Potential Occurrence of Special-Status Wildlife within the Study Area) contains the complete list of all sensitive plants and wildlife that were detected or have the potential to occur in the project area.

1. Introduction/Regional Setting

The Littlerock Reservoir (Reservoir) is located approximately three miles southwest of the community of Littlerock, within the boundaries of the Santa Clara Mojave Rivers Ranger District in the Angeles National Forest (ANF) (Figure 1). The Palmdale Water District (PWD) operates the Reservoir as a local surface water impoundment, and water is conveyed from the reservoir to Palmdale Lake. Inflow into the Reservoir is seasonal and varies widely depending on annual precipitation and snowmelt. Littlerock Dam, constructed in 1924, was originally built to provide a source of irrigation for downstream agricultural activities. With the construction of the California Aqueduct, which started in 1960, the Reservoir became a back-up water source for the communities it served.

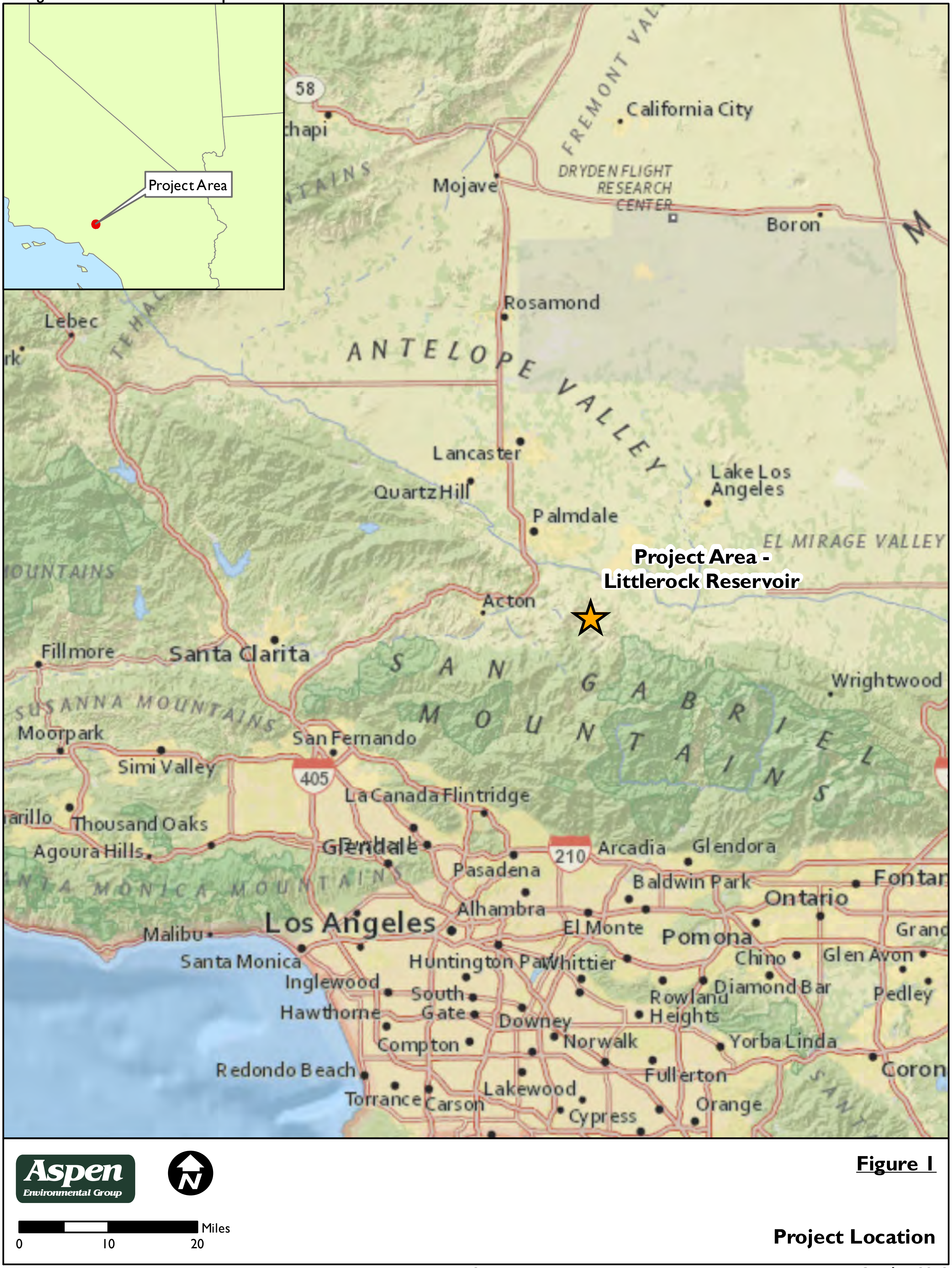


Figure 1

Project Location

In addition to providing drinking water, the Reservoir supports a variety of recreational opportunities including boating, fishing, and swimming. When the reservoir is drained, typically at the end of summer and pursuant to the expected water needs of the PWD, dry portions of the Reservoir support recreational off highway vehicle (OHV) travel.

From a regional standpoint, the Reservoir is located in the Antelope Valley at the transition of the southern border of the Mojave Desert and the northeastern foothills of the San Gabriel Mountains. The Reservoir and proposed access roads are surrounded by National Forest lands with portions bordered by small private in-holdings, rural residences, and privately-held natural lands. This area is located in a broad transition zone between the Mojave Desert and the Transverse Ranges which supports a variety of native and introduced plants and wildlife. Though varied floristic influences exist in the Antelope Valley and surrounding foothills, this region has been subject to a historic land uses such as farming, grazing, recreation, water diversion (i.e., the Littlerock Reservoir and the California Aqueduct), and infrastructure development (i.e., the construction of residential and commercial properties, military land uses including Edwards Air Force Base, Interstate 14, and Highway 138).

1.1 Report Overview

The report describes the existing environmental conditions and biological resources (with special emphasis on special-status plant and wildlife species, wildlife corridors, and sensitive habitats) that occur or have the potential to occur at or near the Reservoir.

1.2 Project Sponsor

Palmdale Water District (PWD)
2029 East Avenue Q
Palmdale, CA 93550

1.3 Project Contact

Mr. Matthew Knudson
Engineering Manager
(661) 456-1018
mknudson@palmdalewater.org

2. Methodologies

Data regarding biological resources that have the potential to occur in the project area were obtained through literature review and field investigation. Aspen Environmental Group (Aspen) conducted biological resource assessments within and adjacent to the Project site between 2007 and 2012. Data methodologies included:

- reconnaissance-level surveys for common species;
- weed and vegetation mapping;
- focused surveys for sensitive plant and wildlife; and
- protocol surveys for listed song birds.

For the purposes of this report, the Project Area is defined as the Reservoir and all day use areas, including roads and recreational areas (Figure 2). The Project Area includes a portion of Littlerock Creek extending approximately 1,000 feet upstream from Rocky Point.

Surveys were also conducted across a much broader geographic range to better characterize the biological resources that occur or have the potential to be present in the vicinity of the Project Area. This area is defined as the project Study Area and includes all portions of the Project Area and a buffer that extends 0.25 miles upstream from Rocky Point (including a portion of Santiago Creek), and approximately one mile downstream of the Littlerock dam (Study Area). Most wildlife surveys included the entire Study Area; however vegetation mapping was limited to a subset of the Study Area extending approximately 500 feet from the Project Area (Vegetation Study Area). Figure 2 defines the limits of the Project Area, Study Area and Vegetation Study Area.

2.1 Literature Review

Sensitive biological resources known to occur in the region or potentially present were identified through a review of existing literature sources including a USGS topographic maps, aerial photography, and the CDFG California Natural Diversity Data Base (CNDDB) (2012). The Project site is located within the U.S. Geological Survey's (USGS) Pacifico Mountain, California 7.5' topographic quadrangle. The following eight adjacent quadrangles were also included in the database search due to their proximity to the Study Area:

- Chilao Flat
- Condor Peak
- Acton
- Ritter Ridge
- Palmdale
- Littlerock
- Juniper Hills
- Waterman Mountain

Additional data regarding the potential occurrence of special-status species and policies relating to these sensitive natural resources were gathered from the following sources:

- Special Animals List (CDFG, 2011b);
- State and federally listed endangered and threatened animals of California (CDFG, 2011c);
- California Wildlife Habitat Relationships (CDFG, 2008);
- Inventory of Rare and Endangered Vascular Plants of California (CNPS, 2011);
- Angeles National Forest Land Management Plan (USFS 2005);
- Pacific Southwest Region Regional Forester's Sensitive Species List (USFS 2001);
- Consortium of California Herbaria;
- Biological Assessment for the Littlerock Dam and Reservoir Sediment Control Plan (PCR 2001);
- Antelope Valley Areawide General Plan;
- County of Los Angeles Significant Ecological Areas; and
- Aerial photographs of Littlerock Reservoir and surrounding areas (from October 2012, December 2011, July 2011, June 2009, July 2008, March 2006, February 2006, December 2005, November 2005, July 2003, June 2002, May 2002, June 1994, and May 1994).

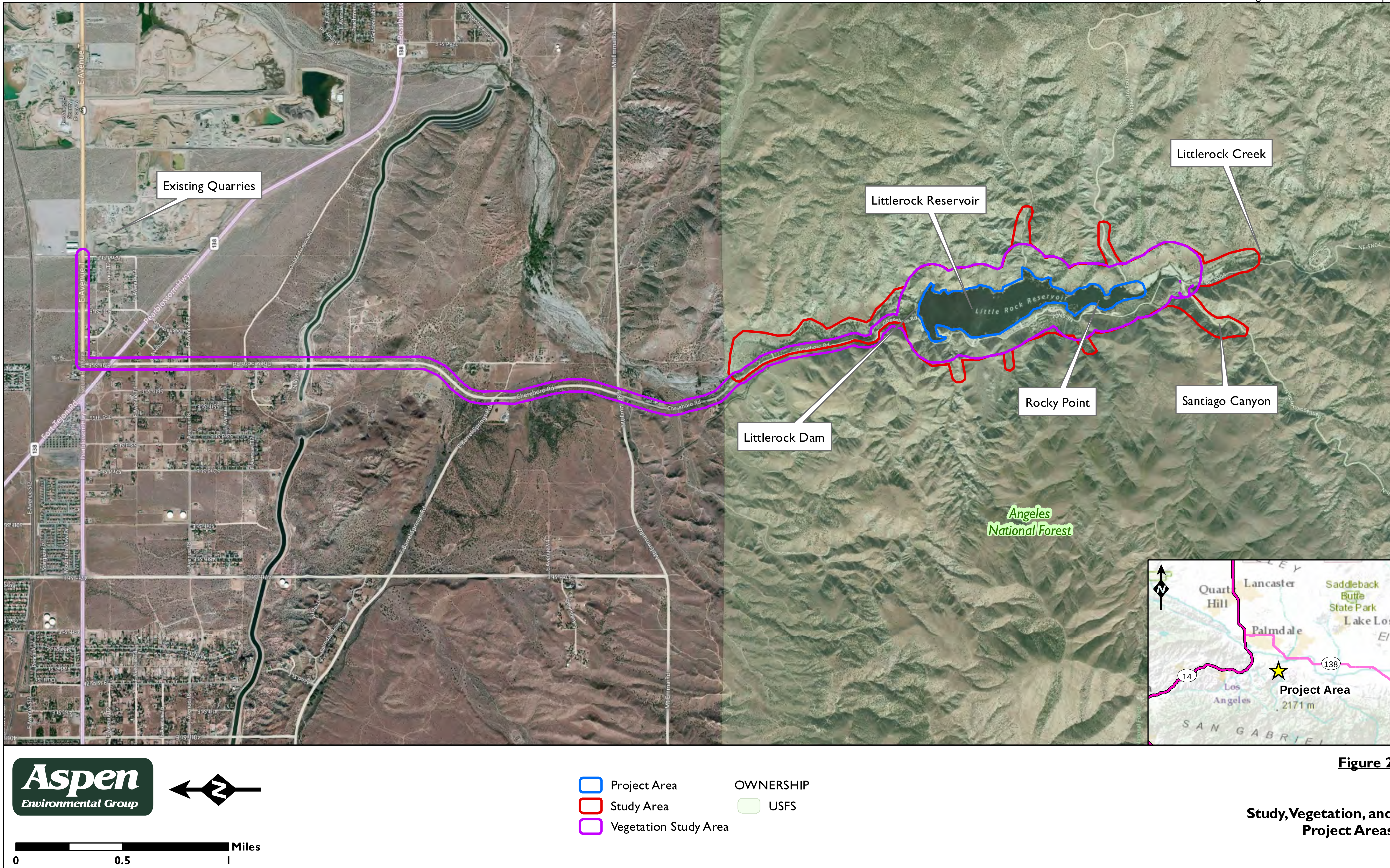


Figure 2

Study, Vegetation, and Project Areas

2.2 Agency Coordination and Consultation

Agency coordination has been ongoing and includes biological resource staff from the Angeles National Forest (ANF), CDFG, and the USFWS. Biological resource data including the use and distribution of sensitive wildlife, including arroyo toads, on the project site has also been obtained from interviews and site visit experts on arroyo toad ecology including Ruben Ramirez, Larry Hunt, and William Haas.

2.3 Biological Surveys and Habitat Assessments

Biological resource investigations including surveys and habitat assessments have been conducted in the Study Area between 2007 and 2012 to support the operation of the existing facility. The surveys were conducted by experienced biologists familiar with the resources expected to occur in the region and were completed at times and conditions when wildlife species were active and when plants were flowering. However, it is acknowledged that some wildlife species and/or individuals may have been difficult to detect due to their elusive behavior, cryptic morphology, or limited distribution in the project area. Similarly, some plants flower for a limited period of time or do not flower during periods of low rainfall. It is possible that some species of rare plants were overlooked or missed during the surveys; however these plants would be expected to occur in areas not subject to Reservoir operations or maintenance activities.

Surveys of the project site were conducted year round in order to evaluate seasonal use of the site and to note wintering bird use. Field personnel included Chris Huntley, Jared Varonin, Cindy Hitchcock, Justin Wood, Tracy Valentovich, Jennifer Lancaster, Lynn Stafford, Larry Hunt, and William Haas. Table 2-1 includes a list of the surveys conducted and a brief summary of their results. Specific protocols, assessments and survey results are described below.

Table 2-1. Summary of Surveys Conducted at the Littlerock Reservoir

Target Species	Survey Type	Date	Comments
Rare Plants and Vegetation	Focused Pedestrian Survey	16 May 2007 23 May 2010 7 Jul 2011 20 and 30 May 2012 6 June 2012	Three special-status plants, Johnston's monkeyflower (*Mimulus johnstoni*), short-joint beavertail (*Opuntia basilaris var. brachyclada*), and Lemmon's syntrichopappus (*Syntrichopappus lemmonii*) were detected within the Vegetation Study Area. However, all occurrences were outside of the Project Area. All vegetation types were mapped in the Vegetation Study Area (which included areas along the proposed haul routes).
Gastropods and Fish	Focused Pedestrian Survey of Micro-Habitats, Hand Raking Seining/Dip Netting/Visual Observations	1 - 3 June 2011 13 January 2012	Sensitive gastropods were not detected in the Study Area. Several species of non-native fish detected. Sensitive fish were not observed in the Study Area.
Amphibians and Reptiles	Acoustic, Focused Pedestrian, Inspections of Microhabitats	16 May 2007 24 September 2007 5, 14 and 18 May 2010 1 - 3 June 2011 12 July 2012	One sensitive amphibian, the arroyo toad, was commonly detected within the Study Area above Rocky Point. The species has not been observed below the dam or within the Reservoir area below Rocky Point. The species was not observed in the small tributary drainages that feed the reservoir. Common amphibians were routinely observed at the Reservoir and along the stream terraces. Western toad was observed on access roads and in upland areas.

Target Species	Survey Type	Date	Comments
			Several sensitive reptiles were observed in the Study Area, including California legless lizard, coastal whiptail, coast horned lizard and southwestern pond turtle.
Terrestrial Mammals	Reconnaissance-Level Surveys; Visual Surveys; Review of Scat, Tracks, Sign, Middens and Burrows	16 May 2007 5 and 14 May 2010 1 - 3 June 2011 13 January 2012 12 July 2012	Sensitive mammals (with the exception of bats, see below) were not detected in the Study Area. However the area is expected to support a number of rare or protected species including bighorn sheep, American badgers, and possibly ringtail.
Bats	Visual and Acoustic (SongMeter™ SM2 and Wildlife Acoustics EM3)	17-18 May 2012 17-18 July 2012	Several species of bats were detected at the Reservoir including the pallid bat and western small-footed myotis were detected within the Project area.
Least Bell's Vireo	Focused (Non-Protocol) Pedestrian Surveys and Protocol Surveys	22 -23 July 2010 29 April 2011 10 and 19 May 2011 1,10 and 21 June 2011 1 and 12 July 2011 16 February 2012 18 April 2012 18 May 2012	Least bell's vireo was detected in the Study Area immediately downstream of Littlerock dam. The birds fledged young in 2011 but did not appear to do so in 2012.
Birds	Focused Pedestrian and Acoustic	14 May 2010 22-23 July 2010 1 - 3 June 2011 12 - 13 July 2012 15 December 2011 18 January 2012 16 February 2012 18 April 2012 18 May 2012 12 July 2012 18 July 2012 30 August 2011 13 January 2012	Eighty-five species of birds were detected in the Study Area including a variety of special status species. Bald eagle is known as an occasional winter visitor.

2.3.1 Survey Methods

Common Wildlife

Wildlife species were detected during field surveys (diurnal and nocturnal) by sight, calls, tracks, scat, or other diagnostic clues (i.e., bones, feathers, prey remains). In addition to species actually observed, expected wildlife usage of the site was determined according to known habitat preferences of regional wildlife species and knowledge of their relative distributions in the area. Reconnaissance-level surveys for common wildlife were performed by methodically walking the perimeter of the Reservoir (where accessible), the adjacent foothills and areas above and below the Reservoir. Surveys were conducted at an average pace of approximately 1.5 km/hr and halted approximately every 50 meters to listen for wildlife or whenever necessary to identify or record data.

Rare Plants

The entire Vegetation Study Area was surveyed by walking "meandering transects" (Nelson, 1987) throughout accessible portions of the Vegetation Study Area with particular attention given to areas of suitable habitat for sensitive plant species. All plant species observed were identified in the field or collected for later identification. Plants were identified using keys, descriptions, and illustrations in Hickman (1993), Munz (1974), applicable volumes of the Flora of North America (1993+), and other regional references. In conformance with CDFG (2009), surveys were (a) floristic in nature, (b) consistent with conservation ethics, (c) systematically covered all habitat types on the sites, and (d) well documented, by this report and by voucher specimens to be deposited at Rancho Santa Ana Botanic Garden. Surveys were completed during multiple years and at all locations that would be subject to proposed sediment removal activities. Table 3-2 (Plant Species Observed Within the Vegetation Study Area) contains a list of all the plant species identified during the surveys. Figure 3 identifies the listed plant species known to occur within the vicinity of the Vegetation Study Area.

Vegetation Mapping

Vegetation maps were prepared by drawing tentative vegetation type boundaries onto high-resolution aerial images in the field, then digitizing these polygons into GIS. The maps were then ground-truthed in the field to verify vegetation community types and clarify uncertainties. Mapping was done electronically using ArcGIS (Version 10) and a 22-inch diagonal flat screen monitor with aerial photos with an accuracy of one foot. Most boundaries shown on the maps are accurate within approximately three feet; however, boundaries between some vegetation types are less precise due to difficulties interpreting aerial imagery and accessing stands of vegetation.

Vegetation descriptions and names are based on Sawyer et al. (2009) and have been defined at least to the alliance level and in some cases to the association level. Some of the vegetation in the Vegetation Study Area does not match the names and descriptions in Sawyer et al. (2009). Therefore, vegetation community names have been adapted in the same style. In addition, each vegetation type has been referenced to Preliminary Descriptions of the Terrestrial Natural Communities of California by Holland (1986) and to particular applicable sections of A Guide to Wildlife Habitats of California (Holland, 1988) whenever possible.

Limitations. The vegetation composition in the Project Area has varied during the course of the studies. Large aggregations of willow and cottonwood trees present in the Reservoir prior to 2011 have been lost through inundation and now occur in lower densities along the margin of the Reservoir. In addition vegetation densities in southern California riparian systems vary with time dependent upon the date of most recent flood scouring events (Faber et al., 1989; Holland and Keil, 1995). Vegetation communities also overlap in most characteristics, and over time, will shift from one community type to another. Note also that all vegetation maps and descriptions are subject to imprecision resulting from several sources, including:

- In some case, vegetation boundaries result from distinct events, such as wildfire or flooding. But, vegetation types usually tend to intergrade on the landscape, without precise boundaries among them. Even distinct boundaries caused by fire or flood can be disguised after years of post-disturbance succession. Mapped boundaries represent best professional judgment, but usually should not be interpreted as literal delineations between sharply defined vegetation types.
- Natural vegetation tends to exist in general recognizable types, but also may vary over time and geographic region. Written descriptions cannot reflect all local or regional variation. Many (perhaps most) stands of natural vegetation do not strictly fit into any named type. Therefore, a mapped unit is given the best name available in the classification, but this name does not imply that the vegetation unambiguously matches written descriptions.

- Vegetation tends to be patchy. Small patches of one named type are often included within larger stands mapped as units of another type. For this report the minimum mapping unit was approximately three feet, and smaller inclusions are described in the text but are not visible on the maps.
- Photo interpretation of some types may be difficult and accuracy of a vegetation map will vary depending on ground-truthing efforts.

Invertebrates

Terrestrial insects and other invertebrates were searched for on flowers and leaves, under loose bark and under stones and logs on the ground throughout the Study Area. Butterflies and other aerial species were noted when observed. Larger aquatic invertebrates were captured/sampled during aquatic surveys within the Study Area (see methodology below). Randomly selected areas within appropriate micro habitats (i.e., leaf litter, underneath felled logs, etc.) were hand raked or visually inspected to determine the presence/absence of gastropods.

Fish

Surveys were performed by methodically walking active portions of Littlerock Creek from just south of Rocky Point to the upstream extent of the Study Area (Figure 2). All areas where standing or flowing water was present were visually inspected. In portions of the channel where water was relatively shallow (<1 foot) and clear (majority of survey area), visual observations were performed for the presence of fish. Dip nets with 1/8" mesh were utilized to probe under and around boulders. In areas that exhibited waters deeper than 1 foot, 1/8" mesh block netting was installed along the downstream sections. Biologists, using 1/8" mesh seine netting, then seined each section from the upstream extent of the deeper water downstream towards the block netting and documented all fish present within the area. Biologists also conducted informal creel census surveys to assess the fish assemblage in the reservoir by interviewing anglers and observing their catch. This yielded useful information on the most common fish caught by shore fishermen.

Amphibians

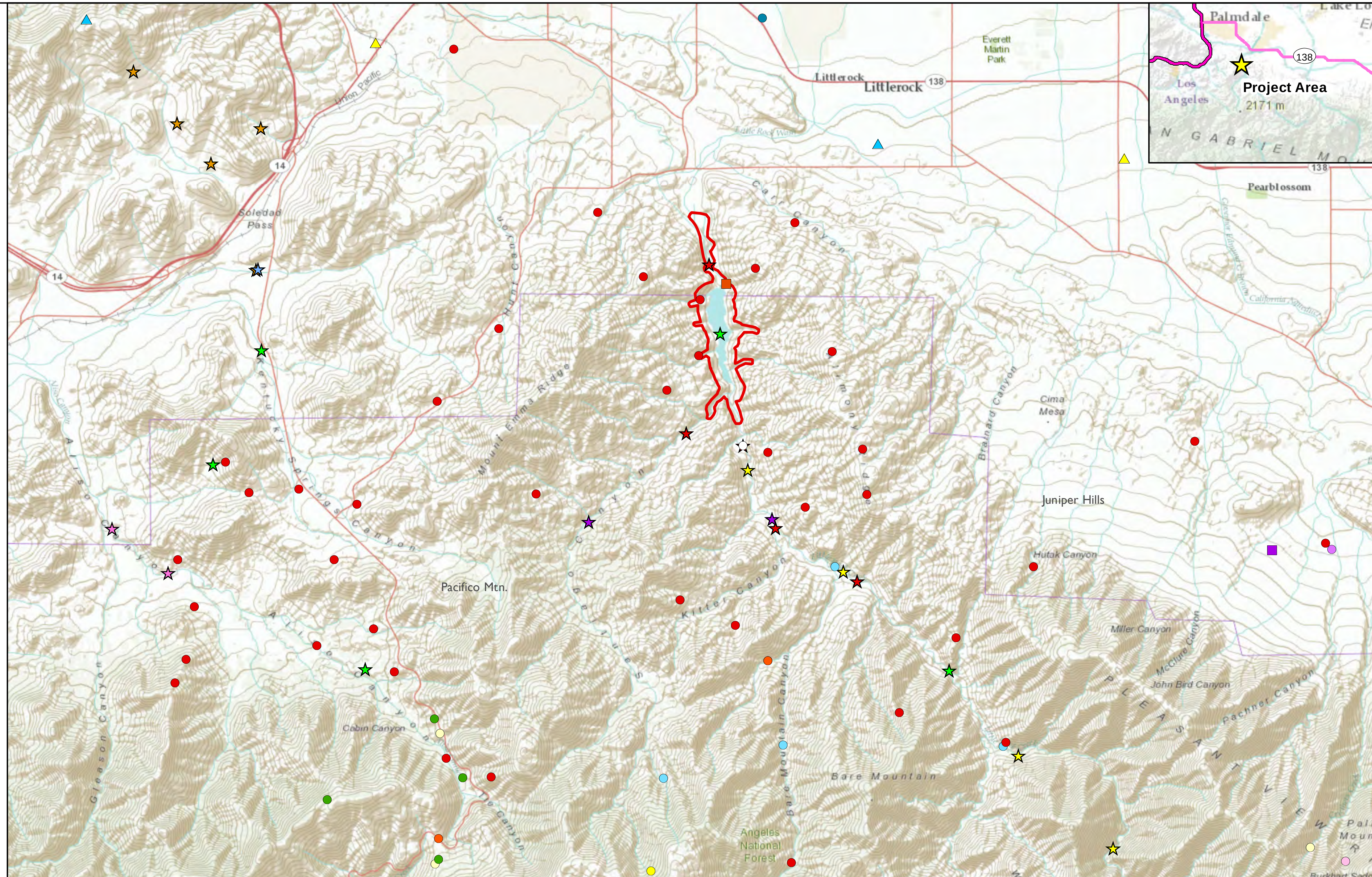
Surveys were performed by methodically walking the western perimeter of the Reservoir (including pooled areas west of the main access road) and within the Littlerock Creek channel upstream of Rocky Point and downstream of the dam. Surveys were also conducted by boat along the eastern shore and within the small tributary drainages that feed the Reservoir from the west. Diurnal and nocturnal surveys were conducted during the time of year and at temperatures when amphibians would be active. Visual observations were made to confirm the presence/absence of tadpoles and/or adults in ephemeral pools or slow moving areas of the active channel of Littlerock Creek, the Reservoir, and storm water basins that border the reservoir.

Focused Surveys – Arroyo Toad

Multiple focused surveys for arroyo toad were performed by methodically walking the western perimeter of the Reservoir (including pooled areas west of the main access road), within the Littlerock Creek channel upstream of Rocky Point and downstream of the dam, the small tributaries that flow into the Reservoir, and within the lower portion of Santiago Creek. Surveys were conducted during the day to search for egg masses, tadpoles or metamorphs and at night observe foraging toads and to listen for reproductive calls.

Common Name

- Le Conte's thrasher
- Loggerhead shrike
- Greata's aster
- Mt. Gleason paintbrush
- Palmer's mariposa-lily
- San Gabriel linanthus
- San Gabriel manzanita
- Lemon lily
- Sagebrush loeflingia
- Short-joint beavertail
- White pygmy-poppy
- Woolly mountain-parsley
- Pallid San Diego pocket mouse
- Yuma myotis
- Arroyo toad
- California red-legged frog
- Coast horned lizard
- Rosy boa
- Sierra Madre yellow-legged frog
- Silvery (California) legless lizard
- Two-striped garter snake



Aspen Environmental Group

N

Miles
0 1 2

StudyArea

Figure 3

CNDDB
Sensitive Species

Arroyo toads are known to occur on Littlerock Creek and portions of the area have been closed to recreation for the protection of the existing population. The focus of the arroyo toad surveys was to maintain a baseline of the distribution of animals in the project area and to evaluate if this species is moving into the Reservoir or adjacent recreation areas.

Reptiles

Surveys for reptiles were performed by methodically walking the Study Area and visually inspecting micro-habitat sites (i.e., basking sites, rock outcrops, leaf litter, wood piles etc.). Focused reptile surveys were conducted during daylight hours when temperatures were such that reptiles would be active (i.e., between 75 – 95^{o}F) and at night concurrent with the amphibian surveys. All refugia sites searched were returned to their original state after inspection.

Birds

Focused (Non-Protocol) Surveys –Common Birds

Surveys for birds were conducted between dawn and 11:00 a.m., and at dusk during calm non-windy conditions. Bird species were identified by sight and sound. Particular attention was given to the riparian corridor below the dam and the large cottonwood and willow trees that occur along the margin of the Reservoir. The adjacent uplands were also searched. Specific protocols for sensitive birds are described further below.

Focused (Non-Protocol) Surveys –Bald and Golden Eagles

Focused surveys for bald and golden eagles included an inspection of the Reservoir, adjacent uplands, mountains, and major lakes and reservoirs in the region. This included surveys of Lake Palmdale, Bouquet Reservoir, and Lake Elizabeth. Searches for bald eagles, a species known as an occasional winter visitor at the Reservoir, were also completed during routine bird and wildlife surveys.

Focused (Protocol) Surveys – Least Bell's Vireo

Focused or protocol surveys for the federally and State endangered least Bell's vireo (*Vireo bellii pusillus*) were conducted annually in the spring/summer from 2010 – 2012. Protocol-level surveys for the least Bell's vireo were conducted in conformance with USFWS Least Bell's Vireo Survey Guidelines (USFWS, 2001). Protocol surveys were conducted no less than ten days apart, between dawn and 11:00 a.m., within all portions of the Study Area containing suitable riparian habitat and adjacent habitat suitable for foraging. Surveys were conducted by slowly walking along and through riparian habitats within the study area at an average pace of approximately 2 km/hr. while visually searching for and listening for songs, scolds, and calls. Non-protocol surveys included monthly surveys in 2012 to monitor existing bird use below the Reservoir.

Terrestrial Mammals

Surveys for terrestrial mammals were conducted in the Study Area and within specific areas containing suitable micro-habitat. Special attention was given to areas that may be affected by sediment removal activities and in which the vegetation and soil structure was conducive to habitation by small mammals such as the upland stream terraces and adjacent uplands. In addition, woodrat middens were searched for both in upland and riparian habitats near the existing Reservoir and parking areas. Biologists recorded all animal observations and visually searched for animal signs (i.e., scat, footprints, fur, burrows, etc.).

Bats

Monitoring for bat calls was conducted using a SongMeter™ SM2 acoustic monitoring and data logging recorder fitted with an SMX-US omnidirectional microphone sensitive to frequencies over 150kHz. Recorded bat calls were analyzed using Song Scope Bioacoustics Software. To enhance identification accuracy, Song Scope files identified to individual bat species were split into individual electronic wave files, which were scrubbed to separate bat echolocation calls from noise, and digitally compensated for microphone frequency response in order to confirm the identity using Sonobat. Bat monitoring was conducted at a single location adjacent to the creek for two 24-hour periods and set to passively record bat calls between 1900 and 0600 hours on 17/18 May and 17/18 June 2012. Bat calls were also actively detected/recorded using a portable Echo Meter EM3 during nocturnal surveys.

3. Existing Conditions

3.1 Local Setting

The Project Area is located in a recreational use area, surrounded by natural lands of the San Gabriel Mountains within the ANF. The upstream portion of the Project Area and the southern extent of the Study Area are located in the northern limit of the Lower Littlerock Creek Critical Biological Zone of the ANF which is currently closed to the public in order to protect designated critical habitat for the federally endangered arroyo toad. From a regional standpoint, the San Gabriel Mountains contain a variety of geographical landforms and vegetation communities that support numerous sensitive biological resources. These mountains are characterized by steep, rugged terrain and deep canyons, as well as numerous creeks, streams, and rivers. The ANF extends across most of the San Gabriel Mountains, and constitutes a regionally rare expanse of wild land habitat.

The 2005 Forest Plan indicates the ANF is home to approximately nine native species of fish, 18 amphibians, 61 reptiles, 299 birds, 104 mammals, 2,900 vascular plants and an unknown number of species of invertebrate animals and non-vascular plants. Some of these species are endemic to the ANF, and some have special status as federally listed threatened, endangered, proposed, candidate, or Forest Sensitive Species. Littlerock Creek is home to several sensitive biological resources including the arroyo toad, two-striped garter snake, southwestern pond turtle, and a variety of rare birds.

3.1.1 Vegetation Communities

The Project Area can be broadly defined to include Chesebro Road, the Reservoir area including the existing parking and recreational facilities, Rocky Point (the location of a proposed grade control structure); and Littlerock Creek south and north of the Reservoir. Access to the Reservoir from the community of Littlerock is provided from Chesebro Road. Vegetation in this area includes a broad assemblage of native and disturbed communities. Creosote bush scrub, Joshua tree woodland, rabbit bush scrub and ruderal vegetation border the road south of Mount Emma Road. Small ranches, horse properties, a dog kennel, and a small network of dirt roads are present in this area. South of Mount Emma Road, the vegetation transitions from more traditional desert scrub communities to areas dominated by California buckwheat scrub, Mormon tea scrub and big sagebrush scrub habitat. Littlerock Creek, located at the bottom of the eastern slope, is dominated by a mosaic of native and non-native woodlands, riparian scrub, and sandy wash. Near the toe of the Dam, the riparian areas of Littlerock Creek support a mixture of arroyo willow thickets, open water and sandy wash habitats.

California buckwheat scrub, California juniper woodland, and singleleaf pinyon woodland dominate the habitat on the slopes and in the foothills surrounding the Reservoir. At the Reservoir the presence of vegetation is affected by a variety of factors including the seasonal fluctuations in water surface elevations that occur as a result of inflow and water deliveries. Because of this, and the lack of soil development on most of the shore, the reservoir area is primarily devoid of vegetation. The exception is the large patches of riparian vegetation that border the margins of the Reservoir and vegetation that becomes seasonally established as the Reservoir recedes.

The shoreline is composed of eroded slopes, sand, and small rock, and fines. Large trees including Fremont cottonwood and willows occur intermittingly across the western and northern portions of the Reservoir. Recreational areas border the Reservoir and include a boat ramp, small dock, and parking areas. Small residences, a cafe, and picnic areas border the Reservoir. Native vegetation occurs intermittingly within this area along parking medians and roadways. In most locations, recreational facilities abut natural lands both within the riparian corridor, Reservoir and uplands.

Eleven types of vegetation were mapped within the Vegetation Study Area. They were classified using names and descriptions in Sawyer et al. (2009). Non-native woodland and ruderal vegetation were also mapped but do not match vegetation described in Sawyer et al. (2009). Three additional un-vegetated cover types were mapped: developed, sandy wash, and open water. Table 3-1 lists the vegetation and cover types identified within the Project Area. Figures 4A and 4B illustrate the vegetation and cover types that occur in the Vegetation Study Area, Project Area, and along the proposed haul roads. Vegetation and cover types are described further below. Appendix A contains representative photographs of the project Area.

Table 3-1. Summary of Vegetation and Cover Types

Vegetation Community		Type	Total Acres		Percentage of Total Acreage (%)	
Sawyer, Keeler-Wolf, and Evens (2009) Vegetation Classification	*Holland (1986) Vegetation Classification*		Vegetation Study Area	Project Area	Vegetation Study Area	Project Area
Arroyo willow thickets	Southern willow scrub	Riparian	5.57	0.00	1.14	0.00
Big Sagebrush Scrub	Big sagebrush scrub	Upland	15.67	0.09	3.21	0.09
California Buckwheat Scrub	Mojave mixed woody scrub	Upland	100.30	0.69	20.54	0.70
California Juniper Woodland	Mojavean juniper woodland and scrub	Upland	55.16	0.43	11.29	0.43
Cattail Marsh	Freshwater marsh	Riparian	2.97	2.95	0.61	2.97
Creosote bush scrub**	Mojave creosote bush scrub	Upland	4.52	0.00	0.93	0.00
Fremont Cottonwood Forest	Southern cottonwood-willow riparian forest	Riparian	25.51	16.21	5.22	16.33
	Mojave riparian forest					
Joshua tree woodland**	Joshua tree woodland	Upland	5.27	0.00	1.08	0.00
Mormon Tea Scrub	Mojave mixed woody scrub	Upland	21.87	0.08	4.48	0.08
	Great Basin mixed scrub					
Rubber rabbitbrush scrub**	Rabbitbrush scrub	Upland	11.21	0.00	2.30	0.00
Singleleaf Pinyon Pine Woodland	Mojavean pinyon woodland	Upland	67.04	1.58	13.73	1.59
Other Cover Types*						
Developed		--	65.80	0.14	6.26	0.14
Non-native woodland**		Upland	4.08	0.00	0.00	0.00
Open Water		--	77.70	74.65	24.10	75.19
Ruderal**		--	13.97	0.00	0.00	0.00
Sandy Wash		--	11.78	2.46	1.42	2.48
Total		--	488.42	99.28		

Vegetation Community		Type	Total Acres		Percentage of Total Acreage (%)	
Sawyer, Keeler-Wolf, and Evens (2009) Vegetation Classification	*Holland (1986) Vegetation Classification*		Vegetation Study Area	Project Area	Vegetation Study Area	Project Area
These communities/land covers are not defined in Sawyer et al. (2009) and Holland (1986) but are included in this table for acreage calculation purposes. ** Observations of these communities were limited to areas along the haul route north of the Reservoir. Communities in **bold** type are considered sensitive by the CDFG.						

Riparian Vegetation Types

Much of the natural riparian vegetation in California has been lost or degraded due to a variety of factors, including land use conversions to agricultural, urban, and recreational uses; channelization for flood control; sand and gravel mining; groundwater pumping; water impoundments; and various other alterations. Faber et al. (1989) estimated that as much as 95 to 97 percent of riparian habitats have been lost in southwestern California.

Riparian habitats are biologically productive and diverse, and are the exclusive habitat for several special-status wildlife species. Many of these species are wholly dependent on riparian habitats throughout the entirety of their life cycles, while others may utilize these habitats during certain seasons or life history phases. For example, numerous amphibian species breed in aquatic habitats but spend most of their lives in upland areas.
In an otherwise arid landscape, primary productivity in riparian habitats is high due to year-round soil moisture. High plant productivity leads to increased habitat structural diversity and increased food, availability for herbivorous animals, and in turn, predatory animals (reviewed by Faber et al., 1989). Insect productivity is also exhibited at relatively higher levels in riparian systems. During warmer months large numbers of insects provide a prey base for a diverse breeding bird fauna. Structural diversity is also much more evident in riparian systems than those of most regional uplands. Riparian woodlands tend to have multiple-layered herb, shrub, and tree canopies, whereas most upland communities are relatively simple-structured. This diverse vertical habitat structure supports a greater diversity of nesting and foraging sites for birds. Similarly, riparian communities support a broader diversity of mammals due to higher biological productivity, denning site availability, thermal cover, and greater access to water.

Fremont cottonwood forest (*Populus fremontii* Forest Alliance). Fremont cottonwood forest is the most mature riparian vegetation in the Vegetation Study Area. It is found at the margin of the reservoir and along Littlerock Creek above and below the reservoir. In the Vegetation Study Area it is dominated by Fremont cottonwood (*Populus fremontii*) with western sycamore (*Platanus racemosa*), black willow (*Salix goodingii*), and arroyo willow (*Salix lasiolepis*). In the upper elevations of the Vegetation Study Area this vegetation best matches southern cottonwood-willow riparian forest as described by Holland (1986) while in the lower elevations of the Vegetation Study Area it best matches the description of Mojave riparian forest (Holland 1986). Southern cottonwood-willow riparian forest and Mojave riparian forest are both recognized as sensitive communities by the California Department of Fish and Game (CDFG; 2010). During surveys conducted in 2012 it was noted that many of the mature cottonwoods and willows that occur along the margins of the reservoir, mapped within Fremont cottonwood forest, were dead or dying (Figure 5). An unknown number of the dead trees were observed to have been felled and left in place. While the exact cause of the dead trees is unknown, it can likely be attributed to extended periods of inundation.

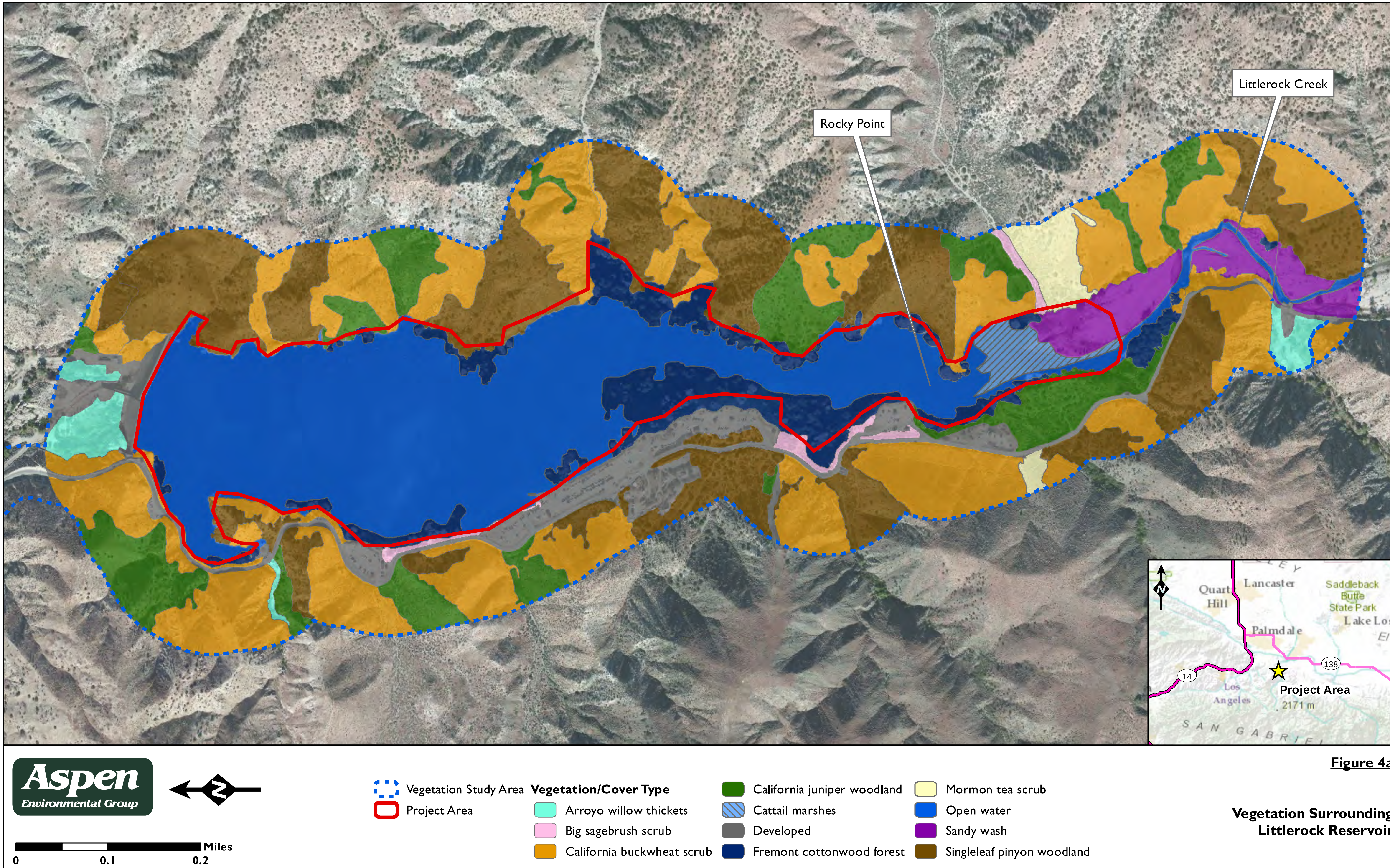
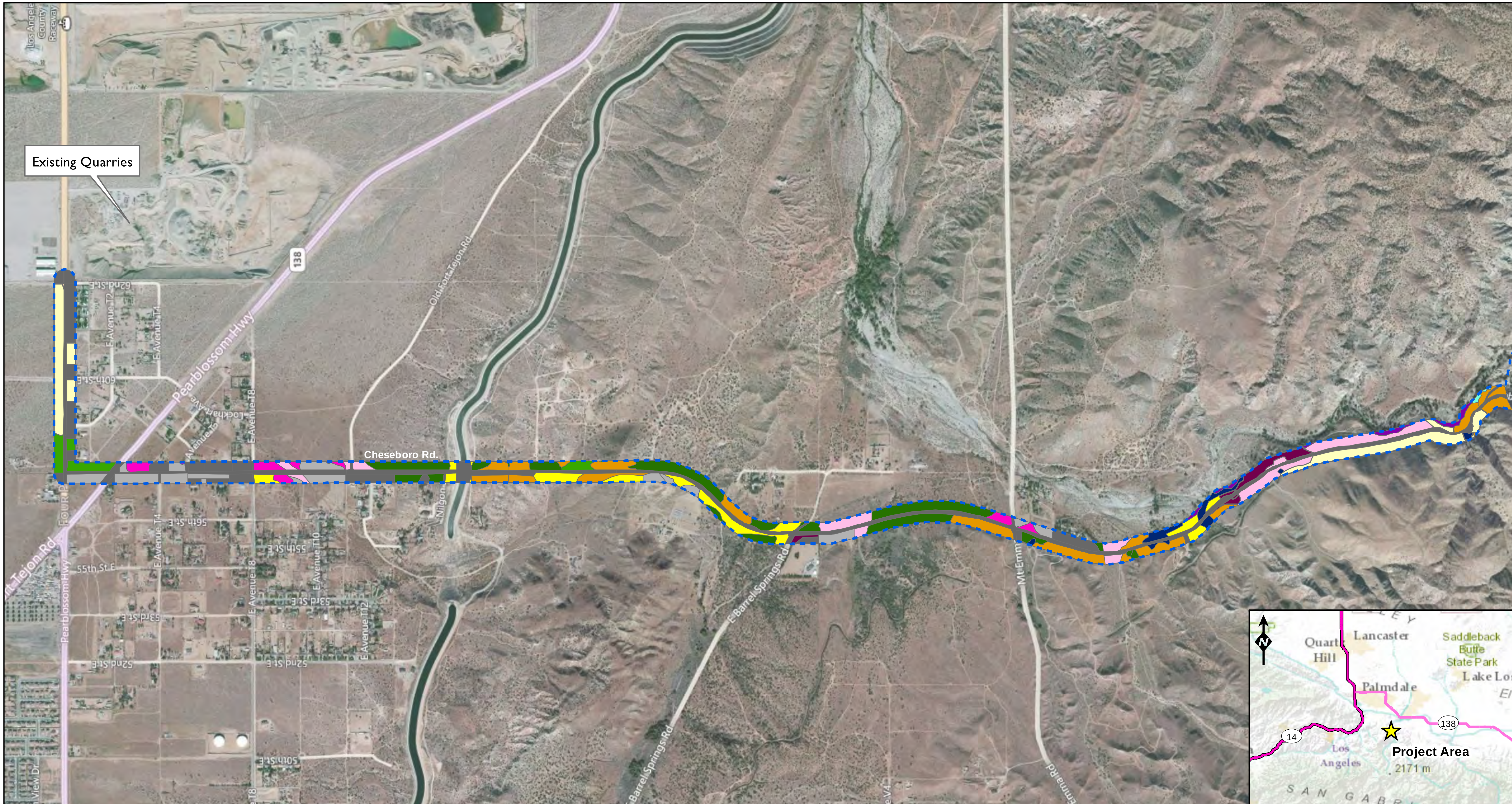


Figure 4a

Vegetation Surrounding Littlerock Reservoir



Vegetation Type

- Arroyo willow thickets
- Big sagebrush scrub
- California buckwheat scrub
- California juniper woodland
- Creosote bush scrub
- Developed
- Fremont cottonwood forest
- Joshua tree woodland
- Mormon tea scrub
- Non-native woodland
- Rubber rabbitbrush scrub
- Ruderal
- Sandy wash
- Vegetation Study Area

0 0.25 0.5 Miles

Aspen Environmental Group

Figure 4b

Vegetation Along Cheseboro Road

Aspen Environmental Group

Feet
0 500 1,000

Dead or Cut-Down Cottonwood Tree
Vegetation Study Area
Project Area

Figure 5

Observation of Recent Cottonwood Mortality

Arroyo willow thickets (*Salix lasiolepis* Shrubland Alliance). Arroyo willow thickets are lower in stature and are typically less mature than cottonwood forests. Arroyo willow thickets tend to establish in recently scoured portions of the floodplain that have available ground water and open soil. Given enough time between disturbances this vegetation may develop into Fremont cottonwood forest. In the Vegetation Study Area arroyo willow thickets are dominated by arroyo willow, black willow, red willow (*Salix laevigata*) with an understory of riparian shrubs and herbaceous perennials. They match descriptions of southern willow scrub in Holland (1986). Arroyo willow thickets also match the description of Southern Riparian Scrub which is recognized as a sensitive community by CDFG (2010).

Cattail marshes [*Typha* (*angustofolia, domingensis, latifolia*) Herbaceous Alliance]. Cattail marsh is abundant at the upstream margin of the reservoir near Littlerock Creek. This community also periodically becomes established at Rocky Point. Broad leaved cattail (*Typha latifolia*) is present along with many other native and non-native wetland plants including rabbits foot grass (*Polypogon monspeliensis*), rushes (*Juncus* spp.), monkey flowers (*Mimulus* spp.), young willows (*Salix* spp.), young saltcedar (*Tamarix ramosissima*), and sweet clovers (*Melilotus* spp.). Given enough time between scouring floods and changes in the water level of the reservoir this vegetation will quickly develop into arroyo willow thickets. This vegetation best matches freshwater marsh as described by Holland (1986).

Upland Vegetation Types

In contrast to riparian and wetland plant species that are adapted to seasonally flooded or periodically saturated soils, upland plant communities consist of plant species that are adapted to dryer conditions and typically require only seasonal precipitation to obtain adequate water resources for growth and reproduction. In the Vegetation Study Area most of the upland plant communities are located in the foothills to the east and west of the Reservoir and adjacent to the haul road.

Big sagebrush (*Artemisia tridentata* Shrubland Alliance). Big sagebrush is uncommon and confined to mature alluvial benches and roadsides in the Vegetation Study Area. It is dominated by big sagebrush (*Artemisia tridentata*) with other plants such as rubber rabbitbrush (*Ericameria nauseosa*), desert bitterbrush (*Purshia glandulosa*), and hairy yerba santa (*Eriodictyon trichocalyx*). It best matches big sagebrush scrub as described by Holland (1986). Big sagebrush intergrades with other types of vegetation such as California juniper woodland, Mormon tea scrub, and rubber rabbitbrush scrub in the Vegetation Study Area. This alliance is not recognized by CDFG as sensitive (2010).

California buckwheat scrub (*Eriogonum fasciculatum* Shrubland Alliance). California buckwheat scrub is common within the Vegetation Study Area primarily on south-facing slopes adjacent to the reservoir and haul road. It is dominated by California buckwheat (*Eriogonum fasciculatum* var. *polifolium*) with other species such as Acton's encelia (*Encelia actoni*), narrowleaf goldenbush (*Ericameria linearifolia*), and Mormon tea (*Ephedra viridis*). California buckwheat scrub partially matches the description of Mojave mixed woody scrub as described in Holland (1986). This vegetation community is not recognized by CDFG as sensitive (2010).

California juniper woodland (*Juniperus californica* Woodland Alliance). California juniper woodland is found at several locations within the Vegetation Study Area. It is characterized by California juniper (*Juniperus californica*) which typically grows with an understory of species similar to those listed in California buckwheat scrub (above) and Mormon tea scrub (below). It best matches descriptions of Mojavean juniper woodland and scrub in Holland (1986). California juniper woodland tends to intergrade with singleleaf pinyon woodland (below) in the Vegetation Study Area. California juniper woodland is not recognized by CDFG as sensitive (2010).

Creosote bush scrub (*Larrea tridentata* Shrubland Alliance). Creosote bush scrub is the most characteristic vegetation of the California deserts and is dominated by creosote bush (*Larrea tridentata*). Other shrub species present in smaller numbers include desert box thorns (*Lycium* spp.), Acton's encelia, and beavertail cactus. Ground cover among the shrubs is fairly open in most of the area, largely dominated by native bunchgrasses and other herbs. This vegetation matches descriptions of Mojave creosote bush scrub in Holland (1986). Creosote bush scrub is not recognized by CDFG as sensitive (2010).

Joshua tree woodland (Yucca brevifolia Woodland Alliance). Joshua trees (*Yucca brevidifolia*) are found at scattered locations throughout the Vegetation Study Area but only the larger, intact patches are separated from adjacent vegetation and mapped. With the exception of the Joshua trees, these woodlands match the description of California juniper woodland (above). This vegetation matches Joshua tree woodland as described by Holland (1986). This vegetation is not recognized by CDFG as sensitive (2010).

Mormon tea scrub (*Ephedra viridis* Shrubland Alliance). This vegetation is similar in composition to California buckwheat scrub but the dominant species are Mormon tea and desert bitterbrush. Within the Vegetation Study Area it is isolated to a few steep north-facing slopes on the west side of the reservoir. It partially matches the description of Mojave mixed woody scrub and Great Basin mixed scrub in Holland (1986). Mormon tea scrub is not recognized by CDFG as sensitive (2010).

Non-native woodland. This vegetation is composed primarily of non-native trees that have been planted for ornamental value and does not match any named vegetation in Sawyer et al. (2009) or Holland (1986). Non-native woodlands are present at several areas within the Vegetation Study Area primarily along the haul routes. The largest non-native woodland in the Vegetation Study Area is near the reservoir entrance station where planted trees are persisting and in some cases reproducing. Non-native trees observed include black locust (*Robinia pseudoacacia*), silk tree (*Albizia julibrissin*), cypresses (*Cupressus* spp.), saltcedar and various pines (*Pinus* spp.). Non-native shrubs such as rosemary (*Rosmarinus officinali*) and oleander (*Nerium oleander*) were also observed. Non-native woodlands are not recognized by CDFG as sensitive (2010).

Rubber rabbitbrush scrub (*Ericameria nauseosa* Shrubland Alliance). This vegetation is characterized by the presence of rubber rabbitbrush. In the Vegetation Study Area it was observed in a few isolated canyon bottoms and roadsides near the Reservoir and at several locations along the haul road. It is similar in species composition to big sagebrush (above) but is dominated by rubber rabbitbrush. It matches descriptions of rabbitbrush scrub in Holland (1986). Rubber rabbitbrush scrub is not recognized by CDFG as sensitive (2010).

Singleleaf pinyon woodland (*Pinus monophylla* Woodland Alliance). Singleleaf pinyon woodland is common within the Vegetation Study Area on slopes surrounding the Reservoir. Singleleaf pinyon pine (*P.monophylla*) is the dominant species with California juniper, desert bitterbrush, and Joshua trees also present. Understory species are similar to those described in California buckwheat scrub (above). This vegetation best matches Mojavean pinyon woodland described in Holland (1986). Singleleaf pinyon woodland is not recognized by CDFG as sensitive (2010).

Ruderal. Ruderal vegetation is characteristic of heavily disturbed sites such as roadsides, graded lands, or former agricultural lands. Ruderal areas typically have little overall vegetation cover, and what vegetation is present is dominated by non-native weeds, "weedy" native species, and escaped ornamental species. Ruderal species identified in the Vegetation Study Area include summer mustard

(*Hirshfeldia incana*), cheat grass (*Bromus tectorum*), Mediterranean grass (*Schismus barbatus*) and pineapple weed (*Chamomilla suaveolens*). This vegetation is not recognized by CDFG as sensitive (2010).

Non-vegetation Cover Types

Developed. There are numerous developed areas within the Vegetation Study Area including roads, parking lots, residential areas, and adjacent cleared areas. These areas are typical devoid of vegetation or support scattered ornamental species.

Sandy wash. This cover type is found in dry stream channels that have recently been scoured by floods. This cover type typically supports low densities of plant cover; however in the absence of scouring flows or inundation these areas may develop more complex vegetation communities.

Open water. The operation of the Reservoir includes seasonal fluctuations in the water surface elevations. Typically the Reservoir is at capacity after winter precipitation. Water levels generally are maintained through the summer and gradually lowered to the dead pool elevation after Labor Day. The change in the water surface elevations greatly affects the type and composition of vegetation that can occur at the Reservoir. When the water recedes, large areas of barren sand and mud are exposed. This habitat is un-vegetated due to seasonal inundation; however riparian vegetation, weeds and herbaceous plants quickly become established along the margins of the creek. Herbaceous vegetation observed near Rocky Point included native and non-native species such as rabbitsfoot grass, willow herb (*Epilobium ciliatum*), salt heliotrope (*Heliotropium curassavicum*), bracted verbena (*Verbena bracteata*), and pineapple weed.

3.1.2 Common Plant Species Observed

Surveys resulted in the documentation of 266 species of native and non-native vascular plants within the Vegetation Study Area. Non-vascular plants, including lichens and bryophytes, were not identified during the surveys. Table 3-2, below, presents a list of all plants observed within the Vegetation Study Area.

Table 3-2. Plant Species Observed Within the Vegetation Study Area

Latin Name	Common Name	Abundance	Voucher
VASCULAR PLANTS			
FILICALES	FERN FAMILIES (SEVERAL INCLUDED TOGETHER)		
Marsilea vestita	Hairy cloverfern	Scarce	4,342
CUPRESSACEAE	CYPRESS FAMILY		
Cupressus sp.	Unid. cypress	Uncommon	
Juniperus californica	California juniper	Common	
EPHEDRACEAE	EPHEDRA FAMILY		
Ephedra nevadensis (?)	Desert tea	Uncommon	
Ephedra viridis	Green ephedra	Occasional	
PINACEAE	PINE FAMILY		
* *Pinus sp.*	Unid. ornamental	Uncommon	
Pinus monophylla	Pinyon pine	Common	
ANACARDIACEAE	CASHEW FAMILY		
Toxicodendron diversilobum	Poison oak	Uncommon	
APIACEAE	CELERY FAMILY		
* *Conium maculatum*	Poison hemlock	Uncommon	

Latin Name	Common Name	Abundance	Voucher
APOCYNACEAE	DOGBANE FAMILY		
* *Nerium oleander*	Ornamental oleander	Uncommon	
ASCLEPIADACEAE	MILKWEED FAMILY		
Asclepias fascicularis	Narrow-leaved milkweed	Uncommon	
ASTERACEAE	ASTER FAMILY		
Acamptopappus sphaerocephalus	Desert goldenhead	Uncommon	4,757
Ambrosia acanthicarpa	Annual sandbur	Occasional	
Artemisia douglasiana	Douglas mugwort	Occasional	
Artemisia dracunculus	Tarragon	Occasional	
Artemisia ludoviciana	Western mugwort	Occasional	
Artemisia tridentata	Great Basin sagebrush	Common	
Baccharis salicifolia	Mulefat	Occasional	
Brickellia californica	Calif. brickellbush	Uncommon	
Calycoseris parryi	Yellow tackstem	Scarce	1,571
* *Centaurea melitensis*	Tocalote	Uncommon	
Chaenactis glabriscula	Yellow pincushion	Uncommon	1,597
Chaenactis steveioides	Broad-flowered pincushion	Occasional	1,567
* *Chamomilla suaveolens*	Pineapple weed	Uncommon	1,580
(Matricaria matricarioides)			
Chrysothamnus nauseosus	Common rabbitbrush	Occasional	
Cirsium occidentale	California thistle	Scarce	4,759
var. californicum (?)			
* *Cirsium vulgare*	Bull thistle	Uncommon	
* *Conyza bonariensis*	Flax-leaved horseweed	Uncommon	
Conyza canadensis	Horseweed	Uncommon	
Coreopsis bigelovii	Bigelow coreopsis	Uncommon	1,599
Encelia actoni	Acton brittlebush	Occasional	
Ericameria cooperi	Cooper goldenbush	Uncommon	1,625
Ericameria linearifolia	Narrowleaf goldenbush	Uncommon	
Eriophyllum confertiflorum	Golden yarrow	Uncommon	
Eriophyllum wallacei	Wallace's woolly daisy	Uncommon	
Gnaphalium canescens	Perennial cudweed	Uncommon	
* *Gnaphalium luteo-album*	Pearly everlasting	Scarce	
Gnaphalium palustre	Meadow everlasting	Uncommon	1,568B
Gnaphalium stramenium	Cotton batting	Uncommon	4,782
Gutierrezia sarothrae	Common matchweed	Occasional	
Heterotheca grandiflora	Telegraph weed	Uncommon	
Hymenoclea salsola	Cheesebush	Uncommon	1,646
* *Lactuca serriola*	Prickly lettuce	Scarce	
Lasthenia californica	California goldfields	Uncommon	
Layia glandulosa	White tidy tips	Uncommon	1,588
Lepidospartum squamatum	Scalebroom	Occasional	
Lessingia filaginifolia	Chaparral aster	Occasional	
(Corethrogyne filaginifolia)			
Microseris lindleyi (M. linearifolia,	Silver puffs	Uncommon	1,631
Uropappus lindleyi)			
Nicolletia occidentalis	Hole-in-the-sand plant	Scarce	4,773

Latin Name		Common Name	Abundance	Voucher
	Rafinesquia californica	Calif. chicory	Uncommon	
	Senecio flaccidus v. douglasii	Sand-wash butterweed	Uncommon	4,766
*	*Sonchus asper*	Prickly sow-thistle	Occasional	
*	*Sonchus oleraceus*	Common sow thistle	Uncommon	
	Stephanomeria exigua	Wreath plant	Uncommon	
	Stephanomeria pauciflora	Wire-lettuce	Uncommon	
	Stephanomeria virgata	Wreath plant	Uncommon	
	Stylocline gnaphalioides	Everlasting nest-straw	Scarce	
	Stylocline psilocarphoides	Perk's nest-straw	Scarce	1,618
	Syntrichopappus fremontii	Freemont's syntrchopappus	Uncommon	1,622
**	*Syntrichopappus lemmonii*	Lemmon's syntrichopappus	Scarce	1,563
	Tetradymia comosa	Hairy horsebrush	Uncommon	
	Tetradymia spinosa (?)	Cottonthorn	Uncommon	1,645
	Xanthium strumarium	Cocklebur	Uncommon	
	Xylorhiza tortifolia	Mojave aster	Scarce	
	(Machaeranthera tortifolia)			
BETULACEAE		BIRCH FAMILY		
	Alnus rhombifolia	White alder	Uncommon	
BORAGINACEAE		BORAGE FAMILY		
	Amsinckia tessellata	Checker fiddleneck	Occasional	
	Cryptantha barbigera	Bearded cryptantha	Uncommon	1,568A
	Cryptantha circumscissa	Cushion cryptantha	Uncommon	1,628
	Cryptantha decipiens	Gravelbar cryptantha	Scarce	1,587B
	Cryptantha muricata	Prickly cryptantha	Occasional	1,587A
	Cryptantha nevadensis var. *rigida*	Nevada cryptantha	Uncommon	1,644
	Cryptantha oxygona	Sharpnut cryptantha	Uncommon	1,603
	Cryptantha pterocarya	Winged cryptantha	Scarce	1,592
	Heliotropium curassavicum	Salt heliotrope	Occasional	
	Pectocarya linearis	Comb-bur	Uncommon	1,649
	Pectocarya setosa	Comb-bur	Uncommon	
	Plagiobothrys arizonicus	Arizona popcornflower	Uncommon	1,574
BRASSICACEAE		MUSTARD FAMILY		
	Arabis pulchra	Beautiful rock-cress	Uncommon	
*	*Brassica geniculata*	Short-pod mustard	Uncommon	
	(Hirschfeldia incana)			
	Descurainia pinnata	Tansy mustard	Scarce	1,569
	Descurainia sophia	Flixweed, tansy mustard	Uncommon	1,593
	Lepidium fremontii	Fremont pepper-grass	Uncommon	
	Rorippa curvisiliqua (?)	Western yellow-cress	Scarce	4,761
	Rorippa nasturtium-aquaticum	Water-cress	Uncommon	
	Rorippa sphaerocarpa (?)	Round fruited yellow-cress	Scarce	4,785
*	*Sisymbrium officinale*	Hedge mustard	Uncommon	
*	*Sisymbrium irio*	London rocket	Uncommon	
	Stanleya pinnata	Prince's plume	Uncommon	
	Thysanocarpus lacinatus	Fringe-pod	Uncommon	1,586

Latin Name	Common Name	Abundance	Voucher
CACTACEAE	CACTUS FAMILY		
* *Opuntia basilaris*	Short-jointed beavertail cactus	Scarce	4,775
var. brachyclada			
Opuntia basilaris var. basilaris	Common beavertail cactus	Occasional	
Opuntia echinocarpa	Silver cholla	Uncommon	
CAMPANULACEAE	BELLFLOWER FAMILY		
Nemacladus longiflorus	Long flowered thread plant	Scarce	1,623A
var. *breviflorus*			
Nemacladus sigmoideus	Small flowered thread plant	Scarce	1,623B
CARYOPHYLLACEAE	CARNATION FAMILY		
Minuartia douglasii	Douglas sandwort	Scarce	1,564
CHENOPODIACEAE	GOOSEFOOT FAMILY		
Atriplex canescens	Four-winged saltbush	Occasional	
* *Chenopodium album (?)*	Common goosefoot	Uncommon	
Chenopodium berlandieri	Pit seed goosefoot	Uncommon	
* *Chenopodium botrys*	Jerusalem oak goosefoot	Uncommon	4,333
Chenopodium californicum	California goosefoot	Uncommon	
* *Chenopodium murale*	Nettle-leaved goosefoot	Uncommon	
Grayia spinosa	Spiny hop-sage	Occasional	1,583
* *Salsola tragus*	Russian thistle, tumbleweed	Uncommon	
CRASSULACEAE	STONECROP FAMILY		
Dudleya lanceolata	Lance-leaved dudleya	Uncommon	1,590
CUCURBITACEAE	CUCUMBER FAMILY		
Marah fabacea	California man-root	Scarce	1,619
CUSCUTACEAE	DODDER FAMILY		
Cuscuta sp.	Unid. witch's hair	Uncommon	
DATISCACEAE	DATISCA FAMILY		
Datisca glomerata	Durango root	Scarce	4,343
ERICACEAE	MANZANITA FAMILY		
Arctostaphylos glauca	Bigberry manzaniga	Uncommon	1,582
EUPHORBIACEAE	SPURGE FAMILY		
Chamaesyce albomarginata	Rattlesnake spurge	Occasional	
(Euphorbia albomarginata)			
FABACEAE	PEA FAMILY		
* *Albizia julibrissin*	Silktree	Uncommon	
Astragalus didymocarpus	Dwarf locoweed	Scarce	1,626
Lotus humistriatus	Hill lotus	Scarce	1,632
Lotus scoparius	Deerweed	Uncommon	
Lotus strigosus	Strigose lotus	Uncommon	1,620
Lupinus bicolor	Miniature lupine	Uncommon	
Lupinus concinnus	Sand lupine	Uncommon	
Lupinus sparsiflorus	Coulter lupine	Uncommon	1,594
* *Melilotus alba*	White sweet-clover	Occasional	
* *Parkinsonia aculeata*	Mexican palo verde	Scarce	4,788
* *Robinia pseudoacacia*	Black locust	Uncommon	
Trifolium microcephalum	Maiden clover	Scarce	4,777
Trifolium willdenovii	Valley clover	Uncommon	4,776

Latin Name	Common Name	Abundance	Voucher
Trifolium sp.	Unid. clover	Scarce	4,764
GENTIANACEAE	GENTIAN FAMILY		
Centaurium exaltatum	Desert centaury	Uncommon	4,338
GERANIACEAE	GERANIUM FAMILY		
* *Erodium cicutarium*	Red-stemmed filaree	Uncommon	
HYDROPHYLLACEAE	WATERLEAF FAMILY		
Emmenanthe penduliflora	Whispering bells	Uncommon	
Eridictyon trichocalyx	Yerba santa	Occasional	1,610
Eucrypta chrysanthemifolia	Common eucrypta	Uncommon	
Nemophila menziesii	Baby blue-eyes	Uncommon	
Phacelia cryptantha	Limestone phacelia	Uncommon	1,566
Phacelia distans	Common phacelia	Occasional	
Phacelia imbricata	Broad-sepaled phacelia	Uncommon	1,589
Phacelia longipes	Longstalk phacelia	Uncommon	1,595
Pholistoma membranaceum	White fiesta-flower	Scarce	1,575
Turricula parryi	Poodle bush	Occasional	4,758
LAMIACEAE	MINT FAMILY		
Salazaria mexicana	Bladder sage, paper bag bush	Occasional	1,641
Salvia columbariae	Chia	Occasional	
Salvia dorrii (S. carnosa)	Blue desert sage	Occasional	1,562
Stachys albens	White hedge-nettle	Uncommon	4,786
Stachys ajugoides (incl. S. rigida)	Hedge nettle	Scarce	
LOASACEAE	STICK-LEAF FAMILY		
Mentzelia veatchiana	Veatch's stick-leaf	Uncommon	1,600
MELIACEAE	MAHOGANY FAMILY		
* *Melia azedarach*	China berry	Uncommon	
NYCTAGINACEAE	FOUR O'CLOCK FAMILY		
Mirabilis laevis	Desert wishbone bush	Uncommon	
OLEACEAE	OLIVE FAMILY		
Forestiera pubescens	Desert olive	Uncommon	
ONAGRACEAE	EVENING PRIMROSE FAMILY		
Camissonia boothii	Shredding evening primrose	Uncommon	4,779
ssp. *decorticans*			
Camissonia campestris (?)	Field evening primrose	Uncommon	1,621
Camissonia pallida	Pale suncup	Scarce	1,647
Epilobium brachycarpum	Summer cottonweed	Uncommon	
(E. paniculatum)			
Epilobium canum	California fuchsia	Uncommon	
(Zauschnaria californica)			
Epilobium ciliatum	Willow-herb	Occasional	
Epilobium densiflorum (?)	Dense-flowere willow-herb	Scarce	4,334
Oenothera californica	California evening primrose	Uncommon	
OROBANCHACEAE	BROOMRAPE FAMILY		
Orobanche californica ssp. feudgei	California broomrape	Uncommon	1,605
PAPAVERACEAE	POPPY FAMILY		
Eschscholzia californica	Calif. poppy	Uncommon	
Eschscholzia minutiflora	Small-flowered poppy	Scarce	1,624

Latin Name	Common Name	Abundance	Voucher
Platystemon californicus	Cream cups	Scarce	1,635
PLATANACEAE	SYCAMORE FAMILY		
Platanus racemosa	California sycamore	Uncommon	
POLEMONIACEAE	PHLOX FAMILY		
Eriastrum densifolium	Perennial woolly-star	Uncommon	4,767
ssp. densifolium			
Eriastrum sapphirinum	Sapphire woollystar	Uncommon	1,613
Gilia brecciarum	Nevada gilia	Scarce	1,638
Gilia splendens	Splendid gilia	Uncommon	1,596
Gilia sp.	Unid. gilia	Scarce	1,601
Leptodactylon californicum	California prickly-phlox	Scarce	
Linanthus aureus	Golden linanthus	Scarce	1,642
Linanthus bigelovii	Biglow's linanthus	Uncommon	1,636
Linanthus parryae	Parry's linanthus	Uncommon	1,627
Loeseliastrum matthewsii	Desert calico	Scarce	1,648
POLYGONACEAE	BUCKWHEAT FAMILY		
Centrostegia thurberi	Thurber spineflower	Uncommon	1,584
(Chorizanther thurberi)			
Chorizanthe brevicornu	Brittle spine-flower	Uncommon	
Chorizanthe staticoides	Turkish rugging	Occasional	1,617
Chorizanthe watsonii	Watson spineflower	Uncommon	
Chorizanthe xanti var. *xanti*	Riverside spineflower	Uncommon	1,629
Eriogonum cithariforme var. *agninum*	Cithara buckwheat	Uncommon	1,570
Eriogonum elongatum	Wand buckwheat	Uncommon	
Eriogonum pusillum	Puny buckwheat	Uncommon	1,581
Eriogonum spp.	2 or more unidentified annuals		
* *Polygonum arenastrum*	Common knotweed	Occasional	
(P. aviculare)			
Polygonum lapathifolium	Willow smartweed	Occasional	
PORTULACACEAE	PURSLANE FAMILY		
Calyptridium monandrum	Common calyptridium	Uncommon	
Claytonia parviflora	Miner's lettuce	Uncommon	1,606
* *Portulaca oleracea*	Common purslane	Uncommon	
RANUNCULACEAE	BUTTERCUP FAMILY		
Delphinium parishii	Parish larkspur	Uncommon	1,561
ROSACEAE	ROSE FAMILY		
Purshia glandulosa	Desert bitterbrush	Occasional	
RUBIACEAE	COFFEE FAMILY		
Galium angustifolium	Bedstraw	Uncommon	
* *Galium aparine*	Goose grass	Uncommon	
SALICACEAE	WILLOW FAMILY		
Populus fremontii	Fremont cottonwood	Common	
Salix exigua	Sandbar willow	Occasional	
Salix goodingii	Black willow	Occasional	
Salix laevigata	Red willow	Occasional	
Salix lasiolepis	Arroyo willow	Occasional	

Latin Name	Common Name	Abundance	Voucher
SAURACEAE	LIZARD TAIL FAMILY		
Anemopsis californica	Yerba mansa	Uncommon	
SCROPHULARIACEAE	SNAPDRAGON FAMILY		
Castilleja linariifolia	Desert paintbrush	Scarce	
Castilleja minor ssp. spiralis	Lesser paintbrush	Uncommon	4,336
Collinsia callosa	Desert collinsia	Scarce	1,565
Mimulus cardinalis	Scarlet monkeyflower	Occasional	
Mimulus floribundus	Showy monkeyflower	Uncommon	4,337
Mimulus guttatus	Seep monkeyflower	Occasional	
* *Mimulus johnstonii*	Johnston's monkeyflower	Scarce	1,572
Mimulus moschatus	Musk monkeyflower	Uncommon	4,335
Mimulus parishii	Parish's monkey-flower	Scarce	4,770
Mimulus pilosus	Downy monkey-flower	Uncommon	
Penstemon centranthifolius	Scarlet bugler	Uncommon	
* *Verbascum virgatum*	Wand muellin	Occasional	4,765
Veronica americana	American brooklime	Scarce	
* *Veronica anagallis-aquatica (?)*	Water speedwell	Uncommon	
SIMAROUBACEAE	QUASSIA FAMILY		
* *Ailanthus altissima*	Tree of heaven	Scarce	
SOLANACEAE	NIGHTSHADE FAMILY		
Datura wrightii (D. meteloides)	Jimsonweed	Occasional	
Lycium andersonii	Anderson thornbush	Uncommon	
Lycium cooperi	Peach desert thorn	Uncommon	
* *Nicotiana glauca*	Tree tobacco	Uncommon	
* *Solanum elaeagnifolium*	Silver-leaf nightshade	Uncommon	4,789
TAMARICACEAE	TAMARISK FAMILY		
Tamarix ramosissima	Mediterranean tamarisk	Occasional	
URTICACEAE	NETTLE FAMILY		
Urtica dioica ssp. holosericea	Stinging nettle	Uncommon	
VERBENACEAE	VERVAIN FAMILY		
Verbena bracteata	Bracted verbena	Occasional	4,762
Verbena lasiostachys	Western verbena	Uncommon	
VISCACEAE	MISTLETOE FAMILY		
Phoradendron densum	Leafy juniper mistletoe	Uncommon	
Phoradendron macrophyllum	Mistletoe (on sycamore or	Uncommon	
ZYGOPHYLLACEAE	CALTROP FAMILY		
Larrea tridentata	Creosote bush	Common	
* *Tribulus terrestris*	Puncture vine	Uncommon	
CYPERACEAE	SEDGE FAMILY		
Carex alma (?)	Sturdy sedge	Uncommon	4,339
Carex fracta (?)	Fragile-sheathed sedge	Uncommon	4,781
Carex praegracilis	Clustered field-sedge	Occasional	
Carex senta (?)	Rough sedge	Uncommon	4,340
* *Cyperus difformis (?)*	Variable flatsedge	Scarce	4,769
Cyperus eragrostis	Tall umbrella sedge	Uncommon	
Eleocharis parishii	Parish spike-sedge	Uncommon	4,770
Scirpus microcarpus	Small-fruited bulrush	Uncommon	

	Latin Name	Common Name	Abundance	Voucher
	JUNCACEAE	RUSH FAMILY		
	Juncus sp. (1 or more unid. spp.)			4,344
	Juncus arcticus (incl. vars.	Wire-grass	Uncommon	
	balticus and mexicanus)			
	Juncus bufonius	Toad rush	Occasional	
	Juncus macrophyllus	Long-leaved rush	Uncommon	1,585
	Juncus rugulosus	Wrinkled rush	Uncommon	4,345
	Juncus tiehmii	Nevada rush	Uncommon	4,331
	Juncus xiphioides	Iris-leaved rush	Occasional	4,346
	LILIACEAE	LILY FAMILY		
	Allium fimbriatum var. fimbriatum	Fringed onion	Scarce	1639
	Bloomeria crocea	Golden stars	Scarce	
	Calochortus kennedyi	Kennedy's mariposa lily	Scarce	1,643
	Dichelostemma capitata	Wild hyacinth, bluedicks	Uncommon	
	(Brodiaea pulchella)			
	Yucca brevifolia	Joshua tree	Occasional	
	Yucca whipplei	Chaparral yucca	Occasional	
	(Hesperoyucca whipplei)			
	POACEAE	GRASS FAMILY		
	Agrostis exarata	Western bentgrass	Occasional	4,787
*	*Agrostis viridis (A. semiverticillata)*	Water bentgrass	Uncommon	
*	*Avena fatua*	Wild oat	Scarce	
*	*Bromus diandrus*	Ripgut brome	Occasional	
*	*Bromus hordeaceus (B. mollis)*	Soft chess	Uncommon	
*	*Bromus madritensis*	Red brome	Occasional	
	ssp. rubens (B. rubens)			
*	*Bromus tectorum*	Cheat grass	Occasional	
*	*Cynodon dactylon*	Bermuda grass	Uncommon	
	Distichlis spicata	Saltgrass	Uncommon	
	Elymus elymoides	Bottlebrush squirreltail	Uncommon	
	(Sitanion hystrix v. hystrix)			
*	*Hordeum murinum*	Hare barley	Uncommon	
*	*Leptochloa uninervia*	Sprangletop	Uncommon	4,768
	Melica imperfecta	Common melic	Uncommon	
*	*Stipa milaceum (Piptatherum m.)*	Smilo grass	Uncommon	
*	*Poa annua*	Annual bluegrass	Uncommon	
*	*Poa pratensis*	Kentucky bluegrass	Occasional	
	Poa secunda	Nodding bluegrass	Occasional	
*	*Polypogon monspeliensis*	Rabbitfoot grass	Occasional	
*	*Schismus barbatus*	Mediterranean schismus	Occasional	
	Stipa hymenoides (Oryzopsis	Indian ricegrass	Uncommon	
	hymenoides, Achnatherum hymenoides)			
	Stipa speciosa	Desert needlegrass	Uncommon	
	(Achnatherum speciosum)			
	Vulpia microstachys	Annual fescue	Uncommon	1,602
	(Festuca microstachys, F. reflexa, F. pacifica, F. confusa)			
*	*Vulpia myuros (Festuca myuros,*	Annual fescue	Uncommon	

Latin Name	Common Name	Abundance	Voucher
F. megalura)			
TYPHACEAE	CATTAIL FAMILY		
Typha domingensis	Slender cattail	Uncommon	
Typha latifolia	Broad-leaved cattail	Occasional	
ZANNICHELLIACEAE	HORNED PONDWEED FAMILY		4,341
Zannichellia palustris	Horned pondweed	Scarce	

Alien species are indicated by asterisk, special status species indicated by two asterisks. This list includes only species observed within the Vegetation Study Area. Others may have been overlooked or unidentifiable due to season. Plants were identified using keys, descriptions, and illustrations in Abrams (1923-1951), Hickman (1993), and Munz (1974). Taxonomy and nomenclature generally follow Hickman. Vouchers, indicated by Justin Wood's collection numbers, will be deposited at Rancho Santa Ana Botanic Garden.

3.1.3 Noxious and Invasive Weeds

The term "noxious weeds" includes all plants formally designated by the Secretary of Agriculture or other responsible State official. These species usually possess one or more of the following characteristics: "aggressive and difficult to manage, poisonous, toxic, parasitic, a carrier or host of serious insects or disease, and being non-native or new to or not common to the United States or parts thereof" (USDA, 1995). Several noxious weeds already exist within the Vegetation Study Area (including the preferred haul routes). Some of these species occur in well-established populations and appear to be associated with historic disturbance.

Surveys within the Study Area identified 51 nonnative plant species. Several of these are considered noxious weeds by the Cal-IPC. Table 3-3 lists the noxious and invasive plant species that were identified during the surveys. Figure 6 graphically depicts the location of each species in relation to the Reservoir and/or haul route. Appendix B provides additional information on the life history characteristics, threat level, and currently recognized methods for their control or eradication.

Table 3-3. Noxious and Invasive Plant Species Identified in the Vegetation Study Area

Scientific Name	Common Name	Threat Level*
Centaurea melitensis	Tocalote	Moderate
Hirschfeldia incana (Brassica geniculata)	Short-pod mustard	Moderate
Nicotiana glauca	Tree tobacco	Moderate
Parkinsonia aculeata	Jerusalem thorn	Evaluated Not Listed
Polypogon monspeliensis	Rabbitsfoot grass	Limited
Solanum elaeagnifolium	White horsenettle	Evaluated Not Listed
Stipa miliacea	Smilo grass	N/A
Tamarix sp.	Tamarisk	High
Verbascum virgatum	Wand mullein	N/A

* Source: Cal-IPC, 2012

3.1.4 Soils

Soil characterization is an important component of any analysis for biological resources because soils often play a pivotal role in the habitat requirements of a variety of special-status plant and wildlife species. It is not uncommon for soil composition and/or texture to define exclusive habitat qualities for many of these species. Several special-status plants require unique soil characteristics in order to set seed, germinate, and grow. Additionally, many special-status reptiles and mammals require suitable soil qualities, such as texture and friability, to construct and maintain adequate burrows. Table 3-4 lists the soils occurring in the Study Area. Figure 7 illustrates the locations of these soil types within the Study Area. However, soil maps are broad in scale and are not used for site specific analysis.

Table 3-4. Soil Units Occurring in the Study Area

Map Unit Symbol	Map Unit Name	Description	Acres Within Study Area	% Total Within Study Area
21	Riverwash	An excessively drained soil that occurs in alluvial flats; generally occurs from 1,800 – 4,800 feet in elevation; parent material consists of alluvium; frequently flooded; extremely stony coarse sand (0-60").	55.15	12.13
711	Trigo family, dry-Lithic Xerorthents, warm complex, 50 to 80 percent slopes	A somewhat excessively drained soil that occurs in the; generally occurs from 3,200 to 6,400 feet in elevation; parent material consists of residuum weathered from granodiorite; not prone to frequent flooding; sandy loam (0 – 20"), weathered bedrock (20 – 24").	213.31	46.91
766	Water	Open Water	186.27	40.96
		Total	454.73	

Source: NRCS, 2012

3.1.5 Jurisdictional Waters/Wetlands

A jurisdictional delineation of State and or federal waters/wetlands was not conducted as part of the surveys presented in this report. Results of the comprehensive delineation will be presented in a separate report. Initial review indicates that the Reservoir and Littlerock Creek would be considered "waters of the United States" and would be subject to the jurisdiction of the USACE, the CDFG and the RWQCB.

3.2 Common Wildlife

Littlerock Creek provides a diverse set of habitats that support a variety of wildlife species. These habitat types contribute to the diversity and abundance of wildlife in the region as they provide for permanent and migratory residency, foraging, and breeding behaviors. In addition, the creek bed and adjacent uplands provide breeding and refugia for a number of wildlife species. The habitat with the greatest intrinsic value to wildlife is the riparian community. The Project Area is also extensively used by recreationists including families, day users, boaters, and anglers. In the fall, portions of the site are opened for OHV use. The disturbance caused by these recreational activities may limit the daytime use of the Project Area by some species of wildlife and degrade the value for wildlife that enters the Reservoir area. Nonetheless common and sensitive wildlife were detected at or near the Study Area. Appendix C provides a list of all the wildlife detected in the project area.

Invertebrates

Habitat conditions in the Study Area provide a suite of microhabitat conditions for a wide variety of terrestrial and aquatic insects, crustaceans, and other invertebrates. This includes swift running portions of Littlerock Creek with cobble and rocks, thick leaf litter, and pools of slow-moving or still water. Like in all ecological systems, invertebrates play a crucial role in a number of biological processes. They serve as the primary or secondary food source for a variety of fish, bird, reptile, and mammal predators; they provide important pollination vectors for numerous plant species; they act as efficient components in

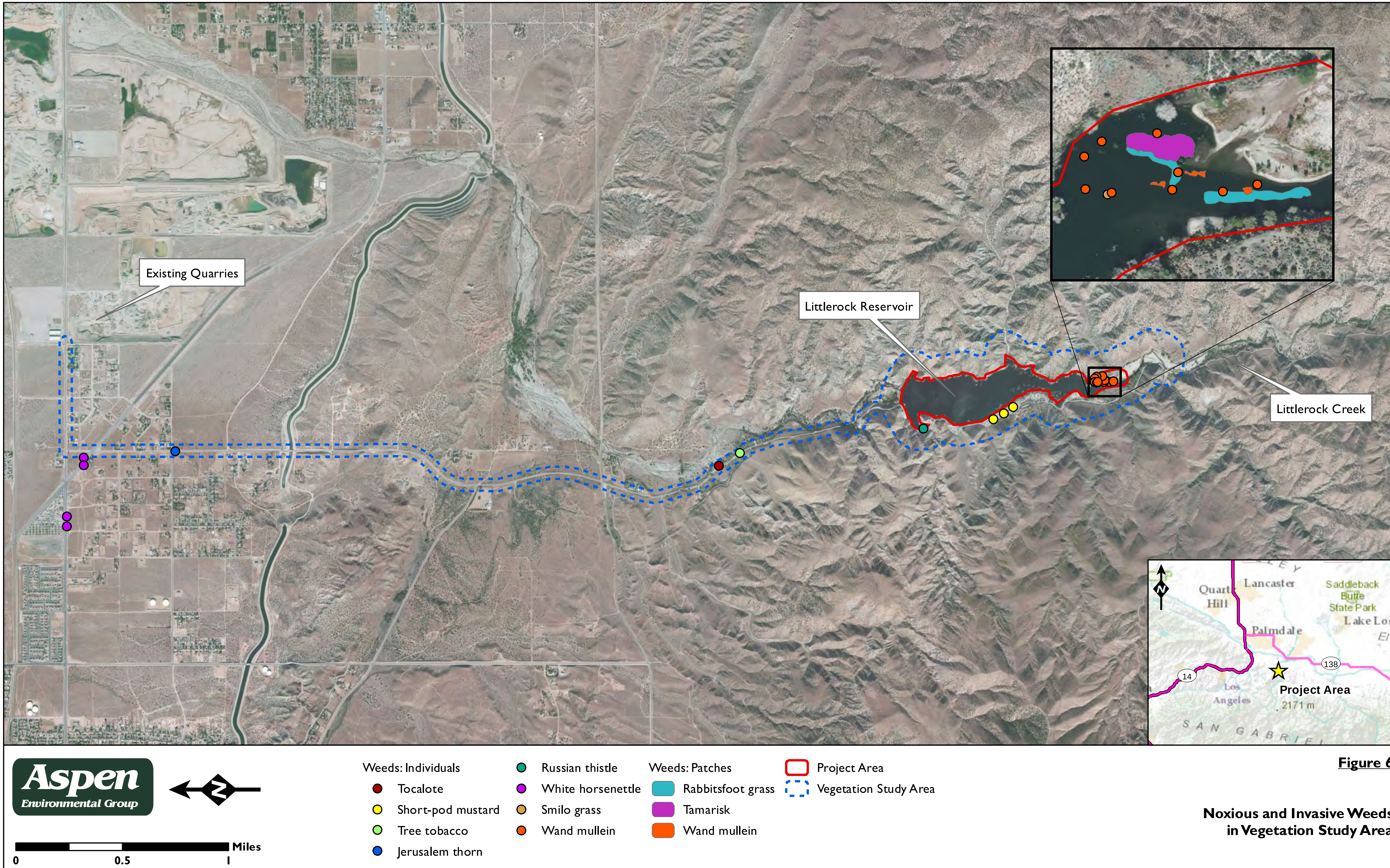
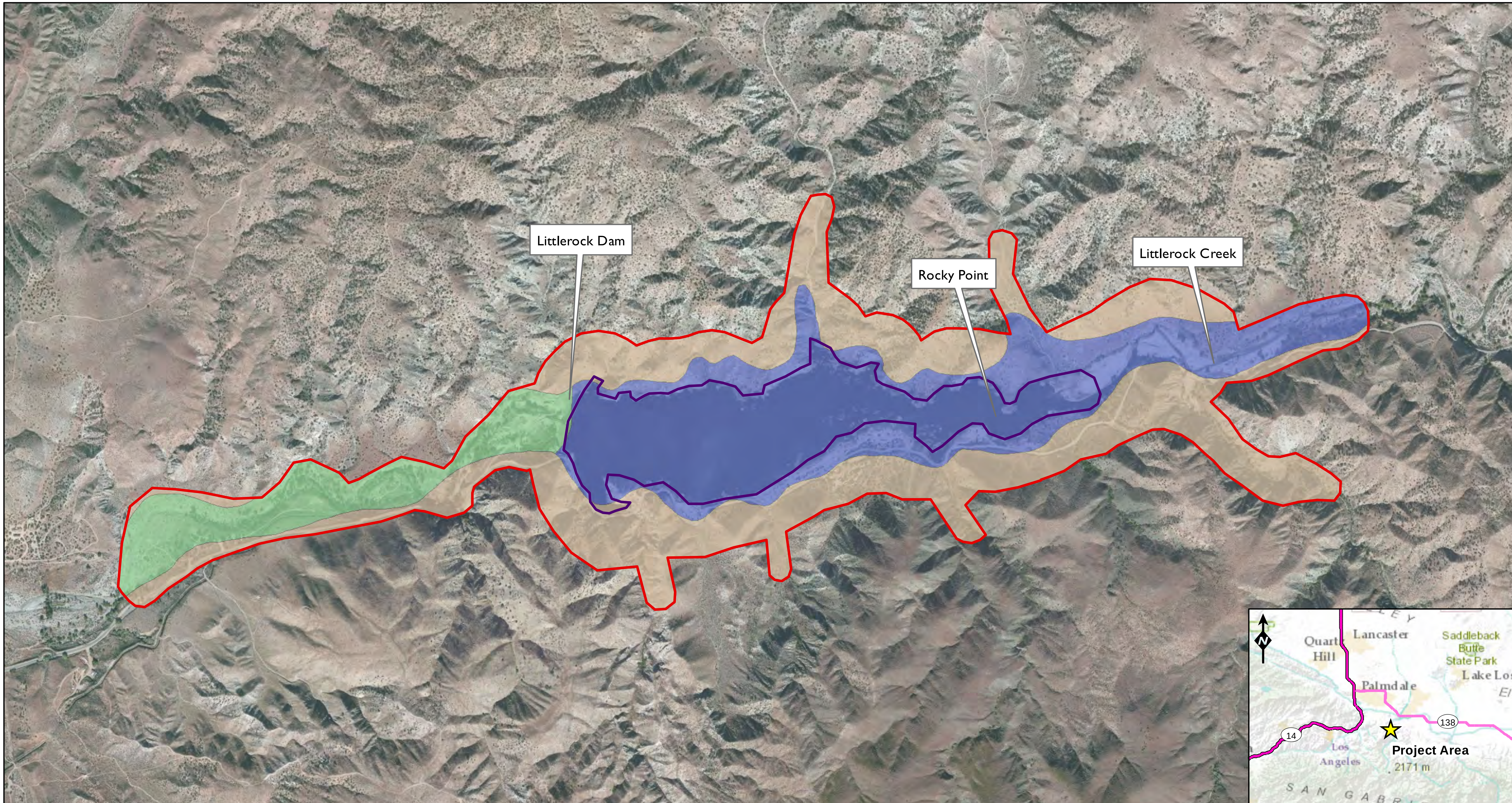


Figure 6

Noxious and Invasive Weeds in Vegetation Study Area



Aspen Environmental Group

Project Area
StudyArea

Soil Type

21 - River Wash
711 - Trigo family, dry-Lithic Xerorthents, warm complex, 50 to 80 percent slopes
766 - Water

Miles
0 0.2 0.4

Figure 7

Soils Types

controlling pest populations; and, they support the naturally occurring maintenance of an area by consuming detritus and contributing to necessary soil nutrients. General surveys of the Study Area detected a wide variety of Anisoptera (dragonflies) Zygoptera (damselflies), Hemiptera (true bugs), Coleoptera (beetles), Diptera (flies), Pleocoptera (stone flies), Lepidoptera (moths and butterflies), Hymenoptera (wasps, bees and ants), and Trichoptera (caddis flies).

Both non-native Argentine ants (*Linepithema humile*, formerly *Iridomyrmex humile*) and native harvester ants (*Pogonomyrmex californicus*) were detected in the Study Area. Harvester ants were commonly observed in upland habitats to the east and west of the Reservoir. Stream invertebrates were common and included a variety of aquatic larvae such as damselflies, dragonfly larvae, and water bugs (i.e., toe biters [family Belostomatidae]). These aggressive insects prey on other insects, small fish, and amphibians.

Fish

Flows in the lower portion of Littlerock Creek are primarily ephemeral and do not support year-round habitat for fish. The Reservoir does support perennial water that fluctuates depending on annual rainfall and water releases. Habitat conditions in Littlerock Creek within the Study Area include overhanging vegetation, deep pools, and sections with short runs and riffles. Substrate conditions vary by location but Littlerock Creek contains areas supporting silty sands, gravel, cobble and boulder-dominated zones. Macro algae communities are present during portions of the year within localized areas and include duck and pond weed and mat-forming algae. The Reservoir, when full, is approximately 100 feet deep and supports an abundance of riparian tree species that provide structure used by a variety of fish species. Shallows and coves are present around portions of the Reservoir and provide habitat for species tolerant of warmer waters (i.e., Sunfish). Reservoir and creek temperatures vary by season and are a function of depth, location, and snow pack in the upper watershed.

Native fish were not detected during the surveys. Bluegill (*Lepomis macrochirus*) and largemouth bass (*Micropterus salmoides*) were the most common non-native species detected and were found to occur in the Reservoir and portions of Littlerock creek above Rocky Point. Rainbow trout (*Oncorhyncus mykiss*) and brown trout (*Salmo trutta*) are known to occur in the Reservoir and the Littlerock Creek Watershed. However, due to potential negative effects on arroyo toad populations, a court order in 2009 required the cessation of all CDFG stocking activities at the Reservoir. As with many reservoirs/streams in California, a variety of nonnative and/or invasive fish were routinely detected during the surveys. Although not detected during the surveys the watershed is known to support other exotic species including green sunfish (*Lepomis cyanellus*), pumpkinseed sunfish (*Lepomis gibbosus*), common carp (*Cyprinus carpio*), channel catfish (*Ictalurus punctatus*), and bullhead (*Ameiurus* Sp.).

Amphibians

Amphibians often require a source of standing or flowing water to complete their life cycle. However, some terrestrial species can survive in drier areas by remaining in moist environments found beneath leaf litter and fallen logs, or by burrowing into the soil. Conditions within the Study Area generally provide year-round habitat for a variety of amphibian species. When flowing, Littlerock Creek can provide small pools, shallow rills and runs, and deep wide slow-moving water supporting several native and nonnative species. The southern extents of the Reservoir provide a year-round water source within coves and shallows that are capable of supporting amphibian species. However, the presence of predatory fish likely decreases the numbers of amphibians that occur along the margins of the lake. Additionally, small pools and/or depressions located on the west side of the main access road were found to support breeding populations of amphibians. Observations of amphibians were also recorded along the western edges of the main entrance road to the recreational area below the dam.

Adjacent upland habitat and existing riparian vegetation provide ample foraging opportunities. Amphibians that were observed during surveys include the California tree frog (*Pseudacris cadaverina*), Baja California chorus frog (*Pseudacris hypochondriaca*), and the nonnative bullfrog (*Lithobates catesbeiana*). Western (California) toad (*Anaxyrus boreas* [*halophilus*]) adults and egg masses were also observed. Upland areas adjacent to the Reservoir have the potential to support populations of western spadefoot toad (*Spea hammondii*). Although not detected in the Study Area, both newts and salamanders are well documented in the region. These species are highly cryptic and often difficult to detect. Downed logs, bark, and other woody material in various stages of decay (often referred to as coarse woody debris) provide shelter and feeding sites for a variety of wildlife, including amphibians and reptiles (Maser and Trappe, 1984; Aubry et al., 1988). Within the Study Area these features are generally found within the Reservoir itself or the Littlerock Creek channel. Many amphibians are often excluded by exotic fish and amphibian species which are common within the Study Area.

Reptiles

The number and type of reptile species that may occur at a given site is related to a number of biotic and abiotic features. These include the diversity of plant communities, substrate, soil type, and presence of refugia such as rock piles, boulders, and native debris. Reptiles were commonly observed in the Study Area, in both disturbed and natural areas. Western fence lizard (*Sceloporus occidentalis*), desert spiny lizard (*Sceloporus magister*), sagebrush lizard (*Sceloporus graciosus*), southern alligator lizard (*elgaria multicarinata*), and side blotch lizard (*Uta stansburiana*) were observed whenever weather conditions were favorable and were broadly distributed within the uplands and along the edge of riparian habitats.

The Study Area also supports a variety of snakes. Southwestern threadsnake (*Rena humilis humilis*), San Diego gopher snake (*Pituophis catenifer annectens*), San Diego nightsnake (*Hypsiglena ochrorhyncha klauberi*), patch-nosed snake (*Salvadora hexalepis*), striped racer (*Masticophis lateralis*), red racer (*Coluber flagellum piceus*), California lyersnake (*Trimorphodon lyrophanes*), long-nosed snake (*Rhinocheilus lecontei*), ring-neck snake (*Diadophis punctatus*), California kingsnake (*Lampropeltis getula californiae*), and Southern pacific rattlesnake (*Crotalus helleri*) were observed within the Study Area.

Although not observed, several other common reptiles likely occur in the Study Area. Most reptile species, even if present in an area, are difficult to detect because they are cryptic and their life history characteristics (i.e., foraging and thermoregulatory behavior) limit their ability to be observed during most surveys. Further, many species are only active within relatively narrow thermal limits, avoiding both cold and hot conditions, and most take refuge in microhabitats that are not directly visible to the casual observer, such as rodent burrows, in crevices, under rocks and boards, and in dense vegetation where they are protected from unsuitable environmental conditions and predators (USACE and CDFG, 2010). In some cases they are only observed when flushed from their refugia.

Desert tortoise (*Gopherus agassizii*), although not detected nor expected to occur within the Study Area, may occur along portions of the preferred haul route and pockets of suitable habitat were observed (refer to Figure 4b). Suitability mapping for desert tortoise in the vicinity of the haul route ranges from moderate to high moving in a northerly direction along Chesebro Road from the entrance to the Reservoir (refer to Figure 8).

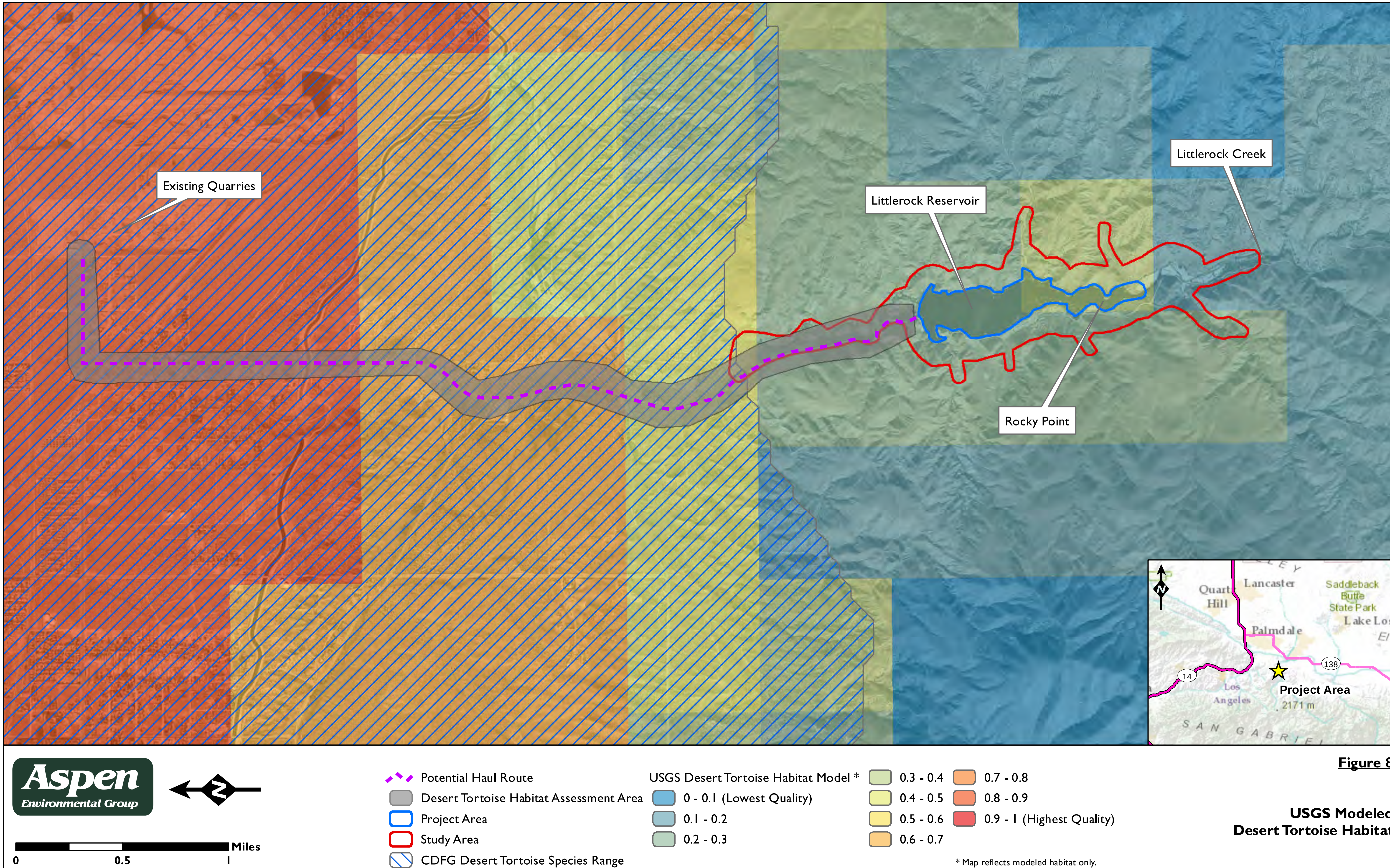


Figure 8

USGS Modeled Desert Tortoise Habitat

Birds

Eighty-five species of common and sensitive birds were identified in the Study Area during surveys completed between 2010 and 2012. It is possible that many other birds use the site either as wintering habitat, seasonal breeding, or as occasional migrants. Special-status species are further discussed in Section 4.4.

The diversity of birds at this location is a function of the presence of perennial water and the wide variation in plant communities that provide habitat for a number of different groups of birds. For example, shore birds and other more aquatic species were commonly detected within the Reservoir and along Littlerock Creek. In a few locations both upstream of the Reservoir and downstream of the dam the presence of small rock weirs have resulted in the formation of large pools where shore birds and ducks prey on insects and/or small fish. Mallard duck (*Anas platyrhynchos*), American coot (*Fulica americana*), green heron (*Butoroides virescens*), and ruddy duck (*Oxyura jamaicensis*) were commonly observed, often feeding, within the surveyed areas. Great blue heron (*Ardea Herodias*), a CDFG Special Animal, was also observed within the Study Area.

Various common song birds were detected within the Study Area and were closely associated or dependent on the riparian vegetation that borders portions of the Reservoir and is present along the Littlerock Creek Channel downstream of the dam structure. Riparian systems are frequently considered one of the most productive forms of wildlife habitat in North America. Many bird species are wholly, or at least partially, dependent on riparian plant communities for breeding and foraging (Warner et.al., 1984). Some of the detected species included song sparrow (*Melospiza melodia*), ash-throated flycatcher (*Myiarchus cinerascens*), Bewick's wren (*Thryomanes bewickii*), cliff swallow (*Petrochelidon pyrrhonota*), house finch (*Carpodacus mexicanus*), yellow-rumped warbler (*Setophaga coronata*), warbling vireo (*Vireo gilvus*), and lesser goldfinch (*Carduelis psaltria*).

Bird use of the upland areas east and west of the Reservoir and adjacent to Littlerock Creek was common and included a variety of song birds, raptors, vultures, and game birds. Western king bird (*Tyrranus verticalis*), spotted towhee (*Pipilo maculatus*), oak titmouse (*Baeolophus inornatus*), mourning dove (*Zenaida macroura*), and California quail (*Callipepla californica*), were fairly common. Rock wren (*Salpinctes obsoletus*), California towhee (*Melozone crissalis*), and mountain quail (*Oreortyx pictus*) were also observed. Common ravens (*Corvus corax*) were observed nesting in several locations along the nearly vertical rock faces of the northeastern perimeter of the Reservoir. Several lesser nighthawk (*Chordeiles acutipennis*), a ground nesting species, were detected near the Reservoir and in Littlerock Creek above and below the dam.

Several raptors including red-tailed hawk (*Buteo jamicensis*), great horned owl (*Bubo virginianus*), western screech owl (*Otus kennicottii*), and American kestrel (*Falco sparverius*) were observed either soaring over the site (red-tailed hawks) or foraging for small birds in the Study Area (great horned owl and kestrel).

Although not detected during surveys described in this report, a review of available online eBird (Cornell, 2012) data (includes observations by C. Yorke) reports observations of northern shoveler (*Anas clypeata*), Say's phoebe (*Sayornis saya*), western bluebird (*Sialia mexicana*), double-crested cormorant (*Phalacrocorax auritus*), red-breasted sapsucker (*Sphyrapicus ruber*), ladder-backed woodpecker (*Picoides scalaris*), ruby-crowned kinglet (*Regulus calendula*), hermit thrush (*Catharus guttatus*), and white-crowned sparrow (*Zonotrichia leucophrys*) at the Reservoir. Cooper's hawk (*Accipiter cooperii*), a

CDFG Watch List species, was also reported at the Reservoir from eBird data. All special-status birds are discussed further in Section 5.4.

Mammals

The distribution of mammals in the Study Area is associated with the presence of such factors as access to perennial water, topographical and structural components (i.e., rock piles, vegetation, and stream terraces) that provide for cover and support prey base; and the presence of suitable soils for fossorial mammals (i.e., sandy areas in the upper portions of the Reservoir when water levels are low).

Small mammals or their sign were commonly observed during most of the surveys. These included California ground squirrel (*Spermophilus beecheyi*), desert shrew (*Notiosorex crawfordi*), California vole (*Microtus californicus*), deer mouse (*Peromyscus maniculatus*), Botta's pocket gopher (*Thomomys bottae*), black-tailed jackrabbit (*Lepus californicus*), and desert cottontail (*Sylvilagus audubonii*).

Mid-size mammals including raccoon (*Procyon lotor*), long-tailed weasel (*Mustela frenata*), bobcat (*Felis rufus*), mountain lion (*Puma concolor*), mule deer (*Odocoileus hemionus*), gray fox (*Urocyon cinereoargenteus*), and coyote (*Canis latrans*) were detected. While not deteceted during surveys striped skunk (*Mephitis mephitis*) have the potential to occur within the Study Area. Because Littlerock and Santiago Creeks provide a large continuous corridor through the Angeles National Forest, far-ranging species like black bear (*Ursus americanus*) appear to frequent the Study Area.

Bats were commonly detected in the Study Area and forage over most of the Study Area where prey species such as small insects, moths, and other invertebrates occur. Many bats tend to concentrate foraging activities in riparian and wetland habitats where insect abundance is high (CDFG, 2000). Common bats detected in the Study Area, using both visual searches (utilizing a Echo Meter EM3) and a Sonobat system, included the canyon bat (*Parastrellus hesperus*), greater bonneted bat (*Eumops perotis*), Mexican free-tailed bat (*Tadarida brasiliensis*), and big brown bat (*Eptesicus fuscus*). Special-status bats (discussed further in Section 4.4 below) detected within the Study Area include pallid bat (*Antrozous pallidus*), Yuma myotis (*Myotis yumanensis*), and western small-footed myotis (*Myotis ciliolabrum*). Although not detected, it is likely that fringed myotis (*Myotis thysanodes*) and long-legged myotis (*Myotis volans*) occur within or adjacent to the Study Area.

4. Sensitive Vegetation Communities and Habitat

Sensitive vegetation communities are defined by CDFG as those "...communities that are of limited distribution statewide or within a county or region and are often vulnerable to environmental effects of projects" (2009). The literature review and vegetation mapping determined that two sensitive vegetation communities, southern cottonwood-willow riparian forest and Mojave riparian forest, are known to occur within or in the vicinity of the Vegetation Study Area (CDFG, 2012). Subsequent field surveys determined that areas mapped within the Vegetation Study Area as Fremont cottonwood forest, using the Sawyer, Keeler-Wolf vegetation classification system, (Figure 9) generally meets the habitat requirements of southern cottonwood-willow riparian forest and Mojave riparian forest.

Designated Critical Habitat

Literature review conducted prior to conducting field surveys determined that designated and/or mapped critical habitat occurs within the Study Area for the arroyo toad (USFWS, 2011). The most recent critical habitat was designated on February 9, 2011 and is part of the Littlerock Creek Basin which is designated as Unit 21 (50 CFR Part 17). Refer to Figure 9 for a graphical depiction of the arroyo toad critical habitat within the Study Area.

5. Special-Status Species

The information presented above, combined with field observations taken during recent surveys conducted by Aspen was used to generate a list of sensitive vegetation communities and special-status plant and animal taxa that either occur or may have the potential to occur within the Study Area and/or adjacent habitats. For the purposes of this report, special-status taxa are defined as plants or animals that:

- Have been designated as either rare, threatened, or endangered by CDFG or the USFWS, and are protected under either the California or Federal ESAs;
- Are candidate species being considered or proposed for listing under these same acts;
- Are considered Species of Special Concern by the CDFG;
- Are ranked as CRPR 1, 2, 3 or 4 plant species;
- Are listed as Forest Sensitive Species by Angeles National Forest;
- Are fully protected by the California Fish and Game Code, Sections 3511, 4700, 5050, or 5515; or
- Are of expressed concern to resource/regulatory agencies, or local jurisdictions.

5.1 Special-Status Plants

Table 5-1 lists special-status plants, including federally and State listed, CRPR 1 – 4, and Forest Service Sensitive Species that may occur in or near the Study Area. A record search using the CNDDB, the CNPS Online Inventory, and the Consortium of California Herbaria (CCH) was performed for special-status plant taxa and botanical surveys were conducted within the Study Area. Figure 10 illustrates the known locations of special-status plants occurring in or near the Study Area (CDFG, 2012). The record search and consultation with local experts identified a total of 24 special-status plant taxa that have been documented within the general region of the Study Area. Each of these taxa was assessed for its potential to occur within the study area based on the following criteria:

- Present: Taxa were observed within the Study Area during recent botanical surveys or population has been acknowledged by CDFG, USFWS, or local experts.
- High: Both a documented recent record (within 10 years) exists of the taxa within the Study Area or immediate vicinity (approximately 5 miles) and the environmental conditions (including soil type) associated with taxa present within the Study Area.
- Moderate: Both a documented recent record (within 10 years) exists of the taxa within the Study Area or the immediate vicinity (approximately 5 miles) and the environmental conditions associated with taxa presence are marginal and/or limited within the Study Area or the Study Area is located within the known current distribution of the taxa and the environmental conditions (including soil type) associated with taxa presence occur within the Study Area.
- Low: A historical record (over 10 years) exists of the taxa within the Study Area or general vicinity (approximately 10 miles) and the environmental conditions (including soil type) associated with taxa presence are marginal and/or limited within the Study Area.

Three special-status plants, Johnston's monkeyflower (*Mimulus johnstoni*), short-joint beavertail (*Opuntia basilaris var. brachyclada*), and Lemmon's syntrichopappus (*Syntrichopappus lemmonii*) were detected within the Vegetation Study Area during the botanical surveys conducted from 2010 – 2012; however, it should be noted that all occurrences of these species were outside of the Project Area. Based on an evaluation of current habitat conditions and the results of surveys in the Vegetation Study Area, Table 5-1 presents an assessment for occurrence potential for the remaining 21 taxa known from the general region. Species accounts for taxa that are present are located in Section 4.3.1. Those species having a low, moderate or high potential or are unlikely to occur are discussed further in Appendix D.

Plants Documented to Occur

Johnston's monkeyflower (Mimulus johnstoni)

Status: Johnston's monkeyflower has a CRPR 4.3. This species is not federally or State listed as threatened or endangered.

General Distribution: Endemic to California, Johnston's monkeyflower is known only from the San Gabriel and San Bernardino Mountains, at elevations of 4,000 to 7,000 feet.

Distribution in the Study Area: This species has been observed within the Vegetation Study Area, just downstream of Littlerock Dam on a steep sandy slope, but has not been observed within the Project Area.

Habitat and Habitat Associations: Johnston's monkeyflower occurs on gravelly, disturbed, or rocky slopes within Joshua tree woodland, lower and upper montane coniferous forest, and pinyon and juniper woodland communities.

Natural History: Johnston's monkeyflower is an annual herb that blooms from May through August.

Threats: This species may be threatened by recreational activities and development.

Short-joint beavertail (Opuntia basilaris var. brachyclada)

Status: Short-jointed beavertail has a CRPR 1B.2 and is designated as a U.S. Forest Service Sensitive species. This species is not federally or State listed as threatened or endangered.

General Distribution: It occurs along the desert-facing slopes and extends into cismontane nearby passes in Los Angeles and San Bernardino Counties, in the Liebre Mountains, San Gabriel Mountains, and western San Bernardino Mountains, roughly from the Newhall area to the Mojave Forks area. Its elevational range is approximately 1,400 to 6,500 feet.

Distribution in the Study Area: This variety was observed at two locations within the Vegetation Study Area just outside of the Project Area.

Habitat and Habitat Associations: Short-tailed beavertail is generally found in desert shrub lands, pinyon or juniper woodlands, Joshua tree woodlands, or desert transition chaparral.

Natural History: Short-jointed beavertail is a low cactus with grayish green stems and no spines or tubercles. It is a variety of the common beavertail cactus (*O. basilaris*), distinguished by the stem joints which are relatively short and conspicuously cylindrical rather than flattened. Short-jointed beavertail generally flowers in May or June, but can be identified year-around by its stem shape.

Threats: This species is threatened by urbanization, mining, horticultural collecting, grazing, and vehicles (CNPS, 2012).

Lemmon's syntrichopappus (Syntrichopappus lemmonii)

Status: Lemmon's syntrichopappus has a CRPR 4.3, and is a U.S. Forest Service Watch List species. This species is not federally or State listed as threatened or endangered.

General Distribution: Lemmon's syntrichopappus occurs in Kern, Los Angeles, Monterey, Riverside, and San Bernardino counties within an elevation range of 1,640 to 6,000 ft.

Distribution in the Study Area: This species was detected within the Vegetation Study Area, just downstream of the dam. It was growing on a steep talus slope adjacent to the haul road. It was not detected within the Project Area.

Habitat and Habitat Associations: Chaparral, Joshua tree woodland, and pinyon and juniper woodlands within sandy or gravelly soils.

Natural History: Lemmon's syntrichopappus is an annual herb in the sunflower family (Asteraceae) that blooms in April and May.

Threats: Possible threats include non-native plants, vehicles, and wind energy development (CNPS, 2012).

Table 5-1. Known and Potential Occurrence of Special-Status Plant Taxa within the Study Area

Name	Status	Habitat	Potential for Occurrence
Federal or State Endangered or Threatened Species			
Chorizanthe parryi var. fernandina San Fernando Valley spineflower	CRPR 1B.1, SE, FC, FSS	Sandy places, gen in coastal or desert shrublands; historically from San Fernando Valley, adjacent foothills, and coastal Orange Co.; now known only in E Ventura & W LA Cos; Elev. 490-4,000 ft.; May-June.	Low: The project area is outside of the historic range of the species. Suitable habitat is, however, present.
Forest Service Sensitive and CRPR Species			
Androsace elongata ssp. acuta California androsace	CRPR 4.2, FSW	Coastal scrub, chaparral, cismontane woodland, meadows and seeps, and valley and foothill grassland habitats. Elev. 492 to 3,936 ft. March to June.	Moderate: There are several populations on the foothill desert slopes of the San Gabriel and Liebre Mountains. Suitable habitat is present.
Anomobryum julaceum Slender silver moss	CRPR 2.2	Non-vascular moss that grows on mesic soils and rocks along creeks in broadleaf and coniferous forests. Elev. 300 to 3,000 ft. Year-around.	Low: This species is represented in southern California from a single collection made from the high elevations of the San Gabriel Mtns. Suitable habitat is present in the project area.
Arctostaphylos gabrielensis San Gabriel manzanita	CRPR 1B.2, FSS	Large shrub that grows on rocky chaparral habitats; endemic to San Gabriel Mtns near Mill Creek Summit, Elev .5,000 ft.; March.	Low: This species is known from the upper watershed but the project area is below the elevation range for this species. It has a low potential to disperse into the project area from the upper watershed.
Calochortus palmeri var. palmeri Palmer's mariposa lily	CRPR 1B.2, FSS	Wet meadows and seeps in lower montane coniferous forest and chaparral habitats. Elev. 3,281-7,841 ft. May-July.	Moderate: This species was not observed during recent surveys but is known from the general area.

Name	Status	Habitat	Potential for Occurrence
Calochortus plummerae Plummer's mariposa lily	CRPR 1B.2, FSS	Granitic rock outcrops or rocky soils of granitic origin, in lower montane coniferous forest, cismontane woodland, coastal scrub, valley and foothill grassland, and chaparral habitats. Elev. 328-5,577 ft. May-July	Low: The project is just outside of the known geographic range for this species but suitable habitat is present within the project area.
Calochortus striatus Alkali mariposa lily	CRPR 1B.2, FSS	Alkaline soils, in floodplains and springs in chaparral, chenopod scrub, and Mojavean desert scrub. Elev. 230-5,232 ft. April-June.	Low*: The species is known from alkaline soils in the Mojave Desert. Poor quality habitat was observed at the northern end of the haul roads but it is not expected in the project area.
Calystegia piersonii Pierson's morning-glory	CRPR 4.2	Shrublands and lower elev. forests; below about 5000 ft. elev.; northern San Gabriel Mts., Liebre Mts., and adjacent Mojave Desert. May-June.	Moderate: This species was not observed during recent surveys but is known from the general area.
Canbya candida Pygmy poppy	CRPR 4.2, FSS	Joshua tree woodland, Mojavean desert scrub, or pinyon and juniper woodland habitats with gravelly, granitic, or sandy soils. Elev. 1,968-4,790 ft. March-June.	High: Suitable habitat is preset within the Vegetation Study Area and numerous historic records are known from the area.
Castilleja gleasonii Mt. Gleason Indian paintbrush	CRPR 1B.2, SR, FSS	Rocky places within lower montane coniferous forest and pinyon and juniper woodland communities. Elev. 2,700-7,120. May-June.	Moderate: This species is known from higher elevation of the San Gabriel Mtns but several collections from lower elevations have been made. Suitable habitat is present.
Castilleja plagiotoma Mojave Indian paintbrush	CRPR 4.3, FSS	Great Basin scrub, Joshua tree woodland, lower montane coniferous forest, and pinyon and juniper woodland habitats. Elev. 984-8,200 ft. April-June.	High: This species was not detected during recent surveys but suitable habitat is present within the Vegetation Study Area and it is known from the general vicinity.
Imperata brevifolia California satintail	CRPR 2.1	Meadows and seeps within chaparral, coastal scrub, and Mojavean desert scrub communities. Elev. below 4,000 ft. September-May.	Low: Suitable habitat is present within the Vegetation Study Area but it was not detected during recent surveys and is not known from the area.
Lilium humboldtii ssp. ocellatum Ocellated Humboldt lily	CRPR 4.2, FSW	Riparian woodland openings within chaparral, cismontane woodland, coastal scrub, and lower montane coniferous forest communities; generally on gravelly soils within gullies. Elev. below 6,000 ft. March-July.	Low: This species is known from deep shaded canyons throughout the San Gabriel Mtns but it was not detected during recent surveys and is not known from the area.
Lilium parryi Lemon lily	CRPR 1B.2, FSS	Meadows and seeps within lower and upper montane coniferous forests communities. Elev. 4,000-9,000 ft. July-August.	Low: Known from the upper reaches of the drainage but the project area is below the elevation range for this species and the project area lacks suitable habitats.
Linanthus concinnus San Gabriel linanthus	CRPR 1B.2, FSS	Dry rocky slopes within chaparral and montane coniferous forest communities. Elev. 5,000-9,200 ft. May-July.	Unlikely: Known from higher elevation areas of the San Gabriel Mtns, the project area is well below the elevation range of the species.
Loeflingia squarrosa var. artemisiarum Sagebrush loeflingia	CRPR 2.2	Sandy soils (dunes) in Great Basin scrub and Sonoran desert scrub. Elev. 2,200-5,300 ft. April-May	Low*: The species is known from very few locations in the vicinity of alkali flats to the north of the project area. Poor quality habitat was observed at the northern end of the haul roads but it is not expected in the project area.
Lupinus peirsonii Peirson's lupine	CRPR 1B.3, FSS	Gravelly or rocky slopes within Joshua tree woodland, lower and upper montane coniferous forest, and pinyon and juniper woodland communities. Elev. 3,200-8,200 ft. April-May.	Low: This species is not known to from the project vicinity but it is known from the upper reaches of the watershed, could be present within the vegetation study area as a wash-down waif species.

Name	Status	Habitat	Potential for Occurrence
Malacothamnus davidsonii Davidson's bush-mallow	CRPR 1B.2	Chaparral, cismontane woodland, coastal scrub, and riparian woodland. Elev. 300-2,500 ft. June-January.	Low: Very few records of this species within the general vicinity of the project area.
Mimulus johnstoni Johnston's monkeyflower	CRPR 4.3	Gravelly or rocky slopes within Joshua tree woodland, lower and upper montane coniferous forest, and pinyon and juniper woodland communities. Elev. 4,000 0-6,000 ft. April-May.	Present*: Observed within the Vegetation Study Area, just downstream of Littlerock Dam on a steep sandy slope, not observed within the project area.
Nemacladus secundiflorus var. robbinsonii Robbins' nemacladus	CRPR 1B.2	Openings in chaparral and foothill grasslands; Elev. 875-4250 ft.; April-June.	Unlikely: The subspecies is known from a single locations in the San Gabriel Mtns, east of the Project Area. No suitable habitat is present.
Opuntia basilaris var. brachyclada Short-joint beavertail	CRPR 1B.2, FSS	Open chaparral, juniper woodland, or similar woodland communities. Elev. 1,394-5,900 ft. April-June.	Present: This variety was observed at two locations within the Vegetation Study Area just outside of the project area.
Oreonana vestitia Woolly mountain-parsley	CRPR 1B.3, FSS	Ridge tops and on rocky soils such as dry gravel or talus in lower and upper montane coniferous forest and subalpine coniferous forest at elevations of 6,500–11,500 feet.	Unlikely. This species is not known from the project vicinity and the project area is well below the elevation range of this species.
Orobanche valida ssp. valida Rock Creek broomrape	CRPR 1B.2, FSS	Granitic soils within chaparral and pinyon and juniper Woodland communities. Elev. 4,000-7,000 ft. May-July.	Unlikely: This species is not known from the project vicinity and the project area is below the elevation range of this species.
Stylocline masonii Mason's neststraw	CRPR 1B.1	Ephemeral annual; sandy washes, saltbush shrubland, pinyon-juniper woodland, etc., western Central Valley (Monterey Co. south to Kern Co.) and Soledad Cyn. wash in LA Co., below about 4,000 ft. elev.; March-April	Low: This species is not known from the project vicinity but suitable habitat is present.
Symphytotrichum greatae Greata's aster	CRPR 1B.3	Woodlands, chaparral, lower montane forests; around springs or mesic sites, Elev.1,000 – 6,600 ft.; San Gabriel Mts. and Liebre Mts. August-October.	Low: This species is known from the upper watershed and although the habitat in the project area is not ideal, it has some potential to occur.
Syntrichopappus lemmonii Lemmon's syntrichopappus	CRPR 4.3, FSW	Chaparral, Joshua tree woodland, and pinyon and juniper woodlands within sandy or gravelly soils. Elev. 1,640-6,004 ft. April-May.	Present*: This species was detected within the vegetation study area, just downstream of the dam. It was growing on a steep talus slope adjacent to the haul road. It was not detected within the Project Area.

SE – California-listed Endangered
ST – California-listed Threatened
SR – California-listed Rare
FSS – USDA Forest Service Sensitive Species
FSW – USDA Forest Service Watch List

CRPR 1B – Rare or endangered in California and elsewhere
CRPR 2 – Rare or endangered in California, more common elsewhere
CRPR 3 – More information needed (Review List)
CRPR 4 – Limited Distribution (Watch List)
0.1 = Seriously threatened in California (over 80% of occurrences threatened / high degree and immediacy of threat)
0.2 = Fairly threatened in California (20-80% occurrences threatened)
0.3 = Not very threatened in California (<20% of occurrences threatened or no current threats known

*= likelihood with an asterisk is based only on habitat adjacent to the haul roads and not within the project area.

5.2 Special-Status Wildlife

Special-status taxa include those listed as threatened or endangered under the federal or California Endangered Species Acts, taxa proposed for listing, Species of Special Concern, and other taxa which have been identified by the USFWS and/or CDFG, and Forest Service Sensitive species. Figure 11 illustrates the known locations of special-status wildlife occurring within or near the Study Area (CDFG, 2011a). The specific habitat requirements and the locations of known occurrences of each special-status wildlife taxa were the principal criteria used for inclusion in the list of taxa potentially occurring within the Study Area. There are currently 87 special-status wildlife taxa that have been documented within the general region of the Study Area. Each of the 87 taxa was assessed for its potential to occur within the Study Area based on the following criteria:

- Present: Taxa (or sign) were observed in the Study Area or in the same watershed (aquatic taxa only) during the most recent surveys, or a population has been acknowledged by CDFG, USFWS, or local experts.
- High: Habitat (including soils) for the taxa occurs on site and a known occurrence occurs within the Study Area or adjacent areas (within 5 miles of the site) within the past 20 years; however, these taxa were not detected during the most recent surveys.
- Moderate: Habitat (including soils) for the taxa occurs on site and a known regional record occurs within the database search, but not within 5 miles of the site or within the past 20 years; or, a known occurrence occurs within 5 miles of the site and within the past 20 years and marginal or limited amounts of habitat occurs on site; or, the taxa's range includes the geographic area and suitable habitat exists.
- Low: Limited habitat for the taxa occurs on site and no known occurrences were found within the database search and the taxa's range includes the geographic area.

A total of twenty taxa were either observed or assumed to be present within, or immediately adjacent to the Study Area. The remaining 68 taxa were determined to have a low, moderate or high potential to occur in the Study Area based on existing recorded occurrences, known geographic range, and/or the presence of suitable habitat. Table 5-2 summarizes the special-status wildlife taxa known to regionally occur and their potential for occurrence in the Study Area. Species accounts for sensitive species either observed or with the potential to occur in the Study Area are included in Appendix D. Some of the sensitive species detected in the project area are described below (see section 4.4.1 for additional information on sensitive species detected in the Study Area).

Sensitive fish or invertebrates were not detected in the Study Area. Arroyo toad (*Anaxyrus californicus*), federally listed as endangered and a CDFG Species of Special Concern, was the only sensitive amphibian detected within Littlerock Creek. This species was detected just upstream of Rocky Point and was routinely observed during the surveys.

A number of sensitive reptiles were observed in the project Study Area. A single coast horned lizard (*Phrynosoma blainvillii*), a CDFG Species of Special Concern and a Forest Sensitive Species, was observed in a sandy drainage adjacent to the main access road to the Reservoir. Coastal whiptail (*Aspidoscelis tigris*), a CDFG Special Animal, was observed along the fringes of the riparian areas just below the dam. Southwestern pond turtles (*Actinemys marmorata*) and Two-striped garter snake (*Thamnophis hammondi*), both CDFG Species of Special Concern and Forest Sensitive Species, were observed within aquatic habitat both above and below the dam.

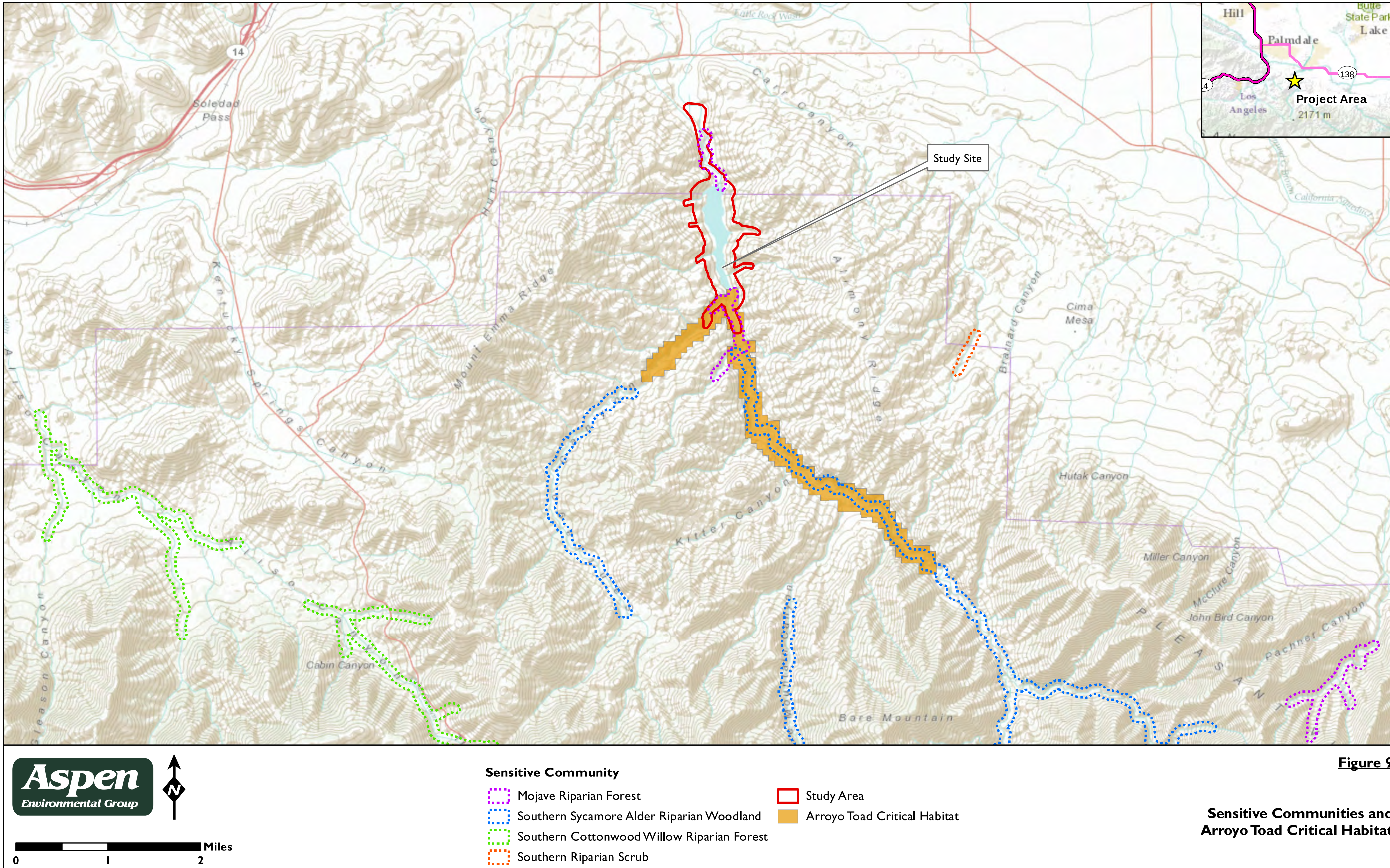


Figure 9

Sensitive Communities and Arroyo Toad Critical Habitat

Aspen Environmental Group

0 0.5 1 Miles

- Johnston's monkeyflower
- Short-joint beavertail
- Lemmon's syntrichopappus
- Project Area
- Vegetation Study Area

Figure 10

Sensitive Plants in Project Vicinity

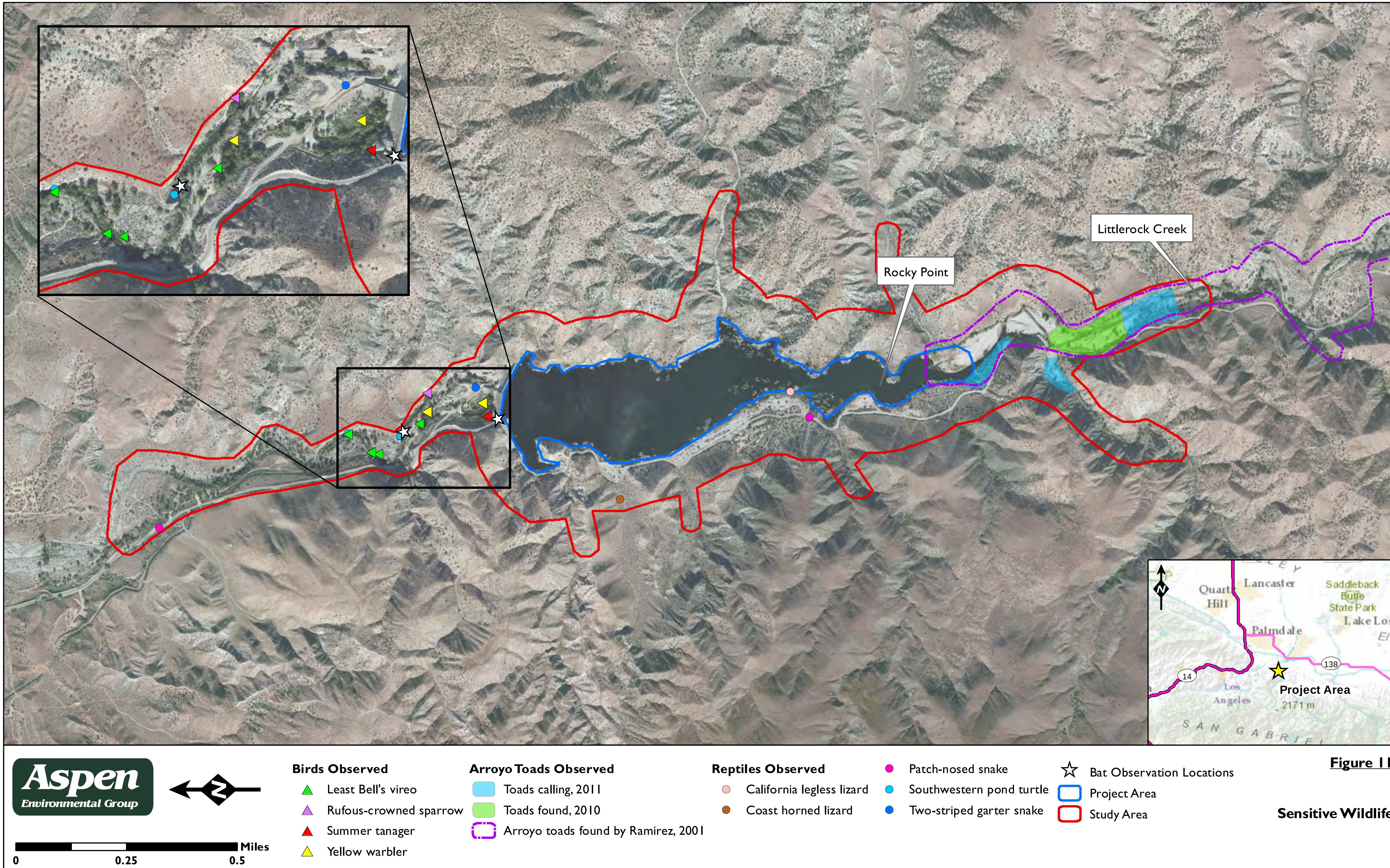


Figure 11

Sensitive Wildlife

Table 5-2. Known and Potential Occurrence of Special-Status Wildlife within the Study Area

Taxa		Status	Habitat Type	Comments	Occurrence Potential
Scientific Name	Common Name				
INVERTEBRATES					
Helminthoglypta traskii	Trask shoulderband snail	SA	Terrestrial; southern California endemic known from Ventura, Los Angeles, Orange, and San Diego Counties; prefers coastal sage scrub and chaparral.	There are no known recent records for this species in the Study Area or within a 20 mile radius of the Study Area; the Study Area is located within the known geographic distribution for this species (Magney, 2005); suitable habitat is limited within the Study Area.	Moderate
Plebulina emigdionis	San Emigdio blue butterfly	SA	Often near streambeds, washes, or alkaline areas. Associated with four-wing saltbush (*Atriplex canescens*) and quail brush (*Atriplex lentiformis*). [USACE and CDFG, 2010]	There are no known recent records for this species in the Study Area. The Study Area is located within the known geographic distribution for this species. Suitable habitat occurs within limited portions of the Study Area.	Low
FISH					
Catostomus santaanae	Santa Ana sucker	FT, CSC, FSS	Typically inhabits small, shallow streams and rivers less than 23 feet (7 meters) wide where water temperature is generally below 72 º F (22 º C), and where currents range from swift to sluggish (USFWS, 2000)	This species has not been documented within the Study Area. The presence of introduced game fish likely precludes this species presence and the Study Area is located outside of the known geographic distribution for this species. The closest known record of this species is from the Santa Clara River approximately 11 – 12 miles to the west of the Study Area.	Not likely to occur
Gasterosteus aculeatus williamsoni	Unarmored threespine stickleback	FE, SE, CFP, FSS	Slow-moving and backwater areas of coastal and inland streams.	This species has not been documented within the Study Area. The presence of introduced game fish likely precludes this species presence and the Study Area is located outside of the known geographic distribution for this species. The closest known record of this species is from the Santa Clara River approximately 12 – 13 miles to the west of the Study Area.	Not likely to occur
Gila orcuttii	Arroyo chub	CSC, FSS	Los Angeles Basin southern coastal streams; slow water stream sections with mud or sand bottoms; feeds heavily on aquatic vegetation and associated invertebrates.	There are no known recent records for this species in the Study Area. The presence of introduced game fish likely precludes this species presence and the Study Area is not located within the known geographic distribution for this species. The nearest known recorded occurrence of this species is over 15 miles to the southeast in the San Gabriel River.	Not likely to occur
Rhinicthys osculus ssp. 3	Santa Ana speckled dace	CSC, FSS	Inhabit various stream and channel types, small springs, brooks, and pools in intermittent streams and perennial rivers.	There are no known recent records for this species in the Study Area. The presence of introduced game fish likely precludes this species presence and he Study Area is not located within the known geographic distribution for this species. The closest known record of this species is from the Big Tujunga Creek approximately 13 – 15 miles to the west of the Study Area..	Not likely to occur
AMPHIBIANS					
Anaxyrus californicus	Arroyo toad	FE, CSC	Semi-arid regions near washes or intermittent streams, including valley-foothill and desert riparian, desert wash; rivers with sandy banks, willows, cottonwoods, and/or sycamores.	This species has been documented within the Study Area. More specifically, arroyo toads have been recorded from Rocky Point (at the Reservoir) and upstream within Littlerock Creek past the confluence with Santiago Creek. Arroyo toads have also been detected within Santiago Creek.	Present

Taxa		Status	Habitat Type	Comments	Occurrence Potential
Scientific Name	Common Name				
Batrachoseps gabrieli	San Gabriel Mountains slender salamander	FSS	Known only from 13 sites within forest communities of the San Gabriel Mountains. Primarily inhabits talus and large rocks, logs, and bark during periods of surface activity.	Not known to occur in Study Area but could potentially utilize Littlerock Creek and adjacent riparian areas. The Study Area is outside of the known range of this species but it is known from the portions of the San Gabriel Mountains to the south of the Study Area.	Low
Ensatina eschscholtzii croceater	Yellow-blotched salamander	CSC, FSS	Litter and debris of oak woodland, pine dominated open woodland, and fir dominated open forest.	Although suitable habitat occurs within portions of the Study Area, it is well outside the known range of this subspecies. .	Not likely to occur
Rana boylii	Foothill yellow-legged frog	CSC, FSS	Inhabits shallow, small to medium-sized, rocky streams, from sea level to about 6,365 feet.	Although suitable habitat occurs within portions of the Study Area, it is outside the known range of this subspecies. .	Not likely to occur
Rana draytonii	California red-legged frog	FT, CSC	Lowlands and foothills in or near permanent sources of deep water with dense, shrubby or emergent riparian vegetation; requires 11-20 weeks of permanent water for larval development; must have access to aestivation habitat.	Although suitable habitat occurs within portions of the Study Area, it is outside the known range of this subspecies. .	Not likely to occur
Rana muscosa	Sierra Madre (=mountain) yellow-legged frog	FE, CSC, FSS	Prefers partly shaded, shallow streams with a rocky substrate; requires a minimum of 15 weeks of permanent water for metamorphosis.	The largest known population of this species occurs within the upper portions of the Littlerock Creek watershed. Pockets of suitable habitat may occur when flows and/or pools are present within Littlerock Creek; this species has not been detected within the Study Area.	Low
Spea hammondii	Western spadefoot	CSC	Occurs in numerous habitat types, primarily in grasslands but can be found in valley-foothill hardwood woodlands, sage scrubs, chaparral where pooled/ponded water, supporting typically clay-rich soils, remains through early spring (April/May); in some areas, vernal pools, stock ponds, and road pools are essential for breeding, egg-laying, and larval development.	There are no known records for this species in the Study Area within a 15 mile radius. The Study Area is located just outside the known geographic distribution for this species. Pockets of suitable habitat occur within the Study Area.	Low
Taricha torosa torosa	Coast Range newt	CSC	Historically distributed in coastal drainages from central Mendocino County in the North Coast Ranges, south to Boulder Creek, San Diego County. Breeds in ponds, reservoirs, streams; terrestrial individuals occupy various adjacent upland habitats, including grasslands, woodlands, forests.	Suitable habitat occurs onsite. Nearest recorded occurrence is approximately 14.5 miles southeast of the Study Area in the west fork of Bear Creek.	Moderate

Taxa		Status	Habitat Type	Comments	Occurrence Potential
Scientific Name	Common Name				
REPTILES					
Anniella pulchra pulchra	Silvery (=California) legless lizard	CSC, FSS	Sandy or loose loamy soils under sparse vegetation; soil moisture is essential; prefer soils with high moisture content.	This species was detected within the Study Area under a small woodpile, adjacent to the Reservoir, during surveys conducted in 2012.	Present
Aspidoscelis tigris stejnegeri	Coastal whiptail	SA	Found in deserts and semi-arid areas with sparse vegetation and open areas; also found in woodland and riparian habitats; substrates may be firm soil, sandy, or rocky.	This species was documented within the Study Area during surveys conducted in 2012. The Study Area is located within the known geographic distribution for this species; suitable habitat occurs throughout the Study Area.	Present
Charina bottae umbratica	Southern rubber boa	ST, FSS	Occurs in conifer forests near streams and meadows. Known to occur in the Transverse Range, San Bernardino Mountains, and thought to be extirpated from the San Gabriel Mountains.	Thought to be extirpated from the San Gabriel Mountains, but focused surveys have not been conducted. Suitable habitat does not occur in the Study Area.	Not likely to occur
Charina trivirgata roseofusca	Coastal rosy boa	SA, FSS	Fairly dense vegetation and rocky habitat within desert and chaparral from the coast to Mojave and Colorado deserts.	Suitable habitat is present within the Study Area outside the perimeter of the Reservoir. This species was reported approximately 6 miles west of the Study Area in June 2009 along a transmission line corridor.	Moderate
Diadophis punctatus modestus	San Bernardino ringneck snake	FSS	Canyons with rocky outcrops or rocky talus slopes in conifer forest or chaparral habitats.	Suitable habit occurs within the Study Area; however, there are no known reports of this species within or adjacent to the Study Area.	Moderate
Emys marmorata	Western pond turtle	CSC, FSS	Inhabits permanent or nearly permanent bodies of water in various habitat types; requires basking sites such as partially submerged logs, vegetation mats, or open mud banks.	This species was observed within the Study Area (above and below the Reservoir) during surveys conducted in 2012. The Study Area is located within the known geographic distribution for this species.	Present
Gopherus agassizii	Desert tortoise	FT, ST	Inhabits semi-arid grasslands, gravelly desert washes, canyon bottoms and rocky hillsides. Associated plant species includes creosote bush, Joshua tree, cheese bush, saltbush, grasses, and cacti.	The Study Area lies outside of the known range of this species; portions of the identified haul routes however do occur within the range and have suitable habitat.	Moderate**
Lampropeltis zonata parvirubra	San Bernardino mountain kingsnake	CSC, FSS	Inhabits canyons with low to moderate tree canopy, with rock outcrops or talus, frequently in association with big cone spruce and chaparral vegetation at lower elevations.	While suitable habitat occurs within the Study Area it is outside of the known geographic distribution for this species.	Moderate
Phrynosoma coronatum blainvillii	Coast/San Diego horned lizard	CSC, FSS	A variety of habitats, including coastal sage scrub, chaparral, oak woodland, riparian woodland, and coniferous forest. Friable, sandy soils in areas with an abundant prey base of native ants are key habitat components.	This species was documented within a sandy drainage, adjacent to the main access road through the Reservoir, during surveys conducted in 2012. The Study Area is located within the known geographic distribution for this species; suitable habitat occurs in portions of the Study Area.	Present

Taxa		Status	Habitat Type	Comments	Occurrence Potential
Scientific Name	Common Name				
Thamnophis hammondii	Two-striped garter snake	CSC, FSS	Highly aquatic; found in or near permanent fresh water; often along streams with rocky beds and riparian growth.	This species was documented within the Study Area downstream of the dam and upstream of Rocky Point. Surveys conducted in 2012. The Study Area is located within the known geographic distribution for this species; suitable habitat occurs throughout the Study Area.	Present
BIRDS					
Accipiter cooperii (nesting)	Cooper's hawk	WL	Woodland, chiefly of open, interrupted, or marginal type; nest sites mainly in riparian growths of deciduous trees.	The eBird online database documents sightings of this species at the Reservoir and the CNDDB reports a historic occurrence approximately 8 miles northwest of the Study Area. These sightings however to not indicate if the individuals were foraging, passing through or nesting. Suitable habitat is present within the riparian areas of the Reservoir perimeter and Littlerock Creek.	Present (non-nesting)
Accipiter gentilis (nesting)	Northern goshawk	CSC, FSS	Nests in old-growth stands of conifer and conifer/hardwood forests.	Suitable nesting habitat for this species does not occur within the Study Area and is highly fragmented within the Angeles National Forest.	Not likely to occur
Accipiter striatus (nesting)	Sharp-shinned hawk	WL	Prefers, but not restricted to riparian habitats; breeds in ponderosa pine, black oak, riparian deciduous, mixed conifer, and Jeffrey pine habitats; requires north-facing slopes with perches.	This species was observed within the Study area during surveys conducted n 2010 as was presumed to be overwintering. No nesting activity was observed.	Present
Agelaius tricolor (nesting colony)	Tricolored blackbird	CSC, BCC	Highly colonial species; requires open water, protected nesting substrate, and foraging areas with insect prey within a few kilometers of colony.	There are no known recent records for this species in the Study Area; the Study Area is located within the known geographic range for this species; suitable breeding and foraging habitat occurs, depending on water levels, within the upper extents of the Reservoir (changes year to year). Nearest recorded occurrence is approximately seven miles northwest of the Study Area in Lake Palmdale.	Moderate
Aimophila ruficeps canescens	Southern California rufous-crowned sparrow	WL	Resident in southern California coastal sage scrub and sparse mixed chaparral; frequents relatively steep, often rocky hillsides with grass and forb patches.	This species was observed within the Study Area during surveys conducted in 2012; breeding was confirmed within the Study Area.	Present
Amphispiza belli bellie	Bell's sage sparrow	WL	Found in shrubby habitats including coastal sage scrub and chaparral, primarily of the chamise type.	There are no known records for this species in the Study Area; suitable habitat is present within the Study Area outside of the Reservoir footprint. Nearest recorded occurrence, from 2005, is approximately 13 miles northwest of the Study Area.	Moderate
Aquila chrysaetos	Golden eagle	CFP	Forages in open grasslands, desert scrub and agricultural fields. Nests on ledges on cliff faces, rock outcrops and occasionally in large trees.	There are no known records for this species within the Study Area; limited suitable nesting habitat for this species occurs within the Study Area but does occur on portions of the ANF. Suitable foraging habitat is present within Study Area.	Moderate (nesting)/High (foraging)

Taxa		Status	Habitat Type	Comments	Occurrence Potential
Scientific Name	Common Name				
Ardea herodias (rookery sites)	Great blue heron	SA	Rookery sites typically occur in groves of large trees within proximity to aquatic foraging areas of streams, wetlands, and grasslands.	This species was documented in the Study Area during surveys conducted in 2012. The Study Area is located within the known geographic distribution for this species; limited suitable rookery habitat occurs within the eastern portions of the Study Area within and adjacent to the Reservoir, suitable foraging habitat occurs throughout the Study Area.	Present (No rookery observed)
Asio flammeus (nesting)	Short-eared owl	CSC	Usually occurs in open areas with few trees, such as grasslands, prairies, dunes, meadows, agricultural fields, emergent wetlands; requires dense vegetation for cover.	There are no known recent records for this species in the Study Area; suitable habitat is not present within the Study Area. Limited suitable habitat may be present along the proposed haul routes.	Low**
Asio otus	Long-eared owl	CSC	Breeds in thickly vegetated desert washes and oases, montane coniferous forests and in riparian and pinyon-juniper woodlands. Requires adjacent open habitats for foraging.	Suitable habit occurs within the Study Area; however, there are no known reports of this species within or adjacent to the Study Area. This species is known to occur on portions of the ANF to the southwest of the Study Area	Moderate
Athene cunicularia (burrowing sites & some wintering sites)	Burrowing owl	BCC, CSC	Open, dry perennial or annual grasslands, deserts, and scrublands characterized by low-growing vegetation; subterranean nester, dependent upon burrowing mammals, particularly California ground squirrels.	There are no known records for this species in the Study Area; nearest CNDDB record for this species occurs approximately 10 miles to the northwest. While suitable habitat for this species does not occur within the Study Area it does occur along portions of the proposed haul routes.	Moderate**
Buteo regalis	Ferruginous hawk	WL	Forages in grasslands and agricultural fields.	There are no known records for this species in the Study Area; nearest CNDDB record for this species occurs approximately 10 miles to the northwest. This species is a known winter resident in the Antelope Valley. Limited foraging habitat is present within the Study Area.	Moderate
Buteo swainsoni (nesting)	Swainson's hawk	ST, BCC, FSS	Breeds in stands with few trees in juniper-sage flats, riparian areas, and oak savannahs.	Limited suitable nesting habitat is present within the Study Area; there are no known records for this species within the Study Area. This species may migrate through the Study Area during the winter.	Moderate (winter migrant)
Calypte costae	Costa's hummingbird	SA	Primarily occurs in desert wash, edges of desert riparian and valley-foothill riparian, coastal scrub, desert scrub, low-elevation chaparral.	This species was documented during surveys within the Study Area in 2012. Suitable habitat is present within the Study Area.	Present
Carduelis lawrencei (nesting)	Lawrence's goldfinch	BCC, SA	Nests in open oak or other arid woodland and chaparral near water; nearby herbaceous habitats used for foraging; closely associated with oaks.	This species was documented during surveys within the Study Area in February 2012 although the breeding status of the individuals was not confirmed.	Present
Chaetura vauxi vauxi (nesting)	Vaux's swift	CSC	Breeds in coniferous and mixed coniferous forests; requires large-diameter, hollow trees for breeding and roosting; forages in areas of open water where insect prey congregates.	This species was documented during surveys within the Study Area in May 2012 although the breeding status of the individuals was not confirmed.	Present

Taxa		Status	Habitat Type	Comments	Occurrence Potential
Scientific Name	Common Name				
Charadrius montanus	Mountain plover	FC, CSC	Winters in short grasslands and agricultural fields. Breeds in short-grass prairies outside of California.	Suitable habitat is not present within the Study Area; there are no known records for this species in the Study Area.	Not likely to occur
Circus cyaneus (nesting)	Northern harrier	CSC	Prefer open country, grasslands, steppes, wetlands, meadows, agriculture fields; roost and nest on ground in shrubby vegetation often at edge of marshes.	There are no known recent records for this species in the Study Area; the Study Area is located within the known geographic range for this species; suitable breeding and foraging habitat occurs within the Study Area.	Moderate
Coccyzus americanus occidentalis (nesting)	Western yellow-billed cuckoo	FC, SE, FSS	Nests along the broad, lower flood-bottoms of larger river systems; also nests in riparian forests and riparian jungles of willow often mixed with cottonwoods, with an understory of blackberry, nettles, or wild grape (USACE and CDFG, 2010).	There are no known records for this species in the Study Area; there are no CNDDB records for this species within a 15 mile radius of the Study Area; the Study Area is located within the known geographic distribution for this species; extremely limited breeding and foraging habitat occurs in the Study Area.	Low
Dendroica petechia brewsteri (nesting)	Yellow warbler	CSC	Riparian plant associations; prefers willows, cottonwoods, aspens, sycamores, and alders for nesting and foraging.	This species was documented within the Study Area during surveys conducted in 2012 and was noted as a potential breeding resident; the Study Area is located within the known geographic distribution for this species; suitable breeding and foraging habitat occurs in the Study Area.	Present
Elanus leucurus (nesting)	White-tailed kite	CFP	Typically nests at lower elevations in riparian trees, including oaks, willows, and cottonwoods; forages over open country.	There are no known records for this species in the Study Area or surrounding areas. The Study Area is located within the known geographic distribution for this species; limited breeding and foraging habitat occurs in the Study Area.	Low
Empidonax traillii extimus (nesting)	Southwestern willow flycatcher	FE, SE	Riparian woodlands in southern California.	There are no known records for this species in the Study Area or surrounding areas. The Study Area is located within the known geographic distribution for this species; suitable breeding habitat is not present within the Study Area as this species prefers riparian areas of greater density than are present. Suitable foraging habitat occurs throughout the Study Area.	Moderate (Migrants)
Eremophila alpestris actia	California horned lark	WL	Occurs in open habitats, forages in bare dirt in short and/or sparse grassland and areas of scattered shrubs.	There are no known records for this species in the Study Area; there are no CNDDB records for this species within a 15 mile radius of the Study Area. Limited breeding and foraging habitat occurs in the Study Area.	Low
Falco columbarius (non-breeding/ wintering)	Merlin	WL	Wide-variety of habitats including marshes, deserts, seacoasts, open woodlands, fields.	There are no known records for this species in the Study Area or surrounding areas; This species is a winter resident that does not breed in California; the Study Area is located within the known geographic winter distribution for this species; suitable foraging habitat occurs throughout the Study Area.	Moderate
Falco mexicanus (nesting)	Prairie falcon	BCC, WL	Rare in southern California; nests along cliff faces or rocky outcrops; forages over open spaces, agricultural fields.	There are no known records for this species in the Study Area. The CNDDB reports one historic occurrence approximately 10 miles to the west of the Study Area. Marginal (at best) nesting habitat occurs within the Study Area; suitable foraging habitat occurs throughout the Study Area.	Low

Taxa		Status	Habitat Type	Comments	Occurrence Potential
Scientific Name	Common Name				
Falco peregrinus anatum	American peregrine falcon	BCC, CFP	Occurs in various open habitats, especially where suitable nesting cliffs present.	There are no known recent records for this species in the Study Area; the Study Area is located within the known geographic range for this species; suitable breeding habitat does not occur within but may be present in areas adjacent to the Study Area; foraging habitat occurs throughout the Study Area.	Low
Gymnogyps californianus	California condor	FE, SE, CFP	Nests in caves, crevices, behind rock slabs, or on large ledges on high sandstone cliffs; requires vast expanses of open savannah, grasslands, and foothill chaparral with cliffs, large trees and snags for roosting and nesting.	There are no known records for this species in the Study Area although they have been observed flying over the San Gabriel Mountains. Suitable breeding and foraging habitat is not present within the Study Area.	Low
Haliaeetus leucocephalus (nesting)	Bald eagle	SE, CFP, FSS	Nests on large trees in the vicinity of large lakes, reservoirs and rivers. Wintering birds are most often found near large concentrations of waterfowl or fish.	Although not documented nesting within the Study Area this species has been observed foraging within the extents of the Reservoir during surveys conducted in 2011.	Present (non-nesting)
Icteria virens (nesting)	Yellow-breasted chat	CSC	Inhabits riparian thickets of willow and other brushy tangles near water courses; nests in low, dense riparian vegetation; nests and forages within 10 feet of ground.	There are no known recent records for this species in the Study Area; the Study Area is located within the known geographic range for this species; limited breeding and foraging habitat occurs in the Study Area.	Moderate
Lanius ludovicianus (nesting)	Loggerhead shrike	BCC, CSC	Broken woodland, savannah, pinyon-juniper woodland, Joshua tree woodland, riparian woodland, desert oases, scrub, and washes; prefers open country for hunting with perches for scanning and fairly dense shrubs and brush for nesting.	Although not documented within the Study Area an occurrence of this species is reported from the CNDDB approximately 2.5 miles east of the Study Area. Suitable foraging and breeding habitat occurs within the Study Area.	High
Numenius americanus	Long-billed curlew	WL	Generally nest in short grasses including grass prairies or agricultural fields and move to denser grasslands after young have fledged. Winter at the coast and in Mexico.	There are no known recent records for this species in the Study Area; There are a variety of eBird records for this species approximately 20 miles to the north within the Lancaster Area. Suitable habitat occurs within portions of the Study Area.	Low
Pandion haliaetus	Osprey	WL	Forages and nests along rivers, lakes, and reservoirs.	There are no known recent records for this species in the Study Area however, this generally coastal species, is known from the San Gabriel Mountains. Suitable foraging habitat occurs within and adjacent to the Reservoir.	Low
Piranga rubra	Summer tanager	CSC	Breeds in mature, desert riparian habitats dominated by cottonwood and willow.	This species was documented during surveys within the Study Area in May and July 2012 although the breeding status of the individuals was not confirmed.	Present

Taxa		Status	Habitat Type	Comments	Occurrence Potential
Scientific Name	Common Name				
Polioptila californica californica	Coastal California gnatcatcher	FT, CSC, BCC	Various sage scrub communities, often dominated by California sage and buckwheat; generally avoids nesting in areas with a slope of greater than 40%, and typically less than 820 feet in elevation (USACE and CDFG, 2010).	There are no known records for this species in the Study Area or surrounding areas; the Study Area is located within the known geographic distribution for this species. Suitable habitat for this species does not occur within the Study Area.	Not likely to occur
Pyrocephalus rubinus	Vermilion flycatcher	CSC	Nests in desert riparian and landscaped cottonwoods and other trees in developed areas including golf courses; often near agricultural or grassland areas.	There are no known recent records for this species in the Study Area; There is a 2010 eBird record for this species approximately 7 miles to the northwest at Lake Palmdale. Suitable habitat occurs within portions of the Study Area.	Moderate
Riparia riparia (nesting)	Bank swallow	ST	Colonial nester; nests primarily in riparian and other lowland habitats west of the desert; requires vertical banks/cliffs with fine-textured/sandy soils near streams, rivers, lakes, or the ocean to dig a nesting hole (USACE and CDFG, 2010).	There are no known recent records for this species in the Study Area; There are numerous eBird records for this species approximately 20 miles to the northwest near the City of Lancaster. Suitable habitat occurs within portions of the Study Area.	Low
Selasphorus sasin	Allen's hummingbird	SA	Most commonly breeds in coastal scrub, valley-foothill hardwood, and valley-foothill riparian habitats; occurs in a variety of woodland and scrub habitat as a migrant.	There are no known recent records for this species in the Study Area. There are several eBird records for this species approximately 5 miles to the northwest and 10 miles to the east. Suitable habitat occurs throughout the Study Area.	Moderate
Spinus lawrencei	Lawrence's goldfinch	SA	Breeds in a variety of habitats throughout its range in southern California, including mixed conifer-oak forest, blue oak savannah, pinyon-juniper woodland, chaparral, riparian woodland, and desert oases.	This species was observed within the Reservoir and within the southern extent of the Study Area in 2012. Suitable habitat occurs within portions of the Study Area.	Present
Strix occidentalis occidentalis	California spotted owl	CSC, BCC, FSS	In Southern California occupies montane hardwood and montane hardwood/conifer forests with dense, multi-layered canopies.	There are no known records for this species in the Study Area or surrounding areas. Suitable habitat does not occur within the Study Area.	Not likely to occur
Toxostoma bendirei	Bendire's thrasher	CSC	Prefers desert habitats with tall vegetation comprised of cholla cactus, creosote bush and yucca. Also found in juniper woodland.	There are no known recent records for this species in the Study Area; the Study Area is located outside the known geographic range for this species. Limited suitable habitat is present within the Study Area.	Not likely to occur.
Toxostoma lecontei	Le Conte's thrasher	CSC	Sparse desert scrub such as creosote bush, Joshua tree, and saltbush scrubs, or sandy-soiled cholla-dominated vegetation. Nests in dense, spiny shrubs or densely branched cactus in desert wash habitat.	There are no known records for this species in the Study Area. The CNDDB reports occurrences of this species approximately 5 miles northeast of the Study Area. Suitable habitat occurs within portions of the Study Area.	Moderate

Taxa		Status	Habitat Type	Comments	Occurrence Potential
Scientific Name	Common Name				
Vireo bellii pusillus (nesting)	Least Bell's vireo	FE, SE, BCC	Summer resident of southern California in low riparian habitats in vicinity of water or dry river bottoms; found below 2000 ft; nests placed along margins of bushes or on twigs projecting into pathways, usually willow, mesquite, baccharis.	This species was detected during surveys conducted below the dam in 2010, 2011 and 2012. Suitable habitat occurs within the northern extent of the Study Area.	Present
MAMMALS					
Antrozous pallidus	Pallid bat	CSC, FSS	Desert, grassland, shrubland, woodland, forest; most common in open, dry habitats with rocky areas for roosting; very sensitive to disturbance of roosting sites.	There are no known recent records for this species in the Study Area; the Study Area is located within the known geographic range for this species. Nearest CNDDB for this record is approximately 12 miles west of the Study Area. Suitable habitat occurs throughout the Study Area.	Present
Bassariscus astutus	Ringtail cat	CFP	Occurs in chaparral, coastal sage scrub, riparian scrub, oak woodlands, and riparian woodlands in proximity to permanent water.	There are no known recent records for this species in the Study Area; the Study Area is located within the known geographic range for this species and it is known to occur within sections of the San Gabriel Mountains. Suitable habitat is present within portions of the Study Area.	Low
Chaetodipus fallax pallidus	Pallid San Diego pocket mouse	CSC	Prefers to inhabit desert wash, desert scrub, desert succulent scrub and/or pinyon-juniper woodland.	There are no known recent records for this species in the Study Area; the Study Area is located within the known geographic range for this species. Nearest CNDDB for this record is approximately 7 miles to the southeast of the Study Area. Suitable habitat occurs within portions of the Study Area.	Low
Corynorhinus townsendii	Townsend's big-eared bat	CSC, FSS	Coastal conifer and broadleaved forests, oak and conifer woodlands, arid grasslands and deserts, and high-elevation forests and meadows. Primarily roosts in caves and abandoned mines, but may roost in buildings, bridges, rock crevices, and hollow trees in many habitat types.	There are no known recent records for this species in the Study Area; the Study Area is located within the known geographic range for this species. Roosting and foraging habitat occur within portions of the Study Area.	Moderate
Dipodomys merriami parvus	San Bernardino kangaroo rat	FE, CSC	Generally found in alluvial scrub vegetation on sandy loam substrates found in alluvial fans and/or flood plains. Needs early to intermediate seral stage vegetation. (CDFG, XX)	There are no known recent records for this species in the Study Area. The nearest CNDDB record is approximately 10 miles northeast of the Study Area. Suitable habitat is not present within the Study Area.	Not likely to occur
Euderma maculatum	Spotted bat	CSC	Occupies a wide variety of habitats from arid deserts and grasslands, to mixed conifer forests; feeds over water and along washes; needs rock crevices in cliffs or caves for roosting (USACE and CDFG, 2010).	There are no known recent records for this species in the Study Area; the Study Area is located within the known geographic range for this species; potential breeding and suitable foraging habitat occurs within portions of the Study Area.	Moderate

Taxa		Status	Habitat Type	Comments	Occurrence Potential
Scientific Name	Common Name				
Eumops perotis californicus	Western mastiff bat	CSC	Many open, semi-arid to arid habitats, including coniferous and deciduous woodland, coastal scrub, grassland, chaparral; roosts in crevices in cliff faces, high buildings, trees, tunnels.	There are no known recent records for this species in the Study Area; the Study Area is located within the known geographic range for this species; potential breeding and suitable foraging habitat occurs within portions of the Study Area.	Moderate
Lasiurus blossevillii	Western red bat	CSC, FSS	Primarily roosts in mature riparian forest but also found in upland forests, woodlands, and orchards	There are no known recent records for this species in the Study Area; the Study Area is located within the known geographic range for this species; potential breeding and suitable foraging habitat occurs within portions of the Study Area.	Moderate
Lasiurus cinereus	Hoary bat	SA	Prefers deciduous and coniferous woodlands; primarily roosts in tree foliage.	There are no known recent records for this species in the Study Area; the Study Area is located within the known geographic range for this species; potential breeding and suitable foraging habitat occurs within portions of the Study Area.	Moderate
Macrotus californicus	California leaf-nosed bat	CSC	Prefers caves, mines and rock shelters in Sonoran desert scrub.	There are no known recent records for this species in the Study Area; the Study Area is located outside the known geographic range for this species; potential breeding and suitable foraging habitat occurs within portions of the Study Area.	Low
Myotis ciliolabrum	Western small-footed myotis	SA	Occurs in a wide variety of arid upland habitats at elevations ranging from sea level to 2,700 meters (8,860 feet); day roosts include rock crevices, caves, tunnels and mines, and, sometimes, buildings and abandoned swallow nests. [CDFG, 2010]	There are no known recent records for this species in the Study Area; the Study Area is located within the known geographic range for this species; potential breeding and suitable foraging habitat occurs within portions of the Study Area.	Moderate
Myotis thysanodes	Fringed myotis	SA	Occurs in a wide variety of habitats. Optimal habitats include pinyon–juniper, valley foothill hardwood and hardwood-conifer woodlands. Forms maternity colonies and roosts in caves, mines, buildings and crevices. [USACE and CDFG, 2010]	There are no known recent records for this species in the Study Area; the Study Area is located within the known geographic range for this species; potential breeding and suitable foraging habitat occurs within portions of the Study Area.	Moderate
Myotis volans	Long-legged myotis	SA	Generally found along forest edges with good sun exposere. Breeds in tree cavities, under loose bark, rock creivces, cliffs and buildings. Forage over ponds, streams and forest clearings (Batcon, 2012).	There are no known recent records for this species in the Study Area; the Study Area is located within the known geographic range for this species; potential breeding and suitable foraging habitat occurs within portions of the Study Area.	Low
Myotis yumanensis	Yuma myotis	SA	Inhabits open forests and woodlands with sources of water. Species is closely tied to bodies of water, over which it feeds. Forms maternity colonies in caves, mines, buildings, or crevices. [USACE and CDFG, 2010]	This species was detected within the Study Area during surveys conducted in 2012. Suitable foraging and breeding habitat occurs within portions of the Study Area.	Present

Taxa		Status	Habitat Type	Comments	Occurrence Potential
Scientific Name	Common Name				
Neotamias speciosus speciosus	Lodgepole chipmunk		Occurs in isolated populations in the Southern California mountains in open-canopy forests and mixed-conifer from 6000 – 10,350 feet in elevation (SIBR, 2012)	There are no known recent records for this species in the Study Area; the Study Area is located outside the known geographic range for this species and is well below the preferred elevation of this species. The CNDDB reports a historic occurrence of this species approximately 10 miles southeast of the Study Area.	Not likely to occur
Onychomys torridus Ramona	Southern grasshopper mouse		Occurs primarily in grassland and sparse coastal sage scrub habitats.	There are no known recent records for this species in the Study Area; the Study Area is located within the known geographic range for this species; Suitable habitat occurs within limited portions of the Study Area.	Low
Ovis Canadensis nelson	Nelson's (San Gabriel Mountains) bighorn sheep	FSS	Inhabits open, rocky, steep areas with access to water and herbaceous vegetation. Populations currently managed in the Sheep management area of the San Gabriel Mountains.	This species has been observed at the Reservoir by Forest Service staff (Chris Huntley, personal communication, 10 September 2012). The Study Area is located within the known geographic distribution for this species; suitable habitat occurs within portions of the Study Area.	Present
Perognathus alticolus alticolus	White-eared pocket mouse	CSC, FSS	Known only from a series of allopatric populations in arid yellow pine communities in the vicinity of Little Bear Valley and Strawberry Peak, San Bernardino Mountains, San Bernardino County. This species is likely to be found among Sagebrush and other shrubs in open, Ponderosa Pine forests and Pinyon-Juniper woodlands and in Sagebrush covered areas on the northern slopes and Big Bear Basin of the San Bernardino Mountains.	There are no known recent records for this species in the Study Area; the Study Area is located outside the known geographic range for this species.	Not likely to occur
Perognathus longimembris brevinasus	Los Angeles pocket mouse	CSC, FSS	Found in open ground of fine sandy composition; prefers fine, sandy soils and may utilize these soil types for burrowing; may be restricted to lower elevation grassland and coastal sage scrub.	There are no known recent records for this species in the Study Area; the Study Area is located outside the known geographic range for this species.	Not likely to occur
Perognathus alticolus inexpectatus	Tehachapi pocket mouse	CSC, FSS	Occurs in a diversity of habitats including, Joshua tree woodland, pinyon-juniper woodland, oak savanna, and native and non-native grasslands. Burrows in friable, sandy soil.	There are no known recent records for this species in the Study Area; the Study Area is located outside the known geographic range for this species. This species is however known to occur on the east slopes of the San Gabriel Mountains. Suitable habitat is present within the Study Area.	Low
Spermophilus mohavensis	Mohave ground squirrel	ST	Occurs in the Mojave Desert in desert scrub and Joshua tree woodlands with winterfat (*Krascheninnikovia lanata*) and spiny hopsage (*Grayia spinosa*).	While this species has not been documented within the Study Area it is known to occur north and east of the Study Area. Although not expected to occur in the Study Area it may occur along the proposed haul routes north of the Study Area.	High**

Taxa		Status	Habitat Type	Comments	Occurrence Potential
Scientific Name	Common Name				
Taxidea taxus	American badger	CSC	Most abundant in drier open stages of most shrub, forest, and herbaceous habitats with friable soils; require sufficient food source, friable soils, and open, uncultivated ground; prey on burrowing rodents.	There are no known records for this species in the Study Area; the Study Area is located within the known geographic distribution for this species; suitable habitat occurs within portions of the Study Area.	Low

Federal Rankings:
FE = Federally Endangered
FT = Federally Threatened
FC = Federal Candidate for Listing
BCC = USFWS Bird of Conservation Concern
FSS = Forest Sensitive Species

State Rankings:
SE= State Endangered
ST = State Threatened
CFP = California Fully Protected
CPF = California Protected Fur-bearer
SA = CDFG Special Animal
WL = CDFG Watch List
CSC = California Species of Special Concern

* Although these species have the some potential to occur or are present within the Study Area they will likely be limited or occasional or sporadic use of the Project Area.

** The occurrence potential for these species is limited to the proposed haul routes only. Suitable habitat for the indicated species is not present within the Project Area.

Six special-status song birds were detected within riparian areas of the Study Area and included least Bell's vireo (*Vireo bellii pusillus*), Lawrence's goldfinch (*Spinus lawrencei*), Vaux's swift (*Chaetura vauxi*), Southern California rufous-crowned sparrow (*Aimophila ruficeps canescens*), summer tanager (*Piranga rubra cooperi*), and yellow warbler (*Setophaga petechia*). Special-status species are discussed further in Section 4.4. Several exotic species including the brown-headed cow bird (*Molothrus ater*) and European starling (*Sturnus vulgaris*) were also observed. Appendix E provides additional information on the survey results for the least Bell's vireo.

Sharp-shinned hawk (*Accipiter striatus*), a CDFG Watch List species, and bald eagle (*Haliaeetus leucocephalus*) were also observed. Bald eagles are a California Fully Protected Species and are a Forest Service Sensitive Species that appears to be a routine winter visitor to the Reservoir.

Sensitive mammals detected at the site included the pallid bat (*Antrozous pallidus*), a CDFG Species of Special Concern and Forest Sensitive Species and Yuma myotis (*M. yumanensis*), a California Special Animal. Although not observed during the surveys, Nelson's (San Gabriel Mountains) bighorn sheep (*Ovis Canadensis nelson*) have been observed at the Reservoir by Forest Service staff (Chris Huntley, personal communication, 10 September 2012).

5.2.1 Special-Status Wildlife Species Accounts

The species accounts below address all special-status species observed or determined to be present within the Study Area.

Amphibians

Arroyo Toad (Anaxyrus californicus)

Status: The arroyo toad is listed as federally endangered by the USFWS. This taxon is also a CDFG Species of Special Concern.

General Distribution: The distribution of arroyo toads historically extended from the upper Salinas River system in San Luis Obispo County south into coastal Baja California (Jennings and Hayes, 1994). Adults are primarily nocturnal and usually active between the first major rains in January and February to early August (Cunningham, 1962). After males emerge from the stream terrace over-wintering sites they precede females to breeding pools and call nightly from February or March through July (Holland and Goodman, 1998).

Distribution in the Study Area: Occurrences of this species is well documented within the Study Area (Figure 11). Most recently, arroyo toads were detected just south of Rocky Point during focused surveys conducted in 2011. The Study Area is located within the known geographic distribution for this species (CDFG, 2008). Suitable habitat occurs in the southern extent of the Study Area within the confines of Littlerock Creek, areas of Littlerock Creek upstream of the Study Area, and within nearby Santiago Creek. All areas of suitable habitat should be considered potentially occupied.

Habitat and Habitat Associations: Arroyo toads have one of the most specialized breeding habitat requirements of any amphibian in California. Adults require overflow pools adjacent to the inflow channel of streams that are generally 3rd order or greater and generally free of predators. Normally, shallow pools with sandy or gravely bottoms surrounded by little woody vegetation are preferred. Regular disturbance in the form of flooding is required to maintain areas of sparsely vegetated, sandy stream channels and terraces, which are used by adults and subadults for foraging and burrowing

(USFWS, 2001). Outside the breeding season, arroyo toads use a wide range of habitats in both upland (to a distance of at least 3,740 feet from the upland-riparian ecotone) and riparian areas (Holland and Sisk, 2001). Upland habitats used by arroyo toads include coastal sage scrub, chaparral, oak woodland, grassland, riparian, and agricultural habitats (Griffin, 1999; USFWS, 2001).

Natural History: The arroyo toad is a medium-sized toad, and adults range from 2.2 to 2.6 inches in length (USFWS, 1999). Dorsal coloration ranges from cream to light gray to light greenish-gray. Formerly considered a subspecies of the southwestern toad (*B. microscaphus*), the arroyo toad was elevated to full species status by Gergus (1998). Arroyo toads typically begin migrating to breeding sites in February or March, and migrations continue through July (Holland and Goodman, 1998). Males produce a trilling call from suitable breeding sites along the stream to attract females. When a female approaches, the male clasps the female across the abdomen (amplexus). The female arroyo toad then deposits 2,000 to 10,000 eggs in 2 long strands that are fertilized externally by the amplectic male (Sweet 1991 in Jennings and Hayes, 1994). Larvae require 65 to 85 days to complete metamorphosis (Jennings and Hayes, 1994; Holland and Goodman, 1998), at which time they are approximately 0.5 to 0.9 inches in length (Holland and Goodman, 1998). Even newly metamorphic individuals are able to burrow into loose sand. Juveniles initially remain near the natal pool until reaching a length of about 1.2 inches, when they may begin dispersing into adjacent riparian vegetation and become nocturnal (Jennings and Hayes, 1994; Holland and Goodman, 1998). Sexual maturity is typically attained in 2 years, though males can reach maturity in one year under favorable environmental conditions (Jennings and Hayes, 1994).

Jennings and Hayes (1994) stated that the arroyo toad has been extirpated from 76 percent of its total historic range in the United States (which is limited to California). They cite loss of habitat to agriculture and urbanization, changes to the hydrological regime in streams and rivers within their historic range, and predation from introduced aquatic species as significant factors in the decline of the arroyo toad. Those and other factors, such as human use and disturbance in and near aquatic habitats (e.g., campgrounds, off-road vehicle use), placer mining, and cattle grazing are threats to remaining populations (Jennings and Hayes, 1994). Additionally, fire and drought have produced severe declines in populations that are already stressed (Jennings and Hayes, 1994).

Threats: Major threats to this species include the direct loss of aquatic, riparian and upland habitat, alteration of natural flow regimes, water pollution and the introduction of exotic predators. Invasion of exotic plant species can also degrade arroyo toad habitat by altering natural flow regimes (USACE and CDFG, 2010).

Reptiles

Silvery legless lizard (Anniella pulchra)

Status: The silvery legless lizard is a CDFG Species of Special Concern. This taxon is not federally or State listed as threatened or endangered.

General Distribution: Silvery legless lizard occurs from Contra Costa County, California, south through the Coast, Transverse, and Peninsular Ranges; through parts of the San Joaquin Valley; and, along the western edge of the southern Sierra Nevada and western edge of the Mohave Desert (Jennings and Hayes, 1994). Its reported elevation range extends from sea level to approximately 5,700 feet in the Sierra Nevada foothills, but most historic localities along the central and southern California coast are below 3,500 feet (Jennings and Hayes, 1994). This fossorial species is rarely seen and it may be more abundant than it appears.

Distribution in the Study Area: This species was observed within the Study Area during surveys conducted in April 2012. An individual was observed, after a light rain, under a woodpile adjacent to the Reservoir.

The Study Area is located within the known geographic distribution for this species (CDFG, 2008). Suitable habitat occurs within limited portions of the Study Area.

Habitat and Habitat Associations: The silvery legless lizard requires sandy or loose loamy soils under sparse vegetation for burrowing and is strongly associated with soils that contain high moisture content. It has been found in beaches, chaparral, and pine-oak woodland habitat and sycamore, cottonwood, or oak riparian habitat that grows on stream terraces. It is most common in coastal dune, valley-foothill, chaparral, and coastal scrub habitats (Zeiner *et al.*, 1988).

Natural History: The silvery legless lizard is a member of the family Anniellidae, commonly known as North American legless lizards. The silvery, gray, or beige dorsal side of this subspecies is separate from the yellow ventral side by a dark mid-dorsal line (Stebbings, 2003). Little is known about specific habitat requirements for courtship and breeding (CDFG, 2008). Breeding occurs in early spring through July. The gestation period lasts for approximately four months (Jennings and Hayes, 1994). Live young are born in September, October, or occasionally as late as November, with litter size ranging from one to four, but two is most common (Stebbins, 1954). Soil moisture is essential for the subspecies and they die if they are unable to reach a moist substrate (Stephenson and Calcarone, 1999). Silvery legless lizards have a relatively low thermal preference, allowing for active behavior on cool days, early morning, and even at night during warmer periods (Bury and Balgooyen, 1976). This subspecies typically forages at the base of shrubs or other vegetation either on the surface or just below in leaf litter or sandy soils. The diet consists of insect larvae, small adult insects, and spiders (Stebbins, 1954).

Threats: The subspecies has been extirpated from approximately 20 percent of its known historical range (Lind, 1998a). Potential threats to local populations may include wildfires that destroy the desert shrub with which the subspecies is associated.

Coastal western whiptail (Aspidoscelis tigris stejnegeri)

Status: The coastal western whiptail is a CDFG Special Animal. This taxon is not federally or State listed as threatened or endangered.

General Distribution: This subspecies is found in coastal southern California, mostly west of the Peninsular Ranges and south of the Transverse Ranges. Its range extends north into Ventura County and south to Baja California.

Distribution in the Study Area: This species was documented within the Study Area during surveys conducted in 2012. The Study Area is located within the known geographic distribution for this subspecies (CDFG, 2008). Suitable habitat occurs throughout the Study Area. All areas of suitable habitat should be considered potentially occupied.

Habitat and Habitat Associations: The coastal western whiptail occurs in a variety of habitats, including valley-foothill hardwood, valley-foothill hardwood-conifer, valley-foothill riparian, mixed conifer, pine-juniper, chamise-redshank chaparral, mixed chaparral, desert scrub, desert wash, alkali scrub, and annual grasslands. This species is most commonly associated with areas of dense vegetation, but are also found around sandy areas along gravelly arroyos or washes (Stebbins, 2003).

Natural History: The coastal western whiptail is a subspecies of the western whiptail (A. tigris). Members of this species are distinctly characterized by a jerking gait and nearly constant mobility when active. The reproductive season for western whiptails generally occurs between May and August; however, this may vary depending on local conditions. It has been reported that whiptails in the southern California desert regions may atypically lay more than one clutch of eggs per year (Pianka, 1970).Whiptails forage actively on the ground hunting a wide variety of ground-dwelling invertebrates, including grasshopper, ants, beetles, termites, and spiders (Stebbins, 2003). This diet may change seasonally to reflect the abundance of prey that is available (Vitt and Ohmart, 1977). Most activities occur in the morning, except on cloudy days when activities may last throughout the day (Vitt and Ohmart, 1977).

Threats to Species: There are no identified threats to this species.

Southwestern pond turtle (Actinemys marmorata pallida)

Status: The southwestern pond turtle is a CDFG Species of Special Concern. This taxon is not federally or State listed as threatened or endangered.

General Distribution: This subspecies occurs from northwestern Baja California north through western California to the central region of the state, where it intergrades with the northwestern pond turtle (*C. m. marmorata*) (Seeliger, 1945; Bury, 1970).

Distribution in the Study Area: This subspecies was documented within aquatic habitat above and below the Reservoir during surveys conducted in 2012. The Study Area is located within the known geographic distribution for this subspecies. Suitable habitat occurs throughout the Project areas where water is present. All areas of suitable habitat should be considered potentially occupied.

Habitat and Habitat Associations: Southwestern pond turtles inhabit permanent or nearly permanent bodies of water in a wide variety of habitat types. Suitable basking sites, such as partially submerged logs, vegetation mats, or open mud banks are a required element for this subspecies.

Natural History: The southwestern pond turtle is a subspecies of western pond turtle (*C. marmorata*) which represent the only abundant native turtles in California. This species is thoroughly aquatic and is possesses a low carapace typically olive, brown, or blackish in color (Stebbins, 2003). The subspecies usually lays a clutch of 3 to 14 eggs between April and August as females may move overland up to over 300 feet to find suitable nesting sites. Nests have been observed in many soil types from sandy to very hard and soils must be at least four inches deep for nesting (CDFG, 2008). Most activity is diurnal, but some crepuscular and nocturnal behavior has been observed (CDFG, 2008). Southwestern pond turtles feed on aquatic plants, insects, worms, fish, amphibian eggs and larvae, crayfish, and carrion (Stebbins, 2003).

Threats: Western pond turtles are estimated to be in decline across 75-80 percent of their range (Stebbins, 2003). The primary reason for this decline has been attributed to loss of suitable habitat associated with urbanization, agricultural activities, and flood control and water diversion projects (Jennings *et al.*, 1992).

Coast (San Diego) horned lizard (Phrynosoma coronatum [blainvillii population])

Status: The coast (San Diego) horned lizard is a CDFG Species of Special Concern. This taxon is not federally or State listed as threatened or endangered.

General Distribution: The coast (San Diego) horned lizard's historic range extended from the Transverse Ranges in Kern, Los Angeles, Santa Barbara, and Ventura Counties south through the Peninsular Ranges of southern California and into Baja California, Mexico as far south as San Vicente; however, the current range is much more fragmented (Jennings and Hayes, 1994).

Distribution in the Study Area: This species was observed within a sandy drainage west of the Reservoir during surveys conducted in 2012. The Study Area is located within the known geographic distribution for this species (CDFG, 2008). Suitable habitat occurs within the Study Area. All areas of suitable habitat should be considered potentially occupied.

Habitat and Habitat Associations: The coast (San Diego) horned lizard occurs in a wide variety of habitats throughout its range, though is found primarily in chaparral and mixed chaparral-coastal sage scrub, to stands of pure coastal sage scrub. It is also known to occur in riparian habitats, washes, and most desert habitats. They are occasionally locally abundant in conifer-hardwood and conifer forests. This species is most common in open, sandy areas where abundant populations of native ant species (e.g., *Pogonomyrmex* and *Messer* spp.) are present.

Natural History: The coast (San Diego) horned lizard is a flat bodied lizard with a wide, oval-shaped body and scattered enlarged pointed scales on the upper body and tail. Coast (San Diego) horned lizards are oviparous and lay one clutch of 6-17 (average 11-12) eggs per year from May through early July (Jennings and Hayes, 1994). Incubation occurs for two months and hatchlings first appear in late July and early August. It is surface active primarily from April to July. This species spends a considerable amount of time basking, either with the body buried and head exposed, or with the entire body oriented to maximize exposure to the sun. Although little is known about longevity in the wild, adults are thought to live for at least eight years (Jennings and Hayes, 1994). They primarily eat native harvester ants (*Pogonmyrmex* spp.) and do not appear to eat invasive Argentine ants that have replaced native ants in much of central and southern California. This species is an opportunistic feeder, and while harvester ants can comprise upwards of 90% of their diet, they will feed on other insect species when those species are abundant (Jennings and Hayes, 1994). Defense tactics used by this species include remaining motionless to utilize its cryptic appearance, only running for the nearest cover when disturbed or touched. Captured lizards puff up with air to appear larger, and if roughly handled, will squirt blood from a sinus in each eyelid (Jennings and Hayes, 1994).

Threats: Though once common throughout much of coastal and cismontane southern California, coast (San Diego) horned lizards have disappeared from much of their former range. Their population decline is mainly attributed to habitat loss due to urbanization and agricultural conversion. The introduction of non-native Argentine ants (*Iridomyrmex humilis*), which are inedible to horned lizards and tend to displace native carpenter and harvester ants, is another factor in their decline.

Two-striped garter snake (Thamnophis hammondii)

Status: The two-striped garter snake is a CDFG Species of Special Concern. This taxon is not federally or State listed as threatened or endangered.

General Distribution: This species occurs along a continuous range from northern Monterey County south through the South Coast and Peninsular Ranges to Baja California. Isolated populations also occur through southern Baja California, Catalina Island, and desert regions along the Mojave and Whitewater Rivers in San Bernardino and Riverside Counties, respectively (Jennings and Hayes, 1994). This species typically occurs at elevations ranging between sea level and approximately 8,000 feet (Jennings and Hayes, 1994).

Distribution in the Study Area: This species was documented within aquatic habitat above and below the Reservoir during surveys conducted in 2012. The Study Area is located within the known geographic distribution for this subspecies. Suitable habitat occurs throughout the Project areas where water is present. All areas of suitable habitat should be considered potentially occupied.

Habitat and Habitat Associations: This species is primarily associated with aquatic habitats that border riparian vegetation and provide nearby basking sites (Jennings and Hayes, 1994). These areas typically include perennial and intermittent streams and ponds in a variety of vegetation communities, including chaparral, oak woodland, and forest habitats (Jennings and Hayes, 1994). During the winter, two-striped garter snakes will seek refuge in upland areas, such as adjacent grassland and coastal sage scrub (Rossman et al., 1996).

Natural History: After several taxonomic revisions, two-striped garter snake has been recognized as a separate species where it had previously been considered a subspecies of the western aquatic garter snake (T. couchii) (Rossman and Stewart, 1987). This species is usually morphologically distinguished by the lack of a mid-dorsal stripe. Two-striped garter snakes breed from late March to early April and young are typically born between late July and August; however, some have been observed as late as November (Rossman et al., 1996; Jennings and Hayes, 1994). Two-striped garter snakes hibernate during the winter months; however, they have been observed actively above ground on warm winter days (Jennings and Hayes, 1994). The mainly aquatic diet of this species consists primarily of fish, fish eggs, and tadpoles and metamorphs of toads and frogs; however, they will also consume worms and newt larvae (Jennings and Hayes, 1994).

Threats: Lind (1998b) noted that quantity and quality of habitat for two-striped garter snakes is declining throughout much of its range. More than 40 percent of this species' historic range has been lost (Jennings and Hayes, 1994). Primary factors for the decline of this species in southern California include habitat conversion and degradation resulting from urbanization, construction of reservoirs, and cement-lining of stream channels.

Birds

Cooper's hawk (Accipiter cooperii)

Status: The Cooper's hawk is a CDFG Watch List Species that was removed from the Species of Special Concern list in 2008. This taxon is not federally or State listed as threatened or endangered.

General Distribution: The Cooper's hawk is widespread, occurring throughout much of the United States, southern Canada, and northern Mexico.

Distribution in the Study Area: A review of online eBird data reports observations of this species at the Reservoir. The Study Area is located within the known geographic distribution for this species and suitable habitat occurs within portions of the Study Area. Suitable foraging habitat occurs throughout the Study Area. The Study Area is located within the known geographic year-round distribution for this species and suitable nesting habitat occurs within the portions of the Study Area. All areas of suitable habitat should be considered potentially occupied.

Habitat and Habitat Associations: The Cooper's hawk breeds in small and large deciduous, conifer, and mixed woodlands. It also nests in pine plantations and suburban and urban environments (Curtis *et al.*, 2006). In California, this species nests predominately in oaks and pines. Cooper's hawks utilize a variety of habitat types with vegetative cover and often hunt on the edges of wooded areas (Palmer, 1988).

Natural History: One of three accipiter species in California, the Cooper's hawk is a medium-sized bird adapted to woodlands. This species shows a high degree of sexual dimorphism, with females generally up to one-third larger than males. Eastern and western individuals also differ in size. The Cooper's hawk generally breeds at two years of age and older and lays 3-6 eggs from early April to late May (Rosenfield and Bielefeldt, 1993). This species feeds primarily on birds (70-80 percent of the diet) (Zeiner *et al.*, 1990a).

Threats: Habitat destruction (including logging and development), pesticide contamination, and shooting have been identified as the primary threats to the Cooper's hawk. However, breeding populations have increased in California and expanded into urban areas and populations are considered stable (Shuford and Gardali, 2008).

Sharp-shinned hawk (Accipiter striatus)

Status: The sharp-shinned hawk is a CDFG Watch List Species that was removed from the Species of Special Concern list in 2008. This taxon is not federally or State listed as threatened or endangered.

General Distribution: This species breeds from central and western Alaska and the greater portion of Canada south to central and south-central California, central Arizona, New Mexico, Texas, northern parts of the Gulf states, and into Mexico (AOU, 1998). Wintering grounds extend from the southern portions of Canada south throughout the United States and Mexico into Central America. In California, sharp-shinned hawks breed throughout the state, including the northern half of the state, and, to a lesser extent, the mountains of southern California (Small, 1994).

Distribution in the Study Area: This species was observed in the Study Area during surveys conducted in 2010. The Study Area is located within the known geographic year-round distribution for this species (CDFG, 2008). Suitable nesting habitat does occur within limited portions of the Study Area; however, suitable foraging habitat occurs throughout the Study Area. All areas of suitable foraging habitat should be considered potentially occupied.

Habitat and Habitat Associations: In California, this species typically nests in coniferous forests, often within riparian areas or on north-facing slopes (Stephenson and Calcarone, 1999). Where conifers are scarce, cottonwoods, poplars, and other tall riparian trees may be used for nest sites (Bent, 1937). Foraging habitat during the breeding season is essentially the same as that chosen for nesting. During the winter, however, males tend to hunt most frequently among hedgerows, field edges and other ecotonal habitats, while females typically hunt in extensive stands of forest or riparian areas (Meyer, 1987).

Natural History: This species is a small hawk with a pronounced size difference among males and females. Although the sexes are alike in color and pattern, the male is often substantially smaller than the female. This size difference is more evident in this species than most other hawks. The sharp-shinned hawk, which is presumed to be serially monogamous, breeds from April through August with peak breeding activity occurring between late May and July. During this period, the male exhibits undulating courtship flights teamed with high bouts of soaring and calling. Once nesting begins, the male brings food to the female and nestling until they fledge after roughly 60 days. Fledging is timed to coincide with fledging of prey birds, providing a food supply for young, inexperienced hunters (CDFG, 2008). Although small birds comprise the primary source of food, sharp-shinned hawks also take small mammals, reptiles, amphibians, and insects.

Threats: The primary threat to this species is the loss of suitable habitat as a result of large stand-replacing fires.

Southern California rufous-crowned sparrow (Aimophila ruficeps canescens)

Status: The southern California rufous-crowned sparrow is a CDFG Watch List Species that was removed from the Species of Special Concern list in 2008. This taxon is not federally or State listed as threatened or endangered.

General Distribution: Rufous-crowned sparrows are year-round residents throughout their range. Historically, four of the subspecies of rufous-crowned sparrow bred in coastal California from Mendocino County south through northwestern Baja California Norte (Thorngate and Parsons, 2005). Southern California rufous-crowned sparrows range from San Luis Obispo County south to San Diego County (Garrett and Dunn, 1981). This subspecies is increasingly restricted due to urbanization and agricultural development in Los Angeles, Orange, Riverside, San Bernardino, and San Diego Counties (Collins, 1999).

Distribution in the Study Area: This species was observed within the Study Area during surveys conducted in 2012 and was documented breeding within areas above and below the Reservoir. The Study Area is located within the known geographic year-round distribution for this species. Suitable breeding and foraging habitat occurs throughout the Study Area. All areas of suitable habitat should be considered potentially occupied.

Habitat and Habitat Associations: Southern California rufous-crowned sparrows typically breed in sparsely vegetated scrubland on hillsides and canyons between 60 and 1400 meters. This subspecies is often found in coastal sage scrub dominated by California sagebrush, but will also utilize coastal bluff scrub, low-growing serpentine chaparral, and along the edges of tall chaparral habitats (Thorngate and Parsons, 2005). Southern California rufous-crowned sparrows thrive in recently burned habitats and can be found utilizing these open areas for years (Thorngate and Parsons, 2005).

Natural History: The southern California rufous-crowned sparrow is one of five subspecies of the rufous-crowned sparrow that occur in the United States. Twelve additional subspecies occur in Mexico (Collins, 1999). This species nests on the ground and has a typical clutch size of three to four eggs (Thorngate and Parsons, 2005). Nests are well-hidden at the base of bushes, grass tussocks, or overhanging rock concealed by vegetation or rock (Thorngate and Parsons, 2005). This species forages at or near the ground in areas of dense grass or herbaceous cover, and is rarely observed foraging in the open. They glean insects from low shrubs, grasses, and herbaceous vegetation (Thorngate and Parsons, 2005).

Threats: This subspecies is extremely sensitive to edge effects and appears to avoid small fragments of habitat in favor of large tracts away from edges (Thorngate and Parsons, 2005). Southern California rufous-crowned sparrows are threatened by urbanization and agricultural conversion of habitat (Thorngate and Parsons, 2005).

Great blue heron (Ardea herodias)

Status: The great blue heron is a CDFG Special Animal. This taxon is not federally or State listed as threatened or endangered.

General Distribution: This species is fairly common all year throughout most of California. Few rookeries are found in southern California, but many are scattered throughout northern California. Knowledge of specific rookery locations is incomplete (Mallette, 1972; Belluomini, 1978; Garrett and Dunn, 1981).

Distribution in the Study Area: This species was documented below and within the Reservoir during surveys conducted in 2012. The Study Area is located within the known geographic year-round distribution for this species (CDFG, 2008). Suitable rookery habitat occurs within portions of the Study

Area and suitable foraging habitat occurs throughout the Study Area. All areas of suitable foraging and/or rookery habitat should be considered potentially occupied.

Habitat and Habitat Associations: Great blue herons are most commonly found in shallow estuaries and fresh or saline emergent wetlands. However, they also can occur along riverine and rocky marine shores, in croplands, pastures, and in mountains above foothills.

Natural History: This species is the largest and most widespread heron in North America. Great blue herons are large, grayish birds with a long “S”-shaped neck, long legs, and a long, thick bill. They are typically distinguishable by a white crown stripe surrounded by a black plume extending from behind the eye to the back of the neck. Great blue herons usually arrive to breeding ground in February and courtship and nest building begin shortly thereafter. Breeding territories are small, usually including only the nest site and immediately surrounding areas (Cottrille and Cottrille, 1958; Mock, 1976). Secluded groves of tall trees near shallow water are preferred for nesting sites. Feeding areas can occur as far as ten miles away and may be defended vigorously, especially during the non-breeding season (Palmer, 1962; Krebs, 1974; Kushlan, 1976). Although this species will occasionally eat small rodents, amphibians, reptiles, insects, and birds, its diet is dominated by fish (nearly 75%) (Cogswell, 1977). When hunting, great blue herons stand motionless, or walk slowly, in shallow water, or less commonly, open fields and grasp prey with their bill, rarely impaling the intended target. This species typically roosts in secluded, tall trees.

Threats: This species is sensitive to human disturbance near nests, and probably to pesticides and herbicides in nesting and foraging areas (Jackman and Scott, 1975).

Costa’s hummingbird (Calypte costae)

Status: The Costa’s hummingbird is a CDFG Special Animal. This taxon is not federally or State listed as threatened or endangered.

General Distribution: This species breeds in central California, southern Nevada, and southwestern Utah south to Santa Barbara Island, Baja California, and offshore islands, southern Arizona, west-central Mexico, and southwestern New Mexico. Wintering populations occur in southern California and southwestern Arizona south to Sinaloa, Mexico (Terres, 1980; AOU, 1998). Costa’s hummingbird occurs as a permanent resident in Ventura County (CDFG, 2008).

Distribution in the Study Area: This species was observed within the Study Area during surveys conducted in 2012 and breeding individuals were confirmed within areas below the Reservoir. The Study Area is located within the known geographic range for this species and suitable breeding and foraging habitat occurs throughout the Study Area. All areas of suitable habitat should be considered potentially occupied.

Habitat and Habitat Associations: Costa’s hummingbird occurs in more arid habitats than other hummingbirds of California, including desert wash, desert riparian edges, coastal scrub, desert scrub, low-elevation chaparral, and palm oases. This species most commonly occurs along canyons and washes when nesting (NatureServe, 2011).

Natural History: Costa’s hummingbird is the second smallest bird in North America, displaying an iridescent violet crown and gorget down the side of the neck and greenish sides and flanks. This species breeds from March through May in the deserts and from April through July along the coast (CDFG, 2008). As is usual in hummingbirds, all nesting activities are performed by the female. Nests are located in a wide variety of trees, cacti, shrubs, woody forbs, and sometimes vines, often in proximity to conspecific nests (Bent, 1940). Costa's hummingbird feeds on the flower nectar of various herbaceous and woody plants; however, small insects and spiders are also consumed. During the winter, exotic shrubs may become an important food source (Garrett and Dunn, 1981).

Threats: No persistent threats have been identified for this species.

Lawrence's goldfinch (Carduelis lawrencei)

Status: Lawrence's goldfinch is a CDFG Special Animal and a USFWS Bird of Conservation Concern. This taxon is not federally or State listed as threatened or endangered.

General Distribution: Lawrence's goldfinch breeds from the western foothills of the Sierra Nevada and the Coast Ranges in Shasta County south to northern Baja California. The wintering range for this species extends from the coastal slope of the Coast Ranges in southern California to northern Baja California, and from the Lower Colorado River Valley in Needles, California, and east to southern Texas, and south to Sonora, Mexico.

Distribution in the Study Area: This species was observed within the Reservoir and within the southern extent of the Study Area in 2012. The Study Area is located within the known geographic range for this species and suitable foraging habitat occurs throughout the Study Area. Suitable breeding habitat present within portions of the Study Area. All areas of suitable habitat should be considered potentially occupied.

Habitat and Habitat Associations: This species breeds in a variety of habitats throughout its range in southern California, including mixed conifer-oak forest, blue oak savannah, pinyon-juniper woodland, chaparral, riparian woodland, and desert oases (Garrett and Dunn, 1981; Lehman, 1994; Roberson and Tenney, 1993; Unitt, 1984). However, it prefers xeric open oak woodland bordering chaparral in the upper foothills. Arid, open woodlands with adjacent bushy areas, such as chaparral or tall weedy fields characterize typical nesting habitat. This species is often found nesting within proximity to foraging habitat and open water (Davis, 1999).

Natural History: This small, conspicuous songbird reaches a height of four to five inches and possesses distinctly bright yellow coloration on its breast and wing bars; however, females are much less distinct. The breeding season for this species begins as early as late May and can last into September with peak activity occurring between late April and August. Nests are typically constructed on the outer branches of trees, particularly oaks (Grinnell and Miller, 1944). Both parents continue to provision the young for five to seven days after fledging, at which time the young join the parents on foraging bouts. Lawrence's goldfinch feeds primarily on seeds of native plant species, particularly fiddleneck (*Amsinckia* spp.) during the spring months and chamise (*Adenostoma fasciculatum*), mistletoe (*Phoradendron* spp.), coffee berry (*Rhamnus californica*), and annual grasses during other seasons (Davis, 1999). Lawrence's goldfinches often form large flocks, particularly in winter. However, both males and females of this species will rigorously defend territories from conspecific intruders during the breeding season.

Threats: Recent survey data (1980-2000) indicates that there has been a substantial, but not significant, decline in populations of this species across its range. Populations in Arizona and California have been reported as significantly declining (Sauer *et al.*, 1996). However, since this species seems to be well adapted to a wide range of woodland habitats and may even thrive, to some extent, from non-intensive human disturbance that increase annual plant populations, there doesn't appear to be a significant problem with this species at this time.

Vaux's swift (Chaetura vauxi vauxi)

Status: Vaux's swift is a CDFG Species of Special Concern. This taxon is not federally or State listed as threatened or endangered.

General Distribution: This swift breeds from southwestern Canada through the western United States to Mexico, Central America and northern Venezuela. (Cornel, 2012)

Distribution in the Study Area: This species was observed within the Study area during surveys conducted in 2012. The Study Area is located within the known geographic range for this species and suitable foraging habitat occurs throughout the Study Area. Suitable breeding habitat is present within the Study Area. All areas of suitable habitat should be considered potentially occupied.

Habitat and Habitat Associations: Hollow trees are this species favored nesting and roosting sites (Cornel, 2012).

Natural History: Found to be the smallest swift in North America, this species constructs a nest of woven twigs held together by its own saliva (Cornel, 2012). Like most swifts this species is predominantly insectivorous and makes up to 50 trips a day for food when feeding young.

Threats: The primary threat to Vaux's swift is habitat loss.

Yellow warbler (Dendroica petechia brewsteri)

Status: The yellow warbler is a CDFG Species of Special Concern. This taxon is not federally or State listed as threatened or endangered.

General Distribution: The breeding range for yellow warblers of the yellow group of subspecies includes the Pacific coast from the northern limits of the boreal forests in Alaska and Canada south to the southern United States and northern Baja California. The winter range extends from the coasts of northern Mexico to northern South America (Lowther *et al.*, 1999). Although this species is primarily a summer resident, some small winter populations remain in the lowlands of southern California (Garrett and Dunn, 1981).

Distribution in the Study Area: This species was observed within the Study Area during surveys conducted in 2012 and breeding individuals were confirmed within areas above and below the Reservoir. The Study Area is located within the known geographic range for this species and suitable breeding and foraging habitat occurs throughout the Study Area. All areas of suitable habitat should be considered potentially occupied.

Habitat and Habitat Associations: In southern California, this species breeds in riparian woodlands situated within lowlands and canyons (Garrett and Dunn, 1981; Lehman, 1994; Roberson and Tenney, 1993; Unitt, 1984). Suitable habitat typically consists of riparian forests containing sycamores, cottonwoods, willows, and/or alders (Stephenson and Calcarone, 1999).

Natural History: There is a considerable morphological variation within the *D. petechia* species. Of the three recognized groups of subspecies, only the "yellow" group breeds in North America. The "yellow" group is further divided into nine subspecies, which are distinguished by slight differences in plumage color and patterns of breast streaking in males (Lowther *et al.*, 1999). Yellow warblers migrate annually between breeding grounds in North America and wintering grounds in the neotropics and are highly territorial on both breeding and wintering grounds (Lowther *et al.*, 1999). During migration, yellow warblers form flocks and will often join with flocks of other species, including warblers, vireos, and flycatchers. The primary diet of yellow warblers consists of arthropods, such as bees, wasps, caterpillars, flies, beetles, and true bugs, which are usually gleaned from leaf surfaces; however, this subspecies will occasionally sally to capture prey in flight. Males typically forage higher in trees than females (Lowther *et al.*, 1999).

Threats: Nest parasitism by brown-headed cowbird (*Malothrus ater*) has been implicated as a major cause to population declines of yellow warblers in southern California (Garrett and Dunn; 1981; Stephenson and Calcarone, 1999; Unitt, 1984).

Bald Eagle (Haliaeetus leucocephalus)

Status: The bald eagle is designated as a Forest Service sensitive species by the Regional Forrester.

General Distribution: The bald eagle occurs throughout most of North America. Historically, bald eagles bred throughout the mountains of coastal California. Currently, breeding populations exist on the Los Padres and San Bernardino National Forests. This species has also been documented in Ventura County at Casitas Lake. Bald eagles have not nested within or adjacent to the Angeles National Forest in Los Angeles County for at least 30 years however, a bald eagle was sighted in a riparian area on the Tejon Ranch on August 24, 1994 (Bautista and Brown, Pers. Obs.). This species are occasionally seen on or near the Santa Clara/Mojave Rivers Ranger District during the winter, but apparently none are resident birds. In the Angeles National Forest, bald eagles were observed at Littlerock Reservoir in 2007 (L. Welch, District Biologist, pers. comm.) and by Aspen in 2012. The largest wintering population of bald eagles in southern California is at Big Bear Lake in the San Bernardino Mountains. It has been successfully reintroduced as a breeding species on Santa Catalina Island after becoming extirpated from the Channel Islands in the 1950s.

Distribution in the Study Area: This species was observed within the Reservoir and the southern extent of the Study Area during surveys conducted in 2012. The Study Area is located within the known geographic range for this species and suitable foraging habitat occurs throughout the Study Area. All areas of suitable habitat should be considered potentially occupied.

Habitat and Habitat Associations: This species requires large bodies of water, or free flowing rivers with abundant fish, and adjacent snags or other perches (Zeiner et al. 1990a). Perches must be high in large, stoutly limbed trees, on snags or broken-topped trees, or on rocks near water (Zeiner et al. 1990a). Bald eagles are active diurnally and yearlong. Bald eagles are primarily fish eaters; however, they are opportunistic and will utilize avian and mammalian prey and carrion if readily available, especially in the nonbreeding season (Evans 1982; Zeiner et al. 1990a). Bald eagles swoop from hunting perches, or soaring flight, to pluck fish from water (Evans 1982; Zeiner et al. 1990a). Bald eagles roost communally in winter in dense, sheltered, remote conifer stands (Zeiner et al. 1990a). Eagle nests are characteristically large, ranging from a minimum of 3 feet in width and depth to 16 feet deep and 10 feet across; size and shape are determined partly by the supporting branches (Evans 1982). Where suitable nest trees are scarce, nests are placed on ridges, cliffs, and on sea stacks (Evans 1982). Nests are located 50-200 feet above ground, usually below tree crown (Zeiner et al. 1990a) and nests are usually located near a permanent water source (Zeiner et al. 1990a). In southern California, nesting most often occurs in large trees near water, but occasionally nests are on cliffs or the ground.

Natural History: Bald eagles are fairly common as a winter migrant at a few favored inland waters in Southern California (Zeiner et al. 1990a). Bald eagles engage in courtship flights consisting of the pair soaring together for long periods of time at great heights (Evans 1982). Occasionally they will lock talons and somersault downward several hundred feet (Evans 1982). Breeding season is February through July, but may start as early as November (Zeiner et al. 1990a). Clutch size is 1-3 (Evans 1982; Zeiner et al. 1990a)and incubation is usually 34-36 days (Evans 1982; Zeiner et al. 1990a) followed by fledging at 10-12 weeks (Evans 1982). Semi-altricial young hatch asynchronously (Zeiner et al. 1990a). Bald eagles are monogamous, and breed first at 4-5 years (Zeiner et al. 1990a). Bald eagles are considered long-lived, with the oldest living bald eagle reported near Haines, Alaska at 28 years old (Schempf 1997). In captivity, bald eagles may live 40 or more years (USDI - Fish and Wildlife Service 1999).

Occasionally raccoons, bobcats, crows, and under unusual circumstances, gulls prey on eggs and small young, forcing the adults away from the nest (Evans 1982). Organochlorine (DDE) interferes with normal calcium metabolism, resulting in thin-shelled eggs, which cannot withstand normal incubation (Evans 982). Dierldrin, PCBs, and mercury have been linked to embryonic and early chick mortality (Evans 1982). High concentrations of dieldrin and DDT are known to result in mortality of bald eagles (Evans 1982).

Threats: Illegal shooting remains the greatest single known cause source of bald eagle mortality (Evans 1982). Roughly half of all recorded bald eagle deaths are a direct result of shooting (Evans 1982). Other causes of mortality include impact injuries (usually power line or tower), electrocution, trapping injuries (eagles caught in "sight bait" sets for fur bearers), automobile or train accidents, and poisoning from contaminated coyotes or other carcasses (Evans 1982). Territories have been abandoned after disturbance from logging, recreational developments, and other human activities near nests (Zeiner et al. 1990a).

Summer Tanager (Piranga rubra)

Status: Summer tanager is a CDFG Species of Special Concern. This taxon is not federally or State listed as threatened or endangered.

General Distribution: The summer tanager is found in the eastern and southwestern United States, Central America, and South America, and regularly occurs north of Mexico. It primarily breeds in the eastern United States from New Jersey south to Florida, west to southern Illinois, and south to Texas. It also breeds in portions of New Mexico, Arizona, California, and Baja California. It winters in Central Mexico, south through Central America, and as far south as Bolivia and Brazil. (Newhall)

Distribution in the Study Area: This species was observed below the Reservoir during surveys conducted in 2012. The Study Area is located within the known geographic range for this species and suitable foraging habitat occurs throughout the Study Area. Suitable breeding habitat is present within the Study Area. All areas of suitable habitat should be considered potentially occupied.

Habitat and Habitat Associations: Western populations of summer tanagers occupy riparian woodlands dominated by willows (Salix spp.) and cottonwoods (Populus spp.) at lower elevations (Robinson 1996; Rosenberg et al. 1982, 1991) and mesquite (Prosopis spp.) and tamarisk (Tamarix spp.) habitats at higher elevations (Robinson 1996). During the winter, the summer tanager occurs in open and second-growth habitats within its range, typically below 1,200 meters (3,937 feet) AMSL (Robinson 1996). (Newhall)

Natural History: The males begin to arrive to the breeding grounds in April, slightly before the females. Nests are constructed on a large, horizontal limb of a tree within riparian vegetation, usually a cottonwood or willow tree, approximately 3 to 6 meters (10 to 20 feet) above the ground (Zeiner et al. 1990A). The nest is constructed in an open-cup shape from dried herbaceous vegetation, and is usually placed among or under leaves (Robinson 1996).

The summer tanager commonly feeds on bees and wasps, often foraging for larvae from hives and nests (Robinson 1996). It feeds on other insects, spiders, and small fruits and berries. It also captures flying insects during short sallies from a perch and gleans insects and fruits from leaf and bark surfaces of trees and shrubs (Robinson 1996).

Threats: There is little specific threat information for the summer tanager. Robinson (1996) describes habitat destruction as the largest effect of human activities on the summer tanager. In the southwest, particularly in southern California and the Colorado River valley, populations of summer tanagers have declined, due the elimination of riparian willow and cottonwood forest. Nest parasitism by brown-headed cowbirds may also be a factor contributing to declining populations.

Least Bell's vireo (Vireo bellii pusillus)

Status: The least Bell's vireo was listed as federally endangered by the USFWS on May 2, 1986 (51 FR 16474-16482). Critical habitat was designated on February 2, 1994 (59 FR 4845-4867). This taxon is also listed as State endangered and considered a USFWS Bird of Conservation Concern.

General Distribution: The least Bell's vireo was historically widespread in riparian woodlands of the Central Valley and low-elevation riverine valleys of California and northern Baja California. However, over 95 percent of historic riparian habitat has been lost throughout its former range, which may have accounted for 60 to 80 percent of the original population throughout the state of California (USFWS, 1986). The current breeding distribution for this subspecies in California is restricted to Kern, San Diego, San Bernardino, Riverside, Ventura, Los Angeles, Santa Barbara, and Imperial Counties.

Distribution in the Study Area: This species was observed within the Study Area during surveys conducted from 2010 – 2012 and breeding individuals were confirmed within areas below the Reservoir. The Study Area is located within the known geographic range for this species and suitable breeding and foraging habitat occurs within portions of the Study Area. All areas of suitable habitat should be considered potentially occupied.

Habitat and Habitat Associations: During the breeding season, least Bell's vireo is a low-elevation riparian obligate that inhabits dense, willow-dominated habitats with lush understory vegetation and in the immediate vicinity of water. Most areas that support viable populations are in early stages of succession where most woody vegetation is between five and ten years old (Franzeb, 1989; Gray and Greaves, 1984).

Natural History: The least Bell's vireo is one of four recognized subspecies of Bell's vireo (*V. bellii*) and is the western-most occurring subspecies, breeding entirely within California and northern Baja California. This subspecies is a small vireo with a short, straight bill and plumage varying from drab gray to green above and white to yellow below. The breeding season for least Bell's vireo begins with males arriving at breeding sites to establish territories, typically by late March. Females settle on male territories within two days of arriving to breeding sites and courtship begins immediately, lasting for 1-2 days before a nest site is selected and both birds construct the nest. Both sexes brood and feed the young. After the breeding season is complete, the least Bell's vireo leaves its breeding range to winter in Baja California. This subspecies typically forages in riparian habitat, feeding primarily on small insects and spiders (Chapin, 1925). Feeding will also occasionally occur in oak woodlands and adjacent chaparral habitats (Salata, 1983).

Threats: The primary threats that have been identified for this subspecies include the loss of lowland riparian habitat and nest parasitism by the brown-headed cowbird (USFWS, 1998)

Mammals

Pallid bat (Antrozous pallidus)

Status: The pallid bat is a CDFG Species of Special Concern. This taxon is not federally or State listed as threatened or endangered.

General Distribution: Pallid bats have a broad geographic range, extending from southern British Columbia to central Mexico and from California east to the Midwestern United States (Harvey *et al.*, 1999). This species occurs most commonly below elevations of roughly 6,000 feet (Stephenson and Calcarone, 1999). Pallid bats are year-round residents in California (Philpott, 1997).

Distribution in the Study Area: This species was detected below the dam structure during surveys conducted in May 2012. The Study Area is located within the known geographic distribution for this species (CDFG, 2008). Suitable roosting habitat occurs within limited portions of the Study Area. Suitable foraging habitat occurs throughout the Study Area. All areas of suitable habitat should be considered potentially occupied.

Habitat and Habitat Associations: Pallid bats occur in a variety of habitats, including grasslands, shrublands, woodlands, scattered desert scrub, agricultural fields, and mixed conifer forests (Barbour and Davis, 1969; Hermanson and O'Shea, 1983; Orr, 1954; Philpott, 1997). This species appears to prefer edges and open areas without trees (SNFPA, 2001). Roosting sites include rock crevices, mines, caves, tree hollows, buildings, bridges, and culverts (Hermanson and O'Shea, 1983; Tactarian, 2001).

Natural History: The pallid bat is a large, light-colored bat with prominent ears. This is a social species, communicating through a variety of vocalizations to indicate territorial disputes, direct individuals to roosting sites, and facilitate mother-infant relations (Nagorsen and Brigham, 1993). Pallid bat maternity colonies form in early April and may contain from 12 to 100 individuals (Zeiner *et al.*, 1990b). The diet of pallid bats primarily consist of large arthropods, including scorpions, crickets, moths, and praying mantids which are gleaned from the ground or on the surfaces of vegetation (Hermanson and O'Shea, 1983). Emergence from roosting sites typically begins 30 to 60 minutes after sunset, but can vary seasonally (Hermanson and O'Shea, 1983; Zeiner *et al.*, 1990b). Foraging is usually concentrated into two periods, with the first activity peak occurring 90 to 190 minutes after sunset, and the second occurring just prior to dawn (Hermanson and O'Shea, 1983; Zeiner *et al.*, 1990b). Nagorsen and Brigham (1993) report that pallid bats will travel up to 2.5 miles between day roosts and foraging areas. Between activity periods, pallid bats may remain torpid for up to five hours (O'Shea and Vaughn, 1977). This species is known to hibernate, but will periodically arouse to forage for food and water (Philpott, 1997).

Threats: Some of the threats that have been associated to the decline of this species in southern California include the destruction of buildings that provide suitable roosting and maternal colony sites, eradication of roosting colonies due to public health concerns, and urban expansion (Brown-Berry, 2002). As bat species often exhibit high site fidelity to maternity roosts and are highly sensitive to disturbance at these sites, local extirpations may be attributed to roost disturbance (Hermanson and O'Shea, 1983; Orr, 1954; O'Shea and Vaughn, 1977; Philpott, 1997).

Yuma myotis (Myotis yumanensis)

Status: The Yuma myotis is a CDFG Special Animal. This taxon is not federally or State listed as threatened or endangered.

General Distribution: The Yuma myotis is widespread throughout western North America from British Columbia, Canada, south through the western United States to Baja California and central Mexico (Hall 1981). In the United States, the species occurs in all of Washington and Oregon, most of California, western Idaho and Montana, the extreme western portion of Nevada, the southeastern half of Utah, all of Arizona and New Mexico, and western Texas. It occurs throughout California except for the most arid areas of the Mojave and Colorado deserts (Zeiner et al. 1990B). [Newhall]

Distribution in the Study Area: This species was detected below the dam structure during surveys conducted in May and July 2012. The Study Area is located within the known geographic distribution for this species (CDFG, 2008). Suitable roosting habitat occurs within limited portions of the Study Area. Suitable foraging habitat occurs throughout the Study Area. All areas of suitable habitat should be considered potentially occupied.

Habitat and Habitat Associations: Although the Yuma myotis occurs in a wide variety of life zones at elevations ranging from sea level to 3,300 meters (10,820 feet), its actual distribution is closely associated with access to water (Zeiner et al. 1990B). Forests and woodlands are primary habitats, and foraging usually occurs within open, uncluttered habitats and occurs low, over water sources such as ponds, streams, and stock ponds (Brigham et al. 1992; Zeiner et al. 1990B). Yuma myotis day roosts include rock crevices, caves, mines, buildings, abandoned swallow nests, and large, live trees (Evelyn et al. 2004; Zeiner et al. 1990B). [Newhall]

Natural History: Females establish colonial maternity roosts with up to several thousand individuals where young are born and raised (Zeiner et al. 1990B). Males appear to establish solitary roosts during the breeding season or roost with other bat species (Wilson and Ruff 1999; Zeiner et al. 1990B). Births are variable, but generally occur in late May to mid-June, with a peak in early June in California (NatureServe 2007; Zeiner et al. 1990B). Time of first flight is unknown. The Yuma myotis typically forages over water sources for moths, true flies, gnats, midges, mosquitoes, termites, true bugs, caddis flies, ants, bees, and wasps (Brigham et al. 1992). [Newhall]

Threats: No documented threats to Yuma myotis colonies have been reported in the scientific literature, but, like most bats, this species is likely very sensitive to human disturbance and, because it may roost in large trees, abandoned buildings, and under bridges (nocturnal roosts), it is vulnerable to vandalism, extermination, or inadvertent disturbance of roost sites. Other plausible threats to Yuma myotis resulting from construction activities include disturbances of day roosts from human activity, noise, and dust, as well as effects of dust on insect prey. Potential long-term impacts from urban development also include human and pet, stray, and feral animals' disturbances of roost sites; roost site and foraging habitat degradation, such as trampling and invasive species; and, pesticides that may cause secondary poisoning and affect prey abundance.

Western small-footed myotis (Myotis ciliolabrum)

Status: Western small-footed myotis is listed as a CDFG Special Animal. This taxon is not federally or State listed as threatened or endangered.

General Distribution: The western small-footed myotis is widespread throughout western North America, from western Canada south through the western United States to northern Baja California and central Mexico (Hall, 1981; as cited in USACE and CDFG, 2010). In the United States, the species occurs in all states west of, and including, North Dakota to the north and Texas to the south. The species is absent from the coastal regions of Washington, Oregon, and California south to about Ventura County (Zeiner *et al.*, 1990b; as cited in USACE and CDFG, 2010).

Distribution in the Study Area: This species was detected while actively monitoring just above the dam structure in July 2012. The Study Area is located within the known geographic distribution for this species (CDFG, 2008). Suitable roosting habitat occurs within limited portions of the Study Area. Suitable foraging habitat occurs throughout the Study Area. All areas of suitable habitat should be considered potentially occupied.

Habitat and Habitat Associations: The western small-footed myotis occurs in a wide variety of arid upland habitats at elevations ranging from sea level to 2,700 meters (8,860 feet) (Zeiner *et al.*, 1990b; as cited in USACE and CDFG, 2010). Habitats used by this species include riparian areas, woodlands, and brushy uplands (Holloway and Barclay, 2001; Zeiner *et al.*, 1990b; all as cited in USACE and CDFG, 2010). Western small-footed myotis day roosts include rock crevices, caves, tunnels and mines, and, sometimes, buildings and abandoned swallow nests (Holloway and Barclay, 2001; as cited in USACE and CDFG, 2010). They also use day roosts as nocturnal roosts (i.e., they may return to the day roost during the night) or may use buildings and concrete underpasses strictly as nocturnal roosts (Holloway and Barclay, 2001; as cited in USACE and CDFG, 2010).

Natural History: In California, it occurs in coastal southern California, the foothills of the Sierra Nevada, and the Great Basin Desert, and it is absent from the higher elevations in the mountains and from the lower elevations in the Mojave and Colorado deserts (Zeiner et al. 1990b; as cited in USACE and CDFG, 2010).

Western small-footed myotis forage for moths, true flies, gnats, midges, mosquitoes, true bugs, and beetles, often along the margins of trees and over water (Zeiner et al. 1990b; as cited in USACE and CDFG, 2010). Females establish maternity roosts, which may be solitary or colonial (with up to 20 individuals), where young are born and raised (Zeiner et al. 1990b; as cited in USACE and CDFG, 2010). Males appear to establish solitary roosts during the breeding season (Zeiner et al. 1990b; as cited in USACE and CDFG, 2010). Births generally occur in May and June, with a peak in late May (Zeiner et al. 1990b; as cited in USACE and CDFG, 2010), and first flight by young occurs by about one month (Wilson and Ruff 1999; as cited in USACE and CDFG, 2010).

Threats: No documented threats to western small-footed myotis colonies have been reported in the scientific literature, but, like most bats, this species is likely very sensitive to human disturbance and because it may roost in abandoned buildings and under bridges (nocturnal roosts), it is vulnerable to vandalism, extermination, or inadvertent disturbance of roost sites.

Nelson's bighorn sheep (Ovis Canadensis nelsoni)

Status: The Nelson's bighorn sheep is a U.S. Forest Service Sensitive species. This taxon is not federally or State listed as threatened or endangered.

General Distribution: Bighorn sheep were originally distributed from Baja California to Texas in the south to the Canadian Rockies in the north, with the eastern boundary reaching western Nebraska and the western boundary in California extending from Mount Shasta in the north to the crest of the central and southern Sierra Nevada to the Transverse Ranges and the east side of the Peninsular Ranges in the south (Cowan, 1940). Traditional taxonomy dating back more than half a century (Cowan, 1940) broke bighorn sheep from the southwestern desert region into four subspecies, one of which, the Nelson Bighorn (Ovis canadensis nelsoni), included bighorn from the Transverse Ranges through most of the desert mountain ranges of California, including the WMPA, and adjacent Nevada and northern Arizona to Utah (Shackleton, 1985). Recent research (Ramey, 1993, 1995; Wehausen and Ramey, 1993) has found a lack of support for Cowan's (1940) desert subspecies and instead has found previously unrecognized north-south variation of the Nelson Bighorn (Wehausen and Ramey, 1993, 1999). [BLM, no date A]

Distribution in the Study Area: Nelson's bighorn sheep have been observed at the Reservoir by Forest Service staff (Chris Huntley, personal communication, 10 September 2012). The Study Area is located within the known geographic distribution for this species; suitable habitat occurs within portions of the Study Area.

Habitat and Habitat Associations: Basic to the biology of bighorn sheep is their agility on steep rocky terrain, an adaptation used to escape predators. Consequently, within the desert, preferred habitat of bighorn is primarily on or near mountainous terrain above the desert floor. Also fundamental to the biology of bighorn sheep is the use of eyesight as the primary sense for detecting predators at sufficient distances to assure adequate time to reach safe terrain (Bleich et al., 1990b). Thus, preferred habitat of bighorn sheep is visually open, as well as steep and rocky. Because of scant rainfall and hot summer temperatures that limit most vegetation to low stature, most Mojave Desert mountain ranges satisfy these habitat requirements well. Surface water is another element of desert bighorn habitat considered to be important to population health (Turner and Weaver, 1980). [BLM, no date]

Natural History: Bighorn sheep have a large rumen, relative to body size (Krausman et al., 1993), which allows digestion of grasses, even in a dry state (Hanly, 1982). This gives them flexibility to select diets that optimize nutrient content from available forage. Consequently, bighorn sheep feed on a large variety of plant species and diet composition varies seasonally and among locations. The nutritional quality of their diet depends on growth activity of forage species and varies greatly among seasons, years, and locations (Wehausen and Hansen, 1988; Wehausen, 1992a), and is influenced greatly by precipitation and temperature (Wehausen, 1992b). While diet quality in the Mojave Desert varies greatly among years, it is most predictably high in late winter and spring (Wehausen, 1992a), and this period coincides with the peak of lambing. Desert bighorn have a long lambing season that can begin in December and end in June in the Mojave Desert, and a small percentage of births commonly occur in summer as well (Thompson and Turner, 1982; Bunnell, 1982; Wehausen, 1991). Within the WMPA, the bighorn occurring north of I-15 have a later initiation of the lambing season than those further south (Wehausen and Ramey, 1999; Wehausen, 1991). The primary breeding season in the WMPA occurs between August and November (Bleich et al., 1997), and the gestation period for bighorn sheep is about 174 days (Hass, 1995). [BLM, no date A]

Threats: Potential threats must be approached from the standpoint of individual populations and metapopulations (BLM, no date A). Actions that impair the ability of bighorn sheep to move between mountain ranges (e.g. fencing along highways or other boundaries, canals, and high densities of human habitation) will limit the potential for natural colonization and gene exchange, both of which are key to metapopulation viability (BLM, no date A). Cattle grazing also poses a threat to this species, by creating competition for and reducing the availability of surface water sources for the bighorn sheep.

5.3 Wildlife Corridors and Special Linkages

Linkages and corridors facilitate regional animal movement and are generally centered around waterways, riparian corridors, flood control channels, contiguous habitat, and upland habitat. Drainages generally serve as movement corridors because wildlife can move easily through these areas, and fresh water is available. Corridors also offer wildlife unobstructed terrain for foraging and for dispersal of young individuals.

As the movements of wildlife species are more intensively studied using radio-tracking devices, there is mounting evidence that some wildlife species do not necessarily restrict their movements to some obvious landscape element, such as a riparian corridor. For example, recent radio-tracking and tagging studies of Coast Range newts, California red-legged frogs, southwestern pond turtles, and two-striped garter snakes found that long-distance dispersal involved radial or perpendicular movements away from a water source with little regard to the orientation of the assumed riparian "movement corridor" (Hunt, 1993; Rathbun et al., 1992; Bulger et al., 2002; Trenham, 2002; Ramirez, 2002, 2003a, 2003b). Likewise, carnivores do not necessarily use riparian corridors as movement corridors, frequently moving overland in a straight line between two points when traversing large distances (Newmark, 1995; Beier, 1993, 1995; Noss, et al., 1996; Noss et al., no date). In general the following corridor functions can be utilized when evaluating impacts to wildlife movement corridors:

a. **Movement corridors** are physical connections that allow wildlife to move between patches of suitable habitat. Simberloff et al. (1992) and Beier and Loe (1992) correctly state that, for most species, we do not know what corridor traits (length, width, adjacent land use, etc.) are required for a corridor to be useful. But, as Beier and Loe (1992) also note, the critical features of a movement corridor may not be its physical traits but rather how well a particular piece of land fulfills several functions, including allowing dispersal, plant propagation, genetic interchange, and re-colonization following local extirpation.

b. **Dispersal corridors** are relatively narrow, linear landscape features embedded in a dissimilar matrix that link two or more areas of suitable habitat that would otherwise be fragmented and isolated from one another by rugged terrain, changes in vegetation, or human-altered environments. Corridors of habitat are essential to the local and regional population dynamics of a species because they provide physical links for genetic exchange and allow animals to access alternative territories as dictated by fluctuating population densities.

c. **Habitat linkages** are broader connections between two or more habitat areas. This term is commonly used as a synonym for a wildlife corridor (Meffe and Carroll, 1997). Habitat linkages may themselves serve as source areas for food, water, and cover, particularly for small- and medium-size animals.

d. **Travel routes** are usually landscape features, such as ridgelines, drainages, canyons, or riparian corridors within larger natural habitat areas that are used frequently by animals to facilitate movement and provide access to water, food, cover, den sites, or other necessary resources. A travel route is generally preferred by a species because it provides the least amount of topographic resistance in moving from one area to another yet still provides adequate food, water, or cover (Meffe and Carroll, 1997).

e. **Wildlife crossings** are small, narrow areas of limited extent that allow wildlife to bypass an obstacle or barrier. Crossings typically are manmade and include culverts, underpasses, drainage pipes, bridges, and tunnels to provide access past roads, highways, pipelines, or other physical obstacles. Wildlife crossings often represent "choke points" along a movement corridor because useable habitat is physically constricted at the crossing by human-induced changes to the surrounding areas (Meffe and Carroll, 1997).

5.3.1 Wildlife Movement in the Study Area

Aside from smaller focused studies, there has been no known widespread analysis conducted within this portion of the Angeles National Forest as a corridor for wildlife movement. Although sufficient evidence is lacking, the Littlerock Creek (and Santiago Creek) riparian corridor, and its associated uplands, is still recognized as a vital pathway for wildlife moving from the higher elevations of the surrounding Angeles National Forest to desired lower elevation habitats. Several migratory songbirds utilize the riparian vegetation within the corridor for breeding, nesting, and foraging, or at a minimum, as transient rest sites during migration flights. Additionally, large, wide-ranging animals, such as black bear, mountain lion, and coyote have been documented within the Angeles National Forest, utilizing Littlerock Creek corridor and the Reservoir in search of prey opportunities, water resources, and cover.

Even considering smaller spatial scales or single habitat types, habitat fragmentation is no less important an issue. At these spatial scales, several studies have documented the negative effects on population structure, home range size, and genetic connectivity resulting from dirt roads, pipeline corridors, transmission line corridors, and other seemingly innocuous features traversing formerly undisturbed habitat (Mader, 1984; Swihart and Slade, 1984; Dunning et al., 1992).

No known anthropogenic barriers to dispersal for ground-dwelling wildlife and plants were observed within the Study Area.

6. Regulatory Environment

6.1 Federal Regulations/Plans

6.1.1 Federal Endangered Species Act

Federal Endangered Species Act (ESA) provisions protect federally listed threatened and endangered species and their habitats from unlawful take and ensure that federal actions do not jeopardize the continued existence of a listed species or result in the destruction or adverse modification of designated critical habitat. Under the ESA, "take" is defined as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any of the specifically enumerated conduct." The U.S. Fish & Wildlife Service's (USFWS) regulations define harm to mean "an act which actually kills or injures wildlife." Such an act "may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering" (50 CFR § 17.3). Critical habitat is defined in Section 3(5)(A) of the ESA as "(i) the specific areas within the geographical area occupied by the species on which are found those physical or biological features (I) essential to the conservation of the species, and (II) which may require special management considerations or protection; and (ii) specific areas outside the geographical area occupied by the species upon a determination by the Secretary of Commerce or the Secretary of the Interior (Secretary) that such areas are essential for the conservation of the species." The effects analyses for designated critical habitat must consider the role of the critical habitat in both the continued survival and the eventual recovery (i.e., the conservation) of the species in question, consistent with the recent Ninth Circuit judicial opinion, Gifford Pinchot Task Force v. USFWS. Activities that may result in "take" of individuals are regulated by the USFWS. The USFWS produced an updated list of candidate species December 6, 2007 (72 FR 69034). Candidate species are not afforded any legal protection under ESA; however, candidate species typically receive special attention from Federal and State agencies during the environmental review process.

6.1.2 Migratory Bird Treaty Act

The Migratory Bird Treaty Act of 1918 (16 U.S.C. 703-711) makes it unlawful to possess, buy, sell, purchase, barter or "take" any migratory bird listed in Title 50 of the Code of Federal Regulations Part 10. "Take" is defined as possession or destruction of migratory birds, their nests or eggs. Disturbances that cause nest abandonment and/or loss of reproductive effort or the loss of habitats upon which these birds depend may be a violation of the Migratory Bird Treaty Act. The Federal Migratory Bird Treaty Act (MBTA) prohibits killing, possessing, or trading in migratory birds except in accordance with regulations prescribed by the Secretary. This act encompasses whole birds, parts of birds, and bird nests and eggs.

6.1.3 Bald and Golden Eagle Protection Act of 1940 (16 USC 668)

The Bald Eagle Protection Act of 1940 (16 U.S.C. 668, enacted by 54 Stat. 250) protects bald and golden eagles by prohibiting the taking, possession, and commerce of such birds and establishes civil penalties for violation of this Act. Take of bald and golden eagles is defined as follows: "disturb means to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available, (1) injury to an eagle, (2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or (3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior'' (72 FR 31132; 50 CFR 22.3).

The USFWS is the primary federal authority charged with the management of golden eagles in the United States. A permit for take of golden eagles, including take from disturbance such as loss of foraging habitat, may be required for this Project. USFWS guidance on the applicability of current Eagle Act statutes and mitigation is currently under review. On November 10, 2009 the USFWS implemented new rules (74 FR 46835) governing the "take" of golden and bald eagles. The new rules were released under the existing Bald and Golden Eagle Act which has been the primary regulation protection unlisted eagle populations since 1940. All activities that may disturb or incidentally take an eagle or its nest as a result of an otherwise legal activity must be permitted by the USFWS under this act. The definition of disturb (72 FR 31132) includes interfering with normal breeding, feeding, or sheltering behavior to the degree that it causes or is likely to cause decreased productivity or nest abandonment. If a permit is required, due to the current uncertainty on the status of golden eagle populations in western United States, it is expected permits would only be issued for safety emergencies or if conservation measures implemented in accordance with a permit would result in a reduction of ongoing take or a net take of zero.

6.1.4 Federally Regulated Habitats

Areas meeting the regulatory definition of "Waters of the U.S." (Jurisdictional Waters) are subject to the jurisdiction of the USACE under provisions of Section 404 of the Clean Water Act (1972) and Section 10 of the Rivers and Harbors Act (1899). These waters may include all waters used, or potentially used, for interstate commerce, including all waters subject to the ebb and flow of the tide, all interstate waters, all other waters (intrastate lakes, rivers, streams, mudflats, sandflats, playa lakes, natural ponds, etc.), all impoundments of waters otherwise defined as "Waters of the U.S.," tributaries of waters otherwise defined as "Waters of the U.S.," the territorial seas, and wetlands (termed Special Aquatic Sites) adjacent to "Waters of the U.S." (33 CFR, Part 328, Section 328.3). Wetlands on non-agricultural lands are identified using the Corps of Engineers Wetlands Delineation Manual (Environmental Laboratory, 1987). The Study Area falls within the South Pacific Division of the USACE, and is under the jurisdiction of the Los Angeles District.

Construction activities within jurisdictional waters are regulated by the USACE. The placement of fill into such waters must comply with permit requirements of the USACE. No USACE permit would be effective in the absence of State water quality certification pursuant to Section 401 of the Clean Water Act. As a part of the permit process the USACE works directly with the USFWS to assess potential Project impacts on biological resources.

6.1.5 National Environmental Policy Act

The National Environmental Policy Act of 1969 (NEPA) requires all Federal agencies to examine the environmental impacts of their actions, incorporate environmental information, and utilize public participation in the planning and implementation of all actions. Federal agencies must integrate NEPA with other planning requirements and prepare appropriate NEPA documents to facilitate better environmental decision making. NEPA requires Federal agencies to review and comment on Federal agency environmental plans/documents when the agency has jurisdiction by law or special expertise with respect to any environmental impacts involved (42 U.S.C. 4321- 4327) (40 CFR 1500-1508).

6.1.6 Angeles National Forest Land Management Plan

The Land Management Plan for the Angeles National Forest (ANF) (USFS 2005; R5-MB-076) includes a strategy to successfully meet the goals of the vision for the National Forests with design criteria detailed to manage the ANF. Primarily, goals relate to the long-term sustainability of social, economic, and ecological objectives of the forest. Many of the management tools and goals described in the plan are linked to National Strategic Plans for National Forests. For example, Invasive Species Prevention and Control (Goal IS 1) is linked to Goal 2 (reduce the impacts from invasive species) objective 1. Extensive guidance is also given for a range of conservation measures that must be applied to avoid, minimize, or mitigate negative, long-term effects on threatened, endangered, proposed, candidate, or sensitive species and habitats. Guidance includes the protection of known raptor nests; protection of all spotted owl territories; allowance for movement along corridors; use of seasonal closures to protect special-status species; avoidance of collection of forest products; and, avoidance of activities that result in the removal, crushing, burying, burning, or mowing of host plants within critical and occupied habitat for special-status butterfly species, among others. The Management Plan also lists relevant laws, regulations, agreements, and other management direction outside of the scope of the proposed project (Appendix A of the Management Plan).

6.1.7 Fish and Wildlife Coordination Act (16 U.S.C. 661-666)

This act applies to any federal project where the waters of any stream or other body of water are impounded, diverted, deepened, or otherwise modified. Project proponents are required to consult with FWS and the appropriate state wildlife agency. These agencies prepare reports and recommendations that document project effects on wildlife and identify measures that may be adopted to prevent loss or damage to wildlife resources. The term "wildlife" includes both animals and plants. Provisions of the Act are implemented through the NEPA process and Section 404 permit process.

6.1.8 National Wild and Scenic Rivers Act (16 U.S.C. 1271-1287)

The National Wild and Scenic Rivers Act is administered by a variety of State and federal agencies. Designated river segments flowing through federally managed lands are administered by the land managing agency, such as U.S. Forest Service, BLM, and the National Park Service. River segments flowing through private lands are administered by the Resources Agency in conjunction with local government agencies. The Act prohibits federal agencies from activities that would adversely affect the values for which the river was designated. Littlerock Creek upstream of the project area is an eligible Wild and Scenic River.

6.1.9 National Wildlife Refuge System Administration Act of 1966, 42 U.S.C. 668dd, enacted by Pub. L. No. 91-135 as amended

The National Wildlife Refuge System Administration Act of 1966 provides guidelines and directives for the administration and management of all lands within the system, including "wildlife refuges, areas for the protection and conservation of fish and wildlife that are threatened with extinction, wildlife ranges, game ranges, wildlife management areas, or waterfowl production areas." The Secretary of the Interior is authorized to permit by regulations the use of any area within the system provided "such uses are compatible with the major purposes for which such areas were established."

6.1.10 Executive Order 11988 Floodplain Management (May 24, 1977)

This order directs all federal agencies to avoid the long-term and short-term adverse impacts associated with floodplain modification and to avoid direct or indirect support of floodplain development whenever there is a practicable alternative.

6.1.11 Executive Order 11990 Protection of Wetlands (May 24, 1977)

This order establishes a National policy to avoid adverse impacts on wetlands whenever there is a practicable alternative.

6.2 State Regulations

6.2.1 California Environmental Quality Act

The California Environmental Quality Act (CEQA) establishes State policy to prevent significant, avoidable damage to the environment by requiring changes in projects through the use of alternatives or mitigation measures. CEQA applies to actions directly undertaken, financed, or permitted by State lead agencies. Regulations for implementation are found in the State CEQA Guidelines published by the Resources Agency. These guidelines establish an overall process for the environmental evaluation of projects.

6.2.2 California Endangered Species Act

Provisions of California Endangered Species Act protect State-listed Threatened and Endangered species. The CDFG regulates activities that may result in "take" of individuals ("take" means "hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill"). Habitat degradation or modification is not expressly included in the definition of "take" under the California Fish and Game Code. Additionally, the California Fish and Game Code contains lists of vertebrate species designated as "fully protected" (California Fish & Game Code §§ 3511 [birds], 4700 [mammals], 5050 [reptiles and amphibians], 5515 [fish]). Such species may not be taken or possessed.

In addition to Federal and State-listed species, the CDFG also has produced a list of Species of Special Concern to serve as a "watch list." Species on this list are of limited distribution or the extent of their habitats has been reduced substantially, such that threat to their populations may be imminent. Species of Special Concern may receive special attention during environmental review, but they do not have statutory protection.

Birds of prey are protected in California under the State Fish and Game Code. Section 3503.5 states it is "unlawful to take, possess, or destroy any birds of prey (in the order Falconiformes or Strigiformes) or to take, possess, or destroy the nest or eggs of any such bird except as otherwise provided by this Code or any regulation adopted pursuant thereto." Construction disturbance during the breeding season could result in the incidental loss of fertile eggs or nestlings or otherwise lead to nest abandonment. Disturbance that causes nest abandonment and/or loss of reproductive effort is considered "take" by the CDFG. Under Sections 3503 and 3503.5 of the State Fish and Game Code, activities that would result in the taking, possessing, or destroying of any birds-of-prey, taking or possessing of any migratory nongame bird as designated in the Migratory Bird Treaty Act, or the taking, possessing, or needlessly destroying of the nest or eggs of any raptors or non-game birds protected by the Migratory Bird Treaty Act, or the taking of any non-game bird pursuant to Fish and Game Code Section 3800 are prohibited.

6.2.3 Native Plant Protection Act (Fish & Game Code 1900-1913)

California's Native Plant Protection Act (NPPA) requires all State agencies to utilize their authority to carry out programs to conserve endangered and rare native plants. Provisions of NPPA prohibit the taking of listed plants from the wild and require notification of the CDFG at least 10 days in advance of any change in land use. This allows CDFG to salvage listed plant species that would otherwise be destroyed. The Applicant is required to conduct botanical inventories and consult with CDFG during project planning to comply with the provisions of this act and sections of CEQA that apply to rare or endangered plants.

6.2.4 Section 3503 & 3503.5 of the Fish and Game Code

Under these sections of the Fish and Game Code, the Applicant is not allowed to conduct activities that would result in the taking, possessing, or destroying of any birds-of-prey, taking or possessing of any migratory non-game bird as designated in the Migratory Bird Treaty Act, or the taking, possessing, or needlessly destroying of the nest or eggs of any raptors or non-game birds protected by the Migratory Bird Treaty Act, or the taking of any non-game bird pursuant to Fish and Game Code Section 3800.

6.2.5 Porter-Cologne Water Quality Control Act

Regional water quality control boards regulate the "discharge of waste" to "waters of the State." All projects proposing to discharge waste that could affect waters of the State must file a waste discharge report with the appropriate regional board. The board responds to the report by issuing waste discharge requirements (WDR) or by waiving WDRs for that project discharge. Both of the terms "discharge of waste" and "waters of the State" are broadly defined such that discharges of waste include fill, any material resulting from human activity, or any other "discharge." Isolated wetlands within California, which are no longer considered "waters of the United States" as defined by Section 404 of the CWA, are addressed under the Porter-Cologne Act.

6.2.6 State-Regulated Habitats

The State Water Resources Control Board is the State agency (together with the Regional Water Quality Control Boards [RWQCB]) charged with implementing water quality certification in California. The Project falls under the jurisdiction of the Los Angeles (Region 4) RWQCB.

The CDFG extends the definition of stream to include "intermittent and ephemeral streams, rivers, creeks, dry washes, sloughs, blue-line streams (USGS defined), and watercourses with subsurface flows.

Canals, aqueducts, irrigation ditches, and other means of water conveyance can also be considered streams if they support aquatic life, riparian vegetation, or stream-dependent terrestrial wildlife" (CDFG, 1994).

Activities that result in the diversion or obstruction of the natural flow of a stream; or which substantially change its bed, channel, or bank, or which utilize any materials (including vegetation) from the streambed, may require that the project applicant enter into a Streambed Alteration Agreement with the CDFG.

6.2.7 California Wild and Scenic Rivers Act (P.R.C. 5093.50 et seq.)

This act preserves certain designated rivers in their free-flowing state. These rivers must possess extraordinary scenic, recreational, fishery, or wildlife values. The Resources Agency is responsible for coordinating activities of State agencies that may affect these designated rivers.

6.3 Local Regulations/Plans

6.3.1 Los Angeles County Draft Preliminary General Plan

The Los Angeles County Draft Preliminary General Plan (2007) is an update of efforts begun in 1970 to formalize a development plan (adopted in 1980). It is the outline for growth and development in the unincorporated areas of Los Angeles County within the next 20 years that guides land use decisions. One of the 10 community priorities described in the plan is the protection of the natural environment, natural resources, and open spaces (Community Priority # 9, Goal C/OS-5). The Significant Ecological Area (SEA) designation provides an additional level of environmental review; any development within SEAs (described below) require a SEA-Conditional Use Permit, unless exempt. SEAs and other Special Management Areas include open space areas, hillside management areas, agricultural opportunity areas, and National Forests. Within the National Forests, development is not encouraged because "development requires the removal of forest vegetation around structures for fire protection, erosion from hillside development may occur, and the mountainous terrain subjects structures to potential landslides due to seismic activity." In addition, the Land Use Element of the General Plan requires development and infrastructure projects to preserve, to the best extent possible, major drainage features, riparian vegetation, rock outcroppings, and stands of other native trees. Productive farmland is also protected within Los Angeles County for local food production, open space, public health, and the local economy (Goal C/OS-6). In addition, the Los Angeles County Zoning Code references, in detail, policies described in the General Plan, such as the Oak Tree and Brushing Ordinances.

6.4 Other Applicable Regulations, Plans, and Standards

6.4.1 California Native Plant Society (CNPS) Rare Plant Program

The mission of the CNPS Rare Plant Program is to develop current, accurate information on the distribution, ecology, and conservation status of California's rare and endangered plants, and to use this information to promote science-based plant conservation in California. Once a species has been identified as being of potential conservation concern it is put through an extensive review process. Once a species has gone through the review process, information on all aspects of the species (listing status, habitat, distribution, threats, etc.) are entered into the online CNPS Inventory and given a California Rare Plant Rank (CRPR). In 2011 the CNPS officially changed the name "CNPS List" to "CRPR." The

Program currently recognizes more than 1,600 plant taxa (species, subspecies and varieties) as rare or endangered in California.

Vascular plants listed as rare or endangered by the CNPS, but which might not have designated status under State endangered species legislation, are defined by the following CRPR:

- CRPR 1A - Plants considered by the CNPS to be extinct in California
- CRPR 1B - Plants rare, threatened, or endangered in California and elsewhere
- CRPR 2 - Plants rare, threatened, or endangered in California, but more numerous elsewhere
- CRPR 3 - Plants about which we need more information – a review list
- CRPR 4 - Plants of limited distribution – a watch list

In addition to the CRPR designations above, the CNPS adds a Threat Rank as an extension added onto the CRPR and designates the level of endangerment by a 1 to 3 ranking, with 1 being the most endangered and 3 being the least endangered. The Threat Ranks are described as follows:

- 0.1 – Seriously threatened in California (high degree/immediacy of threat)
- 0.2 – Fairly threatened in California (moderate degree/immediacy of threat)
- 0.3 – Not very threatened in California (low degree/immediacy of threats or no current threats known.

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Appendix A Site Photographs

Photo 1 - View from the Reservoir looking north towards the dam structure.

Photo 2 - View of a potential raptor nest along the vertical rock face of the northeastern perimeter of the Reservoir.

Photo 3 – View looking west from within the Reservoir at the existing docks with the restaurant and residential structures in the background.

Photo 4 – View of a pool adjacent to and west of Cheseboro Road, near the boat launch in June 2001

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Photo 5 – View looking east from the uplands immediately west of Fishermen's Point.

Photo 6 – Western toad observed during arroyo toad surveys on June 1, 2011.

Photo 7 - View from atop the dam structure looking northeast at the Littlerock Creek.

Photo 8 - View of a birds nest constructed of fishing line within a tree along the edge of the cove just north of Fisherman's Point on the west side of the Reservoir.

Photo 9 - View south at the Reservoir from the west side of the Reservoir just north of Fisherman's Point.

Photo 10 - View looking north from the boat docks at the Reservoir.

Photo 11 - View looking at inundated Fremont cottonwood forest on the west side of the Reservoir just south of the boat docks.

Photo 12 - View looking southeast at the Reservoir from Rocky Point.

Photo 13 - View of the active Littlerock Creek channel downstream of the dam structure.

Appendix B – Invasive Weed Descriptions and Control Methods

Noxious weeds present a severe threat to natural habitats. When noxious weeds become established in an area, they can cause a permanent or long-lasting change in the environment by increasing vegetative cover, thereby creating a dense layer that prevents native vegetation from germinating, and essentially halting normal successional processes that would typically allow an area to recover from disturbance. Weed populations can also alter edaphic and hydrological conditions and structure through nitrogen fixation (as in Spanish broom, *Spartium junceum*) or draining of the water table (as in giant reed [*Arundo donax*]). Monocultures of noxious weeds typically create an unfavorable environment for wildlife. Consequently, mutualistic species necessary for native plant life cycles, such as seed dispersers, fossorial mammals, or pollinators, can be lost from the area. Heavy infestations can also significantly reduce the recreational or aesthetic value of open space. This being said, weed control efforts are costly, labor intensive, often require several years of follow-up monitoring and a combination of control methods to completely eradicate populations, and in many cases pose significant risk to native plants that may occur within the weed control area. Even still, the ecological costs and risks associated with not managing noxious weed populations are so great that these exceed risks posed by most control methods (DiTomaso, 1997).

Weed species occurring in the Study Area and along the haul routes are ranked by three threat levels as defined by Cal-IPC (Cal-IPC, 2012):

- **High** – These species have severe ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal and establishment. Most are widely distributed ecologically.
- **Moderate** – These species have substantial and apparent (but generally not severe) ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal, though establishment is generally dependent upon ecological disturbance. Ecological amplitude and distribution may range from limited to widespread.
- **Limited** – These species are invasive but their ecological impacts are minor on a statewide level or there was not enough information to justify a higher score. Their reproductive biology and other attributes result in low to moderate rates of invasiveness. Ecological amplitude and distribution are generally limited, but these species may be locally persistent and problematic.
- **Evaluated Not Listed** – Sufficient information is lacking to assign a rating or the available information indicates that the species does not have significant impacts at the present time

Species Accounts

High Risk Invasive Plant Species

Tamarisk (*Tamarix sp.*)

Cal-IPC Pest Rating: High.

Present at the project site: Yes.

This species occurs in a large stand on the east side of the southern extent of the Reservoir. Current levels of this species are low however the salt cedar can quickly colonize open stream terraces after scouring events provided a source population is present.

Description:

Tamarisk is a type of woody shrub or small tree in the tamarisk family (Tamaricaceae) that invades desert washes and arid riparian areas throughout the western U.S. The Tehachapi Mountains are known to support at least four related Eurasian species with the common names Chinese tamarisk (T. chinensi), French tamarisk (T.gallica), smallflower tamarisk (T. parviflora), and saltcedar (T. ramosissima). Tamarisk reproduces by seed and by root sprouting or even disconnected stem fragments. Seedlings have very low survivorship because the deep root system that would protect them from desiccation or being washed away in floods is undeveloped (DiTomaso and Healy, 2007). Once this root system forms, however, tamarisk trees are associated with several negative effects, including draining of the water table, loss of diversity, and reduced habitat quality for many bird and wildlife species. Seed germination is not inhibited in saline soils, and the plants can tolerate saline conditions quite well. The plants can extract groundwater efficiently from deep in the soil profile and sequester the resulting salts in their leaf tissues. When these tissues decompose on the soil surface, they increase soil salinity, making the site less suitable for native species. Once established, tamarisk can spread quickly through vegetative means.

Control:

Prevention: Sites with intact native riparian vegetation are resistant to tamarisk invasion because the seedlings are such poor competitors. Minimizing impacts in riparian and desert wash habitats and restoring any necessary impacts with native vegetation will thus reduce the potential for tamarisk invasion into new areas.

Mechanical: Trees cut from the soil surface re-sprout from the root system, so aboveground tree removal should be followed with herbicidal methods as outlined below. Otherwise, the root system will need to be manually removed, which may cause more soil disturbance than necessary and leave the site open to new invasions.

Biocontrol: In 2002, the saltcedar beetle (*Diorhabda elongata*) was released in efforts to control tamarisk, but it is not yet known how effective the species will be in control of these species (DiTomaso and Healy 2007).

Fire Management: Burning is not recommended because plants re-sprout readily following fire.

Herbicide: Cut stumps should be painted with an herbicide preparation specifically approved for use in aquatic and wetland ecosystems in California. Care should be taken to use a strong enough application to kill the root crown bud. Repeat applications are required the following year when seedlings germinate in the spring. Young plants are easily scraped with a Hula Hoe or pulled by hand.

Figure 6

Noxious and Invasive Weeds in Vegetation Study Area

Moderate Risk Invasive Plant Species

Tocalote (*Centaurea melitensis*)

Cal-IPC Pest Rating: Moderate.

Present at the project site: Yes.

This species occurs in a single location along Cheseboro Road downstream of the dam structure.

Description:

Tocalote, also known as Maltese star-thistle, is an annual plant in the sunflower family (Asteraceae) that is native to southern Europe. It is widely distributed throughout California, with larger, more problematic populations being found in central-western and southwestern regions of the state within grassland and oak woodland communities. Dense infestations of tocalote threaten natural ecosystems by displacing native plants and animals. This species has an earlier phenology (annual timing of life stages) than the closely related, more widespread yellow star-thistle (C.solstitialis), and generally flowers from April to June (Bossard et al., 2000). Tocalote also is similar in appearance to yellow star-thistle. As it flowers and senesces earlier in the year than yellow star-thistle, control treatments should be timed appropriately. Otherwise, mechanical and herbicidal control techniques developed and used for yellow star-thistle are also effective for tocalote infestations (DiTomaso and Healy 2007).

Control:

Prevention: When working in areas infested with tocalote, equipment (including undercarriages) should be carefully cleaned before moving to a non-infested area. The collection and export of fill soils, pasture hay, and crops from infested areas should be avoided or minimized to the maximum extent practicable.

Mechanical: Mowing can provide effective treatment of infested areas if mowed at the correct time, which is immediately after the earliest 2 to 5% of plants have begun to produce flower heads, usually in April or early May (DiTomaso and Healy 2007). Mowing too early may cause plants to become bushier and produce more flower heads. Treatments should continue for at least 2 to 3 years, after which spot eradication may be required indefinitely.

Biocontrol: Responsible rangeland management, where range is grazed by sheep, goats, or cattle to a moderate degree can help prevent establishment or spread of populations in grasslands. Infested areas can be treated by high-intensity grazing between the period when the plant bolts (April) to just before the plant produces spiny seed heads in May-June. Biocontrol insects used to control yellow star-thistle may also feed on tocalote flower heads, but are more attracted to, and better at damaging yellow star-thistle.

Fire Management: Prescribed burning of tocalote can reduce populations if timed correctly, but to avoid heavy damage to native vegetation, burns should be timed to occur after other annual plants have dried but before tocalote seeds are produced. Due to its late spring-early summer flowering period, burning may be difficult to implement for tocalote.

Herbicide: Herbicide treatments by foliar spray or wick application are generally used to control or reduce spot infestations, or as follow-up to more intensive mechanical, grazing, or fire management-based treatments.

Shortpod Mustard (Hirschfeldia incana)

Cal-IPC Pest Rating: Moderate.

Present at the project site: Yes.

Summer mustard is distributed at several locations along the main access road adjacent to the Reservoir.

Description:

Shortpod mustard (*Hirschfeldia incana*) is an annual or short-lived perennial forb in the mustard family (Brassicaceae) that is native to Eurasia. It matures quickly in the spring and produces a large amount of biomass in infested areas, potentially outcompeting native species through shading or an early reduction in soil moisture. Reproduction occurs by seeds, which are sticky when wet and are thus easily transferred by equipment, vehicles, or people working or traveling through infested areas when moisture is present (Brooks 2004). Similar to other invasive mustard species, shortpod mustard can build up a large, long-lived seed bank at infestation sites. This species often invades areas dominated by exotic annual grasses and can contribute to type conversion of woodlands and scrublands into annual grasslands by adding to the early season fuel load of an area, as this can increase the amount of fuel available for fires. Fire frequency and intensity can increase such that shrub and tree species can no longer establish or survive. While the species is generally considered a successional plant, and thus might be expected to decrease in density or extent with increasing time since disturbance, the typically large seed bank in combination with repeated disturbance in riparian areas or associated with heavy grazing can favor the establishment of long-term infestations (Brooks 2004).

Black mustard (*Brassica nigra*) is very similar in appearance to shortpod mustard, and the two species are often difficult to tell apart in the field. The ecological effects of black mustard invasion are virtually identical to shortpod mustard in how it impacts ecosystems, but black mustard tends to be taller, may regularly produce sdenser infestations than shortpod mustard, and may be more widespread. It can readily invade chaparral and sensitive coastal sage scrub habitats, contributing to increased fire frequency and intensity leading to type conversion of these habitats into annual grasslands. Deeply buried black mustard seeds may remain viable for as much as 50 years under field conditions (DiTomaso and Healy 2007).

Control:

Prevention: Disturbance and fire favor establishment of these mustard species. Additionally, shortpod mustard may be more likely to invade areas already dominated by annual grasses (Brooks 2004). Therefore, protection and sound management of remaining bunchgrass grasslands and quick eradication of initial infestations in scrub- or woodlands is recommended.

Mechanical: Black and shortpod mustard are best controlled mechanically by hand-pulling of plants each year after they have bolted but before they produce seed. The plants have a fairly weak root system, and as annuals, do not re-sprout from root fragments left in the soil. Over time, this can deplete the seed banks and allow native or grassy vegetation to dominate previously infested areas. Mowing, particularly when timing is poor, can produce plants that branch heavily from the base, and could produce even more seed than undisturbed plants.

Fire Management: Burning is not recommended for shortpod mustard control as it can damage co-occurring native vegetation due to heavy fuel loads, as well as the fact that shortpod and other exotic mustard species appear to be somewhat fire-adapted and can increase in density following fires.

Herbicide: Because early season mustards such as these emerge early in the growing season, often before native vegetation has broken dormancy, it is thought that early post-emergence herbicidal treatments may be effective for members of this group (Bossard et al. 2000), but more research is needed to develop a standardized, optimized methodology for control of these species.

Tree Tobacco (*Nicotiana glauca*)

Cal-IPC Pest Rating: Moderate.

Present at the project site: Yes.

This species occurs in a single location along Cheseboro Road downstream of the dam structure.

Description:

Tree tobacco is a shrub or tree in the nightshade family (*Solanaceae*), native to South America. Leaves and other structures of this species contain the highly toxic alkaloid anabasine, which can cause fetal deformities or even death in livestock that graze the plants. Tree tobacco occurs on sandy or gravelly soils, usually near streams, lakes, or ditches, although the plants are extremely drought tolerant and can withstand long periods of hot, dry weather (Guertin and Halvorson 2003). Tree tobacco plants are short-lived and the species does not appear to produce dense infestations in California (Cal-IPC, 2012), although the species is spreading throughout lower elevations of Arizona and California. While toxic to livestock, the plant is beneficial for native species such as hummingbirds and hawkmoths. Little is known about specifics of reproduction in this species, and optimal control methods are still being developed.

Control:

Prevention: In Australia, it has been observed that stem densities are significantly reduced in non-grazed plots, possibly due to the competition from native wetland vegetation (Florentine and Westbrooke 2005). As wetland areas are often grazed heavily by livestock in arid areas, protection of native emergent wetland vegetation by excluding livestock from sensitive areas may prevent seedling establishment or spread of existing infestations.

Mechanical: No mechanical methods of control other than hand-pulling are known, although cutting before herbicide application is an accepted control method for many weedy, woody species.

Herbicide: Optimal methods for control are still being developed, but glyphosate applied as foliar spray, drizzle, or as a treatment to cut-stumps all showed high levels of initial success when applied in fall (Oneto et al. 2004), although later regrowth was not assessed and other timing regimes were not compared in the 2004 publication.

Appendix C – Wildlife Species Observed in the Study Area

Wildlife Observed in the Study Area During 2007 – 2012 Surveys	
Common Name	Latin Name
REPTILES	
Southwestern pond turtle	*Actinemys marmorata*
California legless lizard	*Anniella pulchra*
Coastal whiptail	*Aspidoscelis tigris stejnegeri*
Red racer	*Coluber flagellum piceus*
Southern pacific rattlesnake	*Crotalus helleri*
San Diego nightsnake	*Hypsiglena ochrorhyncha klauberi*
California kingsnake	*Lampropeltis getula californiae*
Coast horned lizard	*Phrynosoma blainvillii*
Gopher snake	*Pituophis catenifer*
San Diego gopher snake	*Pituophis catenifer annectens*
Southwestern threadsnake	*Rena humilis humilis*
Long-nosed Snake	*Rhinocheilus lecontei*
Patch-nosed snake	*Salvadora hexalepis*
Western fence lizard	*Sceloporus occidentalis*
Two-striped garter snake	*Thamnophis hammondi*
Red-eared slider	*Trachemys scripta elegans*
California lyresnake	*Trimorphodon lyrophanes*
Western/California side-blotched lizard	*Uta stansburiana elegans*
FISH	
Bluegill	*Lepomis macrochiru*
Largemouth bass	*Micropterus salmoides*
AMPHIBIANS	
Western/California toad	*Anaxyrus boreas halophilus*
Arroyo toad	*Anaxyrus californicus*
California chorus frog	*Pseudacris cadaverina*
Baja California chorus frog	*Pseudacris hypochondriaca*
Bullfrog*	*Lithobates catesbeiana*
MAMMALS	
Pallid bat	*Antrozous pallidus*
Coyote	*Canis latrans*
Big Brown Bat	*Eptesicus fuscus*
Greater bonneted bat	*Eumops perotis*
Black-tailed jackrabbit	*Lepus californicus*
Bobcat	*Lynx rufus*
California vole	*Microtus californicus*
Long-tailed weasel	*Mustela frenata*
California myotis	*Myotis californicus*
Western small-footed myotis	*Myotis ciliolabrum*
Yuma myotis	*Myotis yumanensis*
Desert shrew	*Notiosorex crawfordi*
Mule deer	*Odocoileus hemionus*
California ground squirrel	*Otospermophilus beecheyi*
Canyon bat	*Parastrellus hesperus*

Wildlife Observed in the Study Area During 2007 – 2012 Surveys	
Common Name	Latin Name
Deer mouse	*Peromyscus maniculatus*
Mountain lion	*Puma concolor*
Raccoon	*Procyon lotor*
Desert cottontail	*Sylvilagus audubonii*
Mexican free-tailed bat	*Tadarida brasiliensis*
Botta's pocket gopher	*Thomomys bottae*
Gray fox	*Urocyon cinereoargenteus*
BIRDS	
Sharp-shinned hawk	*Accipiter striatus*
Spotted sandpiper	*Actitis macularia*
White-throated swift	*Aeronautes saxatalis*
Red-winged blackbird	*Agelaius phoeniceus*
So. Cal. rufous-crowned sparrow	*Aimophila ruficeps canescens*
Sage sparrow	*Amphispiza belli*
American wigeon	*Anas americana*
Mallard	*Anas platyrhynchos*
Gadwall	*Anas strepera*
Western scrub-jay	*Aphelocoma californica*
Black-chinned hummingbird	*Archilochus alexandri*
Great blue heron	*Ardea herodias*
Oak titmouse	*Baeolophus inornatus*
Great horned owl	*Bubo virginianus*
Bufflehead	*Bucephala albeola*
Red-tailed hawk	*Buteo jamaicenis*
Green heron	*Butoroides virescens*
California quail	*Callipepla californica*
Anna's hummingbird	*Calypte anna*
Costa's hummingbird	*Calypte costae*
Cactus wren	*Campylorhynchus brunneicapillus*
Wilson's warbler	*Cardellina pusilla*
House finch	*Carpodacus mexicanus*
Turkey vulture	*Cathartes aura*
Vaux's swift	*Chaetura vauxi*
Wrentit	*Chamaea fasciata*
Killdeer	*Charidrius vociferus*
Lark sparrow	*Chondestes grammacus*
Lesser nighthawk	*Chordeiles acutipennis*
Western wood-pewee	*Contopus sordidulus*
Common raven	*Corvus corax*
Western flycatcher	*Empidonax difficilis*
Willow flycatcher	*Empidonax traillii brewsteri*
Brewer's blackbird	*Euphagus cyanocephalus*
American kestrel	*Falco sparverius*
American coot	*Fulica americana*

Wildlife Observed in the Study Area During 2007 – 2012 Surveys	
Common Name	Latin Name
Common yellowthroat	*Geothlypis trichas*
Bald eagle	*Haliaeetus leucocephalus*
Barn swallow	*Hirundo rustica*
Bullock's oriole	*Icterus bullockii*
Song sparrow	*Melospiza melodia*
California towhee	*Melozone crissalis*
Brown-headed cowbird	*Molothrus ater*
Ash-throated flycatcher	*Myiarchus cinerascens*
Black-crowned night-heron	*Nycticorax nycticorax*
Mountain quail	*Oreortyx pictus*
Orange-crowned warbler	*Oreothlypis celata*
Nashville warbler	*Oreothlypis ruficapilla*
Western screech-owl	*Otus kennicottii*
Ruddy duck	*Oxyura jamaicensis*
Lazuli bunting	*Passerina amoena*
Cliff swallow	*Petrochelidon pyrrhonota*
Phainopepla	*Phainopepla nitens*
Black-headed grosbeak	*Pheucticus melanocephalus*
Double-crested cormorant	*Phlacrocorax auritus*
Nuttall's woodpecker	*Picoides nuttallii*
Downy woodpecker	*Picoides pubescens*
Spotted towhee	*Pipilo maculatus*
Western tanager	*Piranga ludoviciana*
Summer tanager	*Piranga rubra cooperi*
Eared grebe	*Podiceps nigricollis*
Pied-billed grebe	*Podilymbus podiceps*
Bushtit	*Psaltriparus minimus*
Great-tailed grackle	*Quiscalus mexicanus*
Rock wren	*Salpinctes obsoletus*
Black phoebe	*Sayornis nigricans*
Rufous hummingbird	*Selasphorus rufus*
Yellow-rumped warbler	*Setophaga coronata*
Yellow warbler	*Setophaga petechia*
Lawrence's goldfinch	*Spinus lawrencei*
Lesser goldfinch	*Spinus psaltria*
Northern rough-winged swallow	*Stelgidopteryx serripennis*
Caspian tern	*Sterna caspia*
European starling	*Sturnus vulgaris*
Tree swallow	*Tachycineta bicolor*
Violet-green swallow	*Tachycineta thalassina*
Bewick's wren	*Thryomanes bewickii*
California thrasher	*Toxostoma redivivum*
Solitary sandpiper	*Tringa solitaria*
House wren	*Troglodytes aedon*

Wildlife Observed in the Study Area During 2007 – 2012 Surveys	
Common Name	Latin Name
Western kingbird	*Tyrranus verticalis*
Barn owl	*Tyto alba*
Least Bell's vireo	*Vireo bellii pusillus*
Warbling vireo	*Vireo gilvus*
Mourning dove	*Zenaida macroura*

Appendix D – Plant and Wildlife Descriptions

Species Accounts

PLANTS WITH THE POTENTIAL TO OCCUR

California androsace (*Androsace elongata ssp. acuta*)

Status: California androsace has a CRPR 4.2, and is a U.S. Forest Service Watch List species. This species is not federally or State listed as threatened or endangered.

General Distribution: This species occurs from Oregon, throughout California, and into Baja California at elevations of 492 to 3,936 ft.

Distribution in the Study Area: There are several populations on the foothill desert slopes of the San Gabriel and Liebre Mountains. Suitable habitat is present.

Habitat and Habitat Associations: California androsace occurs in coastal scrub, chaparral, cismontane woodland, meadows and seeps, and valley and foothill grassland habitats.

Natural History: California androsace is an annual herb that is highly localized and often overlooked; many occurrences have been extirpated and it is very rare in Southern California. It flowers from March through June.

Threats: California androsace is possibly threatened by grazing, trampling, non-native plants, alteration of fire regimes, and recreational activities. It may also be threatened by wind energy development.

Slender silver moss (*Anomobryum julaceum*)

Status: Slender silver moss has a CRPR 2.2 This species is not federally or State listed as threatened or endangered.

General Distribution: This species occurs infrequently in California, but is abundant in Oregon. It can be found on road cuts at elevations of 300 to 3,000 feet.

Distribution in the Study Area: This species is represented in southern California from a single collection made from the high elevations of the San Gabriel Mountains. Suitable habitat is present in the project area.

Habitat and Habitat Associations: Slender silver moss grows on mesic soils and rocks along creeks in broadleaf and coniferous forests.

Natural History: Slender silver moss is a non-vascular moss.

Threats: This species may be threatened by human activities such as vehicle use, since it is often found along road cuts.

San Gabriel manzanita (*Arctostaphylos gabrielensis*)

Status: San Gabriel manzanita has a CRPR 1B.2, FSS This species is not federally or State listed as threatened or endangered.

General Distribution: This species is endemic to the San Gabriel Mountains near Mill Creek Summit, with an elevation range of 1900 to 5000 feet.

Distribution in the Study Area: This species is known from the upper watershed but the project area is below the elevation range for this species. It has a low potential to disperse into the project area from the upper watershed.

Habitat and Habitat Associations: San Gabriel manzanita is a large perennial evergreen shrub that grows on rocky chaparral habitats.

Natural History: San Gabriel manzanita blooms in March.

Threats: The primary threat to this species is development.

Palmer's mariposa lily (*Calochortus palmeri var. palmeri*)

Status: Palmer's mariposa lily has a CRPR 1B.2, and is designated a U.S. Forest Service Sensitive species. This species is not federally or State listed as threatened or endangered.

General Distribution: This species is endemic to California, and has been found in Kern, Los Angeles, Riverside, Santa Barbara, San Bernardino, San Luis Obispo, and Ventura counties. It occurs at elevations of 3,281-7,841 ft.

Distribution in the Study Area: This species was not observed during recent surveys but is known from the general area.

Habitat and Habitat Associations: Palmer's mariposa lily is found in wet meadows and seeps in lower montane coniferous forest and chaparral habitats.

Natural History: Palmer's mariposa lily is a perennial bulb that blooms from May through July.

Threats: This species is threatened by development, grazing, non-native plants, recreational activities and vehicles (CNPS, 2012).

Plummer's mariposa lily (*Calochortus plummerae*)

Status: Plummers's mariposa lily is a CRPR List 1B.2 species and is considered a U.S. Forest Service Sensitive species. This species is not federally or State listed as threatened or endangered.

General Distribution: Plummer's mariposa lily is known to occur in Riverside, San Bernardino, Orange, Los Angeles, and Ventura counties at elevations between 100 and 1,700 meters AMSL.

Distribution in the Study Area: This species was not documented within the Vegetation Study Area. The project is just outside of the known geographic range for this species but suitable habitat is present within the Vegetation Study Area.

Habitat and Habitat Associations: This bulbiferous herb is typically found in chaparral, coastal scrub, cismontane woodland, lower montane coniferous forest, and grassland, often on granitic and/or rocky soils, and blooms between May and July (CNPS, 2012).

Natural History: Perennial bulbs, including Plummer's mariposa lily, may persist below ground without producing flowers or even leaves during years of poor rainfall or other environmental causes. This species is identified by its (usually) toothed petal margins; petals covered with long yellow hairs inside; and its round, slightly depressed nectar gland at the base of each petal surrounded by hairs but without hairs on the nectary surface itself (Hickman, 1993). Seed dispersal for Calochortus is limited, with no obvious adaptations for wind or animal dispersal; fruits are capsular and borne close to the ground, with relatively heavy, passively dispersed seeds that lack fleshiness, sticktights, or (except in one species) wings (Patterson and Givnish, 2003). Typically, Calochortus flowers are generalists in terms of their pollinators, although bees have been observed to be the primary pollinator in some Calochortus species, such as Lyall's mariposa lily (C. lyallii) (Dilley *et al.*, 2000; Miller, 2000).

Threats: In addition to the direct loss of individuals, Plummer's mariposa lily is vulnerable to several effects related to urbanization. Non-native plant species, which compete for light, water, and nutrients, have been found to invade native vegetation communities and become established after repeated burnings, changes in surface and subsurface hydrologic conditions (changes in irrigation and runoff), use of chemical pollutants, clearing of vegetation, trampling, or following periods of drought and overgrazing, all of which are possible side effects of nearby human habitation. The successful invasion of exotic plant species may alter habitats and displace native species over time, leading to extirpation of natives such as the Plummer's mariposa lily.

Alkali mariposa lily (*Calochortus striatus*)

Status: Alkali mariposa lily has a CRPR 1B.2 and is designated a U.S. Forest Service Sensitive species. This species is not federally or State listed as threatened or endangered.

General Distribution: The geographic range of Alkali mariposa lily includes the southern Sierra Nevada; the western, central and southern Mojave Desert; the north base of the San Bernardino Mountains; the southern San Joaquin Valley; and disjunctly in southern Nevada. It occurs at elevations between 230ft and 5,232 feet.

Distribution in the Study Area: The species is known from alkaline soils in the Mojave Desert. Poor quality habitat was observed at the northern end of the haul roads but it is not expected in the project area.

Habitat and Habitat Associations: Alkali mariposa lily occurs in seasonally moist alkaline areas of arid lands (alkali meadows, ephemeral washes, vernally moist depressions, seeps; Fiedler 1985) in chaparral, chenopod scrub, and Mojavean desert scrub of southern California and southern Nevada.

Natural History: It is a perennial growing from a bulb; it has two or three slender, grass-like leaves that wither by the time the plant flowers (April through June). The flowers about 20-30 mm long, white to lavender with conspicuous purple veins. In dry years, the bulbs may remain dormant and no plants may be visible above-ground. It is threatened by the lowering of water tables, urbanization, trampling or grazing by cattle, and perhaps competition with native and non-native grasses (Greene and Sanders no date).

Threats: Alkali mariposa lilies face threats from urbanization, grazing, trampling, road construction, hydrological alterations, and water diversions that result in the lowering of the water table (CNPS 2012).

Peirson's morning-glory (*Calystegia peirsonii*)

Status: Peirson's morning glory has a CRPR 4.2. This species is not federally or State listed as threatened or endangered.

General Distribution: It is a rhizomatous perennial herb occurring in the San Gabriel and Liebre Mountains and the Antelope Valley of Los Angeles County (Allan et al. 1995), from about 100 ft. to 5000 feet elevation.

Distribution in the Study Area: This species was not observed during recent surveys but is known from the general area.

Habitat and Habitat Associations: It is a perennial vine found climbing over shrubs in coastal sage scrub, chaparral, and woodlands, often in the first few years following wildfire. It was known only from a few collections prior to 1970, but it is fairly common in the Newhall-Mint Canyon region (Boyd 1999).

Natural History: This perennial vine blooms from April to June.

Threats: Primary threats to this species include grazing and development (CNPS 2012).

Pygmy poppy (*Canbya candida*)

Status: Pygmy poppy has a CRPR 4.2 and is designated a U.S. Forest Service Sensitive species. This species is not federally or State listed as threatened or endangered.

General Distribution: Pygmy poppy is found in the foothills of the south-eastern Sierra Nevada range, the San Gabriel and San Bernardino Mountains, and in the Antelope Valley. It occurs at elevations of 1,968-4,790 feet.

Distribution in the Study Area: Suitable habitat is preset within the Vegetation Study Area and numerous historic records are known from the area.

Habitat and Habitat Associations: Pygmy poppy occurs in Joshua tree woodland, Mojavean desert scrub, or pinyon and juniper woodland habitats with gravelly, granitic, or sandy soils.

Natural History: Pygmy poppy is an annual herb of desert shrublands, only one or a few centimeters wide and tall. It may flower between March and June, depending on rainfall, and may not germinate at all in dry years.

Threats: This species may be threatened by land use changes, vehicles, and invasive non-native plants (CNPS 2012).

Mt. Gleason Indian paintbrush (*Castilleja gleasonii*)

Status: Mt. Gleason Indian paintbrush has a CRPR 1B.2, is State-listed as Rare, and is designated a U.S. Forest Service Sensitive species. This species is not federally or State listed as threatened or endangered.

General Distribution: Mt. Gleason Indian paintbrush is endemic to the San Gabriel Mountains of Los Angeles County.

Distribution in the Study Area: This species is known from higher elevation of the San Gabriel Mountains but several collections from lower elevations have been made. Suitable habitat is present.

Habitat and Habitat Associations: This species grows in rocky places within lower montane coniferous forest and pinyon and juniper woodland communities at elevations of 3800 to 7,120 feet (CNPS 2007).

Natural History: Mt. Gleason Indian paintbrush is a perennial hemi-parasitic herb in the figwort family (Scrophulariaceae) that blooms from May to June.

Threats: Threats to this species include recreational activities such as fuel wood harvesting, off-highway vehicle activities, and close proximity to trails and campgrounds (CNPS 2007).

Mojave Indian paintbrush (*Castilleja plagiotoma*)

Status: Mojave Indian paintbrush has a CRPR 4.3 and is designated a U.S. Forest Service Sensitive species. This species is not federally or State listed as threatened or endangered.

General Distribution: Mojave paintbrush is endemic to California, and is found in Kern, Los Angeles, San Bernardino, and San Luis Obispo counties at elevations between 984 and 8,200 feet.

Distribution in the Study Area: This species was not detected during recent surveys but suitable habitat is present within the Vegetation Study Area and it is known from the general vicinity.

Habitat and Habitat Associations: Mojave paintbrush is associated with Great Basin scrub, Joshua tree woodland, lower montane coniferous forest, and pinyon and juniper woodland habitats.

Natural History: Mojave paintbrush is a hemi-parasitic, perennial herb that blooms from April through June.

Threats: Threats to this species include recreational activities and road maintenance (CNPS 2012).

San Fernando Valley spineflower (*Chorizanthe parryi var. fernandina*)

Status: San Fernando Valley spineflower has a CRPR 1B.1 and is designated a U.S. Forest Service Sensitive species. It is listed as Endangered under the California Endangered Species Act and is a Candidate for federal listing.

General Distribution: It was historically known from the foothills surrounding the San Fernando Valley in Los Angeles County and from one site in Orange County. It had been presumed extinct, but was rediscovered on the Ahmanson Ranch in 1999 (Ventura County) in 1999 (Boyd 2001). Since then it has been discovered at Newhall Ranch (Los Angeles County; FWS 2002) and there are historic records from Newhall and Castaic (Boyd 1999). It occurs at elevations of 490 to 4,000 feet.

Distribution in the Study Area: The project area is outside of the historic range of the species; however suitable habitat is present.

Habitat and Habitat Associations: This species is found in sandy places, generally in coastal or desert shrublands; historically from San Fernando Valley, adjacent foothills, and coastal Orange County; it is now known only in E Ventura and W Los Angeles Counties; its habitat is open shrubland, generally on mesas or moderate slopes, in fine, silty sedimentary soils. It may also occur on alluvial benches or as occasional waifs in washes.

Natural History: San Fernando Valley spineflower is a low-growing annual species, flowering between April and June. It persists as long as a year after flowering season due to its wiry structure, and can be identified by its characteristic long straight spines even in dried condition.

Threats: This species is seriously threatened by development and non-native plants; most of its historical habitat is heavily urbanized.

California satintail (*Imperata brevifolia*)

Status: California satintail has a CRPR 2.1. This species is not federally or State listed as threatened or endangered.

General Distribution: California satintail occurs throughout the southwest U.S. at elevations below 4,000 feet. In California, it is known from only four extant occurrences, in Ventura, Los Angeles, and San Bernardino counties.

Distribution in the Study Area: Suitable habitat is present within the Vegetation Study Area but it was not detected during recent surveys and is not known from the area.

Habitat and Habitat Associations: Meadows and seeps within chaparral, coastal scrub, and Mojavean desert scrub communities.

Natural History: California satintail is a perennial grass that blooms from September to May.

Threats: Agriculture and development are threats to this species (CNPS, 2012).

Ocellated Humboldt lily (*Lilium humboldtii ssp. ocellatum*)

Status: Ocellated Humboldt lily has a CRPR of 4.2 and is a U.S. Forest Service Watch List species. This species is not federally or State listed as threatened or endangered.

General Distribution: It grows in shaded riparian woodlands of the Coast Ranges, Peninsular Ranges, and Transverse Ranges, from San Luis Obispo County to San Diego County, and inland to the San Bernardino and San Jacinto Mountains. Its elevation range is from just above sea level to about 6000 feet.

Distribution in the Study Area: This species is known from deep shaded canyons throughout the San Gabriel Mountains but it was not detected during recent surveys and is not known from the area.

Habitat and Habitat Associations: Riparian woodland openings within chaparral, cismontane woodland, coastal scrub, and lower montane coniferous forest communities; generally on gravelly soils within gullies.

Natural History: Depending on elevation, it may flower as early as March, but generally flowers in early to mid-summer in montane habitats.

Threats: This species may be threatened by development and horticultural collecting.

Lemon lily (*Lilium parryi*)

Status: Mojave Indian paintbrush has a CRPR 1B.2 and is designated a U.S. Forest Service Sensitive species. This species is not federally or State listed as threatened or endangered.

General Distribution: Lemon lily can be found in suitable habitats with elevations of 4,000 to 9,000 feet.

Distribution in the Study Area: Known from the upper reaches of the drainage but the project area is below the elevation range for this species and the project area lacks suitable habitats.

Habitat and Habitat Associations: Lemon lily can be found in meadows and seeps within lower and upper montane coniferous forests communities.

Natural History: Lemon lily is a perennial bulb that blooms from July to August.

Threats: Threats to this species include horticultural collecting, water diversion, recreational activities, and grazing (CNPS, 2012).

San Gabriel linanthus (*Linanthus concinnus*)

Status: San Gabriel linanthus has a CRPR 1B.2 and is designated a U.S. Forest Service Sensitive species. This species is not federally or State listed as threatened or endangered.

General Distribution: This species is endemic to the San Gabriel Mountains of southern California, occuring at elevations of 5,000 to 9,200 feet.

Distribution in the Study Area: Known from higher elevation areas of the San Gabriel Mountains, the project area is well below the elevation range of the species.

Habitat and Habitat Associations: San Gabriel linanthus is associated with dry rocky slopes within chaparral and montane coniferous forest communities.

Natural History: San Gabriel linanthus is an annual herb that blooms from April to July.

Threats: This species is threatened by recreational activities and road maintenance.

Sagebrush loeflingia (*Loeflingia squarrosa var. artemisiarum*)

Status: Sagebrush loeflingia has a CRPR 2.2. This species is not federally or State listed as threatened or endangered.

General Distribution: Sagebrush loeflingia is widespread at scattered locations in California deserts and more common to the east (Nevada) at elevations of 2,200 to 5,300 feet.

Distribution in the Study Area: The species is known from very few locations in the vicinity of alkali flats to the north of the project area. Poor quality habitat was observed at the northern end of the haul roads but it is not expected in the project area.

Habitat and Habitat Associations: Sagebrush loeflingia is found in sandy soils (dunes) in Great Basin scrub and Sonoran desert scrub.

Natural History: It is an annual herb, flowering in April or May, depending on rainfall. Like most desert annuals, it may not germinate at all during drought years.

Threats: This species may be threatened by grazing and vehicles.

Peirson's lupine (*Lupinus peirsonii*)

Status: Peirson's lupine has a CRPR 1B.3 and is designated a U.S. Forest Service Sensitive species. This species is not federally or State listed as threatened or endangered.

General Distribution: This species is known only from the San Gabriel Mountains, at elevations of 3,200 to 8,200 feet.

Distribution in the Study Area: This species is not known from the project vicinity but it is known from the upper reaches of the watershed, could be present within the vegetation study area as a wash-down waif species.

Habitat and Habitat Associations: Peirson's lupine occurs on gravelly or rocky slopes within Joshua tree woodland, lower and upper montane coniferous forest, and pinyon and juniper woodland communities.

Natural History: This species is a perennial herb that blooms from April to May.

Threats: This species may be threatened by development in the San Gabriel Mountains.

Davidson's bush-mallow (*Malacothamnus davidsonii*)

Status: Davidson's bush-mallow has a CRPR 1B.2. This species is not federally or State listed as threatened or endangered.

General Distribution: Its geographic range is the western margin of the San Gabriel Mountains and San Fernando Valley (Allan et al. 1995) and reportedly from the central coast ranges (Monterey and San Luis Obispo Counties; Tibor 2001), between about 600 and 2800 feet elevation.

Distribution in the Study Area: There are very few records of this species within the general vicinity of the project area.

Habitat and Habitat Associations: Davidson's bush-mallow occurs in chaparral, coastal sage scrub, cismontane woodland, riparian woodland, and open sandy alluvial benches and washes.

Natural History: Davidson's bush-mallow is a shrub that flowers in summer (June - September) but can be identified without flowers, by characteristics of its stems and leaves.

Threats: In Los Angeles County, this species may be threatened by urbanization (CNPS, 2012).

Robbins' nemacladus (*Nemacladus secundiflorus var. robbinsonii*)

Status: Robbins' nemacladus has a CRPR 1B.2. This species is not federally or State listed as threatened or endangered.

General Distribution: Known occurrences of this species have been recorded as far north as San Benito Canyon, and as far south as the San Gabriel Mountains, at elevations of 875 to 4250 feet.

Distribution in the Study Area: The subspecies is known from a single location in the San Gabriel Mtns, east of the Project Area. No suitable habitat is present.

Habitat and Habitat Associations: This species can be found in openings in chaparral and foothill grasslands.

Natural History: Robbins' nemacladus is an annual herb that blooms from April through June.

Threats: Road maintenance and widening may be a threat to this species (CNPS 2012).

Woolly mountain-parsley (*Oreonana vestitia*)

Status: Wooly mountain parsley has a CRPR 1B.3 and is designated a U.S. Forest Service Sensitive species. This species is not federally or State listed as threatened or endangered.

General Distribution: Wooly mountain-parsley occurs at elevations of 6,500 to 11,500 feet in the San Gabriel and San Bernardino mountains, as well as near Walker Pass.

Distribution in the Study Area: This species is not known from the project vicinity and the project area is well below the elevation range of this species.

Habitat and Habitat Associations: This species grows along ridge tops and on rocky soils such as dry gravel or talus in lower and upper montane coniferous forest and subalpine coniferous forest.

Natural History: Wooly mountain-parsley is a perennial herb that blooms from March to September.

Threats: Threats to this species include foot traffic and recreational activities within its habitat (CNPS 2012).

Rock Creek broomrape (*Orobanche valida ssp. valida*)

Status: Rock Creek broomrape has a CRPR 1B.2 and is designated a U.S. Forest Service Sensitive species. This species is not federally or State listed as threatened or endangered.

General Distribution: In California, this species has occurs in the San Gabriel and the Topatopa Mountains, at elevations of 4,000 to 7,000 feet.

Distribution in the Study Area: This species is not known from the project vicinity and the project area is below the elevation range of this species.

Habitat and Habitat Associations: Rock Creek broomrape grows on granitic soils within chaparral and pinyon and juniper woodland communities.

Natural History: Rock Creek broomrape is a parasitic, perennial herb that blooms from May through July.

Threats: This species may possibly be threatened by non-native plants and recreational activities (CNPS, 2012).

Mason's neststraw (*Stylocline masonii*)

Status: Mason's neststraw is a federal species of concern and has a CRPR 1B.1.

General Distribution: Mason's neststraw is known only from the southern San Joaquin Valley and adjacent inner coastal ranges (Morefield, 1992) and the desert slopes of the Liebre Mountains in Los Angeles County (Ross and Boyd, 1996), between 300 and 1300 feet in elevation (and rarely to almost 4000 feet).
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Distribution in the Study Area: This species is not known from the project vicinity but suitable habitat is present.

Habitat and Habitat Associations: Mason's neststraw occurs in open, dry sandy soils in juniper woodland or saltbush scrub vegetation.

Natural History: Mason's neststraw is a diminutive ephemeral annual herb that flowers between March and May.

Threats: A major threat to Mason's neststraw is disturbances from land use conversion.

Greata's aster (*Symphytotrichum greatae*)

Status: Greata's aster has a CRPR 1B.3. This species is not federally or State listed as threatened or endangered.

General Distribution: Its geographic range is the Liebre and San Gabriel Mountains, between about 1000 and 6600 feet elevation.

Distribution in the Study Area: Greata's aster is known from the upper watershed and although the habitat in the project area is not ideal, it has some potential to occur.

Habitat and Habitat Associations: Greata's aster generally occurs along streams, near springs, or where ground water nears the surface in chaparral, woodlands, and lower montane forests.

Natural History: This species is a tall, perennial herb with daisy-like flowers, which blooms from June through October.

Threats: Greata's aster is threatened by recreational activities, trail maintenance, and non-native plants (CNPS, 2012).

WILDLIFE WITH THE POTENTIAL TO OCCUR

INVERTEBRATES

Trask shoulderband snail (*Helminthoglypta traskii*)

Status: The trask shoulderband snail is considered a CDFG Special Animal. This taxon is not federally or State listed as threatened or endangered.

General Distribution: This snail is a southern California endemic, known from Ventura, Los Angeles, Orange, and San Diego Counties (Magney, 2005).

Distribution in the Study Area: Although there are no known records from the Study Area, the Study Area is located within the known geographic distribution for this species. Suitable habitat occurs throughout the Study Area. All areas of suitable habitat should be considered potentially occupied.

Habitat and Habitat Associations: Trask shoulderband snails are terrestrial and occur in a variety of habitats, including coastal sage scrub, chaparral, oak woodland, and riparian woodland.

Natural History: *Haplotrema* is a genus of predatory, air-breathing terrestrial snails. The shells of these snails vary in size from relatively small to medium and usually consist of a low, flattened spire and very wide umbilicus. The structure of the radula, or teeth, is unusual in this genus. The haplotrematids have fewer cusps than most snails, but they are considerably elongated (hence the name "lancetooth"), suitable for predatory behavior. The known diet of these snails consists entirely of other terrestrial mollusks (Pilsbry, 1946).

Members of the genus *Helminthoglypta* are air-breathing, terrestrial snails. Shells are relatively medium to large in size, with no apertural teeth, but usually with a reflected apertural lip. These snails possess a single dart apparatus with one stylophore (dart sac) and two mucus glands which are utilized to create love darts. Love darts, shaped in many distinctive ways which vary considerably between species, are hard, sharp, calcareous or chitinous darts that are used as part of the sequence of events during courtship before actual mating takes place.

Threats: There are no identified threats to these species.

San Emigdio blue butterfly (*Plebulina emigdionis*)

Status: The San Emigdio blue butterfly is designated by CDFG as a California Special Animal. This taxa is not federally or State listed as threatened or endangered.

General Distribution: The San Emigdio blue butterfly is restricted to southern California in lower Sonoran and riparian habitats from the Owens Valley south to the Mojave River, and west to northern Ventura and Los Angeles Counties. The primary location where this species has been collected is along the Mojave River near Victorville, but isolated colonies have been reported in Bouquet and Mint canyons near Castaic, in canyons along the north side of the San Gabriel Mountains near the desert's edge, and in arid areas south of Mount Abel near San Emigdio Mesa (Emmel and Emmel, 1973; Murphy, 1990).

Distribution in the Study Area: There are no known recent records for this species in the Study Area. The Study Area is located within the known geographic distribution for this species. Suitable habitat occurs within limited portions of the Study Area.

Habitat and Habitat Associations: This butterfly can be locally abundant in association with its primary host plant, four-wing saltbush (*Atriplex canescens*), but has also been observed in association with quail brush (*A. lentiformis*).

Natural History: Although its primary host plant is widespread throughout the western United States, the distribution of the San Emigdio blue butterfly is much more localized, suggesting that other factors may determine habitat suitability (Murphy, 1990). For example, habitat suitability may, at least in part, be attributed to a suspected symbiotic relationship with at least one ant species, *Formica pilicornis* (Ballmer and Pratt, 1991). These ants presumably extract droplets containing glucose and amino acids from the nectary glands of San Emigdio blue butterfly larvae and provide the butterfly larvae protection from predators.

San Emigdio blue butterfly adults are active from late April to early September. The species can have up to three broods per year, with the first brood generally occurring in late April to May, the second brood in late June to early July, and the third brood in August to early September (Emmel and Emmel, 1973). Adults are generally observed perching on their host plant or other plants in the immediate vicinity, and nectaring on nearby flowers.

Threats: The San Emigdio blue butterfly has a limited distribution and often occurs in small, isolated colonies. These characteristics make colonies vulnerable to direct and indirect habitat disturbance, given the limited extent of occupied habitat and limited potential for recolonization. Many colonies in the Mojave Desert and Owens Valley are isolated from anthropogenic disturbances, but other colonies found closer to growing urban areas may be situated near major roads, railroad tracks, and other developments, which may contribute to further decline.

AMPHIBIANS

Mountain (foothill) yellow-legged frog (*Rana boylii*)

Status: Mountain yellow-legged frog is a CDFG Species of Special Concern. This species is not federally or State listed as threatened or endangered.

General Distribution: Range includes Pacific drainages from the upper reaches of the Willamette River system, Oregon (west of the Cascades crest), south to the upper San Gabriel River, Los Angeles County, California, including the Coast Ranges and Sierra Nevada foothills in the United States

(Stebbins 2003). The species occurred at least formerly in a disjunct location in northern Baja California. [Natureserve, 2012]

Distribution in the Study Area: Although suitable habitat occurs within portions of the Study Area, it is outside the known range of this subspecies.

Habitat and Habitat Associations: In the mountains of southern California, inhabits rocky streams in narrow canyons and in the chaparral belt from 984 ft. to over 12,000 ft. in elevation. [CaliforniaHerps, 2011]

Natural History: This small frog differs from the related red-legged frog in having yellow on its hind limbs and having no well-developed dorsolateral folds (Natureserve, 2012). Most often found in or close to water and preys on a variety of terrestrial and aquatic invertebrates with mating and egg laying activities taking place from March – May (CaliforniaHerps, 2011).

Threats: Primary threats to this species include predation by non-native amphibians and fish, cattle grazing, off highway vehicle use, excessive flooding and poor water quality.

Western spadefoot (*Spea hammondii*)

Status: The western spadefoot toad is a CDFG Species of Special Concern. This species is not federally or State listed as threatened or endangered.

General Distribution: The western spadefoot toad is endemic to California and northern Baja California. The species ranges from the north end of California's great Central Valley near Redding, south, east of the Sierras and the deserts, into northwest Baja California (Jennings and Hayes, 1994; Stebbins, 2003; all as cited in USACE and CDFG, 2010).

Distribution in the Study Area: There are no known records for this species in the Study Area within a 15 mile radius. The Study Area is located just outside the known geographic distribution for this species. Pockets of suitable habitat occur within the Study Area.

Habitat and Habitat Associations: Although the species primarily occurs in lowlands, it also occupies foothill and mountain habitats. Within its range, the western spadefoot toad occurs from sea level to 1,219 meters (4,000 feet) AMSL, but mostly at elevations below 910 meters (3,000 feet) AMSL (Stebbins, 2003; as cited in USACE and CDFG, 2010). Holland and Goodman (1998) report that riparian habitats with suitable water resources may also be used. The species is most common in grasslands with vernal pools or mixed grassland/coastal sage scrub areas (Holland and Goodman, 1998; as cited in USACE and CDFG, 2010).

Natural History: The western spadefoot toad is almost completely terrestrial, remaining underground eight to 10 months of the year and entering water only to breed (Jennings and Hayes, 1994; Holland and Goodman, 1998; Storey *et al.*, 1999; all as cited in USACE and CDFG, 2010). The species aestivates in upland habitats near potential breeding sites in burrows approximately one meter in depth (Stebbins, 1972) and adults emerge from underground burrows during relatively warm rainfall events to breed. While adults typically emerge from burrows from January through March, they may also emerge in any month between October and April if rain thresholds are met (Stebbins, 1972; Morey and Guinn, 1992; Jennings and Hayes, 1994; Holland and Goodman, 1998; all as cited in USACE and CDFG, 2010).

Eggs are deposited in irregular small clusters attached to vegetation or debris (Storer, 1925; as cited in USACE and CDFG, 2010) in shallow temporary pools or sometimes ephemeral stream courses (Stebbins, 1985; Jennings and Hayes, 1994; all as cited in USACE and CDFG, 2010) and are usually hatched within six days. Complete metamorphosis can occur rapidly, within as little as three weeks (Holland and Goodman, 1998; as cited in USACE and CDFG, 2010), but may last up to 11 weeks (Burgess, 1950; Feaver, 1971; Jennings and Hayes, 1994; all as cited in USACE and CDFG, 2010).

Western spadefoot toads likely do not move far from their breeding pool during the year (Zeiner *et al.*, 1988; as cited in USACE and CDFG, 2010), and it is likely that their entire post-metamorphic home range is situated around a few pools. However, opportunistic field observations indicate that they readily move up to at least several hundred meters from breeding sites (NatureServe, 2012).

Threats: Loss of aquatic and adjacent upland habitats supporting the life cycle of the western spadefoot toad is a primary threat to this species, but other factors related to urban development probably are contributing to this species' decline.

Coast Range newt (*Taricha torosa torosa*)

Status: The Coast Range newt is a CDFG Species of Special Concern. This taxon is not federally or State listed as threatened or endangered.

General Distribution: The Coast Range newt occurs along the coast ranges of California, from Mendocino County south to Los Angeles County and disjunctly south to the Cuyumaca Mountains in San Diego County (NatureServe, 2012). This subspecies has also been recorded along the southern Sierra Nevada from Tulare County to Kern County (Kuchta and Tan, 2006).

Distribution in the Study Area: Suitable habitat occurs onsite. Nearest recorded occurrence is approximately 14.5 miles southeast of the Study Area in the west fork of Bear Creek.

Habitat and Habitat Associations: This subspecies breeds in ponds, reservoirs, and streams. Terrestrial adults occupy various adjacent upland habitats, including grasslands, woodlands, and forests (NatureServe, 2012).

Natural History: The Coast Range newt belongs to the genus *Taricha*, whose members are readily distinguishable from all other western salamanders by a distinctive tooth pattern, lack of costal grooves, and rough skin (except in breeding males) (Stebbins, 2003). Migration towards suitable breeding grounds usually occurs at night following the first rains in the fall (CDFG, 2008). Upon arriving at breeding sites, adults become aquatic and may remain at these sites for several weeks. Breeding typically occurs between December and May with optimal peaks between February and April (NatureServe, 2012). Adults migrate back to subterranean refuges during the spring and remain at these aestivation sites through the summer. Larvae normally transform in the summer or fall, or when water dries up, of their first year (CDFG, 2008). Metamorphosed individuals feed on earthworms, snails, slugs, sow bugs, and various other invertebrates. Some adults, especially females may consume conspecific eggs. Larvae eat small aquatic organisms and decomposing organic material (Stebbins, 1951).

Threats: This subspecies has suffered marked population declines likely due to the introduction of exotic predators, including green sunfish (*Lepomis cyanellus*), mosquito fish, and crayfish (*Procambarus* sp.) (Stebbins, 2003).

San Gabriel Mountains slender salamander (*Batrachoseps gabrieli*)

Status: The San Gabriel Mountains slender salamander is a U.S. Forest Service Sensitive Species. This taxon is not federally or State listed as threatened or endangered.

General Distribution: This species is known from select localities in the San Gabriel Mountains and the Mt. Baldy area of Los Angeles County and the western end of the San Bernardino Mountains in San Bernardino Co., with an elevation range of 1,200 -5,085 feet (Stebbins, 2003).

Distribution in the Study Area: The San Gabriel slender salamander is not known to occur in Study Area but could potentially utilize Littlerock Creek and adjacent riparian areas. The Study Area is outside of the known range of this species but it is known from the portions of the San Gabriel Mountains to the south of the Study Area.

Habitat and Habitat Associations: This species occurs on talus slopes surrounded by a variety of conifer and montane hardwood species, including bigcone spruce, pine, white fir, incense cedar, canyon live oak, black oak, and California laurel (Wake 1996, Stebbins, 2003).

Natural History: Known to seek cover in cavities below talus rocks and under logs. Because of the need for moisture, near-surface activity is probably limited to a few winter and early spring months (Wake, 1996). Summer and fall drought probably cause individuals to retreat deep into the talus slope (Wake 1996).

Threats: Habitat degradation is the main threat to this species.

REPTILES

Southwestern pond turtle (*Actinemys marmorata pallida*)

Status: The southwestern pond turtle is a CDFG Species of Special Concern. This taxon is not federally or State listed as threatened or endangered.

General Distribution: This subspecies occurs from northwestern Baja California north through western California to the central region of the state, where it intergrades with the northwestern pond turtle (*C. m. marmorata*) (Seeliger, 1945; Bury, 1970).

Distribution in the Study Area: This species was observed within the Study Area (above and below the Reservoir) during surveys conducted in 2012. The Study Area is located within the known geographic distribution for this species.

Habitat and Habitat Associations: Southwestern pond turtles inhabit permanent or nearly permanent bodies of water in a wide variety of habitat types. Suitable basking sites, such as partially submerged logs, vegetation mats, or open mud banks are a required element for this subspecies.

Natural History: The southwestern pond turtle is a subspecies of western pond turtle (*C. marmorata*) which represent the only abundant native turtles in California. This species is thoroughly aquatic and is possesses a low carapace typically olive, brown, or blackish in color (Stebbins, 2003). The subspecies usually lays a clutch of 3 to 14 eggs between April and August as females may move overland up to over 300 feet to find suitable nesting sites. Nests have been observed in many soil types from sandy to very hard and soils must be at least four inches deep for nesting (CDFG, 2008). Most activity is diurnal, but some crepuscular and nocturnal behavior has been observed (CDFG, 2008). Southwestern pond turtles feed on aquatic plants, insects, worms, fish, amphibian eggs and larvae, crayfish, and carrion (Stebbins, 2003).

Threats: Western pond turtles are estimated to be in decline across 75-80 percent of their range (Stebbins, 2003). The primary reason for this decline has been attributed to loss of suitable habitat associated with urbanization, agricultural activities, and flood control and water diversion projects (Jennings *et al.*, 1992).

Coast (San Diego) horned lizard (*Phrynosoma coronatum* [*blainvillii* population])

Status: The coast (San Diego) horned lizard is a CDFG Species of Special Concern. This taxon is not federally or State listed as threatened or endangered.

General Distribution: The coast (San Diego) horned lizard's historic range extended from the Transverse Ranges in Kern, Los Angeles, Santa Barbara, and Ventura Counties south through the Peninsular Ranges of southern California and into Baja California, Mexico as far south as San Vicente, however, the current range is much more fragmented (Jennings and Hayes, 1994).

Distribution in the Study Area: This species was documented within a sandy drainage, adjacent to the main access road through the Reservoir, during surveys conducted in 2012. The Study Area is located within the known geographic distribution for this species; suitable habitat occurs in portions of the Study Area.

Habitat and Habitat Associations: The coast (San Diego) horned lizard occurs in a wide variety of habitats throughout its range, though is found primarily in chaparral and mixed chaparral-coastal sage scrub, to stands of pure coastal sage scrub. It is also known to occur in riparian habitats, washes, and most desert habitats. They are occasionally locally abundant in conifer-hardwood and conifer forests. This species is most common in open, sandy areas where abundant populations of native ant species (e.g., *Pogonomyrmex* and *Messer* spp.) are present.

Natural History: The coast (San Diego) horned lizard is a flat bodied lizard with a wide, oval-shaped body and scattered enlarged pointed scales on the upper body and tail. Coast (San Diego) horned lizards are oviparous and lay one clutch of 6-17 (average 11-12) eggs per year from May through early July (Jennings and Hayes, 1994). Incubation occurs for two months and hatchlings first appear in late July and early August. It is surface active primarily from April to July. This species spends a considerable amount of time basking, either with the body buried and head exposed, or with the entire body oriented to maximize exposure to the sun. Although little is known about longevity in the wild, adults are thought to live for at least eight years (Jennings and Hayes, 1994). They primarily eat native harvester ants (*Pogonmyrmex* spp.) and do not appear to eat invasive Argentine ants that have replaced native ants in much of central and southern California. This species is an opportunistic feeder, and while harvester ants can comprise upwards of 90% of their diet, they will feed on other insect species when those species are abundant (Jennings and Hayes, 1994). Defense tactics used by this species include remaining motionless to utilize its cryptic appearance, only running for the nearest cover when disturbed or touched. Captured lizards puff up with air to appear larger, and if roughly handled, will squirt blood from a sinus in each eyelid (Jennings and Hayes, 1994).

Threats: Though once common throughout much of coastal and cismontane southern California, coast (San Diego) horned lizards have disappeared from much of their former range. Their population decline is mainly attributed to habitat loss due to urbanization and agricultural conversion. The introduction of non-native Argentine ants (*Iridomyrmex humilis*), which are inedible to horned lizards and tend to displace native carpenter and harvester ants, is another factor in their decline.

Two-striped garter snake (*Thamnophis hammondii*)

Status: The two-striped garter snake is a CDFG Species of Special Concern. This taxon is not federally or State listed as threatened or endangered.

General Distribution: This species occurs along a continuous range from northern Monterey County south through the South Coast and Peninsular Ranges to Baja California. Isolated populations also occur through southern Baja California, Catalina Island, and desert regions along the Mojave and Whitewater Rivers in San Bernardino and Riverside Counties, respectively (Jennings and Hayes, 1994). This species typically occurs at elevations ranging between sea level and approximately 8,000 feet (Jennings and Hayes, 1994).

Distribution in the Study Area: This species was documented within the Study Area downstream of the dam and upstream of Rocky Point. Surveys conducted in 2012. The Study Area is located within the known geographic distribution for this species; suitable habitat occurs throughout the Study Area.

Habitat and Habitat Associations: This species is primarily associated with aquatic habitats that border riparian vegetation and provide nearby basking sites (Jennings and Hayes, 1994). These areas typically include perennial and intermittent streams and ponds in a variety of vegetation communities, including chaparral, oak woodland, and forest habitats (Jennings and Hayes, 1994). During the winter, two-striped garter snakes will seek refuge in upland areas, such as adjacent grassland and coastal sage scrub (Rossman *et al.*, 1996).

Natural History: After several taxonomic revisions, two-striped garter snake has been recognized as a separate species where it had previously been considered a subspecies of the western aquatic garter snake (*T. couchii*) (Rossman and Stewart, 1987). This species is usually morphologically distinguished by the lack of a mid-dorsal stripe. Two-striped garter snakes breed from late March to early April and young are typically born between late July and August; however, some have been observed as late as November

(Rossman *et al.*, 1996; Jennings and Hayes, 1994). Two-striped garter snakes hibernate during the winter months, however, they have been observed actively above ground on warm winter days (Jennings and Hayes, 1994). The mainly aquatic diet of this species consists primarily of fish, fish eggs, and tadpoles and metamorphs of toads and frogs; however, they will also consume worms and newt larvae (Jennings and Hayes, 1994).

Threats: Lind (1998b) noted that quantity and quality of habitat for two-striped garter snakes is declining throughout much of its range. More than forty percent of this species' historic range has been lost (Jennings and Hayes, 1994). Primary factors for the decline of this species in southern California include habitat conversion and degradation resulting from urbanization, construction of reservoirs, and cement-lining of stream channels.

Coastal rosy boa (Charina trivirgata roseofusca)

Status: The rosy boa is designated by CDFG as a California Special Animal. This taxon is not federally or State listed as threatened or endangered.

General Distribution: The rosy boa in California ranges from Los Angeles, eastern Kern, and southern Inyo counties, and south through San Bernardino, Riverside, Orange, and Diego counties (Spiteri, 1988; Stebbins, 2003; Zeiner *et al.,* 1988). The species occurs at elevations from sea level to 5,000 feet AMSL in the Peninsular and Transverse mountain ranges. Within its range in southern California, the rosy boa is absent only from the southeastern corner of California around the Salton Sea and the western and southern portions of Imperial County (Zeiner *et al.,* 1988).

Distribution in the Study Area: Suitable habitat is present within the Study Area outside the perimeter of the Reservoir. This species was reported approximately 6 miles west of the Study Area in June 2009 along a transmission line corridor.

Habitat and Habitat Associations: The rosy boa inhabits rocky shrubland and desert habitats and is attracted to oases and streams but does not require permanent water (Stebbins, 2003). In coastal areas, the rosy boa occurs in rocky chaparral-covered hillsides and canyons, while in the desert it occurs on scrub flats with good cover (Zeiner *et al.,* 1988).

Natural History: Rosy boas are primarily nocturnal but may be active at dusk and rarely in the daytime (Stebbins 2003). Rosy boas are active between April and September (Holland and Goodman 1998). The rosy boa may aestivate in the hottest months and hibernate in the coolest months of the year, remaining inactive in burrows or under surface debris (NatureServe, 2012). There is little information on the foraging habits or prey species for the rosy boa. Holland and Goodman (1998) and Stebbins (2003) indicate that this species preys upon small mammals (including pocket mice (*Chaetodipus* and *Perognathus* spp.) and young woodrats), reptiles, amphibians, and birds.

Threats: This species may be threatened with local extirpation in coastal regions of southern California resulting from development-related habitat fragmentation and isolation of populations. The species is noted to search black top roads for prey (Stebbins, 2003), making it vulnerable to road mortality. Other potential threats related to urban development include the use of rodenticides near open space, which could result in fewer mammal burrows that provide refugia and a reduced prey base, collecting of snakes (the rosy boa is popular in the pet trade (NatureServe, 2012)), and habitat degradation (*e.g.*, trampling of vegetation and introduction of exotic species).

San Bernardino ringneck snake (Diadophis punctatus modestus)

Status: The San Bernardino ringneck snake is designated by CDFG as a California Special Animal. This taxon is not federally or State listed as threatened or endangered.

General Distribution: The ringneck snake is widespread in California and is absent only from large portions of the Central Valley, high mountains, desert, and areas east of the Sierra–Cascade crest (Zeiner *et al.,* 1988). Currently there are six recognized subspecies in California occurring at elevations ranging from sea level to 2,150 meters (7,050 feet) AMSL (Zeiner *et al.,* 1988). The San Bernardino ringneck snake subspecies is found along the southern California coast from the Santa Barbara area south to northern San Diego County, and inland into the San Bernardino Mountains.

Distribution in the Study Area: Suitable habit occurs within the Study Area; however, there are no known reports of this species within or adjacent to the Study Area.

Habitat and Habitat Associations: The ringneck snake is found in moist habitats, including woodlands, hardwood and conifer forest, grassland, sage scrub, chaparral, croplands/hedgerows, and gardens (NatureServe, 2012; Stebbins, 2003).

Natural History: A fair amount of information is available for the full species ringneck snake (*Diadophis punctatus*), while less information is available for the subspecies San Bernardino ringneck snake (*D. p. modestus*). Therefore, much of this discussion is based on the life history of the full species ringneck snake, with expected similarities occurring in behaviors and habitat associations with the San Bernardino ringneck snake subspecies.

During the day in the spring and summer, ringneck snakes are typically found under surface objects (Holland and Goodman, 1998; Zeiner *et al.,* 1988), with crepuscular (dawn and dusk) and some nocturnal activity observed during the summer (Holland and Goodman, 1998; Zeiner *et al.* 1988). Ringneck snakes may aestivate during the heat of summer and are generally inactive and hibernate during the winter (NatureServe, 2012).

Threats: Habitat degradation is the main threat to San Bernardino ringneck snakes.

Desert tortoise (Gopherus agassizii)

Status: The desert tortoise is Federal-listed and State-listed as Threatened.

General Distribution: The desert tortoise is an herbivorous reptile that occurs in the Mojave and Sonoran deserts in southern California, southern Nevada, Arizona, and the southwestern tip of Utah in the U.S., as well as Sonora and northern Sinaloa in Mexico. The designated Mojave population of the desert tortoise includes those animals living north and west of the Colorado River in the Mojave Desert of California, Nevada, Arizona, and southwestern Utah, and in the Sonoran (Colorado) Desert in California (USFWS, 2011a).

Distribution in the Study Area: The Study Area lies outside of the known range of this species; portions of the identified haul routes however do occur within the range and have suitable habitat.

Habitat and Habitat Associations: The desert tortoise occupies a variety of habitats from flats and slopes typically characterized by creosote bush scrub at lower elevations to rocky slopes in blackbrush scrub and juniper woodland ecotones (transition zone) at higher elevations. Throughout most of the Mojave Desert, tortoises occur most commonly on gently sloping terrain with sandy-gravel soils and where there is sparse cover of low-growing shrubs, which allows establishment of herbaceous (non-woody) plants. However, surveys at the Nevada Test Site revealed that tortoise sign (e.g., scat, burrows, tracks, shells) was more abundant on upper alluvial fans and low mountain slopes than on the valley bottom. Soils must be friable (easily crumbled) enough for digging burrows, but firm enough so that burrows do not collapse.

Natural History: During the winter, tortoises will opportunistically use burrows of various lengths, deep caves, rock and caliche crevices, or overhangs for cover. Neonate desert tortoises use abandoned rodent burrows for daily and winter shelter; these burrows are often shallowly excavated and run parallel to the surface of the ground (USFWS, 2011a).

Threats: Threats to the desert tortoise include degradation and loss of habitat (including through the spread of nonnative, invasive plants), disease, raven predation on juvenile tortoises, collection for the pet trade, and direct mortality and crushing of burrows by off-highway vehicles.

San Bernardino mountain kingsnake (*Lampropeltis zonata parvirubra*)

Status: The San Bernardino mountain kingsnake is a CDFG Species of Special Concern. This taxon is not federally or State listed as threatened or endangered.

General Distribution: The San Bernardino mountain kingsnake is only known to occur within the San Bernardino Mountains and San Jacinto Mountains bioregions above 4,500 feet (Fisher and Case, 1997).

Distribution in the Study Area: While suitable habitat occurs within the Study Area it is outside of the known geographic distribution for this species.

Habitat and Habitat Associations: San Bernardino mountain kingsnakes are restricted to rock outcrops, talus, and steep shady canyons within coniferous and mixed coniferous, hardwood, or riparian woodlands and other edge habitats when associated with coniferous habitat.

Natural History: This species is normally diurnally and crepuscularly active from mid-March to mid-October at lower elevations with a reduced period at higher elevations (Newton and Smith 1975; Zeiner et al. 1988; Holland and Goodman 1998). Their diet is known to include lizards, lizard eggs, smaller snakes, nestling birds and eggs, and small mammals.

Threats: Poaching is a major threat to this species. Firewood harvesting is another threat, as collection of fallen wood removes the ground debris that is a limiting habitat requirement for this species.

BIRDS

Tricolored blackbird (*Agelaius tricolor*)

Status: The tricolored blackbird is a CDFG Species of Special Concern. This taxon is not federally or State listed as threatened or endangered.

General Distribution: This species is primarily a permanent resident across its range in California and occurs throughout the Central Valley and in coastal districts from Sonoma County south to Baja California.

Distribution in the Study Area: There are no known recent records for this species in the Study Area; the Study Area is located within the known geographic range for this species; suitable breeding and foraging habitat occurs, depending on water levels, within the upper extents of the Reservoir (changes year to year). Nearest recorded occurrence is approximately seven miles northwest of the Study Area in Lake Palmdale.

Habitat and Habitat Associations: The tricolored blackbird breeds near fresh water, preferably in emergent wetland with tall dense cattails (*Typha* spp.) or tules, but also in thickets of willows, blackberry, wild rose, and tall herbs (CDFG, 2008). This species forages primarily in grassland and cropland habitats.

Natural History: The tricolored blackbird is distinguishable from similar species by dark red shoulder patches with broad white tips bordering the distal side. This highly gregarious species is highly colonial and nesting areas must be large enough to support a minimum colony of roughly fifty pairs (Grinnell and Miller, 1944). Tricolored blackbirds are polygynous and during the breeding season, which typically occurs from mid-April into late July, each male may claim several mates nesting in his small territory. Foraging generally occurs in the vicinity of colony sites; however, some breeding individuals have been documented leaving nest sites as far as four miles to feed (Orians, 1961).

Threats: Some of the threats that have been identified for this species include loss of habitat due to draining of freshwater marshes and cowbird parasitism.

Bell's sage sparrow (*Amphispiza belli bellie*)

Status: Bell's sage sparrow is a CDFG Watch List species. This taxon is not federally or State listed as threatened or endangered.

General Distribution: Five subspecies of sage sparrow are recognized, two of which are migratory (County of Riverside, 2008). The subspecies Bell's sage sparrow (formerly known as Bell's sparrow), *A. b. belli*, occurs as a non-migratory resident on the western slope of the central Sierra Nevada Range and in the coastal ranges of California southward from Marin County and Trinity County, extending into north-central Baja California (County of Riverside, 2008).

Distribution in the Study Area: There are no known records for this species in the Study Area; suitable habitat is present within the Study Area outside of the Reservoir footprint. Nearest recorded occurrence, from 2005, is approximately 13 miles northwest of the Study Area.

Habitat and Habitat Associations: Bell's sage sparrow is uncommon to fairly common in dry chaparral and coastal sage scrub along the coastal lowlands, inland valleys, and lower foothills of the mountains within its range. The Bell's sage sparrow often occupies chamise chaparral in the northern part of its range (Gaines, 1988; Unitt, 1984) and in coastal San Diego County (Bolger *et al.,* 1997). At higher elevations in southern California, Bell's sage sparrow often occurs in big sagebrush (County of Riverside, 2008).

Natural History: Sage sparrows primarily forage on the ground, usually near or under the edges of shrubs (Zeiner *et al.,* 1990A; County of Riverside, 2008). During the breeding season, the species consumes adult and larval insects, spiders, seeds, small fruits, and succulent vegetation (County of Riverside, 2008). Bell's sage sparrow usually nests in sagebrush or chaparral, and may have two broods per nesting season (Ehrlich *et al.,* 1988). In Riverside County, nests of Bell's sage sparrow have been found in brittlebush, black sage, California buckwheat, California sagebrush, and bush mallow. In other locations, chamise, white sage, cholla, ceanothus, and willows have been used by the species (County of Riverside, 2008). Sage sparrows also nest occasionally in bunchgrass or on the ground under shrubs (County of Riverside, 2008).

Threats: The largest threat to the sage sparrow is the loss and fragmentation of appropriate shrub habitat. Like other species, it has lost suitable habitat to urbanization and agricultural conversion, especially in southern California (County of Riverside, 2008). This species is also vulnerable to brown-headed cowbird nest parasitism (County of Riverside, 2008), which is increased near habitat edges. Grazing may result in habitat degradation and reduction of populations, such as on San Clemente Island where removal of grazing animals resulted in the recovery of native vegetation and sage sparrow populations (County of Riverside, 2008). Proximity to humans also increases the possibility of predation by domestic cats.

Golden eagle (*Aquila chrysaetos*)

Status: The golden eagle is on CDFG Watch List and a California Fully Protected species. This taxon is not federally or State listed as threatened or endangered.

General Distribution: In North America, this species breeds locally from northern Alaska eastward to Labrador and southward to northern Baja California and northern Mexico. The species winters from southern Alaska and southern Canada southward through the breeding range. The golden eagle ranges from sea level up to 11,500 feet AMSL (Grinnell and Miller, 1944).

Distribution in the Study Area: There are no known records for this species within the Study Area; limited suitable nesting habitat for this species occurs within the Study Area but does occur on portions of the ANF. Suitable foraging habitat is present within Study Area.

Habitat and Habitat Associations: The golden eagle requires rolling foothills, mountain terrain, and wide arid plateaus deeply cut by streams and canyons, open mountain slopes and cliffs, and rock outcrops (Zeiner *et al.* 1990A).

Natural History: The golden eagle requires rolling foothills, mountain terrain, and wide arid plateaus deeply cut by streams and canyons, open mountain slopes and cliffs, and rock outcrops (Zeiner *et al.* 1990A). Nest construction in southern California occurs in fall and continues through winter (Dixon 1937). This species nests on cliffs with canyons and escarpments and in large trees (generally occurring in open habitats) and is primarily restricted to rugged, mountainous country (Garrett and Dunn 1981; Johnsgard 1990). It is common for the golden eagle to use alternate nest sites, and old nests are reused. The nests are large platforms composed of sticks, twigs, and greenery that are often three meters (10 feet) across and one meter (three feet) high (Zeiner *et al.* 1990A).

Threats: A major threat to this species is human disturbance in the form of habitat loss as well as human development and activity adjacent to golden eagle habitat. Accidental deaths attributed to increased development include collisions with vehicles, power lines, and other structures; electrocution; hunting; and poisoning (Franson *et al.* 1995). Golden eagles avoid developed areas; the golden eagle population in California has undergone a decline within the past century due to a decrease in open habitats (Grinnell and Miller 1944). If nests are disturbed by humans, abandonment of these nests in early incubation will typically occur (Thelander 1974), thereby threatening the species' reproductive success.

Short-eared owl (*Asio flammeus*)

Status: The short-eared owl is a CDFG Species of Special Concern. This taxon is not federally or State listed as threatened or endangered.

General Distribution: This species is a widespread winter migrant in California, primarily occurring in the Central Valley, the western Sierra Nevada foothills, and along the coastline. Short-eared owls very irregularly breed along the southern California coast (Garrett and Dunn, 1981).

Distribution in the Study Area: There are no known recent records for this species in the Study Area; suitable habitat is not present within the Study Area. Limited suitable habitat may be present along the proposed haul routes.

Habitat and Habitat Associations: The short-eared owl is usually found in open areas with few trees, including annual grasslands, prairies, dunes, meadows, agricultural fields, and emergent wetlands. Tall grasses, brush, ditches, and wetlands are used for resting and roosting cover (Grinnell and Miller, 1944).

Natural History: This species is a big-headed, short-necked owl with tawny to buff-brown plumage and whitish belly. Short-eared owls typically breed from early March through July (Bent, 1938; as cited in USACE and CDFG, 2010). Courtship activities consist of aerial displays and hooting (Pitelka *et al.*, 1955; as cited in USACE and CDFG, 2010). Clutches usually consist of 5-7 eggs, however, may be higher during periods of high prey abundance. Females incubate the eggs and care for the semialtrical young while males bring food to females at the nest. This species is primarily a crepuscular hunter and the great majority of their diet consists of small mammals (Holt and Leasure, 1993; Clark, 1975).

Threats: Numbers of this species have declined over much of its range due to the destruction and fragmentation of grassland habitats, grazing, and increased levels of predation (Remsen, 1978; Holt and Leasure, 1993).

Long-eared owl (*Asio otus*)

Status: The long-eared owl has been designated by CDFG as a California Species of Special Concern. This taxon is not federally or State listed as threatened or endangered.

General Distribution: The long-eared owl (*Asio otus*) occurs in North America, Europe, Asia, and northern Africa between elevations from near sea level to over 2,000 meters (6,560 feet) AMSL (Zeiner *et al.* 1990A). In North America, this species breeds from British Columbia east across Canada and the United States and south to southern California, southern Arizona, and northern Mexico. It also winters in most of its breeding range, except in the northernmost areas. The long-eared owl's wintering range extends from southern Canada and northern New England to the Gulf states and to the Jalisco, Michoacan, Guerrero, and Oaxaca states in Mexico (Marks *et al.* 1994).

Distribution in the Study Area: Suitable habit occurs within the Study Area; however, there are no known reports of this species within or adjacent to the Study Area. This species is known to occur on portions of the ANF to the southwest of the Study Area

Habitat and Habitat Associations: The long-eared owl primarily uses riparian habitat for roosting and nesting, but can also use live oak thickets and other dense stands of trees (Zeiner *et al.* 1990A). It appears to be more associated with forest edge habitat than with open habitat or forest habitat (Holt 1997). The long-eared owl usually does not hunt in the woodlands where it nests, but in open space areas such as fields, rangelands, and clearings. At higher elevations, the species is found in conifer stands that are usually adjacent to more open grasslands and shrublands (Marks *et al.* 1994). In California, long-eared owls also nest in dense or brushy vegetation amid open habitat (Bloom 1994). Long-eared owls have also been known to nest in caves, cracks in rock canyons, and in artificial wicker basket nests (Marks *et al.* 1994; Garner and Milne 1997).

Natural History: The long-eared owl eats mostly voles and other rodents, though it also occasionally eats birds and other vertebrates (Armstrong 1958). It typically begins hunting before sunset, especially during the nesting season and while feeding its young (Bayldon 1978). The long-eared owl uses abandoned crow, magpie, hawk, heron, and squirrel nests in a variety of trees with dense canopy (Call 1978; Marks 1986). The nest is usually three to 15 meters (9.8 to 49.2 feet) above the ground; rarely is the nest on the ground or in a tree cavity (Karalus and Eckert 1974). Breeding season extends from early March to late July (Call 1978).

Threats: Resident populations of the long-eared owl in California have been declining since the 1940s, especially in southern California (Grinnell and Miller 1944; Remsen 1978; Bloom 1994). Habitat destruction, including grasslands used for foraging, fragmentation of riparian nesting habitat and live oak groves, and proximity to urban development are cited as major factors in the decline of populations in California (Marks *et al.* 1994; Bloom 1994; Remsen 1978). Nesting long-eared owls appear to be particularly sensitive to human activity. Human disturbance usually flushes females from active nests, and while females usually return within 10 minutes of the disturbance, eggs and hatchlings are vulnerable to predation while the nest is exposed (Marks 1986). Other urban-related factors that could affect long-eared owls are nighttime lighting, which may disrupt activity patterns and expose nests to nocturnal predators; use of pesticides, which may cause secondary poisoning and reduction or loss of prey; and predation and harassment by pet, stray, and feral cats and dogs.

Burrowing owl (*Athene cunicularia*)

Status: The burrowing owl is a CDFG Species of Special Concern. This taxon is not federally or State listed as threatened or endangered.

General Distribution: The burrowing owl (Athene cunicularia) breeds from southern interior British Columbia, southern Alberta, southern Saskatchewan, and southern Manitoba, south through eastern Washington, central Oregon, and California to Baja California, east to western Minnesota, northwestern Iowa, eastern Nebraska, central Kansas, Oklahoma, eastern Texas, and Louisiana, the southern portion of Florida, and south to central Mexico. The species is also locally distributed throughout suitable habitat in Central and South America to Tierra del Fuego, and in Cuba, Hispaniola, the northern Lesser Antilles, Bahama Islands, and in the Pacific Ocean off the west coast of Mexico (County of Riverside, 2008; as cited in USACE and CDFG, 2010). The western subspecies, western burrowing owl, occurs throughout North and Central America west of the eastern edge of the Great Plains south to Panama (County of Riverside, 2008; as cited in USACE and CDFG, 2010). The winter range of the western burrowing owl is much the same as the breeding range, except that most individuals apparently vacate the northern areas of the Great Plains and the Great Basin (County of Riverside, 2008; as cited in USACE and CDFG, 2010).

Distribution in the Study Area: There are no known records for this species in the Study Area; nearest CNDDB record for this species occurs approximately 10 miles to the northwest. While suitable habitat for this species does not occur within the Study Area it does occur along portions of the proposed haul routes.

Habitat and Habitat Associations: In California, western burrowing owls are yearlong residents of flat, open, dry grassland and desert habitats at lower elevations (Bates, 2006; as cited in USACE and CDFG, 2010). They typically inhabit annual and perennial grasslands and scrublands characterized by low-growing vegetation and also may occur in areas that include trees and shrubs if the cover is less than 30% (Bates, 2006; as cited in USACE and CDFG, 2010); however, they prefer treeless grasslands. Although western burrowing owls prefer large, contiguous areas of treeless grasslands, they have also been observed in fallow agriculture fields, golf courses, cemeteries, road allowances, airports, vacant lots in residential areas and university campuses, and fairgrounds when nest burrows are present (Bates 2006; County of Riverside, 2008; as cited in USACE and CDFG, 2010). The availability of numerous small mammal burrows, such as those of California ground squirrel (*Spermophilus beecheyi*), is a major factor in determining whether an area with apparently suitable habitat supports western burrowing owls (Coulombe, 1971; as cited in USACE and CDFG, 2010).

Natural History: The majority of western burrowing owls that breed in Canada and the northern United States are believed to migrate south during September and October and north during March and April, and into the first week of May. These individuals winter within the breeding habitat of more southern-located populations. Thus, winter observations may include both the migrant individuals as well as the resident population (County of Riverside, 2008; as cited in USACE and CDFG, 2010). Western burrowing owls occurring in Florida are predominantly non-migratory, as are populations in southern California (Thomsen, 1971; as cited in USACE and CDFG, 2010). Western burrowing owls in northern California are believed to migrate (Coulombe, 1971; as cited in USACE and CDFG, 2010). In many parts of the United States, the western burrowing owl's breeding range has been reduced and it has been extirpated from certain areas, including western Minnesota, eastern North Dakota, Nebraska, and Oklahoma (Bates 2006; as cited in USACE and CDFG, 2010).

Western burrowing owls are opportunistic feeders, primarily feeding on arthropods, small mammals, and birds, and often need short grass, mowed pastures, or overgrazed pastures for foraging (County of Riverside, 2008; as cited in USACE and CDFG, 2010). Western burrowing owls are primarily crepuscular in their foraging habits but hunting has been observed throughout the day (Thomsen 1971; Marti 1974; all as cited in USACE and CDFG, 2010). Insects are often taken during daylight, whereas small mammals are taken more often after dark (County of Riverside, 2008; as cited in USACE and CDFG, 2010).

Threats: Factors related to declines in western burrowing owl populations include the loss of natural habitat due to urban development and agriculture; other habitat destruction; predators, including domestic dogs; collisions with vehicles; and pesticides/poisoning of ground squirrels (Grinnell and Miller 1944; Zarn 1974; Remsen 1978; as cited in USACE and CDFG, 2010). A ranking of the most important threats to the species included loss of habitat, reduced burrow availability due to rodent control, and pesticides (James and Espie 1997; as cited in USACE and CDFG, 2010).

Ferruginous hawk (*Buteo regalis*)

Status: The California horned lark is designated a CDFG Watch List species. This taxon is not federally or State listed as threatened or endangered.

General Distribution: The ferruginous hawk (*Buteo regalis*) occurs throughout western North America from southernmost Canada between the Great Plains and Rocky Mountains, south to northern Arizona and New Mexico. This species breeds from southeast Alberta and extreme southwest Manitoba south to the northwest corner of Texas, west to the Great Basin, Columbia River Basin regions of eastern Oregon and southeast Washington. It was more recently discovered breeding in California (Small 1994). The ferruginous hawk most commonly winters from southern California, Colorado, Arizona, and New Mexico to northern Texas. Northern populations are completely migratory, while birds from southern breeding locations appear to migrate short distances or to be sedentary (Bechard and Schmutz 1995). The ferruginous hawk is an uncommon winter resident and migrant at lower elevations and open grasslands in the Modoc Plateau, Central Valley, and Coast Ranges of California (Polite and Pratt 1999).

Distribution in the Study Area: There are no known records for this species in the Study Area; nearest CNDDB record for this species occurs approximately 10 miles to the northwest. This species is a known winter resident in the Antelope Valley. Limited foraging habitat is present within the Study Area.

Habitat and Habitat Associations: The ferruginous hawk forages in open grasslands, agriculture (primarily grazing lands), sagebrush flats, desert scrub, and fringes of pinyon–juniper habitats (Polite and Pratt 1999). Birds seem to show a strong preference for elevated nest sites (boulders, creek banks, knolls, low cliffs, buttes, trees, large shrubs, utility structures, and haystacks), but will nest on nearly level ground when elevated sites are absent and when located far from human activities (Bechard and Schmutz 1995). Their winter range consists of open terrain from grassland to desert.

Natural History: Nest-building generally occurs in March in southern to mid-latitudes and birds occur on breeding areas from late February through early October (NatureServe 2012). In California, it has been reported that this species prefers native grassland and shrubland habitats over cropland, and areas with no perches for their nest sites (Janes 1985). Clutch size for this species is usually two to four with an incubation period of about 32 to 33 days. Young fledge in 35 to 50 days (Natureserve 2012).

Threats: The major threat to this species is the loss of breeding and wintering habitat. Local declines of ferruginous hawk have been noted (*e.g.*, Woffinden and Murphy 1989), but a widespread decline was not evident as of the early 1990s (57 FR 37507–37513; Olendorff 1993). Olendorff (1993) attributed population declines to the effects of cultivation, grazing, poisoning, and controlling small mammals, mining, and fire in nesting habitats, with cultivation being the most serious source of impact. Impacts from collisions with stationary or moving structures or objects, pesticides and other contaminants, and shooting and trapping are not considered significant for this species.

Swainson's hawk (*Buteo swainsoni*)

Status: Swainson's hawk is State Listed as Threatened. This taxon is a USFWS Bird of Conservation Concern and a U.S. Forest Service Sensitive species.

General Distribution: Swainson's hawks breed regularly from southwestern Canada to northern Mexico. The western limit of their breeding distribution extends from eastern Washington, eastern Oregon, and northeastern California, through Nevada to northern and southeastern Arizona. The eastern limit of the breeding range extends to western Minnesota, eastern Nebraska, central Kansas, central Oklahoma, and central Texas. Apparently isolated outlier populations also occur in the interior valleys of British Columbia, the Central Valley of California, west-central Missouri, and in northeastern Illinois. Nearly all Swainson's hawks spend the northern hemisphere winter in South America (BLM, 2005).

Historically, the Swainson's hawk breeding range in California included the Great Basin (including the Modoc Plateau); the Sacramento and San Joaquin Valleys; along the coast in Marin, Monterey, Ventura, Los Angeles, and San Diego counties; and a few scattered sites in the Colorado and Mojave deserts. Today, Swainson's hawks still nest in most previously occupied regions of the state, but the number of breeding birds has been greatly reduced throughout major portions of the range (e.g., Central Coast Ranges), and the species has been extirpated in coastal southern California. Only the Central Valley and Modoc Plateau still support more than a few isolated pairs. In California, migrating flocks of up to 100 or more Swainson's hawks may be observed away from the major mountain ranges during the spring and fall. These observations have become less frequent as the overall population has declined. About 30 birds have wintered in the Sacramento-San Joaquin River Delta annually since 1991 and are the only confirmed regularly wintering population in California (BLM, 2005).

Distribution in the Study Area: Limited suitable nesting habitat is present within the Study Area; there are no known records for this species within the Study Area. This species may migrate through the Study Area during the winter.

Habitat and Habitat Associations: The natural foraging habitat of Swainson's hawks is relatively open stands of grass-dominated vegetation and relatively sparse shrublands. Trees are typically widely scattered or found in bands along riparian corridors. Much of the original habitat has been converted to either urban development or cultivated agricultural uses. Swainson's hawks can forage agricultural fields with many types of crops. However, some studies have found that this species is more abundant in areas of moderate agricultural development than in either grassland or areas of extensive agricultural development. Alfalfa fields are routinely used by foraging Swainson’s hawks. Orchards and vineyards in general are not suitable foraging habitat for Swainson's hawk due to the dense woody cover (BLM, 2005).

Natural History: Breeding Swainson’s hawks have three general habitat requirements: (1) suitable foraging habitat with adequate prey, (2) nest sites, and (3) and isolation from disturbances that may disrupt breeding activities. The primary nest trees in the western Mojave Desert are Joshua trees and Fremont cottonwoods, but other large trees could also be used, especially where planted in narrow bands such as agricultural windbreaks (e.g., cottonwoods). In both the West Mojave Planning Area and the Eastern Mojave National Preserve, Swainson’s hawks forage on suitable prey within the Joshua tree woodlands. In addition, agricultural areas with suitable crop types and located in proximity to nest sites may meet Swainson’s hawk foraging requirements (BLM, 2005).

Threats: Several hypotheses have been suggested to explain the decline of Swainson's hawks in California. Among them are: (1) mortality during migration and on the wintering grounds in South America; (2) poisoning by toxic chemicals, including pesticides, in South America; (3) eggshell thinning; (4) habitat loss on the wintering grounds; (5) disturbance on the breeding grounds; (6) loss or degradation of habitat on the breeding grounds; and (7) increased competition with other species. No single hypothesis provides an adequate explanation for the observed declines in California, and all are likely contributors. Within the West Mojave Planning Area, loss or degradation of nesting and foraging habitat is the primary threat to the small breeding population of Swainson’s hawks (BLM, 2005).

Northern harrier (*Circus cyaneus*)

Status: The northern harrier is a CDFG Species of Special Concern. This taxon is not federally or State listed as threatened or endangered.

General Distribution: The northern harrier is found throughout the northern hemisphere. In North America, this species breeds from Alaska and the southern Canadian provinces south to Baja California, New Mexico, Texas, Kansas, and North Carolina (Limas, 2001).

Distribution in the Study Area: There are no known recent records for this species in the Study Area; the Study Area is located within the known geographic range for this species; suitable breeding and foraging habitat occurs within the Study Area.

Habitat and Habitat Associations: Northern harriers use a wide variety of open habitats in California, including deserts, coastal sand dunes, pasturelands, croplands, dry plains, grasslands, estuaries, flood plains, and marshes (MacWhirter and Bildstein, 1996; as cited in USACE and CDFG, 2010). The species can also forage over coastal sage scrub or other open scrub communities.

Natural History: The northern harrier's owl-like facial disk and white rump patch, which is prominent in flight, distinguish this species from all other North American falconiformes (Alsop III, 2001). Many California populations, including those in Ventura County, are residents, and many migrating harriers winter in California (CPIF, 2000). The breeding season for this species typically occurs between mid-March to early April. During this period, males, and occasionally females, exhibit uniquely characteristic courtship flights consisting of a series of nose dives (Bent, 1937). The northern harrier is predominately monogamous, but polygyny occurs when prey abundance is high. Nests are built on the ground. Clutch size averages five, and incubation lasts 30-32 days with nestlings fledging at 30-35 days. Hatching occurs from April through June (CPIF, 2000). This bird relies on hearing as well as sight while hunting and primarily feeds on small mammals, but will also take reptiles, amphibians, birds, and invertebrates.

Threats: The primary threat to northern harriers is habitat loss through development and agricultural conversion (CPIF, 2000).

Western yellow-billed cuckoo (*Coccyzus americanus occidentalis*)

Status: The western yellow-billed cuckoo is state listed as endangered and is listed as a federal candidate for listing.

General Distribution: The yellow-billed cuckoo (Coccyzus americanus) occurs as a breeding bird in temperate North America, south to Mexico, and the Greater Antilles. It possibly breeds in Central America and northwestern South America, although its breeding range may be confused by reports of non-breeding adult vagrants outside of known breeding areas during the breeding season. The northern limit of its distribution extends west from southern Maine through southern New Hampshire, Vermont, northern and central New York, extreme southwestern Quebec, southern Ontario, the Upper Peninsula of Michigan, northern Minnesota, and possibly into southeastern North Dakota and northeastern and western South Dakota (Hughes 1999; as cited in USACE and CDFG, 2010). Its breeding range extends southward along the Atlantic Coast to southern Florida, and west to the extreme eastern portion of Wyoming, the eastern plains of Colorado, and throughout Texas (Hughes 1999; as cited in USACE and CDFG, 2010).

Distribution in the Study Area: There are no known records for this species in the Study Area; there are no CNDDB records for this species within a 15 mile radius of the Study Area; the Study Area is located within the known geographic distribution for this species; extremely limited breeding and foraging habitat occurs in the Study Area.

Habitat and Habitat Associations: Breeding habitat for the western yellow-billed cuckoo primarily consists of large blocks of riparian habitat, particularly cottonwood–willow riparian woodlands (66 FR 38611–38626; as cited in USACE and CDFG, 2010). Laymon and Halterman (1989; as cited in USACE and CDFG, 2010) proposed that the suitable habitat for the western yellow-billed cuckoo for California be defined as habitat classified as willow–cottonwood with a patch size greater than 80 hectares (198 acres) and width greater than 600 meters (1,270 feet). It prefers dense riparian thickets with dense low-level foliage near slow-moving water sources.

Natural History: The western yellow-billed cuckoo's range is considered to be where it formerly bred from southwestern British Columbia, western Washington, northern Utah, central Colorado, and western Texas south and west to southern Baja California, Sinaloa, and Chihuahua in Mexico (Hughes, 1999; as cited in USACE and CDFG, 2010). In California, the western yellow-billed cuckoo's breeding distribution is now thought to be restricted to isolated sites in the Sacramento, Amargosa, Kern, Santa Ana, and Colorado river valleys (Laymon and Halterman, 1987; as cited in USACE and CDFG, 2010). Nests are constructed in willows on horizontal branches in trees, shrubs, and vines, but cottonwoods (Populus spp.) are used extensively for foraging and humid lowland forests are used during migration (Hughes, 1999; as cited in USACE and CDFG, 2010).

The western yellow-billed cuckoo is a long-distance migrant, though details of its migration patterns are not well known (Hughes, 1999; as cited in USACE and CDFG, 2010). It is a relatively late spring migrant, arriving on the breeding grounds starting mid- to late May (Franzreb and Laymon, 1993; as cited in USACE and CDFG, 2010). The migratory route of western yellow-billed cuckoos is not well known because few specimens collected on wintering grounds have been ascribed to the western or eastern subspecies. The western yellow-billed cuckoo likely moves down the Pacific Slope of Mexico and Central America to northwestern South America (Hughes, 1999; as cited in USACE and CDFG, 2010).

Yellow-billed cuckoos generally forage for caterpillars and other large insects by gleaning (Hughes 1999; as cited in USACE and CDFG, 2010). They occasionally prey on small lizards, frogs, eggs, and young birds as well (Zeiner *et al.*, 1990a; as cited in USACE and CDFG, 2010). Foraging occurs extensively in cottonwood riparian habitat (Hughes, 1999).

Threats: The western yellow-billed cuckoo is sensitive to habitat fragmentation and degradation of riparian woodlands due to agricultural and residential development (Hughes, 1999; as cited in USACE and CDFG, 2010), and major declines among western populations reflect local extinctions and low colonization rates (Laymon and Halterman, 1989; as cited in USACE and CDFG, 2010).

White-tailed kite (*Elanus leucurus*)

Status: The white-tailed kite is a CDFG Fully Protected Species. This taxon is not federally or State listed as threatened or endangered.

General Distribution: The white-tailed kite is a permanent resident in California, southern Texas, Washington, Oregon, and Florida. It also occurs as a resident from Mexico into parts of South America (Dunk, 1995). In California, this species inhabits coastal and valley lowlands and is typically found in agricultural areas. It has increased population numbers and range in recent decades (Zeiner *et al.*, 1990a).

Distribution in the Project Areas: There are no known records for this species in the Study Area or surrounding areas. The Study Area is located within the known geographic distribution for this species; limited breeding and foraging habitat occurs in the Study Area.

Habitat and Habitat Associations: The white-tailed kite inhabits savanna, open woodlands, marshes, desert grasslands, partially cleared lands, and cultivated fields (Dunk, 1995). This species roosts in trees with dense canopies as well as saltgrass and Bermuda grass (Zeiner *et al.*, 1990a).

Natural History: The white-tailed kite is a medium-sized, long-winged raptor with red eyes. This monogamous species breeds from February to October, with peak activity occurring between May and August. Incubation is solely performed by the female; however, during incubation and the nestling period, the male feeds the female and provides her with food to feed the young (CDFG, 2008). The white-tailed kite is the only North American kite that hovers while hunting, usually less than thirty meters above the ground before descending vertically upon prey (Alsop III, 2001; Zeiner *et al.*, 1990a). This species primarily feeds on voles and other small mammals but will also take birds, insects, reptiles, and amphibians. Although white-tailed kites are non-migratory, individuals may become nomadic in response to prey availability (Zeiner *et al.*, 1990a).

Threats: While the white-tailed kite is reported to have increased in numbers and range over the past several decades, it is still vulnerable to habitat loss due to development.

Southwestern willow flycatcher (*Empidonax traillii extimus*)

Status: The southwestern willow flycatcher is federally and state listed as endangered.

General Distribution: The southwestern willow flycatcher has a known United States breeding range in six states: Arizona, New Mexico, California, southwestern Colorado, extreme southern portions of Nevada and Utah, and, possibly, western Texas. In California, its breeding range extends from the Mexican border north and inland to the City of Independence in the Owens Valley east of the Sierra Nevada, to the South Fork Kern River in the San Joaquin Valley and coastally to the Santa Ynez River in Santa Barbara County (Craig and Williams 1998; as cited in USACE and CDFG, 2010). The southwestern willow flycatcher was formerly a common summer resident throughout California, but has been extirpated from most of its historic breeding range in California.

Distribution in the Study Area: There are no known records for this species in the Study Area or surrounding areas. The Study Area is located within the known geographic distribution for this species; suitable breeding habitat is not present within the Study Area as this species prefers riparian areas of greater density than are present. Suitable foraging habitat occurs throughout the Study Area.

Habitat and Habitat Associations: The southwestern willow flycatcher is a riparian-obligate species restricted to complex streamside vegetation. Four general habitat types are used by the southwestern willow flycatcher at its breeding sites: monotypic high-elevation willow; exotic monotypes (e.g., dense stands of tamarisk (Tamarix spp.) or Russian olive (Elaeagnus angustifolius)), especially in the desert southwest; native broadleaf-dominated riparian forest; and mixed native/exotic forests (Sogge *et al.*, 1997; as cited in USACE and CDFG, 2010). Of these, native broadleaf-dominated and mixed native/exotic are the primary habitats used by southwestern willow flycatcher in California. The native broadleaf-dominated habitat is composed of a single species, such as Goodding's or other willow (Salix spp.) species,, or a mixture of broadleaf trees and shrubs, including cottonwood (Populus spp.), willow, box elder (Acer negundo), ash (Fraxinus spp.), and alder (Alnus spp.). Stands are usually three to 15 meters (10 to 50 feet) in height and are characterized by trees of different size classes, yielding multiple layers of canopy (Sogge *et al.*, 1997; as cited in USACE and CDFG, 2010).

Natural History: Willow flycatchers are late spring migrants and have a breeding season of three months or less (Sedgwick 2000; as cited in USACE and CDFG, 2010). The earliest spring arrival of the willow flycatcher in southern California is typically between late April and early May. When a willow flycatcher is observed in southern California after about June 22, or if nesting activity is observed, it can be concluded that the individual is E. t. extimus (southwestern willow flycatcher). By this date, most migrant willow flycatchers have passed through southern California; however, migrant willow flycatchers may again be observed—virtually always away from the coast—in late July as they pass through the region heading south to their wintering area (Sogge *et al.* 1997; as cited in USACE and CDFG, 2010).

Breeding territory sizes of the southwestern willow flycatcher vary greatly in relation to population density, habitat quality, and nesting stage (USFWS 2002c; as cited in USACE and CDFG, 2010). The observed range of territory sizes is 0.1 to 2.30 hectares (0.26 to 5.70 acres), with most in the range of 0.2 to 0.5 hectares (0.5 to 1.2 acres) (USFWS 2002c; as cited in USACE and CDFG, 2010). Clutches of two to four eggs are laid in the third week in June, with fledglings first appearing in mid-July (Sanders and Flett 1989; as cited in USACE and CDFG, 2010). Fledglings stay close to the nest and to each other for three to five days after leaving the nest and stay in the area for a minimum of 14 to 15 days (Sogge *et al.* 1997; as cited in USACE and CDFG, 2010).

Threats: The decline of southwestern willow flycatchers is primarily due to loss, fragmentation, and degradation of suitable riparian habitat resulting from urbanization, recreation, water diversion and impoundments, channelization, invasive plant species, overgrazing by livestock, and conversion of riparian habitat to agricultural land (USFWS, 2002; Sedgwick, 2000; all as cited in USACE and CDFG, 2010). Channelization, bank stabilization, levees, and other flow control structures, surface water diversions, and groundwater pumping for agricultural, industrial, and municipal uses are major factors in the deterioration of suitable southwestern willow flycatcher habitat.

California horned lark (*Eremophila alpestris actia*)

Status: The California horned lark is designated a CDFG Watch List species. This taxon is not federally or State listed as threatened or endangered.

General Distribution: Horned larks (*Eremophila alpestris*) have a holarctic distribution, ranging from the Arctic south to central Asia and Mexico. There are numerous regional subspecies representing the superspecies across this holarctic range, including the California horned lark (*Eremophila alpestris* ssp. *actia*). Horned larks are common and abundant residents in a variety of open habitats, usually where trees and shrubs are absent and can be found from sea level to elevations of 4,000 meters (13,123 feet) AMSL (Beason 1995). In general, the northernmost populations of horned lark are migratory, moving south during the winter into remaining areas of the breeding range. There are also southward movements into areas south of the breeding range, particularly in the southeastern United States (Beason 1995). The California horned lark breeds and resides in the coastal region of California from Sonoma County southeast to the United States–Mexico border, including most of the San Joaquin Valley, and eastward to the foothills of the Sierra Nevada (Grinnell and Miller 1944; AOU 1998).

Distribution in the Study Area: There are no known records for this species in the Study Area; there are no CNDDB records for this species within a 15 mile radius of the Study Area. Limited breeding and foraging habitat occurs in the Study Area.

Habitat and Habitat Associations: It is found in grasslands along the coast and deserts near sea level and alpine dwarf-shrub habitat above the tree line. It is less common in mountain regions, on the north coast, and in coniferous or chaparral habitats (McCaskie *et al.* 1979). The California horned lark uses predominantly agriculture, grassland, and disturbed areas for foraging, as well as sparse shrub and scrub habitats (Garrett and Dunn 1981). In winter, flocks frequent roadsides, feedlots, and fields where manure from feedlots is spread.

Natural History: California horned larks breed from March through July, with a peak in activity in May and they frequently raise two broods in a season (Zeiner *et al.* 1990A).

Threats: In addition to direct loss of habitat and fragmentation, California horned larks are vulnerable to several effects related to agriculture and urbanization. Increased use of pesticides, specifically Carbofuran and Fenthion, have been shown to poison and kill horned larks (Beason 1995). The demonstrated deleterious effects of these pesticides illustrate that horned larks may be vulnerable to certain chemicals because of their ground-foraging habits and seasonally varying diet. Pesticides may also cause a decline in prey abundance. Mowing of grasslands occupied by nesting horned larks substantially increased nest failures (Kershner and Bollinger 1996). Horned lark nests can also be parasitized by brown-headed cowbirds, especially after the first brood when there are multiple broods in a single season (Beason 1995). Other development- and human-related impacts expected to affect this species include construction-related dust; noise and ground vibration; nighttime lighting, which may induce physiological stress and increase predation by nocturnal predators; and increased predation by pet, stray, and feral cats and dogs. Areas of increased moisture may attract Argentine ants that prey on nestlings.

Merlin (*Falco columbarius*)

Status: The merlin is a CDFG Watch List Species that was removed from the Species of Special Concern list in 2008. This taxon is not federally or State listed as threatened or endangered.

General Distribution: In North America, this species breeds from the northward tree limit in Alaska and Canada southward to southern Alaska, Oregon, Idaho, South Dakota, the northern Great Lakes region, New York, Maine, and Nova Scotia. Breeding does not occur in California; however, this species does occur in most of the western half of the state below roughly 4000 feet through the winter season (September to May) (CDFG, 2008).

Distribution in the Study Area: There are no known records for this species in the Study Area or surrounding areas; this species is a winter resident that does not breed in California; the Study Area is located within the known geographic winter distribution for this species; suitable foraging habitat occurs throughout the Study Area.

Habitat and Habitat Associations: The merlin occurs in a wide variety of habitats, including marshes, deserts, seacoasts, open woodlands, fields, and communities in early successional stages (Garrett and Dunn, 1981).

Natural History: The merlin is a small, averaging twelve inches in length, member of the falcon family (Falconidae) with a long tail and long, pointed wings. This species winters in California from September to May and wanders, but does not apparently defend, foraging territories throughout the winter range (Becker and Sieg, 1987; Warkentin and Oliphant, 1990; Sodhi and Oliphant, 1992). Merlins primarily prey on small birds, which are captured on the ground or in the air, after direct pursuit (CDFG, 2008). Small mammals and insects are also consumed, the latter of which may be taken while young merlins are developing their predatory skills.

Threats: There are no persistent threats identified for this species; however, because merlins feed primarily on birds, numbers have been likely reduced due to pesticide use.

Prairie Falcon (*Falco mexicanus*)

Status: The prairie falcon is a CDFG Watch List Species that was removed from the Species of Special Concern list in 2008, and a USFWS Bird of Conservation Concern. This taxon is not federally or State listed as threatened or endangered.

General Distribution: This species is an uncommon permanent resident that occurs throughout California with the exception of the humid northwest coastal belt (Small, 1994).

Distribution in the Study Area: There are no known records for this species in the Study Area. The CNDDB reports one historic occurrence approximately 10 miles to the west of the Study Area. Marginal (at best) nesting habitat occurs within the Study Area; suitable foraging habitat occurs throughout the Study Area.

Habitat and Habitat Associations: The prairie falcon occurs in a wide variety of habitats from annual grasslands to alpine meadows, but is most commonly associated with perennial grasslands, savannahs, rangelands, some agricultural fields, and desert scrub areas (CDFG, 2008). This species usually nests on sheltered cliff ledges overlooking open areas.

Natural History: This species is a medium-sized falcon with a dark brown cap and cheek and distinct dark mustache markings. Prairie falcons breed in mid-April on cliff edges or rock outcrops in open areas. The male rarely takes an active role in the incubation process; however, may provide food to the female during this time (Stephenson and Calcarone, 1999). Hatchlings are tended by both adults until fledging at roughly forty days (Baicich and Harrison, 1997). Prairie falcons prey primarily on small passerine birds; however, lizards, ground squirrels, and other small mammals are also consumed (Steenhof, 1998). This species utilizes two hunting strategies, including flushing a prey item while flying along a concealed route until the last moment and patrolling along long distances close to the ground until surprising and attacking a prey item (Dunne *et al.*, 1988).

Threats: The loss of suitable foraging habitat to human development, particularly in coastal California, has been identified as a primary threat to this species.

American peregrine falcon (*Falco peregrinus anatum*)

Status: The peregrine falcon is a California Fully Protected species.

General Distribution: The peregrine falcon has a worldwide distribution that is more extensive than that of any other bird. In North America, the peregrine falcon breeds from Alaska to Labrador, southward to Baja California and other parts of northern Mexico, and east across central Arizona through Alabama. Its distribution is patchy in North America, and populations in the eastern United States are still chiefly in urban areas (AOU, 1998; White *et al.*, 2002; as cited in USACE and CDFG, 2010).

Distribution in the Study Area: There are no known recent records for this species in the Study Area; the Study Area is located within the known geographic range for this species; suitable breeding habitat does not occur within but may be present in areas adjacent to the Study Area; foraging habitat occurs throughout the Study Area.

Habitat and Habitat Associations: Peregrine falcons in general use a large variety of open habitats for foraging, including tundra, marshes, seacoasts, savannahs, grasslands, meadows, open woodlands, and agricultural areas. Sites are often located near rivers or lakes (AOU, 1998; Brown, 1999; Snyder, 1991; all as cited in USACE and CDFG, 2010). Riparian areas, as well as coastal and inland wetlands, are also important habitats year-round for this species. The species breeds mostly in woodland, forest, and coastal habitats (Zeiner et al,. 1990a; Brown, 1999; all as cited in USACE and CDFG, 2010).

Natural History: In California, the American peregrine falcon is an uncommon breeder or winter migrant throughout much of the state. It is absent from desert areas (Zeiner *et al.*, 1990a; as cited in USACE and CDFG, 2010). Active nests have been documented along the coast north of Santa Barbara, in the Sierra Nevada, and in other mountains of northern California. As a transient species, the American peregrine falcon may occur almost anywhere that suitable habitat is present (Garrett and Dunn, 1981; as cited in USACE and CDFG, 2010).

The diet of the American peregrine falcon primarily consists of birds that, while most are pigeon-sized, can be as small as hummingbirds or as large as small geese (White *et al.*, 2002; as cited in USACE and

CDFG, 2010). Other prey species include jays, flickers, meadowlarks, starlings, woodpeckers, shorebirds, and other readily available birds. The American peregrine falcon may feed on large numbers of rodents when present (Brown, 1999; as cited in USACE and CDFG, 2010).

Breeding requires cliffs or suitable surrogates that are close to preferred foraging areas. Nests are typically located in cliffs between 50 and 200 meters (164 to 656 feet) tall that are prominent in the landscape. American peregrine falcons have also been known to nest in trees and on small outcrops. Tall buildings, bridges, or other tall man-made structures are also suitable for nesting (White *et al.*, 2002; as cited in USACE and CDFG, 2010). The nest site usually provides a panoramic view of open country and often overlooks water. It is always associated with an abundance of avian prey, even in an urban setting. A cliff or building nest site may be used for many years (Brown, 1999; as cited in USACE and CDFG, 2010). The nest site itself usually consists of a rounded depression or scrape with accumulated debris that is occasionally lined with grass (Call, 1978; as cited in USACE and CDFG, 2010). Higher-quality nest sites confer greater protection from the elements and have greater breeding success (Olsen and Olsen, 1989; as cited in USACE and CDFG, 2010).

Threats: There are no persistent threats identified for this species.

California condor (*Gymnogyps californianus*)

Status: The California condor is listed as both state and federally endangered and is a California Fully Protected species.

General Distribution: The southern California population of the California condor is largely confined to the semi-arid, rugged mountain ranges surrounding the southern San Joaquin Valley, including the Coast Ranges from Santa Clara County south to Los Angeles County, the Transverse Ranges, Tehachapi Mountains, and southern Sierra Nevada (Zeiner *et al.*, 1990a; as cited in USACE and CDFG, 2010). The California condor has also historically occurred in northern Baja California, Mexico; northern California; Oregon; Washington; and south British Columbia, Canada in the early nineteenth century (Harris, 1941; Koford, 1953; Wilbur, 1978; Kiff, 2000; Snyder and Snyder, 2000; all as cited in USACE and CDFG, 2010).

Distribution in the Study Area: There are no known records for this species in the Study Area although they have been observed flying over the San Gabriel Mountains. Suitable breeding and foraging habitat is not present within the Study Area.

Habitat and Habitat Associations: California condors require vast expanses of open savannah, grasslands, and foothill chaparral, with cliffs, large trees, and snags for roosting and nesting (Zeiner *et al.*, 1990a; as cited in USACE and CDFG, 2010).

Natural History: Prior to all California condors being removed from the wild for captive breeding in the late 1980s, nonbreeding California condors often moved north to Kern and Tulare counties in April and returned south in September to winter in the Tehachapi Mountains, Mount Pinos, and Ventura and Santa Barbara counties (Zeiner et al,. 1990A; as cited in USACE and CDFG, 2010). Since that time, California condors have been reintroduced into suitable habitat in eastern Ventura County as well as in the Ventana Wilderness area along the coast south of San Francisco.

The California condor requires an adequate food supply, open habitat in which food can readily be found and accessed, and reliable air movements that allow extended soaring flight (Snyder and Schmitt, 2002; as cited in USACE and CDFG, 2010). Most foraging has been documented in grasslands and oak woodlands, where individuals can easily launch into flight from nearly any location by running downhill, and where winds deflected by topographic relief usually provide the uplift necessary for extended flight (Snyder and Schmitt, 2002; as cited in USACE and CDFG, 2010). Most California condors forage within 50 to 70 kilometers (31 to 43 miles) of nesting areas, with core foraging areas ranging around 2,500 to 2,800 square kilometers (1,553 to 1,740 miles). This wide-ranging foraging area appears to be an adaptation to unpredictable food supplies.

The California condor primarily feeds on mammalian carrion, although remains of reptiles and birds have been occasionally found within nests (Collins *et al.*, 2000; as cited in USACE and CDFG, 2010). California condors are scavengers of fresh medium- to large-sized carcasses, such as sheep, cattle, deer, and elk (Koford, 1953; Snyder and Snyder, 2000; Collins *et al.*, 2000; all as cited in USACE and CDFG, 2010). California condors are not known to feed on vehicle-killed animals, but in recent years, hunter-shot mule deer, shot or poisoned coyotes, and ground squirrels were consumed when available (Snyder and Schmitt, 2002; as cited in USACE and CDFG, 2010).

California condors typically breed annually but frequently breed less often. Observations of new pair formations have been observed in late fall and early winter (Snyder and Schmitt 2002; as cited in USACE and CDFG, 2010). Once pairs have been formed, the California condors stay together year round for multiple years. California condors lay only one egg; this can occur from the last week of January through the first week of April, with an incubation period averaging 57 days. The hatching of the eggs ranges between the last week of March and the first week of June. The chicks are tended by both parents until the chicks are fledged, which occurs five and a half to six months after hatching. The chicks are fully dependent on their parents for approximately another six months, ending roughly a year after hatching, from early March to mid-May (Snyder and Schmitt, 2002; as cited in USACE and CDFG, 2010).

Threats: Major threats to this species include lead poisoning, collisions, poisoning due to ingestion of antifreeze, drowning and shooting. An increase in power lines and utility poles, which can result in collisions and electrocution; microtrash (e.g., bottle caps, pull tabs, broken glass, cigarette butts, small plastic items, lead bullets, and shell casings, which condors can ingest); long-term habitat degradation; and contaminants other than lead and antifreeze also have the potential to affect individuals.

Yellow-breasted chat (*Icteria virens*)

Status: The yellow-breasted chat is a CDFG Species of Special Concern. This taxon is not federally or State listed as threatened or endangered.

General Distribution: Although this species is a widespread summer resident in eastern North America, its distribution is much more fragmented in the west. In California, yellow-breasted chat primarily occurs in the northern portion of the state and is considered scarce in the central and southern portions.

Distribution in the Study Area: There are no known recent records for this species in the Study Area; the Study Area is located within the known geographic range for this species; limited breeding and foraging habitat occurs in the Study Area.

Habitat and Habitat Associations: In southern California, this species utilize dense riparian thickets and brushy tangles near watercourses for breeding (Garrett and Dunn, 1981). Similar habitat is used during migration (Dunn and Garrett, 1997).

Natural History: The yellow-breasted chat is the largest member of the warbler family (Parulidae). Its yellow throat and breast, olive underparts and white spectacles distinguish this species from other similar birds. The yellow-breasted chat breeds in April or May through August. Females initiate nest construction, which begins shortly after pair formation, above ground in dense shrubs along a river or stream. Both parents tend to nestlings until they fledge at roughly nine days (Stephenson and Calcarone, 1999). This species feeds primarily on insects and spiders that are gleaned from the foliage of low trees and shrubs; however, berries and other fruits are also consumed (CDFG, 2008).

Threats: The loss and degradation of riparian habitat have resulted in a marked decline of breeding populations of yellow-breasted chat in California. Nest parasitism by brown-headed cowbird (*Molothrus ater*) has also contributed to declines (Gaines, 1974; Remsen, 1978).

Loggerhead shrike (*Lanius ludovicianus*)

Status: The loggerhead shrike is a CDFG Species of Special Concern and a USFWS Bird of Conservation Concern. This taxon is not federally or State listed as threatened or endangered.

General Distribution: The breeding range of the loggerhead shrike includes Alberta, Saskatchewan, and Manitoba in Canada; the majority of the United States except the Pacific Northwest; and Mexico (Yosef, 1996). This species is a common resident and winter visitor in lowlands and foothills throughout California.

Distribution in the Study Area: Although not documented within the Study Area an occurrence of this species is reported from the CNDDB approximately 2.5 miles east of the Study Area. Suitable foraging and breeding habitat occurs within the Study Area.

Habitat and Habitat Associations: The loggerhead shrike prefers open habitats with scattered shrubs, trees, posts, fences, utility lines, or other perches. This species most often occurs in open-canopied valley foothill hardwood forests, valley-foothill hardwood-conifer forests, valley foothill riparian, pinyon-juniper woodlands, desert riparian, and Joshua tree habitats.

Natural History: The loggerhead shrike is a large-headed bird with a hooked beak and whitish underparts. The breeding season for this species generally begins in late January or early February, earlier than those of other sympatric passerine species, and lasts through July (Stephenson and Calcarone, 1999). Nests are typically constructed in well-concealed microsites in densely foliaged trees or shrubs (Miller, 1931; Bent, 1950). Females typically feed nestlings until fledging occurs at 16 to 20 days; however, males will feed nestlings if females are absent from the nest for extended periods of time (Stephenson and Calcarone, 1999). This species preys primarily on large insects, but will also take small birds, mammals, amphibians, reptiles, fish, carrion, and various invertebrates. Loggerhead shrikes often impale their prey on barbed wire or other sharp objects.

Threats to Species: Breeding Bird Survey data indicate that loggerhead shrike populations are declining in most states (Sauer *et al.*, 1996). Threats include habitat loss and degradation, shooting, and pesticide and other toxic contamination.

Long-billed curlew (*Numenius americanus*)

Status: The long-billed curlew is a CDFG Watch List Species. This taxon is not federally or State listed as threatened or endangered.

General Distribution: The breeding range of this migratory species extends from eastern New Mexico and the Texas panhandle, north through western Kansas, central Nebraska, central South Dakota, and western North Dakota and west to portions of Montana and southern Alberta, Saskatchewan, Manitoba, and British Columbia. In the Great Basin the curlew ranges from Utah west to California and north into eastern Washington and British Columbia. Winter distribution is scattered across the southern United States. Long-billed curlews winter from California, into western Nevada, Arizona, eastern New Mexico, western and southern Texas, and coastal Louisiana south to Baja, California, and Guatemala. Wintering curlews are found in small numbers along the Atlantic coast from South Carolina to Florida as well. [NRCS, 2010]

Distribution in the Study Area: There are no known recent records for this species in the Study Area; there are a variety of eBird records for this species approximately 20 miles to the north within the Lancaster Area. Suitable habitat occurs within portions of the Study Area.

Habitat and Habitat Associations: Generally nest in short grasses including grass prairies or agricultural fields and move to denser grasslands after young have fledged. Long-billed curlews winter at the coast and in Mexico.

Natural History: The long-billed curlew is the largest nesting or regularly-occurring sandpiper in North America. The bird usually feeds in flocks. Using its long bill, it probes the mud near its habitat, foraging for suitable food. The usual food consists of crabs and various other small invertebrates. The species also feeds on grasshoppers, beetles and other insects. This bird has occasionally been known to eat the eggs of other birds. The long-billed curlew is a precocial bird, and the chicks leave the nest soon after hatching. Both parents look after the young.

Threats: Development and urbanization along the coastal habitats threaten this species.

Osprey (*Pandion haliaetus*)

Status: The osprey is a CDFG Watch List Species. This taxon is not federally or State listed as threatened or endangered.

General Distribution: The osprey is one of only two wild bird species with a worldwide distribution (the other is peregrine falcon). In California, this species typically breeds in the northern part of the state from the Cascade Range south to Lake Tahoe and along the coast to Marin County (Stephenson and Calcarone, 1999). Osprey is an uncommon visitor along the coast of southern California (Zeiner *et al.*, 1990a). Although this species is almost entirely migratory across its range, some areas of southern California, including Ventura County, support year-round residents (Ferguson-Lees and Christie, 2001).

Distribution in the Study Area: There are no known recent records for this species in the Study Area; there are a variety of eBird records for this species approximately 20 miles to the north within the Lancaster Area. Suitable habitat occurs within portions of the Study Area.

Habitat and Habitat Associations: This species most commonly occurs along rivers, lakes, reservoirs, and sea coasts, often crossing land between bodies of water (AOU, 1998). Nests are typically found in tree snags, on cliffs, and among various manmade structures, usually near or above water.

Natural History: The osprey is easily distinguished by its unmarked white belly, wing shape, and flight style. This species typically breeds between late March and early June as the male arrives to breeding sites first followed by the female a few days later (Johnsgard, 1990). Nests consist of a massive accumulation of sticks and other debris and may be added to and used in successive years (Stephenson and Calcarone, 1999). A single brood of three eggs is incubated by both sexes. Ospreys hunt by initially scanning water surfaces from an elevated perch, often followed by a period of hovering, and then diving from heights of roughly 16-23 feet above the water (Stephenson and Calcarone, 1999). Prey consists almost entirely of salt or freshwater surface feeding fish; however, reptiles, sick or injured birds, crustaceans, or small mammals are sometimes taken (Ferguson-Lees and Christie, 2001).

Threats: Threats that have been identified for this species include disturbance from recreation and other activities near nests, development near lakes and rivers, and removal of suitable nesting sites.

Vermilion flycatcher (*Pyrocephalus rubinus*)

Status: The vermilion flycatcher is designated by CDFG as a California Species of Special Concern. This taxon is not federally or State listed as threatened or endangered.

General Distribution: In California, the vermilion flycatcher was formerly considered a more common and widespread breeder along the lower Colorado River, Imperial Valley, Coachella Valley, upper Mojave River drainage, and San Diego County (Grinnell and Miller 1944; Garrett and Dunn 1981), but its breeding range has declined throughout this area (Wolf and Jones 2000). Currently, in California, there are some isolated breeding populations in the lowlands in the south central and southeast portions of the state, including San Bernardino, Riverside, San Diego, Santa Barbara, Ventura, and Kern counties (Wolf and Jones 2000). Zeiner *et al.* (1990A) state that there are sporadic breeding populations in desert oases west and north of the Morongo Valley and Mojave Narrows in San Bernardino County. It has been recorded in summer along the Santa Clara River near Castaic and at Frazier Park, Kern County; however, there has been no evidence of breeding, and these observations are likely vagrants (Garrett and Dunn 1981).

Distribution in the Study Area: There are no known recent records for this species in the Study Area; there is a 2010 eBird record for this species approximately 7 miles to the northwest at Lake Palmdale. Suitable habitat occurs within portions of the Study Area.

Habitat and Habitat Associations: This species is found in riparian thickets near open, mesic habitats. It breeds in cottonwood, willow, mesquite, oak, sycamore, and other vegetation in desert riparian communities that are located adjacent to irrigated fields, irrigated ditches, or pastures (Zeiner *et al.* 1990A; Wolf and Jones 2000).

Natural History: Although the vermilion flycatcher is largely a resident species, where it does show migratory movements, the male arrives to the breeding locations in February or March and females arrive afterwards, typically in March or April, depending on location (Wolf and Jones 2000). Males play a large role in determining the nest site, which is built in a horizontal fork or branch under a canopy in an area free of leaves, about eight to 20 feet above ground (Wolf and Jones 2000; Tinkham 1949). The nest is a shallow open cup, loosely constructed out of small twigs, forbs, rootlets, grasses, fibers, or other similar materials and is lined with feathers and hair (Wolf and Jones 2000).

Threats: This species primarily is threatened by the degradation and loss of habitat. The abundance and distribution of this species has been drastically reduced over the last 50 years in the lower Colorado River Valley. Water management, such as groundwater pumping and damming, can reduce and degrade riparian habitat and remove vegetation, such as cottonwoods and willows, that is critical to its breeding. Urbanization and human development have also degraded or reduced vermilion flycatcher habitat. Like other riparian bird species, however, several other potential human- or development-related factors may affect the vermilion flycatcher. Construction-related impacts include dust; noise and ground vibration; diminished water quality and altered hydrology; increased human activity in close proximity to foraging areas; and lighting, which may alter foraging behavior, induce physiological stress, and increase predation risk. Long-term effects related to development include increased human activity; noise; lighting; diminished water quality and altered hydrology; predation and harassment by pet, stray, and feral cats and dogs and other mesopredators; and pesticides, which may reduce insect prey or cause secondary poisoning.

Bank swallow (*Riparia riparia*)

Status: The bank swallow is state listed as threatened.

General Distribution: A neotropical migrant found primarily in riparian and other lowland habitats in California west of the deserts during the spring-fall period. A spring and fall migrant in the interior, less common on coast; an uncommon and very local summer resident. Casual in southern California in winter; a few winter records along central coast to San Mateo Co. (McCaskie *et al.*, 1988).

Distribution in the Study Area: There are no known recent records for this species in the Study Area; There are numerous eBird records for this species approximately 20 miles to the northwest near the City of Lancaster. Suitable habitat occurs within portions of the Study Area.

Habitat and Habitat Associations: This swallow requires fine-textured or sandy banks or cliffs to dig horizontal nesting tunnels/burrows (CDFG, 1999).

Natural History: Predominantly a colonial breeder; colonies range in size of 10 to 1,500 nesting pairs in California, although most colonies have 100-200 nesting pairs. Forages by hawking insects during long, gliding flights. Feeds predominantly over open riparian areas, but also over brushland, grassland, wetlands, water, and cropland. Feeds on a wide variety of aerial and terrestrial soft-bodied insects including flies, bees, and beetles. Uses holes dug in cliffs and river banks for cover. Will also roost on logs, shoreline vegetation, and telephone wires. [CDFG, 1999].

Threats: Channelization and stabilization of banks of nesting rivers, and other destruction and disturbance of nesting areas, are major factors causing the marked decline in numbers in recent decades (CDFG, 1999)

Allen's hummingbird (*Selasphorus sasin*)

Status: The Allen's hummingbird is a CDFG Special Animal. This taxon is not federally or State listed as threatened or endangered.

General Distribution: This species is a permanent resident in Ventura County. It also occurs as a common summer resident and migrant along much of the California coast.

Distribution in the Study Area: There are no known recent records for this species in the Study Area. There are several eBird records for this species approximately 5 miles to the northwest and 10 miles to the east. Suitable habitat occurs throughout the Study Area.

Habitat and Habitat Associations: Breeding for this species most commonly occurs in coastal scrub, valley and foothill hardwood forests, valley and foothill riparian forests, and urban habitats. Allen's hummingbird also occurs in a variety of woodland and scrub habitats as a migrant (CDFG, 2008).

Natural History: This species is a small hummingbird with a green back and crown and distinctive rufous markings on the flanks and tail. The Allen's hummingbird often attaches its nest to more than one lateral support on eucalyptus, juniper, willow, other trees, vines, shrubs, or ferns (CDFG, 2008). Breeding occurs from mid-February through early August with peak activity occurring in April. Large mating territories are rigorously defended as are smaller feeding territories (Legg and Pitelka, 1956). The primary diet of this species consists of nectar taken from a variety of herbaceous and woody flowering plants; however, small insects and spiders may also be consumed (CDFG, 2008).

Threats: No persistent threats have been identified for this species.

Le Conte's thrasher (*Toxostoma lecontei*)

Status: The Le Conte's thrasher is designated by CDFG as a California Species of Special Concern. This taxon is not federally or State listed as threatened or endangered.

General Distribution: The Le Conte's thrasher is found throughout the Southwestern United States and Northwestern Mexico.

Distribution in the Study Area: There are no known records for this species in the Study Area. The CNDDB reports occurrences of this species approximately 5 miles northeast of the Study Area. Suitable habitat occurs within portions of the Study Area.

Habitat and Habitat Associations: Sparse desert scrub such as creosote bush, Joshua tree, and saltbush scrubs, or sandy-soiled cholla-dominated vegetation. Nests in dense, spiny shrubs or densely branched cactus in desert wash habitat.

Natural History: The Le Conte's thrasher forages on the ground for insects and spiders, as well as some seeds and berries.

Threats: In some parts of its range, the Le Conte's Thrasher has lost extensive habitat to development. Irrigated lawns, groves, and fields are not compatible with its need for desert vegetation.

MAMMALS

Ringtail (*Bassariscus astutus*)

Status: The ringtail is a CDFG Fully Protected Species. This taxon is not federally or State listed as threatened or endangered.

General Distribution: This species is widely distributed throughout California with the exceptions of the northeastern deserts and the Central Valley.

Distribution in the Study Area: There are no known recent records for this species in the Study Area; the Study Area is located within the known geographic range for this species and it is known to occur within sections of the San Gabriel Mountains. Suitable habitat is present within portions of the Study Area.

Habitat and Habitat Associations: Ringtails occur in a variety of habitats, including chaparral, coastal sage scrub, riparian scrub, oak woodlands, and riparian woodlands. This species prefers habitats in proximity to permanent water.

Natural History: Some authors consider ringtails a subfamily of the family Procyonidae, which includes the raccoons and coatis (Burt and Grossenheider, 1954). Ringtails are long, slender animals with large ears and eyes, semi-retractile claws, and distinct black and white bands on a bushy tail. This species nests in rock recesses, hollow trees, logs, snags, abandoned burrows, or woodrat nests and breeding typically occurs between February and May (NatureServe, 2012). Ringtails are opportunistic feeders, but primarily prey on rodents, rabbits, birds, bird eggs, reptiles, and invertebrates (Zeiner *et al.*, 1990b).

Threats: While no persistent threats have been identified for this species, the degradation of preferred riparian habitats has been suggested as a potential threat (Stephenson and Calcarone, 1999).

Pallid San Diego pocket mouse (*Chaetodipus fallax pallidus*)

Status: The pallid San Diego pocket mouse is designated by CDFG as a California Species of Special Concern. This taxon is not federally or State listed as threatened or endangered.

General Distribution: The pallid San Diego pocket mouse occurs mainly in arid coastal and desert border areas in San Diego Co., in Riverside Co. southwest of Palm Springs, in San Bernardino Co. from Cactus Flat in the San Bernardino Mts. to Oro Grande and east to Twenty-nine Palms. Elevational range from sea level to 4500 feet (Santa Rosa Mts., Riverside Co.) and 6000 feet (Cactus Flat, north slope San Bernardino Mts.) (Zeiner, et al., 1990b).

Distribution in the Study Area: There are no known recent records for this species in the Study Area; the Study Area is located within the known geographic range for this species. Nearest CNDDB for this record is approximately 7 miles to the southeast of the Study Area. Suitable habitat occurs within portions of the Study Area.

Habitat and Habitat Associations: The pallid San Diego pocket mouse prefers to inhabit desert wash, desert scrub, desert succulent scrub and/or pinyon-juniper woodland.

Natural History: This is a nocturnal species that is active year-round, although surface activity may be reduced during cold periods (Zeiner, et al., 1990b). The primary diet consists of seeds of forbs, grasses and shrubs, which are transported in cheek pouches. Predators include foxes, coyotes, badgers, owls and snakes.

Threats: A potential threat to this species is urban expansion and development.

Townsend's big-eared bat (*Corynorhinus townsendii*)

Status: The Townsend's big-eared bat is designated by CDFG as a California Species of Special Concern, and is a U.S. Forest Service Sensitive species. This taxon is not federally or State listed as threatened or endangered.

General Distribution:
The Townsend's big-eared bat (*Corynorhinus townsendii*) (big-eared bat) ranges throughout the western United States, British Columbia, Canada, and Mexico (Kunz and Martin, 1982). In the United States, it occurs in a continuous distribution in all the western states and east into western South Dakota, northwestern Nebraska, southwestern Kansas, western Oklahoma, and western Texas (Kunz and Martin 1982). It also is known from isolated gypsum caves in northeast Texas, Oklahoma, and Kansas and from limestone areas in Arkansas, Missouri, Oklahoma, Kentucky, Virginia, and West Virginia (Kunz and Martin, 1982). These relict populations are thought to reflect post-Pleistocene climates (Kunz and

Martin, 1982). In California, the CNDDB (CDFG, 2007A) contains 212 records for this species, of which 52 are from four counties in southern California: San Bernardino (33 records), San Diego (10 records), Riverside (five records) and Imperial (four records). There are no records for Los Angeles, Orange, or Ventura counties.

Distribution in the Study Area: There are no known recent records for this species in the Study Area; the Study Area is located within the known geographic range for this species. Roosting and foraging habitat occur within portions of the Study Area.

Habitat and Habitat Associations:
The big-eared bat is primarily associated with mesic habitats characterized by coniferous and deciduous forests, although it also occurs in xeric areas (Kunz and Martin 1982). In California, this species was historically associated with limestone caves and lava tubes located in coastal lowlands, agricultural valleys, and hillsides with mixed vegetation; it occurs in all parts of California, with the exception of alpine and subalpine areas of the Sierra Nevada (Zeiner *et al*. 1990B). The species also occurs in man-made structures and tunnels (Kunz and Martin 1982), and it has been suggested that the big-eared bat has become more common in the western United States due to the availability of man-made structures (Kunz and Martin 1982).

Natural History:
Big-eared bats are relatively sedentary and are not known to disperse or migrate large distances.
Maternity roosts are established in the warm parts of caves, mines, and buildings, with one or more clusters of females numbering up to about 100 individuals. Summer roosts of males are solitary. Young are born from late spring to early summer and are fully weaned by 42 days of age. First flight occurs by about 18 to 21 days. Big-eared bats take a variety of prey on the wing from the edge of forested habitats but also glean prey from vegetation to forage, including small moths, beetles, flies, lacewings, wasps, bees, and ants.

Threats:
Big-eared bats are very sensitive to human disturbances and a single disturbance of a maternity roost or hibernation site may cause abandonment (Zeiner *et al*. 1990B). All known limestone cave sites in California, for example, have been abandoned (Zeiner *et al*. 1990B). Other plausible threats to big-eared bats resulting from construction activities include disturbances of day roosts from human activity, noise, and dust, as well as effects of dust on insect prey. Potential long-term impacts from urban development also include human and pet, stray, and feral animals' disturbances of roost sites, roost site and foraging habitat degradation, such as trampling and invasive species, and pesticides that may cause secondary poisoning and affect prey abundance.

Spotted bat (*Euderma maculatum*)

Status: The spotted bat is a CDFG Species of Special Concern. This taxon is not federally or State listed as threatened or endangered.

General Distribution: The spotted bat has been found at a small number of localities, mostly in the foothills, mountains and desert regions of southern California. [CDFG, 2000]

Distribution in the Study Area: There are no known recent records for this species in the Study Area; the Study Area is located within the known geographic range for this species; potential breeding and suitable foraging habitat occurs within portions of the Study Area.

Habitat and Habitat Associations: Habitats occupied include arid deserts, grasslands and mixed conifer forests. Elevational range extends from below sea level in California to above 3000 m (10000 ft) in New Mexico. [CDFG, 2000]

Natural History: This bat prefers to roost in rock crevices but is occasionally found in caves and buildings; cliffs provide optimal roosting habitat. Moths are the principal food source of this species (CDFG, 2000). This species feeds in flight, over water, and near the ground, using echolocation to find prey and prefers sites with adequate roosting habitat, such as cliffs.

Threats: Threats to the spotted bat may include loss of habitat to development and the use of insecticides.

Western mastiff bat (*Eumops perotis californicus*)

Status: The western mastiff bat is a CDFG Species of Special Concern. This taxon is not federally or State listed as threatened or endangered.

General Distribution: The western mastiff bat occurs in two populations; one from the southwestern United States to central Mexico and the other from the northern and central portions of South America (Harvey *et al.*, 1999). The western or California mastiff bat subspecies primarily occurs from low to mid elevations in southern and central California southeast to Texas and south to central Mexico (Best *et al.*, 1996).

Distribution in the Study Area: There are no known recent records for this species in the Study Area; the Study Area is located within the known geographic range for this species; potential breeding and suitable foraging habitat occurs within portions of the Study Area.

Habitat and Habitat Associations: The western mastiff bat utilizes a variety of habitat types including desert scrub, chaparral, mixed conifer forest, giant sequoia forests, and montane meadows (Philpott, 1997). In southern California this bat typically roosts in semiarid areas with low-growing chaparral that does not obstruct cliffs or rock outcrops (Best *et al.*, 1996). Because of its large wingspan, this bat requires roosts that have at least 2 m of free space to drop from to initiate flight. These bats utilize natural crevices in granitic and sandstone cliffs as well as crevices in buildings for roosting (Best *et al.*, 1996; NatureServe, 2012).

Natural History: The western mastiff bat is the largest bat in the United States with a total length of 15.7 to 18.5 cm (NatureServe, 2012). This bat breeds in early spring with most births likely occurring from June through July, and females usually give birth to one offspring (NatureServe, 2012). Colonies typically consist of less than 100 individuals (NatureServe, 2012). Western mastiff bats are primarily insectivorous, and the diet contains a high proportion of moths (Philpott, 1997). Predators include peregrine falcon, American kestrel, red-tailed hawk, and barn owl (Best *et al.*, 1996).

Threats: Threats to the western mastiff bat include loss of habitat to development and the use of insecticides (Williams, 1986). In the southwest, loss of large open ponds used for drinking water threaten this subspecies, and activities that disturb or destroy cliff habitat (such as water impoundments, highway construction, and quarry operations) pose a threat as well (Texas Parks and Wildlife, 2009).

Western red bat (*Lasiurus blossevillii*)

Status: The Western red bat is designated by CDFG as a California Species of Special Concern, and is a U.S. Forest Service Sensitive species. This taxon is not federally or State listed as threatened or endangered.

General Distribution: The western red bat (*Lasiurus blossevillii*) occurs in California from Shasta County and Mendocino County in the north, and through the central coastal region and the Central Valley west of the Sierra Nevada/Cascade ranges to coastal southern California (Cryan 2003; Zeiner *et al*. 1990B), east into Arizona and New Mexico, and south into Baja California and mainland Mexico to South America (Cryan 2003). The species inhabits California year-round but makes seasonal movements within the state and, possibly, to Arizona and New Mexico (Cryan 2003).

Distribution in the Study Area: There are no known recent records for this species in the Study Area; the Study Area is located within the known geographic range for this species; potential breeding and suitable foraging habitat occurs within portions of the Study Area

Habitat and Habitat Associations: Red bats (*Lasiurus* spp.) typically roost in trees, occasionally in shrubs, and even on the ground (Shump and Shump 1982). They are usually solitary, but different bats may use different roosts on different days, and they occasionally form nursery colonies. Day roosts are commonly located in edge habitats adjacent to streams, open fields, and urban areas (Shump and Shump 1982).

Natural History: Red bats take a variety of prey, including moths, crickets, flies, true bugs, beetles, and cicadas (Shump and Shump 1982). They generally forage in grasslands, shrublands, open woodlands, and croplands, but they also take advantage of congregations of insects attracted to streetlights and building floodlights. Births occur in about mid-June and young develop rapidly, with flight occurring by 21 to 42 days of age (Shump and Shump 1982).

Threats: Like other bats, western red bats probably are generally vulnerable to human activity and related impacts. Unlike many other bat species, due to their use of day roosts in trees, shrubs, and sometimes on the ground, western red bats are especially vulnerable to predation by domestic cats, as well as opossums, great horned owls, kestrels, and roadrunners. Other plausible threats to western red bats resulting from construction activities include disturbances of day roosts from human activity, noise, and dust, as well as effects of dust on insect prey. Potential long-term impacts from urban development, in addition to pet, stray, and feral animals, include human disturbances of roost sites, roost site and foraging habitat degradation, such as trampling and invasive species, and pesticides that may cause secondary poisoning and affect prey abundance.

Hoary bat (*Lasiurus cinereus*)

Status: The hoary bat is a CDFG Special Animal. This taxon is not federally or State listed as threatened or endangered.

General Distribution: This species is the most widespread North American bat and occurs throughout California, although distribution is patchy in the southeastern deserts.

Distribution in the Study Area: There are no known recent records for this species in the Study Area; the Study Area is located within the known geographic range for this species; potential breeding and suitable foraging habitat occurs within portions of the Study Area.

Habitat and Habitat Associations: The hoary bat occurs in a wide variety of environments, but prefers open habitats or habitat mosaics with access to trees for cover. Open areas or habitat edges are also preferred for foraging.

Natural History: This species is distinguishable by its size and color, exhibiting distinct white markings on hair tips over most of the body (Burt and Grossenheider, 1954). Hoary bats breed in autumn and young are typically born between mid-May and early June (Zeiner *et al.*, 1990b). Females bear young while roosting in trees and may leave the young at the roosting site while foraging (Zeiner *et al.*, 1990b). Typically a solitary species, hoary bats are known to forage with many other bat species (CDFG, 2008). The primary diet of hoary bats consists of moths that are taken in flight; however, other flying insects are also consumed (Black, 1974, Whitaker *et al.*, 1977, 1981). There is a relatively high incidence of rabies in this species (Shump and Shump, 1982). No important predators are known, but owls likely prey on hoary bats (Zeiner *et al.*, 1990b).

Threats: No persistent threats have been identified for this species.

California leaf-nosed bat (*Macrotus californicus*)

Status: California leaf-nosed bat is listed as a CDFG Special Animal. This taxon is not federally or State listed as threatened or endangered.

General Distribution: This species has a limited distribution which extends from northwestern Mexico (Sonora and Sinaloa) and Baja California into Arizona, southern Nevada, and southern California (CDFG, 1998).

Distribution in the Study Area: There are no known recent records for this species in the Study Area; the Study Area is located outside the known geographic range for this species; potential breeding and suitable foraging habitat occurs within portions of the Study Area.

Habitat and Habitat Associations: The California leaf-nosed bat appears to be confined to lowland Sonoran Desert habitat below 900 m. This species also appears to be totally dependent on either caves or mines for roosting. Although it has occasionally been found night roosting in buildings or bridges, its maternity, mating, and overwintering sites are all in mines or caves. [CDFG, 1998]

Natural History: This bat is colonial, forming large seasonal aggregations. Females congregate in the spring and summer in maternity colonies of typically 100 to 200 bats (Barbour and Davis 1969, Vaughan 1959), although colonies of only 6-20 bats are also found. Within the larger colonies, clusters of five to 25 females will be associated with a single “harem” male that defends the cluster against intruding males (Brown and Berry 1991). Large male roosts may also form. Each female bears a single young between mid-May and early July. Maternity colonies disband once the young are independent in late summer. In September and October, males aggregate in “display” roosts, which may be separate from the maternity sites, where they are visited by females for mating (Pierson, 1998). Although pregnancy is initiated immediately, embryos undergo several months of “delayed development,” remaining at a very early embryonic stage until development resumes in March (Bradshaw 1962). The total gestation period is almost nine months. This species also forms larger, mixed sex aggregations of up to 2,000 bats in winter. Unlike vespertilionids, phyllostomids do not hibernate. M. californicus has a narrow thermal-neutral zone, and appears incapable of entering torpor (Pierson, 1998). [CDFG, 1998]

Threats: Potential threats to this species include renewed mining, abandoned mine closures, disturbance from the public, urban expansion, loss of foraging habitat, landfills and military activities.

Western small-footed myotis (*Myotis ciliolabrum*)

Status: The Western small-footed myotis is designated by CDFG as a California Special Animal. This taxon is not federally or State listed as threatened or endangered.

General Distribution:
The western small-footed myotis (*Myotis ciliolabrum*) is widespread throughout western North America, from western Canada south through the western United States to northern Baja California and central Mexico (Hall 1981). In the United States, the species occurs in all states west of, and including, North Dakota to the north and Texas to the south. The species is absent from the coastal regions of Washington, Oregon, and California south to about Ventura County (Zeiner *et al.* 1990B). In California, it occurs in coastal southern California, the foothills of the Sierra Nevada, and the Great Basin Desert, and it is absent from the higher elevations in the mountains and from the lower elevations in the Mojave and Colorado deserts (Zeiner *et al.* 1990B).

Distribution in the Study Area: There are no known recent records for this species in the Study Area; the Study Area is located within the known geographic range for this species; potential breeding and suitable foraging habitat occurs within portions of the Study Area.

Habitat and Habitat Associations:

The western small-footed myotis occurs in a wide variety of arid upland habitats at elevations ranging from sea level to 2,700 meters (8,860 feet) (Zeiner *et al.* 1990B). Habitats used by this species include riparian areas, woodlands, and brushy uplands (Holloway and Barclay 2001; Zeiner *et al.* 1990B). Western small-footed myotis day roosts include rock crevices, caves, tunnels and mines, and, sometimes, buildings and abandoned swallow nests (Holloway and Barclay 2001). They also use day roosts as nocturnal roosts (*i.e.*, they may return to the day roost during the night) or may use buildings and concrete underpasses strictly as nocturnal roosts (Holloway and Barclay 2001).

Natural History:
Western small-footed myotis forage for moths, true flies, gnats, midges, mosquitoes, true bugs, and beetles, often along the margins of trees and over water (Zeiner *et al.* 1990B). Females establish maternity roosts, which may be solitary or colonial (with up to 20 individuals), where young are born and raised (Zeiner *et al.* 1990B). Males appear to establish solitary roosts during the breeding season (Zeiner *et al.* 1990B). Births generally occur in May and June, with a peak in late May (Zeiner *et al.* 1990B), and first flight by young occurs by about one month (Wilson and Ruff 1999).

Threats:
No documented threats to western small-footed myotis colonies have been reported in the scientific literature, but, like most bats, this species is likely very sensitive to human disturbance and because it may roost in abandoned buildings and under bridges (nocturnal roosts), it is vulnerable to vandalism, extermination, or inadvertent disturbance of roost sites.

Fringed myotis (*Myotis thysanodes*)

Status: The fringed myotis is designated by CDFG as a California Special Animal. This taxon is not federally or State listed as threatened or endangered.

General Distribution: The fringed myotis (*Myotis thysanodes*) is widespread throughout the western United States, southern British Columbia, Canada, Mexico, and Central America (O'Farrell and Studier 1980).

Distribution in the Study Area: There are no known recent records for this species in the Study Area; the Study Area is located within the known geographic range for this species; potential breeding and suitable foraging habitat occurs within portions of the Study Area.

Habitat and Habitat Associations: The fringed myotis typically occurs in a wide variety of desert, grass, and woodland habitats at middle elevations of 1,200 to 2,850 meters AMSL (3,937 to 9,350 feet) but is known from lower elevations along the west coast and may occur in pine–fir associations at higher elevations (O'Farrell and Studier 1980). Individuals observed in desert/steppe habitats were within a one-hour flight of forest and riparian habitats (O'Farrell and Studier 1980).

Natural History: During their most active season (April through September), fringed myotis leave their roosts at sundown and forage for small beetles, which comprise about 73% of their diet, in the vegetation canopy (O'Farrell and Studier 1980). They return to the roost by daylight. Females establish maternity colonies in late April in caves, tunnels, mines, and buildings where young are born and raised. Males establish solitary roost areas during the breeding season. Females leave by late September and probably migrate or disperse to winter hibernacula (Wilson and Ruff 1999). Young are born in late June to early July (O'Farrell and Studier 1980). Young develop rapidly, with flight occurring by 16 days of age, and are fully developed by 20 to 21 days.

Threats: The fringed myotis is sensitive to disturbance of roost sites by humans, potentially resulting in abandonment (O'Farrell and Studier 1980; Wilson and Ruff 1999). Such disturbances could also disrupt the interaction of females and young, such as females failing to retrieve young that have fallen from the neonate cluster, which can result in mortality of the young. Other plausible threats to fringed myotis resulting from construction activities include disturbances of day roosts from human activity, noise, and dust, as well as effects of dust on insect prey. Potential long-term impacts from urban development also include pet, stray, and feral animals' disturbances of roost sites; roost site and foraging habitat degradation, such as trampling and invasive species; and pesticides that may cause secondary poisoning and affect prey abundance.

Long-legged myotis (*Myotis volans*)

Status: The long-legged myotis is designated by CDFG as a California Special Animal. This taxon is not federally or State listed as threatened or endangered.

General Distribution: The long-legged myotis (*Myotis volans*) is widespread throughout western North America, from extreme southeastern Alaska and western Canada (British Columbia and Alberta) south into Baja California and central Mexico (Hall 1981). In California, it occurs throughout the state except for the Central Valley, eastern Lassen and Modoc counties, and the non-mountainous regions of the Mojave and Colorado deserts (Zeiner *et al.* 1990B).

Distribution in the Study Area: There are no known recent records for this species in the Study Area; the Study Area is located within the known geographic range for this species; potential breeding and suitable foraging habitat occurs within portions of the Study Area.

Habitat and Habitat Associations: The long-legged myotis is a yearlong resident of California and primarily occurs in coniferous forests, but it also uses riparian and oak woodland habitats for roosting and foraging (Warner and Czaplewski 1984; Wilson and Ruff 1999; Zeiner *et al.* 1990B). Day roosts during warmer months typically are in hollow trees and under the bark of exfoliating trees (Zeiner *et al.* 1990B) but also include abandoned buildings, cracks in the ground, and crevices in canyons and cliff faces (Warner and Czaplewski 1984). Johnson *et al.* (2007) found that the long-legged myotis in a forested region of north-central Idaho used snags for roosts located mid-slope. This species uses caves and tunnels as winter hibernation areas, indicating local seasonal migrations. In addition to using forests and woodlands, the long-legged myotis also forages in coastal scrub, chaparral, and desert habitat (Zeiner *et al.* 1990B). Johnson *et al.* (2007) suggest that habitat selection is a function of preferred prey availability. Long-legged myotis occur at elevations ranging from 60 to 3,770 meters (197 to 12,370 feet) but are most commonly found at 2,000 to 3,000 meters (6,560 to 9,840 feet).

Natural History: Long-legged myotis appear to be opportunistic feeders, foraging both within and above the forest canopy and congregating with other bat species at areas of high insect concentrations (Zeiner *et al.* 1990B). They may be moth specialists, but they also feed on a variety of insects, including true flies, gnats, midges, mosquitoes, termites, true bugs, leafhoppers, ants, bees, wasps, lacewings, and beetles. They are active throughout the night, with a peak of foraging activity three to four hours after dark (Warner and Czaplewski 1984). Large maternity colonies of several hundred individuals are formed in day roosts (Zeiner *et al.* 1990B). Timing of births is variable and occurs from May to August, possibly in relation to climate (Czaplewski 1984). Young have been observed flying by mid-July (Zeiner *et al.* 1990B).

Threats: No documented threats to long-legged myotis colonies have been reported in the scientific literature, but, like most bats, this species is likely very sensitive to human disturbance and because it may also roost in abandoned buildings, it is vulnerable to vandalism, extermination, or inadvertent disturbance of roost sites.

Southern grasshopper mouse (*Onychomys torridus Ramona*)

Status: The southern grasshopper mouse is designated by CDFG as a California Species of Special Concern. This taxon is not federally or State listed as threatened or endangered.

General Distribution: The southern grasshopper mouse (*Onychomys torridus*) occurs throughout desert habitats in the southwestern United States and much of Mexico, including western Nevada; the southern portions of California, Arizona, and New Mexico; northern Baja California; western Texas; and south to central Mexico (Hall 1981). The subspecies *O. t. ramona*, which is a California Species of Special Concern (CSC), is restricted to coastal southern California.

Distribution in the Study Area: There are no known recent records for this species in the Study Area; the Study Area is located within the known geographic range for this species; Suitable habitat occurs within limited portions of the Study Area.

Habitat and Habitat Associations: The southern grasshopper mouse is found rangewide in low arid scrub and semi-scrub vegetation (Frank and Heske 1992; McCarty 1975), and the subspecies *O. t. ramona* (which is the subspecies designated as a California Species of Special Concern) occurs in grasslands and sparse coastal scrub habitats. Specific habitat requirements of the southern grasshopper mouse generally are unknown, but Stapp (1997) found that the southern grasshopper mouse uses open expanses and microhabitats dominated by gopher mounds and burrows, possibly because of greater prey availability (*e.g.*, arthropods using burrows for refuge), greater mobility in open expanses, and dust bathing sites in these microhabitats.

Natural History: The southern grasshopper mouse's diet consists mainly of arthropods (*e.g.*, crustaceans, insects, centipedes, millipedes, and arachnids), but may also include other insects and small rodents (Baily and Sperry 1929; Horner *et al.* 1965; McCarty 1975; Stapp 1997). The southern grasshopper mouse is primarily nocturnal and appears to be active on the surface all year round (Baily and Sperry 1929; Frank and Heske 1992; McCarty 1975). Because of its high population turnover, relatively early age of sexual maturity, and senescence after the first year, the southern grasshopper mouse probably is subject to "boom and bust" population cycles and is perhaps at high risk of local extirpation under poor conditions.

Threats: There are no identified threats to the southern grasshopper mouse other than loss and fragmentation of grassland and sparse sage scrub habitats in coastal southern California, which probably are the greatest threats to local southern grasshopper mouse populations.

Tehachapi pocket mouse (*Perognathus alticolus inexpectatus*)

Status: The Tehachapi pocket mouse is designated by CDFG as a California Species of Special Concern, and is a U.S. Forest Service Sensitive species. This taxon is not federally or State listed as threatened or endangered.

General Distribution: P. a. inexpectatus occupies the Tehachapi Mountains from Tehachapi Pass southwest towards Gorman, as far west as Cuddy Valley near Mount Pinos, and east along the lower slopes of the San Gabriel Mountains to Elizabeth Lake (Williams et al., 1993).

Distribution in the Study Area: There are no known recent records for this species in the Study Area; the Study Area is located outside the known geographic range for this species. This species is however known to occur on the east slopes of the San Gabriel Mountains. Suitable habitat is present within the Study Area.

Habitat and Habitat Associations: The Tehachapi pocket mouse typically occupies native and non-native grasslands, Joshua tree woodland, pinyon-juniper woodland, yellow pine woodland, and oak savannah (Williams et al., 1993). It has also been captured in open pine forests at higher elevations (Huey, 1926), in chaparral and coastal sage communities at lower elevations (Best, 1994), and on rangeland and fallow grain fields (Sulentich, 1983). It constructs burrows in loose, sandy soils (Zeiner et al., 1990b).

Natural History: Little information is available concerning the ecology of the Tehachapi pocket mouse. Other members of the species group are nocturnal granivores, foraging primarily on seeds of grasses, forbs and annuals, but also on leafy plant material and insects (Verts and Kirkland, 1988). Most other members of the genus exhibit seasonal hibernation (Verts and Kirkland, 1988), and it is expected that P. a. inexpectatus does as well.

Threats: Livestock grazing is the predominate land-use throughout much of its range. It is unclear how grazing and its subsequent effects on plant diversity and abundance affect the Tehachapi pocket mouse. Many areas within the range of the Tehachapi pocket mouse are used for wind-generated electricity production or have the potential to support wind farms. Such areas are typically crossed by a network of roads, which could lead to increased erosion in steeper terrain. Mineral extraction is another potential threat to the Tehachapi pocket mouse. In general, surface disturbing activities such as mineral extraction are incompatible with persistence of the native small mammal assemblage. Conversion of native habitats to urban use has occurred in the Elizabeth Lake area. If the subspecies persists in small, scattered populations, it is highly vulnerable to local extirpation resulting from natural or human-related events. [BLM, No Date B]

Mohave ground squirrel (*Spermophilus mohavensis*)

Status: The Mohave ground squirrel is State Listed as Threatened.

General Distribution: The Mohave ground squirrel occupies portions of Inyo, Kern, Los Angeles and San Bernardino counties in the western Mojave Desert. The species ranges from near Palmdale on the southwest to Lucerne Valley on the southeast, Olancha on the northwest and the Avawatz Mountains on the northeast (BLM, 2005).

Distribution in the Study Area: While this species has not been documented within the Study Area it is known to occur north and east of the Study Area. Although not expected to occur in the Study Area it may occur along the proposed haul routes north of the Study Area.

Habitat and Habitat Associations: The Mohave ground squirrel occupies all major desert scrub habitats in the western Mojave Desert. It has been observed in habitats such as Mojave creosote scrub, desert saltbush scrub, desert sink scrub, desert greasewood scrub, shadscale scrub, and Joshua tree woodland. These habitat types are distributed throughout the range of the Mohave ground squirrel. In the northern portion of the range of the Mohave ground squirrel, it is found in a plant association described as Mojave mixed woody scrub, typically occurring on hilly terrain and composed of a variety of shrub species (BLM, 2005).

Natural History: Activity periods for this species vary, and little is known about their reproduction (Ingles, 1979). Their diet consists of seeds and vegetative parts of desert plants, including fruits of the Joshua tree. Because of the aridity and high temperatures of its environment, the Mohave ground squirrel is a diurnal species spending up to seven months underground (Vanherweg, 2010).

Threats: The primary cause of the decline of the Mohave ground squirrel is destruction and fragmentation of its habitat and conversion to urban, suburban, agricultural, military and other uses (BLM, 2005).

American badger (*Taxidea taxus*)

Status: The American badger is a CDFG Species of Special Concern. This taxon is not federally or State listed as threatened or endangered.

General Distribution: The vast geographic range of the American badger extends as far north as Alberta, Canada and as far south as central Mexico (Hall, 1981). This species occurs in suitable habitat throughout California with the exceptions of the humid coastal forests of Del Norte and Humboldt Counties in the northwest part of the state (Williams, 1986). The elevation range for this species occurs between below sea level at Death Valley to as high as the Arctic-Alpine Life Zone (Long, 1973).

Distribution in the Study Area: There are no known records for this species in the Study Area; the Study Area is located within the known geographic distribution for this species; suitable habitat occurs within portions of the Study Area.

Habitat and Habitat Associations: American badgers exploit a wide variety of open, arid habitats, but are most commonly found in grasslands, savannas, mountain meadows, and open areas of desert scrub (Stephenson and Calcarone, 1999). Basic requirements that have been identified for this species appear to be sufficient food (burrowing rodents), friable soils, and relatively open, uncultivated ground (Williams, 1986).

Natural History: American badgers are most often solitary animals that are primarily nocturnal, but have been reported occasionally foraging and dispersing during the daytime (Lindzey, 1978; Messick and Hornocker, 1981). This species is active year-round except at higher elevations and latitudes, where winter torpidity is common. During winter, individuals at lower elevations will exhibit reduced surface activity and may remain in a single burrow for days or even weeks (Long, 1973; Messick and Hornocker, 1981). This species is an opportunistic predator feeding on such prey resources as mice, chipmunks, ground squirrels, gophers, rabbits, and kangaroo rats. Reptiles, insects, birds, eggs, and carrion are also consumed (Williams, 1986; Zeiner *et al.*, 1990b). American badgers mate in the summer and early autumn with young born in March and early April (Long, 1973).

Threats: This species has experienced large population declines in many areas of southern California and has been steadily decreasing throughout the state over the last century (Williams, 1986). The major cause of mortality to adult badgers is vehicular accidents. Other common threats include habitat conversion to urban and agricultural uses, farming operations, shooting and trapping, poisoning, and reduction of prey base as a result of rodent control activities (Williams, 1986).

Appendix E – Least Bell's Vireo Survey Report

Appendix B

Geotechnical Investigation, Data Collection, and Survey Memoranda

EVALUATION OF GEOTECHNICAL TESTING ACTIVITIES AT LITTLEROCK RESERVOIR

1. Introduction

The intent of this evaluation is to provide the USDA Forest Service, Angeles National Forest (Forest Service) with information regarding geotechnical testing activities required to be undertaken associated with project design of the Littlerock Reservoir Sediment Removal Project as proposed by the Palmdale Water District (District). At the request of the Forest Service, this evaluation consists of a description of the geotechnical testing activities, and a discussion of impacts to hydrology, biology, and heritage resources.

2. Description of Drilling Activities

Overview and Purpose

The Littlerock Reservoir Sediment Removal Project would consist of the construction of a grade control structure and the excavation of between 270,000 and 540,000 cubic yards of sediment from Littlerock Reservoir (Reservoir). The grade control structure would be constructed of soil cement or concrete and span approximately 250 feet of the channel.

The purpose of the geotechnical drilling and testing is to obtain subsurface information to be used in a geotechnical investigation in support of the design of the proposed grade control structure.

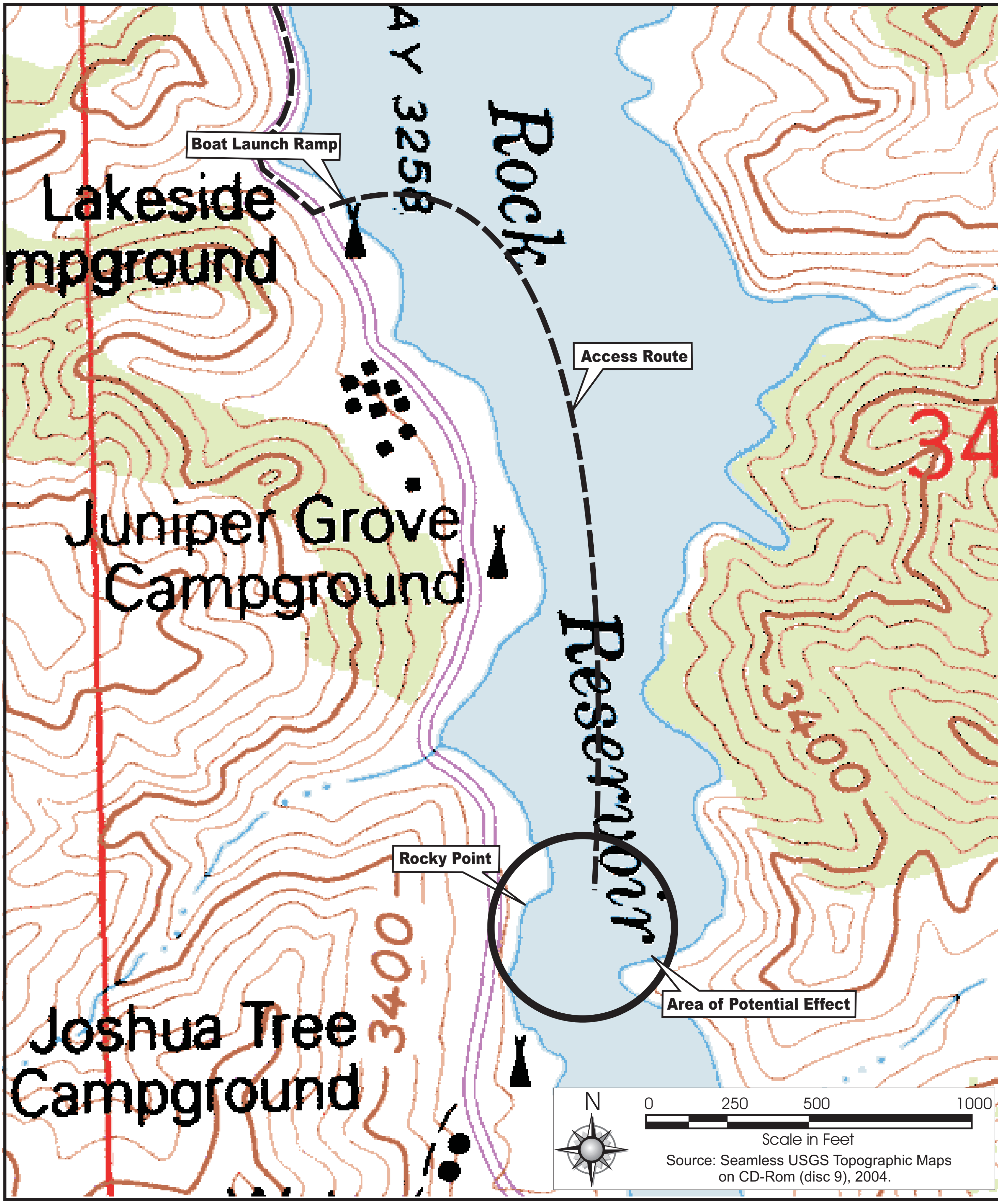
Location, Schedule, and Equipment

The geotechnical testing would occur at the proposed grade control site within the Littlerock Reservoir, which is a man-made feature formed by the impoundment of water by the Littlerock Dam. The Reservoir is located on Littlerock Creek in the northeastern foothills of the San Gabriel Mountains on the western edge of the Mojave Desert. The Reservoir is located within the boundaries of the Santa Clara Mojave Rivers Ranger District of the Angeles National Forest. Littlerock Creek, which supplies water to the reservoir, is an intermittent stream supported by annual rainfall and snowmelt, and flows north from its headwaters located on the slope of nearby Mount Williamson. Regionally, the reservoir is located approximately 10 miles southeast of the City of Palmdale and 4 miles south of the community of Littlerock in the northern Los Angeles County area.

Construction of the proposed grade control structure would occur at or just downstream of River Station 4,235 (the Rocky Point area). Although there is some flexibility in the location of the grade-control structure, this area has been selected at a location that would allow a minimum size of the structure, allow for the removal of reservoir sediment, and prevent impacts to the stream channel from sediment loss and headcutting upstream of this location.

The area of potential effect (APE) for geotechnical testing activities is shown on Figure 1, which illustrates the access (via a dashed line) route that testing equipment would use, and a circle where drilling of test pits could potentially occur.

Drilling activities would begin approximately the last week of August 2007, and would take up to 10 calendar days.



Aspen Environmental Group	Area of Potential Effect for Geotechnical Testing	**LITTLEROCK RESERVOIR SEDIMENT REMOVAL PROJECT** Figure 1

Equipment that would be used to conduct the drilling and testing activities include an all-terrain (caterpillar-tread) drilling rig with up to two support vehicles. Support vehicles would be a pick-up truck and a water truck. A water tank may be towed behind the drill rig instead of using a separate truck for water. A drill rig plus support vehicles would enter the dry reservoir at the boat ramp and travel up the dry reservoir bed to the Rocky Point area as shown in Figure 1. Alternatively, the equipment would access to the reservoir at the existing off highway vehicle access point just north of Rocky Point. The drill rig will set up and make borings up to 100 feet in depth and approximately 8 inches in diameter. Drilling will be by rotary wash drilling.

Mud brought up from the hole would be collected in a metal pan and removed with the drill rig when the job is complete. The drilling mud would be tested for hazardous substances and, if any found, the mud will be disposed of in an approved hazardous waste disposal facility.

The total area of disturbance for each boring will be about 12 feet by 15 feet, and there will be a disturbance from vehicle access and turn-around. After drilling is finished the holes are sealed with grout. The final observed result on the ground is a disturbed area about 180 square feet in size, plus surrounding vehicle tracks. There will be up to seven borings. Each boring may have a separate set up.

3. Biological Resources Evaluation

The proposed geotechnical testing would occur within and/or adjacent to Littlerock Creek at Rocky Point near the upstream terminus of the Reservoir. This area is historically subject to annual inundation and when water levels recede, routine off highway vehicle use. Littlerock Creek is also known to support sensitive biological resources at locations upstream of the Reservoir including the arroyo toad (*Bufo californicus*), a federally endangered species. Under optimal conditions, arroyo toads have been documented to occur above Sage Campground which is located approximately 300 feet upstream of Rocky point. This biological resources evaluation is intended to provide a concise summary of the existing biological conditions at the proposed testing site and to provide an assessment of the potential to impact arroyo toads or other sensitive plant or wildlife species that may occur in the area.

Literature Review

The project area is currently located within the project footprint of the Littlerock Reservoir Sediment Removal Project. As part of the environmental documentation for the project, a literature search was performed prior to conducting the field surveys of the project area. This included portions of the project located within the U.S. Geological Survey's (USGS) Pacifico Mountain California 7.5' topographic quadrangle. A search of the California Department of Fish and Game California Natural Diversity Data Base (CNDDB) was also conducted for this quadrangle and the surrounding eight quadrangles to determine special-status plants, wildlife, and vegetation communities that have been documented within the vicinity of the proposed Project. Additional data regarding the potential occurrence of special-status species and policies regarding these sensitive natural resources were gathered from the following sources:

- State and federally listed endangered and threatened animals of California (CDFG 2007a);
- Special animals list (CDFG 2007b);
- Inventory of Rare and Endangered Plants of California (CNPS 2001);
- Inventory of Rare and Endangered Plants (online edition, v7-07b). (CNPS 2007);

- Angeles National Forest Land Management Plan (USDA Forest Service, 1987);
- County of Los Angeles General Plan (County of Los Angeles 1980);
- Pacific Southwest Region Regional Forester's Sensitive Species List (USDA Forest Service 2001); and
- Biological Assessment for the Littlerock Dam and Reservoir Sediment Control Plan (PCR 2001).

This information, combined with field observations, was used to determine the potential for impacts to sensitive plants and wildlife at the proposed geotechnical testing site.

Survey Methodology

Both the USDA Forest Service (USFS) and the District's environmental consultant, Aspen Environmental Group (Aspen), have conducted a variety of surveys in the project area and Rocky Point, particularly for arroyo toads. The field survey areas have included the entire Project area of the reservoir and area immediately upstream of the reservoir. Surveys for arroyo toads were performed at Rocky Point and the area upstream of Sage Campground. However, as typical toad usage has been documented at and above Santiago Canyon, most of the focused surveys for these species has commenced in this section of the creek. Santiago Canyon is located over one thousand feet upstream of the proposed geotechnical testing site. Some of the field surveys of the project area were conducted on June 19, 2005, July 8, 2006, October 5, 2006, December 7, 2006, January 15, 2007, and June 11, 2007. Weather conditions varied during the surveys but were generally conducted when the weather was clear with temperatures ranging between 55 and 95 degrees Fahrenheit.

Vegetation and Wildlife

Habitat at the proposed testing site was characterized according to Holland (1986) where applicable. The proposed testing area is located within the existing creek bed of Littlerock Creek. The creek in this area is sand dominated with a narrow, less than 3-foot wide mud dominated channel. This area is largely unvegetated as the site is submerged most of the year. As the water levels recede, the area is then open to off highway vehicle (OHV) usage the remainder of the year. Similarly, as the water recedes most of the emergent vegetation that remains becomes desiccated in the hot dry air as the riparian species are unable to keep pace with the receding water levels of the Reservoir. Currently the portions of the site are largely barren with small patches of herbaceous vegetation. The evegated areas support emergent black willow (*Salix gooddingii*) with a very limited herbaceous layer of scattered vervain (*Verbena lasiostachys*), alkali mallow (*Malvella leprosa*), salt heliotrope (*Heliotropium currassavicum*), and cocklebur (*Xanthium strumarium*). Rabbits foot grass (*Polypogon monspeliensis*) lamb's quarters (*Chenopodium album*), rushes (*Juncus sp.*), willow herb (*Epilobium ciliatum*), salt heliotrope, and monkey flowers (*Mimulus spp.*) are present to some degree in the northern section of the testing site. This area typically supports vegetation for slightly longer periods of time as it has been placed off limits to OHV use. However, the orange snow fence is routinely breached by OHV's. Vegetation currently present at the testing site may be present for up to a year or two until the next major scour event occurs.

Southern cottonwood-willow riparian forest occurs along the upper banks and flood terraces at the site and is dominated by mature western cottonwood (*Populus fremontii ssp. fremontii*) and black willow. The understory is very limited, with only scattered vegetation including vervain, alkali mallow, salt and heliotrope. As described above, due to both biotic and abiotic factors; little evidence of cottonwood recruitment was apparent and portions of the Reservoir may ultimately be subject to a total loss of riparian habitat.

Although a wide variety of wildlife likely use the Reservoir, few species of wildlife were observed at or near the testing site. Common raven (*Corvus corax*), ground squirrels (*Spermophilus beecheyi*), and the tracks of bush rabbit (*Sylvilagus bachmani*), coyote (*Canus latrans*) and mule deer (*Odocoileus hemionus*) were observed. Other common species include Bottas' pocket gopher (*Thomomys bottae*), western scrub jay (*Aphelocoma californica*), and mourning dove (*Zenaida macroura*). Red-tailed hawks (*Buteo jamaicensis*) were observed soaring above the Reservoir but there was no indication of stick nests near the testing site. Anna's hummingbird (*Calypte anna*) and a great blue heron (*Ardea herodias)* were observed overhead and probably also use this habitat.

Sensitive Plants and Wildlife

Sections of Littlerock Creek, outside the project area, are known to support populations of rare species including the arroyo toad, mountain yellow-legged frog (*Rana muscosa*), and two-striped garter snake (*Thamnophis hammondii*). In addition, there is potential habitat in some areas to support a variety of riparian birds, albeit not federally listed. However, these sections are generally well outside the proposed testing area. Rare plants, while they may occur in the adjacent upland areas, are not expected to occur in the channel or Reservoir area due to a lack of suitable habitat.

Sensitive plants and wildlife were not observed at or near the testing site. Due to the high level of disturbance at the site rare plants are not expected to occur and would not be impacted by testing activities. Wildlife usage at the testing site is very low and sensitive wildlife including arroyo toads are not expected to be present at this time. During a period of high rainfall and subsequent run off it may be possible for toads to be washed or move downstream but there have been no documented sightings at the proposed testing site. Toads that entered the Reservoir would also be subject to predation by exotic fish or mechanical crushing from recreationists and vehicles. Current surveys of the project area conducted in 2007 did not detect the presence of toads, egg masses or larvae within three thousand feet of the testing site. In addition, toads were not detected anywhere below Santiago creek. Tadpoles, that may have been arroyo toads, were detected approximately three thousand feet upstream of the project site and adult toads are likely foraging in the upstream sections of the creek. However, these animals were not detected during the surveys.

While sensitive plants and wildlife are known in the region these species are not present in the proposed testing site at this time. Nonetheless it is recommended that the drilling crew implement the following biological guidelines when working in the stream.

1) The District shall conduct a pre-construction (diurnal and nocturnal) survey for arroyo toads within 500 feet of the testing site. If arroyo toads are detected no activities shall occur without authorization from the USFS. The biologist shall also ensure that nesting raptors are not present. Testing activities shall not occur if nesting raptors are present within 150 feet of the project area. (This buffer is based on the routine use of OHV in the project area); and

2) The District shall provide a biological monitor that will be present during all testing activities. The monitor shall ensure that arroyo toads or other sensitive wildlife are not present in the testing area.

The District's consultant, Aspen Environmental Group, can provide a biological monitor during drilling activities to ensure that these measures are implemented.

4. Hydrology Evaluation

Drilling will be performed during the month of August, 2007. Based on historical records, and current (July 2007) observations of zero flow at the location of the drilling, no stream flow is expected at the drilling site. The reservoir level will be well below the drilling site, and below the access route. Drilling will be performed on a dry ground surface. Possible impacts to hydrologic resources include:

- Disposal of drilling mud into the stream bed, resulting in later turbidity problems as these muds are carried into the reservoir by stream flows; and,
- Accidental spill or discharge of oil, gasoline, or other vehicle fluids into the stream bed along the access route or at the drill site.

The drilling contractor will be collecting and removing drill mud from the site, such that a negligible amount would be left at the site. Drill muds will be non-toxic, and the impact of this minor residual amount is not significant.

Hydrology impacts of the drilling will not occur if the drilling permit contains the following provisions, which are adhered to:

1) The District shall ensure that excess drilling mud will be collected and removed from the site, and disposed of in a permitted landfill according to applicable disposal regulations;

2) The District shall ensure that no vehicle maintenance involving the use of fluids which may contaminate surface or groundwater shall take place within the stream bed; and

3) The District shall ensure that any spill of oil or other vehicular or drilling fluid will be collected and removed from the site prior to the termination of drilling.

The District's consultant, Aspen Environmental Group, can provide a construction monitor during drilling activities to ensure that these measures are implemented.

5. Heritage Resources Evaluation

As part of the EIR/EIS preparation process for the Littlerock Reservoir Sediment Removal Project, the District has prepared a Phase I Cultural Resources Investigation (attached). The location for the proposed geotechnical testing is within the APE studied in the Phase I Cultural Resources Investigation conducted for the project by Conejo Archaeological Consultants. The Phase I Cultural Resources Investigation Report (Report) for the project did not identify any historic resources, pre-historic resources, or traditional cultural properties in the area of the proposed geotechnical testing other than the Angeles National Forest itself (CAC Document No. 06-442, page 16). The Report identifies the potential to disturb buried cultural sites in undisturbed soils outside the Littlerock Creek bed and recommends that a professional archaeologist be on-site to monitor earth moving activities in these soils. Due to the location of the proposed geotechnical testing in the bed of the creek, an archaeological monitor should not be required. However, to ensure that impacts of the drilling will not occur the following is recommended:

- The District shall ensure that an archaeologist reviews the proposed testing location in the field to verify it is within the historic bed of the creek and that the set-up and completion of the geotechnical testing will not impact the adjacent banks; and

- The District shall ensure that an archaeologist will be on-call to respond to any unanticipated cultural discoveries made during the testing activities.

The District's consultant, Aspen Environmental Group, can provide an archaeological monitor during drilling activities to implement these measures.

Appendix C

Littlerock Reservoir Hydrologic and Sediment Transport Analysis Technical Report

Littlerock Reservoir

Hydrologic and Sediment Transport Analysis
Technical Report

Prepared for
Palmdale Water District

Prepared by
Aspen Environmental Group

June 2005

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1. INTRODUCTION

The Littlerock Reservoir is approximately 100 acres in size and is located on the Littlerock Creek near Palmdale, California. The reservoir is contained by Littlerock Dam, which was originally constructed in 1924. Littlerock Reservoir has been filling with sediment resulting in a substantial reduction in water storage capacity. The Palmdale Water District (District) desires to remove sediment to increase reservoir capacity and to ensure the long-term viability of the reservoir as a water source.

A population of the arroyo toad exists in the stream channel upstream of the reservoir. The arroyo toad relies on a sandy bed channel, with sand bars, as habitat. Should removal of sediment from the reservoir result in alteration of the channel bed upstream of the reservoir, habitat for the toad could be affected. The purpose of this study is to develop sediment removal alternatives, and evaluate their potential effect on the channel bed upstream of the reservoir.

2. SETTING AND BASELINE CONDITIONS

2.1 AREA DESCRIPTION

Figures 1 and 2 illustrate the basic area setting. Littlerock Reservoir has an area of approximately 100 acres when full, and extends a distance of approximately one mile upstream of the dam. The dam spillway crest is at elevation 3,270 (feet above mean sea level). The reservoir bed is mostly coarse sand, with cobbles present in the streambed upstream of the dam. The surrounding area, including the 60-square-mile watershed (at the upstream end of the reservoir), is mountainous, arid, and primarily in a natural state. Littlerock Creek drains to the north out of the San Gabriel Mountains and the Angeles National Forest. Major features referred to in this report include Littlerock Dam, Rocky Point, the maximum upstream limit of the reservoir pool (as of February, 2005), Santiago Creek, and the USGS stream gage for Littlerock Creek. Figure 1 shows the location of these features. Rocky Point is a campground area on the south side of the reservoir at a point where the reservoir narrows by encroachment of a local ridge, approximately 4,500 feet upstream of the dam. The upstream limit of the reservoir pool is as observed in early February of 2005.

2.2 HYDROLOGY

The watershed area of Little Rock Creek at the upstream end of the reservoir is 60 square miles. Santiago Creek, which enters Littlerock Creek just upstream of the reservoir, comprises 11 square miles. Littlerock Creek above Santiago Creek is 49 square miles. USGS flow records include average daily flows, average monthly and yearly flows, and annual peaks. The record for Littlerock Creek, USGS Stream Gage #10264000, extends from 10/1/1930 to 9/30/1979, and from 1/25/2002 to 9/30/2003. The Santiago Creek record (USGS Stream Gage #10264100) extends from 1/19/2002 to 9/30/2003 (USGS, 2005).

The 100-year discharge for Littlerock Creek at Littlerock Reservoir was estimated by Woodward Clyde (1991) at 21,120 cfs. Peak discharge rates for other return periods for Littlerock Creek and Santiago Creek at the USGS stream gages are listed in Table 1.

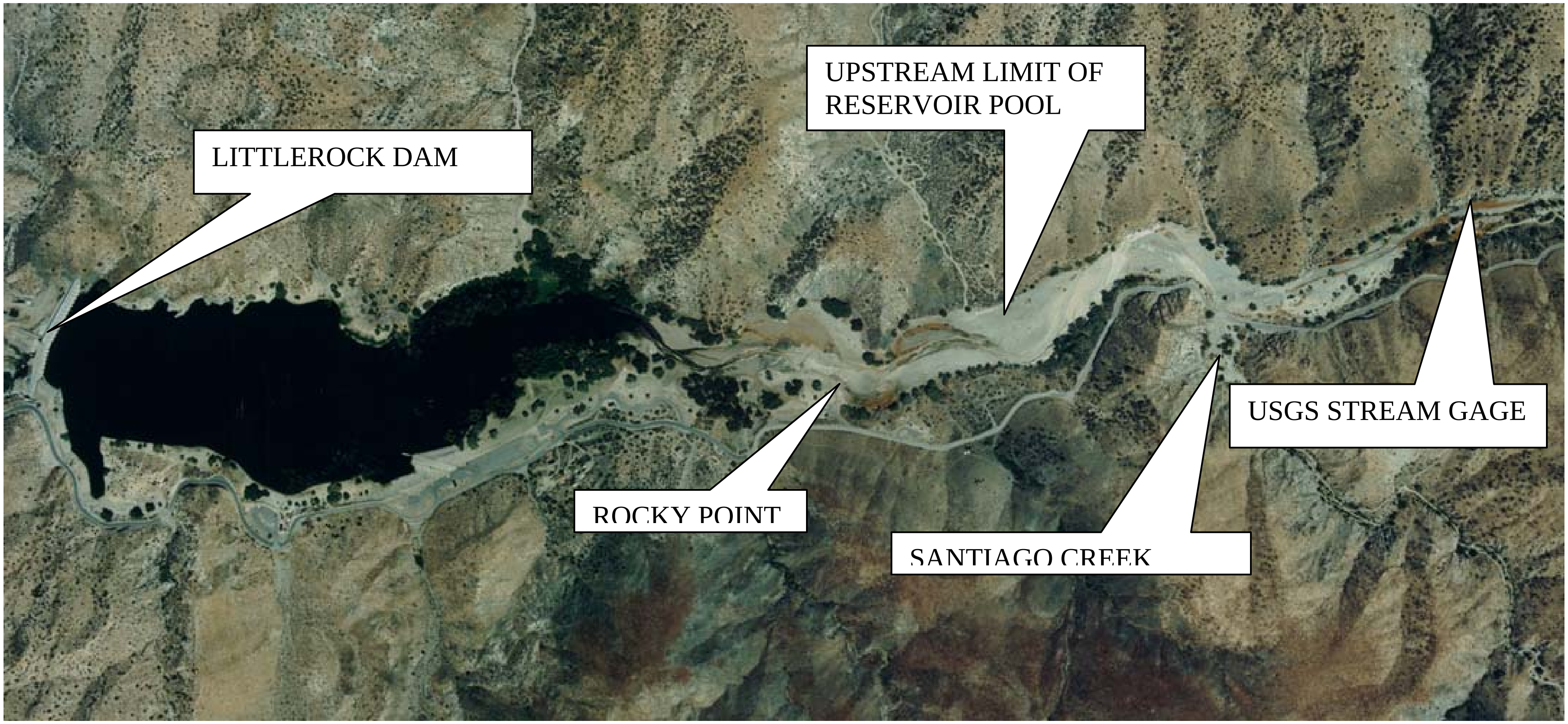

Figure 1 Aerial Photograph

VIEW LOOKING DOWNSTREAM TOWARD THE RESERVOIR

VIEW LOOKING UPSTREAM FROM ROCKY POINT

Figure 2 Typical Views of the Reservoir

Table 1 Peak Discharge Rates for Littlerock Creek and Santiago Creek for Various Return Period Floods

Flood Return Period	Peak Discharge in cfs	
	Santiago Creek	Littlerock Creek
100-Year	4,337	16,320
50-Year	2,309	11,415
25-Year	1,154	7,568
10-Year	400	3,893
2-Year	24	528

Source: Woodward Clyde (1991). Data derived from stream gage records. Santiago Creek gage is at the confluence with Littlerock Creek. Littlerock gage is above the confluence with Santiago Creek.

Whereas the Santiago Creek 100-year peak is approximately one-fourth that of Littlerock, the frequent floods are proportionally much less. The Santiago Creek 2-year flood is only 5 percent of the Littlerock flow. Comparison of average daily flow records for the period of gage record overlap reveals that Santiago Creek flows were generally less than 1 percent of Littlerock flows for the same day. For this reason, and since none of the average daily discharges represented in the USGS record for Littlerock Creek are above 2,700 cfs, Littlerock Creek is assumed to be dominant in the frequent flows, which are the main basis of the analysis presented below. Only Littlerock Creek flow records, from USGS Stream Gage #10264000, are used in the subsequent analysis.

Flows are highly seasonal (Figure 3), as is the precipitation in the area. Highest flows are in February, averaging approximately 42 cfs. Lowest flows are in the summer, July to October, with August flows averaging the lowest at 0.4 cfs. Annual recorded discharge into Littlerock Reservoir ranges from a low of 1,332 acre feet in 1961 to a high of 51,185 acre feet in 1941, and averages 11,636 acre feet.

Figures 4, 5, and 6 show seasonal flow hydrographs for a typical dry year (1961), median year (1955) and typical wet year (1941) inflow to the reservoir. The time interval of the hydrographs is one day, from the USGS data. Figure 7 shows the time to fill the reservoir assuming the current 1995 topography adjusted for sediment inflow and 2005 survey, and assuming no outflow from the reservoir. It is assumed for this figure and for all subsequent analyses that relate to reservoir filling, that the reservoir is empty at the beginning of the runoff season.

Dry year (1961) average daily inflow to the reservoir never exceeded 25 cfs for the entire season. Under current topographic conditions, the 1961 total annual inflow would not fill the reservoir. Median year (1955) average daily inflow exceeded 25 cfs on 30 days, and reached an average daily peak of 116 cfs. The median year inflow, received today, would fill the reservoir by approximately March 2. Approximately 60 percent of the 1955 flow arrived after March 2. Wet year (1941) average daily inflow exceeded 25 cfs on 132 days, and reached an average daily peak of 1,730 cfs. The 1941 inflow would fill the reservoir by February 9. Approximately 94 percent of the 1941 flow arrived after February 9.

Reservoir water storage capacity is currently approximately 3,000 acre feet. Based on the USGS record, runoff volume in approximately 80 percent of the years exceeds that amount. Runoff volume for more than half of the years exceeds 6,000 acre feet.

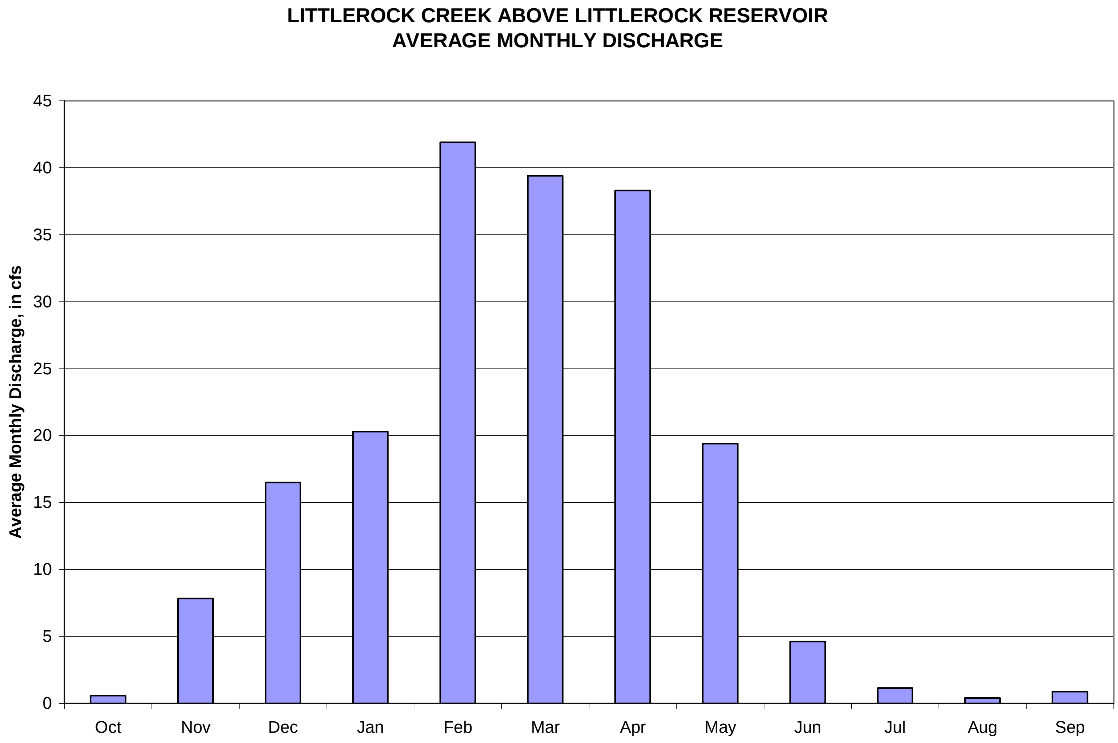

Figure 3 Average Monthly Discharge for Littlerock Creek

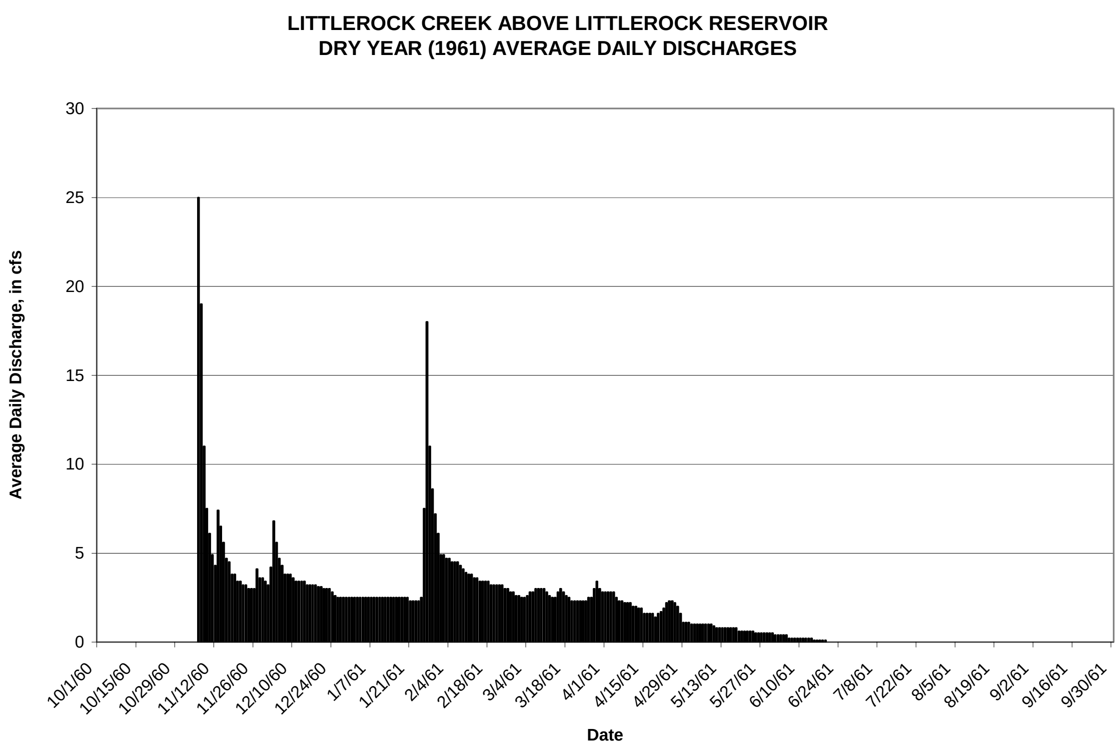

Figure 4 Typical Dry Year (1961)

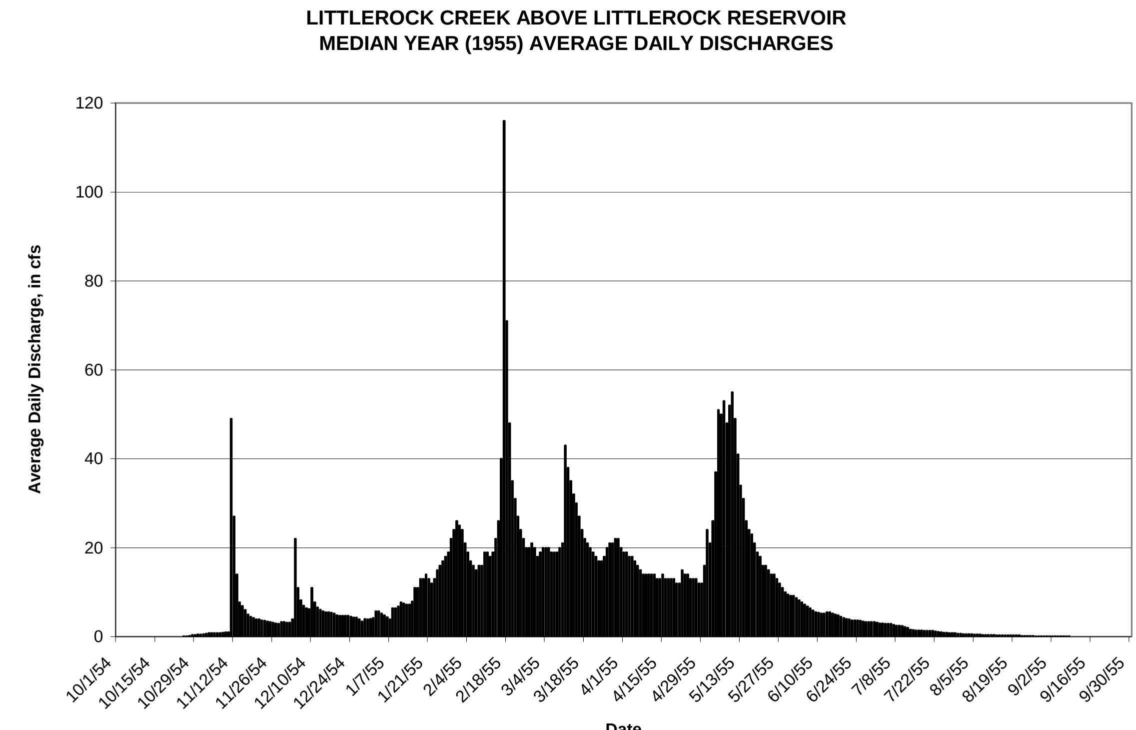

Figure 5 Median Year (1955)

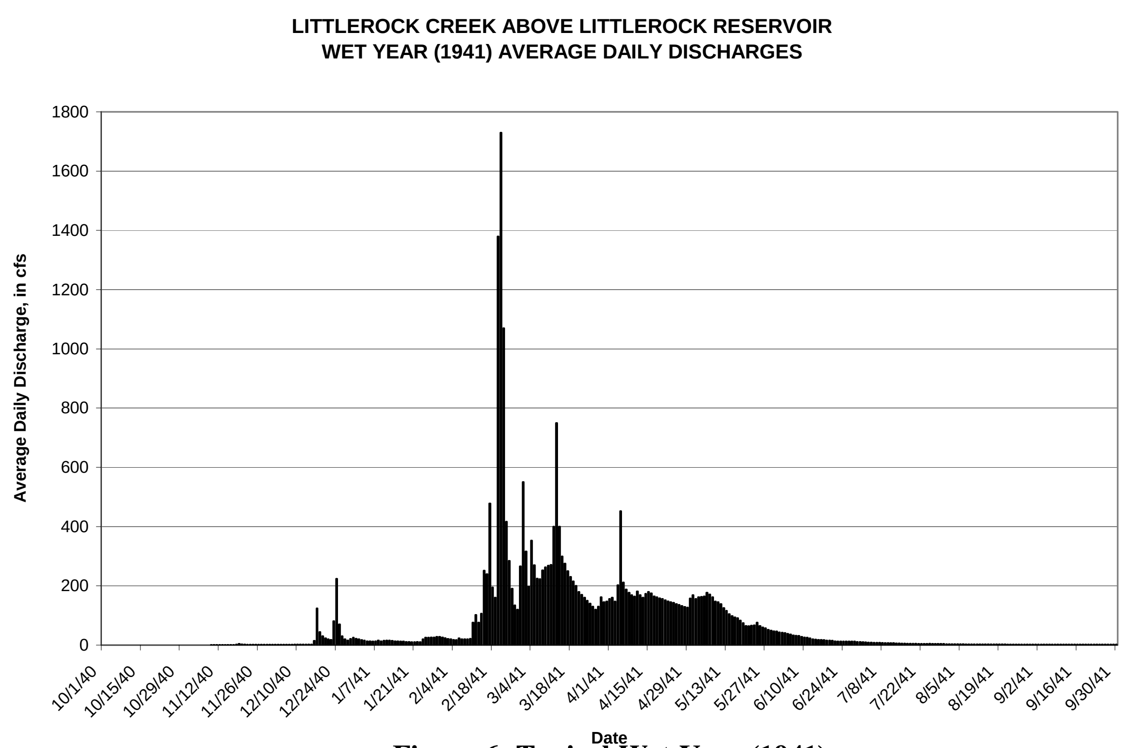

Figure 6 Typical Wet Year (1941)

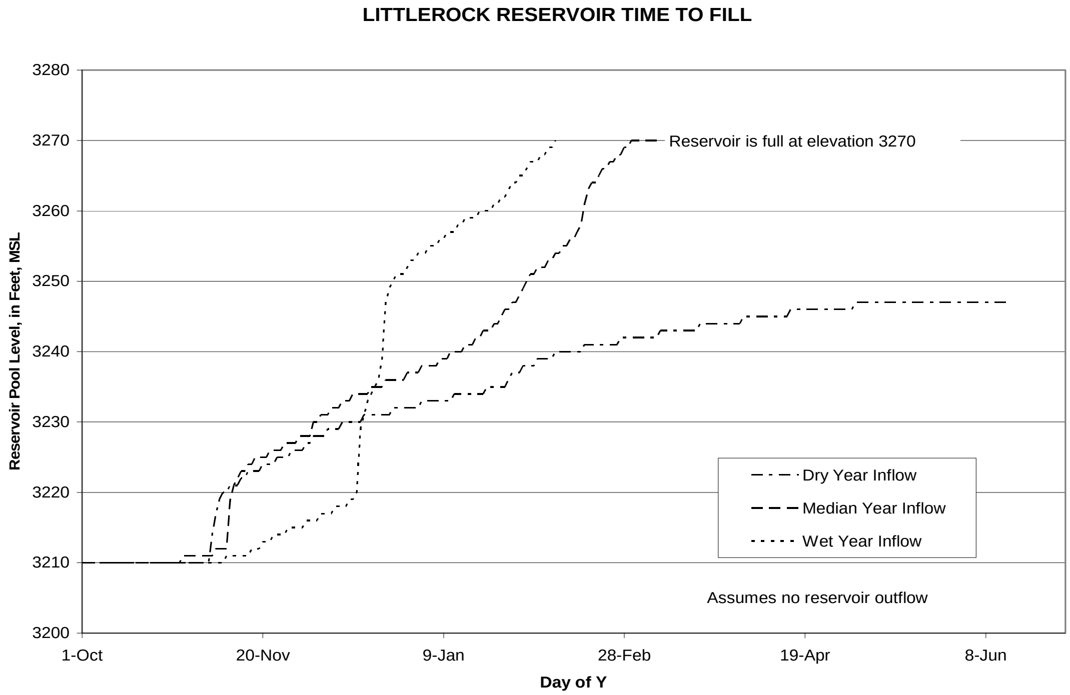

Figure 7 Reservoir Time to Fill

2.3 RESERVOIR TOPOGRAPHY

Topographic maps of the reservoir are available for the years 1915, 1989, and 1995. These maps are presented in the Appendix. Additional topography includes the USGS (1959) topography, which shows no information below the reservoir water surface, and cross section and profile information obtained from a field survey of the channel upstream of the reservoir in January of 2005. This field survey took place after the January, 2005 floods, when the reservoir was full to the spillway crest. No 2005 topographic information below the water surface was available. Stream cross sections were taken in the vicinity of the USGS gage. The downstream terminus of this survey was at the upstream reservoir water's edge. Since the reservoir was full at this time, this point represented the maximum upstream extent of the reservoir pool.

Figures 8 and 9 show thalweg profiles of the stream for the topography available. Station zero is approximately at the Littlerock Dam. The assumed 2005 profile is based on extending the profile downstream of the terminus of the 2005 surveyed profile such that the volume between the 2005 profile and the 1995 profile would equal the amount of sediment expected to have been delivered to the reservoir in that period of time. It was assumed that 54,000 cubic yards of sediment per year were delivered, based on the Woodward Clyde (1991) estimate. For a period of ten years, this would give an accumulated volume of 540,000 cubic yards.

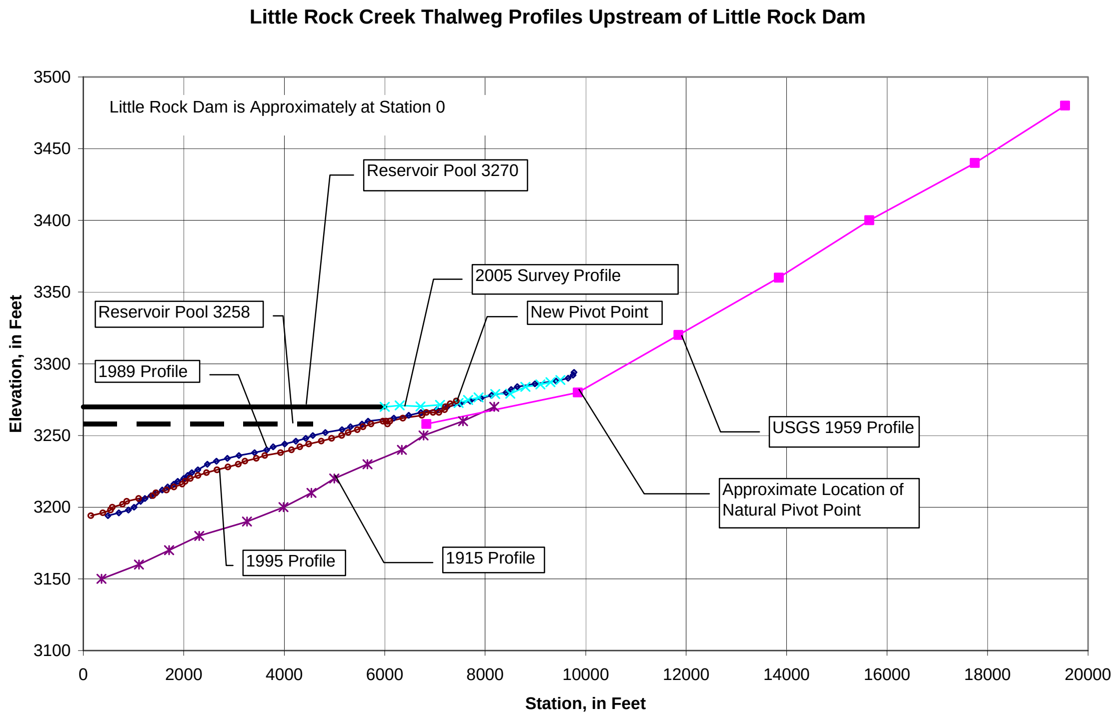

Figure 8 Thalweg Profile Showing Upstream Topography

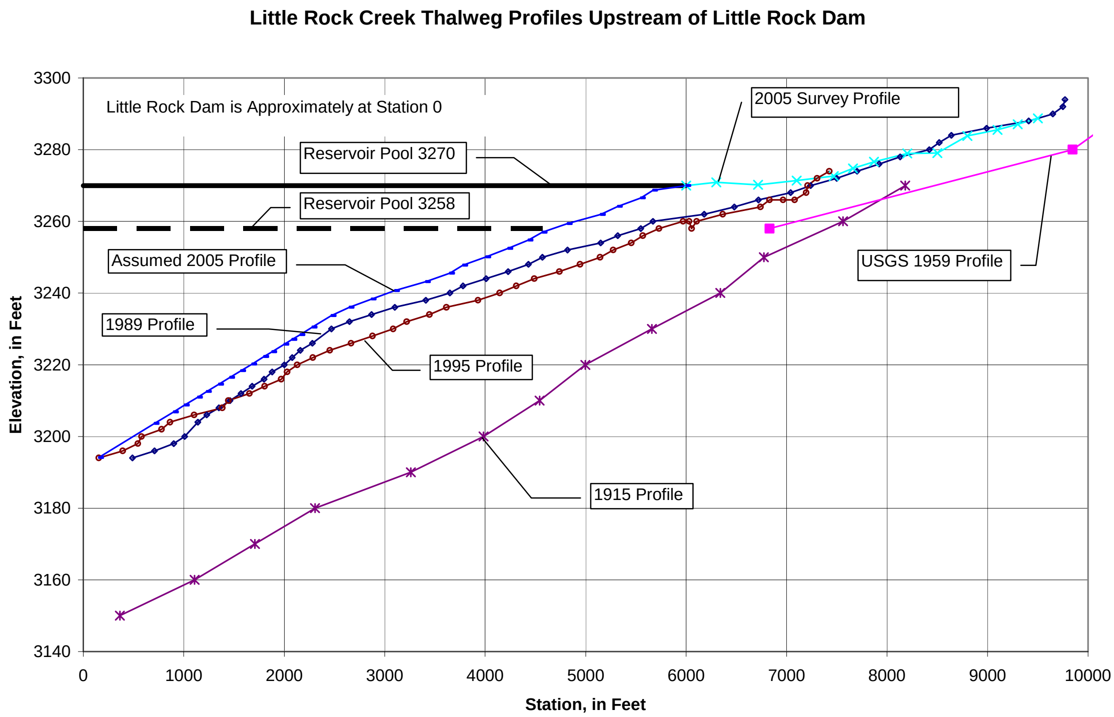

Figure 9 Thalweg Profile

2.4 QUALITATIVE GEOMORPHIC ANALYSIS

Prior to construction of the dam, Littlerock Creek at the site of the reservoir was likely in a state of dynamic sediment equilibrium, meaning that the supply of sediment to the reach now occupied by the reservoir was approximately equal to the sediment transport capacity of the reach. There would likely be natural fluctuations resulting from changing watershed characteristics (for instance by fire) or by flood events of varying magnitude, but in the long run the channel slope would remain fairly constant at about 0.016 (see Figure 9, 1915 slope).

The dam altered the hydraulics of the creek such that sediment transport capacity of the creek through the reservoir was essentially reduced to zero, resulting in deposition. Based on Figure 9, deposition within the reservoir has been as much as 50 feet or more in places.

Deposition of sediment at the upper end of the reservoir would reduce the capacity of the channel immediately upstream of the reservoir to transport sediment by reducing the bed slope and widening the channel. Sediment transport capacity is partly a function of flow velocity and depth. Both would be reduced by a flatter slope and wider channel. Since the sediment supply to this area would remain unchanged, deposition upstream of the reservoir would be expected to occur. Comparison of the 1915 and 1959 profiles with the 1989, 1995, and 2005 profiles indicates that approximately 10 feet of aggradation has occurred upstream of the reservoir everywhere post-1959 topography is available.

Sediments brought by the creek would cease to be transported soon after arriving at the reservoir pool. Since the runoff from most years exceeds the capacity of the reservoir to store water, deposition for most years would arrive at a full or near full reservoir, and therefore tend to be concentrated toward the upper end of the reservoir, resulting in a deposition slope (topset slope) as shown in Figure 10 (USACE, 1989). According to the Army Corps of Engineers (USACE, 1989), a rule of thumb for the deposition slope (topset slope) is that it should be 50 percent of the original stream slope. This is approximately the case with the observed 1989 and 1995 deposition slopes at Littlerock Reservoir (Figure 9). These slopes are approximately 0.009 to 0.010 feet per foot. The original bed slope was approximately 0.016. Further, the 1989 and 1995 profiles show a grade break, with steepening slope in the downstream direction at approximately channel station 1400. The 2005 profile shows a similar break, but this is an assumption. This grade break corresponds to the break between the topset and bottomset slopes in Figure 10. According to USACE (1989), this break, which in 1989 and 1995 was at about elevation 3225, occurs at approximately the mean operating elevation

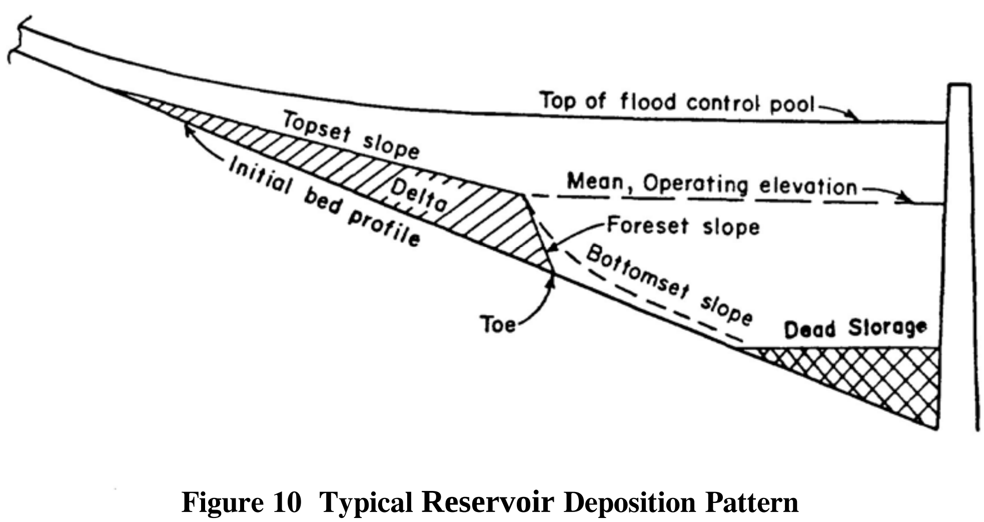

Figure 10 Typical Reservoir Deposition Pattern

Dry year flows, which do not deliver enough runoff to fill the reservoir, constitute about 20 percent of the flow record. During dry years, and at the beginning of the season in all years, flow entering the lower portions of the dry reservoir, where the slope is steeper than at the upper end, would pick up sediment due to higher flow velocities on the steeper slope, and channel cutting would occur. This cutting would progress upstream, and likely be most pronounced at locations where the channel bed profile breaks to a steeper slope such as at the break between the topset and bottomset slopes, and at the maximum upstream extent of the reservoir pool in the 2005 profile. In this way sediments would be transported toward the lower end of the reservoir, and some temporary channel degradation at the upper end, and beyond, would be expected. Thus, the natural cycle of the channel bed in the upper end of the reservoir and in the immediate area upstream of it would be of seasonal aggradation and degradation, with the overall trend toward aggradation.

Table 2 provides a summary of various channel bed slopes. Review of this table and Figures 8 and 9 indicate the following observations:

- Assuming the 1915 slope was the natural equilibrium slope in the vicinity of the reservoir, all of the current reservoir bed slopes are flatter than the natural equilibrium slope. By 1959, a slope of approximately 0.008 had been established in the channel for a distance of approximately 3,000 feet upstream of the reservoir pool. However, this reach of the channel was approximately 10 feet lower than the current channel bed in that reach. In 1989 this same reach was at a slope of 0.009. Currently (2005 survey) the slope is 0.007 to 0.009. It appears a slope of approximately 0.009 for the reach upstream of the dam is relatively stable, and, with some limitations, this reach may serve as a supply reach for a sediment transport analysis.
- There are two pivot points (points of abrupt slope change from steep to flat). One is in the 2005 survey at approximately Station 5890. This is approximately 930 feet upstream of the maximum extent of the reservoir pool. The other is in the 1959 profile just upstream of the USGS gage, which is approximately at Station 8300. These pivot points are indicators of possible degradation control points. Sediment transport capacity depends heavily on flow velocity. With other flow-related variables equal, flow velocities are lower on flat slopes than on steep slopes, so sediment transport capacity would be lower downstream of a pivot point than upstream, resulting in sediment deposition (channel aggradation) downstream of the pivot point. Artificial removal of sediment from the deposition area, as long as it does not exceed the depth represented by the projection of the slope from upstream of the pivot, may not cause cutting upstream of the pivot.
- None of the previous slopes are as flat as the 2005 survey between the maximum reservoir pool and Station 7470. This slope appears to be the result of deposition following the January 2005 storm. It is likely that as the reservoir level drops this reach of the channel will degrade.
- Maximum channel degradation, particularly at or near the upstream end of the reservoir, is likely limited to the elevation produced by extension of the slope of 0.009 from the supply reach as shown in Figure 11. At Rocky Point, this depth is 13 feet.

Table 2 Littlerock Creek Channel Bed Slopes.

Bed Slope Description	Approximate Bed Slope, in Feet per Foot
1915 Topography. Beneath current reservoir pool.	0.016
1959 Topography. USGS stream gage to current reservoir pool.	0.008
1959 Topography. Upstream of USGS stream gage.	0.021
1989 Topography. Upstream of Station 2400	0.009
1989 Topography. Upstream of the Reservoir Pool	0.009
1995 Topography. Upstream of Station 2470.	0.010
2005 Survey. Upstream of Station 6240.	0.007
2005 Survey. Maximum reservoir pool to Station 5890 (Reservoir pool is at Station 4960.	0.002

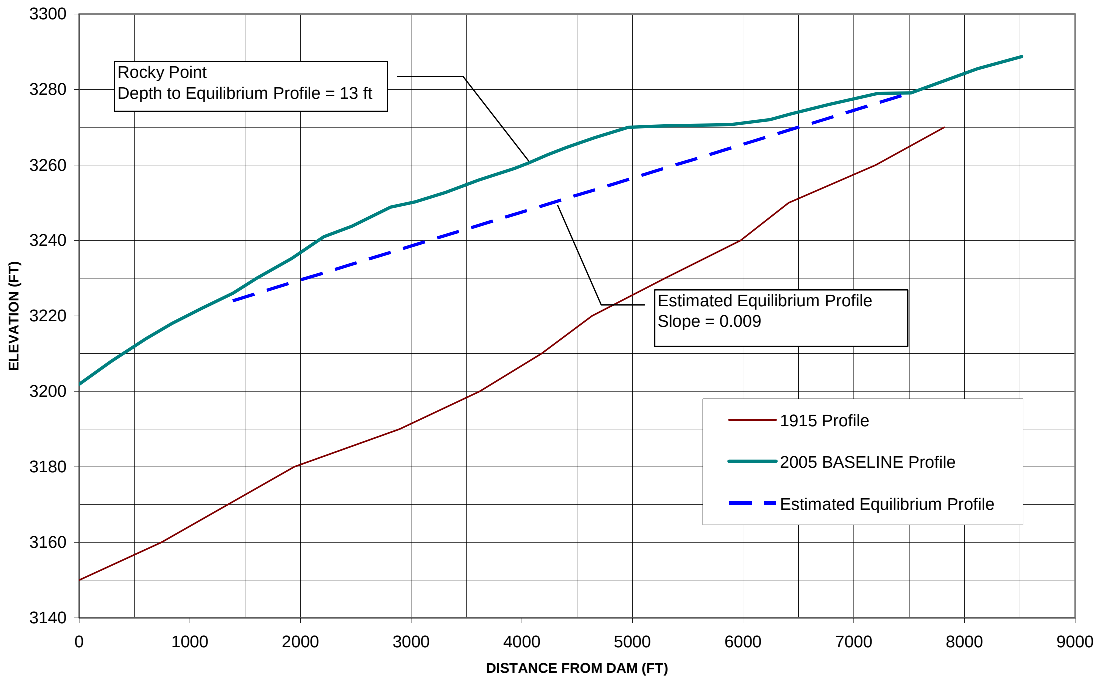

Figure 11 Maximum Potential Degradation

2.5 HYDRAULIC ANALYSIS

Hydraulic analysis was conducted using the U.S. Army Corps of Engineers HEC-RAS program using the 1989 and 1995 Topography, and the 2005 Survey. It is assumed for purposes of the hydraulic analysis that the reservoir is empty and has no influence on flow conditions. The analysis is based on stream cross sections located as shown in Figure 12. 2005 surveyed cross sections, for the sediment supply reach, are identified in Figure 13. All other cross sections for 2005 were adjusted from the 1989 and 1995 cross sections based on the 2005 profile and assumed extent of channel deposition since 1995. Figure 14 shows a comparison of 1989, 1995 and 2005 cross sections. The hydraulic analysis below presents only the 2005 analysis.

Figure 12 HEC-RAS Cross Section Locations

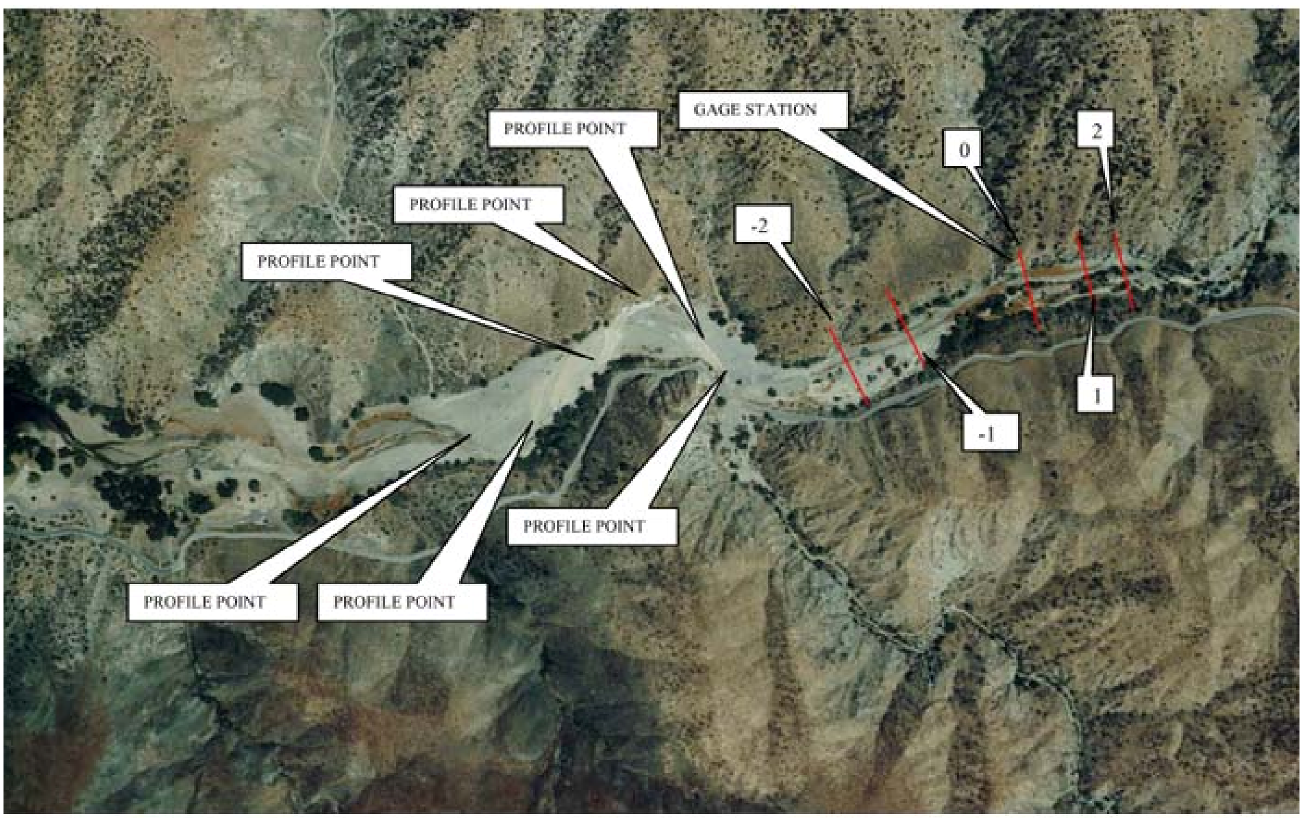

Figure 13 Survey Cross Section Locations

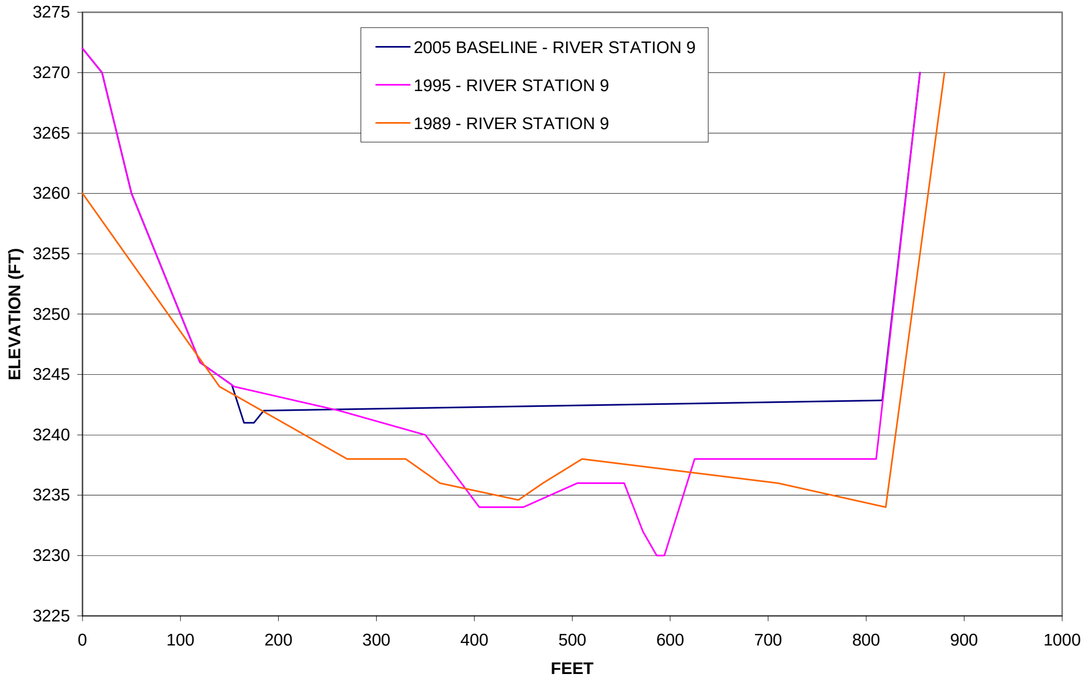

Figure 14 Cross Section 9 Comparison

Mannings roughness coefficients (Mannings "n") were computed based on the following basic procedure:

$$n = (n_b + n_1 + n_2 + n_3 + n_4) * M$$

Where:
n = Overall channel roughness coefficient;
n_b = Base value of "n" for material involved;
n_1 = Value for degree of irregularity;
n_2 = Value for variations of cross section;
n_3 = Value for obstructions;
n_4 = Value for vegetation; and,
M = Multiplier to account for degree of meandering.

Table 3 shows the results of the calculation for the channel upstream of Cross Section 25 as an example. Roughness coefficients for all cross section channels and overbanks are presented in the Appendix.

A hydraulic analysis was performed for a range of discharges from 1 cfs to the 100-year discharge of 21,120 cfs. Discharges used are listed in the Appendix. Figures 15, 16 and 17 summarize flow top widths, velocities and depths for a range of representative discharges. Flow velocities and depths are highest in the upper portion of the modeled reach, decreasing in the downstream direction due primarily to the widening of the channel in the downstream direction.

The reservoir would dramatically alter the hydraulic conditions presented above up to about cross sections 20 to 23. As flow reaches the reservoir pool, flow velocities would drop to near zero, and the depth would increase to the reservoir depth. The reservoir pool would also represent a hydraulic boundary condition that would increase flow depths and decrease flow velocities in the channel immediately upstream of the pool.

Table 3. Computation of Channel *n* Value for Cross Sections Upstream of Cross Section 23.

Roughness Coefficient Component	Assigned Value	Comments
n_b = Base value of "*n*" for material involved.	0.034	Based on Limerinos equation for California Streams as referenced in USGS (1998). Limerinos equation is: $n_b = (0.0926R^{1/6})/(0.35 + 2.0\log(R/d_{50}))$ Where: R = Hydraulic radius, d_{50} = 50% Sediment size, in feet. D_{50} = 20mm (0.066 feet) from sediment samples. R (assumed representative) = 1.
n_1 = Value for degree of irregularity	0.002	Smooth to minor irregularity.
n_2 = Value for variations of cross section	0002	Cross section gradual to alternating occasionally.
n_3 = Value for obstructions	0	Negligible in-channel obstructions.
n_4 = Value for vegetation	0	Negligible in-channel vegetation.
Multiplier for channel meandering	1	Minor meandering.
Overall "*n*" value is (0.034 + 0.002 +0.002) x 1 = 0.038.		

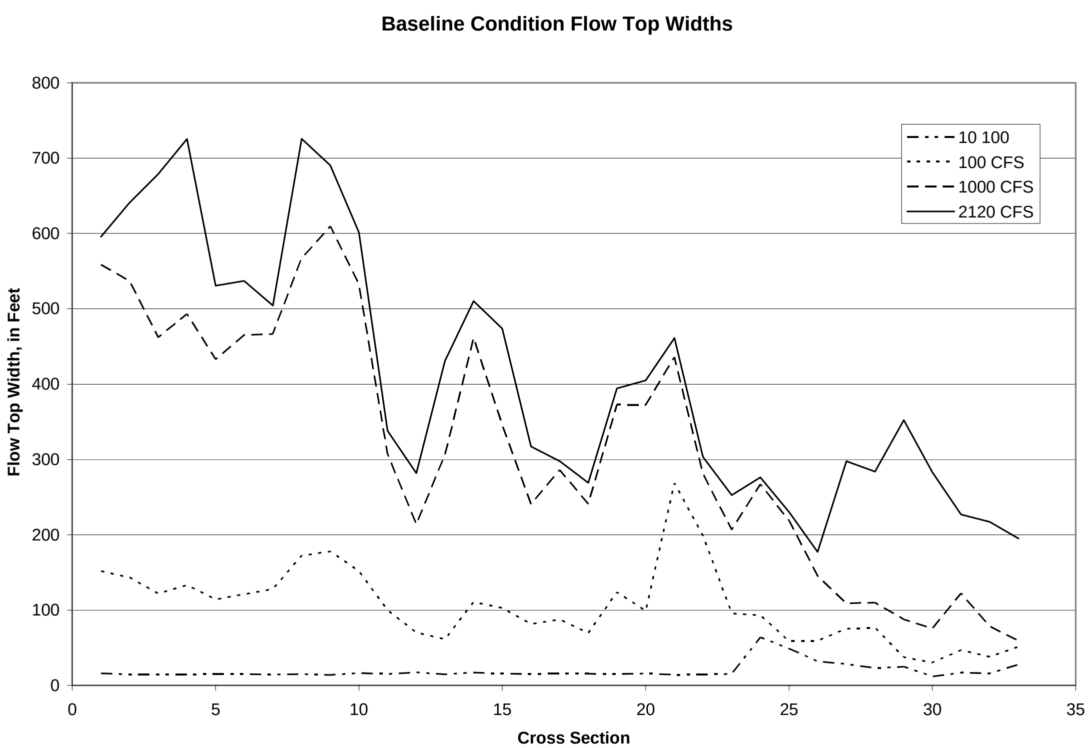

Figure 15 Baseline Condition Flow Top Widths

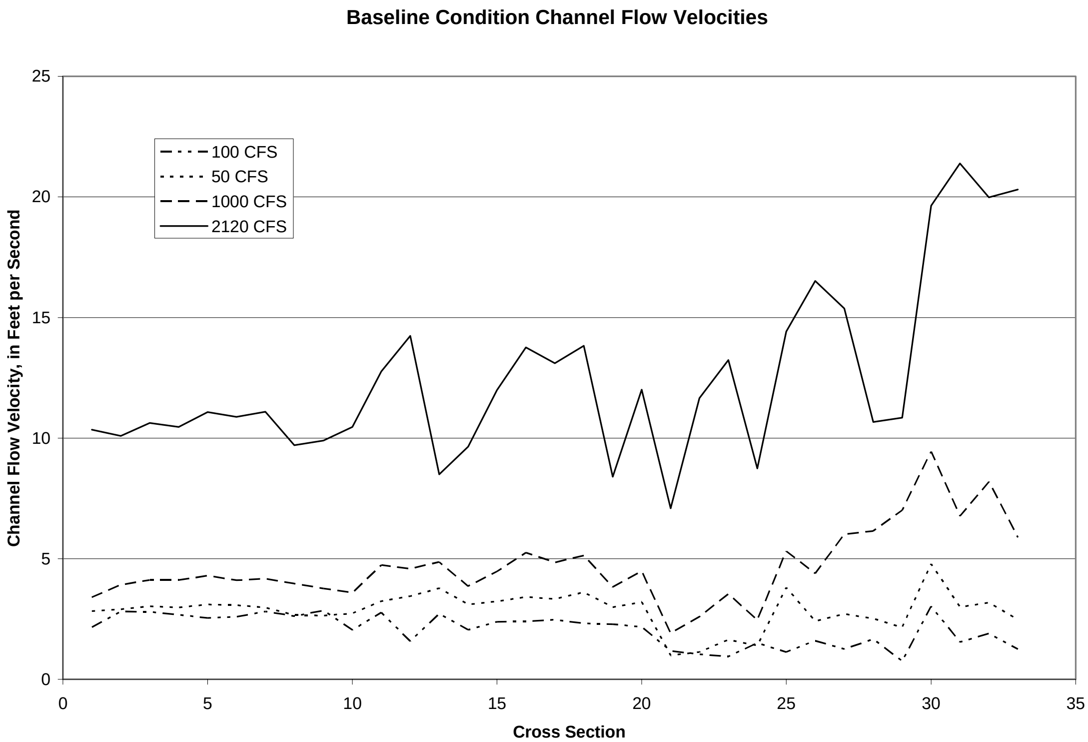

Figure 16 Baseline Condition Channel Flow Velocities

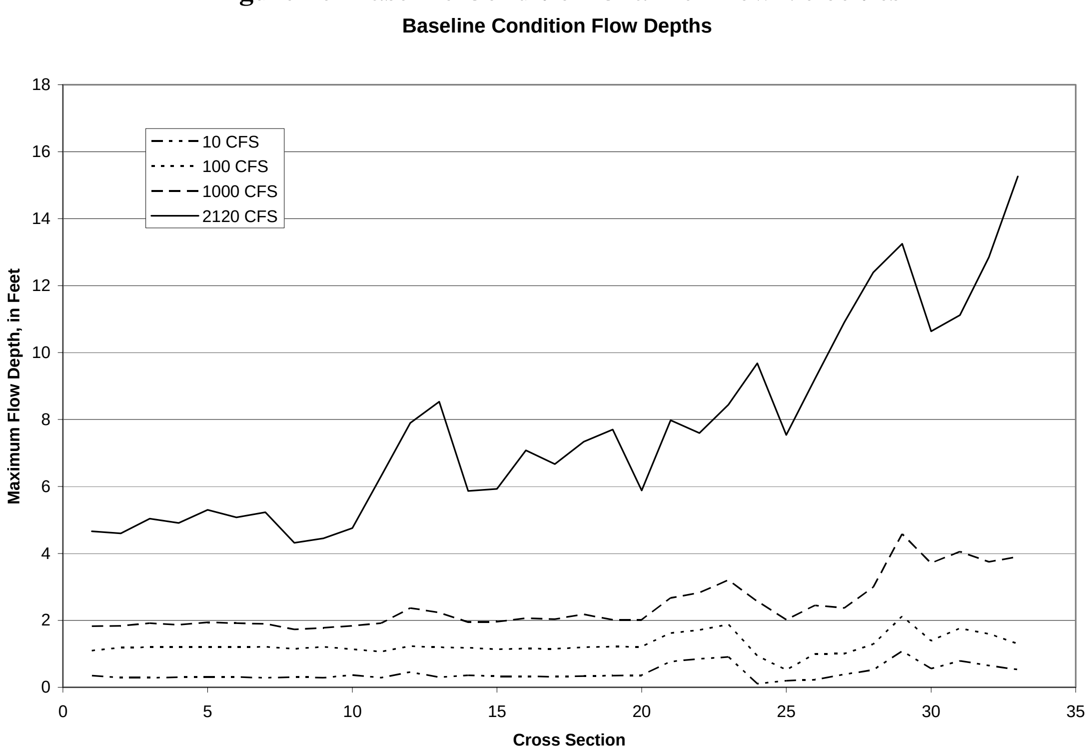

Figure 17 Baseline Condition Flow Depths

2.6 SEDIMENT TRANSPORT

The baseline sediment transport analysis was conducted using the hydraulic U.S. Army Corps of Engineers HEC-RAS program, which has the capability of performing a steady-state sediment transport analysis. A steady-state analysis predicts a sediment transport capacity for a channel cross section given a particular discharge. Cross sections are not updated for differences in sediment supply. The sediment analysis uses the hydraulic information computed from the HEC-RAS model, and sediment size distributions for the channel and channel overbanks. The Yang equation for sediment transport (USACE, 2002) was selected as the sediment transport equation for the reason that it was generally applicable to most of the sediment sizes used in the analysis, and gave results that most closely matched the observed record of sediment inflow.

Sediment size distributions were taken from sediment samples taken from the stream in January 2005, and from those published by Woodward Clyde (1991). The appendix provides maps showing the locations of sediment samples and the size distributions. Best results were obtained from using Woodward Clyde data for the channel, and January 2005 data for the overbanks.

The sediment model was calibrated using the uppermost four cross sections shown in Figure 13 as a supply reach. This supply reach contains the USGS stream gage for Littlerock Creek. A relationship between water discharge and sediment discharge was obtained. This relationship is summarized in Figure 18.

The water/sediment discharge relationship was then used to obtain sediment transport volumes for each day of the 48-year USGS stream gage record and the daily volumes summed and used to make an estimate of average annual sediment transport into the reservoir. The sediment transport model was then calibrated to obtain an estimate of average annual sediment supply that approximated the estimate of 54,000 cubic yards sediment deposited in the reservoir (Woodward Clyde, 1991). Calibration consisted of using channel sediment sizes from data published by Woodward Clyde, and adjusting channel and overbank roughness coefficients. Roughness coefficients were also calibrated from observed high water marks and a known discharge (discharge obtained from the USGS) for the January, 2005 runoff event. The calibrated model gives an average annual sediment transport estimate of 60,000 cubic yards, as opposed to 54,000 estimated by Woodward Clyde.

The study channel was divided into four reaches for the sediment transport analysis. The purpose was to compare reaches with relatively similar hydraulic conditions, and to reduce the effect of variations in sediment transport rate from cross section to cross section, which can be substantial. The reaches, numbered R1 to R4, are shown in Figure 19 and described in Table 4.

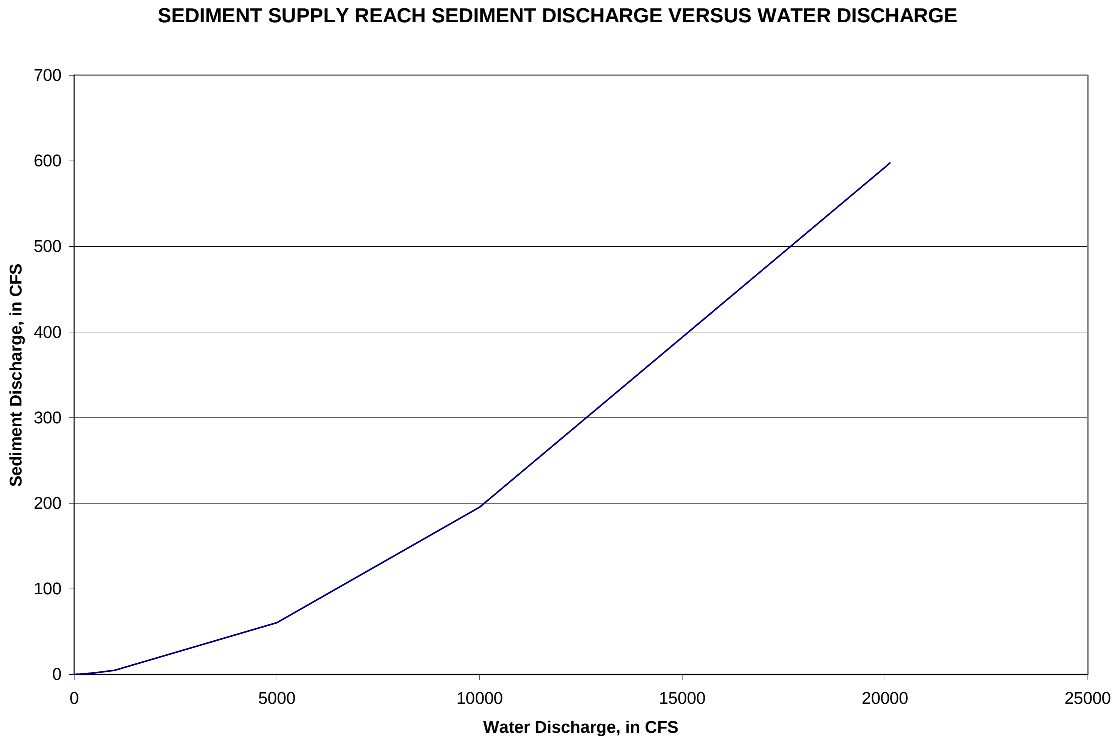

Figure 18 Sediment Supply Reach Sediment Discharge Versus Water Discharge

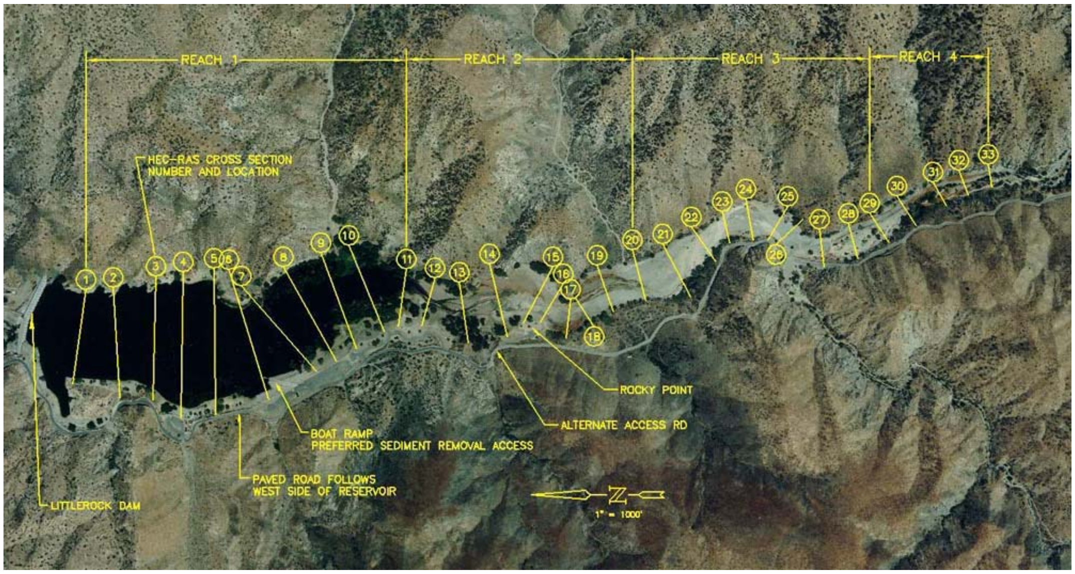

Figure 19 Sediment Transport Reach Locations

Table 4 Sediment Transport Reach Descriptions

Reach Number	Hec-Ras Cross Sections	Channel Stations, In Feet	Description and Comments
R1	0 – 11	0 – 2815	Downstream reach of reservoir. Includes reservoir bottomset slope.
R2	11-20	2815 – 4962	Middle reach of reservoir. Ends at maximum upstream reservoir pool
R3	20-29	4962 – 7517	Reach immediately upstream of the reservoir. Includes recent deposition area
R4	29-33	7517 – 8517	Sediment supply reach. Includes USGS gage.

Total sediment transport out of a reach, compared to total sediment transport into a reach, for a given discharge and given time period, can be compared to determine whether a reach is expected to aggrade or degrade for that discharge and that time period. The volume of the sediment deficit/surplus, in cubic feet, divided by the surface area of the reach, will give an estimate of the amount, in feet, of degradation or aggradation. This can be done for each time step of an inflow hydrograph to estimate total aggradation or degradation for the hydrograph. In this way, an estimate of probable aggradation or degradation can be obtained. The limitation is that the cross sections are not adjusted for sediment deficit/surplus after each time step, so estimates of aggradation/degradation are likely to be worst case.

Potential degradation or aggradation for a reach was estimated using sediment inflow/outflow volumes predicted by the relationships such as the one depicted in Figure 18. Depths of degradation/aggradation were estimated by dividing the sediment deficit/surplus for each reach for each time step by the wetted surface area for the reach obtained from HEC-RAS, and assuming a trapezoidal cut cross section with 3:1 side slopes for cuts. No estimate was made of aggradation depth. Although the hydraulic conditions estimated by the HEC-RAS model ignore the presence of the dam, the influence of the dam, and associated static rising water levels in the reservoir, was accounted for by tracking reservoir levels as the hydrograph enters, and stopping the analysis for each reach as that reach filled.

Although Reach 1 has no outlet, there is a sediment transport potential in the upper reaches of Reach 1 provided that this reach is not inundated by the reservoir. The estimated sediment transport for Reach 1 and the resulting estimates of aggradation or degradation are considered applicable to the upper end of Reach 1, not the entire reach.

The inflow hydrograph to the reservoir was taken from daily discharges available from USGS records for known years. The dry, median and wet years shown in Figures 15, 16 and 17 were used, as well as the peak discharge from the largest storm on record (1943). These are considered representative of the range of discharges likely to be encountered by the reservoir. It was assumed that the reservoir is empty at the beginning of each runoff season. Baseline condition results are shown in Figure 20. The 1943 storm results were similar to those of a wet year.

Reaches 1 and 2 are predicted to degrade in all three years. Reach 3, which is just upstream of the reservoir pool, is expected to aggrade. The degradation predicted in Reaches 1 and 2 reflects the expected cutting of those reaches during dry years and at the beginning of the runoff season when the reservoir is assumed to start the season empty. The aggradation/degradation pattern is as expected from an observation of the slopes. Reach 3 is generally flatter than the supply reach. Consequently, flow velocities would be slower in this reach, resulting in less sediment transport capacity, and deposition.

Reach 2 is steeper than Reach 3, and Reach 1 steeper than Reach 2, so degradation is expected in these reaches.

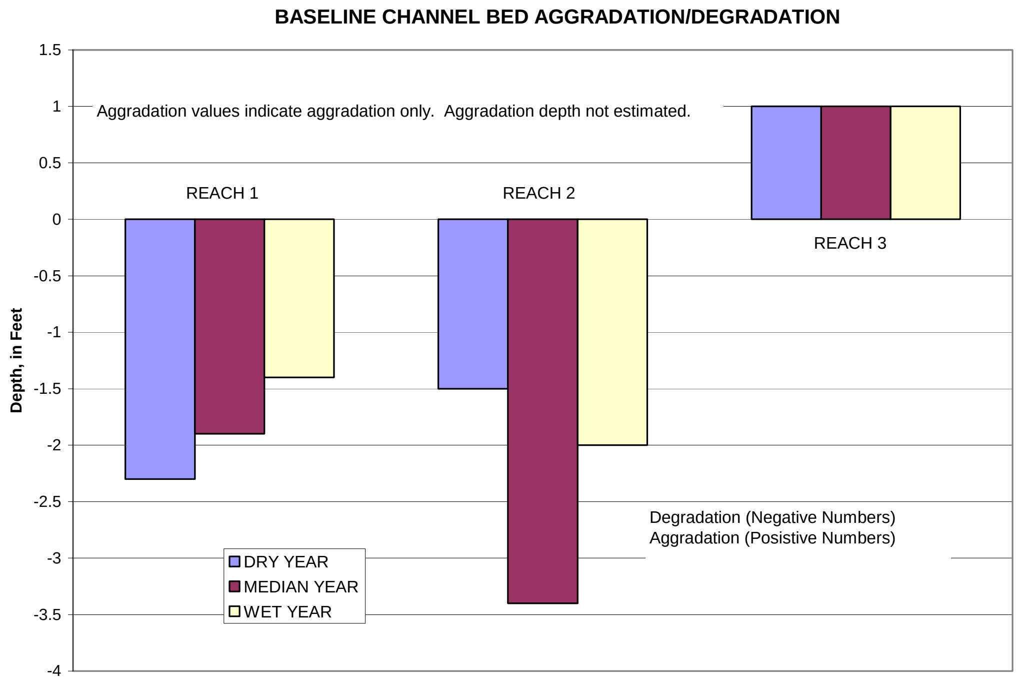

Figure 20 Baseline Channel Bed Aggradation/Degradation Predicted by the Sediment Transport Model

Since the purpose of this study is to determine probable degradation at and upstream of the Rocky Point area (at channel Station 4235), an estimate was made of the probable upstream distance the cut predicted for Reach 2 would extend by projecting a cut at a slope of 0.009 (the probable stable slope) extending upstream into Reach 3 from the maximum predicted cut at Reach 2. The result indicates a probable maximum cut distance from the Rocky Point area of 1,200 feet, with the cut diminishing in depth from 3.4 feet at Rocky Point to zero at a point 1,200 feet upstream of the Rocky Point area.

Although a cut at the Rocky Point area is likely and expected under current conditions, it is likely to be temporary, and may exist for only a few weeks or months depending on the hydrology. The degradation analysis is worst-case in the sense that it does not take into account refilling of cut areas that would occur at or near the leading edge of the reservoir pool as the pool moves upstream. This could occur in any of the three reaches. Furthermore, in most years a substantial amount of sediment is delivered to the reservoir after the reservoir fills. This sediment would all deposit in or just downstream of Reach 3, and tend to reduce or eliminate any cutting that may have occurred in that reach. For instance, in the median year, the reservoir fills by approximately the end of February. All of the cutting predicted in Figure 20 and described above would occur by that time. However, the sediment analysis shows that for this year approximately 16,000 cubic yards of sediment would arrive after the reservoir fills. This amount of sediment is more than the entire cut volume estimated for Reaches 1 and 2, and more than enough to refill the cut in Reach 3 predicted by extension of the Reach 2 cut. The excess sediment would be deposited in Reach 3, and be extended into Reach 2, beneath the water surface, as a sediment plume. Thus, the predicted cut would likely not last through the runoff season unless the reservoir is drawn down abruptly partway through the season. In the wet year, the amount of sediment arriving after the reservoir fills is approximately 160,000 cubic yards. This amount is 5.5 times the amount of the predicted Reach 1/Reach 2 cut for that year, and 3 times the average annual sediment inflow.

The dry year runoff volume was not sufficient to fill the reservoir. Although the predicted cut at the Rocky Point area (Reach 2) is only 1.9 feet, this cut would likely last through the summer and into the next runoff season. Should another dry year occur, the cut would likely deepen and extend upstream. Dry years, in which the runoff volume is not sufficient to fill the reservoir, occur in about one out of every five years.

In summary for baseline conditions, Reaches 1 and 2 are expected to degrade slightly during dry years and at the beginning of the runoff season in all years. Maximum predicted degradation at the Rocky Point area is 3.4 feet, with a maximum possible upstream cut distance of 1,200 feet. For most years, this cut at and upstream of the Rocky Point area is expected to be temporary, and not likely to last into the summer unless the reservoir is drawn down before the runoff season ends. A dry year cut could deepen and continue if followed by more dry years, but would eventually be filled as wetter years occur. The long-term trend is aggradation, because all sediment brought into the reservoir is trapped there, resulting in the channel bed at and upstream of Rocky Point becoming wider and sandier.

3. DESCRIPTION OF ALTERNATIVES

The purpose of the proposed project is to excavate accumulated sediment from the reservoir to recover storage capacity that has been lost through sedimentation. Initial excavation quantities would be either 270,000 cubic yards or 540,000 cubic yards, followed by subsequent periodic excavations sufficient to ensure that the capacity obtained from the initial excavation remains. Since the upstream slopes of the excavated areas will be steeper than the existing slope, channel bed cutting, progressing upstream, is expected to be induced by the alternatives. The objective of the alternatives is to remove the desired amount of sediment while limiting or eliminating the upstream cut. Five alternatives, plus a no-project alternative, were developed. The no-project alternative is the same as continuing the baseline condition. The other five alternatives are described below:

3.1 ALTERNATIVE 1

Alternative 1 is designed to excavate 270,000 cubic yards of material from the reservoir, and to keep the excavation as close to the dam as possible so that any channel cutting that may occur as a result of Alternative 1 would begin as far downstream of the Rocky Point area as possible. The disadvantage of Alternative 1 is a steep cut slope likely to produce more dramatic upstream channel cutting than a cut of flatter slope.

Alternative 1 consists of excavating a trapezoidal section with approximately 80-foot bottom width and 5:1 side slopes beginning just upstream of the dam and ending at River Station 1,390. Maximum excavation depth just upstream of the dam would be approximately 43 feet. Excavation depth at Station 1,390 would be zero. Excavation top width would be approximately 520 feet just upstream of the dam, tapering to approximately 150 feet at River Station 1,110 and zero at Station 1,390. Figures 21, 22, and 23 show the plan view, cut profile and typical cross section for Alternative 1. Excavation volume would be approximately 270,000 cubic yards. This alternative would include continued annual removal of 54,000 cubic yards of material from the same area as the initial excavation of Alternative 1.

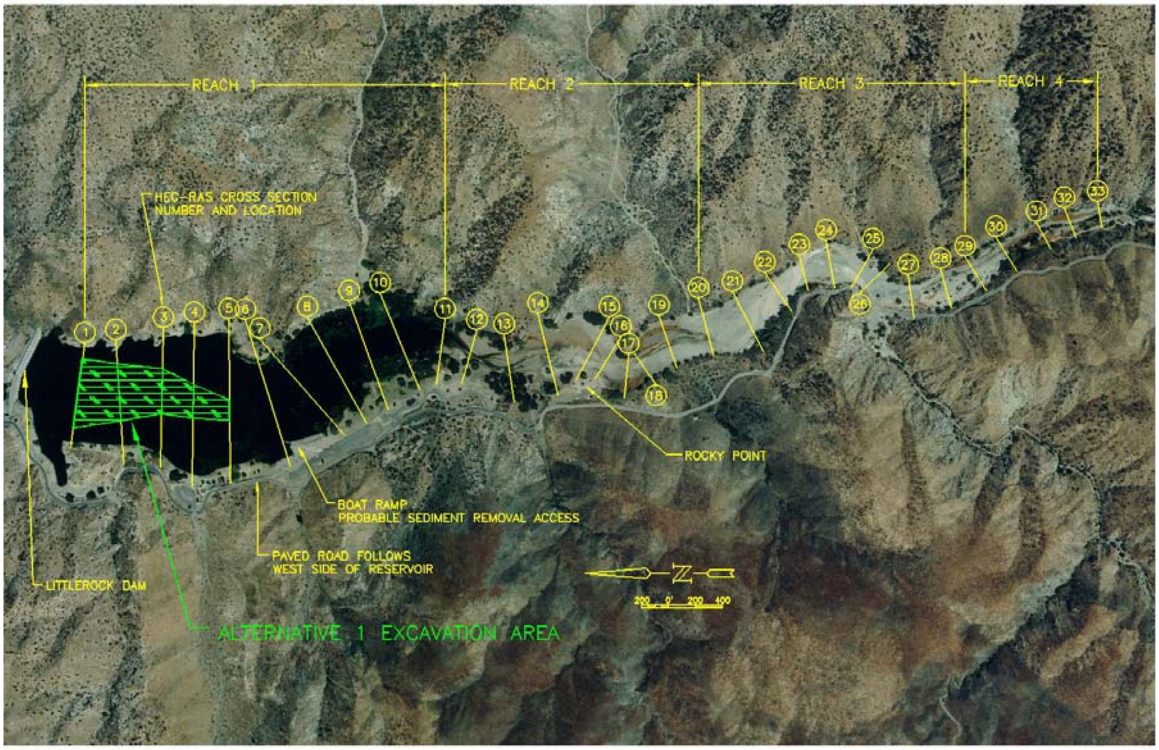

Figure 21 Alternative 1 Plan View

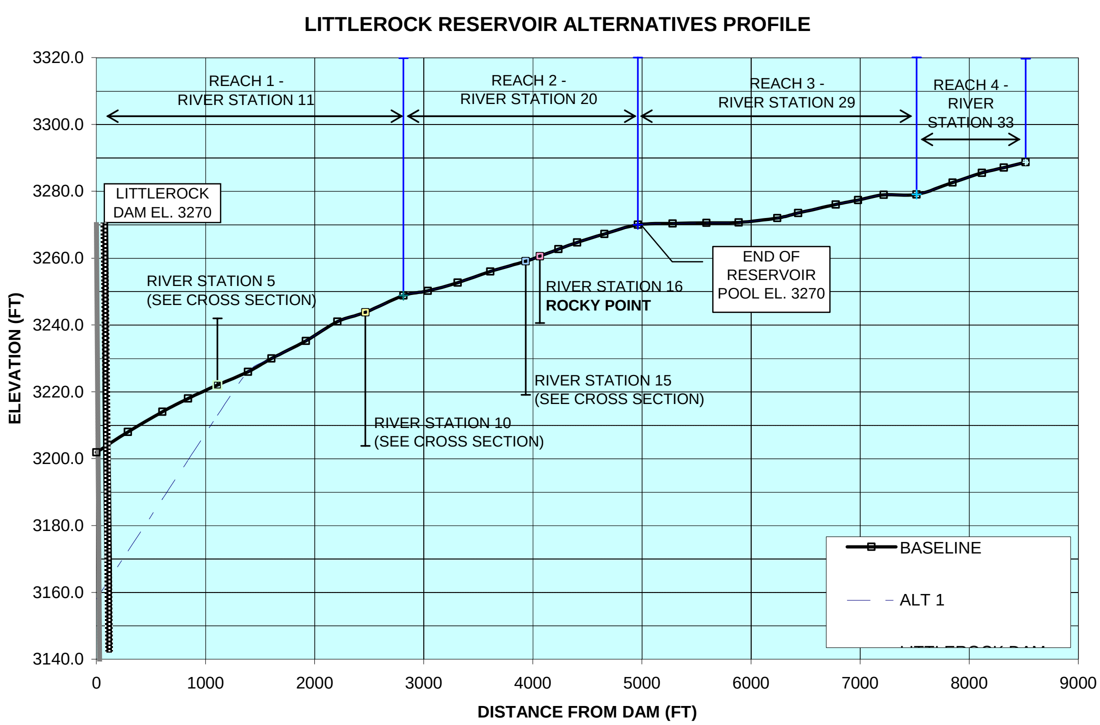

Figure 22 Alternative 1 Cut Profile

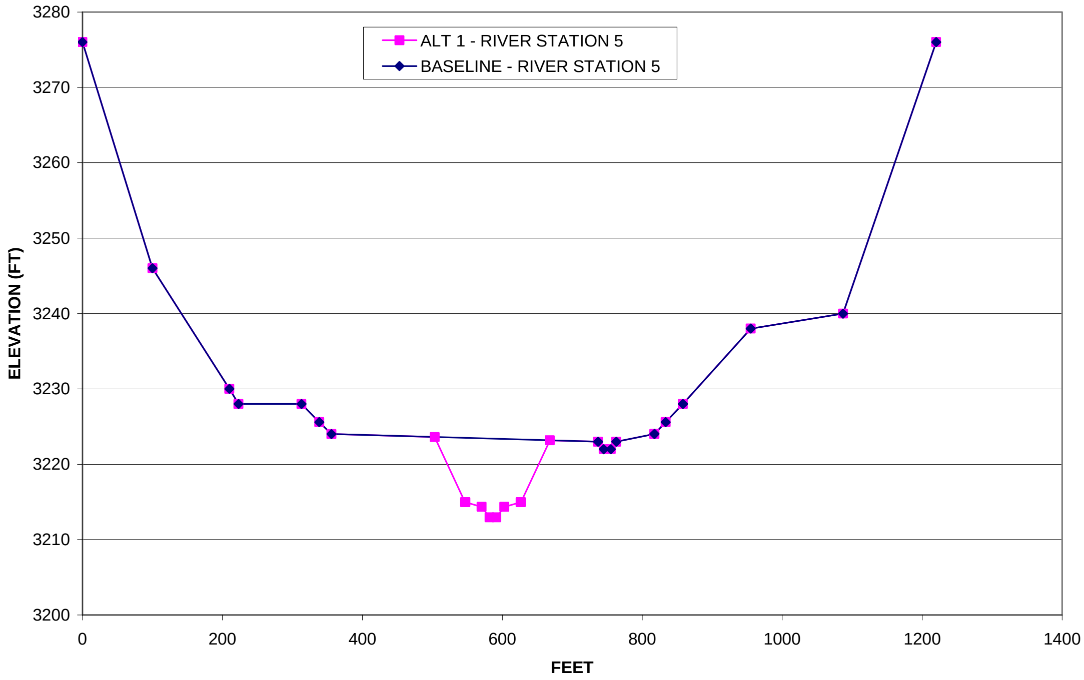

Figure 23 Alternative 1 Typical Cross Section

3.2 ALTERNATIVE 2

Alternative 2 is designed to excavate 270,000 cubic yards of material from the reservoir, and to keep the excavation slope as flat as possible to reduce disparities in sediment transport capacity and thereby keep the upstream cut to a minimum. The disadvantage of Alternative 1 is that it extends to the Rocky Point area so that any induced cut would almost certainly extend upstream of that point.

Alternative 2 consists of excavating a trapezoidal section with approximately 200-foot bottom width and 5:1 side slopes beginning just upstream of the dam and ending at River Station 4,235 (at the Rocky Point area). Figures 24, 25, and 26 show plan view, profile, and typical cross section. Excavation depth would vary depending on location as shown in Figure 25. Maximum excavation depth would be at approximately 11 feet at Station 2,210. Excavation depth at Rocky Point (Station 4,235) would be zero. Excavation top width would be 250 to 300 feet from the dam to Station 2,815, tapering to zero at Station 4,235. Excavation volume would be approximately 270,000 cubic yards. This alternative would include continued removal of 54,000 cubic yards of material from the same area as the initial excavation.

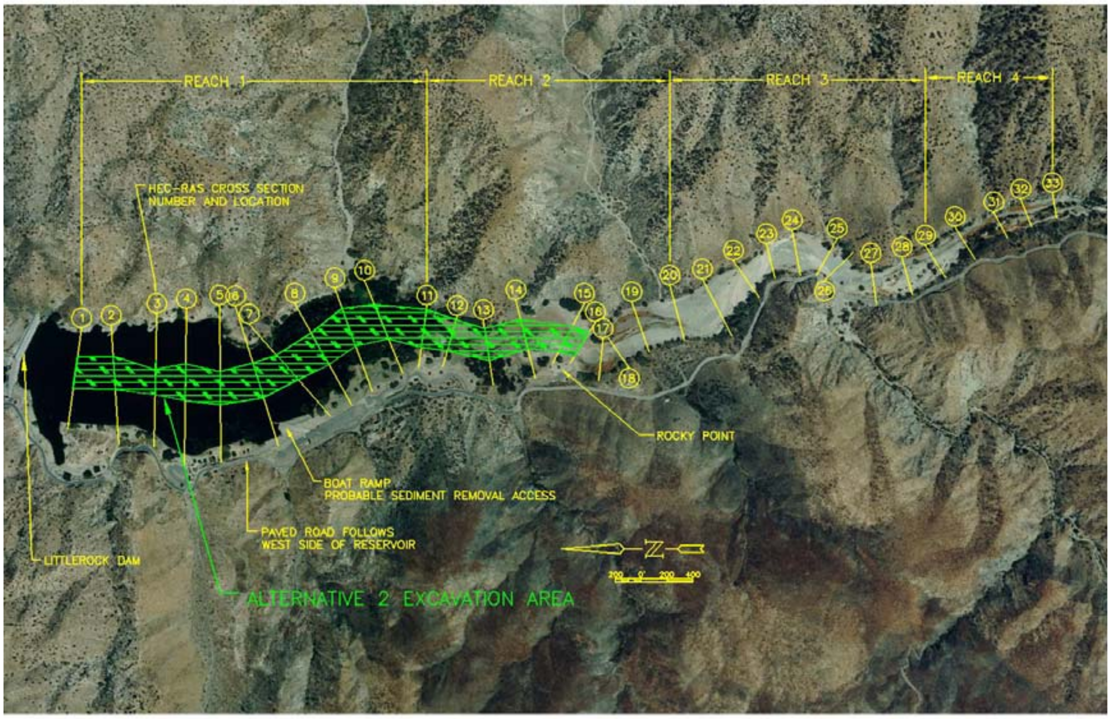

Figure 24 Alternative 2 Plan View

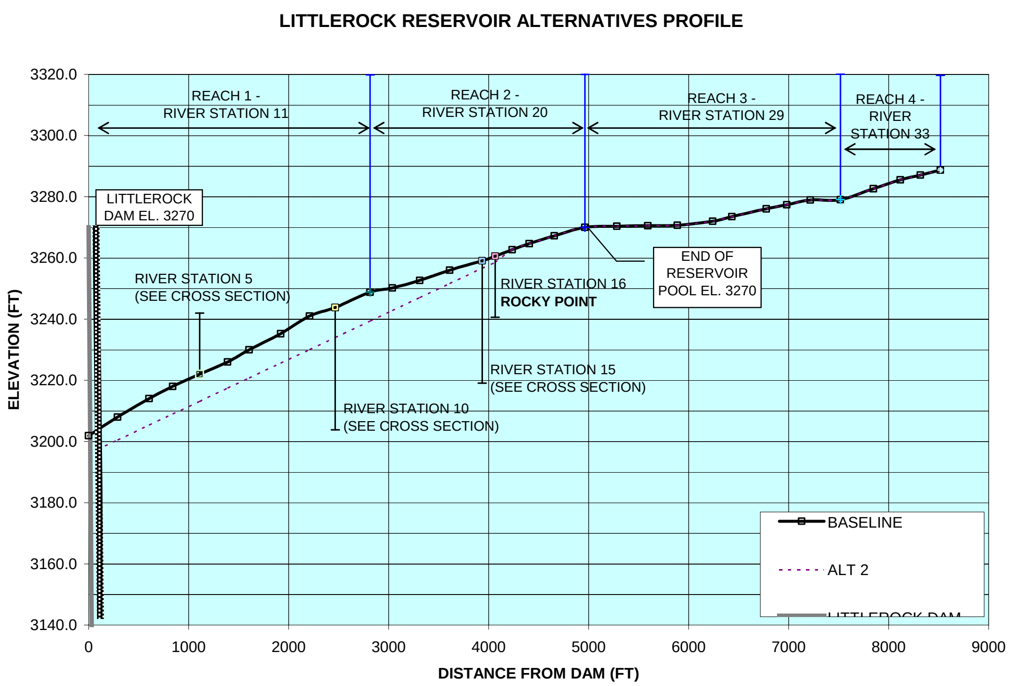

Figure 25 Alternative 2 Cut Profile

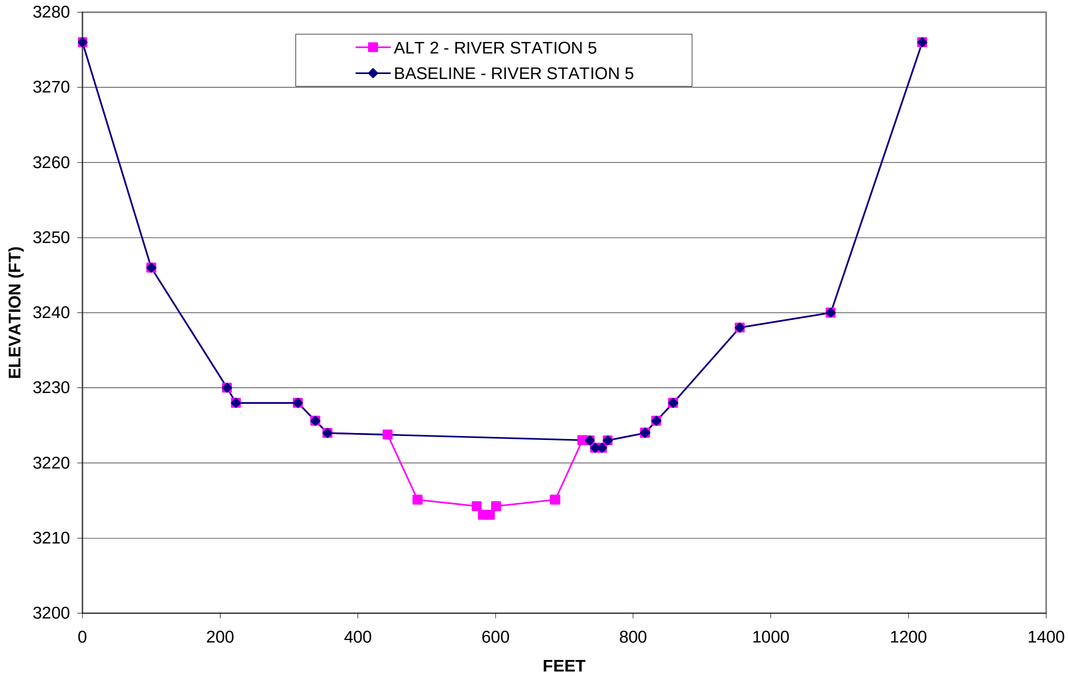

Figure 26 Alternative 2 Typical Cross Section

3.3 ALTERNATIVE 3

Alternative 3 is the same as Alternative 1, but with the goal of excavating 540,000 cubic yards rather than 270,000 cubic yards of sediment. Figures 27, 28, and 29 show plan view, profile, and typical cross section. Maximum excavation depth just upstream of the dam would be approximately 43 feet, same as Alternative 1, but excavation would extend to Station 2815. Excavation top width would be approximately 520 feet just upstream of the dam, tapering to zero at Station 2815. Excavation volume would be approximately 540,000 cubic yards. This alternative would include removal of 270,000 cubic yards of material from the same area as the initial excavation every five years.

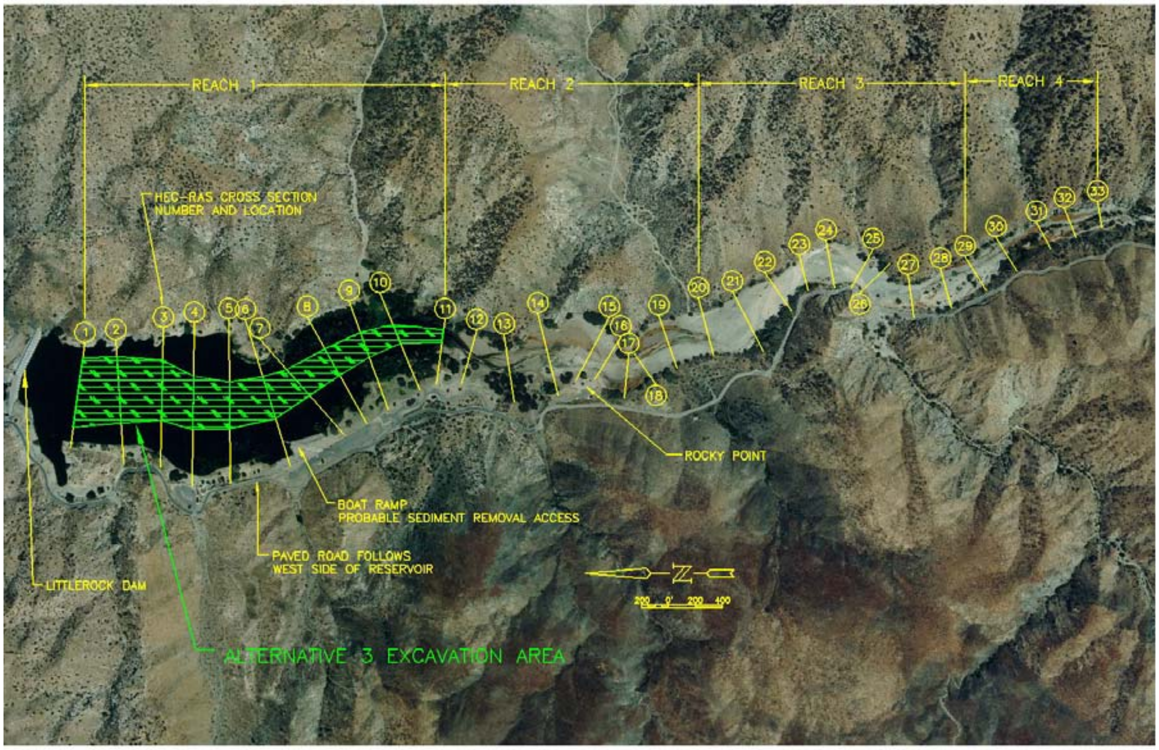

Figure 27 Alternative 3 Plan View

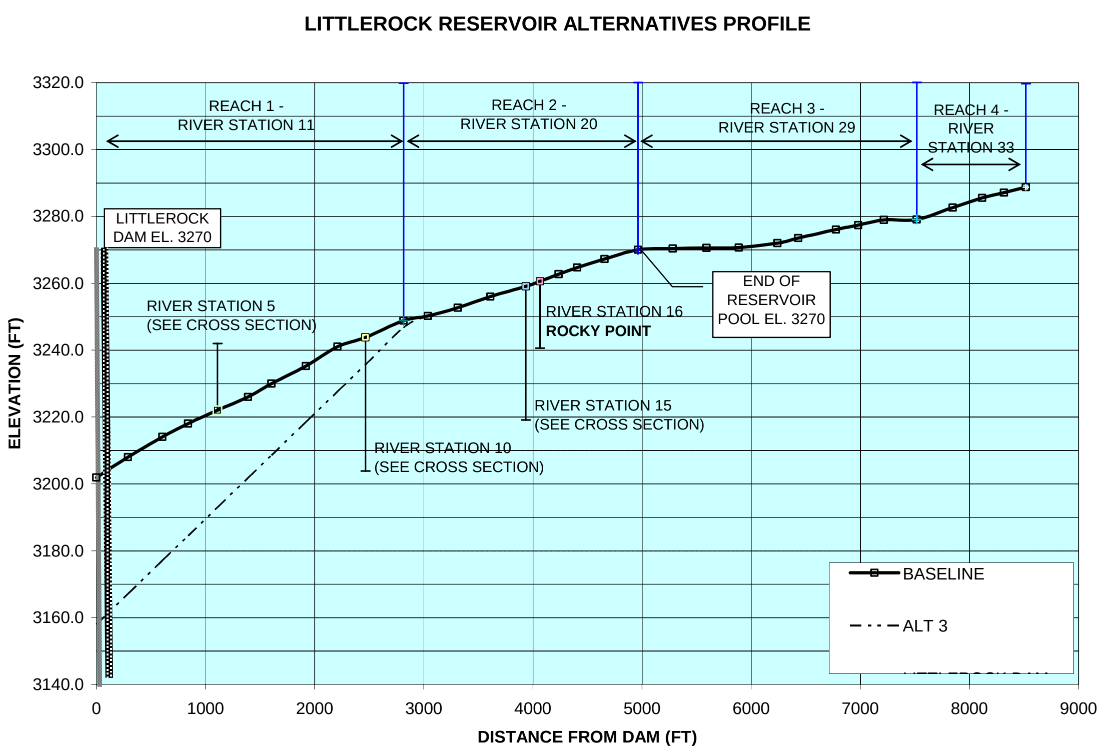

Figure 28 Alternative 3 Cut Profile

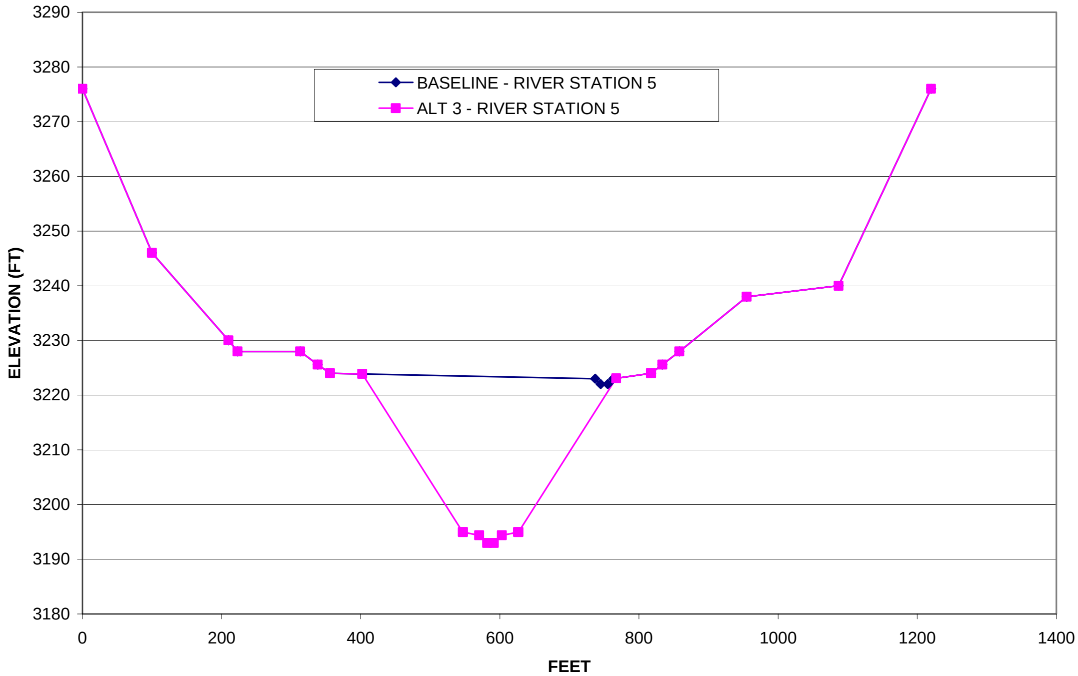

Figure 29 Alternative 3 Typical Cross Section

3.4 ALTERNATIVE 4

Alternative 4 is the same as Alternative 2, but with the goal of excavating 540,000 cubic yards rather than 270,000 cubic yards of sediment. Figures 30, 31 and 32 show plan view, profile, and typical cross section. Maximum excavation depth at Station 605 would be approximately 22 feet. Excavation top widths would be approximately 370 feet from the dam to approximately River Station 2,815, then taper to zero at Station 4,235. Excavation volume would be approximately 540,000 cubic yards. This alternative would include removal of 270,000 cubic yards of material from the same area as the initial excavation every five years.

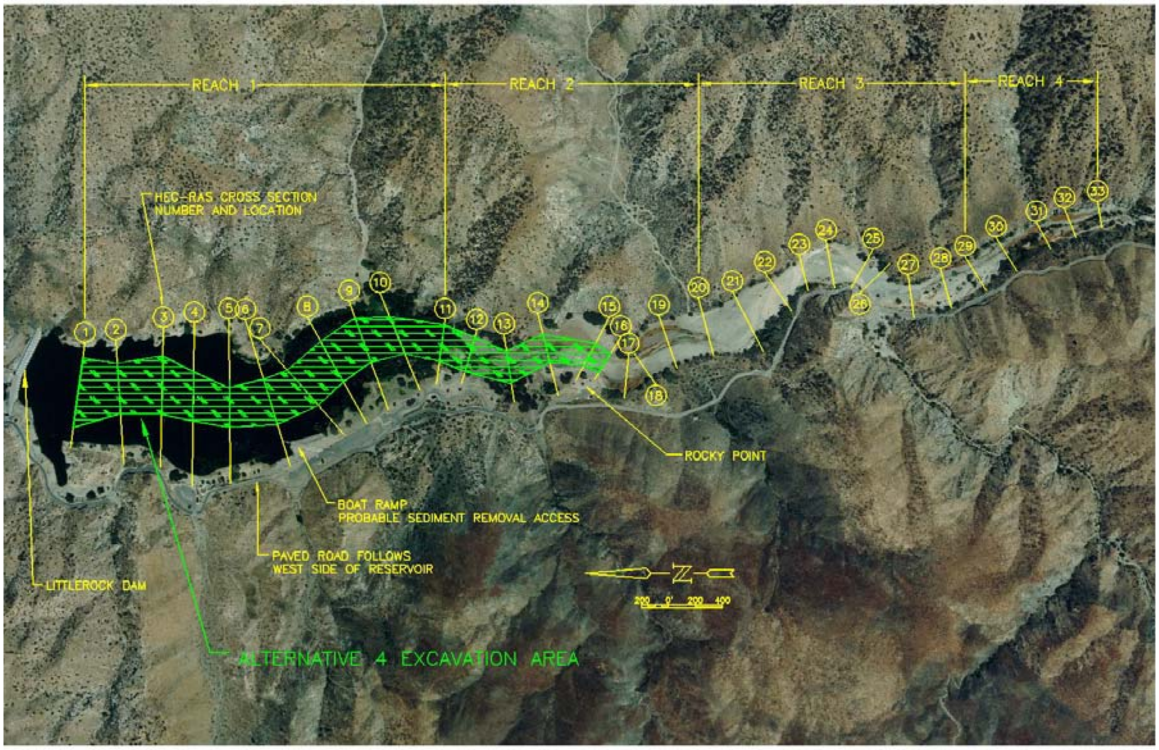

Figure 30 Alternative 4 Plan View

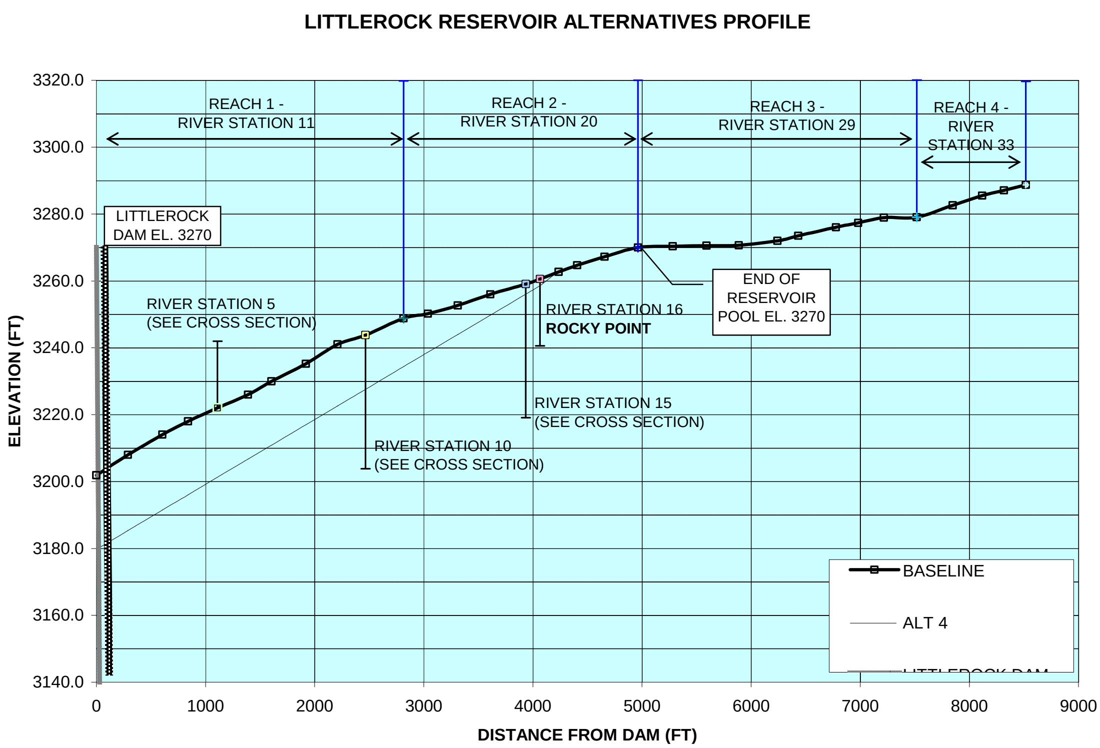

Figure 31 Alternative 4 Cut Profile

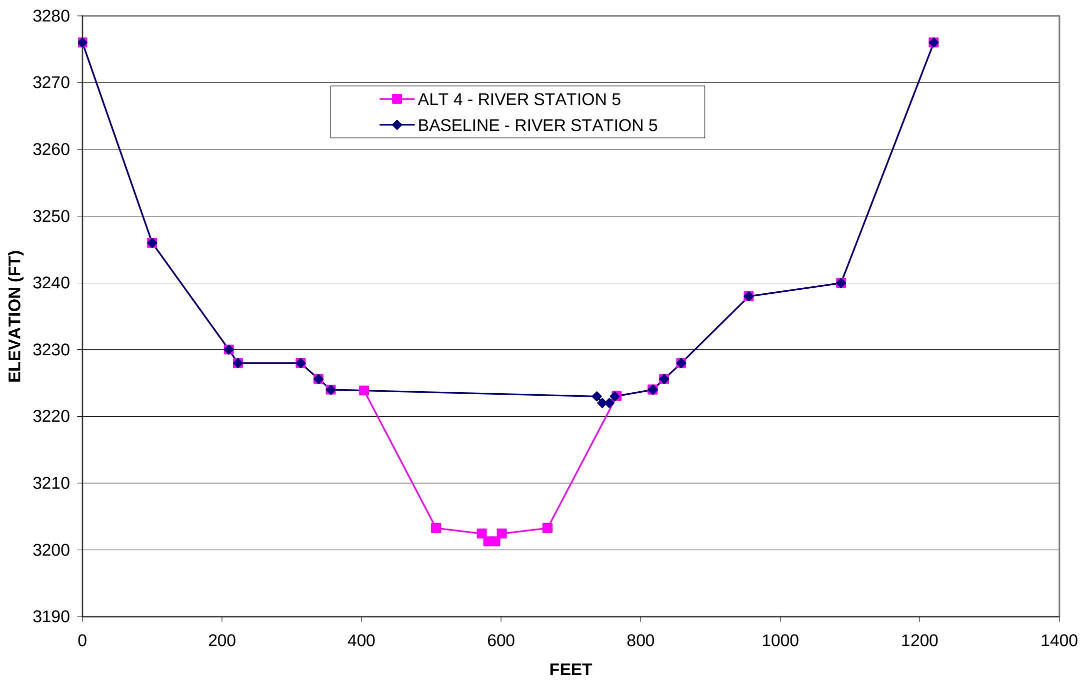

Figure 32 Alternative 4 Typical Cross Section

3.5 ALTERNATIVE 5

Alternative 5 consists of building a grade control structure at or just downstream of River Station 4,235 (the Rocky Point area) and excavating downstream of the grade control. Although there is some flexibility in the location of the grade-control structure, the approximate location is at Rocky Point shown in Figure 33 and Figure 19. The structure would be constructed of soil cement or concrete and span approximately 250 feet of the channel. Figure 33 shows a conceptual plan view and cross section. The structure would be buried, with the top flush with, or slightly below, the existing channel surface. Maximum depth of the structure would be approximately 70 feet. Construction of the structure would disturb a section of channel and adjacent bank approximately 300 feet wide in a direction perpendicular to flow, and 500 feet wide in the direction parallel to flow as shown in Figure 33. Disturbed channel areas would be returned to pre-construction conditions after construction. Alternative 5 would include excavation of the accumulated sediments in the reservoir downstream of the grade control structure. Since the grade control structure would be designed to prevent project-related reservoir excavation from progressing upstream, reservoir excavation could proceed according to a design and schedule determined by the District. For purposes of this analysis an excavation and maintenance schedule the same as Alternative 3 should be assumed.

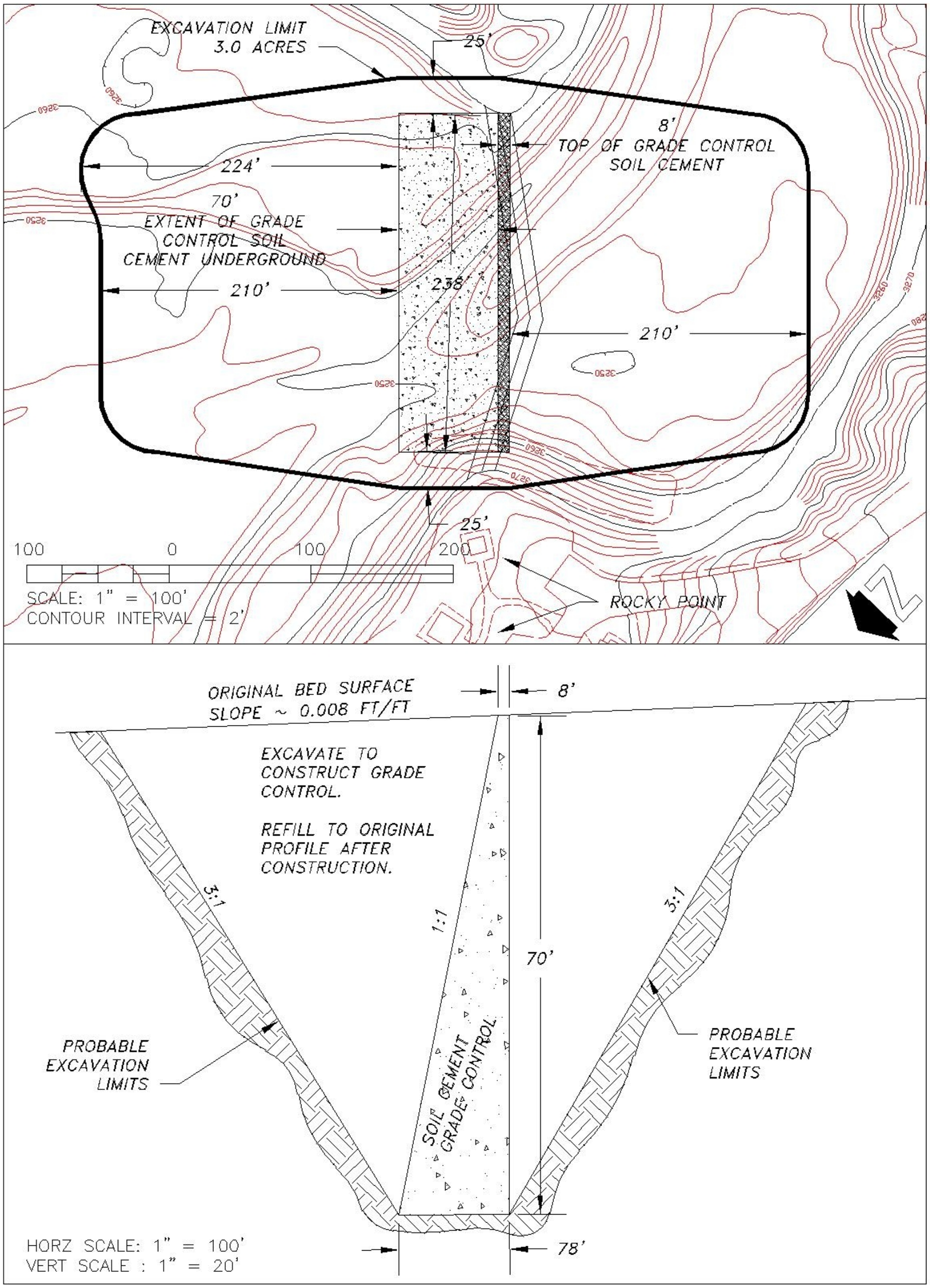

Figure 33 Alternative 5 Plan and Profile

4. IMPACT ANALYSIS

The purpose of the impact analysis was to determine whether the alternatives were likely to result in channel degradation upstream of the Rocky Point area, and make an estimate of how deep the degradation would be, and how far upstream it would extend. The analysis consisted of a sediment transport analysis similar to the evaluation described above for baseline conditions, and a qualitative geomorphic analysis based on reservoir and alternative topography, and channel profiles. Given the complexity of sediment transport, particularly in a situation such as the Littlerock Reservoir where hydraulic boundary conditions are constantly changing, and the variability and uncertainty of the future hydrology, the results of the analysis should be considered approximate and for comparison purposes rather than as firm predictions.

The results are presented as 1) short-term (one-year) impact based on the sediment transport analysis and the dry, median and wet year inflow scenarios; and 2) probable long-term effect assuming continued maintenance excavation of the reservoir as described in the alternatives.

4.1 ALTERNATIVE 1

Figure 34 shows the results of the sediment transport analysis for Alternative 1. As would be expected from a steepening of the slope from the Alternative 1 cut, substantial channel degradation, ranging from 6.5 to 13.5 feet, is expected in Reach 1. Reach 2 has predicted degradation up to 3.5 feet, and Reach 3 is expected to aggrade.

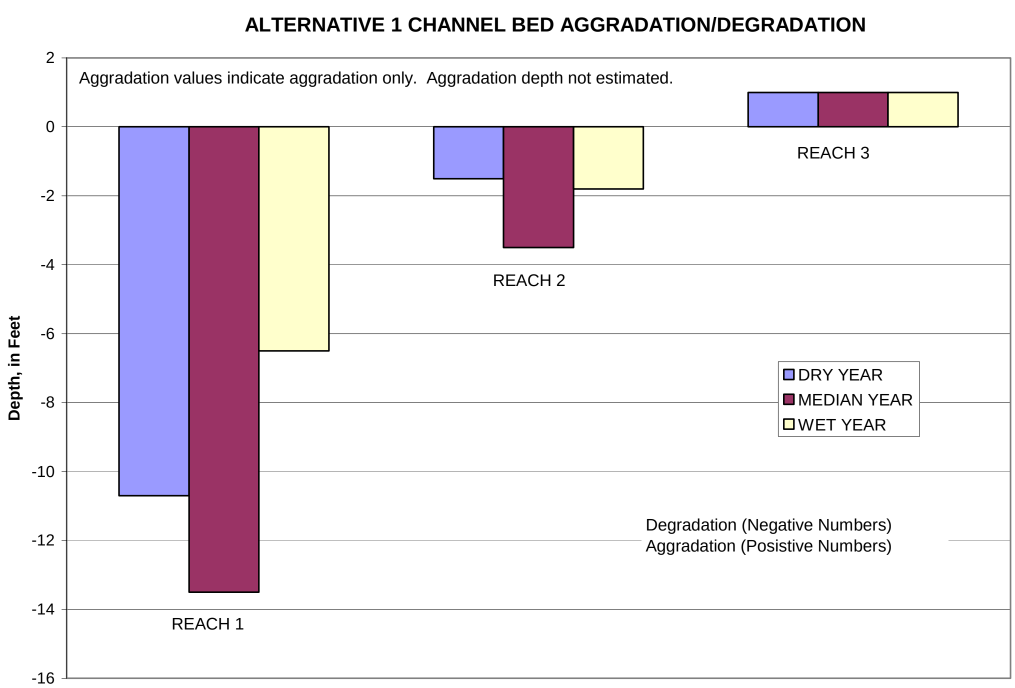

Figure 34 Alternative 1 Channel Bed Aggradation/Degradation by Reach as Predicted by the Sediment Transport Model

Predicted short-term degradation for Reach 1 is much more than for Reach 2. It is expected that this cut will actually extend upstream from Reach 1 at a relatively constant slope. An estimate of the possible extent of this cut was made by extending a line from the upstream end of the predicted Reach 1 cut, to the upstream end of the Reach 2 cut, and from there at a slope of 0.009, connecting with existing ground in Reach 3, which is predicted to aggrade. This with-project short-term profile is shown in Figure 35. The profile predicts a maximum cut at Rocky Point of 7 feet, extending to zero at a point 1,335 feet upstream of Rocky Point. Based on the results of the hydraulic and sediment analysis, the width of the low-flow channel in the 1989 and 1995 topography, and field observations, the cut is expected to be approximately 20 feet wide at the bottom. Side slopes in the sandy material would be 3:1 or flatter.

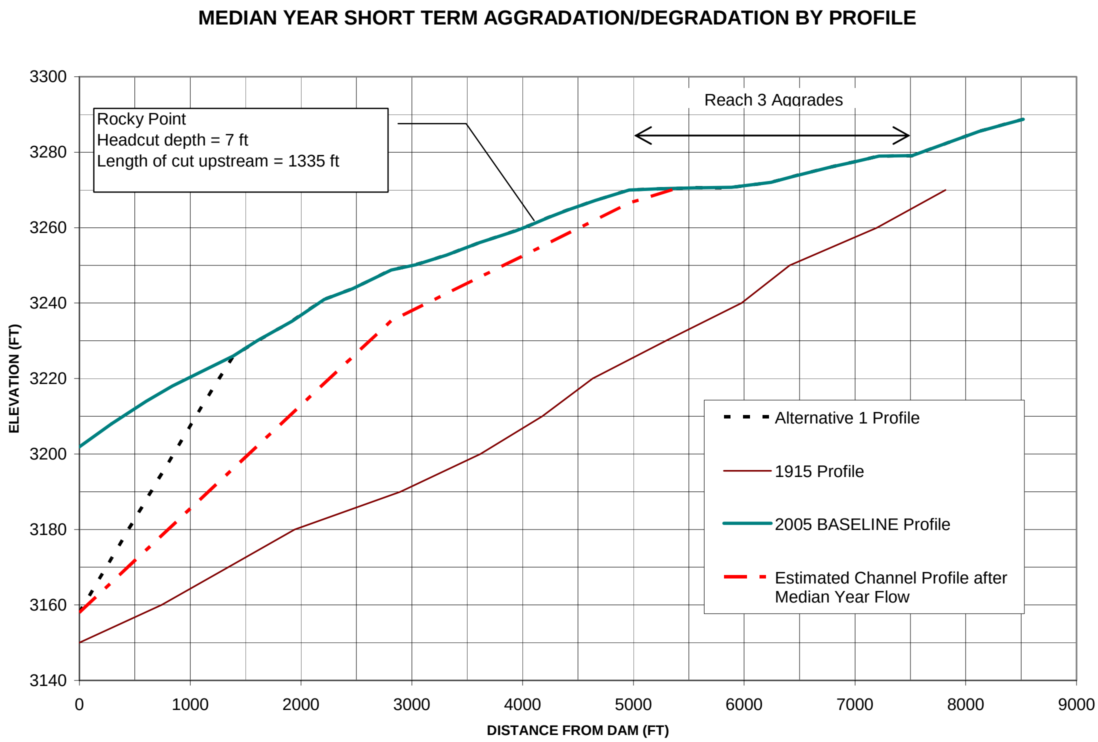

Figure 35 Alternative 1 Estimated Channel Profile After Median Year Flow

For the same reasons as for the Baseline Conditions cut, the degradation effect of Alternative 1 at and upstream of Rocky Point will be temporary unless excavation of incoming sediment is continued on a yearly basis. In the case of the 7-foot cut predicted for Rocky Point, predicted by the median year model, sufficient sediment would be delivered to the reservoir after the reservoir fills to completely fill this cut. All of this sediment would be deposited in the vicinity of the cut, so it is possible that by the end of the runoff season the cut would no longer be present.

Removal of incoming sediment, as proposed for this alternative, will simulate natural sediment transport in the sense that sediment will be transported out of the system. A new equilibrium will be reached, with the accumulated sediment in the reservoir not removed by Alternative 1 serving as the base elevation. Since it is proposed to remove sediment at the same rate as the supply, the channel can be expected to drop to a slope approximating the supply slope, particularly in the upper end of the reservoir. Given these conditions, the cut line represented by a slope of 0.009 in Figure 11 is a likely worst-case upstream channel degradation limit for Alternative 1 at Rocky Point.

Although a long-term worst-case cut of 13 feet at Rocky is estimated from the supply slope, the reservoir bed profile will actually not be at a constant slope, but be flatter at the upstream end and steeper at the downstream end due to backloading of sediment deposition at the upstream end of the reservoir after the reservoir is filled. Most (approximately 80 percent) of the years will bring sediment into the upstream end of the reservoir after the reservoir is filled. This sediment will be deposited at the upstream end and fill, at least partially, any cut that may exist there.

The volume of the maximum channel degradation cut upstream of Rocky Point is approximately 62,000 cubic yards. For Alternative 1, in a typical year, approximately 16,000 cubic yards of sediment are delivered after the reservoir is filled. This is sufficient to reduce the worst-case cut at Rocky Point to 8 feet. In a wet year, such as 1944, the excess arriving after the reservoir is filled is 160,000 cubic yards, 2.6 times the amount necessary to entirely fill the cut. On average, approximately 42,000 cubic yards of sediment arrive after the reservoir is filled each year, resulting in a probable average degradation at Rocky Point of three feet. Thus, with Alternative 1 in place, the long-term cut at Rocky Point is expected to vary, ranging from zero to 13 feet, and averaging about three feet. Table 5 provides a summary of estimated Alternative 1 impacts.

Table 5 Alternative 1 Impact Summary

Impact	Depth of Degradation At Rocky Point, in Feet	Maximum Distance of Cut Upstream of Rocky Point, in Feet
Short-Term (one year) Degradation	7	1,335
Worst-Case Long-Term Degradation Assuming Annual Excavation of 54,000 Cubic Yards	13	3,300
Probable Long-Term Average Degradation Based on Sediment Deposition at the Upstream End of the Reservoir	3	3,300

4.2 ALTERNATIVE 2

Figure 36 shows the results of the sediment transport analysis for Alternative 2. Because Alternative 2 would result in the steepening of Reach 2, substantial channel degradation is predicted there, ranging from 5.4 to 7.2 feet. Reach 2 degradation is approximately the same as or more than that of Reach 1, so Reach 2 is the dominant reach for predicting degradation. Maximum degradation of 7.2 feet occurs in a median year. Reach 3 is expected to aggrade.

Although Reach 3 is expected to aggrade, in the short term, the Reach 2 cut will likely extend into Reach 3. An estimate of the possible extent of the cut upstream of Reach 2 was made by extending a line at a slope of 0.009 from the upstream end of the predicted Reach 2 cut to connect with the Reach 3 profile. This with-project short-term profile is shown in Figure 37. The profile predicts that the 7.2-foot Reach 2 cut will extend upstream of Rocky Point a distance of approximately 1,335 feet. The cut would be approximately 20 feet wide with 3:1 or flatter side slopes.

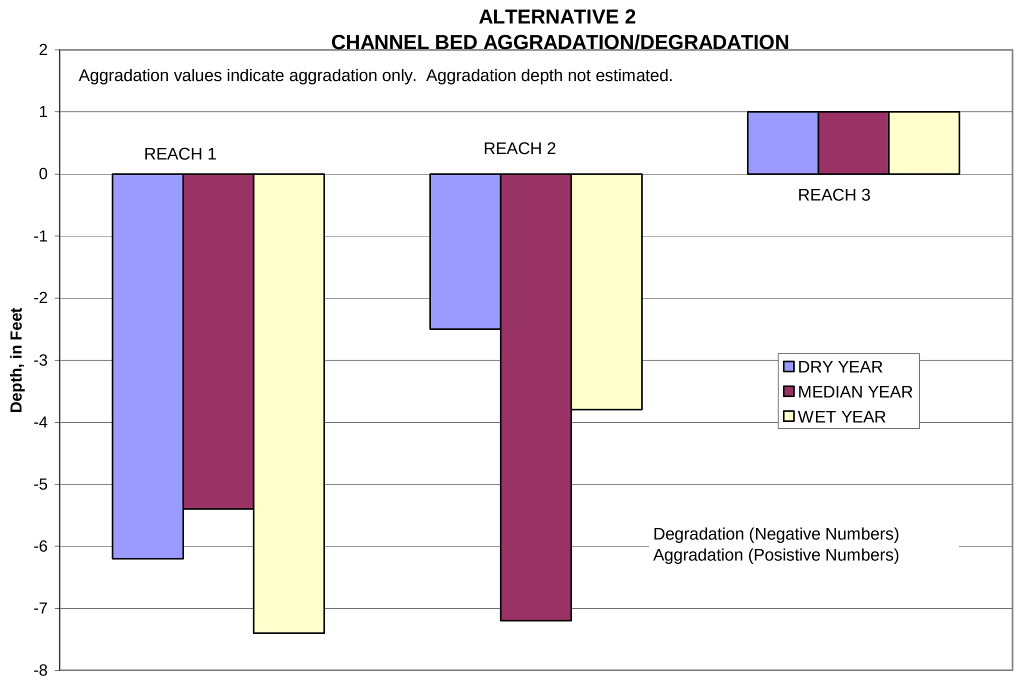

Figure 36 Alternative 2 Channel Bed Aggradation/Degradation by Reach as Predicted by the Sediment Transport Model

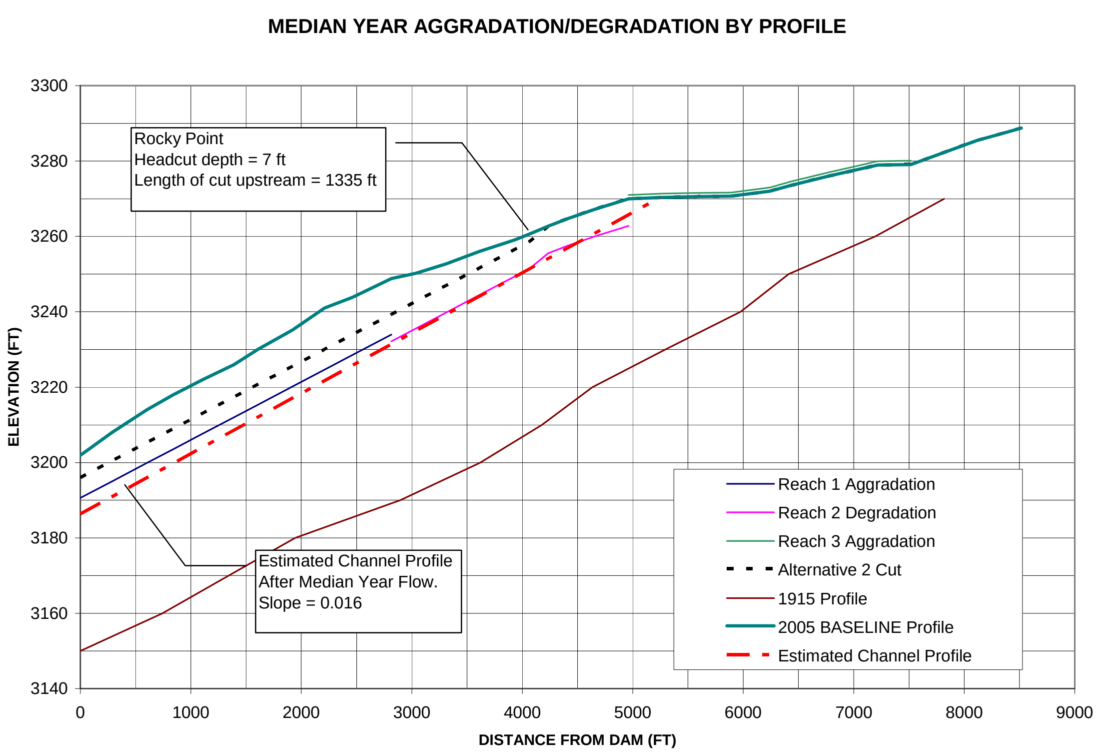

Figure 37 Alternative 2 Estimated Channel Profile After Median Year Flow

Alternative 2 involves annual removal of sediment from the Alternative 2 cut area. The stable slope discussion for Alternative 1 applies to the long-term degradation for Alternative 2 at Rocky Point. However, Alternative 2 involves an annual active excavation cut up to the Rocky Point area, resulting in a probable deeper average annual degradation than predicted for Alternative 1, similar to that predicted by the sediment transport analysis. Based on the results of the sediment transport analysis, and the long-term degradation analysis, the long-term average channel elevation at Rocky Point is likely to be approximately 7 feet. With Alternative 2 in place, the long-term cut at Rocky Point is expected to vary, ranging from zero to 13.2 feet, and averaging about 7 feet below the existing bed surface. Table 6 provides a summary of estimated Alternative 2 impacts.

Table 6 Alternative 2 Impact Summary

Impact	Depth Of Degradation At Rocky Point, In Feet	Maximum Distance Of Cut Upstream Of Rocky Point, In Feet
Short-Term (one year) Degradation	7	1,335
Worst-Case Long-Term Degradation Assuming Annual Excavation of 54,000 Cubic Yards	13	3,300
Probable Long-Term Average Degradation Based on Sediment Deposition at the Upstream End of the Reservoir	7	3,300

4.3 ALTERNATIVE 3

Figure 38 shows the results of the sediment transport analysis for Alternative 3. Similar to Alternative 1, substantial channel degradation, ranging from 5.4 to 8.7 feet, is expected in Reach 1. Degradation depth is less in Reach 1 than for Alternative 1 for the reason that the Alternative 3 excavation slope is flatter. Reach 2 has predicted degradation up to 4.1 feet, and Reach 3 is expected to aggrade.

It is expected that the Reach 1 cut will extend upstream from Reach 1 at a relatively constant slope. An estimate of the possible extent of this cut was made in the same manner as described for Alternative 1 and is shown in Figure 39. The profile predicts a maximum cut at Rocky Point of 7 feet, extending to zero at a point 1,335 feet upstream of Rocky Point. The cut is expected to be approximately 20 feet wide at the bottom with 3:1 side slopes.

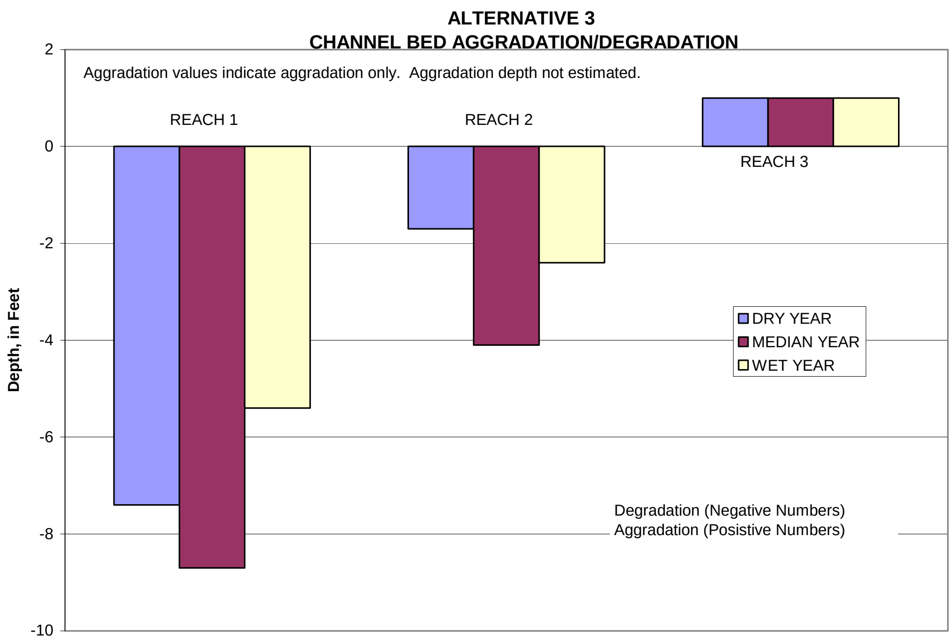

Figure 38 Alternative 3 Channel Bed Aggradation/Degradation by Reach as Predicted by the Sediment Transport Model

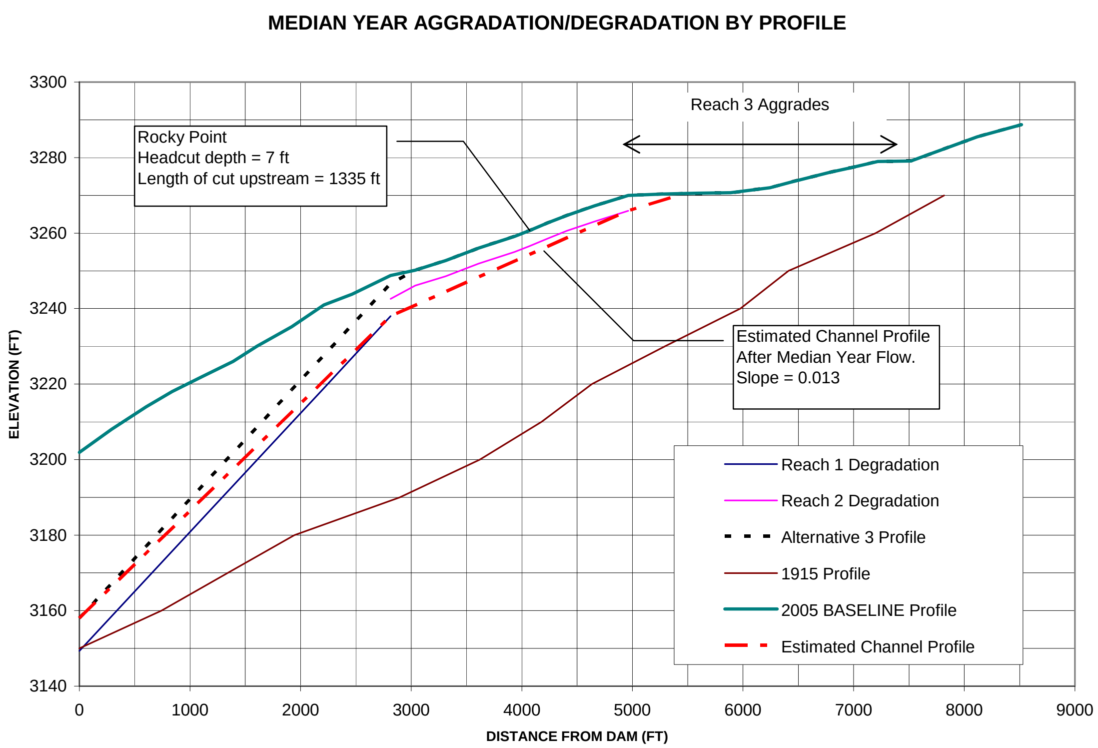

Figure 39 Alternative 3 Estimated Channel Profile After Median Year Flow

Alternative 3 involves removal of incoming sediment from the Alternative 3 cut area every five years. The removal amount would be the same as the incoming sediment volume (approximately 270,000 cubic yards). This would simulate natural sediment transport as described for Alternative 1, and the stable slope discussion for Alternative 1 applies to the long-term degradation for Alternative 3. Although Alternative 3 involves a much greater excavation than Alternative 1, and would therefore tend to move more quickly toward the equilibrium cut of 13 feet at Rocky Point, subsequent sediment removals would be every five years rather than annual, which would compensate by allowing sediment backloading of the reservoir more opportunity to recover the cut. The Alternative 3 long-term channel degradation at and upstream of Rocky Point (Table 7) is expected to be approximately the same as for Alternative 1. Alternative 3, with an annual active excavation cut up to the Rocky Point area, would result in a probable deeper average annual degradation than predicted for Alternative 1, with more dramatic fluctuations in bed level at Rocky Point.

Table 7. Alternative 3 Impact Summary

Impact	Depth Of Degradation At Rocky Point, In Feet	Maximum Distance Of Cut Upstream Of Rocky Point, In Feet
Short-Term (one year) Degradation	7	1,335
Worst-Case Long-Term Degradation Assuming Excavation of 270,000 Cubic Yards every five years.	13	3,300
Probable Long-Term Average Degradation Based on Sediment Deposition at the Upstream End of the Reservoir	3	3,300

4.4 ALTERNATIVE 4

Figures 40 and 41 show the results of the sediment transport analysis for Alternative 4. Reach 2 degradation is estimated at 11.4 feet. Reaches 1 and 3 are predicted to aggrade. Since the Reach 3 predicted aggradation is less than the Reach 2 degradation, the Reach 2 cut is expected to extend into Reach 3. Assuming a slope of 0.009 from the upstream end of the predicted Reach 2 cut, this cut is expected to extend approximately 1,485 feet upstream of the Rocky Point area. The cut is expected to be approximately 20 feet wide with 3:1 or flatter side slopes.

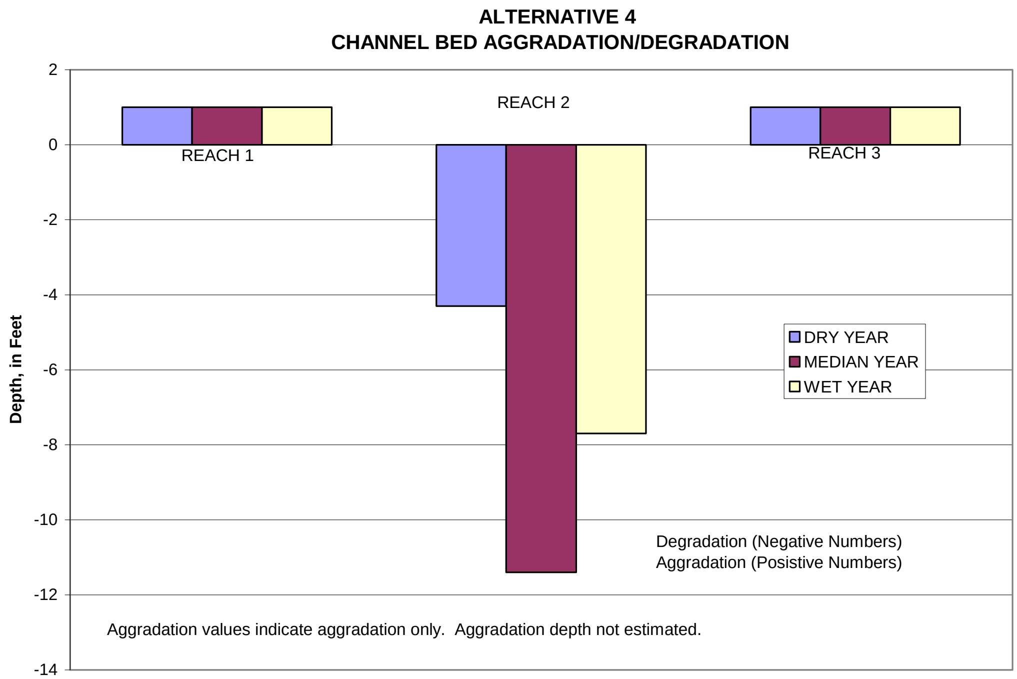

Figure 40 Alternative 4 Channel Bed Aggradation/Degradation by Reach as Predicted by the Sediment Transport Model

Alternative 4 involves 5-year removal of 270,000 cubic yards of sediment from the Alternative 4 cut area. The stable slope discussion for Alternative 1 applies to the long-term degradation for Alternative 4 at Rocky Point. However, as with Alternative 2, Alternative 4 involves active excavation cut up to the Rocky Point area, resulting in a probable deeper average annual degradation than predicted for Alternatives 1, 2, and 3. Based on the results of the sediment transport analysis, and the long-term degradation analysis, the long-term average channel elevation at Rocky Point is estimated at approximately 11 feet. With Alternative 4 in place, the long-term cut at Rocky Point is expected to vary dramatically, ranging from zero to 13 feet, and averaging about 11 feet below the existing bed surface. Table 8 provides a summary of estimated Alternative 4 impacts.

Table 8. Alternative 4 Impact Summary

Impact	Depth Of Degradation at Rocky Point, in Feet	Maximum Distance of Cut Upstream of Rocky Point, in Feet
Short-Term (one year) Degradation	11	1,485
Worst-Case Long-Term Degradation Assuming Annual Excavation of 54,000 Cubic Yards	13	3,300
Probable Long-Term Average Degradation Based on Sediment Deposition at the Upstream End of the Reservoir	11	3,300

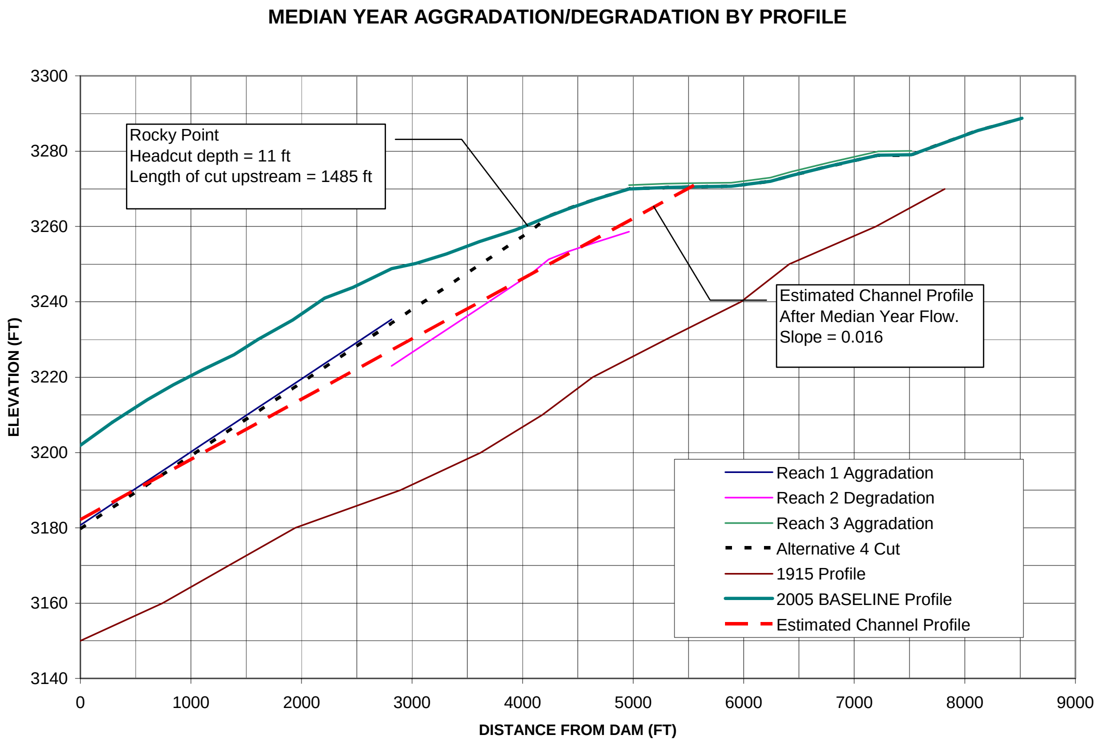

Figure 41 Alternative 4 Estimated Channel Profile After Median Year Flow

4.5 ALTERNATIVE 5

The Alternative 5 grade control structure would prevent project-related channel downcutting from extending upstream of the Rocky Point area. Substantial cutting would occur downstream of the structure, due to project-related excavation and alterations in sediment transport capacity. Upstream of the grade control structure, the channel bed would remain at the current condition, with perhaps some minor temporary downcutting as described for baseline conditions. Minor downcutting would be seasonal and generally follow periods of high flow when sediment deposited in the upper end of the reservoir causes the channel to aggrade. This is the same as the current baseline condition.

4.6 ALTERNATIVE SUMMARY AND DISCUSSION

Table 9 provides a summary of the results of the analysis for baseline conditions and the alternatives. In all cases seasonal fluctuations are expected, as was predicted under the baseline condition. Bed elevation fluctuations will be greatest in dry years when insufficient flow to fill the reservoir occurs. This should happen in about 20 percent of the years. In most years sediment is delivered to the reservoir after the reservoir fills, and most of this sediment will be deposited in and near the upper end of the reservoir, filling channel degradation cuts that may be present.

Alternatives 1 and 3 have the least expected degradation. These alternatives have the advantage that the excavation cut is far removed from the Rocky Point area, and are at a lower elevation, resulting in being covered by reservoir water earlier in the season, thus inhibiting the growth of a headcut.

Alternatives 2 and 4 would have the excavation cut extend to Rocky Point, and therefore have the most expected channel degradation. Alternative 5 stabilizes the channel from Rocky Point up, and prevents project-related cutting from occurring.

The amount of channel downcutting with Alternatives 1 to 4, as well as baseline conditions, is highly dependent on the hydrology. After a series of dry years, with Alternatives 1 to 4 in place, particularly if annual or 5-year maintenance excavation proceeds at the described schedule (54,000 cubic yards per year for Alternatives 1 and 2, and 270,000 cubic yards every 5 years for Alternatives 2 and 4) the channel at Rocky Point could degrade to a level approaching 13 feet. A series of wet years would likely produce aggradation with all alternatives in place. The probable long-term average given in Table 9 provides the results of an attempt to quantify the average lowering of the bed elevation that would occur with the alternatives in place.

Because of the effect of dry years, it is recommended that with Alternatives 1 to 4, the maintenance excavation schedule be modified to limit annual sediment removal to the amount delivered by the previous year.

Table 9 Summary of Expected Channel Degradation at Rocky Point

Alternative	Depth Of Degradation At Rocky Point, In Feet	Degradation Distance Upstream Of Rocky Point, In Feet
Short-Term (One Year) Impact		
Baseline Conditions	3	1,200
Alternative 1	7	1,335
Alternative 2	7	1,335
Alternative 3	7	1,335
Alternative 4	11	
Alternative 5	3	
Probable Long-Term Average		
Baseline Conditions	0*	0
Alternative 1	3	3,300
Alternative 2	7	3,300
Alternative 3	3**	3,300
Alternative 4	11	3,300
Alternative 5	0	0
Probable Long-Term Worst Case		
Baseline Conditions	0	0
Alternative 1	13	3,300
Alternative 2	13	3,300
Alternative 3	13	3,300
Alternative 4	13	3,300
Alternative 5	0	0
All estimates rounded to the nearest foot. * Seasonal fluctuations will occur. ** Same as Alternative 1 but more dramatic fluctuations expected.		

5. REFERENCES

U.S. Army Corps of Engineers (USACE). 1989. "Sedimentation Investigations of Rivers and Reservoirs" Engineer Manual 1110-2-4000. Department of the Army, U.S. Army Corps of Engineers, Washington, DC 20314-1000.

U.S. Army Corps of Engineers (USACE). 2002. "HEC-RAS River Analysis System Hydraulic Reference Manual" U.S. Army Corps of Engineers Institute for Water Resources Hydrologic Engineering Center, 609 Second Street, Davis, California.

U.S. Geological Survey (USGS). 2005. "Surface-Water Data for the Nation." Website http://waterdata.usgs.gov/nwis/sw accessed February, 2005.

U.S. Geological Survey (USGS). 1998. "Verification of Roughness Coefficients for Selected Natural and Constructed Stream Channels in Arizona. U.S. Geological Survey Professional Paper 1584.

Woodward-Clyde Consultants. 1991. "Littlerock Dam Reservoir Restoration Project. Evaluation of Aggregates for RCC Construction. Prepared for Palmdale Water District and Littlerock Creek Irrigation District." Woodward-Clyde Consultants, 500 12th Street, Suite 100, Oakland, California.

Appendix D

Special Use Permit

FS-2700-4 (7/96)
OMB No. 0596-0082

U. S. DEPARTMENT OF AGRICULTURE Forest Service	Holder No. 1011-01	Issue Date 12/05/97	Expir. Date 12/31/37
SPECIAL-USE PERMIT	Type Site(s) 925-752	Authority 676	Auth. Type __20
Authority: Act of October 21, 1976 (Public Law 99-545); 36 CFR 251.57 et seq.	Region/Forest/District 05/01/54		State/County 06/037
	Cong. Dist. 25	Latitude 34-29-20	Longitude 118-01-125

Palmdale Water District/ Littlerock Creek Irrigation District	of	2029 East Avenue "Q"	
(Holder Name)		(Billing Address - 1)	
---------------------	Palmdale,	California	93550
(Billing Address - 2)	(City)	(State)	(Zip Code)

(hereinafter called the Holder) is hereby authorized to use or occupy National Forest System lands, to use subject to the conditions set out below, on the Angeles National Forest, Valyermo Ranger District.

DEC 1997 RECEIVED

This permit covers approximately 120 acres and is located within:

San Bernardino Meridian
T.4N., R.11W., sec. 3, NE1/4NW1/4;
T.5N., R.11W., sec. 34, W1/2;
T.5N., R.11W., sec. 27, SW1/4SW1/4 and SE1/4SW1/4;

as shown on the LOCALITY AND SITE MAPS attached to and made a part of this permit, and is issued for the purpose of: Operating and maintaining the Littlerock Dam, reservoir (to high water mark at 3270 feet above mean sea level), valve house and gated valve house access road. However, this permit excludes the boat launch ramp, boat dock and concrete handicapped fisherman's access path. The following exhibits are included as part of this permit:

Exhibit "A" -- Locality Map.
Exhibit "B" -- Site Map.
Exhibit "C" -- Dam Drawings "as-built", dated June 5, 1995. [on file PWD & USFS].
Exhibit "D" -- Fire Plan.
Exhibit "E" -- Littlerock Dam Joint Powers/Lead Agency Agreement.
Exhibit "F" -- Dam Emergency Action Plan dated May, 1995. [on file PWD & USFS].
Exhibit "G" -- Bat Monitoring Plan.
Exhibit "H" -- Riparian Vegetation Mitigation and Monitoring Plan dated 2/1995.
Exhibit "I" -- Operation and Maintenance Plan.

The above described or defined area shall be referred to herein as the "permit area".

TERMS AND CONDITIONS

I. AUTHORITY AND GENERAL TERMS OF THE PERMIT

A. Authority. This permit is issued pursuant to the authorities enumerated at Title 36, Code of Federal Regulations, Section 251 Subpart B, as amended. This permit, and the activities or use authorized, shall be subject to the terms and conditions of the Secretary's regulations and any subsequent amendment to them.

B. Authorized Officer. The authorized officer is the Forest Supervisor or a delegated subordinate officer.

C. License. This permit is a license for the use of federally owned land and does not grant any permanent, possessory interest in real property, nor shall this permit constitute a contract for purposes of the Contract Disputes Act of 1978 (41 U.S.C. 611). Loss of the privileges granted by this permit by revocation, termination, or suspension is not compensable to the holder.

D. Amendment. This permit may be amended in whole or in part by the Forest Service when, at the discretion of the authorized officer, such action is deemed necessary or desirable to incorporate new terms, conditions, and stipulations as may be required by law, regulation, land management plans, or other management decisions.

E. Existing Rights. This permit is subject to all valid rights and claims of the following known third party Special Uses Authorizations existing on the date of execution of this Special Use Authorization:

Third Party	Permit Designation
Littlerock Resort	2720 Special Uses

The United States is not liable to the holder for the exercise of any such right or claim.

F. Nonexclusive Use and Public Access. Unless expressly provided for in additional terms, use of the permit area is not exclusive. The Forest Service reserves the right to use or allow others to use any part of the permit area, including roads, for any purpose, provided, such use does not materially interfere with the holder's authorized use. ~~A final determination of conflicting uses is reserved to the Forest Service.~~

G. Forest Service Right of Entry and Inspection. The Forest Service has the right of unrestricted access of the permitted area or facility to ensure compliance with laws, regulations, and ordinances and the terms and conditions of this permit.

H. Assignability. This permit is not assignable or transferable. If the holder through death, voluntary sale or transfer, enforcement of contract, foreclosure, or other valid legal proceeding ceases to be the owner of the improvements, this permit shall terminate.

I. Permit Limitations. Nothing in this permit allows or implies permission to build or maintain any structure or facility, or to conduct any activity unless specifically provided for in this permit. Any use not specifically identified in this permit must be approved by the authorized officer in the form of a new permit or permit amendment.

II. TENURE AND ISSUANCE OF A NEW PERMIT

A. Expiration at the End of the Authorized Period. This permit will expire at midnight on DECEMBER 31, 2037. Expiration shall occur by operation of law and shall not require notice, any decision document, or any environmental analysis or other documentation. On or about December 31, 2017 and on or about December 31, 2027, the authorized officer may modify the terms, conditions, and special stipulations of this permit only to reflect any new requirements imposed by the then-current Federal and State land use plans, laws, or regulations.

B. Minimum Use or Occupancy of the Permit Area. Use or occupancy of the permit area shall be exercised at least 365 days each year, unless otherwise authorized in writing under additional terms of this permit.

C. Notification to Authorized Officer. If the holder desires issuance of a new permit after expiration, the holder shall notify the authorized officer in writing not less than six (6) months prior to the expiration date of this permit.

D. Conditions for Issuance of a New Permit. At the expiration or termination of an existing permit, a new permit may be issued to the holder of the previous permit or to a new holder subject to the following conditions:

1. The authorized use is compatible with the land use allocation in the Forest Land and Resource Management Plan.
2. The permit area is being used for the purposes previously authorized.
3. The permit area is being operated and maintained in accordance with the provisions of the permit.
4. The holder has shown previous good faith compliance with the terms and conditions of all prior or other existing permits, and has not engaged in any activity or transaction contrary to Federal contracts, permits, laws, or regulation.

E. Discretion of Forest Service. Notwithstanding any provisions of any prior or other permit, the authorized officer may prescribe new terms, conditions, and stipulations when a new permit is issued. The decision whether to issue a new permit to a holder or successor in interest is at the absolute discretion of the Forest Service.

III. RESPONSIBILITIES OF THE HOLDER

A. Compliance with Laws, Regulations, and other Legal Requirements. The holder shall comply with all applicable Federal, State, and local laws, regulations, and standards, including but not limited to, the Federal Water Pollution Control Act, 33 U.S.C. 1251 *et seq.*, the Resource Conservation and Recovery Act, 42 U.S.C. 6901 *et seq.*, the Comprehensive Environmental Response, Control, and Liability Act, 42 U.S. C. 9601 *et seq.*, and other relevant environmental laws, as well as public health and safety laws and other laws relating to the siting, construction, operation, and maintenance of any facility, improvement, or equipment on the property.

B. Plans. Plans for development, layout, construction, reconstruction, or alteration of improvements on the permit area, as well as revisions of such plans, must be prepared by a qualified individual acceptable to the authorized officer and shall be approved in writing prior to commencement of work. The holder may be required to furnish as-built plans, maps, or surveys, or other similar information, upon completion of construction.

C. Maintenance. Except for recreational facilities, the holder shall maintain the improvements and permit area to standards of repair, orderliness, neatness, sanitation, and safety acceptable to the authorized officer and consistent with other provisions of this authorization. If requested, the holder shall comply with inspection requirements deemed appropriate by the authorized officer.

D. Hazard Analysis. The holder has a continuing responsibility to identify all hazardous conditions on the permit area which would affect the improvements, resources, or pose a risk of injury to individuals. Any non-emergency actions to abate such hazards shall be performed after consultation with the authorized officer. In emergency situations, the holder shall notify the authorized officer of its actions as soon as possible, but not more than 48 hours, after such actions have been taken.

E. Change of Address. The holder shall immediately notify the authorized officer of a change in address.

F. Change in Ownership. This permit is not assignable and terminates upon change of ownership of the improvements or control of the business entity. The holder shall immediately notify the authorized officer when a change in ownership or control of business entity is pending. Notification by the present holder and potential owner shall be executed using Form FS-2700-3, Special Use Application and Report, or Form FS-2700-3a, Request for Termination of and Application for Special-Use Permit. Upon receipt of the proper documentation, the authorized officer may issue a permit to the party who acquires ownership of, or a controlling interest in, the improvements or business entity.

IV. LIABILITY

For purposes of this section, "holder" includes the holder's heirs, assigns, agents, employees, and contractors.

A. The holder assumes all risk of loss to the authorized improvements within the permit area.

B. The holder shall indemnify, defend, and hold the United States harmless for any violations incurred under any such laws and regulations or for judgments, claims, or demands assessed against the United States in connection with the holder's use or occupancy of the property. The holder's indemnification of the United States shall include any loss by personal injury, loss of life or damage to property in connection with the occupancy or use of the property during the term of this permit. Indemnification shall include, but is not limited to, the value of resources damaged or destroyed; the costs of restoration, cleanup, or other mitigation; fire suppression or other types of abatement costs; third party claims and judgments; and all administrative, interest, and other legal costs. This paragraph shall survive the termination or revocation of this authorization, regardless of cause.

C. The holder has an affirmative duty to protect from damage the land, property, and interests of the United States.

C(2). The holder shall be strictly liable (liability without proof of negligence) to the United States for any injury, loss, or damage arising under this authorization. Such strict liability shall be in the amount of $1 million unless the Forest Supervisor determines at the time of issuance of this authorization that a lesser amount of strict liability is appropriate based upon a risk assessment for the use authorized by this instrument. Liability for injury, loss, or damage to the United States in excess of the prescribed amount of strict liability shall be determined under the general law of negligence.

D. In the event of any breach of the conditions of this authorization by the holder, the Authorized Officer may, following the delivery of written notice to the holder specifying the breach in sufficient detail to enable the holder to identify the actions necessary to cure the breach, and following a reasonable opportunity to do so, cure the breach for the account at the expense of the holder. If the Forest Service at any time pays any sum of money or does any act which will require payment of money, or incurs any expense, including reasonable attorney's fees, in instituting, prosecuting, and/or defending any action or proceeding to enforce the United States rights hereunder, the sum or sums so paid by the United States, with all interests, costs and damages shall, at the election of the Forest Service, be deemed to be additional fees hereunder and shall be due from the holder to the Forest Service on the first day of the month following such election.

E. With respect to roads, the holder shall be proportionally liable for damages to all roads and trails of the United States open to public use caused by the holder's use to the same extent as provided above, except that liability shall not include reasonable and ordinary wear and tear.

F. The Forest Service has no duty to inspect the permit area or to warn of hazards and, if the Forest Service does inspect the permit area, it shall incur no additional duty nor liability for identified or non-identified hazards. This covenant may be enforced by the United States in a court of competent jurisdiction.

V. TERMINATION, REVOCATION, AND SUSPENSION

A. General. For purposes of this permit, "termination", "revocation", and "suspension" refer to the cessation of uses and privileges under the permit.

"Termination" refers to the cessation of the permit under its own terms without the necessity for any decision or action by the authorized officer. Termination occurs automatically when, by the terms of the permit, a fixed or agreed upon condition, event, or time occurs. For example, the permit terminates at expiration. Terminations are not appealable.

"Revocation" refers to an action by the authorized officer to end the permit because of noncompliance with any of the prescribed terms, or for reasons in the public interest. Revocations are appealable.

"Suspension" refers to a revocation which is temporary and the privileges may be restored upon the occurrence of prescribed actions or conditions. Suspensions are appealable.

B. Revocation or Suspension. The Forest Service may suspend or revoke this permit in whole or part for:

1. Noncompliance with Federal, State, or local laws and regulations.
2. Noncompliance with the terms and conditions of this permit.
3. Reasons in the public interest.
4. Abandonment or other failure of the holder to otherwise exercise the privileges granted.

C. Opportunity to Take Corrective Action. Prior to revocation or suspension for cause pursuant to Section V (B), the authorized officer shall give the holder written notice of the grounds for each action and a reasonable time, not to exceed 90 days, to complete the corrective action prescribed by the authorized officer.

D. Removal of Improvements. Prior to abandonment of the improvements or within a reasonable time following revocation or termination of this authorization, the holder shall prepare, for approval by the authorized officer, an abandonment plan for the permit area. The abandonment plan shall address removal of improvements and restoration of the permit area and prescribed time frames for these actions. If the holder fails to remove the improvements or restore the site within the prescribed time period, they become the property of the United States and may be sold, destroyed or otherwise disposed of without any liability to the United States. However, the holder shall remain liable for all cost associated with their removal, including costs of sale and impoundment, cleanup, and restoration of the site.

VI. FEES

A. Termination for Nonpayment. This permit shall automatically terminate without the necessity of prior notice when land use rental fees are 90 calendar days from the due date in arrears.

B. The holder shall pay an annual fee of SIXTY FOUR HUNDRED Dollars ($ 6,400 for the period from JANUARY 1st, 1997, to DECEMBER 31, 1997, and thereafter annually on JANUARY 1st , SIXTY FOUR HUNDRED Dollars ($ 6,400 : Provided, charges for this use shall be made or readjusted whenever necessary to place the charges on a basis commensurate with the fair market value of the authorized use.

C. Payment Due Date. The payment due date shall be the close of business on JANUARY 1st of each calendar year payment is due. Payments due the United States for this use shall be deposited at **COLLECTION OFFICER, FS, Pacific Southwest Region, P.O. Box 60000, FILE NO. 31381, San Francisco, CA 94160-1381** , in the form of a check, draft, or money order payable to "Forest Service, USDA." Payments shall be credited on the date received by the designated Forest Service collection officer or deposit location. If the due date for the fee or fee calculation statement falls on a non workday, the charges shall not apply until the close of business on the next workday.

D. Late Payment Interest. Pursuant to 31 USC 3717, and regulations at 7 CFR Part 3, Subpart B, and 4 CFR Part 102, an interest charge shall be assessed on any payment or financial statement not received by the due date. Interest shall be assessed using the most current rate prescribed by the United States Department of Treasury's Financial Manual (TFM-6-8020). Interest shall accrue from the date the payment or financial statement was due. In the event that two or more billings are required for delinquent accounts, administrative costs to cover processing and handling of the delinquent debt will be assessed.

E. Additional Penalties. In the event of permit termination pursuant to provisions VI (A), and prior to the issuance of a new permit, a penalty of 6 percent per year shall be assessed on any fee amount overdue in excess of 90 days from the payment due date. This penalty shall accrue from the due date of the first billing or the date the fee calculation financial statement was due. The penalty is in addition to interest and any other charges specified in the above paragraph.

F. Disputed Fees. Disputed fees are due and payable by the due date. No appeal of fees will be considered by the Forest Service without full payment of the disputed amount. Adjustments, if necessary, will be made in accordance with settlement terms or appeal decision.

G. Delinquent Fees.

1. Delinquent fees and other charges shall be subject to all rights and remedies afforded the United States pursuant to Federal law and implementing regulations (31 U.S.C. 3711 et seq.).

2. The authorized officer shall require payment of fees owed the United States under any Forest Service authorization before issuance of a new permit.

VII. OTHER PROVISIONS

A. Members of Congress. No Member of or Delegate to Congress or Resident Commissioner shall benefit from this permit either directly or indirectly, except when the authorized use provides a general benefit to a corporation.

B. Appeals and Remedies. Any discretionary decisions or determinations by the authorized officer are subject to the appeal regulations at 36 CFR 251, Subpart C, or revisions thereto.

C. Superior Clauses. In the event of any conflict between any of the preceding printed clauses or any provision thereof and any of the following clauses or any provision thereof, the preceding printed clauses shall control.

SUPPLEMENTAL CLAUSES

1. **Private Road, Secondary Use (for gated access road).**

[1]. All construction or reconstruction of the road shall be in accordance with plans, specifications, and written stipulations previously approved by the Forest Service.

[2]. The holder, in exercising the privileges granted by this authorization, shall comply with all applicable State and Federal laws, Orders, and rules and regulations, and shall comply with all State standards for public health and safety, environmental protection, and siting construction, operation, maintenance if in the opinion of the authorized officer those State standards are more stringent than Federal standards, and promulgation of State standards precede the date of this special use authorization.

[3]. The holder shall cut no timber except as authorized by construction stipulations or maintenance agreements.

[4]. The holder shall provide maintenance so that no damage occurs on adjacent National Forest land. The holder shall construct and maintain lead-off drainage and water barriers as necessary to prevent erosion.

[5]. The United States may use the roads without cost for all purposes, including the removal of timber cut in construction or maintnenance of the road or other incidental use, deemed necessary or desirable in connection with the protection and administration of the lands or resources of the United States; provided that the road only will be used for commercial hauling purposes, only after payment by the United States of its pro rata share of road maintenance costs.

[6]. Only the Forest Service may extend rights and privileges for use of the road constructed on the premises to other nonfederal users on the condition that such users shall pay a fair share of the current replacement cost less depreciation of the road and any reconstruction costs necessary to accommodate their use. Provided, however, that the exercise of such rights and privileges by other non-federal users shall ~~occupancy-and-use-does~~ not unreasonably interfere with the rights granted herein.

[7]. The Forest Service retains the right to occupy and use the right-of-way. It also may issue other uses including rights-of-way, on and through the permitted area provided that the occupancy and use does not unreasonably interfere with the rights granted herein.

[8]. The Forest Service shall have the right to cross and recross the premises and road at any place by any reasonable means and for any purpose in such manner as does not unreasonably interfere with use of the road.

[9]. The holder shall maintain the right-of-way clearing by means of chemicals only after the Forest Supervisor has given specific written approval. Application for such approval must be in writing and must specify the time, method, chemicals and the exact portion of the right-of-way to be chemically treated.

2. Signs

No signs or advertising devices shall be erected on the area covered by this permit, or highways leading thereto, without prior approval by the Forest Service as to location, design, size, color, and message. Erected signs shall be maintained or renewed as necessary to neat and presentable standards, as determined by the Forest Service.

3. Insurance Clause.

The holder shall have in force public liability insurance covering: (1) property damage in the amount of **ONE MILLION** dollars ($1,000,000) and (2) damage to persons in the minimum amount of **ONE MILLION** dollars ($1,000,000) in the event of death or injury to one individual, and in the minimum amount of **THREE MILLION** dollars ($3,000,000) in the event of death or injury to more than one individual. The coverage shall extend to property damage, bodily injury, or death rising out of the holder's activities under the permit including, but not limited to, the occupancy or use of the land and the construction, maintenance, and operation of the structures, facilities, or equipment authorized by this permit. Such insurance shall also name the United States as a co-insured and provide for specific coverage of the holder's contractually assumed obligation to indemnify the United States. The holder shall send an authenticated copy of its insurance policy to the Forest Service immediately upon issuance of the policy. The policy shall also contain a specific provision or rider to the effect that the policy will not be cancelled or its provisions changed or deleted before thirty (30) days written notice to the Forest Supervisor, Valyermo Ranger District, 29835 Valyermo Rd., P.O. Box 15, Valyermo, CA 93563, by the insurance company.

4. Rider Clause (for insurance companies)

It is understood and agreed that the coverage provided under this policy will not be cancelled or its provisions changed or deleted before thirty (30) days of receipt of written notice to the Forest Supervisor, Angeles National Forest, 701 North Santa Anita Avenue, Arcadia, California 91006, from the insurance company.

5. Dam Safety

[[1]] Definitions. The following definitions apply to this clause:

Qualified Engineer. An engineer authorized to practice engineering in the field of dams in the State where the dam is located, either by professional registration as provided by State law or by reason of employment by the State or Federal Government.

Dam Failure. Catastrophic event characterized by the sudden, rapid, and uncontrolled release of impounded water. It is recognized that there are lesser degrees of failure and that any malfunction or abnormality outside the design assumptions and parameters which adversely affect a dam's primary function of impounding water may also be considered a failure.

Maintenance. Performance of work to keep structures and equipment in intended operation condition; equipment repair and minor structure repair.

Rehabilitation or Modification. Repair of major structure deterioration to restore original condition; alteration of structures to meet current design criteria, improve dam stability, enlarge reservoir capacity, or increase spillway and outlet works capacity; replacement of equipment.

Hazard Potential. The classification of a dam based on the potential for loss of life or property damage in the event of failure of the dam under clear weather breach conditions with normal base inflow and the water surface at the elevation of the uncontrolled spillway crest.

Emergency Action Plan. Formal plan of procedures to prevent or reduce loss of life and property during construction or after completion of a dam if conditions develop in which dam failure is likely. The plan does not include flood plain managment for the controlled release of floodwaters for which the project is designed.

Authorized Officer. The Forest Service official delegated authority to issue this authorization in accordance with 36 CFR 251.52. Generally, this authorization will be approved and administered by the Forest Supervisor. As used herein, the term shall include any official acting as the representative of the authorized officer or pursuant to other delegation of authority.

Holder. The individual, partnership, corporation, association, or other legal entity, which is the recipient of this authorization.

[[2]] Dam Classification

The dam constructed pursuant to this authorization shall be classified according to its height and storage capacity as well as its hazard potential as follows:

Height and Storage Capacity (A, B, C, or D): "A" @ 113' and 3500+ ac.ft.

Hazard Potential (Low, Moderate, High): HIGH.

Classification criteria are contained in FSM 7511, which the Forest Service may amend from time to time.

The provisions of paragraphs (5) and (8) apply only to dams classified as high hazard, or as otherwise may be specifically provided for in this authorization to address special or unique circumstances.

The hazard potential of the dam shall be reassessed at least every ten years by a qualified engineer retained by the holder, and this information made available to the authorized officer. The Forest Service may change the hazard potential at any time based on changed conditions or new information.

[[3]] Construction, Inspection, Certification, and Project Files.

For construction, rehabilitation or improvement, the holder shall provide for inspection by a qualified engineer to ensure adequate control of the work being performed. At a minimum, the qualified engineer shall maintain a daily inspection diary, descriptions of design changes, and records of construction material and foundation tests.

Upon completion of construction, rehabilitation, or improvement, the holder shall forward to the Forest Service a statement from the qualified engineer responsible for inspection certifying that the works were built in accordance with the approved plans and specifications, or approved revisions thereto. ~~No water shall be impounded until approval is given by the authorized officer.~~

All design notes, as-built plans, and the aforementioned diaries and records shall be maintained in a project file by the holder for the duration of this authorization, and shall be available to the Forest Service or other inspection personnel.

[[4]] Dam Operation and Maintenance Plans.

Prior to the storage of water, the holder shall have an approved plan or plans for the operation and maintenance of the dam and appurtenant structures. The plans will, at a minimum, describe operating requirements and procedures to be followed for the operation of the structure; routine or recurring maintenance required; recordkeeping to be performed for operation and maintenance; and individuals responsible for implementing the plans. The holder shall ensure the plans available to the individual responsible for plan implementation and the engineer performing any inspection, are reviewed at least at the time of the operation and maintenance inspection and are amended as conditions or requirements so warrant. No plans or amendments thereto shall be valid until approved by the authorized officer.

[[5]] Dam Emergency Action Plan.

The holder shall, prior to storage of water, prepare an emergency action plan which will include, but not be limited to:

(A) Actions to be taken upon discovery of an unsafe condition or impending failure situation to prevent or delay dam failure, and reduce damage or loss of life from subsequent failure;

(B) Procedures for notification of law enforcement, civil preparedness, and Forest Service personnel;

(C) Procedures for notifying persons in immediate danger of losing life or property;

(D) Maps delineating the area which would be inundated in the event of dam failure;

(E) The names of those individuals responsible for activating the plan and carrying out the identified actions.

In preparing the emergency action plan, the holder shall consult and cooperate with appropriate law enforcement and civil preparedness personnel, who may be responsible for implementing all or part of the plan.

[[6]] Inspection and Maintenance of Dams

The holder shall have the dam and appurtenant structures inspected by a qualified engineer or the State Division of Safety of Dams to determine the state of operation and maintenance at least every 5 years. An inspection shall also be made following earthquakes, major storms, or overflow of spillways other than the service spillway. Two copies of the inspection report shall be provided to the authorized officer within 30 days of the date of inspection.

Repairs or operational changes recommended by the inspecting engineer shall be made by the holder within a reasonable period of time following the inspection, but in no event later than one year from the inspection (unless a longer period of repairs is authorized in writing, or a shorter period is required when such repairs are deemed by the authorized officer as immediately required for reasons of public safety). Upon request by the authorized officer, the holder shall provide a plan of action outlining planned time and methods for performing said repairs or operational changes, and notify the authorized officer when actions are completed.

[[7]] <u>Forest Service Inspection of Dams</u>

The holder shall allow inspection of the dam and appurtenant structures at any time by the authorized officer. Any condition adversely affecting or which would adversely affect the operation of the facility; safety of the structure or the public, or surrounding lands and resources shall, upon written notice, be corrected or changed by the holder at the holder's expense. A copy of the Forest Service inspection report shall be provided to the holder.

An inspection performed by the Forest Service does not relieve the holder of the responsibility of ensuring that inspections are made in accordance with paragraph 6 of this clause.

[[8]] <u>Dam Safety Evaluations.</u>

Beginning in 1995 and at 5-year intervals thereafter, the holder shall have a formal dam safety evaluation performed by a qualified engineer or by the State Division of Safety of Dams to verify the safety and integrity of the dam and appurtenant structures. The evaluation will include, but is not limited to, a detailed field inspection of the dam and appurtenant structures and a review of all pertinent documents, such as investigation, design, construction, instrumentation, operation, maintenance, and inspection records. The evaluation shall be based on current accepted design criteria and practices. The holder shall provide two copies of the evaluation report to the authorized officer and Regional Engineer. Based on this report, the authorized officer may require the holder to perform additional evaluations pursuant to such standards as the officer may define and may require rehabilitation or modification of the structure within a reasonable time.

[[9]] <u>Right of Action to Abate Emergency Situations</u>

~~In situations where the authorized officer determines on the available facts that there is danger of a dam failure for any reason, such officer may exercise discretionary authority to enter upon the structure and appurtenances authorized herein and take such actions as are necessary to abate or otherwise prevent a failure. Such actions include, but are not limited to, lowering the level of the impounded waters utilizing existing structures or by artificial breach of the dam. In the event that such actions are taken, the United States shall not indemnify or otherwise be liable to the holder for losses or damages, including losses or damages to the structure or the value of impounded waters. The failure of the Forest Service to exercise any discretion under this provision shall not be a violation of any duty by the United States, and shall not relieve the holder of any and all liability for damages in the event of a dam failure.~~

[[10]] Liability

The activities authorized by this permit shall be deemed a high risk and occupancy. Sole responsibility for the safety of the dam and associated facilities and any liability resulting therefrom shall be on the holder and his successors, agents, or assigns. Pursuant to 36 CFR 251.56(d), as such regulation may be amended from time to time, the holder shall be liable for injury, loss or damage resulting from this authorization regardless of the holder's fault or negligence. Maximum strict liability shall not exceed $1,000,000.00 except as that amount may be changed in the aforementioned regulations.

In addition to all waivers and limitations on liability of the United States under this authorization, the provisions of 33 U.S.C. 702(c) shall apply to any damages from or by floods or flood waters at any place.

6. Construction Safety

The holder shall carry on all operations in a skillful manner, having due regard for the safety of employees; and shall safeguard with fences, barriers, fills, covers, or other effective devices, pits, cuts, and other excavations which otherwise would unduly imperil the life, safety, or property of other persons.

7. Explosives, Use of

1. Only electronic detonators shall be used for blasting.

2. In the use of explosives, the holder shall exercise the utmost care not to endanger life or property and shall comply with the requirements of the Forest Service. The holder shall be responsible for any and all damages resulting from the use of explosives and shall adopt precautions that will prevent damage to surrounding objects. The holder shall furnish and erect special signs to warn the public of blasting operations. Such signs shall be placed and maintained so as to be clearly evident to the public during all critical periods of the blasting operations, and shall include a warning statement to have radio transmitters turned off.

3. All storage places for explosives shall be marked "DANGEROUS-EXPLOSIVES." The method of storing and handling explosives shall conform to recommended procedures contained in the "Blasters Handbook", published by E.I. du Pont de Nemours and Company, and in all Federal, State, and local laws and regulations.

4. When using explosives, the holder shall adopt precautions which will prevent damage to landscape features and other surrounding objects. When directed by the Forest officer in charge, trees within an area designated to be cleared shall be left as a protective screen for surrounding vegetation during blasting operations. Trees so left shall be removed and disposed of after blasting has been completed. When necessary, and at any point of special danger, the holder shall use suitable mats or some other approved method to smother blasts.

8 Spark Arrester and Engine Mufflers

A muffler or spark arrester satisfactory to the authorized officer shall be maintained on the exhausts of all trucks and tractors or other internal combustion engines used in connection with this permit.

9. Water Pollution

No waste or byproduct shall be discharged into water if it contains any substance in concentrations which will result in harm to fish and wildlife, or to human water supplies.

Storage facilities for materials capable of causing water pollution, if accidentally discharged, shall be located so as to prevent any spillage into waters or channels leading into water, that would result in harm to fish and wildlife or to human water supplies.

10. Esthetics

The holder shall protect the scenic esthetic values of the area under this permit, and the adjacent land, as far as possible with the authorized use, during construction, operation, and maintenance of the improvements.

11. Refuse Disposal

The holder shall remove from National Forest Lands refuse located within the permit area resulting from the construction or operation of the Dam, including waste materials, garbage, and rubbish of all kinds.

12. Archaeological-Paleontological Discoveries

If, prior to or during excavation work, items of archaeological, paleontological, or historic value are reported or discovered, or an unknown deposit of such items is disturbed, the holder will immediately cease excavation in the area so affected. Holder will then notify the Forest Service and will not resume excavation until written approval is given by the authorized officer.

If it deems it necessary or desirable, the Forest Service may require the holder to have performed recovery, excavation, and preservation of the site and its artifacts at the holder's expense. At the option of the Forest Service, this authorization may be terminated at no liability by the United States when such termination is deemed necessary or desirable to preserve or protect archaeological, paleontological, or historic sites and artifacts.

13. Surveys, Land Corners

The holder shall protect, in place, all public land survey monuments, private property corners, and Forest boundary markers within the permit area. In the event that any such land markers or monuments are destroyed by the holder or others authorized by the holder, in the exercise of the privileges authorized by this permit, depending on the type of monument destroyed, the holder shall see that they are reestablished or referenced in accordance with (1) the procedures outlined in the "manual of Instructions for the Survey of the Public Land of the United States," (2) the specifications of the county surveyor, or (3) the specifications of the Forest Service.

Futher, the holder shall cause such official survey records as are affected to be amended as provided by law. Nothing in this clause shall relieve the holder's liability for the willful destruction or modification of any Government survey marker as provided at 18 U.S.C. 1858.

16. Environmental Standards

Holder shall conduct all activities associated with the **Littlerock Dam and Reservoir** in a manner that will avoid or minimize degradation of air, land, and water quality. In the construction, operation, maintenance, and termination of the **Littlerock Dam and Reservoir**, holder shall perform its activities in accordance with applicable air and water quality standards, related facility siting standards, and related plans of implementation, including but not limited to standards adopted pursuant to the Clean Air Act, as amended (42 USC 1857) and the Federal Water Pollution Control Act, as amended (33 USC 1321).

17. Water Rights

This permit confers no right to the use of water by the holder, nor does this permit affect any rights the holder may have to store or distribute water pursuant to any license from the California Water Resources Control Board.

18. Reservoir Storage Increase

~~The Forest Service reserves the right to issue additional permits to other applicants to increase the storage capacity of this site if such action proves feasible. No permit will be granted for additional facilities that will jeopardize the privileges granted by this permit. Any additional permits authorizing larger facilities will provide for payment of costs, including the cost of construction of the original project works, on a cost-benefit ratio mutually agreeable to the holder and the new applicant. If the holder and applicant cannot agree on division of costs, the Forest Service shall decide on an equitable division between the old and new works.~~

19. **Reservoir Drainage**

Upon revocation of this permit for noncompliance with conditions of this permit, or for other cause, the Forest Service will have the right to require holder to drain the water from the reservoir by means of the structural control provided or by other methods in a timely manner, in accordance with holder's operational needs.

20. **Forest Service Representative**.

The Forest Service representative for this Special-Use permit is:

District Ranger
Valyermo Ranger District
29835 Valyermo Road, P.O. Box 15
Valyermo, CA 93563
(805) 944-2187

21. **Superseded Permit**

This permit supersedes a special use permit designated: Uses-Angeles, Palmdale Irrigation District, et al, Reservoir, 11/27/24 (Los Angeles 037681).

THIS PERMIT IS ACCEPTED SUBJECT TO THE CONDITIONS SET OUT ABOVE.

HOLDER NAME: Palmdale Water District/
Littlerock Creek Irrigation District

By: Leslie D. Carter
(Holder Signature)

President, Board of Directors
Palmdale Water District
(Title)

Date: November 5, 1997

U. S. DEPARTMENT OF AGRICULTURE
Forest Service

By: MICHAEL J. ROGERS

Angeles Forest Supervisor
(Title)

Date: 12/5/, 1997

According to the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number. The valid OMB control number for this information collection is 0596-0082.

This information is needed by the Forest Service to evaluate requests to use National Forest System lands and manage those lands to protect natural resources, administer the use, and ensure public health and safety. This information is required to obtain or retain a benefit. The authority for that requirement is provided by the Organic Act of 1897 and the Federal Land Policy and Management Act of 1976, which authorize the Secretary of Agriculture to promulgate rules and regulations for authorizing and managing National Forest System lands. These statutes, along with the Term Permit Act, National Forest Ski Area Permit Act, Granger-Thye Act, Mineral Leasing Act, Alaska Term Permit Act, Act of September 3, 1954, Wilderness Act, National Forest Roads and Trails Act, Act of November 16, 1973, Archeological Resources Protection Act, and Alaska National Interest Lands Conservation Act, authorize the Secretary of Agriculture to issue authorizations for the use and occupancy of National Forest System lands. The Secretary of Agriculture's regulations at 36 CFR Part 251, Subpart B, establish procedures for issuing those authorizations.

The Privacy Act of 1974 (5 U.S.C. 552a) and the Freedom of Information Act (5 U.S.C. 552) govern the confidentiality to be provided for information received by the Forest Service.

Public reporting burden for this collection of information, if requested, is estimated to average 1 hour per response for annual financial information; average 1 hour per response to prepare or update operation and/or maintenance plan; average 1 hour per response for inspection reports; and an average of 1 hour for each request that may include such things as reports, logs, facility and user information, sublease information, and other similar miscellaneous information requests. This includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Department of Agriculture, Clearance Officer, OIRM, Room 404-W, Washington D.C. 20250; and to the Office of Management and Budget, Paperwork Reduction Project (OMB #0596-0082), Washington, D.C. 20503.

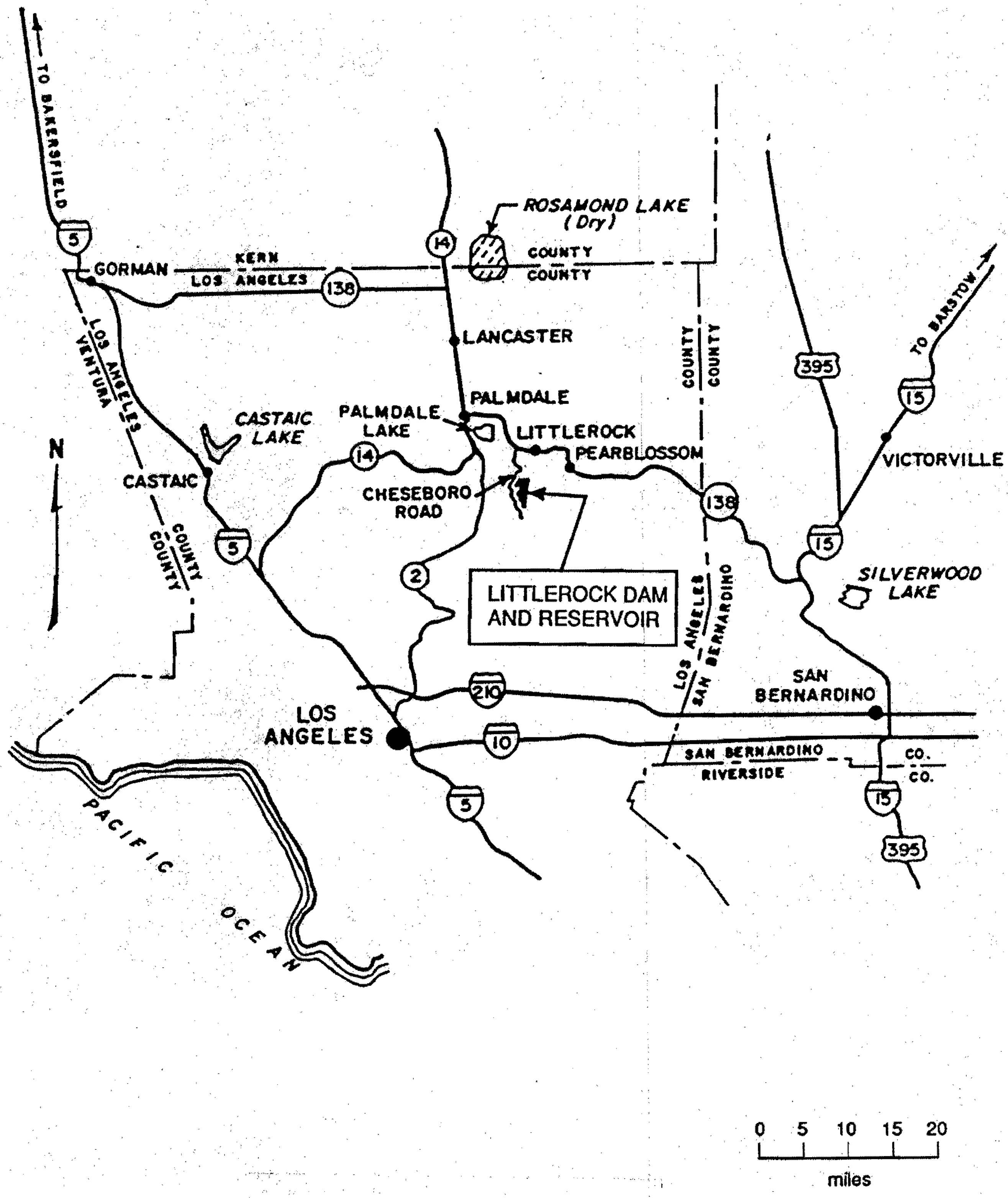

EXHIBIT A

Source: DWR 1988

Project No. 8910104B	Littlerock Dam	Site Location Map	Figure 1
Woodward-Clyde Consultants			

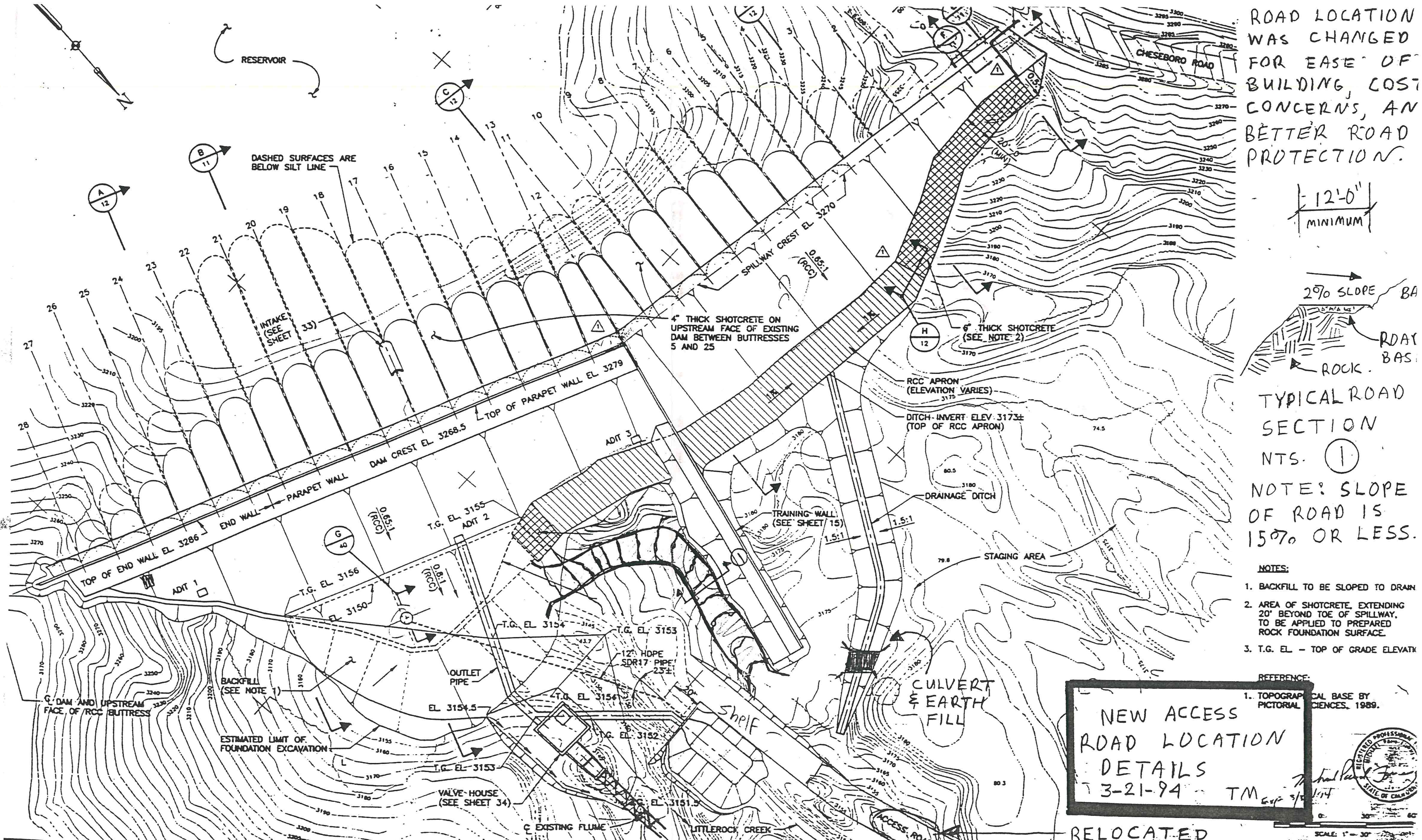

EXHIBIT "B"

DATE	BY	APPR.	REVISION DESCRIPTION
2/19/93	MPF	NCW	ADDENDUM 2

SUBMITTED: MPF 1/30/94
APPROVED: NCW 1/30/94
APPROVED:

LITTLEROCK CREEK IRRIGATION DISTRICT
AND
PALMDALE WATER DISTRICT

PLAN OF DAM

SCALE: AS NOTED

DAM No 57

FILE COPY

FROM
STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
P.O. BOX 942836
SACRAMENTO, CA 94236-0001

TO: MR DENNIS LAMOREAUX GENERAL MANAGER
PALMDALE WATER DISTRICT
2029 EAST AVENUE Q
PALMDALE CA 93550

JUN 1995
RECEIVED

DWR 1235 (REV. 5/87)

...NTRACT DRAWINGS FOR ...CK DAM AND RESERVOIR ...ESTORATION PROJECT

RECEIVED
JUNE 15, 1995

Prepared for

PALMDALE WATER DISTRICT AND ...EROCK CREEK IRRIGATION DISTRICT

As Constructed
June 5, 1995
Division of Safety of Dam

PALMDALE WATER DISTRICT BOARD OF DIRECTORS	LITTLEROCK CREEK IRR. DIST. BOARD OF DIRECTORS
Leslie O. Carter, President	Jerry Gilin, President
John M. Sidwell, Vice President	Arthur Stout, Vice President
Nolan Neggard, Secretary	Jess Brown, Secretary
J. B. Freeman, Asst. Secretary	Charles Yingst, Treasurer
Walter M. Dahlitz, Director	Brian Okerlund, Director

EXHIBIT "C"

JANUARY 1993

REGISTERED PROFESSIONAL ENGINEER
MICHAEL PAUL FORREST
No. C 027855
CIVIL
STATE OF CALIFORNIA
Exp. 3/31/98

Prepared By

Woodward-Clyde Consultants

AS-CONSTRUCTED - SHOTCRETE ONLY ⚠

December 6, 1994

MICHAEL P. FORREST

NOEL C. WONG

AS BUILT

SHEET NO
1

12-28-98

UNITED STATES FOREST SERVICE

PACIFIC SOUTHWEST REGION

VALYERMO RANGER DISTRICT

ANGELES NATIONAL FOREST

FIRE PREVENTION AND CONTROL PLAN

Palmdale Water District
LITTLEROCK DAM AND RESERVOIR AREA

EXHIBIT "D"

DEFINITIONS

Contractor- Holder of a Special Use Permit, Rights-of-Way Permit, Easement, Federal License, or Memorandom of Understanding, entitling the holder to occupancy of National Forest lands.

District Ranger's Representative (DRR)

Person designated in writing to represent the Forest Service related to specific matters pertaining to the work to be completed within the scope of the contract. Delegations of authority are specific.

Contractor's Representative

Person designated in writing to represent the contractor related to specific matters pertaining to the work to be completed within the scope of the contract. Delegations of authority are specific.

Project Fire Guard

The person employed by the contractor soley for fire prevention and suppression purposes.

I. SCOPE

The provisions set forth below outline the channels of responsibility for fire prevention and suppression activities and establish procedure for suppression of fires within the Contract Area.The Contract Area is delineated by map in the Contract.The provisions set forth below also specify conditions under which contract activities will be curtailed or shut down.

II. RESPONSIBILITIES

A. CONTRACTOR

(1) Shall abide by the requirements of this fire plan.

(2) Shall take all steps necessary to prevent their employees,subcontractors their employees,or other persons associated with the contract from setting fires not required in completion of the contract,shall be responsible for preventing the escape of fires set directly or indirectly as a result of contract operations,shall assist in extinguishing all such fires which may escape and shall be responsible for suppression costs incurred by all agencies used in controlling such fires.When a project fire guard is not required ,the duties of the project fire guard must be assumed by the contractor or a designated representative on the project.

(3) Shall furnish to the DRR a list showing key contractor personnel,their specific responsibilities and authority,and their office and home phone numbers.Shall advise the DRR of any changes in personnel and organization as they occur.

B. Forest Service

(1) Will inspect the Project Area to assure compliance with the requirements of the fire plan.

(2) Will take immediate action to curtail hazardous fire and safety activity.

(3) Will notify the contractor to correct any discrepancies with regard to the requirements of this fire plan.

(4) Will suspend the entire operation until full compliance with the fire plan is restored.

(5) Will furnish the contractor with list of key personnel their phone numbers,and emergency phone numbers.

III. TOOLS ,EQUIPMENT,and PERSONNEL

A. Contractor

(1) Shall equip all diesel and or gasoline powered engines,both stationary and mobile,and all flues used in any contract or camp operations with spark arresters that meet Forest Service standards set forth in the Forest Service Spark Arrester guide. Spark arresters are not required on equipment powered by turbo charged engines,these are engines which all exhaust passes thru the turbo-charging unit.

(2) Shall furnish and have available for emergency use on each piece of equipment used in conjuction with performance of the contract the hand tools and or equipment listed below:

(a) One shovel,and a fully charged fire extinguisher U.L.rated at 1A,10B,C or more on each truck,personnel vehicle,grader or other heavy equipment.

(b) One shovel,one U.L.rated 1A,10B,C fire extinguisher and one back pack 5 gallon water filled tank with pump with each welder.

(c) One chemical pressurized fire extinguisher (fully charged)

for each gasoline powered tool,including, but not limited to, chain saws, soil augers, rock drills, generators, portable compactors, compressors and the like.

(3) All tools and equipment required in (1) and (2) above shall be in good working condition and shall meet the following principle Forest Service specifications for fire tools:

(a) Shovels shall meet F.S Spec.5100-000326.

(b) Fire extinguishers shall be of the type and size specified in the California Public Resources Code Section 4431 and the California Administrative Code Title 14 Section 1234.

(4) The contractor will ( ) will not (XX) be required to furnish a fire patrol truck on the contract area in good working order and meet the following specifications:

(a) The fire patrol truck may not be used for any other work on the contract.

(b) Sufficient power and traction,when equiped,to reach all portions of the Contract Area where work is being done.

(c) A tank capable of containing not less than 100 gallons of water or approved fire retardant.

(d) A pump capable of delivering 23 gallons per minute at 175 psi at sea level.

(e) 300 ft. of fire hose F.S.spec.5100-185,3/4"250#w.p.or F.S. spec.5100-186,1"400#w.p.

(f) 1 each combination fog-straight stream nozzle capable of 6 to 23 gpm delivery rates.

(g) 2 each 5 gallon back pumps filled with water or other suitable fire retardant.

(h) 3 each shovel,fire fighters F.S. spec.5100-00326.

(i) 2 each pulaski tool,F.S spec.5100-3556.

(j) 2 each mcleod tool,F.s spec.5100-353 b.

(k) 2-way radio communications from the project area,on the contractor's frequency,capable of contacting a base station where telephone communications are available.

(5) The contractor will ( ) will not (XX) be required to employ a Project Fire Guard to prevent,detect,and suppress any fires in the contract area,and who,prior to acceptance by the DR, shall be able to demonstrate the following;

(a) Knowledge of County,State,and Federal fire laws governing activities in hazardous fire areas.

(b) Skill in the operation and maintenance of fire apparatus, appliances and hand tools.

(c) Knowledge of safe wildland fire prevention and suppression practices.

The Forest Service shall make the final determination as to whether or not an individual meets the above criteria.

B. The Project Fire Guard shall perform the following duties;

(a) Will be on duty on the Contract Area whenever any activity is in progress,and shall remain on duty at least one hour after any welding,cutting,or burning operations have been terminated.

(b) Make regular inspections of all fire tools,equipment and extinguishers to assure that they are operable and meet specifications.

(c) Inspect all project equipment and vehicles to assure compliance with spark arrester and fire equipment requirements.

(d) Enforce all County,State,and Federal fire laws as they apply to the project.

(e) Maintain a daily log showing times and dates of;

1. Time on duty.
2. Inspections of equipment.
3. Violations found,to whom reported,and corrective action.
4. Predicted activity levels.

(f) Advise the Project Engineer or Superintendant of the predicted activity levels for the following day.

(g) Will make initial attack on all fires within the project area,and direct the Contractor's manpower in suppression efforts until relieved by qualified Forest Officer. all project personnel,sub-contractors,and visitors are aware of and comply with same.

(i) Accompany the DR,DRR,contractor or his representative on fire inspections of project site.

(j) Will shut down any operation not in compliance with any County,State,Federal law or regulation,or any other provisions of this fire plan.

(k) Continually monitor contractor's radio frequency.

(l) When a weather station is provided by the contractor,the fire guard shall measure and record the daily weather observations.

(m) The Fire Guard will not have any duties other than those directly related to fire prevention,detection,and suppression.

IV. GENERAL

A. State Law

The contractor must comply with all aplicable laws.These include, but are not limited to,the State Public Resource Code and the Los Angeles County Fire Code.

B. Permits Required

The contractor must secure a special written permit from the DR or designated representative before engaging in any of the activities listed below;

(1) Blasting and/or the storage of explosives or detonators.

(2) Burning

(3) Air Polution

(4) Camp,Lunch,and Warming Fires

(5) Welding or Cutting

C. Regulations for Burning

Before building or kindling any fires whatsoever,the contractor shall notify the DRR of the scope of the project.Special care shall be taken to prevent scorching or causing damage to adjacent structures,trees and shrubbery.

D. Smoking and Fire Rules

Smoking shall not be permited during the fire season,except,in a barren area or in an area cleared to mineral soil at least 10 ft. in diameter.In areas closed to smoking,special areas may be approved for smoking by the DRR.These areas shall be signed by the contractor.Under no circumstances shall smoking be permited during the fire season while personnel,sub-contractors,or visitors are operating equipment,walking or working in grass or brush covered areas.

Contractor shall post signs regarding smoking and fire rules in conspicous places for all personnel and visitors to see.Contractor and contractors representative and/or supervisory personnel are responsible for compliance with these regulations.

E. Storage and Parking Areas

All such areas must be approved in advance and in writing by the DR or the DRR.Equipment service areas,parking areas and gas/oil/diesel storage areas shall be cleared of all grass,brush or other combustible material for a radious of at least 50 ft.,and conform to local County,State or Federal Codes.Small mobile or stationary engine sites shall be cleared of combustible material for at least 15 ft. from engine.Parking and storage areas shall be maintained in a neat and orderly manner at all times.

V. Emergency Measures

An activity level is a measure of fire danger based on fuel and weather conditions in the contract area or a comparable rating area.This project shall be governed by weather data obtained at the VINCENT station or alternate VALYERMO unless the contractor exercises the option to install an approved station on site.
In the event that no weather data is available from the Forest Service weather station that governs the project site,the following pre-set Activity Levels will apply,unless otherwise notified by the DRR;

(1) End of Declared Fire Season to April 30	Level 1
(2) May 1 to July 31	Level 2
(3) August 1 to end of declared Fire Season	Level 3

A. The contractor shall curtail operations for the following day to the extent shown below based on the predicted Activity Level for that area,or when notified by a Forest Officer that his activity constitutes a hazard;

Activity Levels	Limitations or Requirements for Next Day Based on Predicted Activity Level
1	(a) Minimum required by State Law (b) Furnish fire guard (if required) (c) Furnish fire patrol truck (if required)
2	(a) No burning,blasting,welding,cutting,or grinding,within 50 ft.of combustible material
3	(a) No burning,blasting,welding,cutting,or grinding within 15 ft.of cumbustible material. (b) Stop all pioneering or any other mechanical activity within 15 ft.of cumbustible vegetation at 1:00 P.M.
4	(a) Stop all burning,blasting,welding,cutting or grinding. (b) Stop all clearing,grubbing,and pioneering (c) Stop all other mechanical activity within 30 ft of combustible vegetation.

(a) Stop all project activities except those specifically authorized in writing by the DR or designated representative.
(b) The project fire guard shall patrol the project area during the normal work hours of the project.

The above requirements are cumulative and are tied directly to the activity level as it is predicted for each day.

B. The contractor may install a fire weather station on the contract area for obtaining activity level records in lieu of those provided by the Forest Service. The Forest Service will designate the actual fire weather station location. Instruments needed to obtain activity level shall meet specifications and standards in "Fire Weather Observers Handbook", which is available for inspection at the District Rangers Office.

Observations shall be taken at 10:00 am, and 1:00 pm daily as a minimum. When activity level 3 or above is reached, additional observations shall be made at 2 hour intervals. Emergency precautions for the measured activity level shall be implimented. Records of weather measurements shall be maintained and shall be available to the Forest Service on request. If the contractor exercises this option the actual activity levels from this weather station shall be used regardless of the predicted activity levels.

VI. Reporting all Wildfires

Contractor, contractor representatives, sub-contractors and visitors shall report all fires to the Forest Service Fire Dispatch Office at (818)-447-8991, or to the County Fire Department via the 911 emergency telephone system. These numbers are for fire reports and other life threatening emergencies only. All other business and/or information calls shall be directed to the DRR

PROJECT FIRE PLAN INFORMATION AND NOTIFICATION PAGE

Address all correspondence to:

Valyermo Ranger District
P.O.Box 15
Valyermo, California 93563

KEY PERSONNEL

Angeles National Forest Fire Dispatcher (818)-447-8991
Angeles National Forest Activity Level Hotline (818)446-2501
(24 hour recording)

	Name	Bus.Phone	Home Phone
Valyermo District Ranger	WILLIAM H. HELIN	805-944-2187	------
District Ranger's Rep.	STEVE CARBAUGH	805-944-2187	------
Field Fire Prev.Spec.	JEFF BRADFORD	805-944-2187	------

Others:

The 24-hour Angeles Forest Dispatch is linked to the "911" Emergency Telephone System.

The phone numbers above are for official use,to be used only in the administration of this project.

LITTLEROCK DAM

JOINT POWERS/LEAD AGENCY

AGREEMENT

BETWEEN

LITTLEROCK CREEK IRRIGATION DISTRICT

AND

PALMDALE WATER AGENCY

EXHIBIT "E"

AGREEMENT

1. **IDENTIFICATION.**

This Agreement is made, entered into and effective this 28th day of December , 1989 between Littlerock Creek Irrigation District ("Littlerock") and Palmdale Water District ("Palmdale"), each a public entity duly organized and existing under and pursuant to the Irrigation District Law of the State of California (Water Code Section 20500, **et seq.**).

2. **RECITALS.**

2.1 Littlerock and Palmdale Irrigation District, the prior name of Palmdale, entered into an agreement on or about May 2, 1922 ("1922 Agreement") pertaining to, among other things, the construction and future operation of a dam to be located in an area then known as Littlerock Rock Canyon.

2.2 Pursuant to the terms and provisions of the 1922 Agreement, the parties jointly constructed said dam which is now known as Littlerock Dam and Reservoir. Said construction was completed in about May 1924.

2.3 On or about April 30, 1925, and in furtherance of the terms, provisions, duties and obligations of the parties under the 1922 Agreement, Palmdale and Littlerock applied for and obtained issuance of a Special Use Permit relating to Littlerock Dam and Reservoir from the United States Department of Agriculture Forest Service designated as follows:

SPECIAL USE PERMIT
USES-ANGELES
PALMDALE IRRIGATION DISTRICT, ET AL
RESERVOIR, 11-27-24
(LOS ANGELES 037681)

2.4 In recent years, studies and investigations have shown that Littlerock Dam and Reservoir is now in need of renovation, strengthening and raising so as to enhance its safety and to increase its storage capactiy for the benefit of Palmdale and Littlerock.

2.5 On or about August 1, 1989, Palmdale and Littlerock jointly authorized Woodward-Clyde Consultants to prepare a feasibility engineering study for the proposed strengthening and raising of Littlerock Dam and Reservoir by use of roller compacted concrete ("Littlerock Project").

2.6 Littlerock and Palmdale have been advised by the United States Forest Service that, under existing policy,, LIttlerock and Palmdale are required to name a "lead agency" for purposes of dealing with the Forest Service in connection with the filing of required special use permit applications, agreements, environmental documents, and other matters relating to the Littlerock project.

3. AGREEMENTS

Palmdale and Littlerock agree as follows:

3.1 **Purpose:** The purpose of this agreement is to designate a lead agency to deal with the United States Department of Agriculture Forest Service and obtain required special use permit applications, agreements, environmental documents, and other matters relating to the proposed strengthening and raising of Littlerock Dam and Reservoir.

3.2 **Method by which purposes shall be accomplished**

A. Littlerock shall be designated lead agency for dealing with the Forest Service, however, any obligations, agreements, or other documents must be approved and ratified by both boards in order for said obligations and agreements to be binding.

B. The parties (Palmdale and Littlerock) shall participate equally in contributing funds to accomplish the purposes set forth in paragraph 3.1 and each board shall approve expenditures from their respective treasuries to provide the funds.

C. The lead agency shall strictly account for all funds and provide reports of all receipts and disbursements.

D. Personnel of either party may be used as necessary to accomplish the purposes of this agreement.

E. In performing the services required and in transacting such business as may be reasonably necessary in relation to the Littlerock project with the Forest Service, Littlerock shall proceed with the expressed understanding that it will adhere to the following procedure in communicating actions and proposed actions to Palmdale and to the Boards of Directors of both Littlerock and Palmdale:

(i) Littlerock's Littlerock project representative shall deliver to each member of the Board of Directors of both Palmdale and Littlerock copies of all written materials and other documents which are transmitted to or delivered by the Forest Service regarding the Littlerock project;

(ii) Littlerock's Littlerock project representatives shall meet with the Project Committees of both Littlerock and Palmdale on a regular basis as requested and directed by said Committees, in order to advise the committees and board members on all matters and developments and to receive instructions and counsel from board members and committee members affecting the project;

(iii) Littlerock's Littlerock project representatives shall obtain the prior approval of the Board of Directors of both Palmdale and Littlerock on all matters requiring formal action pursuant to public notice relating to the Littlerock project before such action is formally taken and notice is reported to the United States Department of Agriculture Forest Service.

3.3 **Effective date:** The effective date of this agreement shall be 28th day of December, **1989.**

3.4 **Duration:** This agreement shall be binding for the period of years or whenever the necessary applications etc. have been obtained.

3.5 **Excess property:** Any property that may be acquired as the result of this joint exercise shall inure to the benefit of both parties on an equal basis.

3.6 **Surplus money:** Upon completion of the agreement purpose, any surplus money on hand shall be returned in proportion to the contributions made.

3.7 **Application for privileges etc. to extraterritorial duties:** All of the privileges and immunities from liability, exemptions from laws, ordinances and rules, all pension relief, disability, workmen's compensation, and other benefits which apply to the activity of officers, agents or employees of the parties when performing their respective functions within the territorial limits of their districts, shall apply to them to the same degree and extent while engaged in the performance of any of their functions and duties extraterritorially under the provisions of this agreement.

4. MISCELLANEOUS

4.1 Any and all notices, demands or payments by or from Palmdale to Littlerock, or Littlerock to Palmdale, shall be in writing and shall be served either personally or by registered or certified mail. If personally served, service shall be conclusively deemed made at the time of service. If served by registered or certified mail, service shall be conclusively deemed made 48 hours after deposit thereof in the United States mail, postage prepaid and addressed to the party to whom such notice or demand is to be given as herinafter provided. Any notice or demand to Palmdale may be given to it at:

2005 E. Avenue Q
Palmdale, California 93550

Any notice or demand to Littlerock may be given to it at:

35141 N. 87th St. East
Littlerock, California 93543

4.2 This Agreement sets forth all of the agreements and understandings between Palmdale and Littlerock relating to the designation of Littlerock as the "lead agency" for purposes of dealing with the United States Department of Agriculture Forest Service in connection with the Littlerock Project. Any change or modification must be in writing and signed by both parties.

4.3 This Agreement shall be governed by and construed in accordance with the laws of the State of California.

4.4 If any provision or provisions of this Agreement is or hereinafter adjudged to be for any reason invalid or unenforceable, the remaining provisions of this Agreement shall nevertheless continue to remain in full force and effect.

Littlerock Creek Irrigation District

By: Carl C. Oehler
President, Board of Directors

Its: John R. Enlow
Secretary, Board of Directors

Palmdale Water District

By: John W. Sidwell

Its: SECRETARY, Board of Directors

DRAFT

Provided by:
Palmdale Water District
2029 East Ave. Q
Palmdale, Ca. 93550

Bat Monitoring

Angeles National Forest Littlerock Creek

In August of 1994 the Palmdale water District completed a bat survey in response to proposed improvements to the Palmdale Ditch. The bats are utilizing approximately a 60 ft. section of concrete flume that is covered by railroad ties. The roost was identified as post-lactating Yuma myotis (Myotis yumanensis), a maternity roost. The approximate roost size is 1800 bats. The maternity season generally begins when the pregnant females converge on the roost in spring and ends when the colonies disperses in the late summer.

Although the Yuma is not listed as threatened or endangered under state or federal Endangered Species Act, large colonies of bats play a critical role in the ecosystem since they are the major controlling agent for night-flying insects, many of which are considered by man to be agricultural and health pests.

Therefore prior to and during the construction of the improvements to the Palmdale Ditch between Littlerock Creek and Littlerock Dam the Palmdale Water District proposes to protect the bat habitat that exists in the Palmdale Water District flume by constructing the new flume around the habitat area and leaving it completing undisturbed.

Stage One ,Prior to construction:

Prior to construction on the canal, the exiting bat location will be monitored for the presence of any bats. Photographs will be taken of the surrounding areas and the protected area will be zoned off limits. Approximately 480 ft. from the existing pump house is the beginning of the fenced in area following the existing concrete canal which will be by-passed when new construction starts. The fenced in area will start at the existing rock headwall, encompass the habitat and end at the southern end of the exiting fence surrounding the covered flume. See Exhitit # I .

Stage two, During Construction:

Construction is scheduled to begin near the end of September The Migrating season for bats in this area is late summer or early fall therefore no presence of bats would not be unusual. During construction the bat habitat area will be fenced off and zoned of limits.

EXHIBIT "G"

DRAFT

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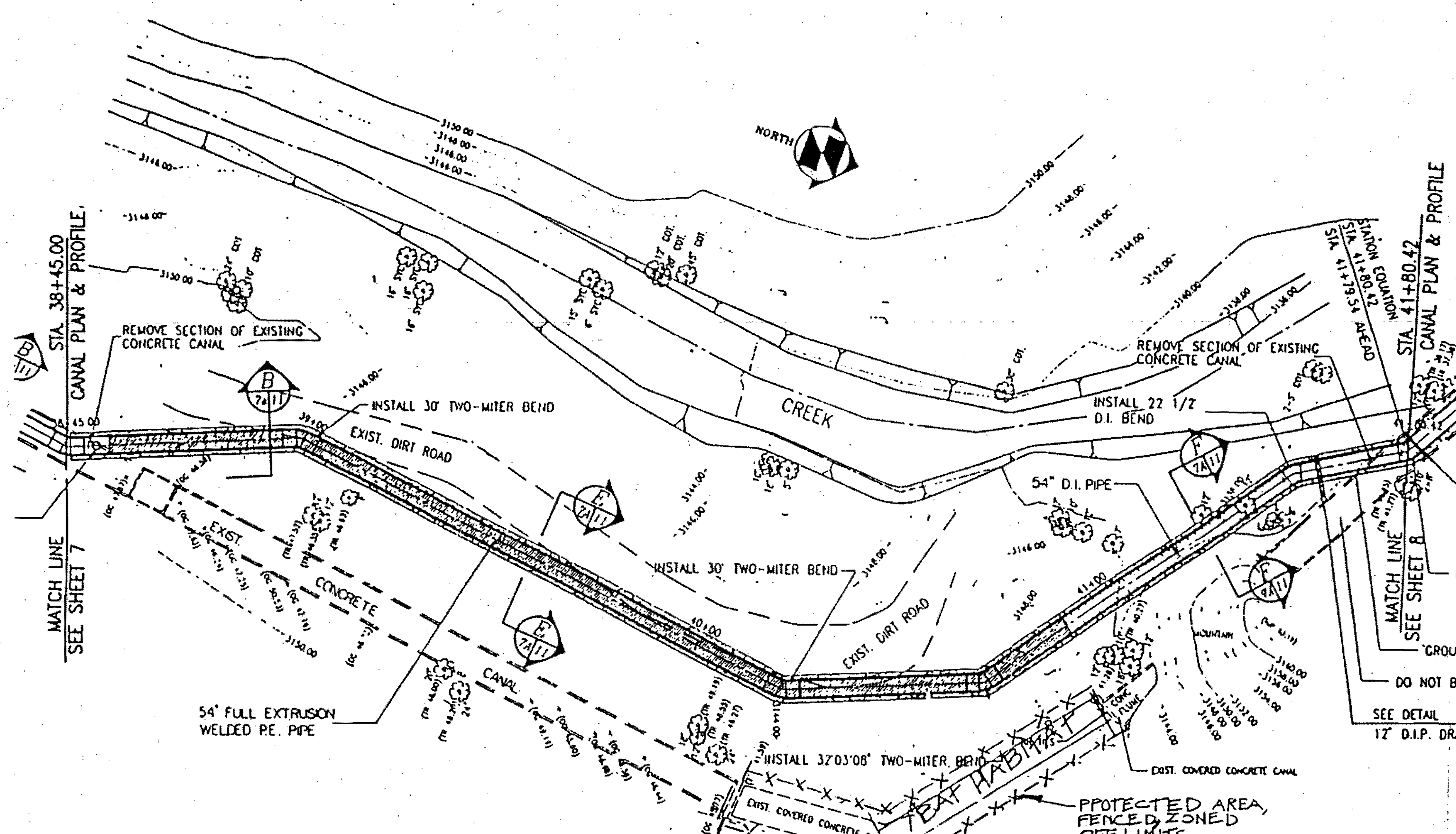
Stage three: After Construction:

Although the flume will be diverted around the bat habitat the viability of the riparian corridor will be maintained. Existing moisture conditions of the habitat will be duplicated by releasing water into it when moving water through Palmdale Ditch.

After Construction the bat habitat will be checked for any damage and Photographs will be taken to document the habitat's condition. A written report will be drawn up and submitted to the U. S. Forest Service.

Bat: Any of various nocturnal flying mammals of the order Chiroptera, with membranous wings extending from the forelimbs to the hind limbs or tail.

DRAFT



BAT HABITAT = 60 FT.
FENCED AREA = 2/0 LIN. FT.
APPROX. 480' FROM
EXISTING PUMP HOUSE
TO FENCED AREA

BY PASS SECTION

EXHIBIT I

MITIGATION AND MONITORING PLAN

FOR

IMPACTS TO RIPARIAN VEGETATION RESULTING FROM THE LITTLEROCK CREEK CANAL IMPROVEMENT PROJECT

FEBRUARY 1995

Prepared for:

Palmdale Water District
Palmdale, California

U.S. Department of Agriculture
Forest Service
Angeles National forest
Arcadia, California

QUAD Consultants
5500 Ming Avenue, Suite #410
Bakersfield, California 93309

EXHIBIT "H"

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1.0 INTRODUCTION

The purpose of this document is to assess the existing riparian and associated vegetation in areas potentially subject to impacts during construction of the Littlerock Creek Canal Improvement Project and to present measures to minimize and mitigate for potential impacts to waters, wetlands, and riparian vegetation resources. The following sections describe the proposed project, affected environment, potential impacts, measures to minimize impacts, and a mitigation and monitoring program for affected riparian tree species. The Palmdale Water District (PWD) is responsible for the mitigation plan, its implementation, monitoring and maintenance. The project and mitigation activities will occur on United States Forest Service (USFS) land within the Angeles National Forest.

This mitigation plan is intended to meet the regulatory requirements of the Army Corps of Engineers (ACOE), USFS, and California Department of Fish and Game (CDFG).

2.0 PROJECT DESCRIPTION

The Littlerock Creek canal improvement project will replace a deteriorating above-ground concrete canal and elevated flume structure with a debris basin, a 54 inch diameter pipe and a siphon under Littlerock Creek. A map of the project site is shown on Sheet 1 of 4. Potential impacts to riparian vegetation will occur at three different structure replacement sites. One area is shown on Sheet 2 of 4. In this area, pipe will be buried to circumvent an existing cave area. Sheet 3 of 4 details an area where the existing concrete canal has been undercut. Supported welded steel pipe (WSP) will be placed in the canal in this area to bridge over the washout areas. Sheet 4 of 4 shows the third area of potential impact to riparian vegetation. In this area, the existing elevated flume structure will be replaced with a siphon under Littlerock Creek. The three potential impact areas are approximately 300 feet, 100 feet, and 400 feet in length respectively over a total distance of approximately 0.5 miles. The project is located downstream from the Littlerock Dam. The removal of existing structures and construction of new water conveyance structures will require the expansion of existing access roads and removal of some associated riparian vegetation.

3.0 EXISTING RIPARIAN VEGETATION

Riparian vegetation downstream of Littlerock Dam is dominated by willows, cottonwoods and sycamores, and alders. Smaller areas of cattails are present along portions of the creek channel. As is typical of desert riparian vegetation, the composition of this vegetation can change dramatically from year to year. Flooding may remove substantial amounts of existing vegetation in wet years and may also alter the creek channel location.

The existing riparian vegetation was mapped during a survey on December 19, 1994. For the purpose of this survey, all trees over four (4) inches diameter at breast height (dbh) were specifically mapped and identified within determined impact areas. Tree species identified and mapped during this survey include white alder (*Alnus rhombifolia*), Fremont cottonwood (*Populus fremontii* ssp. *fremontii*), western sycamore (*Platanus racemosa*), and Goodding's black willow (*Salix gooddingii*). Additionally, general riparian vegetation was mapped including mulefat (*Baccharis salicifolia*), arroyo willow (*Salix lasiolepis*), narrow-leaved willow (*Salix exigua*), and cattails (*Typha* sp.).

4.0 IMPACTS TO RIPARIAN VEGETATION

Removal of existing water conveyance facilities and new construction below Littlerock Dam will result in impacts to existing riparian vegetation along Littlerock Creek. These impacts may be caused directly or indirectly. Direct impacts to waters, wetlands, and riparian vegetation may occur during modification of existing access roads, removal of existing structures, construction of new facilities or during vehicle and personnel movement near construction areas. Direct impacts may include removal of existing trees, shrubs and/or herbaceous vegetation, and damage to existing vegetation.

Indirect impacts may occur during any stages of removal, construction, or activity preparation in the Littlerock Creek drainage. Indirect impacts may be caused by alteration of water flow including channel disruption and water volume increase or decrease. Indirect impacts to riparian vegetation may occur by a change in water quality or alteration of soil condition which may affect existing growth patterns or may affect establishment of new vegetation.

5.0 MEASURES TO MINIMIZE POTENTIAL IMPACTS

A variety of measures will be implemented to minimize potential impacts to waters, wetlands, and riparian vegetation. These measures include the identification of staging and access areas to be utilized during construction activities. These areas are indicated on Sheet 1 of 4 located in Appendix A. Staging areas will utilize two existing staging areas that are level and devoid of vegetation. Two additional staging areas will be utilized next to existing access roads. These staging areas are located outside of the existing creek channel in areas that are primarily rocky and gravelly with little vegetation. It is anticipated that no riparian vegetation removal will occur in the identified staging areas. Access areas will utilize existing access roads. Minor modification to the existing roads including grading and expansion may be needed for equipment access. Information provided on the tree and vegetation survey maps (See Sheets 2, 3, and 4 of 4 in Appendix A) will be utilized to maximize avoidance of riparian vegetation and minimize impacts. When possible, trees will be cut-back instead of removed entirely to preserve the presence of individuals. Access areas into riparian vegetation will, to the maximum extent practicable, avoid impacts through the implementation of the following measures: 1) access routes will be designed to avoid riparian vegetation, 2) access routes will be designed to avoid trees over four inches dbh, 3) access routes will be designed to avoid marshy areas and areas with cattails or standing water, and 4) access routes crossing the creek channel will incorporate culverts and gravel to maintain water flow.

Access routes will be flagged prior to construction activities to minimize impacts to riparian vegetation. Marshy areas and areas with cattails or standing water will be flagged to avoid encroachment into these areas. The types of vegetation impacted, the acreage of impact disturbance and the numbers and species of trees over four inches dbh removed during construction activities will be presented in a brief post-construction environmental compliance report to be submitted to ACOE, CDFG, and USFS within fifteen (15) days following the completion of construction activities.

6.0 MITIGATION PLAN

This mitigation plan was developed through communication with the Palmdale Water District and coordination with the CDFG and ACOE. This discussion applies to mitigation for the Section 404 permit, the Streambed Alteration Agreement and requirements of the USFS.

6.1 Goals of Mitigation

The project will disturb some existing riparian vegetation. The goals of the mitigation are to minimize the removal of existing riparian vegetation and to offset the loss of riparian vegetation and associated quality of habitat. The proposed mitigation plan provides for replacement of trees greater than four (4) inches dbh removed during project activities.

The mitigation plan focuses on mitigation for the loss of riparian trees greater than four (4) inches dbh. Replacement of trees in appropriate ratios should fulfill the permitting requirements of the ACOE, CDFG, and USFS and meet the mitigation goals.

6.2 Determination of Replacement Plantings

The specific determination of the species and number of individuals to be planted as mitigation for impacts to riparian vegetation will occur following the completion of construction activities. Tree and vegetation survey maps produced for this document will be utilized and a post-construction survey will be conducted by a qualified botanist to assess the species and number of individuals removed. A brief report will be produced that will document the species and number of individual trees over four inches dbh lost in each of the three construction impact areas. The report will also include the replacement plantings to occur following the guidelines presented below. The report will be presented to Palmdale Water District (PWD), CDFG, and ACOE.

Replacement plantings will occur at a ratio of three (3) sycamores planted for every one (1) removed, one (1) cottonwood planted for every one (1) removed, one (1) willow planted for every one (1) removed, and one (1) alder planted for every one (1) removed. This ratio has been determined to be appropriate for mitigation for this project as was discussed with Becky Jones, CDFG.

6.3 Site Selection and Preparation

All mitigation will be accomplished on-site. Replacement trees shall be planted on-site, as close as is feasible to the removed trees for which the replacement mitigation is occurring. The individual planting sites will not be specially prepared. The site will require no modifications, it has a known potential to sustain riparian vegetation, and the use of unaltered existing sites will not result in any adverse effects to sensitive habitats. The existing soil will be utilized for all plantings since this soil is currently appropriate for riparian vegetation. Appropriate site selection will be utilized instead of extensive soil altering site preparation.

6.4 Planting Design

No areas scheduled for planting will require modification of the topsoil. The riparian tree species to be planted are suited to topsoil conditions presently found in the potential impact areas. Four tree species are included in the planting plan: Goodding's black willow (*Salix gooddingii*), Fremont cottonwood (*Populus fremontii* ssp. *fremontii*), western sycamore (*Platanus racemosa*), and white alder (*Alnus rhombifolia*). One-gallon and 5-gallon plants will be utilized for the plantings.

6.4.1 Planting Schedule

Planting of the mitigation areas will be conducted after construction activities on the site and following a quantitative assessment of impacts to mapped tree species. The planting schedule will be implemented between November and March and will be completed within 60 days of planting initiation.

6.4.2 Irrigation

Irrigation will be provided as needed for the first year after planting. the timing and quantity of irrigation will depend on the climatic and hydrological factors affecting the mitigation site during tree establishment. If rainfall and water flow are sufficient to supply the plantings during this time, irrigation will not be required. If rainfall and/or surface inundation are low during this time, irrigation will be provided by hand or truck to supplement normal water regimes in the existing riparian site.

6.4.3 Fencing and Signage

Since access to the construction and future mitigation site is restricted by gates and adjacent slope steepness and to facilitate access to wildlife and the maintenance of natural environmental conditions, no additional fencing of the area is required. Personnel with access to the area should be made aware of the mitigation activities occurring on the site. This may occur through the use of signs or notification of personnel through their regular place of employment. This notification will be the responsibility of PWD.

6.5 Mitigation Maintenance

Any maintenance requirements for the mitigation site will be determined by monitoring results conducted during the five-year monitoring/maintenance period. Actions needed to correct damage resulting from natural or human causes will be performed as needed to maintain re-establishment success. The ACOE, CDFG, and USFS will be consulted regarding any recommended maintenance activities.

6.6 Notification

The ACOE, CDFG, and USFS will be notified and their approval obtained for any changes to this mitigation plan.

7.0 *MONITORING AND REPORTING*

A monitoring program will be implemented to assess the success of the mitigation plan. The success of the program will be evaluated by comparing annual results with target goals. Initial quarterly reports will generally assess the effectiveness of the mitigation at the beginning of the program. Monitoring will occur for a period of five years to identify trends and to compare with target goals and assess the need for mitigation plan adjustment. Annual monitoring reports will be submitted to the ACOE, CDFG, and USFS for the duration of the program.

7.1 Monitoring Requirements

The compensatory riparian mitigation is expected to be established and self-sustaining within five (5) years. The trees will continue to mature for a substantial period following termination of the monitoring program with the target goal being establishment of similar quality habitat. The PWD will be responsible for the implementation of this mitigation plan. The following are the monitoring and reporting requirements to evaluate the success of mitigation and to determine if remedial actions are necessary. These measures are summarized in Table 7-1.

Initial monitoring will begin following planting of trees. Initial monitoring shall include the number and species of trees planted and a general map of planting locations. Monitoring will be conducted quarterly for the first two years following completion of planting and annually thereafter. The quarterly monitoring surveys will collect data on survivorship, estimated percent cover, and growth as measured by dbh and height estimates. In addition, photographs of the mitigation area will be taken from established photopoints in each monitoring period. These data, field notes and recommendations will be kept on file by PWD. Remedial actions in the form of replacement of individuals lost by disease or other causes may be required following monitoring surveys. Replacement of vegetation should occur between November and March. PWD should not be responsible for complete replacement of vegetation lost or damaged by flooding, scouring or sediment deposition. If these actions cause sufficient loss of vegetation that identified success criteria are not likely to be met, then PWD will re-plant one time at a rate of 50 percent of the individual trees lost.

Annual reports will evaluate the previous year's data. All reports will be submitted to the ACOE, CDFG, and USFS for their review and evaluation. Each annual report will address the criteria for success and, if needed, measures to meet target goals or modifications to the plan.

7.2 Criteria for Success

Criteria for success within the mitigation area will be monitored as described in Section 6.1. Quantitative measures of these criteria include percentage survival of plantings, cover estimates, and dbh and height requirements for trees. Each annual monitoring report will evaluate these criteria and if needed prescribe modifications to meet the target goals. If major plan revisions are needed, PWD will coordinate with ACOE, CDFG, and USFS.

Following the first year of monitoring, a 80 percent planting survival rate will be considered suitable for success for all tree species. Following the first year, a 100 percent survival rate is considered suitable for success. Any trees not surviving will be removed and replacements will be provided to meet the success criteria.

Success for height estimate criteria depend upon the size of containers utilized for plantings and the length of time. One-gallon plantings should reach five (5) feet after three (3) years and nine (9) feet after five (5) years. Five-gallon plantings should reach seven (7) feet after three (3) years and 13 feet after five years. These success criteria will be evaluated in annual reports and medial action determined through consultation with the California Department of Fish and Game if the target goals are not achieved. The overall guiding criterion utilized for remedial action decision making will be percent survival.

8.0 PREPARERS

This document was prepared by Scott K. Wilson, botanist, QUAD Consultants.

TABLE 7-1

MONITORING AND REPORTING REQUIREMENTS

Monitoring Report	Data Collected
Initial Monitoring	Number of species and individuals planted, map of the site, quantitative data on dbh, cover, and height estimates for plantings
Quarters 1-1, 1-2, and 1-3	Percentage survival, dbh, cover and height for plantings, site photos, recommendations
Annual 1	Summarize previous year's reports, percentage survival, dbh, cover and height for plantings, site photos, assessment of success criteria, recommendations
Semi-Annual 2-1	Percentage survival, dbh, cover and height for plantings, site photos, recommendations
Annual 2, 3 and 4	Summarize previous year's reports, percentage survival, dbh, cover and height for plantings, site photos, assessment of success criteria, recommendations
Annual 5	Summarize all previous and current annual reports, provide percentage survival, dbh, cover and height for plantings, final site photos, assessment of success criteria, recommendations, conclude monitoring program

SPECIAL USE PERMIT

EXHIBIT "I"

OPERATION AND MAINTENANCE PLAN

FOR

LITTLEROCK DAM AND RESERVOIR

OPERATION AND MAINTENANCE PLAN FOR LITTLEROCK DAM AND RESERVOIR

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I. INTRODUCTION

Statement of Purpose

Palmdale Water District (PWD) and Littlerock Creek Irrigation District (LCID) own the improvements known as Littlerock Dam and Reservoir located on Angeles National Forest lands. Palmdale Water District operates it under the agreement contained in Exhibit "E" to the Special-Use Permit. Both Districts were formed and continue to operate under Division 11 of the California Water Code as irrigation districts and as political subdivisions of the State of California. The Districts are empowered under the Water Code to own and operate facilities such as Littlerock Dam and Reservoir.

This Operations and Maintenance Plan is included as an exhibit to the Special-Use Permit for Littlerock Dam and Reservoir in accordance with the requirement of the permit. It is intended to provide the Angeles National Forest with an overview of the operations and maintenance activities anticipated within the permit area related to Littlerock Dam and Reservoir and to assure the Angeles National Forest all said activities are in compliance with applicable laws and regulations. The primary authority over the District's activities remains the statutes of the State of California. The principal objective in the operational and maintenance activities is to achieve optimal management and maximize the use of the Districts' total water resources.

Overview

The following is organized based on the operational and maintenance activities associated with Littlerock Dam and Reservoir. The maintenance activities are divided into subcategories of Littlerock Dam, Valve House, Sediment Basin, and Littlerock Reservoir. Operational activities are divided into Routine Operations, Operational Constraints, Operational Decisions, and Informational Tours. Each subcategory includes a general description along with specific information.

The Littlerock Dam Operations and Maintenance Manual is also attached as Appendix "A". It contains detailed information on operational procedures, equipment shop drawings, equipment use, and maintenance procedures. The Manual is referred to throughout the Plan. Also included as Appendix "B" is the Certificate of Approval issued on January 25, 1995 by the State of California, Department of Water Resources, Division of Safety of Dams after completion of the Littlerock Dam and Reservoir Restoration Project.

Responsibility for Implementation

The responsibility for implementing and following this Plan is with PWD for the term of the Special-Use Permit. The specific positions responsible are as follows:

General Manager
Assistant General Manager
Facilities and Operations Manager

Other positions may become involved as deemed necessary by PWD staff.

II. MAINTENANCE ACTIVITIES

Littlerock Dam

Littlerock Dam went through an extensive strengthening project in 1993 and 1994. The completed structure is fully documented by the as-built drawings contained in the permit as Exhibit "C" to the Special-Use Permit. Major components of Littlerock Dam include the reinforced and roller compacted concrete structure, outlet tower and piping, audits and interior passages, and instrumentation.

Routine maintenance for the Dam consists mostly of monitoring and inspection. This is currently done on a monthly basis or as otherwise required by the Division of Safety of Dams (DSOD). Inspections consist of interior and exterior examination. Interior inspection is done by entering the Dam and visiting all accessible areas of the interior. Entries must be conducted in accordance with the PWD Confined Space Entry Program, Cal-OSHA, and OSHA requirements. Additional monthly monitoring includes measurement of water flows from foundation drains, piezometer readings, and crackmeter readings. Exterior inspection occurs at the same time as interior inspection and includes all viewable surfaces. The upstream face of the Dam will be inspected each year when the reservoir is empty. Survey monuments are checked horizontally and vertically twice a year.

Detailed maintenance procedures for the Dam are contained in Appendix "A". These procedures include periodic clearing of the water and air passages as needed and clearing of the intake holes in the outlet tower after the reservoir is drained in the Fall. The exterior of the Dam is posted with warning signs and will be checked for vandalism during inspections. Correction of problems caused by vandalism will be prioritized and completed in a timely manner.

Another major feature of the Dam is the new spillway. It is twelve feet higher and 2.5 times wider than the old spillway. The new height enables the reservoir to hold 3,500 acre-feet of water as opposed to 1,600 acre-feet prior to the strengthening project. The new width reduces the depth of water going over the spillway by roughly 2.5 times when compared to the old spillway. This will prevent most floating debris from being washed out of the reservoir as it was before. Therefore, maintenance activities will include removing trees, limbs, etc. left on or at the upstream face of the Dam. This work will be done after the reservoir is emptied in the Fall.

The reduced depth of water flowing over the spillway also increases public safety on the reservoir. Installation of a log boom would be another means of protecting the public, but a log boom is not practical for the reservoir. The reservoir's water surface can change very rapidly and has been known to fill from empty to spilling in less than twenty-four hours; a difference of over eighty feet. Log booms cannot readily fluctuate that extensively and would not therefore be practical in this reservoir. Based on historical records, reservoir spillage is very infrequent at Littlerock Reservoir and generally occurs during periods of low public use. The new, larger spillway will further reduce that occurrence.

Valve House

The valve house is located directly North of Littlerock Dam and contains the control valving for releasing water from the reservoir. The equipment includes a 36-inch valve, two sixteen-inch gate valves, two sixteen-inch cone valves, and control mechanisms. The 36-inch valve is used to release water into Littlerock Creek. The 16-inch valves control water released into Palmdale Ditch for delivery to the Palmdale Water Treatment Plant. The control mechanisms provide for remote operation of main valve and cone valves. This can be done from the Dam overlook or the Palmdale Water Treatment Plant.

Maintenance of the equipment will be done in accordance with the recommendations contained in Appendix "A". The exterior of the valve house will be monitored for vandalism. Correction of problems caused by vandalism will be prioritized and completed in a timely manner.

Sediment Basin

The sediment basin is attached to the North side of the valve house. It is approximately 72-feet long, 23-feet wide, and a maximum depth of 16-feet. The sediment basin receives water from the cone valves in the valve house, reduces the velocity to allow suspended particles to settle out, and then directs the water into the Palmdale Ditch. Major components include a perimeter fence. access ramp, surface skimmer, and weir.

Maintenance consists of removing and disposing of settled material from the sediment basin. This will occur at times when water is not being released into Palmdale Ditch and when several inches of material accumulate. The sediment basin will be monitored for vandalism. Correction of problems caused by vandalism will be prioritized and completed in a timely manner.

Littlerock Reservoir

Littlerock Reservoir is located South and upstream of Littlerock Dam. It has a surface area of approximately 110 acres when at the spillway elevation of the Dam, 3270, and a volume of approximately 3,500 acre-feet. Water collected in this reservoir is rain and snow runoff originating in the 64 square mile drainage area above Littlerock Dam. Average yearly flows from the drainage area are over 14,000 acre-feet. PWD and LCID have the sole right to divert water from this area. The diversion right is currently 5,500 acre-feet.

The reservoir has existed since 1924. Silt and heavier sediments regularly flowed into the reservoir over the years and reduced the storage capacity by 2,700 acre-feet or an average of 54,000 cubic yards per year. The District's maintenance plan, as contemplated in the Littlerock Dam and Reservoir Restoration Project Final EIR/EIS, is aimed at preventing the continued loss of storage volume. Therefore, the District's maintenance plan calls for the removal of an average of 54,000 cubic yards of sediment when the reservoir is empty. This activity will likely require permits from regulatory agencies such as the U. S. Army Corps of Engineers, California Department of Fish and Game, and the Lahontan Regional Water Quality Control Board.

More specifically, the majority of sediment will be removed from the area South of Rocky Point. A minor amount of material will be removed from the area surrounding the outlet tower on the face of the Dam to prevent clogging of the tower. The material will be removed using standard earth moving equipment and haul trucks and properly disposed of off Angeles National Forest lands. The trucks will access the reservoir on the boat ramp, (which was designed for this use.) Designation of the removal area, construction of cut slopes into the removal area, and removal procedures will be done in accordance with mitigation measures adopted with the Littlerock Dam and Reservoir Restoration Project Final EIR/EIS, including dust control measures.

III. OPERATIONAL ACTIVITIES

Routine Operations

Littlerock Dam and Reservoir are part of the larger water resource, treatment, and distribution system operated by PWD to provide service to customers, including LCID. The Dam and Reservoir are one of three water sources for the District. The other water sources are groundwater and the State Water Project. Decisions on which source to use and when to use it depend on factors such as availability, quality, and cost. Normally, the District meets a major percentage of its water demand with treated surface water. This comes from either the State Water Project or Littlerock Reservoir and is stored in Palmdale Lake for treatment.

Water from Littlerock Reservoir is the preferred surface water source due to cost and quality considerations. The decision to take water from the Reservoir depends on the quantity of water available. Assuming the water is available and all operational constraints are met, water is released into Palmdale Ditch through valving in the valve house. The specific procedure is described in Appendix "A". The following summarizes the routine operation during an average water year:

1) Releases into Palmdale Ditch begin when the reservoir level is between the minimum pool elevation of 3228 and the spillway elevation of 3270, usually in January or February;

2) Releases continue until reservoir elevation decreases to approximately 3240, usually in late May or June;

3) Releases into Palmdale Ditch begin again after Labor Day and continue until the reservoir is empty, usually in October.

Operational Constraints

The routine operations described above are subject constraints. The most obvious one is leaving water in Littlerock Reservoir through the summer. This constraint is a result of the Davis-Grunsky Act Grant used by PWD and LCID to partially fund the recent work to strengthen and renovate the Dam. The grant agreement required recreational development of the area and a minimum pool in the reservoir during summer months. The minimum pool is defined as 500 acre-feet in volume and 3228 reservoir elevation. The minimum pool must be left in place when the reservoir refills during the winter months and may be removed only after Labor Day.

A second constraint is the water diversion right. As previously stated, the Districts' right is 5,500 acre-feet. Release will cease when that amount of water has been reached during a calendar year. Historically, this has not affected operations because the reservoir's yield has never reached that volume.

A third constraint is available storage in Palmdale Lake. Releases into Palmdale Ditch may cease at any time if Palmdale Lake is full and the Palmdale Water Treatment Plant is not functioning.

Another constraint is the weather. Unusually wet or dry years will change the routine operations described above. Drought years, when surface water supplies are severely reduced, will override the minimum pool requirement and any water available will be taken for public consumption. Conversely, wet years will extend the periods when water is released into Palmdale Ditch.

Operational Decisions

As stated above, Littlerock Dam and Reservoir is only one part of PWD's complete water system. The water system is dynamic. Demands change hourly, daily and seasonally. Supplies must be provided to match these demands. It is within this framework that decisions are made regarding the use of Littlerock Dam and Reservoir. Water will be taken from the facility when it is needed to meet demands and is available within the various constraints listed above.

Informational Tours

Public information and education are increasingly important for issues relating to water and its use. These issues include water conservation, water quality, awareness of water sources and protection of those sources, and the wildlife and environment associated with water sources. PWD is very active with local schools in these areas. Activities include participation in the California Water Awareness Program, poster and jingle contests, water courses for teachers, water conservation education, and landscape contests.

A large part of the school program is actual tours of District facilities; namely the Palmdale Water Treatment Plant and Littlerock Dam. PWD funds the field trip costs and accompanies the classes to teach about the facilities and water. These tours occur mostly in Spring and early Summer. However, tours can occur at any time scheduled with PWD by the class. Tours to Littlerock Dam and Reservoir can vary, but typically include visiting the Dam's base and overlook. They also generally include lunch at one of the picnic areas.

APPENDIX A

LITTLEROCK DAM

OPERATIONS AND MAINTENANCE

MANUAL

APPENDIX B

CERTIFICATE

OF

APPROVAL

State of California
The Resources Agency
DEPARTMENT OF WATER RESOURCES
Division of Safety of Dams

Certificate of Approval

This Is To Certify That, pursuant to Part 1 of Division 3 of the California Water Code, the Department of Water Resources of the State of California has found that the Littlerock Dam and Reservoir, State Application Number 57, located in Sec. 27, Tp. 5 N., R. 11 W., SB B. & M., Los Angeles County, State of California, are safe to impound water; and the use of said dam and reservoir to impound water in accordance with and subject to the following terms and conditions is hereby authorized: Water may be impounded to Elevation 3270.00 USC&GS datum, the crest of the concrete ogee spillway.

This certificate of approval supersedes every previous certificate of approval or written consent for use issued by the State of California relative to said dam and reservoir.

Witness my hand and the Seal of the Department of Water Resources of the State of California

this 25th day of January 1995

Division Engineer, Reg. C. E. No.12372

Appendix E

Flood Analysis References Include:

- Flood Insurance Rate Maps (FIRM)
- Flood Insurance Study

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures.** Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 11. The **horizontal datum** was NAD83, GRS1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum.** For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov/ or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, MD 20910-3282

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713-3242,** or visit its website at http://www.ngs.noaa.gov/.

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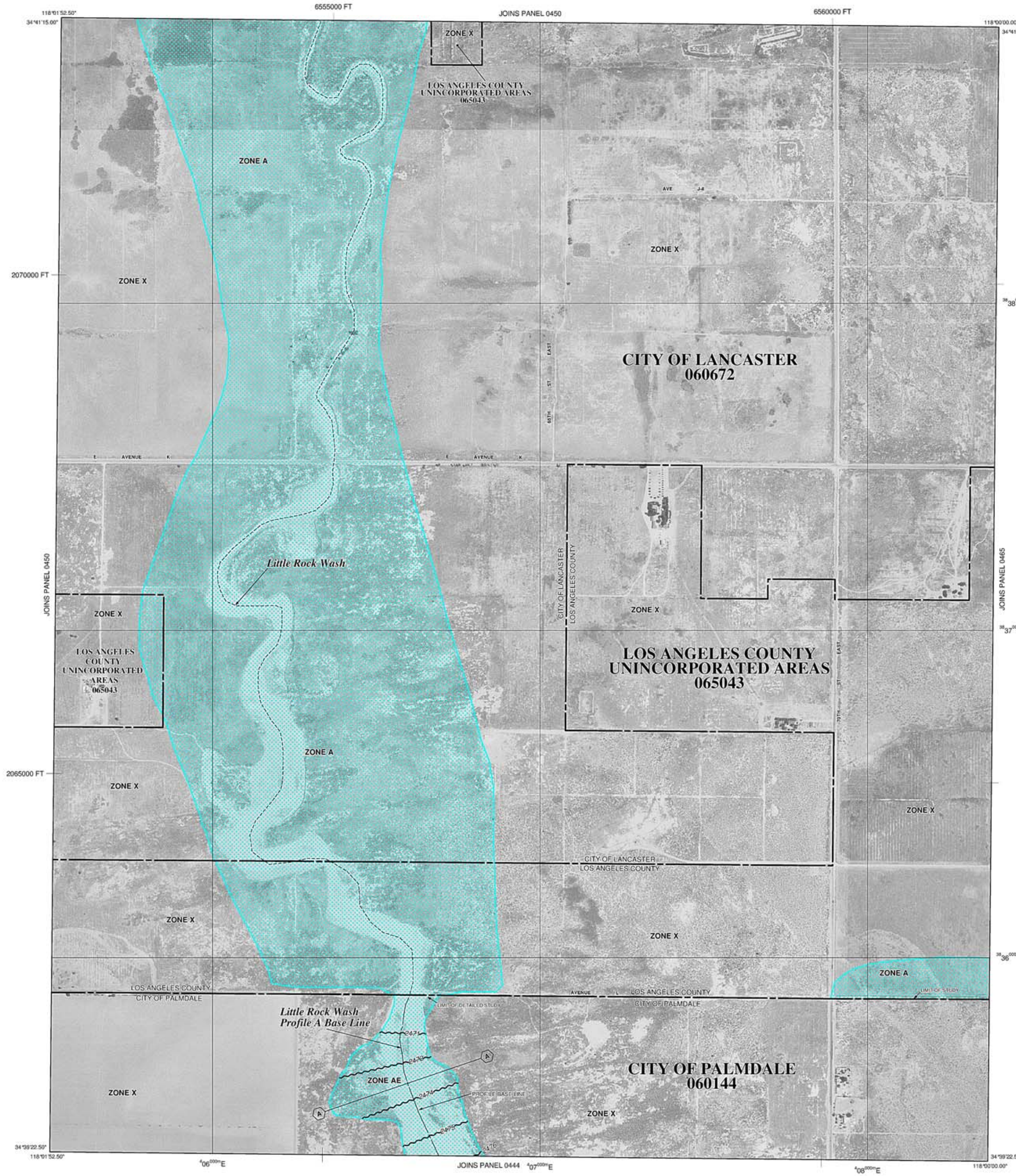
If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/.



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% annual chance floodplain boundary
0.2% annual chance floodplain boundary
Floodway boundary
Zone D boundary
CBRS and OPA boundary
Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.

~~ 513 ~~~~	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

(A)——(A)	Cross section line
(23)- - - -(23)	Transect line
97°07'30", 32°22'30"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
4275000mN	1000-meter Universal Transverse Mercator grid values, zone 11
6000000 FT	5000-foot grid ticks: California State Plane coordinate system, V zone (FIPSZONE 0405), Lambert Conformal Conic
DX5510 ×	Bench mark (see explanation in Notes to Users section of this FIRM panel)
• M1.5	River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
September 26, 2008
EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET

150 0 150 300 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0442F

FIRM
FLOOD INSURANCE RATE MAP

LOS ANGELES COUNTY, CALIFORNIA
AND INCORPORATED AREAS

PANEL 442 OF 2350

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
LOS ANGELES COUNTY	065043	0442	F
LANCASTER, CITY OF	060672	0442	F
PALMDALE, CITY OF	060144	0442	F

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
06037C0442F

EFFECTIVE DATE
SEPTEMBER 26, 2008

Federal Emergency Management Agency

NOTES TO USERS

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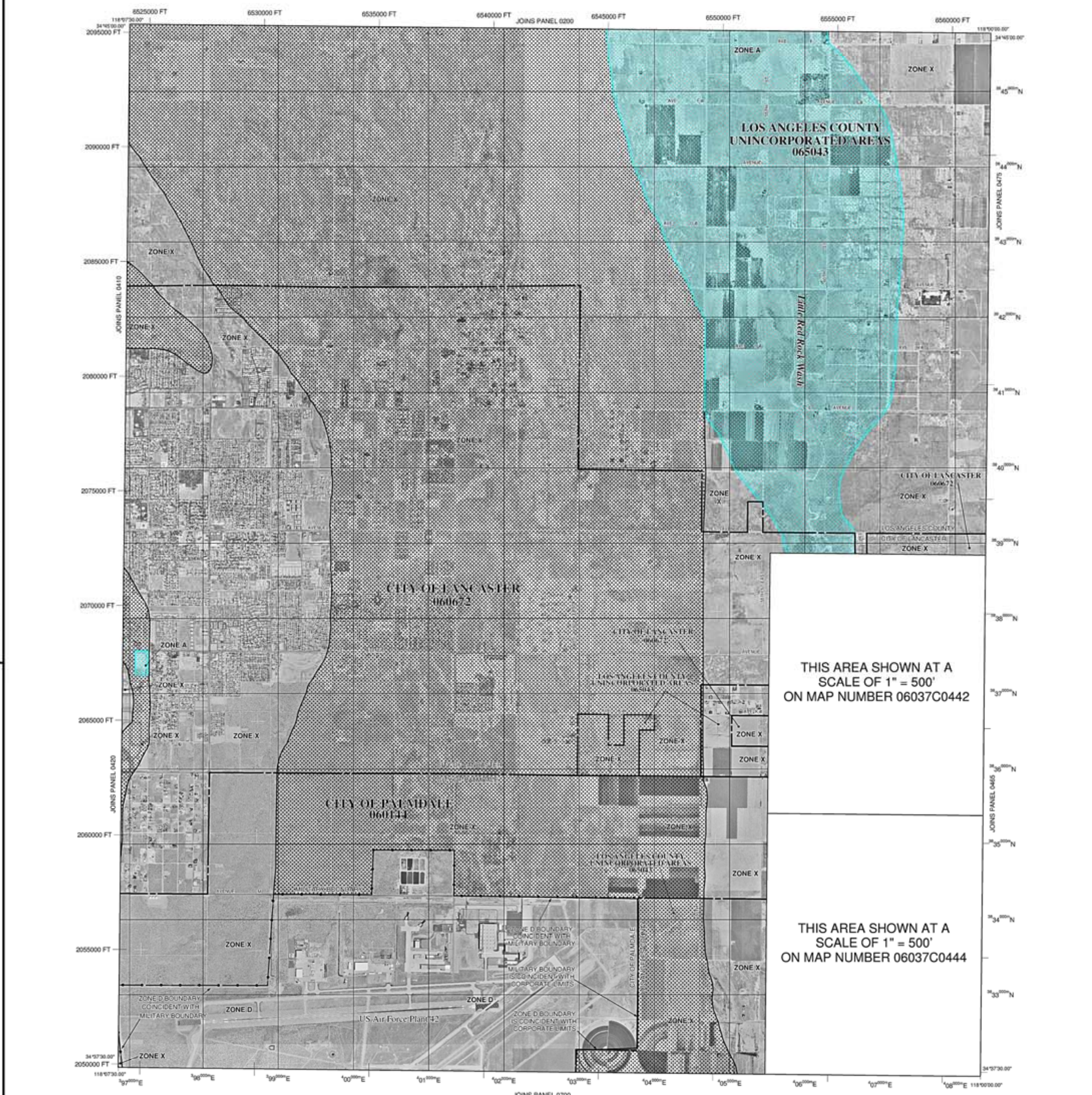

LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

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ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

	1% annual chance floodplain boundary
	0.2% annual chance floodplain boundary
	Floodway boundary
	Zone D boundary
	CBRS and OPA boundary
	Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
~~ 513 ~~~	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

(A)———(A)	Cross section line
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• M1.5	River Mile

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FLOOD INSURANCE RATE MAP
September 26, 2008
EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

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MAP SCALE 1" = 2000'

1000 0 2000 4000 FEET
600 0 600 1200 METERS

NFIP

PANEL 0450F

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP
LOS ANGELES COUNTY, CALIFORNIA
AND INCORPORATED AREAS

PANEL 450 OF 2350
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
LOS ANGELES COUNTY	065043	0450	F
LANCASTER, CITY OF	060672	0450	F
PALMDALE, CITY OF	060144	0450	F

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MAP NUMBER
06037C0450F

EFFECTIVE DATE
SEPTEMBER 26, 2008

Federal Emergency Management Agency

NOTES TO USERS

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Services

Survey

Highway
20910–3282

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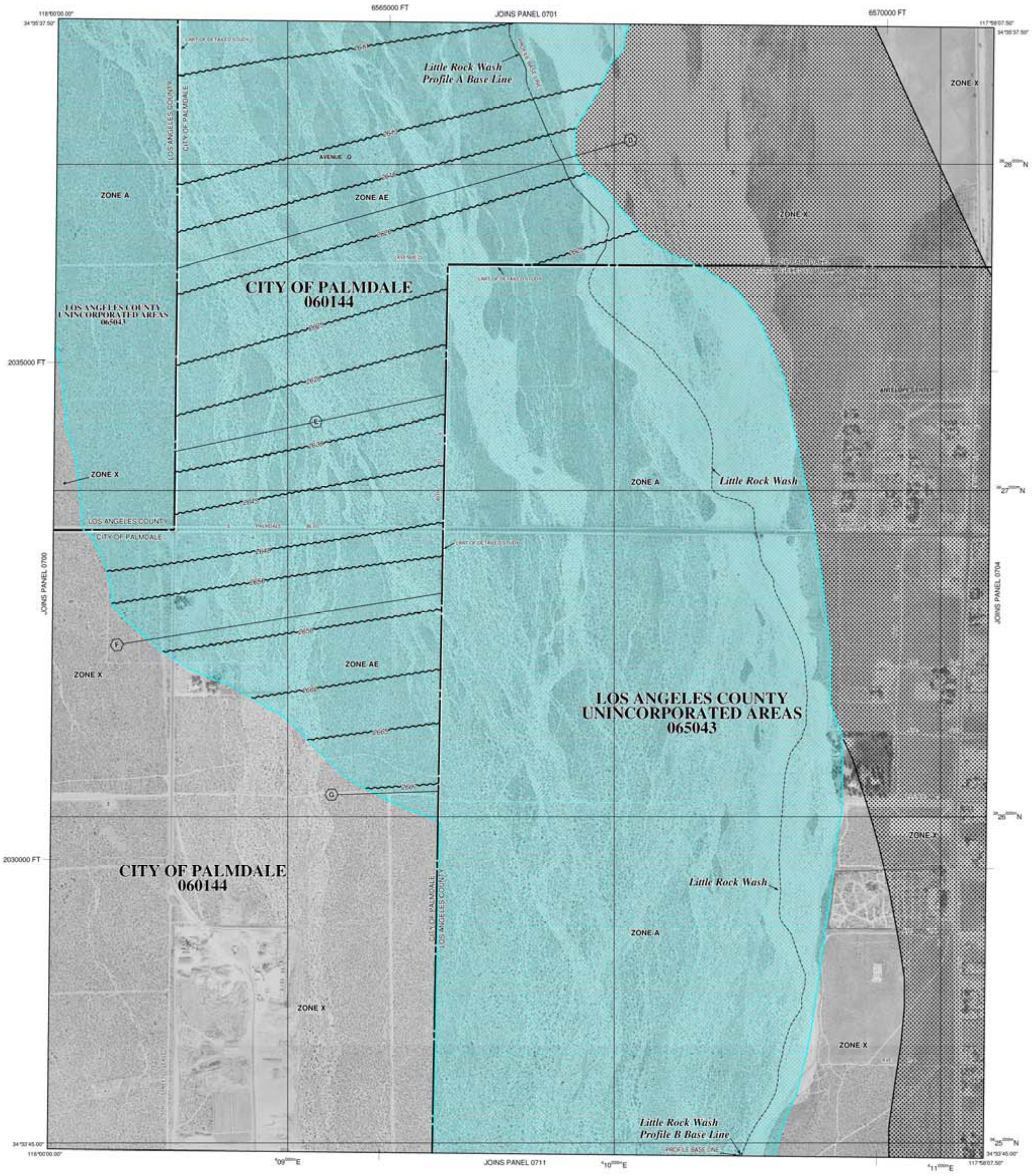

LEGEND

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FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

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	Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
~~ 513 ~~~~	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

(A)———(A)	Cross section line
(23)- - - -(23)	Transect line
97°07'30", 32°22'30"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
4275000mN	1000-meter Universal Transverse Mercator grid values, zone 11
6000000 FT	5000-foot grid ticks: California State Plane coordinate system, V zone (FIPSZONE 0405), Lambert Conformal Conic
DX5510 ×	Bench mark (see explanation in Notes to Users section of this FIRM panel)
• M1.5	River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
September 26, 2008
EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

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To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET

150 0 150 300 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0703F

FIRM
FLOOD INSURANCE RATE MAP
LOS ANGELES COUNTY, CALIFORNIA
AND INCORPORATED AREAS

PANEL 703 OF 2350
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
LOS ANGELES COUNTY	065043	0703	F
PALMDALE, CITY OF	060144	0703	F

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
06037C0703F

EFFECTIVE DATE
SEPTEMBER 26, 2008

Federal Emergency Management Agency

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures.** Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 11. The **horizontal datum** was NAD83, GRS1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum.** For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov/ or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, MD 20910-3282

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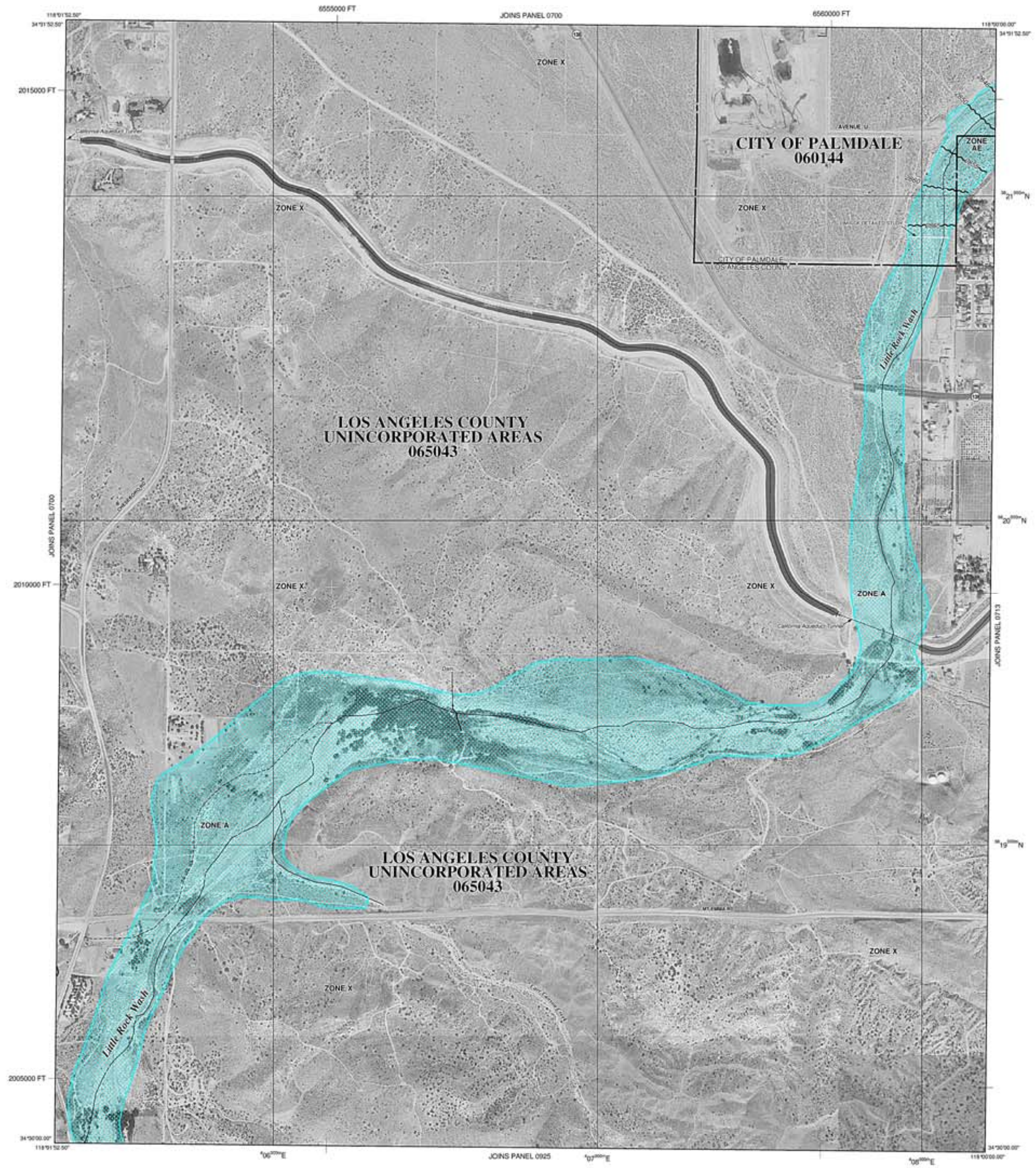
Contact the **FEMA Map Service Center** at 1-800-358-9616 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a *Flood Insurance Study* report, and/or digital versions of this map. The FEMA Map Service Center may also be reached by Fax at 1-800-358-9620 and its website at http://www.msc.fema.gov/.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/.



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

- **ZONE A** No Base Flood Elevations determined.
- **ZONE AE** Base Flood Elevations determined.
- **ZONE AH** Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
- **ZONE AO** Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
- **ZONE AR** Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
- **ZONE A99** Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
- **ZONE V** Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
- **ZONE VE** Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

- **ZONE X** Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

- **ZONE X** Areas determined to be outside the 0.2% annual chance floodplain.
- **ZONE D** Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- 1% annual chance floodplain boundary
- 0.2% annual chance floodplain boundary
- Floodway boundary
- Zone D boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
- ~~~~ 513 ~~~~ Base Flood Elevation line and value; elevation in feet*
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250 0 500 1000 FEET
150 0 150 300 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0694F

FIRM
FLOOD INSURANCE RATE MAP
LOS ANGELES COUNTY, CALIFORNIA
AND INCORPORATED AREAS

PANEL 694 OF 2350
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
LOS ANGELES COUNTY	065043	0694	F
PALMDALE, CITY OF	060144	0694	F

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MAP NUMBER
06037C0694F

EFFECTIVE DATE
SEPTEMBER 26, 2008

Federal Emergency Management Agency

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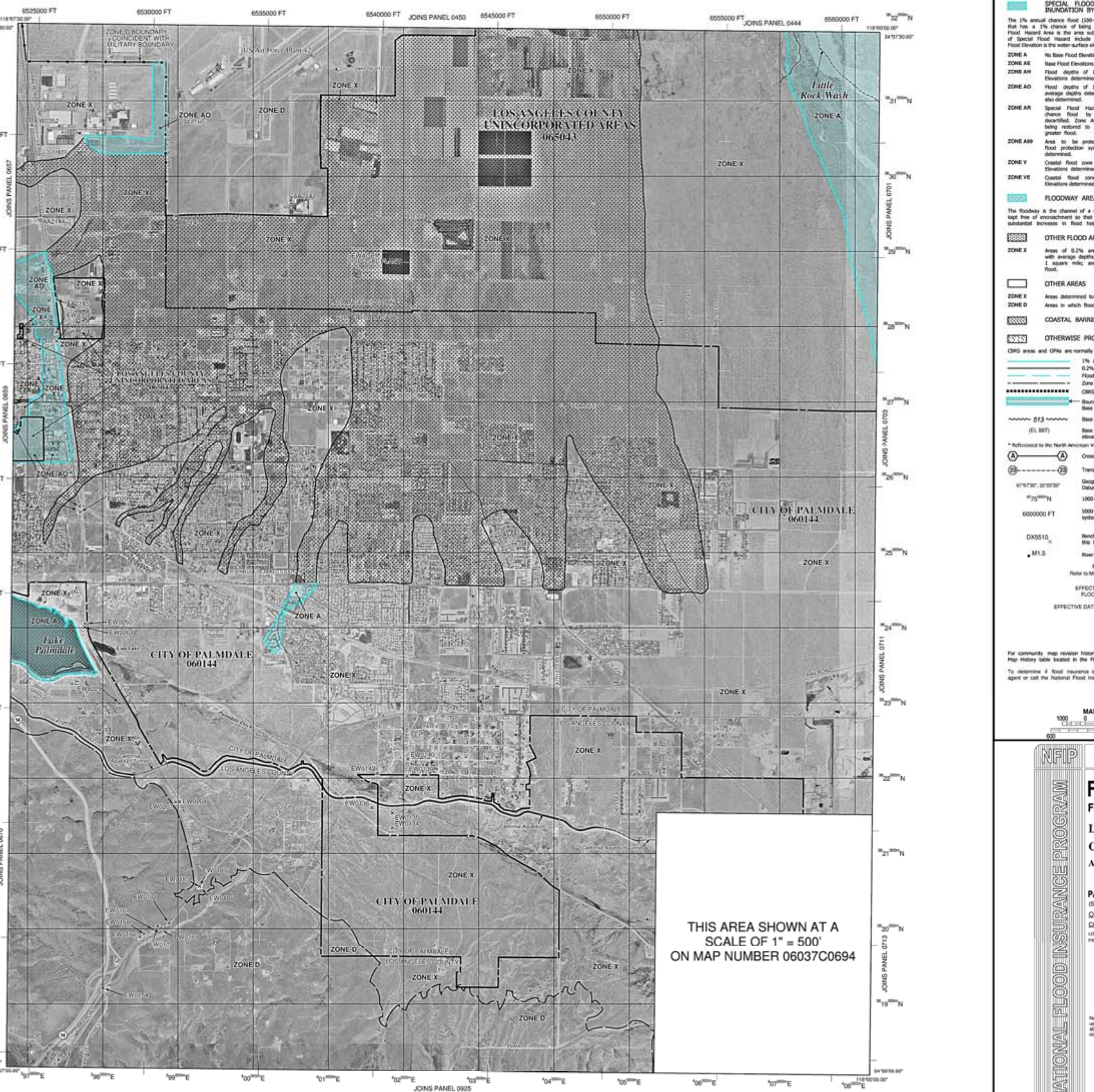

LEGEND

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1% annual chance floodplain boundary
0.2% annual chance floodplain boundary
Floodway boundary
Zone D boundary
CBRS and OPA boundary
Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.

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September 26, 2008
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MAP SCALE 1" = 2000'
1000 0 2000 4000 FEET
600 0 600 1200 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0700F

FIRM
FLOOD INSURANCE RATE MAP
LOS ANGELES COUNTY, CALIFORNIA
AND INCORPORATED AREAS

PANEL 700 OF 2350
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
LOS ANGELES COUNTY	065043	0700	F
PALMDALE,CITY OF	060144	0700	F

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MAP NUMBER
06037C0700F

EFFECTIVE DATE
SEPTEMBER 26, 2008

Federal Emergency Management Agency

FLOOD INSURANCE STUDY

LOS ANGELES COUNTY, CALIFORNIA

AND INCORPORATED AREAS

VOLUME 1 OF 4

Community Name	Community Number	Community Name	Community Number	Community Number	Community Name	Community Number	Community Number
LOS ANGELES COUNTY, UNINCORPORATED AREAS	065043	DIAMOND BAR, CITY OF	060741	LAWNDALE, CITY OF*	060134	SAN DIMAS, CITY OF	060154
AGOURA HILLS, CITY OF	065072	DOWNEY, CITY OF	060645	LOMITA, CITY OF*	060135	SAN FERNANDO, CITY OF*	060628
ALHAMBRA, CITY OF*	060095	DUARTE, CITY OF	065026	LONG BEACH, CITY OF	060136	SAN GABRIEL, CITY OF*	065055
ARCADIA, CITY OF	065014	EL MONTE, CITY OF*	060658	LOS ANGELES, CITY OF	060137	SAN MARINO, CITY OF*	065057
ARTESIA, CITY OF*	060097	EL SEGUNDO, CITY OF	060118	LYNWOOD, CITY OF	060635	SANTA CLARITA, CITY OF	060729
AVALON, CITY OF	060098	GARDENA, CITY OF	060119	MALIBU, CITY OF	060745	SANTA FE SPRINGS, CITY OF	060158
AZUSA, CITY OF	065015	GLENDALE, CITY OF	065030	MANHATTAN BEACH, CITY OF	060138	SANTA MONICA, CITY OF	060159
BALDWIN PARK, CITY OF*	060100	GLENDORA, CITY OF	065031	MAYWOOD, CITY OF*	060651	SIERRA MADRE, CITY OF	065059
BELL GARDENS, CITY OF	060656	HAWAIIAN GARDENS, CITY OF*	065032	MONROVIA, CITY OF	065046	SIGNAL HILL, CITY OF*	060161
BELL, CITY OF*	060101	HAWTHORNE, CITY OF*	060123	MONTEBELLO, CITY OF	060141	SOUTH EL MONTE, CITY OF*	060162
BELLFLOWER, CITY OF	060102	HERMOSA BEACH, CITY OF	060124	MONTEREY PARK, CITY OF*	065047	SOUTH GATE, CITY OF	060163
BEVERLY HILLS, CITY OF*	060655	HIDDEN HILLS, CITY OF	060125	NORWALK, CITY OF	060652	SOUTH PASADENA, CITY OF*	065061
BRADBURY, CITY OF	065017	HUNTINGTON PARK, CITY OF*	060126	PALMDALE, CITY OF	060144	TEMPLE CITY, CITY OF	060653
BURBANK, CITY OF	065018	INDUSTRY, CITY OF	065035	PALOS VERDES ESTATES, CITY OF	060145	TORRANCE, CITY OF	060165
CALABASAS, CITY OF	060749	INGLEWOOD, CITY OF*	065036	PARAMOUNT, CITY OF	065049	VERNON, CITY OF*	060166
CARSON, CITY OF	060107	IRWINDALE, CITY OF*	060129	PASADENA, CITY OF	065050	WALNUT, CITY OF	065069
CERRITOS, CITY OF	060108	LA CANADA FLINTRIDGE, CITY OF	060669	PICO RIVERA, CITY OF	060148	WEST COVINA, CITY OF	060666
CLAREMONT, CITY OF	060109	LA HABRA HEIGHTS, CITY OF	060701	POMONA, CITY OF	060149	WEST HOLLYWOOD, CITY OF	060720
COMMERCE, CITY OF	060110	LA MIRADA, CITY OF	060131	RANCHO PALOS VERDES, CITY OF	060464	WESTLAKE VILLAGE, CITY OF	060744
COMPTON, CITY OF	060111	LA PUENTE, CITY OF*	065039	REDONDO BEACH, CITY OF	060150	WHITTIER, CITY OF	060169
COVINA, CITY OF	065024	LA VERNE, CITY OF	060133	ROLLING HILLS ESTATES, CITY OF*	065054		
CUDAHY, CITY OF	060657	LAKEWOOD, CITY OF	060130	ROLLING HILLS, CITY OF	060151		
CULVER CITY, CITY OF	060114	LANCASTER, CITY OF	060672	ROSEMEAD, CITY OF	060153		

*Non-floodprone communities

September 26, 2008

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
06037CV001A

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study (FIS) may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

Selected Flood Insurance Rate Map (FIRM) panels for the community contain information that was previously shown separately on the corresponding Flood Boundary and Floodway Map (FBFM) panels (e.g. floodways, cross sections). In addition, former flood hazard zone designations have been changed as follows:

Old Zone	New Zone
A1 through A30	AE
V1 through V30	VE
B	X (Shaded)
C	X (Unshaded)

Part or all of this FIS may be revised and republished at any time. In addition, part of this FIS may be revised by the Letter of Map Revision process, which does not involve republication or redistribution of the FIS. It is, therefore, the responsibility of the user to consult with community officials and to check the community repository to obtain the most current FIS components.

Initial Countywide FIS Effective Date: September 26, 2008

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Exhibit 1 - Flood Profiles (continued)

Volume 4

PUBLISHED SEPARATELY:

FLOOD INSURANCE STUDY
LOS ANGELES COUNTY, CALIFORNIA AND INCORPORATED AREAS

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study (FIS) revises and updates information on the existence and severity of flood hazards in the geographic area of Los Angeles County, California, including the Cities of Agoura Hills, Alhambra, Arcadia, Artesia, Avalon, Azusa, Baldwin Park, Bell Gardens, Bell, Bellflower, Beverly Hills, Bradbury, Burbank, Calabasas, Carson, Cerritos, Claremont, Commerce, Compton, Covina, Cudahy, Culver City, Diamond Bar, Downey, Duarte, El Monte, El Segundo, Gardena, Glendale, Glendora, Hawaiian Gardens, Hawthorne, Hermosa Beach, Hidden Hills, Huntington Park, Industry, Inglewood, Irwindale, La Canada Flintridge, La Habra Heights, La Mirada, La Puente, La Verne, Lakewood, Lancaster, Lawndale, Lomita, Long Beach, Los Angeles, Lynwood, Malibu, Manhattan Beach, Maywood, Monrovia, Montebello, Monterey Park, Norwalk, Palmdale, Palos Verdes Estates, Paramount, Pasadena, Pico Rivera, Pomona, Rancho Palos Verdes, Redondo Beach, Rolling Hills Estates, Rolling Hills, Rosemead, San Dimas, San Fernando, San Gabriel, San Marino, Santa Clarita, Santa Fe Springs, Santa Monica, Sierra Madre, Signal Hill, South El Monte, South Gate, South Pasadena, Temple City, Torrance, Vernon, Walnut, West Covina, West Hollywood, Westlake Village, Whittier and the unincorporated areas of Los Angeles County (referred to collectively herein as Los Angeles County), and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. Please note that the Cities of Alhambra, Artesia, Baldwin Park, Bell, Beverly Hills, El Monte, Hawaiian Gardens, Hawthorne, Huntington Park, Inglewood, Irwindale, La Puenta, Lawndale, Lomita, Maywood, Monterey Park, Rolling Hills Estates, San Fernando, San Gabriel, San Marino, Signal Hill, South El Monte, South Pasadena, and Vernon are non-floodprone. This study has developed flood hazard data for various areas of the community that will be used to establish actuarial flood insurance rates and to assist the community in its efforts to promote sound floodplain management. Minimum floodplain management requirements for participation in the National Flood Insurance Program (NFIP) are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some States or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the State (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this FIS are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The FIS was prepared to include the unincorporated areas of, and incorporated areas, within Los Angeles County in a countywide format. Information on the authority and acknowledgements of each jurisdiction included in this countywide FIS, as compiled from their previously printed FIS reports, is shown below.

Hydraulic analyses for unincorporated areas of the County were performed by the Los Angeles County Flood Control District, for FEMA, under Contract No. H-3940. The hydraulic analyses were completed in December 1979. In unincorporated coastal areas, the hydrologic analyses for this study were performed by Dames & Moore, for FEMA, under Contract No. C-0970. This work was completed in 1984.

The hydrologic and hydraulic analyses for the City of Agoura Hills were performed by the Los Angeles County Flood Control District, as reported in the FIS for Los Angeles County, California (Federal Emergency Management Agency, 1980). Hydrologic and hydraulic analyses for the August 3, 1998 restudy were performed for FEMA by Ensign & Buckley under Contract No. EMW-93-C-4151.

Hydraulic analyses for the City of Avalon was performed by the Los Angeles County Flood Control District, for FEMA, under Contract No. H-3940. The hydraulic analyses were completed in 1977. In coastal areas of the City of Avalon, the hydrologic and hydraulic analyses were performed by Tetra Tech, Inc., for FEMA, under Contract No. H-4543. This study was completed in June 1981.

Hydraulic analyses for the Cities of Bellflower, Carson, Compton, Downey, Gardena, Lakewood, Lynwood, Paramount, Pico Rivera, and South Gate and for the restudy for Los Angeles County were prepared by Schaaf & Wheeler, Consulting Civil Engineers, the study contractor, for the Federal Emergency Management Agency (FEMA), under Contract No. EMW-86-C-2248. The work for this study was completed on May 15, 1991.

Hydrologic data used in the study of the Cities of Bellflower, Carson, Compton, Downey, Gardena, Lakewood, Lynwood, Paramount, Pico Rivera, and South Gate and in the restudy for Los Angeles County, were provided by the U.S. Army Corps of Engineers (USACE), from the "Los Angeles County Drainage Area - Draft Feasibility Report" (LACDA); Appendix A - Hydrology, updated February 1990. As-built plans for the channel and bridges were obtained from the USACE and the California Department of Transportation (CALTRANS).

Hydrologic and hydraulic analyses for the study of the City of Burbank were performed by the Los Angeles County Flood Control District, for the Federal Insurance Administration, under Contract No. H-3940. This work, which was completed in July 1978, covered all significant flooding sources affecting the City of Burbank.

The hydrologic and hydraulic analyses for the January 20, 1999 restudy were performed for FEMA by Ensign & Buckley under Contract No. EMQ-90-C-9133.

Hydrologic and hydraulic analyses for the study of the City of Culver City were performed by the Los Angeles County Flood Control District, for the Federal Insurance Administration, under Contract No. H-3940. This work, which was completed in June 1978, covered all significant flooding sources affecting the City of Culver City.

Hydrologic and hydraulic analysis for Hidden Hills for the Long Valley Storm Drain is based on plans and specifications for the Long Valley Road Storm Drain improvements dated March 27, 1991, and the Project Concept Report for Long Valley Drain dated September 1986. Based on the submitted information, the FIRM was revised to incorporate the effects to construction of Long Valley Drain and Jed Smith Drain storm water improvement projects. Based on this information, the Zone D designations from Long Valley Road near its intersection with Twin Oaks Road to the upstream corporate limits of the City and from Jed Smith Road have been removed. Also, the Zone A area just south of Long Valley Road to just south of Twin Oaks Road has also been changed to Zone X shaded as a result of the information submitted for the Long Valley Storm Drain improvement project.

Hydrologic and hydraulic analyses for the study of the City of La Mirada were performed by the Los Angeles County Flood Control District, for the Federal Insurance Administration, under Contract No. H-3940. This work, which was completed in January 1979, covered all significant flooding sources affecting the City of La Mirada.

Hydrologic and hydraulic analyses for the study of the City of Lancaster were performed by the Los Angeles County Flood Control District, for the Federal Insurance Administration, under Contract No. H-3940. This work, which was completed in March 1979, covered all significant flooding sources affecting the City of Lancaster.

Hydrologic and hydraulic analyses for the original study of the City of Long Beach were performed by the Los Angeles County Flood Control District (LACFCD) and Tetra Tech, Inc., for the Federal Emergency Management Agency (FEMA), under Contract Nos. H-3940 and H-4543. This work was completed in June 1981.

Hydraulic analysis for the restudy of the City of Long Beach was prepared by Schaaf & Wheeler, Consulting Civil Engineers, the study contractor, for FEMA, under Contract No. EMW-86-C-2248. The work for this study was completed on May 15, 1991. Hydrologic data used in this study were provided by the USACE in the "Los Angeles County Area Review - Draft Feasibility Report" (LACDA) Appendix A - Hydrology, updated February 1990. As built plans for the channel and bridges were obtained from the USACE and California Department of Transportation (CALTRANS).

Hydrologic and hydraulic analyses for the study of the City of Los Angeles were performed by Los Angeles County Flood Control District, for FEMA, under Contract No. H-3940. This study was completed in August 1979. In coastal areas,-the hydrologic analyses for this study were performed by Dames & Moore, for FEMA, under Contract No. C-0970. This work was completed in 1984.

The hydraulic analysis for the revised study for the City of Los Angeles was prepared by Schaaf & Wheeler for FEMA under contract No. EMW-86-C-2248. The work for this study was completed on May 15, 1991. Hydrologic data used in this study were provided by the USACE in the "Los Angeles County Area Review - Draft Feasibility Report" (LACDA) Appendix A - Hydrology, updated February 1990. As-built plans for the channel and bridges were obtained from the USACE and California Department of Transportation (CALTRANS). The hydraulic and hydrologic analyses for part two of this restudy were performed for FEMA by Ensign & Buckley under Contract No. EMW-90-C-9133.

Hydrologic and hydraulic analyses for the original study of the City of Montebello were performed by the Los Angeles County Flood Control District (LACFCD), for the Federal Insurance Administration (FIA), under Contract No. H-3940. This work was completed in September 1978.

Hydraulic analysis for the revised study of the City of Montebello was prepared by Schaaf & Wheeler, Consulting Civil Engineers, the study contractor, for the Federal Emergency Management Agency (FEMA), under Contract No. EMW-86-C-2248. The work for this study was completed on May 15, 1991. Hydrologic data used in this study were provided by the USACE in the "Los Angeles County Area Review - Draft Feasibility Report" (LACDA) Appendix A - Hydrology, updated February 1990. As-built plans for the channel and bridges were obtained from the USACE and California Department of Transportation (CALTRANS).

Hydrologic and hydraulic analyses for the original study of the City of Palmdale were performed by the Los Angeles County Flood Control District (LACFCD), for the Federal Emergency Management Agency (FEMA), under Contract No. H-3940. The study was revised by Rick Engineering Company (REC) under Contract No. EMW-84-1639. This study was completed in May 1979, and revised in November 1985. The study was revised again on March 30, 1998 by Ensign & Buckley, for FEMA, under Contract No. EMW-90-C-3133.

Hydrologic and hydraulic analyses for the study of the City of Redondo Beach were performed by Tetra Tech, Inc. and the Los Angeles County Flood Control District, for the Federal Emergency Management

Agency, under Contract Nos. H-4543 and H-3940. This work, which was completed in June 1981, covered all significant flooding sources affecting the City of Redondo Beach.

Hydrologic and hydraulic analyses used to prepare the study of the City of Santa Clarita were performed by the Los Angeles Flood Control District, for the Federal Emergency Management Agency (FEMA), under Contract No. H-3940. This work was completed in 1984.

Hydrologic and hydraulic analyses for the study of the City of Santa Fe Springs were performed by the Los Angeles County Flood Control District, for the Federal Insurance Administration, under Contract No. H-3940. This work, which was completed in October 1978, covered all significant flooding sources affecting the City of Santa Fe Springs.

Hydrologic and hydraulic analyses for the study of the City of Torrance were performed by the Los Angeles County Flood Control District, for the Federal Insurance Administration, under Contract No. H-3940. This work, which was completed in August 1978, covered all significant flooding sources affecting the City of Torrance.

Hydraulic analyses for the study of the City of West Hollywood were performed by the Los Angeles County Flood Control District, for the Federal Emergency Management Agency (FEMA), as part of the Flood Insurance Study for Los Angeles County, California, under Contract No. H-3940. Because the City of West Hollywood was incorporated out of the County of Los Angeles on November 29, 1984, this Flood Insurance Study was prepared by compiling all existing technical and scientific data originally prepared for the Flood Insurance Study for Los Angeles County, California, Unincorporated Areas, dated December 2, 1980 and revised November 15, 1985. The Los Angeles County Flood Insurance Study was completed December 2, 1980 and revised November 15, 1985.

Hydrologic and hydraulic analyses for the study of the City of Whittier were performed by the Los Angeles County Flood Control District, for the Federal Insurance Administration, under Contract No. H-3940. This work, which was completed in August 1978, covered all significant flooding sources affecting the City of Whittier.

In September 2008, HDR Engineering Inc. completed a countywide DFIRM and FIS for the County of Los Angeles. HDR Engineering Inc. was hired as an IDIQ study contractor for FEMA Region IX under contract number EMF-2003-CO-0045, Task Order 15. The DFIRM process included digitizing floodplain boundaries from the effective paper FIRMs and fitting them to a digital base map, thus converting the existing manually produced FIRMs to digitally produced FIRMs, referred to as DFIRMs. Individual community effective FIS reports were also combined into one report for the entire county.

Planimetric Base map information was provided in digital format for FIRM panels. UTM grid and land ownership data were provided by Bureau of Land Management. Information on roads was provided by TIGER/Line Files, U.S. Department of Commerce, U.S. Census Bureau, Geography Division. Digital Orthophotographic Quarter Quadrangles (DOQQ) were provided by USGS. Users of this FIRM should be aware that minor adjustments may have been made to specific base map features.

The coordinate system used for the production of this FIRM is Universal Transverse Mercator (UTM), North American Datum of 1983 (NAD 83), and GRS 1980 spheroid. Corner coordinates shown on the FIRM are in latitude and longitude referenced to NAD 83. Differences in datum and spheroid used in the production of FIRMs for adjacent counties may result in slight positional differences in map features and at the county boundaries. These differences do not affect the accuracy of information shown on the FIRM.

1.3 Coordination

Consultation Coordination Officer's (CCO) meetings may be held for each jurisdiction in this countywide FIS. An initial CCO meeting is held typically with representatives of FEMA, the community, and the study contractor to explain the nature and purpose of a FIS, and to identify the streams to be studied by detailed methods. A final CCO meeting is held typically with representatives of FEMA, the community, and the study contractor to review the results of the study.

The following agencies (Table 1 – Contacted Agencies) were contacted in an attempt to explore all possible sources of data. Information describing hydrological conditions, drainage patterns, historical storm systems, tides, and waves as well as information on the topography, roads, beach profiles, shelf bathymetry flood protection structures (sea walls, breakwaters), and the demography of communities of Los Angeles County was sought from:

Table 1 - CONTACTED AGENCIES

California Coastal Commission	California Department of Transportation	California State Department of Boating and Waterways
California State Office of Emergency Services	CH2M Hill, Inc.	City of Santa Monica
Department of Defense	Fleet Numerical Weather Center	Los Angeles County Engineers Facilities
Los Angeles County Flood Control District	Los Angeles County Office of Emergency Services	Los Angeles County Regional Planning Department
Los Angeles Public Library	National Climatic Center	National Oceanic and Atmospheric Administration
National Oceanic and Atmospheric Administration, Eastern	National Oceanic and Atmospheric Administration, Tide Predictions Branch	National Weather Service, Los Angeles
Pacific Hurricane Center	Santa Catalina Island Company	Scripps Institute of Oceanography
Security Pacific Bank	Small Business Administration	South Coast Regional Coastal Commission
U.S. Army Corps of Engineers, Coastal Engineering Research Center	U.S. Army Corps of Engineers, Los Angeles District	U.S. Army Corps of Engineers, Waterways Experiment Station
U.S. Department of Defense, Fleet Numerical Weather Center	U.S. Geological Survey	

The State Coordinator was involved in these study efforts through the San Francisco Regional office of the Federal Emergency Management Agency.

For unincorporated areas of Los Angeles County, an initial coordination meeting attended by representatives of the County, FEMA, the California State Department of Water Resources, and the study contractor was held in February 1976. The purpose of the meeting was to discuss the nature and scope of the study and to determine the areas to be studied by detailed and approximate methods.

During the course of the study, representatives of the County were contacted to gather the latest relevant information. Flood elevations and flood boundaries were reviewed with appropriate county officials.

The U.S. Soil Conservation Service; the U.S. Army Corps of Engineers; the U.S. Geological Survey, Water Resources Division; the California State Departments of Water Resources and Transportation; and the Southern Pacific (now Union Pacific) Transportation Company were contacted and provided information used in this report.

The preliminary results of the Los Angeles County study for unincorporated areas were reviewed at four intermediate coordination meetings. The Antelope Valley meeting was held on January 22, 1979; the Santa Clarita Valley meeting on July 10, 1979; and the Malibu meetings on March 3 and 4, 1980. Representatives of FEMA, the study contractor, the Office of the County Engineer, and interested citizens, attended all meetings.

The results of this study were reviewed at a final coordination meeting held on May 7, 1980. Attending the meeting were representatives of FEMA, the study contractor, the Office of the County Engineer, and the county. No problems were raised at the meeting.

On January 26, 1984, Dames & Moore was instructed by FEMA to proceed with an existing data study for the City of Agoura Hills, using the detailed study data from the Los Angeles County FIS.

In preparing the Los Angeles County FIS, the State Department of Water Resources, the U.S. Geological Survey, and the U.S. Army Corps of Engineers were contacted for information and data. In addition, the U.S. Soil Conservation Service and the Southern Pacific Transportation Company were also contacted.

In preparing this existing data study, the City of Agoura Hills was contacted for information regarding cultural features and existing conditions in the community.

The final CCO meeting for this study was held on December 20, 1984, and was attended by representatives of FEMA, the study contractor, and the City of Agoura Hills. No problems were raised at this meeting.

The initial CCO meeting for the August 3, 1998 revision was held on October 12, 1995, and attended by representatives of the City of Agoura Hills and the study contractor. Available data were discussed, and a field reconnaissance was performed jointly with the City of Agoura Hills. The scope of methods of study were proposed to, and agreed upon, by FEMA and the City of Agoura Hills.

An initial coordination meeting for study of the City of Avalon, attended by representatives of the City, FEMA, the State Department of Water Resources, and the Flood Control District, was held in February 1976. The purpose of the meeting was to discuss the nature and scope of the study and to determine the areas which would be studied by detailed and approximate methods.

During the course of the work done by the Los Angeles County Flood Control District on the City of Avalon, flood elevations and flood boundaries were reviewed with appropriate community officials.

On December 14, 1976, the preliminary results of the work were reviewed at an intermediate coordination meeting. Representatives of the Los Angeles County Flood Control District, FEMA, the State Department of Water Resources, and the offices of the City Engineer, Manager, and Planning attended the meeting.

The final coordination meeting for the City of Avalon was held on November 9, 1977. Representatives of the City, FEMA, and the study contractor attended the meeting. No major problems with the study were found at the meeting.

For information pertinent to coastal areas within the City of Avalon, used to revise and update the study, numerous agencies were contacted in an attempt to explore all possible sources of data. Information describing hydrological conditions, drainage patterns, historical storm systems, tides, and waves as well as information on the topography, roads, benchmarks, beach profiles, shelf bathymetry flood protection structures (seawalls, breakwaters), and the demography of coastal areas was sought.

The initial Consultation Coordination Officer (CCO) meeting for the Cities of Bellflower, Carson, Compton, Downey, Gardena, Lakewood, Lynwood, Paramount, Pico Rivera, and South Gate, was held on January 28, 1986 and attended by representatives of the Cities of Downey, Long Beach, Lynwood, Vernon, Bellflower, Paramount, Los Angeles County and the Los Angeles County Flood Control District (LACFCD), the USACE, FEMA, and the study contractor.

On April 4, 1991, an interim coordination meeting was held with representatives from FEMA and community officials from the Cities of Pico Rivera, Bellflower, South Gate, Lynwood, Seal Beach, Torrance, Bell Gardens, Signal Hill, Los Angeles, Downey, Long Beach, Compton, Paramount, Lakewood, Carson, Cerritos, Gardena, and Los Angeles County, and representatives of the California Department of Water Resources, the USACE, Los Angeles District, State Senator David Roberti's office, and the study contractor. Preliminary results of the study were presented.

The USACE provided as-built plans of the channel and bridge characteristics along with peak discharge and original design information. They also provided hydrologic and hydraulic information for the study area, from the LACDA Appendix A - Hydrology, updated February 1990, and Hydraulic Appendix dated July 1989. This report will be referred to as the LACDA report. Coordination with the USACE concerning certification of levees, breakout locations and progress of work was on-going during this study. The CALTRANS was helpful in providing information regarding bridge and highway geometric data. Vertical control data to establish the Elevation Reference Marks (ERM) were obtained from the United States Geological Survey (USGS), the United States Coast and Geodetic Survey, and the Cities of Long Beach, Paramount, and Compton.

The results of the study of the Cities of Bellflower, Carson, Compton, Downey, Gardena, Lakewood, Lynwood, Paramount, Pico Rivera, South Gate and Los Angeles County were reviewed at the final CCO meeting held on October 30, 1991, and attended by representatives of FEMA, the study contractor, and communities affected by the Los Angeles River and Rio Hondo restudy. All problems raised at that meeting have been addressed in this study.

A final CCO meeting for the restudy of the Los Angeles River and Rio Hondo affecting the City of Los Angeles was held on December 3, 1997. This meeting was attended by representatives of the City of Los Angeles and FEMA. All problems raised at this meeting have been addressed in the restudy.

An initial CCO meeting for the City of Burbank, attended by representatives of the community, the Federal Insurance Administration, the State Department of Water Resources, and the study contractor, was held in February 1976. The purpose of the meeting was to discuss the nature and scope of the study and to determine the areas to be studied by detailed and approximate methods.

A request for information relevant to the study was made to various governmental and local agencies, including the U.S. Soil Conservation Service; the U.S. Army Corps of Engineers; the U.S. Geological Survey, Water Resources Division; and the State Department of Water Resources.

Drainage deficiency reports and historical flooding information on file at the Los Angeles County Flood Control District were reviewed.

During the course of the work done by the study contractor, flood elevations and flood boundaries were reviewed with appropriate community officials.

On May 18, 1978, the preliminary results of this study were reviewed at an intermediate coordination meeting. Representatives of the study contractor, the Federal Insurance Administration, and the office of the City Engineer attended the meeting.

The results of the study of the City of Burbank were reviewed at a final CCO meeting held on November 2, 1979. Attending the meeting were representatives of the Federal Insurance Administration, the study contractor, and the city. No problems were raised at the meeting.

Results of the January 20, 1999 revision for the City of Burbank were reviewed at a final CCO meeting held on October 15, 1997, and attended by representatives of FEMA and the City of Burbank. All problems raised at this meeting have been addressed in the restudy.

An initial CCO meeting, attended by representatives of the City of Culver City, the Federal Insurance Administration, the California State Department of Water Resources, and the Los Angeles County Flood Control District (the study contractor), was held in February 1976. The purpose of the meeting was to discuss the nature and scope of the study and to determine the areas to be studied by detailed and approximate methods.

The U.S. Soil Conservation Service; the U.S. Army Corps of Engineers; the U.S. Geological Survey, Water Resources Division; and, the California State Department of Water Resources were contacted and provided information used in the study of the City of Culver City.

On May 16, 1978, the preliminary results of the study of the City of Culver City were reviewed at an intermediate coordination meeting. Representatives of the Federal Insurance Administration, the study contractor, and the office of the City Engineer attended the meeting.

The results of the study of the City of Culver City were reviewed at a final CCO meeting held on January 11, 1979. Attending the meeting were representatives of the Federal Insurance Administration, the study contractor, and the City. No problems were raised at the meeting.

An initial CCO meeting was held for the City of La Mirada, attended by the City Engineer and representatives of the Federal Insurance Administration, the California State Department of Water Resources, and the Los Angeles County Flood Control District, in February 1976.

The U.S. Soil Conservation Service, the U.S. Army Corps of Engineers, the U.S. Geological Survey Water Resources Division, and the State Department of Water Resources were contacted for information relevant to the study. During the study, representatives from the Office of the City Engineer were contacted on several occasions to gather the latest possible relevant information. During the course of the work done by the study contractor, flood information was reviewed with Toups Corporation and VTN Corporation.

Flood elevations and flood boundaries were reviewed with the City Engineer and the Planning Director at a meeting held in the Office of the City Engineer on September 11, 1978. Zoning information supplied by the Planning Director was used to refine the limits of flooding along La Mirada Creek upstream of La Mirada Boulevard.

On October 3, 1978, the preliminary results of the study of the City of La Mirada were reviewed at an intermediate coordination meeting. The meeting was attended by the city planning director and representatives of the study contractor, and the Federal Insurance Administration.

The results of this study were reviewed at a final community coordination meeting held on May 21, 1979. Attending the meeting were representatives of the Federal Insurance Administration, the study contractor, Los Angeles County Flood Control District, and the City. No problems were raised at the meeting.

An initial CCO meeting for the original study of the City of Long Beach, attended by the City Engineer, FEMA, the State Department of Water Resources, and the Los Angeles County Flood Control District (the study contractor), was held in February 1976.

A request for information relevant to the study was made to various governmental and local agencies, including the U.S. Soil Conservation Service; the USACE; the U.S. Geological Survey (USGS), Water Resources Division; the State Department of Water Resources; the California Coastal Commission; the CALTRANS; the State Department of Boating and Waterways; the State Office of Emergency Services; the National Oceanic and Atmospheric Administration; the National Weather Service, Los Angeles; the Fleet Numerical Weather Center; Department of Defense; the Los Angeles County Engineers Facilities; the County Office of Emergency Services; the County Regional Planning Department; CH2M Hill, Inc.; Scripps Institute of Oceanography; the South Coast Regional Coastal Commission; the City Engineer's Office, and the Long Beach Harbor Department.

On October 25, 1978, the preliminary results of this study were reviewed at an intermediate coordination meeting. Representatives of the study contractor, FEMA, and the City Engineer’s Office attended the meeting. No objections were made at this time and the study was acceptable to the community.

The final CCO meeting on the original study of the City of Long Beach was held on October 27, 1982, and was attended by representatives of FEMA, the study contractor, and the city. All problems raised at the meeting were resolved.

The initial CCO meeting for the revised study of the City of Long Beach was held on January 28, 1986 and attended by representatives of the Cities of Downey, Long Beach, Lynwood, Vernon, Bellflower, Paramount, and the LACFCD, the USACE, FEMA, and the study contractor.

On April 4, 1991, an interim coordination meeting was held with representatives from FEMA and community officials from the Cities of Pico Rivera, Bellflower, South Gate, Lynwood, Seal Beach, Torrance, Bell Gardens, Signal Hill, Los Angeles, Downey, Long Beach, Compton, Paramount, Lakewood, Carson, Cerritos, Gardena, and Los Angeles County, and representatives of the California Department of Water Resources, the USACE, Los Angeles District, State Senator David Roberti's office, and the study contractor. Preliminary results of the study were presented.

The results of the re-study of the City of Long Beach were reviewed at the final CCO meeting held on October 30, 1991, and attended by representatives of FEMA, the study contractor, and communities affected by the Los Angeles River and Rio Hondo restudy. All problems raised at that meeting have been addressed in this study.

An initial CCO meeting on the City of Los Angeles, attended by representatives of FEMA, the California State Department of Water Resources, and the study contractor, was held in February 1976.

Agencies providing information used in this study included: the U.S. Soil Conservation Service; the U.S. Army Corps of Engineers; the U.S. Geological Survey, Water Resources Division; and the California State Department of Water Resources.

During the study, the study contractor reviewed drainage deficiencies and historic flooding information, on file at the Los Angeles County Flood Control District.

In a series of meetings held on November 7 and 9, 1978, the study contractor met with San Fernando Valley Councilpersons to review the flood elevations and flood, plain boundaries affecting their districts.

On November 28, 1978, FEMA and the study contractor, which was attended by representatives of the Mayor’s Office, the City Council, the Board of Public Works, the City Planning Department, the Department of Building and Safety, and the City Engineer’s Office, conducted a Flood Insurance Study session. A FEMA representative gave a briefing on the current and future status of the city in the National Flood Insurance Program (NFIP). A study contractor representative provided the City Engineer with a preview of the preliminary results of the study.

On November 1 and 9, 1978, and June 5, 1979, the study contractor displayed and explained the flood elevations and flood plain boundaries to the staff of the City Engineer's Offices representing the Harbor, San Fernando Valley, West Los Angeles, and Central Los Angeles Districts.

On July 10, 1979, representatives of FEMA and the study contractor conducted another study session for the City Councilpersons representing the West and Central Los Angeles Districts-in order to explain the city's participation in the NFIP and to review the 1-Percent Annual Chance flooding affecting their districts.

The preliminary results of the City of Los Angeles study were reviewed at three intermediate coordination meetings. The San Fernando Valley meeting was held on December 18, 1978; the Harbor District meeting was held on January 30, 1979; and a joint meeting for both the Central and West Los Angeles Districts was held on July 11, 1979. Representatives of FEMA, the study contractor, and the City Engineer’s Office, as well as concerned citizens attended all meetings.

The results of this study were reviewed at a final community coordination meeting held on May 7, 1980, and attended by representatives of FEMA, the study contractor, and the City. No problems were raised at the meeting.

On April 19, 1984, the Los Angeles County Flood Control District submitted information indicating a reduction in flood hazards as a result of Bond Issue Storm Drain Project No. 5204 on Jefferson Boulevard. This information was used to revise Flood Insurance Rate Map Panels 0072, 0073, 0079, and 0080 for the City of Los Angeles.

An initial CCO meeting for the original study of the City of Montebello attended by city officials, the FIA, the State Department of Water Resources, and the study contractor, was held in February 1976. The purpose of the meeting was to discuss the nature and scope of the study and to determine the areas to be studied by detailed and approximate methods.

The U.S. Soil Conservation Service; the USACE; the United States Geological Survey (USGS), Water Resources Division; and the State Department of Water Resources were contacted for information relevant to the study.

While conducting the study, representatives of the City Engineer's office were contacted on several occasions to gather the latest possible relevant information. During the course of the work done by the study contractor, flood elevations and flood boundaries were reviewed with the City Engineer at a meeting held in the City Engineer's office on May 15, 1978.

On August 15, 1978, the preliminary results of this study were reviewed at an intermediate coordination meeting. Representatives of the study contractor, the FIA, and the offices of the City Engineer and City Planning Department attended the meeting.

The results of this original study of the City of Montebello were reviewed at the final community coordination meeting held on January 24, 1979. Attending the meeting were representatives of the FIA, the study contractor, and the City. No problems were raised at this meeting which would affect the technical results of this study.

The initial CCO meeting for the revised study of the City of Montebello was held on January 28, 1986 and attended by representatives of the Cities of Downey, Long Beach, Lynwood, Vernon, Bellflower, Paramount, and the LACFCD, the USACE, FEMA, and the study contractor.

On April 4, 1991, an interim coordination meeting was held with representatives from FEMA and community officials from the Cities of Pico Rivera, Bellflower, South Gate, Lynwood, Seal Beach, Torrance, Bell Gardens, Signal Hill, Los Angeles, Downey, Long Beach, Compton, Paramount, Lakewood, Carson, Cerritos, Gardena, and Los Angeles County, and representatives of the California Department of Water Resources, the USACE, Los Angeles District, State Senator David Roberti's office, and the study contractor. Preliminary results of the study were presented.

The USACE provided as-built plans of the channel and bridge characteristics along with peak discharge and original design information. They also provided hydrologic and hydraulic information for the study area in the LACDA Appendix A - Hydrology, updated February 1990 and Hydraulic Appendix dated July 1989. This report will be referred to as the LACDA report. Coordination with the USACE concerning the certification of the levees, the breakout locations and progress of work was on going during this study. The CALTRANS was helpful in providing information regarding bridge and highway geometric data. Vertical control data to establish the Elevation Reference Marks (ERM) were obtained from the USGS, the United States Coast and Geodetic Survey, and the Cities of Long Beach, Paramount, and Compton.

The results of the study were reviewed at the final CCO meeting for the City of Montebello, held on October 30, 1991, and attended by representatives of FEMA, the study contractor, and communities affected by the Los Angeles River and Rio Hondo restudy. All problems raised at that meeting have been addressed in this study.

An initial CCO meeting for the original study of the City of Palmdale, was held in February 1976, and was attended by city officials, representatives of the Federal Insurance Administration, the California State Department of Water Resources, and the LACFCD.

During the course of study, representatives of the City Engineering Office were contacted on several occasions to gather information. The U.S. Soil Conservation Service; the USACE; the U.S. Geological Survey, Water Resources Division; the California State Departments of Water Resources and

Transportation; and the Southern Pacific Railroad were also contacted and provided information used in this study.

During the course of the study, flood depths were reviewed with appropriate community officials.

On January 22, 1979, the preliminary results of the original study were reviewed at an intermediate coordination meeting attended by representatives of the Federal Insurance Administration, the LACFCD, and the offices of the City Manager and the City Engineer. No problems resulting in changes to the study were encountered at the meeting.

City officials, representatives of FEMA, the California State Department of Water Resources, and REC, attended an initial coordination meeting for the revised study, held in April 1984.

A notice explaining the purpose of the revised study was published in the Antelope Valley Press on October 11, 1984. This notice served as an invitation to interested parties to bring any relevant facts and technical data to the attention of FEMA.

A final CCO meeting for the study of the City of Palmdale was held on January 8, 1986, and attended by representatives of the City of Palmdale, FEMA, and REC. The revised study was found to be acceptable to the City of Palmdale.

On August 23, 1990, an initial CCO meeting for the March 30, 1998 revision for the City of Palmdale was held with representatives of FEMA, the California State Department of Water Resources, the Los Angeles County Department of Public Works, the City of Palmdale, and the study contractor. The stream to be studied and limits of study were identified at the meeting. Available mapping, previous studies, and other data were also identified at the meeting.

During the conduct of the restudy, additional meetings were held among representatives of the California Department of Water Resources, the City of Palmdale, and the study contractor.

The results of this revision were reviewed at a final CCO meeting held on April 24, 1997, and attended by representatives of FEMA and the City of Palmdale. All problems raised at this meeting have been addressed in this restudy.

An initial CCO meeting for the study of the City of Redondo Beach, attended by representatives of the City Engineering Office, the Federal Emergency Management Agency, the State Department of Water Resources, and the Los Angeles County Flood Control District (the study contractor), was held in February 1976. The purpose of the meeting was to discuss the nature and scope of the study and to determine the areas to be studied by detailed and approximate methods.

Representatives of the study contractor reviewed flood elevations and flood boundaries with representatives from the Office of the City Engineer at a meeting held on February 21, 1978. The final community coordination meeting was held on October 27, 1982, and attended by representatives of the Federal Emergency Management Agency, the study contractor, and the city. No problems were raised at this meeting.

An initial CCO meeting for the City of Santa Fe Springs, attended by representatives of the Federal Insurance Administration, the State Department of Water Resources, and the study contractor, was held in February 1976.

Initial contact was made with the city's Director of Public Works on July 6, 1977, to discuss the scope of the study, flooding problems, and study procedures. On several occasions, officials of the city's engineering department were contacted to gather the latest relevant information.

Representatives of the study contractor reviewed flood elevations and flood boundaries with the City Engineer at a meeting held in the City Engineer's office on April 25, 1978.

On August 16, 1978, the preliminary results of this study were reviewed at an intermediate coordination meeting. The meeting was attended by representatives of the study contractor, the Federal Insurance Administration, and the offices of the City Engineer and Public Works Department.

The results of the study of the City of Santa Fe Springs were reviewed at a final CCO meeting held on February 28, 1979. Attending the meeting were representatives of the Federal Insurance Administration, the study contractor, and the City. No problems were raised at the meeting.

An initial CCO meeting for the City of Torrance, attended by city officials, and representatives of the Federal Insurance Administration, the State Department of Water Resources, and the study contractor, was held in February 1976. The purpose of the meeting was to discuss the nature and scope of the study and to determine the areas to be studied by detailed and approximate methods.

During the course of the study, representatives of the City Engineer's office were contacted on several occasions to gather the latest possible relevant information.

The U.S. Soil Conservation Service; the U.S. Army Corps of Engineers; the U.S. Geological Survey, Water Resources Division; and the State Department of Water Resources were contacted for information relevant to the study.

During the course of the work done by the study contractor, flood elevations and flood boundaries were reviewed with appropriate community officials.

On May 16, 1978, the preliminary results of this study were reviewed at an intermediate coordination meeting. The meeting was attended by representatives of the study contractor, the Federal Insurance Administration, and the office of the City Engineer.

A final CCO meeting was held on January 11, 1979, attended by city officials and representatives of the Federal Insurance Administration, and the study contractor. All corrections resulting from the meeting have been incorporated into the study.

An initial coordination meeting for the study of the City of Whittier, attended by city officials, the Federal Insurance Administration, the State Department of Water Resources, and the study contractor was held in February 1976. The purpose of the meeting was to discuss the nature and scope of the study and to determine the areas to be studied by detailed and approximate methods.

While conducting the study, representatives of the community were contacted on several occasions to gather the latest information.

Drainage deficiencies and historical flooding information on file at the Los Angeles County Flood Control District were reviewed in the course of the study.

A request for information relevant to the study was made to various governmental and local agencies, including the U.S. Soil Conservation Service; the U.S. Army Corps of Engineers; the U.S. Geological Survey, Water Resources Division; and the California State Department of Water Resources. These agencies did not have any data relevant to the study. However, Toups Corporation in the City of Santa Ana, California, supplied hydrologic data and 1-Percent Annual Chance flooding limits for La Mirada Creek in the adjoining City of La Habra.

During the course of the work done by the study contractor, flood elevations and flood with appropriate community officials.

On May 18, 1978, the preliminary results of this study were reviewed at an intermediate coordination meeting. The meeting was attended by representatives of the study contractor, the Federal Insurance boundaries were reviewed Administration, and the office of the City Engineer.

The results of this study were reviewed at a final CCO meeting held on November 1, 1979. Attending the meeting were representatives of the Federal Insurance Administration, the study contractor, the Los Angeles County Flood Control District, and the city. No problems were raised at the meeting.

An initial CCO meeting for the study of the City of Lancaster, attended by city officials and representatives of the Federal Insurance Administration, the California State Department of Water Resources, and the study contractor, was held in February 1976.

During the course of the study, representatives of the City Engineer's office were contacted on several occasions to gather the latest possible relevant information.

The U.S. Soil Conservation Service; the U.S. Army Corps of Engineers; the U.S. Geological Survey, Water Resources Division; the California State Departments of Water Resources and Transportation; and the Southern Pacific Transportation Company were contacted to provide information used in this study.

During the course of the study, flood elevations arid flood boundaries were reviewed with appropriate community officials.

On January 22, 1979, the preliminary results of this study were reviewed at an intermediate coordination meeting attended by representatives of the Federal Insurance Administration, the study contractor, and the offices of the City Engineer and Planning Department. No problems resulting in changes to the study were encountered at the meeting.

The final community coordination meeting was held in Palmdale, California, on January 13, 1981, and was attended by representatives of the Federal Insurance Administration, the study contractor, and the city. All problems and questions raised at that meeting have been resolved in this study.

On October 11, 1988, an initial CCO meeting for the City of Santa Clarita was held. On November 17, 1988, a final CCO meeting was held, at which the results of the study were reviewed. Representatives of FEMA, the City, and the community attended this meeting.

Coordination for the original study of what became the City of West Hollywood began as study of Los Angeles County’s unincorporated areas. Study began with a CCO meeting held in February 1976 attended by the County, FEMA, the California State Department of Water Resources and the study contractor.

The U.S. Soil Conservation Service; the U.S. Army Corps of Engineers; the U.S. Geological Survey, Water Resources Division; the California State Department of Water Resources and Transportation; and the Southern Pacific Transportation Company were contacted and provided information used in the Los Angeles County Flood Insurance Study.

The results of the Los Angeles County Flood Insurance Study were reviewed at a final CCO meeting held on May 7, 1980. Attending the meeting were representatives of FEMA, the study contractor, the Office of the County Engineer, and the County. No problems were raised at the meeting.

In February 1986, FEMA initiated the processing of a separate Flood Insurance Study for the City of West Hollywood. On July 3, 1986, the results of this study were reviewed and accepted at a final coordination meeting attended by representatives of the community and FEMA.

The dates of the initial and final CCO meetings held for Los Angeles County and the incorporated areas and communities within its boundaries are shown in Table 2, "Initial and Final CCO Meetings."

Table 2 - INITIAL AND FINAL CCO MEETINGS

Community Name	Initial CCO Date	Final CCO Date
Los Angeles County (Unincorporated Areas)	February 1976	May 7, 1980
Agoura Hills, City of	January 26, 1984 October 12, 1995	December 20, 1984
Alhambra, City Of	N/A	N/A
Arcadia, City Of	N/A	N/A
Artesia, City Of	N/A	N/A
Avalon, City Of	February 1976	November 9, 1977
Azusa, City Of	N/A	N/A
Baldwin Park, City Of	N/A	N/A
Bell Gardens, City Of	N/A	N/A
Bell, City Of	N/A	N/A
Bellflower, City Of	January 28, 1986	October 30, 1991
Beverly Hills, City Of	N/A	N/A
Bradbury, City Of	N/A	N/A
Burbank, City Of	February 1976	November 2, 1979 October 15, 1997
Calabasas, City Of	N/A	N/A

Table 2 - INITIAL AND FINAL CCO MEETINGS

Community Name	Initial CCO Date	Final CCO Date
Carson, City Of	January 28, 1986	October 30, 1991
Cerritos, City Of	N/A	N/A
Claremont, City Of	N/A	N/A
Commerce, City Of	N/A	N/A
Compton, City Of	January 28, 1986	October 30, 1991
Covina, City Of	N/A	N/A
Cudahy, City Of	N/A	N/A
Culver City, City Of	February 1976	January 11, 1979
Diamond Bar, City Of	N/A	N/A
Downey, City Of	January 28, 1986	October 30, 1991
Duarte, City Of	N/A	N/A
El Monte, City Of	N/A	N/A
El Segundo, City Of	N/A	N/A
Gardena, City Of	January 28, 1986	October 30, 1991
Glendale, City Of	N/A	N/A
Glendora, City Of	N/A	N/A
Hawaiian Gardens, City Of	N/A	N/A
Hawthorne, City Of	N/A	N/A
Hermosa Beach, City Of	N/A	N/A
Hidden Hills, City Of	N/A	N/A

Table 2 - INITIAL AND FINAL CCO MEETINGS

Community Name	Initial CCO Date	Final CCO Date
Huntington Park, City Of	N/A	N/A
Industry, City Of	N/A	N/A
Inglewood, City Of	N/A	N/A
Irwindale, City Of	N/A	N/A
La Canada Flintridge, City Of	N/A	N/A
La Habra Heights, City Of	N/A	N/A
La Mirada, City Of	February 1976	May 21, 1979
La Puente, City Of	N/A	N/A
La Verne, City Of	N/A	N/A
Lakewood, City Of	January 28, 1986	October 30, 1991
Lancaster, City Of	February 1976	January 13, 1981
Lawndale, City Of	N/A	N/A
Lomita, City Of	N/A	N/A
Long Beach, City Of	February 1976 January 28, 1986	October 27, 1982 October 30, 1991
Los Angeles, City Of	February 1976	May 7, 1980 December 3, 1997
Lynwood, City Of	January 28, 1986	October 30, 1991
Malibu, City Of	N/A	N/A
Manhattan Beach, City Of	N/A	N/A
Maywood, City Of	N/A	N/A
Monrovia, City Of	N/A	N/A

Table 2 - INITIAL AND FINAL CCO MEETINGS

Community Name	Initial CCO Date	Final CCO Date
Montebello, City Of	February 1976 January 28, 1986	January 24, 1979 October 30, 1991
Monterey Park, City Of	N/A	N/A
Norwalk, City Of	N/A	N/A
Palmdale, City Of	February 1976 August 23, 1990	January 8, 1986 April 24,1997
Palos Verdes Estates, City Of	N/A	N/A
Paramount, City Of	January 28, 1986	October 30, 1991
Pasadena, City Of	N/A	N/A
Pico Rivera, City Of	January 28, 1986	October 30, 1991
Pomona, City Of	N/A	N/A
Rancho Palos Verdes, City Of	N/A	N/A
Redondo Beach, City Of	February 1976	October 27, 1982
Rolling Hills Estates, City Of	N/A	N/A
Rolling Hills, City Of	N/A	N/A
Rosemead, City Of	N/A	N/A
San Dimas, City Of	N/A	N/A
San Fernando, City Of	N/A	N/A
San Gabriel, City Of	N/A	N/A
San Marino, City Of	N/A	N/A
Santa Clarita, City Of	October 11, 1988	November 17, 1988
Santa Fe Springs, City Of	February 1976	February 28, 1979

Table 2 - INITIAL AND FINAL CCO MEETINGS

Community Name	Initial CCO Date	Final CCO Date
Santa Monica, City Of	N/A	N/A
Sierra Madre, City Of	N/A	N/A
Signal Hill, City Of	N/A	N/A
South El Monte, City Of	N/A	N/A
South Gate, City Of	January 28, 1986	October 30, 1991
South Pasadena, City Of	N/A	N/A
Temple City, City Of	N/A	N/A
Torrance, City Of	February 1976	January 11, 1979
Vernon, City Of	N/A	N/A
Walnut, City Of	N/A	N/A
West Covina, City Of	N/A	N/A
West Hollywood, City Of	February 1976 February 1986	May 7, 1980 July 3, 1986
Westlake Village, City Of	N/A	N/A
Whittier, City Of	February 1976	November 1, 1979

N/A – Not Applicable

In September 2008, HDR Engineering Inc. completed a countywide DFIRM and FIS for the County of Los Angeles. HDR Engineering Inc. was hired as an IDIQ study contractor for FEMA Region IX under contract number EMF-2003-CO-0045, Task Order 15. The DFIRM process included digitizing floodplain boundaries from the effective paper FIRMs and fitting them to a digital base map, thus converting the existing manually produced FIRMs to digitally produced FIRMs, referred to as DFIRMs. Individual community effective FIS reports were also combined into one report for the entire county.

On May 9-12, 2005, the initial CCO meeting for the Los Angeles countywide DFIRM and FIS were held. Attending the meeting were representatives of FEMA Region IX, HDR Engineering Inc. the study contractor, RMC, Los Angeles County, cities of Arcadia, Bell, Burbank, Carson, Downey, La Canada

Flintridge, La Mirada, La Verne, Lakewood, Lancaster, Long Beach, Los Angeles, Lynwood, Malibu, Palos Verdes Estates, Redondo Beach, San Dimas, Santa Fe Springs, and West Covina.

On November 15-16, 2005, the final CCO meeting for the Los Angeles countywide DFIRM and FIS were held. Attending the meeting were representatives of FEMA Region IX, HDR Engineering Inc. the study contactor, Los Angeles County, cities of Agoura Hills, Arcadia, Burbank, Diamond Bar, Gardena, Glendale, Glendora, Irwindale, La Canada Flintridge, La Mirada, Lancaster, Long Beach, Los Angeles, Lynwood, Malibu, Monrovia, Pico Rivera, San Dimas, San Fernando, Santa Clarita, West Covina, and West Hollywood.

2.0 <u>AREA STUDIED</u>

2.1 Scope of Study

This FIS covers the geographic area of Los Angeles County, California, including the incorporated communities listed in Section 1.1. The areas studied by detailed methods were selected with priority given to all known flood hazards and areas of projected development.

Los Angeles County

The unincorporated areas of the County have been generally divided into four primary sub-areas: those of the Antelope Valley, Santa Clarita Valley, the Malibu area, and the Los Angeles basin. Unincorporated territory in the Los Angeles basin consists primarily of "islands" partially or completely surrounded by incorporated cities or National Forest boundaries. The largest portion of unincorporated territory in the Los Angeles basin is currently located in the Hacienda Heights-Diamond Bar area in the southeastern portion of the County. Areas within National Forest lands were not studied in detail because of low development potential. Edwards Air Force Base was not included in this study.

Flooding sources that affect developed areas or areas with high potential for development were studied by detailed methods. A detailed analysis of the Pacific Ocean was performed for the entire coastline of Los Angeles County. Portions of the County to be studied by detailed methods were selected after considering the level of existing and proposed development. Areas with little or no potential for future development were studied by approximate methods or excluded from the study.

There are watersheds of less than 1 square mile within the County that have historically caused flooding. In order to complete an adequate detailed study, it was necessary to evaluate drainage areas of less than 1 square mile.

Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon by FEMA and Los Angeles County.

City of Agoura Hills

This FIS covers the incorporated areas of the City of Agoura Hills, Los Angeles County, California. Flooding caused by Lindero Canyon was studied in detail from its confluence with Medea Creek upstream to the southern edge of Agoura Road and from Mainmast Drive upstream through the City of Agoura Hills. Medea Creek was studied in detail from a point approximately 400 feet downstream of Sideway Road, upstream to a point approximately 1,150 feet above Canwood Street. Cheseboro Creek was studied in detail from the southern edge of Driver Avenue to a point approximately 1,450 feet upstream of Driver Avenue. Palo Comado Creek was studied in detail from a point approximately 400 feet downstream of Balkins Drive to a point approximately 5,500 feet upstream.

Medea Creek was studied by approximate methods from a point approximately 1,150 feet upstream of Canwood Street to the corporate limits.

The FIS for the City of Agoura Hills was revised on December 18, 1986 to add approximate Zone A flooding along Liberty Canyon. Depths of flooding were determined using Manning's equation. The 1-percent annual chance flood discharge was obtained from the 1980 FIS for Los Angeles County (Federal Emergency Management Agency, 1980).

The FIS for the City of Agoura Hills was also revised on August 3, 1998, to incorporate detailed flood-hazard information along Medea Creek from approximately 1,040 feet downstream of Kanan road to approximately 385 feet upstream of Fountainwood Street.

Along Medea Creek, the Los Angeles County Department of Public Works constructed approximately 2,000 linear feet of reinforced-concrete-lined channel approximately 500 feet downstream of Kanan Road to approximately 200 feet downstream of Thousand Oaks Boulevard to approximately 700 feet upstream of Thousand Oaks Boulevard. The channel has a side-slope lining with an earthen-channel invert. In addition, channel modifications have been completed from 1,600 feet upstream of Thousand Oaks Boulevard to Ventura County line. These modifications include channel excavation, installation of riprap slope protection, and construction of riprap grade stabilization structures.

City of Alhambra

The City of Alhambra is identified as a non-flood prone community.

City of Arcadia

The City of Arcadia is identified as a non-flood prone community.

City of Artesia

The City of Artesia is identified as a non-flood prone community.

City of Avalon

Coastal areas from the western corporate limits to approximately 0.3 mile from the eastern corporate limits were studied by detailed methods that considered tidal flooding and wave run-up. Avalon Canyon was also studied by detailed methods.

The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development or proposed construction through 1986.

Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon by, FEMA and the City of Avalon.

Cities of Bellflower, Carson, Compton, Downey, Gardena, Lakewood, Los Angeles, Lynwood, Paramount, Pico Rivera, South Gate and Los Angeles County

The primary flood threat to the communities listed above is caused by the Los Angeles River. This Countywide FIS encompasses the Los Angeles River from the Arroyo Seco confluence to the Pacific Ocean and the Rio Hondo from Whittier Narrows Dam to the confluence with the Los Angeles River in Los Angeles County, California. The study effort divided the River into four reaches. The upper reach begins at the confluence of the Arroyo Seco River and ends downstream of Interstate 10. The middle reach starts downstream of Interstate 10 and ends at the confluence of the Rio Hondo River. The lower reach extends from the confluence of the Rio Hondo to the Pacific Ocean. The Rio Hondo reach begins at the Whittier Narrows Dam and ends at Interstate 105, the Century Freeway. Flooding from the San Gabriel River is not in the scope of this study. Discharge from Arroyo Seco enters the Los Angeles River at its confluence.

The Los Angeles River concrete channel was built by the USACE in cooperation with LACFCD in 1958. The middle reach was certified in September 1987 as having adequate design capacity to carry the 100 year discharge in accordance with FEMA guidelines. The upper and lower reach and the Rio Hondo were not certified. These areas were studied using detailed methods. Overflow maps were provided by the USACE for the middle reach. Breakout locations and magnitudes on both the Los Angeles River and the Rio Hondo as well as Compton Creek were also provided by the USACE in the LACDA report. The scope and methods of study were agreed to by FEMA, USACE, and LACFCD.

City of Azusa

Results of the mapping study were not previously summarized in an effective FIS report for the City of Azusa; therefore, no scope of study is provided.

City of Baldwin Park

Results of the mapping study were not previously summarized in an effective FIS report for the City of Baldwin Park; therefore, no scope of study is provided.

City of Bell Gardens

Results of the mapping study were not previously summarized in an effective FIS report for the City of Bell Gardens; therefore, no scope of study is provided.

City of Bell

The City of Bell is identified as a non-flood prone community.

City of Beverly Hills

Results of the mapping study were not previously summarized in an effective FIS report for the City of Beverly Hills; therefore, no scope of study is provided.

City of Bradbury

The City of Bradbury is identified as a non-flood prone community.

City of Burbank

The Los Angeles River Flood Control Channel and the Burbank Western Flood Control Channel were studied by detailed methods. All shallow flooding sources that affect the community were studied in detail. Lockheed Storm Drain was studied by approximate methods.

Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to and agreed upon by the Federal Insurance Administration and the City of Burbank.

The January 20, 1999 revision incorporated detailed flood hazard information along the Lockhead Drain Channel in the City of Burbank. The study limits extend from the confluence with the Burbank Western Flood Control Channel to approximately 1,300 feet downstream of Vineland Avenue. The length of the reach studied is approximately 2.9 miles. Flood hazard information along Lake Street, North Overflow, and Empire Avenue was also incorporated in this restudy.

City of Calabasas

Results of the mapping study were not previously summarized in an effective FIS report for the City of Calabasas; therefore, no scope of study is provided.

City of Cerritos

Results of the mapping study were not previously summarized in an effective FIS report for the City of Cerritos; therefore, no scope of study is provided.

City of Claremont

Revised effective FIRMs were issued 7/2/2004 and have been included into the countywide FIRM. Results of the mapping study were not previously summarized in an effective FIS report for the City of Claremont; therefore, no detailed information is provided.

City of Commerce

Results of the mapping study were not previously summarized in an effective FIS report for the City of Commerce; therefore, no scope of study is provided.

City of Covina

Results of the mapping study were not previously summarized in an effective FIS report for the City of Covina; therefore, no scope of study is provided.

City of Cudahy

Results of the mapping study were not previously summarized in an effective FIS report for the City of Cudahy; therefore, no scope of study is provided.

City of Culver City

Ballona Creek Channel, Sawtelle-Westwood Storm Drain Channel, Benedict Canyon Channel, Centinela Creek Channel, and the shallow flooding areas in the vicinity of the intersection of Adams and Washington Boulevards and along the western border of Hannum Avenue, in the northeast section of the Fox Hills Mall were studied in detail. An oil field in the eastern portion of the city was studied by approximate methods due to a lack of potential for development.

Those areas studied by detailed methods were chosen with consideration given to all proposed construction and forecasted development through 1983.

City of Diamond Bar

Results of the mapping study were not previously summarized in an effective FIS report for the City of Diamond Bar; therefore, no scope of study is provided.

City of Duarte

The City of Duarte is identified as a non-flood prone community.

City of El Monte

The City of El Monte is identified as a non-flood prone community.

City of El Segundo

Results of the mapping study were not previously summarized in an effective FIS report for the City of El Segundo; therefore, no scope of study is provided.

City of Glendale

Results of the mapping study were not previously summarized in an effective FIS report for the City of Glendale; therefore, no scope of study is provided.

City of Glendora

Results of the mapping study were not previously summarized in an effective FIS report for the City of Glendora; therefore, no scope of study is provided.

City of Hawaiian Gardens

Results of the mapping study were not previously summarized in an effective FIS report for the City of Hawaiian Gardens; therefore, no scope of study is provided.

City of Hawthorne

The City of Hawthorne is identified as a non-flood prone community.

City of Hermosa Beach

Results of the mapping study were not previously summarized in an effective FIS report for the City of Hermosa Beach; therefore, no scope of study is provided.

City of Hidden Hills

Revised effective FIRMs were issued 1/19/2006 and have been included into the countywide FIRM. Results of the mapping study were not previously summarized in an effective FIS report for the City of Hidden Hills; therefore, no detailed information is provided.

City of Huntington Park

The City of Huntington Park is identified as a non-flood prone community.

City of Industry

Results of the mapping study were not previously summarized in an effective FIS report for the City of Industry; therefore, no scope of study is provided.

City of Inglewood

Results of the mapping study were not previously summarized in an effective FIS report for the City of Inglewood; therefore, no scope of study is provided.

City of Irwindale

Results of the mapping study were not previously summarized in an effective FIS report for the City of Irwindale; therefore, no scope of study is provided.

City of La Canada Flintridge

The City of La Canada Flintridge is identified as a non-flood prone community.

City of La Habra Heights

Results of the mapping study were not previously summarized in an effective FIS report for the City of La Habra Heights; therefore, no scope of study is provided.

City of La Mirada

Flooding caused by the overflow of La Mirada Creek and ponding areas throughout the community was studied in detail.

Those areas studied by detailed methods were chosen with consideration given to all proposed construction and forecasted development through 1984.

City of La Puente

Results of the mapping study were not previously summarized in an effective FIS report for the City of La Puente; therefore, no scope of study is provided.

City of La Verne

Results of the mapping study were not previously summarized in an effective FIS report for the City of La Verne; therefore, no scope of study is provided.

City of Lancaster

Streams selected for detailed study affecting the City of Lancaster were Amargosa Creek, Amargosa Creek Tributary, and Portal Ridge Wash.

Portions of Lancaster that were studied by detailed methods were those areas shown as having a potential for development in the preliminary North Los Angeles County General Plan.

Those areas studied by detailed methods were chosen with consideration given to all proposed construction and forecasted development through 1984.

City of Lawndale

The City of Lawndale is identified as a non-flood prone community.

City of Lomita

The City of Lomita is identified as a non-flood prone community.

City of Long Beach

This FIS covers the incorporated areas of the City of Long Beach, including those affected by potential overflow of the Los Angeles River (as discussed, and as studied under the City of Bellflower, et al., above).

In addition, as discovered in the original study, some watersheds within the city which have historically caused flooding in developed low-lying areas are less than 1 square mile in area. To complete a detailed study of the community, it was necessary to evaluate these watersheds.

Low-lying areas between the San Gabriel River and the San Gabriel River Freeway were studied by approximate methods.

Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon by, FEMA and the study contractor.

City of Los Angeles

This FIS covers the incorporated areas of the City of Los Angeles, as studied for the Los Angeles River from the Arroyo Seco confluence to the Pacific Ocean and the Rio Hondo from Whittier Narrows Dam to the confluence with the Los Angeles River in Los Angeles County, California (as discussed under the City of Bellflower, above).

The study area was also broken into four primary subareas: the San Fernando Valley, Harbor, Central, and West Districts. This was possible because of the hydrologic independence of each watershed and necessary because of the geographical expanse of the city. Portions of the Central District tributary to Ballona Creek were studied within the West Los Angeles District.

Flooding sources studied by detailed methods include: Weldon Canyon, Kagel Canyon, Rustic Canyon, Pacomia Wash, Little Tujunga Wash, and Big Tujunga Wash, as well as areas affected by surface runoff and shallow flooding throughout the city. There are several rock quarries, public parks, and golf courses in the city that will be flooded during a 1-percent chance flood. These areas were studied by approximate methods due to the lack of potential for development.

As mentioned earlier, a detailed analysis of coastal areas affected by the Pacific Ocean was performed along the entire coastline of the City of Los Angeles, including Los Angeles Harbor.

There are watersheds of less than 1 square mile within the city that have historically caused flooding in developed low-lying areas. Therefore, to complete a detailed study of the community, it was necessary to evaluate drainage areas of less than 1 square mile.

The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development or proposed construction through 1989.

Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon by, FEMA and the City of Los Angeles.

The City of Los Angeles FIS was revised on May 4, 1999. This restudy was done in two parts. Part one incorporates detailed flood-hazard information from the Los Angeles River and Rio Hondo affecting the City of Los Angeles. Part two incorporates detailed flood hazard information along Overflow Area of Lockheed Drain Channel from Vanowen Street to approximately 380 feet northwest of Vanowen Street.

City of Malibu

Results of the mapping study were not previously summarized in an effective FIS report for the City of Malibu; therefore, no scope of study is provided.

City of Manhattan Beach

Results of the mapping study were not previously summarized in an effective FIS report for the City of Manhattan Beach; therefore, no scope of study is provided.

City of Maywood

The City of Maywood is identified as a non-flood prone community.

City of Monrovia

The City of Monrovia is identified as a non-flood prone community.

City of Montebello

All flooding sources that affect the community, including the flooding area at the intersection of Garfield Avenue and Beverly Boulevard, the ponding area at the intersection of Mines Avenue and Taylor Avenue, and Whittier Narrows Flood Control Basin were studied in detail for the original study. The rock quarry in the southwest portion of the city and the pond in Montebello Municipal Golf Course were studied by approximate methods due to a lack of potential for development.

Watersheds of less than 1 square mile within the city have historically caused flooding in developed low-lying areas. Therefore, to complete a detailed study of the community, it was necessary to evaluate drainage areas of less than l square mile.

Those areas studied by detailed methods for the original study were chosen with consideration given to all proposed construction and forecasted development through 1983.

The revised study of the City of Montebello included the results of the study of the Los Angeles River from the Arroyo Seco confluence to the Pacific Ocean and the Rio Hondo from Whittier Narrows Dam to the confluence with the Los Angeles River, as discussed under the City of Bellflower, et al., above.

The areas studied by detailed methods for the revised study were selected with priority given to all known flood hazards and areas of projected development or proposed construction through 1991.

City of Monterey Park

Results of the mapping study were not previously summarized in an effective FIS report for the City of Manhattan Beach; therefore, no scope of study is provided.

City of Norwalk

Results of the mapping study were not previously summarized in an effective FIS report for the City of Norwalk; therefore, no scope of study is provided.

City of Palmdale

This Countywide FIS covers the incorporated areas of the City of Palmdale, excluding U.S. Air Force Plant 42, located within the City.

Portions of Palmdale that were studied by detailed methods are those areas shown as having a potential for development in the preliminary North Los Angeles County General Plan, which includes much of central and western Palmdale. The city is situated on an alluvial fan at the northern base of the San Gabriel Mountain foothills. Floodflows discharge from the foothills onto the alluvial fan, where there are relatively few permanent streams, causing the flows to spread out over much of the city. Included in the detailed analysis are areas flooded by Amargosa Creek, Amargosa Creek Tributary, Anaverde Creek, Big Rock Wash and Little Rock Wash. Also studied in detail was flooding from segments of Anaverde Creek Tributary, located south of the city, which affects the southwestern portion of the city.

The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development or proposed construction through November 1990.

Areas studied by approximate methods include an area in the western part of the city affected by alluvial fan flooding from Ritter Ridge in the San Gabriel Mountains and a small segment of Anaverde Creek in western Palmdale. Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon by, FEMA and the City of Palmdale.

The March 30, 1998 restudy consisted of the analysis of approximately 2 miles of Anaverde Creek, from the Antelope Valley Freeway (California State Highway 14) to the California Aqueduct.

For approximately 4,000 feet at the upstream end of the study, Anaverde Creek has been channelized and consists of an unlined trapezoidal section. This work was performed as part of the construction of the California Aqueduct. A short floodway structure has been constructed under the California State Highway 14 undercrossing bridge for Rayburn Road at the downstream limit of this study. This structure was constructed as part of the Route 14 project, and serves to channelize the flow under the freeway.

City of Palos Verdes Estates

Revised effective FIRMs were issued July 2, 2004 and have been included into the countywide FIRM.

Results of the mapping study were not previously summarized in an effective FIS report for the City of Palos Verdes Estates; therefore, no detailed information is provided. .

City of Pasadena

The City of Pasadena is identified as a non-flood prone community.

City of Pomona

Results of the mapping study were not previously summarized in an effective FIS report for the City of Pomona; therefore, no scope of study is provided.

City of Rancho Palos Verdes

Results of the mapping study were not previously summarized in an effective FIS report for the City of Rancho Palos Verdes; therefore, no scope of study is provided.

City of Redondo Beach

The small watersheds within the City and coastal areas along Santa Monica Bay fronted by King Harbor comprising the City were studied in detail. Redondo State Beach was not included in this study.

City of Rolling Hills Estates

Results of the mapping study were not previously summarized in an effective FIS report for the City of Rolling Hills Estates; therefore, no scope of study is provided.

City of Rolling Hills

The City of Rolling Hills is identified as a non-flood prone community.

City of Rosemead

Results of the mapping study were not previously summarized in an effective FIS report for the City of Rosemead; therefore, no scope of study is provided.

City of San Dimas

Results of the mapping study were not previously summarized in an effective FIS report for the City of San Dimas; therefore, no scope of study is provided.

City of San Fernando

Results of the mapping study were not previously summarized in an effective FIS report for the City of San Fernando; therefore, no scope of study is provided.

City of San Gabriel

The City of San Gabriel is identified as a non-flood prone community.

City of San Marino

The City of San Marino is identified as a non-flood prone community.

City of Santa Clarita

The following stream reaches were studied by detailed methods in the City of Santa Clarita:

- Santa Clara River, from western corporate limits at U.S. Highway 5 to eastern corporate limits;
- South Fork Santa Clara River, from confluence with Santa Clara River to U.S. Highway 5;
- Placerita Creek, from confluence with Newhall Creek to State Highway 14;
- Mint Canyon, from confluence with Santa Clara River to 7,250 feet upstream of Scherzinger Road;
- Sand Canyon, from confluence with Santa Clara River to approximately 6,400 feet upstream of Sulters Street;
- Newhall Creek, from confluence with South Fork Santa Clara River to. State Highway 14;
- Oak Springs Canyon, from confluence with Santa Clara River to Union Pacific (former Southern Pacific) Railroad;
- Iron Canyon, from confluence with Sand Canyon to approximately 3,000 feet upstream of Devell Road extended.

The areas studied by detailed methods were selected with priority given to known flood hazard areas and areas of projected development or proposed construction.

Several unnamed tributaries were studied by approximate methods.

City of Santa Fe Springs

The San Gabriel River, Milan Creek, Coyote Creek - North Fork, and Coyote Creek were studied in detail. Flooding from all unnamed streams in the community and from ponded areas was also studied in detail. There are watersheds of less than 1 square mile within the city which have historically caused flooding in developed low-lying areas. Therefore, to complete a detailed study of the community, it was necessary to evaluate drainage areas of less than 1 square mile.

City of Santa Monica

Results of the mapping study were not previously summarized in an effective FIS report for the City of Santa Monica; therefore, no scope of study is provided.

City of Sierra Madre

The City of Sierra Madre is identified as a non-flood prone community.

City of Signal Hill

Results of the mapping study were not previously summarized in an effective FIS report for the City of Signal Hill; therefore, no scope of study is provided.

City of South El Monte

Results of the mapping study were not previously summarized in an effective FIS report for the City of South El Monte; therefore, no scope of study is provided.

City of South Pasadena

The City of South Pasadena is identified as a non-flood prone community.

City of Temple City

The City of Temple City is identified as a non-flood prone community.

City of Torrance

All flooding sources that affect the City of Torrance were studied in detail, except for a gravel pit in the southern portion of the city and coastal flooding from the Pacific Ocean, which were studied by approximate methods.

There are watersheds of less than 1 square mile within the City that have historically caused flooding in developed low-lying areas. Therefore, to complete a detailed study of the community, it was necessary to evaluate drainage areas of less than 1 square mile.

Those areas studied by detailed methods were chosen with consideration given to all proposed construction and forecasted development through 1983.

City of Vernon

The City of Vernon is identified as a non-flood prone community.

City of Walnut

Results of the mapping study were not previously summarized in an effective FIS report for the City of Walnut; therefore, no scope of study is provided.

City of West Covina

Revised effective FIRMs were issued 12/2/2004 and have been included into the countywide FIRM. Results of the mapping study were not previously summarized in an effective FIS report for the City of West Covina; therefore, no detailed information is provided.

City of West Hollywood

Shallow flooding methods were used to study flooding sources in the vicinity of Rosewood Avenue and Huntley Drive and also in the vicinity of Santa Monica Boulevard and Genesee Avenue. The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development or proposed construction through 1989.

City of Westlake Village

Results of the mapping study were not previously summarized in an effective FIS report for the City of Westlake Village; therefore, no scope of study is provided.

City of Whittier

Areas affected by flooding along Turnbull Canyon, Savage Creek, and at Whittier Narrows Flood Control Basin were studied by detailed methods. Watersheds of less than 1 square mile within the city have caused flooding in developed and low-lying areas. Therefore, in order to complete a detailed study of the community, it was necessary to evaluate drainage areas of less than 1 square mile.

A landfill at a city dump east of Canyon Crest Drive, the Friendly Hills Country Club golf course, and La Mirada Creek were studied by approximate methods.

Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to and agreed upon by the Federal Insurance Administration and the City of Whittier.

All or portions of the flooding sources listed in Table 3, "Flooding Sources Studied by Detailed Methods," were studied by detailed methods. Limits of detailed study are indicated on the Flood Profiles (Exhibit 1) and on the FIRM.

Table 3 - FLOODING SOURCES STUDIED BY DETAILED METHODS

Amargosa Creek	Los Angeles River left overbank path 2
Anaverde Creek	Los Angeles River right overbank path 1
Avalon Canyon	Los Angeles River right overbank path 2
Big Rock Wash	Los Angeles River right overbank path 3
Cheseboro Creek	Malibu Creek
Cold Creek	Medea Creek
Dark Canyon	Medea Creek (above Ventura Freeway)
Dry Canyon	Mill Creek
Escondido Canyon	North Overflow
Flow Along Empire Avenue	Old Topanga Canyon
Flowline No. 1	Overflow Area of Lockheed Drain Channel
Garapito Creek	Overflow Area of Lockheed Storm Drain
Hacienda Creek	Palo Comando Creek
Kagel Canyon	Ramirez Canyon
La Mirada Creek	Rio Hondo River left overbank path 3
Lake Street Overflow	Rio Hondo River left overbank path 5
Las Flores Canyon	Rio Hondo River left overbank path 6
Las Virgenes Creek	Rustic Canyon
Liberty Canyon	Santa Maria Canyon
Lindero Canyon above confluence with Medea Creek	Stokes Canyon
Lindero Canyon above Lake Lindero	Topanga Canyon
Little Rock Wash - Profile A	Trancas Creek
Little Rock Wash - Profile B	Triunfo Creek
Little Rock Wash - Profile C	Unnamed Canyon (Serra Retreat Area)
Lobo Canyon	Upper Los Angeles River left overbank
Lockheed Drain Channel	Weldon Canyon
Lopez Canyon Channel	Zuma Canyon

All or portions of the flooding sources listed in Table 4, "Flooding Sources Studied by Approximate Methods," were studied by approximate methods. Approximate analyses were used to study only those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon by, FEMA and Los Angeles County.

Table 4 - FLOODING SOURCES STUDIED BY APPROXIMATE METHODS

ABC River	Abrams Canyon Creek	Acton Canyon	Adams Canyon Creek
Agua Amarge Canyon	Agua Dulce Canyon Creek	Alamitos Bay	Alder Gulch
Aliso Canyon Creek	Aliso Creek	Alpine Canyon Creek	Amargosa Creek Tributary

Table 4 - FLOODING SOURCES STUDIED BY APPROXIMATE METHODS

Antimony Canyon	Arrastre Canyon Creek	Arroyo Pescadero	Arroyo San Miguel
Arroyo Sequit	Avalon Bay	Back Channel	Baldwin Grade Canyon Creek
Baldwin Hills Reservoir	Ballona Creek	Bar Creek	Bare Mountain Canyon Creek
Bartholomaus Canyon Creek	Bear Canyon Creek	Bear Gulch	Beartrap Canyon Creek
Bee Canyon	Bee Canyon Creek	Big Dalton Wash	Big Rock Creek
Big Rock Wash Profile Base Line	Big Tujunga Canyon Creek	Big Tujunga Wash	Bitter Canyon Creek
Blartrad Canyon Creek	Bleich Canyon Creek	Bluff Cove	Bobcat Canyon Creek
Bootleggers Canyon Creek	Boulder Canyon Creek	Bouquet Canyon Creek	Bouquet Reservoir
Bouton Creek	Bouton Lake	Brea Canyon Creek	Broad Canyon Creek
Browns Creek	Bull Creek	Burbank Canyon	Burbank Western Flood Control Channel
Burns Canyon Creek	Burnside Canyon Creek	California Aqueduct	Canada De Los Alamos
Canyon Creek	Carbon Canyon Creek	Carlos Canyon Creek	Carr Canyon Creek
Cassara Canyon Creek	Castaic Creek	Castaic Lagoon	Castaic Lake
Cedar Canyon Creek	Cedar Creek	Centinela Creek	Centinela Creek Channel
Cerritos Channel	Channel No. 1	Channel No. 2	Channel No. 3
Charles Oak Creek	Charlie Canyon Creek	Chatsworth Reservoir	Cherry Canyon Creek
Clark Gulch	Clear Springs	Cloudbrook Creek	Cloudburst Canyon Creek
Cold Canyon Creek	Cold Springs Canyon Creek	Colorado Lagoon	Compton Creek
Compton Creek Channel	Consolidated Channel	Coral Canyon Creek	Cow Springs Canyon Creek
Coyote Canyon Creek	Coyote Creek	Craig Spring	Cruthers Creek
Dagger Flat Canyon Creek	Dark Canyon West Branch	Deadhorse Canyon Creek	Deer Canyon Creek
Delaware River	Descanso Bay	Devil Canyon Creek	Devils Gulch

Table 4 - FLOODING SOURCES STUDIED BY APPROXIMATE METHODS

Dewitt Canyon Creek	Dix Canyon Creek	Dominguez Channel	Dorothy Canyon Creek
Dorr Canyon Creek	Dowd Canyon	Dowd Canyon Creek	Drinkwater Canyon Creek
Dry Canyon Creek	Dry Canyon Flood Control Channel	Dry Canyon Reservoir	East Basin
East Canyon Creek	East Compton Creek	Echo Park Lake	El Toro Canyon Creek
Elizabeth Canyon	Elizabeth Lake	Elizabeth Lake Canyon Creek	Eller Slough
Elsmere Canyon Creek	Encinal Canyon Creek	Encinal Creek Channel	Entrance Channel
Evil Canyon Creek	Fairmont Reservoir	Fall Canyon Creek	Fall Creek
Falls Gulch	Fenner Canyon Creek	Fish Canyon Creek	Fish Creek
Fish Fork	Fish Harbor	Flume Canyon Creek	Forsuthe Canyon Creek
Franklin Canyon Reservoir	Fryer Canyon Creek	Gail Canyon	Garden Gulch
Gary Creek	Gates Canyon Creek	Gavin Canyon Creek	Gookins Dry Lake
Gooseberry Canyon Creek	Gordon Canyon Creek	Gorman Creek	Government Canyon Creek
Graham Canyon Creek	Grande Canyon Creek	Grandview Canyon Creek	Grasshopper Canyon Creek
Halsey Canyon Creek	Happy Valley Creek	Harbor Lake	Haskell Canyon
Haskell Channel	Hasley Canyon Creek	Hauser Canyon Creek	Heryford Canyon Creek
Hiat Canyon Creek	Hidden Lake	Hideaway Canyon Creek	Hog Canyon Creek
Holcomb Canyon Creek	Holiday Lake	Hollywood Reservoir	Holmes Creek
Hondo Canyon Creek	Horse Camp Canyon Creek	Hosler Canyon Creek	Hudson River
Hughes Canyon Creek	Hughes Lake	Hunt Canyon Creek	Hutak Canyon Creek
Indian Bill Canyon Creek	Indian Canyon Creek	Inner Harbor	Iron Canyon
Iron Canyon Creek	Iron Fork	Islip Canyon Creek	Jesus Canyon Creek
John Bird Canyon Creek	Jones Canyon Creek	Kashmere Canyon	Kentucky Springs Canyon Creek

Table 4 - FLOODING SOURCES STUDIED BY APPROXIMATE METHODS

Kimbrough Canyon Creek	Kings Canyon Creek	Kitter Canyon Creek	La Canada Creek
La Canada Verde Creek	Lachusa Canyon Creek	Lake Lindero	Lake Palmdale
Latigo Canyon Creek	Laurel Canyon Creek	Leaming Canyon Creek	Lechler Canyon Creek
Lemontaine Creek	Liebre Gulch	Limekiln Canyon	Limekiln Creek
Lindero Canyon	Lindero Creek	Little Las Flores Canyon Creek	Little Red Rock Wash
Little Rock Creek	Little Rock Reservoir	Little Rock Wash	Little Tujunga Wash
Lockheed Storm Drain	Long Beach Channel	Loop Canyon Creek	Los Alisos Canyon Creek
Los Angeles County Flood Control Channel	Los Angeles County Storm Drain	Los Angeles Harbor	Los Angeles River
Los Angeles River Flood Control Channel	Los Cerritos Channel	Los Flores Canyon	Los Llajas Canyon Creek
Lost Canyon Creek	Lucky Canyon Creek	Lunada Bay	Lynx Gulch
Lyon Canyon Creek	Maher Canyon Creek	Main Channel	Malaga Canyon
Malaga Cove	Malibu Lake	Malibu Reservoir	Maple Canyon Creek
Marek Canyon Creek	Marie Canyon Creek	Marina Del Ray	Marine Stadium
Matay Canyon Creek	Mattox Canyon Creek	May Canyon Channel	May Canyon Creek
McClure Canyon Creek	McCorkle Canyon Creek	McCoy Canyon Creek	Medea Creek (above Mulholland Highway)
Michael Creek	Middle Fork Mill Creek	Middle Harbor	Milan Creek
Miller Canyon Creek	Milton B. Arthur Lakes	Mine Gulch	Mint Canyon Creek
Mint Canyon Spring	Montaria Lake	Monte Cristo Creek	Montebello Municipal Golf Course Pond
Morris Reservoir	Munz Canyon Creek	Muscal Creek	Mystic Canyon Creek
Nellus Canyon Creek	Newhall Creek	Noel Canyon Creek	North Fork Mill Creek
North Long Canyon Creek	OA Canyon Creek	Oak Springs Canyon	Oakdale Canyon
Oakgrove Canyon Creek	Old Topanga Canyon	Oro Fino Canyon	Orr Spring Canyon Creek

Table 4 - FLOODING SOURCES STUDIED BY APPROXIMATE METHODS

Osito Canyon Creek	Oso Canyon Creek	Overflow Area of Lockheed Drain	Pacific Ocean
Pacific Terrace Harbor	Pacoima Canyon Creek	Pacoima Wash	Pallett Creek
Palmdale Ditch	Palmer Trout Lake	Palomas Canyon Creek	Pan Pacific Detention Basin
Paradise Cove	Pena Canyon Creek	Pico Canyon	Pico Canyon Creek
Piedra Gorda Canyon Creek	Pine Canyon Creek	Pine Creek	Piru Creek
Placerita Creek	Plum Canyon Creek	Poison Oak Canyon Creek	Pole Canyon Creek
Portal Ridge Wash	Posey Canyon Creek	Potrero Canyon Creek	Potrero Valley Creek
Praire Fork	Pratt Canyon Creek	Price Canyon Creek	Puddingstone Reservoir
Puerco Canyon Creek	Punchbowl Canyon Creek	Puzzle Canyon Creek	Pyramid Lake
Quail Lake	Quigley Canyon Creek	Qwerty River	Railroad Canyon
Rattlesnake Canyon Creek	Reed Canyon Channel	Rice Canyon Creek	Richardson Canyon Creek
Rio Hondo Channel	Ritter Canyon Creek	Rivera Canyon Creek	Roberts Canyon Creek
Robinson Canyon Creek	Rock Creek	Rockbound Canyon Creek	Rogers Creek
Romero Canyon Creek	Ross Gulch	Rowley Channel	Ruby Canyon Creek
Rustic Canyon Channel	Salt Canyon Creek	San Antonio Creek	San Antonio Reservoir
San Antonio Wash Channel	San Dimas Wash	San Francisquito Canyon Creek	San Gabriel Reservoir
San Gabriel River	San Jose Creek	San Martinez Chiquito Canyon	San Martinez Grande Canyon Creek
San Nicholas Canyon Creek	San Pedro Bay	Sand Canyon	Sand Canyon Creek
Santa Clara River	Santa Felicia Canyon Creek	Santa Margarita Canyon Creek	Santa Monica Bay
Santa Susana Creek	Santa Susana Pass	Santa Susana Pass Wash	Santa Ynez Canyon Reservoir
Santiago Canyon Creek	Savage Creek	Saw Canyon Creek	Sawmill Canyon Creek
Sawtelle-Westwood Channel	Sawtelle-Westwood Storm Drain Channel	Schoolhouse Canyon Creek	Scychull River

Table 4 - FLOODING SOURCES STUDIED BY APPROXIMATE METHODS

Shake Canyon Creek	Sharps Canyon Creek	Sierra Canyon Creek	Silver Lake Reservoir
Sleeper Canyon Creek	Sloan Canyon Creek	Snowslide Canyon	Solano Canyon
Soldier Creek	Soledad Canyon	Solstice Canyon Creek	Sombrero Canyon Creek
Sonome Canyon Creek	Sorensen Avenue Drain	South Fork	South Fork Santa Clara River
South Portal Canyon Creek	South Tule Canyon Creek	Spade Spring Canyon Creek	Spencer Canyon Creek
Spring Canyon Creek	Steep Hill Canyon	Steep Hill Canyon Creek	Steine Canyon Creek
Stone Canyon Reservoir	Sullivan Canyon	Sulpher Canyon Creek	Sunshine Canyon
Swimming Lagoon	Sycamore Canyon Creek	Tacobi Creek	Tapia Canyon
Taylor Creek	Tentrock Canyon Creek	Texas Canyon Creek	Thompson Creek
Tonner Canyon	Towsley Canyon Creek	Trent River	Trough Canyon Creek
Tuna Canyon Creek	Turnbull Canyon	Tweedy Lake	Una Lake
Upper Franklin Canyon Reservoir	Upper Stone Canyon Reservoir	Vasquez Canyon	Via Coronel
Villa Canyon Creek	Vincent Gulch	Vine Creek	Violin Canyon Creek
Walnut Canyon Creek	Walnut Creek	Water Canyon Creek	Wayside Canyon Creek
Webb Canyon	Weldon Canyon	West Basin	West Branch
West Branch California Aqueduct Angeles	West Channel	West Fork	West Fork Fox Creek
West Fork Liebre Gulch	Whitewater Canyon Creek	Whitney Canyon Creek	Whittier Narrows
Whittier Narrows Flood Control Basin	Wickham Canyon Creek	Wilbur Creek	Wilbur Wash
Wilbur Wash East	Wildwood Canyon	Wiley Canyon Creek	Willow Springs Canyon Creek
Wilson Canyon	Wilson Canyon Drain	Winter Canyon Creek	Woodley Creek
Worsham Creek	XX River	Ybarra Canyon Creek	Young Canyon Creek

This FIS also incorporates the determinations of letters issued by FEMA resulting in map changes (Letter of Map Revision [LOMR], Letter of Map Revision - based on Fill [LOMR-F], and Letter of Map Amendment [LOMA], as shown in Table 5, "Letters of Map Change."

Table 5 - LETTERS OF MAP CHANGE

Community	Flooding Source(s)/Project Identifier	Date Issued	Type	Case Number
City of Agoura Hills	Mariposa Place Apartments	02/22/2007	LOMR	07-09-0403P
City of Azusa	San Gabriel River – 600’ upstream to 3,900’ upstream of confluence with Roberts Canyon Creek – and Roberts Canyon Creek from the confluence to 2,200’ upstream	04/17/2002	102-D	02-09-330P
City of Burbank	Burbank Empire Center North Overflow	5/19/2004	LOMR	02-09-944P
City of Burbank	Burbank Empire Center North Overflow	5/19/2004	LOMR	02-09-944P
City of Burbank	Lockheed Channel/Burbank Costco	5/20/2004	LOMR	02-09-874P
City of Burbank	Lockheed Channel/Burbank Costco	5/20/2004	LOMR	02-09-874P
City of Calabasas	Las Virgenes Creek from Thousand Oaks Boulevard to County Boundary	7/30/1987	102A	--
City of Calabasas	Las Virgenes Creek	9/2/1999	LOMR	99-09-334P
City of Gardena City of Los Angeles	Los Angeles County Drainage Area Project (LACDA) along Compton Creek and Los Angeles River from Ocean Blvd to Long Beach Blvd. – Los Angeles River Left Overbank Path 1	2/25/2000	LOMR	00-09-177P

Table 5 - LETTERS OF MAP CHANGE

Community	Flooding Source(s)/Project Identifier	Date Issued	Type	Case Number
City of Lancaster	Amargosa Creek - Avenue M to Avenue K and Amargosa Creek Tributary – from Southern Pacific Railroad to Valleyline Drive	05/20/2005	LOMR	04-09-0375P
City of Los Angeles	Topham Street Tampa Ave To Melvin Ave	12/15/1988	LOMR	89-09-14P
City of Los Angeles	Catch Basins and Storm Drain Systems along Topham Street between Tampa and Melvin Avenues	12/22/1988	LOMR	--
City of Los Angeles	Gravel Pit bounded by Union Pacific Railroad, Laurel Canyon Boulevard, Saticoy Avenue, and Hollywood Freeway	2/18/1994	102	94-09-192P
City of Los Angeles	Adams Boulevard Drain, Units 1-3	3/30/1995	LOMR	94-09-909P
City of Los Angeles	Adams Boulevard Drainage Area	5/15/1996	LOMR	96-09-681P
City of Los Angeles	Ventura-Canoga Drain	8/20/1996	LOMR	96-09-970P
City of Los Angeles	Ventura-Canoga Drain	8/20/1996	LOMR	96-09-857P
City of Los Angeles City of West Hollywood	Hollyhills Drain, Units 1-5	3/12/1999	LOMR	99-09-419P
City of Los Angeles	Unnamed Ponding Area - 4251 West Lockwood Avenue, Conner's Subdivision, Lot 86	3/6/2001	LOMR	00-09-515P

Table 5 - LETTERS OF MAP CHANGE

Community	Flooding Source(s)/Project Identifier	Date Issued	Type	Case Number
City of Los Angeles	Unnamed Flooding Source -- Airport Boulevard Storm Drain -- Howard Hughes Development Center	11/9/2001	LOMR	01-09-557P
City of Los Angeles	Rustic Canyon 700 feet upstream of Sunset Boulevard to 2,000 feet upstream of Sunset Boulevard	6/17/2004	LOMR	04-09-0102P
City of Montebello	Storm Drains along Garfield Avenue at Wilcox Avenue and Beverly Boulevard	4/21/1998	LOMR	98-09-445P
City of Palmdale	Amargosa Creek from Avenue O to the Antelope Valley Freeway	04/29/2005	LOMR	04-09-0306P
City of Palmdale	Amargosa Creek Tributary – from Railroad to Valleyline Drive	05/20/2005	LOMR	04-09-0375P
City of Palmdale	Amargosa Creek	9/22/2006	LOMR	06-09-BD11P
City of Palmdale	Ritter Ranch Anaverde Creek – North Branch Tract 51508	03/30/2007	LOMR	07-09-0755P
City of Redondo Beach City of Torrance	Doris Coast Drain	12/15/1997	LOMR	98-09-097P
City of Santa Clarita	Santa Clara River – South Fork from Lyons Avenue to South of Wiley Canyon Road	3/21/1990	LOMR	--

Table 5 - LETTERS OF MAP CHANGE

Community	Flooding Source(s)/Project Identifier	Date Issued	Type	Case Number
City of Santa Clarita	Tract 31198	7/18/1990	LOMR	--
City of Santa Clarita	Near Santa Clara River	8/20/1990	LOMR	--
City of Santa Clarita	Santa Clara River 1,100 feet downstream to 800 feet downstream of the Sierra Highway	10/6/1992	LOMR	92-09-170P
City of Santa Clarita	Bouquet Canyon Tributary	10/20/1992	LOMR	92-09-191P
City of Santa Clarita	Unnamed Wash just north of Placerita Creek	11/16/1993	LOMR	94-09-045P
City of Santa Clarita	Area bounded by Lyons Avenue, Wayman Avenue, Eighth Street, and Arcadia Street	5/23/1994	LOMR	94-09-256P
City of Santa Clarita	Newhall Canyon at confluence with Railroad Canyon	1/18/2000	LOMR	99-09-399P
City of Santa Clarita	Sand Canyon Lateral	5/15/2000	LOMR	00-09-025P
City of Santa Clarita	Tract 51963-Dockweiler, M.T.D. 1525 Storm Drain	10/24/2000	LOMR	00-09-851P
City of Santa Clarita	Newhall Creek - Tract No. 53114, Mtd No. 1670	1/12/2004	LOMR	04-09-0237P
City of Santa Clarita	Santa Clara River from 5,000' downstream to 1,000' downstream of McBean Parkway; South Fork Santa Clara River from the confluence with the Santa Clara River to Valencia Boulevard	07/23/2004	LOMR	04-09-1001P
City of Santa Clarita	Santa Clara River from 3,100 feet downstream of 2,100 downstream of Soledad Canyon Road	10/22/2004	LOMR	03-09-1325P

Table 5 - LETTERS OF MAP CHANGE

Community	Flooding Source(s)/Project Identifier	Date Issued	Type	Case Number
City of Santa Clarita	Santa Clara River from 6,500 feet downstream of 1.500 downstream of the Los Angeles Aqueduct	3/3/2005	LOMR	04-09-1681P
City of Santa Clarita	River Park Soil Cement Bank Protection	05/29/2007	LOMR	07-09-1041P
Los Angeles County	Levee within Tract 31198 from Antelope Valley Freeway to 1,500 feet downstream of Antelope Valley Road	12/22/1986	102	--
Los Angeles County	Las Virgenes Creek from Thousand Oaks Boulevard to County Boundary	7/30/1987	LOMR	--
Los Angeles County	Oakdale Canyon	8/9/1988	102	--
Los Angeles County	Tributary to Santa Clara River – Acton Area	1/23/1992	102A	92-09-018P
Los Angeles County	Dry Canyon Creek 5,900 feet upstream of Francisquito Road	3/2/1992	LOMR	92-09-007P
Los Angeles County	Channel Improvements along Oakdale Canyon and along Unnamed Wash north of Placerita Creek	10/05/1993	102A	93-09-501P
Los Angeles County	Santa Clarita Family Recreation Center	5/23/1994	LOMR	94-09-049P
Los Angeles County City of Los Angeles City of West Hollywood	Pan Pacific Flood Control System Area	6/3/1994	102A	94-09-540P
Los Angeles County	Violin Canyon Creek from confluence with Castaic Creek to 2,600 feet Upstream of Lake Hughes Road	9/12/1994	102	94-09-680P

Table 5 - LETTERS OF MAP CHANGE

Community	Flooding Source(s)/Project Identifier	Date Issued	Type	Case Number
Los Angeles County	Medea Creek (above Mulholland Highway)	11/18/1994	102	94-09-552P
Los Angeles County	Castaic Creek from Interstate 5 to 2,700 feet downstream of Interstate 5	3/1/1995	102	94-09-716P
Los Angeles County	Harbor Area	9/13/1995	LOMR	95-09-405P
Los Angeles County	Santa Clara River 500 feet downstream of McBean Parkway to 1,800 feet upstream of confluence with South Fork Santa Clara River and along the South Fork Santa Clara River from confluence with Santa Clara River to 1,200 upstream of confluence	10/25/1995	102	95-09-398P
Los Angeles County	Basin at Villa Canyon Road and Route 5	1/3/1997	102	97-09-070P
Los Angeles County	Bouquet Canyon Creek, Dry Canyon And Santa Clara River	8/18/1997	102	97-09-783P
Los Angeles County	San Francisquito Canyon Creek	2/19/1998	LOMR	98-09-285P
Los Angeles County	Hasley Canyon Creek	9/18/1998	LOMR	98-09-1022P
Los Angeles County City of Compton	Los Angeles County Drainage Area Project (LACDA) along Compton Creek and Los Angeles River from Ocean Blvd to Long Beach Blvd. – Los Angeles River Left Overbank Path 1	2/25/2000	LOMR	00-09-177P

Table 5 - LETTERS OF MAP CHANGE

Community	Flooding Source(s)/Project Identifier	Date Issued	Type	Case Number
Los Angeles County	Hacienda Heights; Private Drain Nos. 746, 1446, & 1560 & Road Dept. Drain No. 024	3/9/2001	102	00-09-294P
Los Angeles County	Hillcrest Park, Private Drains 2157, 2279, 2316, & 2467	5/1/2001	102	01-09-190P
Los Angeles County	Private Drain No. 2275, Tract No. 48150	5/23/2001	102	01-09-127P
Los Angeles County	San Francisquito Canyon Creek	6/7/2001	102	01-09-491P
Los Angeles County	Haskel Canyon, Tract 47657, P.D. No. 2469	8/22/2001	102	01-09-459P
Los Angeles County City of Bellflower City of Carson City of Compton City of Downey City of Lakewood City of Long Beach City of Lynwood City of Montebello City of Paramount City of Pico Rivera City of South Gate	Los Angeles County Drainage Area Project (LACDA) along Compton Creek and Los Angeles River from Ocean Blvd to Long Beach Blvd	1/11/2002	LOMR	02-09-034P
Los Angeles County	Santa Clara River at confluences with San Martinez Chiquito Canyon and San Martinez Grande	10/24/2002	102	01-09-559P
Los Angeles County	Pico Canyon Creek at confluence with Dewitt Canyon Creek	1/15/2003	102	03-09-0065P

Table 5 - LETTERS OF MAP CHANGE

Community	Flooding Source(s)/Project Identifier	Date Issued	Type	Case Number
Los Angeles County	Santa Clara River - Tract 45023 upstream of Antelope Valley Freeway	4/21/2003	LOMR	02-09-404P
Los Angeles County City of Santa Clarita	San Francisquito Canyon Creek from 500 feet downstream of Decoro Drive to 1,800 feet upstream of Copper Hill Drive, Tract 44831-A	4/30/2003	102	03-09-0041P
Los Angeles County City of Santa Clarita	Soilcement Bank Protection At East Creek	4/30/2003	LOMR	03-09-0694X
Los Angeles County	Hasley Canyon Creek	9/26/2003	102	03-09-0311P
Los Angeles County City of Palmdale	Amargosa Dam	3/10/2005	LOMR	04-09-1388P
Los Angeles County	Oak Creek Mixed Use Development Tentative Tract 53752,Medea Creek From Canwood Street up 1,700 feet upstream	6/30/2005	LOMR	04-09-1686P
Los Angeles County	San Francisquito Canyon Creek – Tract No. 51644	10/31/2005	LOMR	05-09-A120P
Los Angeles County	Triunfo Creek – upstream of Hidden Park Bridge	11/14/2005	LOMR	05-09-0892P
Los Angeles County	Pico Canyon Creek upstream of Stevenson Ranch Parkway	11/14/2005	LOMR	05-09-1072P
Los Angeles County	Plum Canyon Creek – 3,000’ upstream to 6,780’ upstream of Bouquet Creek	02/28/2006	LOMR	06-09-B003P
Los Angeles County	San Francisquito Canyon Creek	10/16/2006	LOMR	06-09-BE13P

Table 5 - LETTERS OF MAP CHANGE

Community	Flooding Source(s)/Project Identifier	Date Issued	Type	Case Number
Los Angeles County	River Ranch	12/18/2006	LOMR	06-09-B867P
Los Angeles County	Valencia Commerce Center	12/22/2006	LOMR	06-09-BF37P
Los Angeles County City of Palmdale	Amargosa Creek Soils Cement Improvements and Arch Culverts @ 10th Street West	02/09/2007	LOMR	07-09-0322P
Los Angeles County	Plum Creek Canyon	10/31/2007	LOMR	07-09-1877P

-- Data Unknown

2.2 Community Description

Los Angeles County

Los Angeles County is located in southwestern California and is bounded on the east by San Bernardino County, on the south by Orange County and the Pacific Ocean, on the west by the Pacific Ocean and Ventura County, and on the north by Kern County.

The communities comprising the incorporated portions of Los Angeles County encompass the vast majority of developable land within the County. The total land area of the County is approximately 4,061 square miles. The total unincorporated area of the County is approximately 3,000 square miles. The primary areas where significant development has occurred and is continuing are the canyon floors of the Antelope Valley, the Santa Clarita Valley, and the Malibu area. In addition, there are many relatively small "islands" in the Los Angeles basin area which are partially or completely surrounded by incorporated cities. Many of these islands are fully developed or undergoing rapid development. The balance of the county area is located within the rugged mountains of the Angeles National Forest or undeveloped agricultural lands. The population of the County has risen from approximately 1,005,900 in 1977, when many original FIS studies were prepared, to approximately 10,179,716 by 2004 (U.S. Census data, 2005), an increase of over 1,000 percent. Along with this phenomenal boom in population has been an accompanying in-filling of much of the remaining developable land in the County.

Land use in Los Angeles County is highly diversified. Development ranges from densely populated areas in the Los Angeles basin, to lower density semi-rural development in the Santa Clarita Valley, Antelope Valley, and Malibu area, to some almost uninhabited mountainous areas of the Angeles National Forest. The terrain within the County can be classified in broad terms as being 30 percent alluvial plain and 70 percent rugged mountains and hills. Elevations range from sea level to nearly 10,000 feet at some locations in the San Gabriel Mountains.

The incorporated areas of Los Angeles County drain to the ocean largely through a system of human-modified channels and storm drains. Much of the incorporated area is protected by a vast network of flood control channels, debris basins, and flood control reservoirs. In the unincorporated areas of the County, with the exception of a few improved channels, the Malibu area is drained by natural watercourses which discharge directly to the Pacific Ocean. The Santa Clarita Valley is drained by the largely-natural channel of the Santa Clara River and its tributaries, which discharges into Ventura County and thence, to the ocean. Some improved channels have been constructed in the Santa Clarita Valley. Flows in the Antelope Valley are northerly from the mountains across the broad alluvial plain, through a network of largely unimproved channels. During minor storms, much of the flow percolates into the ground. In major storms, flows reach the lake at the northern county limits, where flood flows pond until evaporated. With the exception of a small portion of Amargosa Creek, there are no flood control improvements in the Antelope Valley.

Throughout most of the County, nearly all precipitation occurs during December through March. Precipitation during the summer is infrequent, except in the desert areas, where intense, short-duration thunderstorms can occur. Major storms consist of one or more frontal systems, and occasionally last 4 days or longer. Average annual rainfall ranges from 13.8 inches at the ocean, to 28.2 inches in the San Gabriel Mountains, to 7.9 inches in the Antelope Valley. In highly developed areas, runoff volumes have increased as the soil surface has become covered by impervious materials, natural ponding areas have been eliminated, and flood control facilities have been constructed.

City of Agoura Hills

The City of Agoura Hills is located in southwest Los Angeles County, in southwestern California, in a relatively flat basin between the Santa Monica Mountains and cluster of hills separating it from Simi Valley. The City of Los Angeles is located approximately 6 miles to the east.

The City of Agoura Hills is bordered by unincorporated areas of Los Angeles County to the east, south, and west, and unincorporated areas of Ventura County to the north.

According to the U.S. Bureau of the Census, the population of the City of Agoura Hills in 2000 was 20,537.

The Agoura Hills area is bisected by a number of drainage courses including Las Virgenes Canyon, Liberty Canyon, Lindero Canyon, and Triunfo Canyon. The most prominent physical feature in the city is Ladyface Mountain, which at an elevation of 2,036 feet is visible from nearly all points in the Agoura Hills area. A prominent ridge line runs along Ladyface Mountain for approximately 2 miles. Much of the terrain in the Santa Monica Mountains is rugged and steep. Elevations in the study area range from 600 feet to approximately 2,000 feet. The canyon bottoms are generally flat, with relatively abrupt transitions to canyon sides sloping at 25 percent to 35 percent from the bottom.

The soils in the Malibu/Santa Monica Mountains Plan area are highly susceptible to erosion. Slope stability hazards not only cause erosion, but erosion leads to problems of run-off and siltation. The top soils are termed expansive in nature.

Land development within the city ranges from low-density rural in Old Agoura to a higher density and urban development in the newer sections of the city.

There are several types of vegetation within the Agoura Hills area consisting of chaparral, coastal sage scrub, Bigleaf Maple. Western Sycamore, and Coast Live Oak. Grassland, characterized by herbs and native grasses, is also found in the area.

Most precipitation occurs during December through March. Precipitation during the summer is infrequent. The average rainfall is 17 inches a year.

City of Alhambra

Results of the mapping study were not previously summarized in effective FIS report for the City of Alhambra; therefore, no community description is provided.

City of Arcadia

Results of the mapping study were not previously summarized in effective FIS report for the City of Arcadia; therefore, no community description is provided.

City of Artesia

Results of the mapping study were not previously summarized in effective FIS report for the City of Artesia; therefore, no community description is provided.

City of Avalon

The City of Avalon is located on Santa Catalina Island, approximately 26 miles south of Los Angeles Harbor. The City is approximately 1.2 square miles in size. It is situated on the coast, and is surrounded by steep headwaters that are primarily unincorporated areas of Los Angeles County. Development is primarily residential, with scattered hotels and commercial areas.

The population of Avalon was 2,022 in 1980, and approximately 3,000 in 2004. This represents an approximate 200 percent increase from the 1970 population of 1,520.

The terrain in Avalon can be classified in broad terms as being 15 percent alluvial plain, 5 percent moderately sloping canyons, and 80 percent mountains. Relief of the terrain ranges from sea level to an elevation of approximately 900 feet.

Nearly all precipitation occurs during December through March. Precipitation during the summer is infrequent, and rainless periods of several months are common. Precipitation in the area occurs primarily as winter orographic rainfall associated with extra-tropical cyclones of North Pacific origin. Major storms consist of one or more frontal systems and occasionally last 4 days or longer.

In mountain areas, the steep canyon slopes and stream channel gradients are conducive to rapid concentration of storm runoff quantities. The watersheds tributary to the City are composed of rough, broken, and stony land not suitable for agricultural production. The soils are classified as having moderately low infiltration rates and, therefore, moderately high runoff rates.

The principal vegetative cover of the upper mountain areas consists of various species of brush and shrubs known as chaparral. Grasses are the principal natural vegetation on the undeveloped portions of the alluvial plains.

A large portion of the developed area of the City of Avalon is situated on a broad alluvial plain at the mouth of Avalon Canyon. The tributary watershed is approximately 3 square miles in size. A small drainage ditch, which originates high up in Avalon Canyon, meanders down to the developed area of the city.

City of Azusa

Results of the mapping study were not previously summarized in effective FIS report for the City of Azusa; therefore, no community description is provided.

City of Baldwin Park

Results of the mapping study were not previously summarized in effective FIS report for the City of Baldwin Park; therefore, no community description is provided.

City of Bell Gardens

Results of the mapping study were not previously summarized in effective FIS report for the City of Bell Gardens; therefore, no community description is provided.

City of Bell

Results of the mapping study were not previously summarized in effective FIS report for the City of Bell; therefore, no community description is provided.

City of Bellflower

The City of Bellflower is located in southeastern Los Angeles County approximately 10 miles from downtown Los Angeles. Bellflower is bordered by the Cities of Downey on the north, Paramount and Long Beach on the west, Lakewood on the south, and Cerritos and Norwalk on the east.

The population of Bellflower was 53,441 in 1980, and approximately 72,878 in 2000, an increase of 36 percent. Bellflower covers an area of 6.1 square miles and is served by State Highway 91 (Artesia Freeway) and State Highway 19. The San Gabriel River flows north to south along the eastern corporate limits of the City.

The Los Angeles River, which is the primary flood threat to the City of Bellflower, originates at the west end of the San Fernando Valley in the northwestern-most corner of the County. The river channel extends through the heart of Los Angeles County by flowing east to Glendale where it turns and flows south to the Pacific Ocean. The Los Angeles River is part of a network of dams, reservoirs, debris collection basins, and spreading grounds built by the LACFCD and USACE to minimize flooding in the County. The portion of the river that affects the City of Bellflower begins at the Arroyo Seco and ends at the mouth of the river at the Pacific Ocean. The floodplain starts in the northeast part of the City of Los Angeles at the Arroyo Seco confluence, passes through the Cities of Los Angeles, Bell, Bell Gardens, South Gate, Lynwood, Lakewood, Paramount, Compton, Bellflower, Carson, Gardena and Long Beach, to its terminus at the Pacific Ocean.

The Rio Hondo originates from the eastern part of Los Angeles County at Whittier Narrows Dam east of the Montebello Hills. The River flows southwest through the Cities of Montebello, Pico Rivera, Bell Gardens, Downey and South Gate to its confluence with the Los Angeles River just north of the Imperial Highway.

The metropolitan areas adjacent to the Los Angeles River and the Rio Hondo are densely populated with residential, commercial, and industrial development. Surface runoff has increased as a consequence of impervious development.

The topography of the coastal plain on which the City of Bellflower resides is gradually sloped from the foothills of the San Gabriel Mountains upstream of the City, to the Pacific Ocean with a few exceptions of rising hills and depressed areas. Ground elevations range from 10,000 feet in the San Gabriel Mountains, to 330 feet near the Arroyo Seco confluence, to mean sea level at the mouth of the Los Angeles River.

Underlying soils are considered alluvial, and vary from coarse sand and gravel, to silty clay and gravel or clay. The land is generally well drained, with relatively few perched water or artesian areas. Large deposits of petroleum are present along the coast. Extensive pumping for oil has caused subsidence in the lower reach.

The climate is considered subtropical. The precipitation regime contributing to the Bellflower area and its surrounding watershed is primarily determined by the course of orographic rainfall associated with extra-tropical cyclones during the months between December and March. Snow fall, common at elevations of 5,000 feet or more, may influence flood events through the occurrence of rapid melting associated with warm weather following a major storm. Major storms consist of one or more frontal systems which may last up to four or more days each. The fall of precipitation is greatly intensified due to the San Gabriel Mountains which lie in the path of storms moving from the west or southwest. Steep canyons and gradients in the mountains contribute to rapid concentrations of storm runoff, which may or may not reach the City. The average annual rainfall ranges from 13.8 inches at the ocean to 28.2 inches in the San Gabriel Mountains. Average daily minimum temperature for January is 46.6°F, while the average daily maximum temperature for July is 83.3°F. In the San Gabriel Mountains (elevation 5,580 feet) the average daily minimum in January is 34.3°F above zero with an average daily maximum of 80.2°F in July.

City of Beverly Hills

Results of the mapping study were not previously summarized in effective FIS report for the City of Beverly Hills; therefore, no community description is provided.

City of Bradbury

Results of the mapping study were not previously summarized in effective FIS report for the City of Bradbury; therefore, no community description is provided.

City of Burbank

The City of Burbank is an urbanized community situated at the southerly foothills of the Verdugo Mountains at the east end of the San Fernando Valley and the central portion of the Los Angeles County basin. It is located approximately 11 miles northeast of the downtown area of the City of Los Angeles. Burbank is bordered on the east by the City of Glendale, on the north by the Verdugo Mountains, and on the west and south by the City of Los Angeles.

The City is approximately 17.1 square miles in size. The population of the City was approximately 83,300 in 1977, and approximately 100,316 in 2000, an increase of 20 percent.

The majority of development in the flood plain is residential, while small portions are either commercial or undergoing re-development.

The topography of the coastal plain on which the City of Burbank resides is gradually sloped from the foothills of the San Gabriel Mountains upstream of the City, to the Pacific Ocean with a few exceptions of rising hills and depressed areas. Ground elevations range from 10,000 feet in the San Gabriel Mountains, to 330 feet near the Arroyo Seco confluence, to mean sea level at the mouth of the Los Angeles River.

The terrain within the corporate limits of the City of Burbank can be classified in broad terms as being 80 percent alluvial plain and 20 percent moderately sloping canyons and mountains. Elevation ranges from 500 feet at the southern portion of the city to approximately 2,600 feet at the Verdugo Mountains to the northeast. The mountain area is characterized by very steep and rugged terrain with very little residential development. The foothill area is characterized by steep (greater than 10 percent slope) ground surface and street gradients. Residential development in the lower foothills has occurred on sites created by varying degrees of cut and fill that have produced a terraced effect. The alluvial fan area, lying between the foothill and valley floor areas, is characterized by moderate (3 to 10 percent slope) ground surface and street gradients, whereas, the valley floor area consists of- flatter slopes (less than 3 percent). The majority of development in these two areas is residential, while a significant portion is commercial.

The Los Angeles River, which is the primary flood threat to the City of Burbank, originates at the west end of the San Fernando Valley in the northwestern-most corner of the County. The river channel extends through the heart of Los Angeles County by flowing east to Glendale where it turns and flows south to the Pacific Ocean. The Los Angeles River is part of a network of dams, reservoirs, debris collection basins, and spreading grounds built by the LACFCD and USACE to minimize flooding in the County.

The climate is considered subtropical. The precipitation regime contributing to the Burbank area and its surrounding watershed is primarily determined by the course of orographic rainfall associated with extra-tropical cyclones during the months between December and March. Snow fall, common at elevations of 5,000 feet or more, may influence flood events through the occurrence of rapid melting associated with warm weather following a major storm. Major storms consist of one or more frontal systems which may last up to four or more days each. The fall of precipitation is greatly intensified due to the San Gabriel Mountains which lie in the path of storms moving from the west or southwest. Steep canyons and gradients in the mountains contribute to rapid concentrations of storm runoff, which may or may not reach the City. The average annual rainfall ranges from 13.8 inches at the ocean to 28.2 inches in the San

Gabriel Mountains. Average daily minimum temperature for January is 46.6°F, while the average daily maximum temperature for July is 83.3°F. In the San Gabriel Mountains (elevation 5,580 feet) the average daily minimum in January is 34.3°F above zero with an average daily maximum of 80.2°F in July.

Soils within the City are generally of the clay type. Vegetation consists primarily of private gardens and urban landscape. The less developed portions of the city, especially the upper foothills and mountain slopes, are characterized by vegetation of the chaparral type, an ecological community occurring widely in southern California and comprised of shrubby plants especially adapted to dry summers and moist winters.

In highly developed areas of the City, local runoff volumes have increased as the soil surface has become covered by impervious materials. Peak runoff rates for valley areas have also increased due to elimination of natural ponding areas and improved hydraulic efficiency of water conveyance systems, such as streets and storm drain systems. Surface runoff traverses the city in a southeasterly direction, draining into the Los Angeles River, located to the south of the community.

City of Calabasas

Results of the mapping study were not previously summarized in effective FIS report for the City of Calabasas; therefore, no community description is provided.

City of Carson

The City of Carson is located in southern Los Angeles County. It is bordered by the City of Los Angeles to the east, south, and west. It is bordered by the City of Compton to the north and the City of Long Beach to the east. The population of the City of Carson was approximately 81,221 in 1980, and approximately 89,730 in 2000, an increase of 10 percent.

Carson has an area of approximately 19.8 square miles. Primary land uses include residential, commercial, and light industrial.

The highest point in Carson is 195 feet above sea level located between Victoria and 190th Street on Wilmington Avenue. The lowest point on land has an elevation of 5 feet below sea level and is located in Del Amo Park. The lowest point is in the center of the Dominguez Channel located at the southeastern corner of the city with an elevation of 14.71 feet below sea level.

The Los Angeles River, which is the primary flood threat to the City of Carson, originates at the west end of the San Fernando Valley in the northwestern-most corner of the County. The river channel extends through the heart of Los Angeles County by flowing east to Glendale where it turns and flows south to the Pacific Ocean. The Los Angeles River is part of a network of dams, reservoirs, debris collection basins, and spreading grounds built by the LACFCD and USACE to minimize flooding in the County. The portion of the river that affects the City of Carson begins at the Arroyo Seco and ends at the mouth of the river at the Pacific Ocean. The floodplain starts in the northeast part of the City of Los Angeles at the Arroyo Seco confluence, passes through the Cities of Los Angeles, Bell, Bell Gardens, South Gate, Lynwood, Lakewood, Paramount, Compton, Bellflower, Carson, Gardena and Long Beach, to its terminus at the Pacific Ocean.

The topography of the coastal plain on which the City of Carson resides is gradually sloped from the foothills of the San Gabriel Mountains upstream of the City, to the Pacific Ocean with a few exceptions of rising hills and depressed areas. Ground elevations range from 10,000 feet in the San Gabriel Mountains, to 330 feet near the Arroyo Seco confluence, to mean sea level at the mouth of the Los Angeles River.

Underlying soils are considered alluvial, and vary from coarse sand and gravel to silty clay and gravel or clay. The land is generally well-drained, with relatively few perched water or artesian areas.

The climate is considered subtropical. The precipitation regime contributing to the Carson area and its surrounding watershed is primarily determined by the course of orographic rainfall associated with extra-tropical cyclones during the months between December and March. Snow fall, common at elevations of 5,000 feet or more, may influence flood events through the occurrence of rapid melting associated with warm weather following a major storm. Major storms consist of one or more frontal systems which may last up to four or more days each. The fall of precipitation is greatly intensified due to the San Gabriel Mountains which lie in the path of storms moving from the west or southwest. Steep canyons and gradients in the mountains contribute to rapid concentrations of storm runoff, which may or may not reach the City. The average annual rainfall ranges from 13.8 inches at the ocean to 28.2 inches in the San Gabriel Mountains. Average daily minimum temperature for January is 46.6°F, while the average daily maximum temperature for July is 83.3°F. In the San Gabriel Mountains (elevation 5,580 feet) the average daily minimum in January is 34.3°F above zero with an average daily maximum of 80.2°F in July.

City of Cerritos

Results of the mapping study were not previously summarized in effective FIS report for the City of Cerritos; therefore, no community description is provided.

City of Claremont

Results of the mapping study were not previously summarized in effective FIS report for the City of Claremont; therefore, no community description is provided.

City of Commerce

Results of the mapping study were not previously summarized in effective FIS report for the City of Commerce; therefore, no community description is provided.

City of Compton

The City of Compton is located in southern Los Angeles County approximately 10 miles south of downtown Los Angeles City. The population of Compton was approximately 78,547 in 1970 and 93,393 in 2000, an increase of approximately 19 percent.

The Los Angeles River, which is the primary flood threat to the City of Compton, originates at the west end of the San Fernando Valley in the northwestern-most corner of the County. The river channel extends through the heart of Los Angeles County by flowing east to Glendale where it turns and flows south to the Pacific Ocean. The Los Angeles River is part of a network of dams, reservoirs, debris collection basins, and spreading grounds built by the LACFCD and USACE to minimize flooding in the County. The portion of the river that affects the City of Compton begins at the Arroyo Seco and ends at the mouth of the river at the Pacific Ocean. The floodplain starts in the northeast part of the City of Los Angeles at the Arroyo Seco confluence, passes through the Cities of Los Angeles, Bell, Bell Gardens, South Gate, Lynwood, Lakewood, Paramount, Compton, Bellflower, Carson, Gardena and Long Beach, to its terminus at the Pacific Ocean.

The metropolitan areas adjacent to the Los Angeles River containing the City of Compton are densely populated with residential, commercial, and industrial development. Surface runoff has increased as a consequence of impervious development.

The topography of the coastal plain on which the City of Compton resides is gradually sloped from the foothills of the San Gabriel Mountains upstream of the City, to the Pacific Ocean with a few exceptions of rising hills and depressed areas. Ground elevations range from 10,000 feet in the San Gabriel Mountains, to 330 feet near the Arroyo Seco confluence, to mean sea level at the mouth of the Los Angeles River.

Underlying soils are considered alluvial, and varies from coarse sand and gravel to silty clay and gravel or clay. The land is generally well-drained, with relatively few perched water or artesian areas.

The climate is considered subtropical. The precipitation regime contributing to the Compton area and its surrounding watershed is primarily determined by the course of orographic rainfall associated with extra-tropical cyclones during the months between December and March. Snow fall, common at elevations of 5,000 feet or more, may influence flood events through the occurrence of rapid melting associated with warm weather following a major storm. Major storms consist of one or more frontal systems which may last up to four or more days each. The fall of precipitation is greatly intensified due to the San Gabriel Mountains which lie in the path of storms moving from the west or southwest. Steep canyons and gradients in the mountains contribute to rapid concentrations of storm runoff, which may or may not reach the City. The average annual rainfall ranges from 13.8 inches at the ocean to 28.2 inches in the San Gabriel Mountains. Average daily minimum temperature for January is 46.6°F, while the average daily maximum temperature for July is 83.3°F. In the San Gabriel Mountains (elevation 5,580 feet) the average daily minimum in January is 34.3°F above zero with an average daily maximum of 80.2°F in July.

City of Covina

Results of the mapping study were not previously summarized in effective FIS report for the City of Covina; therefore, no community description is provided.

City of Cudahy

Results of the mapping study were not previously summarized in effective FIS report for the City of Cudahy; therefore, no community description is provided.

City of Culver City

Culver City is an urbanized community situated at the westerly base of the Baldwin Hills, in the western portion of the Los Angeles County basin. The City is approximately 4.9 square miles in size. The City had a population in 1977 of approximately 38,600, and approximately 38,816 in 2000, almost no increase in 30 years. It is located approximately 11 miles west of the downtown area of the City of Los Angeles and is bordered by the City of Los Angeles and unincorporated County territory.

The terrain within Culver City's corporate limits can be classified, in broad terms, as being 90 percent alluvial plain and 10 percent moderately sloping canyons and hills. Elevations range from 20 feet at the western portion of the city to approximately 400 feet at the Baldwin Hills to the east.

The terrain within Culver City's corporate limits can be classified, in broad terms, as being 90 percent alluvial plain and 10 percent moderately sloping canyons and hills. Elevations range from 20 feet at the western portion of the city to approximately 400 feet at the Baldwin Hills to the east.

Nearly all precipitation occurs during the months of December through March. Precipitation during the summer months is infrequent, and rainless periods of several months are common. Precipitation in the area occurs primarily in the form of winter orographic rainfall associated with extratropical cyclones of North Pacific origin. Major storms consist of one or more frontal systems and occasionally last 4 days or longer.

In the highly developed areas, local runoff volumes have increased as the soil surface has become covered by impervious materials.

Peak runoff rates for valley areas have also increased due to elimination of natural ponding areas and improved hydraulic efficiency of water carriers, such as streets and storm drain systems.

City of Diamond Bar

Results of the mapping study were not previously summarized in effective FIS report for the City of Diamond Bar; therefore, no community description is provided.

City of Downey

The City of Downey, incorporated December 17, 1956, is located 12 miles southeast of Los Angeles in Los Angeles County. The population of Downey was approximately 88,573 in 1970, and approximately 107,323 in 2000, and increase of 21 percent.

Downey is serviced by the Santa Ana Freeway (Interstate 5), Long Beach Freeway (Interstate 710), and the San Gabriel Freeway (Interstate 605). Downey is approximately 8 miles from Long Beach Airport and 17 miles from Los Angeles International Airport.

The Rio Hondo, which is the primary flood threat to the City of Downey, originates at Whittier Narrows Dam, a flood control facility that controls runoff originating in the northeastern portion of the County. The Rio Hondo channel joins the Los Angeles River downstream of the City of Downey. Rio Hondo flows southwest through the Cities of Montebello, Pico Rivera, Bell Gardens, Downey and South Gate to its confluence with the Los Angeles River just north of the Imperial Highway. The Los Angeles River and Rio Hondo are part of a network of dams, reservoirs, debris collection basins, and spreading grounds built by the LACFCD and USACE to minimize flooding in the County.

The metropolitan areas adjacent to the Los Angeles River and the Rio Hondo are densely populated with residential, commercial, and industrial development. Surface runoff has increased as a consequence of impervious development.

The metropolitan areas adjacent to the Rio Hondo containing the City of Downey are densely populated with residential, commercial, and industrial development. Surface runoff has increased as a consequence of impervious development.

The topography of the coastal plain on which the City of Downey resides is gradually sloped from the foothills of the San Gabriel Mountains upstream of the City, to the Pacific Ocean with a few exceptions of rising hills and depressed areas. Ground elevations range from 10,000 feet in the San Gabriel Mountains, to 330 feet near the Arroyo Seco confluence, to mean sea level at the mouth of the Los Angeles River.

Underlying soils are considered alluvial, and varies from coarse sand and gravel to silty clay and gravel or clay. The land is generally well-drained, with relatively few perched water or artesian areas.

The climate is considered subtropical. The precipitation regime contributing to the Downey area and its surrounding watershed is primarily determined by the course of orographic rainfall associated with extra-tropical cyclones during the months between December and March. Snow fall, common at elevations of 5,000 feet or more, may influence flood events through the occurrence of rapid melting associated with warm weather following a major storm. Major storms consist of one or more frontal systems which may last up to four or more days each. The fall of precipitation is greatly intensified due to the San Gabriel Mountains which lie in the path of storms moving from the west or southwest. Steep canyons and gradients in the mountains contribute to rapid concentrations of storm runoff, which may or may not reach the City. The average annual rainfall ranges from 13.8 inches at the ocean to 28.2 inches in the San Gabriel Mountains. Average daily minimum temperature for January is 46.6°F, while the average daily maximum temperature for July is 83.3°F. In the San Gabriel Mountains (elevation 5,580 feet) the average daily minimum in January is 34.3°F above zero with an average daily maximum of 80.2°F in July.

City of Duarte

Results of the mapping study were not previously summarized in effective FIS report for the City of Duarte; therefore, no community description is provided.

City of El Monte

Results of the mapping study were not previously summarized in effective FIS report for the City of El Monte; therefore, no community description is provided.

City of El Segundo

Results of the mapping study were not previously summarized in effective FIS report for the City of El Segundo; therefore, no community description is provided.

City of Gardena

The City of Gardena is located in southwestern Los Angeles County, 12 miles south of the City of Los Angeles. It is bordered by the City of Hawthorne to the west and north, the City of Torrance to the west and south, and the City of Los Angeles to the east and south.

Gardena was incorporated in 1930 and was once known as the world's strawberry capital. The population of Gardena was approximately 45,165 in 1980, and approximately 57,746 in 2000, an increase of 28 percent. The primary employment markets for Gardena are manufacturing, professional and retail sales.

Gardena covers an area of 5.7 square miles and is serviced by the San Diego Freeway (Interstate 405), the Harbor Freeway (Interstate 110) and the Artesia Freeway (State Highway 91).

The Los Angeles River, which is the primary flood threat to the City of Gardena, originates at the west end of the San Fernando Valley in the northwestern-most corner of the County. The river channel extends through the heart of Los Angeles County by flowing east to Glendale where it turns and flows south to the Pacific Ocean. The Los Angeles River is part of a network of dams, reservoirs, debris collection basins, and spreading grounds built by the LACFCD and USACE to minimize flooding in the County. The portion of the river that affects the City of Gardena begins at the Arroyo Seco and ends at the mouth of the river at the Pacific Ocean. The floodplain starts in the northeast part of the City of Los Angeles at the Arroyo Seco confluence, passes through the Cities of Los Angeles, Bell, Bell Gardens, South Gate, Lynwood, Lakewood, Paramount, Compton, Bellflower, Carson, Gardena and Long Beach, to its terminus at the Pacific Ocean.

The metropolitan areas adjacent to the Los Angeles River containing the City of Gardena are densely populated with residential, commercial, and industrial development. Surface runoff has increased as a consequence of impervious development.

The topography of the coastal plain on which the City of Gardena resides is gradually sloped from the foothills of the San Gabriel Mountains upstream of the City, to the Pacific Ocean with a few exceptions of rising hills and depressed areas. Ground elevations range from 10,000 feet in the San Gabriel Mountains, to 330 feet near the Arroyo Seco confluence, to mean sea level at the mouth of the Los Angeles River.

Underlying soils are considered alluvial, and varies from coarse sand and gravel to silty clay and gravel or clay. The land is generally well-drained, with relatively few perched water or artesian areas.

The climate is considered subtropical. The precipitation regime contributing to the Gardena area and its surrounding watershed is primarily determined by the course of orographic rainfall associated with extra-tropical cyclones during the months between December and March. Snow fall, common at elevations of 5,000 feet or more, may influence flood events through the occurrence of rapid melting associated with warm weather following a major storm. Major storms consist of one or more frontal systems which may last up to four or more days each. The fall of precipitation is greatly intensified due to the San Gabriel Mountains which lie in the path of storms moving from the west or southwest. Steep canyons and gradients in the mountains contribute to rapid concentrations of storm runoff, which may or may not reach the City. The average annual rainfall ranges from 13.8 inches at the ocean to 28.2 inches in the San Gabriel Mountains. Average daily minimum temperature for January is 46.6°F, while the average daily maximum temperature for July is 83.3°F. In the San Gabriel Mountains (elevation 5,580 feet) the average daily minimum in January is 34.3°F above zero with an average daily maximum of 80.2°F in July.

City of Glendale

Results of the mapping study were not previously summarized in effective FIS report for the City of Glendale; therefore, no community description is provided.

City of Glendora

Results of the mapping study were not previously summarized in effective FIS report for the City of Glendora; therefore, no community description is provided.

City of Hawaiian Gardens

Results of the mapping study were not previously summarized in effective FIS report for the City of Hawaiian Gardens; therefore, no community description is provided.

City of Hawthorne

Results of the mapping study were not previously summarized in effective FIS report for the City of Hawthorne; therefore, no community description is provided.

City of Hermosa Beach

Results of the mapping study were not previously summarized in effective FIS report for the City of Hermosa Beach; therefore, no community description is provided.

City of Hidden Hills

Results of the mapping study were not previously summarized in effective FIS report for the City of Hidden Hills; therefore, no community description is provided.

City of Huntington Park

Results of the mapping study were not previously summarized in effective FIS report for the City of Huntington Park; therefore, no community description is provided.

City of Industry

Results of the mapping study were not previously summarized in effective FIS report for the City of Industry; therefore, no community description is provided.

City of Inglewood

Results of the mapping study were not previously summarized in effective FIS report for the City of Inglewood; therefore, no community description is provided.

City of Irwindale

Results of the mapping study were not previously summarized in effective FIS report for the City of Irwindale; therefore, no community description is provided.

City of La Canada Flintridge

Results of the mapping study were not previously summarized in effective FIS report for the City of La Canada Flintridge; therefore, no community description is provided.

City of La Habra Heights

Results of the mapping study were not previously summarized in effective FIS report for the City of La Habra Heights; therefore, no community description is provided.

City of La Mirada

The City of La Mirada is an urban community situated south of the Puente Hills, in the eastern portion of the Los Angeles County basin. The City is approximately 6 square miles in size. The City had a 1977 population of approximately 40,500, and approximately 46,783 in 2000, and increase of 16 percent. It is located approximately 20 miles southeast of downtown Los Angeles and is bordered by the Cities of Cerritos to the south and west, Santa Fe Springs to the west, La Habra to the north and east, Fullerton to the east, and Buena Park to the south. It is also bordered by unincorporated areas of Los Angeles County to the north and east and Orange County to the south and west.

The terrain within the La Mirada corporate limits can be classified in broad terms as 90 percent alluvial plain and 10 percent moderately sloping canyons and hills. Elevations range from approximately 200 feet in the northern portion of the city to 60 feet at the southern corporate limits.

Nearly all precipitation occurs during the months of December through March. Precipitation during the summer months is infrequent, with rainless periods of several months being common. Precipitation in the area occurs primarily in the form of winter orographic rainfall associated with extratropical cyclones of North Pacific origin. Major storms consist of one or more frontal systems and occasionally last 4 days or longer.

In the highly developed areas, local runoff volumes have increased because the soil surface has become covered by impervious materials, such as pavement areas and rooftops. Peak runoff rates for coastal plain areas have also increased due to the elimination of natural ponding areas and improved hydraulic efficiency of water carriers, such as streets and storm drain systems.

City of La Puente

Results of the mapping study were not previously summarized in effective FIS report for the City of La Puente; therefore, no community description is provided.

City of La Verne

Results of the mapping study were not previously summarized in effective FIS report for the City of La Verne; therefore, no community description is provided.

City of Lakewood

The City of Lakewood, incorporated April 16, 1954, is located 20 miles southeast of the City of Los Angeles in Los Angeles County. Lakewood is bordered by the Cities of Bellflower on the north, Long Beach to the west and south, Cerritos on the east and Bellflower on the north. The San Gabriel River flows north to south along the eastern corporate limits.

The population of Lakewood was approximately 82,973 in 1970, and 79,345 in 2000, a decrease of 4 percent. Lakewood is serviced by Interstate Highways 5, 405, 605, and 710 and State Highways 19 and 91. Long Beach Airport is approximately 2 miles and Los Angeles International Airport is approximately 20 miles from Lakewood.

The Los Angeles River, which is the primary flood threat to the City of Lakewood, originates at the west end of the San Fernando Valley in the northwestern-most corner of the County. The river channel extends through the heart of Los Angeles County by flowing east to Glendale where it turns and flows south to the Pacific Ocean. The Los Angeles River is part of a network of dams, reservoirs, debris collection basins, and spreading grounds built by the LACFCD and USACE to minimize flooding in the County. The portion of the river that affects the City of Lakewood begins at the Arroyo Seco and ends at the mouth of the river at the Pacific Ocean. The floodplain starts in the northeast part of the City of Los Angeles at the Arroyo Seco confluence, passes through the Cities of Los Angeles, Bell, Bell Gardens, South Gate, Lynwood, Lakewood, Paramount, Compton, Bellflower, Carson, Gardena and Long Beach, to its terminus at the Pacific Ocean.

The metropolitan areas adjacent to the Los Angeles River containing the City of Lakewood are densely populated with residential, commercial, and industrial development. Surface runoff has increased as a consequence of impervious development.

The topography of the coastal plain on which the City of Lakewood resides is gradually sloped from the foothills of the San Gabriel Mountains upstream of the City, to the Pacific Ocean with a few exceptions of rising hills and depressed areas. Ground elevations range from 10,000 feet in the San Gabriel Mountains, to 330 feet near the Arroyo Seco confluence, to mean sea level at the mouth of the Los Angeles River.

Underlying soils are considered alluvial, and varies from coarse sand and gravel to silty clay and gravel or clay. The land is generally well-drained, with relatively few perched water or artesian areas.

The climate is considered subtropical. The precipitation regime contributing to the Lakewood area and its surrounding watershed is primarily determined by the course of orographic rainfall associated with extra-tropical cyclones during the months between December and March. Snow fall, common at elevations of 5,000 feet or more, may influence flood events through the occurrence of rapid melting associated with warm weather following a major storm. Major storms consist of one or more frontal systems which may last up to four or more days each. The fall of precipitation is greatly intensified due to the San Gabriel Mountains which lie in the path of storms moving from the west or southwest. Steep canyons and gradients in the mountains contribute to rapid concentrations of storm runoff, which may or may not reach the City. The average annual rainfall ranges from 13.8 inches at the ocean to 28.2 inches in the San Gabriel Mountains. Average daily minimum temperature for January is 46.6°F, while the average daily maximum temperature for July is 83.3°F. In the San Gabriel Mountains (elevation 5,580 feet) the average daily minimum in January is 34.3°F above zero with an average daily maximum of 80.2°F in July.

City of Lancaster

Lancaster is an urbanized community situated in the Antelope Valley of northeastern Los Angeles County, in southern California. The City had a population of approximately 44,600 in 1977, and 118,718 in 2000, an increase of 266 percent. It is located approximately 56 miles north of the downtown area of the City of Los Angeles, and it is bordered by the City of Palmdale to the south and unincorporated county land to the west, north, and east.

The terrain within Lancaster's corporate limits can be classified, in broad terms, as being 100 percent alluvial plain.

The Antelope Valley is located on the leeward side of the San Gabriel Mountains, so orographic rainfall is generally sparse and occurs only during the winter months. Some snow falls at the higher elevations. Intense, short-duration summer thunderstorms are not uncommon and have created flooding in downstream areas.

The primary flood threat to the City of Lancaster is created by runoff originating in the Amargosa Creek and Portal Ridge Wash watersheds.

The average annual rainfall in Lancaster is approximately 6 inches. In the mountain watersheds to the south, the annual rainfall averages over 19 inches. On occasion, rainfall is of such intensity or duration that flows continue down major stream courses to the dry lakes north of the city where it ponds and eventually evaporates.

City of Lawndale

Results of the mapping study were not previously summarized in effective FIS report for the City of Lawndale; therefore, no community description is provided.

City of Lomita

Results of the mapping study were not previously summarized in effective FIS report for the City of Lomita; therefore, no community description is provided.

City of Long Beach

The City of Long Beach is located on the coast, in the southern region of the Los Angeles County basin. The City is approximately 50 square miles in size. The City had a population in 1980 of approximately 361,334, and approximately 461,522 in 2000, an increase of 28 percent.

Long Beach is located approximately 24 miles south of the downtown area of the City of Los Angeles. The city is bordered by the Cities of Paramount, Bellflower, Lakewood, Seal Beach, Signal Hill, Los Angeles, and Carson; unincorporated areas of Los Angeles County; and the Pacific Ocean.

The development in the flood-prone areas of Long Beach is commercial, industrial, and residential.

The terrain within the Long Beach corporate limits can be classified in broad terms as being 100 percent coastal plain. Elevation ranges from 60 feet in the northern portion of the city to sea level along the coast.

In the highly developed areas, local runoff volumes have increased as the soil surface has become covered by impervious materials. Peak runoff rates for coastal plain areas have also increased due to elimination of natural ponding areas and improved hydraulic efficiency of water carriers, such as streets and storm drain systems.

The Los Angeles River, which is the primary flood threat to the City of Long Beach, originates at the west end of the San Fernando Valley in the northwestern-most corner of the County. The river channel extends through the heart of Los Angeles County by flowing east to Glendale where it turns and flows south to the Pacific Ocean. The Los Angeles River is part of a network of dams, reservoirs, debris collection basins, and spreading grounds built by the LACFCD and USACE to minimize flooding in the County. The portion of the river that affects the City of Long Beach begins at the Arroyo Seco and ends at the mouth of the river at the Pacific Ocean. The floodplain starts in the northeast part of the City of Los Angeles at the Arroyo Seco confluence, passes through the Cities of Los Angeles, Bell, Bell Gardens, South Gate, Lynwood, Lakewood, Paramount, Compton, Bellflower, Carson, Gardena and Long Beach, to its terminus at the Pacific Ocean.

The metropolitan areas adjacent to the Los Angeles River containing the City of Long Beach are densely populated with residential, commercial, and industrial development. Surface runoff has increased as a consequence of impervious development.

The topography of the coastal plain on which the City of Long Beach resides is gradually sloped from the foothills of the San Gabriel Mountains upstream of the City, to the Pacific Ocean with a few exceptions of rising hills and depressed areas. Ground elevations range from 10,000 feet in the San Gabriel Mountains, to 330 feet near the Arroyo Seco confluence, to mean sea level at the mouth of the Los Angeles River. Two prominent hill formations are located in the lower reach of the floodplain. They include the Dominguez Hills on the west side of the Los Angeles River approximately 4 miles north of the coast and Signal Hill in the City of Long Beach. The Dominguez Hills reach an elevation of 200 feet and Signal Hill reaches 110 feet. Industrial areas just north of the Long Beach Harbor experience depressed elevations of -8.0 feet below sea level.

Underlying soils are considered alluvial, and varies from coarse sand and gravel to silty clay and gravel or clay. The land is generally well-drained, with relatively few perched water or artesian areas. Deposits of petroleum are present along the coast. Extensive pumping for oil has caused subsidence in the lower reach. ERMs along the coast and in the City of Long Beach are updated on a regular basis.

The climate is considered subtropical. The precipitation regime contributing to the Long Beach area and its surrounding watershed is primarily determined by the course of orographic rainfall associated with extra-tropical cyclones during the months between December and March. Snow fall, common at elevations of 5,000 feet or more, may influence flood events through the occurrence of rapid melting associated with warm weather following a major storm. Major storms consist of one or more frontal systems which may last up to four or more days each. The fall of precipitation is greatly intensified due to the San Gabriel Mountains which lie in the path of storms moving from the west or southwest. Steep canyons and gradients in the mountains contribute to rapid concentrations of storm runoff, which may or may not reach the City. The average annual rainfall ranges from 13.8 inches at the ocean to 28.2 inches in the San Gabriel Mountains. Average daily minimum temperature for January is 46.6°F, while the average daily maximum temperature for July is 83.3°F. In the San Gabriel Mountains (elevation 5,580 feet) the average daily minimum in January is 34.3°F above zero with an average daily maximum of 80.2°F in July.

City of Los Angeles

The City of Los Angeles is the largest city in Los Angeles County. It is located in the southwestern portion of Los Angeles County. The City of Los Angeles occupies the central portion of the Los Angeles basin, surrounded by the. San Gabriel, Santa Susana, and Verdugo Mountains on the north; incorporated cities within the coastal plain on the east; the Pacific Ocean on the south and southwest; and unincorporated areas of Los Angeles County and Malibu on the west. The Malibu area is within the western portion of the Santa Monica Mountains, which also extends to the east within the downtown area of the city.

The city encompasses an area of approximately 464 square miles. The City had a population in 1977 of approximately 2,762,000, and 3,694,820 in 2000, an increase of 34 percent. The City of Los Angeles is bordered by the Cities of Burbank, Glendale, Pasadena, South Pasadena, Alhambra, Monterey Park, Commerce, Vernon, Huntington Park, Carson, Long Beach, Rancho Palos Verdes, Lomita, Torrance, Gardena, Inglewood, Culver City, and Santa Monica, and by unincorporated areas of Los Angeles County.

Land use in the City of Los Angeles is diverse, with large areas of residential, commercial, and industrial development. Development varies from the densely populated central city to the quiet, secluded areas of the Santa Monica Mountains. The full development of the flat lands of the Los Angeles basin, the great demand for new residential units, and the tremendous increase in real estate values in the past years have resulted in extensive hillside development in the San Gabriel, Verdugo, and Santa Monica Mountains.

The terrain within the Los Angeles corporate limits can be classified in broad terms as being 75 percent alluvial plain and 25 percent rugged canyons and hills. Elevations range from 5,074 feet at Sister Elsie Peak in the San Gabriel Mountains to nearly mean sea level in the southwestern part of the city.

The Los Angeles River, which is the primary flood threat to the City of Los Angeles, originates at the west end of the San Fernando Valley in the northwestern-most corner of the County. The river channel extends through the heart of Los Angeles County by flowing east to Glendale where it turns and flows south to the Pacific Ocean. The Los Angeles River is part of a network of dams, reservoirs, debris collection basins, and spreading grounds built by the LACFCD and USACE to minimize flooding in the County. The portion of the river that affects the City of Los Angeles begins at the Arroyo Seco and ends at the mouth of the river at the Pacific Ocean. The floodplain starts in the northeast part of the City of Los Angeles at the Arroyo Seco confluence, passes through the Cities of Los Angeles, Bell, Bell Gardens, South Gate, Lynwood, Lakewood, Paramount, Compton, Bellflower, Carson, Gardena and Long Beach, to its terminus at the Pacific Ocean.

The remaining major drainage networks within the City are those of the Ballona Creek and Dominguez Channel systems. The West Los Angeles area is tributary to Ballona Creek and other channels that discharge into the Pacific Ocean on the west side of the County. The Central District is tributary to Compton Creek and the Los Angeles River, which flows southerly beyond the city limits and discharges into the ocean. The Harbor District is tributary to Dominguez Channel and Harbor Lake, which drain adjacent to the Los Angeles River mouth.

The topography of the coastal plain on which much of the City of Los Angeles resides is gradually sloped from the foothills of the San Gabriel Mountains upstream of the City, to the Pacific Ocean with a few exceptions of rising hills and depressed areas. Ground elevations range from 10,000 feet in the San Gabriel Mountains, to 330 feet near the Arroyo Seco confluence, to mean sea level at the mouth of the Los Angeles River. The City contains numerous steep, developed hillside residential areas.

Underlying soils are considered alluvial, and varies from coarse sand and gravel to silty clay and gravel or clay. The land is generally well-drained, with relatively few perched water or artesian areas.

The climate is considered subtropical. The precipitation regime contributing to the Los Angeles area and its surrounding watershed is primarily determined by the course of orographic rainfall associated with extra-tropical cyclones during the months between December and March. Snow fall, common at elevations of 5,000 feet or more, may influence flood events through the occurrence of rapid melting associated with warm weather following a major storm. Major storms consist of one or more frontal systems which may last up to four or more days each. The fall of precipitation is greatly intensified due to the San Gabriel Mountains which lie in the path of storms moving from the west or southwest. Steep canyons and gradients in the mountains contribute to rapid concentrations of storm runoff, which may or may not reach the City. The average annual rainfall ranges from 13.8 inches at the ocean to 28.2 inches in the San Gabriel Mountains. Average daily minimum temperature for January is 46.6°F, while the average daily maximum temperature for July is 83.3°F. In the San Gabriel Mountains (elevation 5,580 feet) the average daily minimum in January is 34.3°F above zero with an average daily maximum of 80.2°F in July.

City of Lynwood

The City of Lynwood is a residential community, with scattered areas of commercial and industrial development, situated in the central basin area of Los Angeles County. The City is approximately 5.0 square miles in size. The City of Lynwood had a population in 1980 of approximately 48,548, and approximately 69,845 in 2000, an increase of 44 percent. It is located approximately 11 miles southeast of the downtown area of the City of Los Angeles and is bordered by the Cities of South Gate, Paramount, Compton, and Los Angeles and incorporated county territory.

The Los Angeles River, which is the primary flood threat to the City of Lynwood, originates at the west end of the San Fernando Valley in the northwestern-most corner of the County. The river channel extends through the heart of Los Angeles County by flowing east to Glendale where it turns and flows south to the Pacific Ocean. The Los Angeles River is part of a network of dams, reservoirs, debris collection basins, and spreading grounds built by the LACFCD and USACE to minimize flooding in the County. The portion of the river that affects the City of Lynwood begins at the Arroyo Seco and ends at the mouth of the river at the Pacific Ocean. The floodplain starts in the northeast part of the City of Los Angeles at the Arroyo Seco confluence, passes through the Cities of Los Angeles, Bell, Bell Gardens, South Gate, Lynwood, Lakewood, Paramount, Compton, Bellflower, Carson, Gardena and Long Beach, to its terminus at the Pacific Ocean.

The metropolitan areas adjacent to the Los Angeles River containing the City of Lynwood are densely populated with residential, commercial, and industrial development. Surface runoff has increased as a consequence of impervious development.

The topography of the coastal plain on which the City of Lynwood resides is gradually sloped from the foothills of the San Gabriel Mountains upstream of the City, to the Pacific Ocean with a few exceptions of rising hills and depressed areas. Ground elevations range from 10,000 feet in the San Gabriel Mountains, to 330 feet near the Arroyo Seco confluence, to mean sea level at the mouth of the Los Angeles River. The terrain within the Lynwood corporate limits can be classified in broad terms as being 100 percent coastal plain. Elevations range from 95 feet at the northerly corporate limits of the city to 71 feet along the southerly corporate limits.

Underlying soils are considered alluvial, and varies from coarse sand and gravel to silty clay and gravel or clay. The land is generally well-drained, with relatively few perched water or artesian areas.

The climate is considered subtropical. The precipitation regime contributing to the Lynwood area and its surrounding watershed is primarily determined by the course of orographic rainfall associated with extra-tropical cyclones during the months between December and March. Snow fall, common at elevations of 5,000 feet or more, may influence flood events through the occurrence of rapid melting associated with warm weather following a major storm. Major storms consist of one or more frontal systems which may last up to four or more days each. The fall of precipitation is greatly intensified due to the San Gabriel Mountains which lie in the path of storms moving from the west or southwest. Steep canyons and gradients in the mountains contribute to rapid concentrations of storm runoff, which may or may not reach the City. The average annual rainfall ranges from 13.8 inches at the ocean to 28.2 inches in the San Gabriel Mountains. Average daily minimum temperature for January is 46.6°F, while the average daily maximum temperature for July is 83.3°F. In the San Gabriel Mountains (elevation 5,580 feet) the average daily minimum in January is 34.3°F above zero with an average daily maximum of 80.2°F in July.

City of Malibu

Results of the mapping study were not previously summarized in effective FIS report for the City of Malibu; therefore, no community description is provided.

City of Manhattan Beach

Results of the mapping study were not previously summarized in effective FIS report for the City of Manhattan Beach; therefore, no community description is provided.

City of Maywood

Results of the mapping study were not previously summarized in effective FIS report for the City of Maywood; therefore, no community description is provided.

City of Monrovia

Results of the mapping study were not previously summarized in effective FIS report for the City of Monrovia; therefore, no community description is provided.

City of Montebello

The City of Montebello is an urbanized community situated in the east-central portion of the Los Angeles County basin. It is located approximately 8 miles east of the downtown area of the City of Los Angeles and is bordered by the Cities of Commerce, Monterey Park, Pico Rivera, and Rosemead, and unincorporated territory of Los Angeles County. The city is approximately 8.2 square miles in size. The City had a population of approximately 52,929 in 1980, and approximately 62,150 in 2000, an increase of 17 percent.

The Rio Hondo, which is the primary flood threat to the City of Montebello, originates at Whittier Narrows Dam, a flood control facility that controls runoff originating in the northeastern portion of the County. The Rio Hondo channel joins the Los Angeles River downstream of the City of Montebello. Rio Hondo flows southwest through the Cities of Montebello, Pico Rivera, Bell Gardens, Downey and South Gate to its confluence with the Los Angeles River just north of the Imperial Highway. The Los Angeles River and Rio Hondo are part of a network of dams, reservoirs, debris collection basins, and spreading grounds built by the LACFCD and USACE to minimize flooding in the County.

The metropolitan areas adjacent to the Los Angeles River and the Rio Hondo are densely populated with residential, commercial, and industrial development. Surface runoff has increased as a consequence of impervious development.

The metropolitan areas adjacent to the Rio Hondo containing the City of Montebello are densely populated with residential, commercial, and industrial development. Surface runoff has increased as a consequence of impervious development.

The topography of the coastal plain on which the City of Montebello resides is gradually sloped from the foothills of the San Gabriel Mountains upstream of the City, to the Pacific Ocean with a few exceptions of rising hills and depressed areas. Ground elevations range from 10,000 feet in the San Gabriel

Mountains, to 330 feet near the Arroyo Seco confluence, to mean sea level at the mouth of the Los Angeles River. The terrain within Montebello's corporate limits can be classified, in broad terms, as being 90 percent alluvial plain and 10 percent moderately sloping hills. Elevations range from 160 feet in the southern portion of the city to approximately 500 feet in the Montebello Hills to the northeast.

Underlying soils are considered alluvial, and varies from coarse sand and gravel to silty clay and gravel or clay. The land is generally well-drained, with relatively few perched water or artesian areas.

The climate is considered subtropical. The precipitation regime contributing to the Montebello area and its surrounding watershed is primarily determined by the course of orographic rainfall associated with extra-tropical cyclones during the months between December and March. Snow fall, common at elevations of 5,000 feet or more, may influence flood events through the occurrence of rapid melting associated with warm weather following a major storm. Major storms consist of one or more frontal systems which may last up to four or more days each. The fall of precipitation is greatly intensified due to the San Gabriel Mountains which lie in the path of storms moving from the west or southwest. Steep canyons and gradients in the mountains contribute to rapid concentrations of storm runoff, which may or may not reach the City. The average annual rainfall ranges from 13.8 inches at the ocean to 28.2 inches in the San Gabriel Mountains. Average daily minimum temperature for January is 46.6°F, while the average daily maximum temperature for July is 83.3°F. In the San Gabriel Mountains (elevation 5,580 feet) the average daily minimum in January is 34.3°F above zero with an average daily maximum of 80.2°F in July.

City of Monterey Park

Results of the mapping study were not previously summarized in effective FIS report for the City of Monterey Park; therefore, no community description is provided.

City of Norwalk

Results of the mapping study were not previously summarized in effective FIS report for the City of Norwalk; therefore, no community description is provided.

City of Palmdale

The City of Palmdale is a growing urban community situated in the Antelope Valley area of northeastern Los Angeles County. It is located approximately 48 miles north of downtown Los Angeles and is bordered by the City of Lancaster and unincorporated areas of Los Angeles County. The population of the City of Palmdale was approximately 20,024 in 1977, and approximately 116,670 in 2000, an increase of 583 percent.

Floodplain development east of the Antelope Valley Freeway is generally commercial and industrial development west of the freeway is primarily residential. Between 10th Street East and 50th Street East, there is a mix of residential and commercial development. Palmdale International Airport is proposed in the northeastern section of the city. Floodplain development along Little Rock Wash is largely agricultural and rural/urban development, with one dwelling unit per 1.0 to 2.5 acres. The proposed land use for this area is generally neighborhood commercial.

The community is located in the Amargosa, Anaverde, Little Rock, and Big Rock Wash watersheds. Major streams, such as Amargosa Creek, Anaverde Creek, Amargosa Creek Tributary, Little Rock Wash, and Big Rock Wash, originate in the San Gabriel Mountains and flow northerly and northeasterly through Palmdale. Anaverde Creek Tributary also originates in the San Gabriel Mountains and flows northerly toward Palmdale. Elevations range from 2900 feet at the foothills of the San Gabriel Mountains in the south and west, to approximately 2450 feet in the northern portion of the city. The terrain within

Palmdale corporate limits can be classified as being 95 percent alluvial fan and 5 percent moderately sloping canyons and hills.

Antelope Valley is located on the leeward side of the San Gabriel Mountains, therefore, orographic rainfall is generally sparse and occurs only during the winter. Some snow falls at the higher elevations. The average annual rainfall in Palmdale is approximately 6 inches. In the mountain watersheds to the south, the annual rainfall averages over 19 inches. On occasion, rainfall is of such intensity or duration that flows continue down major stream courses to the dry lakes in the northern portion of the city where water ponds and eventually evaporates.

Soils in the vicinity of Palmdale consist of sandy alluvial deposits ranging from very coarse deposits near the base of the San Gabriel Mountains to finer deposits extending to the northeast.

City of Palos Verdes Estates

Results of the mapping study were not previously summarized in effective FIS report for the City of Palos Verdes Estates; therefore, no community description is provided.

City of Paramount

The City of Paramount is located in southern Los Angeles County approximately 12 miles southeast of downtown Los Angeles City. The population of the City of Paramount was approximately 36,407 in 1980, and 55,266 in 2000, and increase of 52 percent.

The Los Angeles River, which is the primary flood threat to the City of Paramount, originates at the west end of the San Fernando Valley in the northwestern-most corner of the County. The river channel extends through the heart of Los Angeles County by flowing east to Glendale where it turns and flows south to the Pacific Ocean. The Los Angeles River is part of a network of dams, reservoirs, debris collection basins, and spreading grounds built by the LACFCD and USACE to minimize flooding in the County. The portion of the river that affects the City of Paramount begins at the Arroyo Seco and ends at the mouth of the river at the Pacific Ocean. The floodplain starts in the northeast part of the City of Los Angeles at the Arroyo Seco confluence, passes through the Cities of Los Angeles, Bell, Bell Gardens, South Gate, Lynwood, Lakewood, Paramount, Compton, Bellflower, Carson, Gardena and Long Beach, to its terminus at the Pacific Ocean.

The metropolitan areas adjacent to the Los Angeles River containing the City of Paramount are densely populated with residential, commercial, and industrial development. Surface runoff has increased as a consequence of impervious development.

The topography of the coastal plain on which the City of Paramount resides is gradually sloped from the foothills of the San Gabriel Mountains upstream of the City, to the Pacific Ocean with a few exceptions of rising hills and depressed areas. Ground elevations range from 10,000 feet in the San Gabriel Mountains, to 330 feet near the Arroyo Seco confluence, to mean sea level at the mouth of the Los Angeles River. The terrain within the Paramount corporate limits can be classified in broad terms as being 100 percent coastal plain. Elevations range from 95 feet at the northerly corporate limits of the city to 71 feet along the southerly corporate limits.

Underlying soils are considered alluvial, and varies from coarse sand and gravel to silty clay and gravel or clay. The land is generally well-drained, with relatively few perched water or artesian areas.

The climate is considered subtropical. The precipitation regime contributing to the Paramount area and its surrounding watershed is primarily determined by the course of orographic rainfall associated with extra-tropical cyclones during the months between December and March. Snow fall, common at elevations of 5,000 feet or more, may influence flood events through the occurrence of rapid melting associated with warm weather following a major storm. Major storms consist of one or more frontal systems which may last up to four or more days each. The fall of precipitation is greatly intensified due to the San Gabriel Mountains which lie in the path of storms moving from the west or southwest. Steep canyons and gradients in the mountains contribute to rapid concentrations of storm runoff, which may or may not reach the City. The average annual rainfall ranges from 13.8 inches at the ocean to 28.2 inches in the San Gabriel Mountains. Average daily minimum temperature for January is 46.6°F, while the average daily maximum temperature for July is 83.3°F. In the San Gabriel Mountains (elevation 5,580 feet) the average daily minimum in January is 34.3°F above zero with an average daily maximum of 80.2°F in July.

City of Pasadena

Results of the mapping study were not previously summarized in effective FIS report for the City of Pasadena; therefore, no community description is provided.

City of Pico Rivera

The City of Pico Rivera is located in southern Los Angeles County approximately 10 miles east of downtown Los Angeles City. The population of Pico Rivera was approximately 58,459 in 1980, and 63,428 in 2000, an increase of 8 percent.

The Rio Hondo, which is the primary flood threat to the City of Pico Rivera, originates at Whittier Narrows Dam, a flood control facility that controls runoff originating in the northeastern portion of the County. The Rio Hondo channel joins the Los Angeles River downstream of the City of Pico Rivera. Rio Hondo flows southwest through the Cities of Montebello, Pico Rivera, Bell Gardens, Downey and South Gate to its confluence with the Los Angeles River just north of the Imperial Highway. The Los Angeles River and Rio Hondo are part of a network of dams, reservoirs, debris collection basins, and spreading grounds built by the LACFCD and USACE to minimize flooding in the County.

The metropolitan areas adjacent to the Rio Hondo containing the City of Pico Rivera are densely populated with residential, commercial, and industrial development. Surface runoff has increased as a consequence of impervious development.

The topography of the coastal plain on which the City of Pico Rivera resides is gradually sloped from the foothills of the San Gabriel Mountains upstream of the City, to the Pacific Ocean with a few exceptions of rising hills and depressed areas. Ground elevations range from 10,000 feet in the San Gabriel Mountains, to 330 feet near the Arroyo Seco confluence, to mean sea level at the mouth of the Los Angeles River. The terrain within Pico Rivera's corporate limits can be classified, in broad terms, as being 90 percent alluvial plain and 10 percent moderately sloping hills. Elevations range from 160 feet in the southern portion of the city to approximately 500 feet in the Montebello Hills to the northeast.

Underlying soils are considered alluvial, and varies from coarse sand and gravel to silty clay and gravel or clay. The land is generally well-drained, with relatively few perched water or artesian areas.

The climate is considered subtropical. The precipitation regime contributing to the Pico Rivera area and its surrounding watershed is primarily determined by the course of orographic rainfall associated with extra-tropical cyclones during the months between December and March. Snow fall, common at elevations of 5,000 feet or more, may influence flood events through the occurrence of rapid melting associated with warm weather following a major storm. Major storms consist of one or more frontal systems which may last up to four or more days each. The fall of precipitation is greatly intensified due to the San Gabriel Mountains which lie in the path of storms moving from the west or southwest. Steep canyons and gradients in the mountains contribute to rapid concentrations of storm runoff, which may or may not reach the City. The average annual rainfall ranges from 13.8 inches at the ocean to 28.2 inches in the San Gabriel Mountains. Average daily minimum temperature for January is 46.6°F, while the average daily maximum temperature for July is 83.3°F. In the San Gabriel Mountains (elevation 5,580 feet) the average daily minimum in January is 34.3°F above zero with an average daily maximum of 80.2°F in July.

City of Pomona

Results of the mapping study were not previously summarized in effective FIS report for the City of Pomona; therefore, no community description is provided.

City of Rancho Palos Verdes

Results of the mapping study were not previously summarized in effective FIS report for the City of Rancho Palos Verdes; therefore, no community description is provided.

City of Redondo Beach

The City of Redondo Beach is located on the central coastline along the western County boundary bordering the Pacific Ocean on Santa Monica Bay. It is located approximately 23 miles southwest of the downtown area of the City of Los Angeles and is bordered by the Cities of Hermosa Beach and Manhattan Beach to the northwest, Hawthorne to the north, Lawndale and Torrance to the east, Palos Verdes Estates to the south, and the Pacific Ocean to the west.

The population of the City of Redondo Beach was approximately 63,100 in 1979, and 63,261 in 2000, a negligible increase.

The coastline of Los Angeles County is approximately 74 miles in length, extending from Sequit Point to the San Gabriel River just south of the Los Angeles/Long Beach Harbor. The shoreline is diverse and varied, consisting of sandy beaches, eroding cliffs, and rock outcroppings. It includes two prominent headlands, Point Dume and Palos Verdes Peninsula, and two bays, Santa Monica Bay and San Pedro Bay. Redondo Beach is on the northeastern portion of Palos Verdes Peninsula off Santa Monica Bay. The shoreline is characterized by a sandy beach backed by cliffs in its northern portion and by extensive urban development behind the beaches along the southern portion of Santa Monica Bay. The coastline of Palos Verdes Peninsula is rocky, with pocket beaches of sand and cobble typical of Redondo Beach. The southern stretch along San Pedro Bay is the highly developed Los Angeles/Long Beach Harbor area.

The City of Redondo Beach is densely populated with residential, commercial, and light industrial development. Surface runoff has increased as a consequence of impervious development.

The topography of the coastal plain on which the City of Redondo Beach resides is gradually sloped from inland communities and hills to the east, to the Pacific Ocean with a few exceptions of rising coastal dune ridges and depressed areas.

Underlying soils are considered alluvial, and varies from coarse sand and gravel to silty clay and gravel or clay. The land is generally well-drained, with relatively few perched water or artesian areas.

The climate is considered subtropical. The precipitation regime contributing to the Redondo Beach area and its surrounding watershed is primarily determined by the course of orographic rainfall associated with extra-tropical cyclones during the months between December and March. Major storms consist of one or more frontal systems which may last up to four or more days each. The average annual rainfall ranges from 13.8 inches at the ocean to 28.2 inches in the San Gabriel Mountains north east of the City. Average daily minimum temperature for January is 46.6°F, while the average daily maximum temperature for July is 83.3°F.

City of Rolling Hills Estates

Results of the mapping study were not previously summarized in effective FIS report for the City of Rolling Hills Estates; therefore, no community description is provided.

City of Rolling Hills

Results of the mapping study were not previously summarized in effective FIS report for the City of Rolling Hills; therefore, no community description is provided.

City of Rosemead

Results of the mapping study were not previously summarized in effective FIS report for the City of Rosemead; therefore, no community description is provided.

City of San Dimas

Results of the mapping study were not previously summarized in effective FIS report for the City of San Dimas; therefore, no community description is provided.

City of San Fernando

Results of the mapping study were not previously summarized in effective FIS report for the City of San Fernando; therefore, no community description is provided.

City of San Gabriel

Results of the mapping study were not previously summarized in effective FIS report for the City of San Gabriel; therefore, no community description is provided.

City of San Marino

Results of the mapping study were not previously summarized in effective FIS report for the City of San Marino; therefore, no community description is provided.

City of Santa Clarita

The City of Santa Clarita is located in west-central Los Angeles County, in southwestern California. Santa Clarita is just north of U.S. Route 5 and State Route 14 on the canyon floor of the Santa Clarita Valley.

Santa Clarita is considered a low-density, semi-rural development, with medium-density development rapidly occurring in alluvial fan and canyon areas. The Santa Clarita Valley is drained by the Santa Clara River and its tributaries, which discharge into Ventura County, eventually reaching the Pacific Ocean. Some improved channels have been constructed in the Santa Clarita Valley.

The topography of the broad floodplain in which much of the City resides is gradually sloped from the foothills upstream of the City, to the Pacific Ocean with major mountainous landforms on either side. Ground elevations range from over 5,000 feet in the mountains, to mean sea level at the Pacific Ocean west of the City.

Underlying soils are considered alluvial, and varies from coarse sand and gravel to silty clay and gravel or clay. The land is generally well-drained, with relatively few perched water or artesian areas.

The climate is considered subtropical. The precipitation regime contributing to the Santa Clarita area and its surrounding watershed is primarily determined by the course of orographic rainfall associated with extra-tropical cyclones during the months between December and March. Snow fall, common at elevations of 5,000 feet or more, may influence flood events through the occurrence of rapid melting associated with warm weather following a major storm. Major storms consist of one or more frontal systems which may last up to four or more days each. The fall of precipitation is greatly intensified due to the mountains which lie in the path of storms moving from the west or southwest. Steep canyons and gradients in the mountains contribute to rapid concentrations of storm runoff, which may or may not reach the City. The average annual rainfall ranges from 13.8 inches at the ocean to 28.2 inches in the San Gabriel Mountains. Average daily minimum temperature for January is 46.6°F, while the average daily maximum temperature for July is 83.3°F. In the San Gabriel Mountains (elevation 5,580 feet) the average daily minimum in January is 34.3°F above zero with an average daily maximum of 80.2°F in July.

City of Santa Fe Springs

The City of Santa Fe Springs is located in southeast Los Angeles County, in southern California.

The City is approximately 8.8 square miles in size, had a population of approximately 15,500 in 1977, and approximately 17,438 in 2002, an increase of 13 percent. It is located approximately 14 miles east of downtown Los Angeles and is bordered by the Cities of Norwalk, Cerritos, La Mirada, Downey, and Whittier and unincorporated areas of Los Angeles County.

The City of Santa Fe Springs is a diverse community with large areas of residential, commercial, industrial, and oil well development. The community is situated in the eastern portion of the Los Angeles County basin.

There is no development within the floodplain in the City of Santa Fe Springs. The San Gabriel River follows the western corporate limits. Its headwaters are located deep in the San Gabriel Mountains, and it flows approximately 31 miles through several residential communities, finally discharging into the Pacific Ocean south of the City.

The terrain within Santa Fe Springs can be broadly classified as a gently sloping plain. Elevations range from 155 feet in the north-central portion of the city to approximately 80 feet at the southern corporate limits.

Underlying soils are considered alluvial, and varies from coarse sand and gravel to silty clay and gravel or clay. The land is generally well-drained, with relatively few perched water or artesian areas.

The climate is considered subtropical. The precipitation regime contributing to the Santa Fe Springs area and its surrounding watershed is primarily determined by the course of orographic rainfall associated with extra-tropical cyclones during the months between December and March. Snow fall, common at elevations of 5,000 feet or more, may influence flood events through the occurrence of rapid melting associated with warm weather following a major storm. Major storms consist of one or more frontal systems which may last up to four or more days each. The fall of precipitation is greatly intensified due to the mountains which lie in the path of storms moving from the west or southwest. Steep canyons and gradients in the mountains contribute to rapid concentrations of storm runoff, which may or may not reach the City. The average annual rainfall ranges from 13.8 inches at the ocean to 28.2 inches in the San Gabriel Mountains. Average daily minimum temperature for January is 46.6°F, while the average daily maximum temperature for July is 83.3°F. In the San Gabriel Mountains (elevation 5,580 feet) the average daily minimum in January is 34.3°F above zero with an average daily maximum of 80.2°F in July.

City of Santa Monica

Results of the mapping study were not previously summarized in effective FIS report for the City of Santa Monica; therefore, no community description is provided.

City of Sierra Madre

Results of the mapping study were not previously summarized in effective FIS report for the City of Sierra Madre; therefore, no community description is provided.

City of Signal Hill

Results of the mapping study were not previously summarized in effective FIS report for the City of Signal Hill; therefore, no community description is provided.

City of South El Monte

Results of the mapping study were not previously summarized in effective FIS report for the City of South El Monte; therefore, no community description is provided.

City of South Gate

The City of South Gate is located in southern Los Angeles County approximately 6 miles south of downtown Los Angeles City. The population of South Gate was approximately 66,784 in 1980, and 96,375 in 2000, an increase of 44 percent.

The Los Angeles River, which is the primary flood threat to the City of South Gate, originates at the west end of the San Fernando Valley in the northwestern-most corner of the County. The river channel extends through the heart of Los Angeles County by flowing east to Glendale where it turns and flows south to the Pacific Ocean. The Los Angeles River is part of a network of dams, reservoirs, debris collection basins, and spreading grounds built by the LACFCD and USACE to minimize flooding in the County. The portion of the river that affects the City of South Gate begins at the Arroyo Seco and ends at the mouth of the river at the Pacific Ocean. The floodplain starts in the northeast part of the City of Los Angeles at the Arroyo Seco confluence, passes through the Cities of Los Angeles, Bell, Bell Gardens, South Gate, Lynwood, Lakewood, Paramount, Compton, Bellflower, Carson, Gardena and Long Beach, to its terminus at the Pacific Ocean.

The metropolitan areas adjacent to the Los Angeles River containing the City of South Gate are densely populated with residential, commercial, and industrial development. Surface runoff has increased as a consequence of impervious development.

The topography of the coastal plain on which the City of South Gate resides is gradually sloped from the foothills of the San Gabriel Mountains upstream of the City, to the Pacific Ocean with a few exceptions of rising hills and depressed areas. Ground elevations range from 10,000 feet in the San Gabriel Mountains, to 330 feet near the Arroyo Seco confluence, to mean sea level at the mouth of the Los Angeles River. The terrain within the South Gate corporate limits can be classified in broad terms as being 100 percent coastal plain. Elevations range from 95 feet at the northerly corporate limits of the city to 71 feet along the southerly corporate limits.

Underlying soils are considered alluvial, and varies from coarse sand and gravel to silty clay and gravel or clay. The land is generally well-drained, with relatively few perched water or artesian areas.

The climate is considered subtropical. The precipitation regime contributing to the South Gate area and its surrounding watershed is primarily determined by the course of orographic rainfall associated with extra-tropical cyclones during the months between December and March. Snow fall, common at elevations of 5,000 feet or more, may influence flood events through the occurrence of rapid melting associated with warm weather following a major storm. Major storms consist of one or more frontal systems which may last up to four or more days each. The fall of precipitation is greatly intensified due to the San Gabriel Mountains which lie in the path of storms moving from the west or southwest. Steep canyons and gradients in the mountains contribute to rapid concentrations of storm runoff, which may or may not reach the City. The average annual rainfall ranges from 13.8 inches at the ocean to 28.2 inches in the San Gabriel Mountains. Average daily minimum temperature for January is 46.6°F, while the average daily maximum temperature for July is 83.3°F. In the San Gabriel Mountains (elevation 5,580 feet) the average daily minimum in January is 34.3°F above zero with an average daily maximum of 80.2°F in July.

City of South Pasadena

Results of the mapping study were not previously summarized in effective FIS report for the City of South Pasadena; therefore, no community description is provided.

City of Temple City

Results of the mapping study were not previously summarized in effective FIS report for the City of Temple City; therefore, no community description is provided.

City of Torrance

The City of Torrance is an urbanized community situated in southwestern Los Angeles County. The city is approximately 20.5 square miles in size. The City had a population of approximately 135,000 in 1977, and approximately 137,946 in 2000, an increase of 2 percent. It is located approximately 19 miles southwest of the downtown area of the City of Los Angeles and is bordered by the Cities of Gardena, Lawndale, Lomita, Los Angeles, Palos Verdes Estates, Redondo Beach, and Rolling Hills Estates, and unincorporated areas of Los Angeles County.

The terrain within the corporate limits of Torrance can be classified, in broad terms, as being 100 percent coastal plain. Elevations range from 300 feet at the southern portion of the city to sea level along the coast.

Underlying soils are considered alluvial, and varies from coarse sand and gravel to silty clay and gravel or clay. The land is generally well-drained, with relatively few perched water or artesian areas.

The climate is considered subtropical. The precipitation regime contributing to the Torrance area and its surrounding watershed is primarily determined by the course of rainfall associated with extra-tropical cyclones during the months between December and March. Major storms consist of one or more frontal systems which may last up to four or more days each. The average annual rainfall ranges from 13.8 inches at the ocean to 28.2 inches in the San Gabriel Mountains. Average daily minimum temperature for January is 46.6°F, while the average daily maximum temperature for July is 83.3°F.

City of Vernon

Results of the mapping study were not previously summarized in effective FIS report for the City of Vernon; therefore, no community description is provided.

City of Walnut

Results of the mapping study were not previously summarized in effective FIS report for the City of Walnut; therefore, no community description is provided.

City of West Covina

Results of the mapping study were not previously summarized in effective FIS report for the City of West Covina; therefore, no community description is provided.

City of West Hollywood

West Hollywood is one of Los Angeles County's older, more established communities. The city was newly incorporated November 29, 1984. It is the 84th, city to be incorporated in Los Angeles County. According to the December 1985 issue of City News, the population of West Hollywood was approximately 37,000, but was recorded as 35,716 in the 2000 Census. The City of West Hollywood, located in Los Angeles County California, is bordered to the south by the City of Beverly Hills and to the east by the City of Hollywood.

Over 51 percent of the land area in West Hollywood is developed as single and multiple family dwellings. Commercial and industrial area accounts for approximately 187 of the 2 square miles of land area within the city.

Underlying soils are considered alluvial, and varies from coarse sand and gravel to silty clay and gravel or clay. The land is generally well-drained, with relatively few perched water or artesian areas.

The climate is considered subtropical. The precipitation regime contributing to the West Hollywood area and its surrounding watershed is primarily determined by the course of orographic rainfall associated with extra-tropical cyclones during the months between December and March. Major storms consist of one or more frontal systems which may last up to four or more days each. The fall of precipitation is greatly intensified due to the San Gabriel Mountains which lie in the path of storms moving from the west or southwest. Steep canyons and gradients in the mountains contribute to rapid concentrations of storm runoff, which may or may not reach the City. The average annual rainfall ranges from 13.8 inches at the ocean to 28.2 inches in the San Gabriel Mountains. Average daily minimum temperature for January is 46.6°F, while the average daily maximum temperature for July is 83.3°F. In the San Gabriel Mountains (elevation 5,580 feet) the average daily minimum in January is 34.3°F above zero with an average daily maximum of 80.2°F in July.

City of Westlake Village

Results of the mapping study were not previously summarized in effective FIS report for the City of Westlake Village; therefore, no community description is provided.

City of Whittier

Whittier is an urban community at the southern base of the Puente Hills, in the southeastern corner of Los Angeles County. It is approximately 15 miles east of the downtown area of the City of Los Angeles and is bordered by the cities of La Habra and Santa Fe Springs, and unincorporated areas of Los Angeles and Orange Counties. The city is approximately 12.1 square miles in area. The City had a population of approximately 70,300 in 1977, and approximately 83,680 in 2000, an increase of 19 percent. Development in the flood plain is mostly residential with some commercial development along Painter Avenue.

Elevations range from 140 feet in the southwest portion of the city to approximately 800 feet at the Puente Hills to the northeast. The terrain within the city can be classified in broad terms as being 90 percent alluvial land and 10 percent moderately sloping canyons and hills.

Underlying soils are considered alluvial, and varies from coarse sand and gravel to silty clay and gravel or clay. The land is generally well-drained, with relatively few perched water or artesian areas.

The climate is considered subtropical. The precipitation regime contributing to the Whittier area and its surrounding watershed is primarily determined by the course of orographic rainfall associated with extra-tropical cyclones during the months between December and March. Major storms consist of one or more frontal systems which may last up to four or more days each. The fall of precipitation is greatly intensified due to the San Gabriel Mountains which lie in the path of storms moving from the west or southwest. Steep canyons and gradients in the mountains contribute to rapid concentrations of storm runoff, which may or may not reach the City. The average annual rainfall ranges from 13.8 inches at the ocean to 28.2 inches in the San Gabriel Mountains. Average daily minimum temperature for January is 46.6°F, while the average daily maximum temperature for July is 83.3°F. In the San Gabriel Mountains (elevation 5,580 feet) the average daily minimum in January is 34.3°F above zero with an average daily maximum of 80.2°F in July.

2.3 Principal Flood Problems

Los Angeles County

Los Angeles County has a long history of destructive flooding. The County suffered the effects of flooding episodes in 1811, 1815, 1825, 1832, 1861-62, 1867, 1876, 1884, 1888-91 (each year), 1914, 1921, and 1927. Similar, and better-documented floods have occurred in January 1934, March 1938, February 1941, January 1943, January 1952, January 1956, January and February 1969, March 1978, January 1979, March 1980, March 1983, January 1992, and January 1994. Many flood control facilities were constructed after the heavy loss of life and property damage incurred in the January 1934 flood event. These facilities have eliminated much of the damage which could have resulted in their absence. However, the floods of January and February 1969 and February and March 1978 demonstrated that Los Angeles County will always be susceptible to flood disaster. Of particular concern are mudflows which frequently occur in the foothill areas during intense rainfall, usually following wildfires in the upstream watershed. This hazard has not been addressed in this study but has been identified and addressed in numerous ways by the County, such as the construction of over one hundred debris basins at the mouths of mountainous canyons, to retain the high volume of sediment and debris that flood flows may carry during large floods. Debris basins have been demonstrated to be the only effective means of keeping downstream channel free of debris blockage, and the subsequent overtopping that would result during large flood events.

As an example of the continued threat from floods, during the 1969 storms, considerable damage occurred in the eastern portion of Los Angeles County, particularly in the foothill areas of the San Gabriel Mountains. Water and mud destroyed or damaged many residences and other buildings near the Cities of Glendora and Azusa, despite the presence of a large network of local flood control channels, storm drains, and debris basins.

In unincorporated areas of the County, much of the damage occurred downstream of brush fires which occurred during the summer of 1968. In the Malibu area, damage was experienced along Malibu Creek and Topanga Canyon where flows damaged homes, swept away bridges, and washed out roads. Approximately 500 people were left homeless or isolated. In the Santa Clarita Valley, most damage was caused by erosion and sedimentation of natural watercourses.

In the Antelope Valley, at least one home was completely destroyed. Railroads, public utilities, and agricultural interests also sustained considerable damage.

Although much of the damage, which occurred during the 1978 storms, was in the City of Los Angeles, unincorporated areas also sustained severe damage. In the La Crescenta area, a debris basin overflowed inundating several homes with mud and water. In addition, localized flooding damaged other homes in the area. Virtually all of the Flood Control District debris basins in this area were filled to capacity. In the Hidden Springs area, mud and water flowing down Mill Creek took 10 lives and destroyed numerous structures.

In the Los Angeles basin area, an extensive flood control system has eliminated much of the flood hazard experienced in years past. However, in the less densely populated areas of Malibu, Santa Clarita Valley, and Antelope Valley, relatively few flood control facilities have been constructed. These areas remain subject to flood hazard during major storms.

Mud flow mapping was incorporated into the DFIRM for the unincorporated areas of Los Angeles County.

City of Agoura Hills

The Los Angeles County Flood Control District indicates a history of flooding in the area from major storms in January 1934, March 1938, February 1941, January 1952, and January 1956 (Los Angeles County Flood Control District, Flood Overflow Maps, Updated Periodically).

Many flood control facilities have been constructed since these storms occurred. These facilities would have eliminated much of the damage which resulted from these storms. However, the more recent storms of January and February 1969 and February and March 1978 have demonstrated that Los Angeles County is still susceptible to flood disaster. Of particular concern are mudflows which frequently occur in the foothills during intense rainfall, usually following brush fires in the upstream watershed.

Damage from the 1969 storms was considerable in the Malibu area. Much of the damage occurred downstream of brush fire areas occurring in the summer of 1968. The Malibu area experienced damage to homes, bridges, and roads. Virtually all of the Flood Control Distict debris basins were filled to capacity. However, relatively few flood control facilities have been constructed in the area.

City of Alhambra

The City of Alhambra is identified as a non-flood prone community.

City of Arcadia

The City of Arcadia is identified as a non-flood prone community.

Mud flow mapping was incorporated into the DFIRM for the City of Arcadia.

City of Artesia

The City of Artesia is identified as a non-flood prone community.

City of Avalon

A small drainage ditch that channels runoff through the City exists along the eastern side of the headwaters canyon at an elevation somewhat higher than that of adjacent developed areas. The channel has capacity for approximately 15 percent of the 1-percent chance flood event. Excess flows break out as sheet flow and spread across the city, creating a wide flood plain that may inundate approximately 75 percent of all the structures located on the canyon floor. Research of local newspaper accounts, and interviews with residents reveal that the capacity of the channel has been exceeded during numerous past floods, and that shops and homes in the floodplain have experienced inundation damage.

Coastal areas of the City may be exposed to waves generated by winter and summer storms originating in the Pacific Ocean. The occurrence of such a storm event in combination with high astronomical tides and strong winds can cause a significant wave run-up allowing waves to reach higher than normal elevations along the coastline. When this occurs, shoreline erosion and coastal flooding frequently results in damage to inadequately protected structures and facilities located along low-lying portions of the shoreline.

On March 27, 1964, 10-foot waves, set in motion by a violent Alaskan earthquake, damaged the unsheltered coast of Santa Catalina Island. No damage was reported on the sheltered side of the island where Avalon Bay and the isthmus anchorage are located. However, there have been occasions when large, wind-driven waves have threatened structures fronting Avalon Bay.

Mud flow mapping was incorporated into the DFIRM for this city

City of Azusa

Results of the mapping study were not previously summarized in the effective FIS report for the City of Azusa; therefore, no flood protection measures are provided.

Mud flow mapping was incorporated into the DFIRM for the City of Azusa.

City of Baldwin Park

Results of the mapping study were not previously summarized in the effective FIS report for the City of Baldwin Park; therefore, no flood protection measures are provided.

City of Bell Gardens

Results of the mapping study were not previously summarized in the effective FIS report for the City of Bell Gardens; therefore, no flood protection measures are provided.

City of Bell

The City of Bell is identified as a non-flood prone community.

Cities of Bellflower, Carson, Compton, Downey, Gardena, Lakewood, Long Beach, Los Angeles, Lynwood, Montebello, Paramount, Pico Rivera, Santa Fe Springs, South Gate, and Whittier

The Cities of Bellflower, Carson, Compton, Downey, Gardena, Lakewood, Long Beach, Los Angeles, Lynwood, Montebello, Paramount, Pico Rivera, Santa Fe Springs, South Gate, and Whittier have a history of flooding roughly parallel to that of the larger Los Angeles River watershed. Prior to the construction of the extensive storm drain and flood control channel system protecting numerous communities within the County, these cities suffered the continual damage wrought by overflow of the Los Angeles River and/or its tributaries. Following completion of this system, and due to the lack of a very large flood event during the intervening period, the major cause of flood damage within these cities has been flooding by overflow of local drainage systems and smaller tributaries to the Los Angeles River system.

Localized flooding occurred to a large extent during the floods of January and February 1969, February and March 1978, and February 1980, March 1983, January 1992, and January 1994. This flooding was due to the occurrence of localized high-intensity rainfall events, which overwhelmed the ability of local storm drains and flood control channels to drain off the excess runoff.

Flood control facilities constructed after the large events of the 1930’s eliminated much of the damage which could have resulted in their absence; however, the level of protection offered by these facilities may have diminished during this period of reapid development of the Los Angeles basin, demonstrated by the almost break-out of the Los Angeles River in 1980, during an event that was recorded as considerably smaller than that of the expected design level of protection. Construction of the Los Angeles County Drainage Area Project (LACDA) has brought to level of protection offered by the system up to a level of greater than a 1-percent annual chance event.

These cities remain susceptible to flood damage from other sources. Of particular concern are mudflows which frequently occur in the foothill areas during intense rainfall, usually following wildfires in the upstream watershed.

Prior to completion of the Corps of Engineers' Los Angeles County Drainage Area study and Los Angeles River and Rio Hondo flood control channel modifications, the upper and lower reach of the Los Angeles River Channel were not capable of adequately conveying a 1-percent annual chance flood event. Overbank areas were susceptible to flooding caused by overtopping and potential failure of levee structures. Completion of this project, and its subsequent pursuit of Map Revision and USACE certification of the level of protection offered by the project, has resulted in these cities' removal from the regulatory 1-percent annual chance floodplain. Breakout is still possible during events larger than the current design of the system is capable of conveying.

In addition to land-based storms, the coastline of the cities of Long Beach and Los Angeles are also susceptible to storm-associated flooding. The southern California coastline is exposed to waves generated by winter and summer storms originating in the Pacific Ocean. It is not uncommon for these storms to cause 15-foot breakers. The occurrence of such a storm event in combination with high astronomical tides and strong winds can cause a significant wave runup and allow storm waves to attack higher than normal elevations along the coastline. When this occurs, shoreline erosion and coastal flooding frequently results in damage to inadequately protected structures and facilities located along low-lying portions of the shoreline.

Brief descriptions of several significant storms follow, which provide information to which coastal flood hazards and the projected flood depths can be compared.

September 16, 1910

Heavy seas and high ground swells undermined homes in the Long Beach area. Efforts were made to check the destruction of the waves by building temporary bulkheads along the waterfront at its most exposed points, but until the tide began to recede late in the evening, little effective good was done. The ocean eroded into the sidewalks which stretch from the Long Beach Bath House to Seaside Park at high tide on the afternoon of the 16th. Within a short period of time, over a mile of the bulkhead and sidewalk were destroyed.

September 1934

A recurrence of destructive waves, similar to those of August 21, 1934, broke along the coast centering northward in the Long Beach area. Damage was reported at Malibu, where portions of the Roosevelt Highway were flooded due to waters backed up at a storm drain project under construction. In addition, the Pine Avenue Pier in Long Beach was destroyed. No damage was reported at either San Pedro or Santa Monica. Structures along the pike were endangered and temporary devices of protection were installed.

September 24-25, 1939

A tropical cyclone lashed the entire southern California coastline on Sunday, September 24th and Monday, September 25th. The storm brought approximately a 20°F drop in temperature throughout southern California and winds reached 65 miles per hour. The gales and rain claimed lives, wreaked havoc with power and phone lines, temporarily destroyed the main railroad systems, closed highways, and flooded homes. Eight large homes along the waterfront at Sunset Beach were swept away. In Long Beach, plate glass windows were smashed by fierce winds. Some Pacific Electric track was washed out at Hermosa Beach. Disruption of phone service was heaviest in the Bellflower, Hynes-Clearwater, and Artesia areas. Homes along the shore from Malibu to Huntington Beach were heavily damaged by pounding seas and high winds. Many small boats were washed ashore, and several were wrecked when the high waves dashed them upon breakwaters or rocky shores. At least 10 yachts and barges were sunk or wrecked upon breakwaters or sands. At Santa Monica, the 227-foot fishing barge Minne A was washed ashore. Five deaths in the surf were reported; two at Los Angeles, two at Long Beach, and one at Newport Beach. At Burbank, one woman was drowned and others injured when a boat overturned.

December 25, 26, and 27, 1940

Twenty- and thirty-foot waves undermined residences and portions of the Strand at Redondo Beach. Two houses collapsed and five blocks of ocean-front walk were destroyed. In addition, 25-foot breakers undermined a house and store 50 feet landward of the normal high tide mark. At Belmont Peninsula, Long Beach, 70 homes were threatened with being cut off from the mainland by intense wave action.

May 22, 1960

Resurgent seismic-triggered ocean waves stemming from Chilean earthquakes smashed dock facilities and hundreds of small craft. Damage was estimated at upwards of $1 million. Hardest hit was the Los Angeles-Long Beach Harbor complex, where a series of tidal currents surged back and forth through narrow Cerritos Channel wreaking havoc among the yacht anchorages. Some 300 yachts and small boats were torn from their slips and estimates indicated that from 15 to 30 boats were sunk. The closing of the Terminal Island bridges and suspension of ferry service caused monumental traffic jams in the Los Angeles/Long Beach area. The peak surge was estimated at between 8 and 9 feet.

Winter 1977-1978

A combination of high astronomical tides, strong onshore winds, and high storm waves resulted in significant coastal flooding along the coastline of Los Angeles County. High tides and waves were responsible for an estimated $1 to 1.8 million in private property losses to homes located along beaches in Malibu; $80,000 worth of damage to the Santa Monica Pier; $150,000 worth of damage to the Long Beach Harbor; and $140,000 worth of damage to a bicycle path in 81 Segundo. Other losses resulting from wave damages occurred at Leo Carillo State Beach, Redondo Beach, Avalon, and other areas along the county shoreline.

Oil pumping in past years has caused subsidence along the ocean front areas of Long Beach. Settlements of up to 30 feet have occurred in some areas of the Long Beach Harbor subjecting many locations along the coast to damage from direct wave action. Much of Naples Island and Belmont Shores in southeastern Long Beach, lie at elevations less than the maximum recorded tide. Interior drainage is handled by means of flap-gated outlets in the seawall.

Mud flow mapping was incorporated into the DFIRM for the Cities of Los Angeles, Montebello, and Whittier.

City of Beverly Hills

Results of the mapping study were not previously summarized in the effective FIS report for the City of Beverly Hills; therefore, no flood protection measures are provided.

City of Bradbury

The City of Bradbury is identified as a non-flood prone community.

Mud flow mapping was incorporated into the DFIRM for the City of Bradbury.

City of Burbank

Stormflows entering the City of Burbank are generated from relatively small watersheds on the southwesterly side of the Verdugo Mountains. Flooding is caused by surface runoff associated with high-intensity orographic rainfalls of several hours duration. Once the ground is saturated, subsequent rainfall, augmented by canyon floodflows and coupled with inadequate local drainage facilities, produces shallow flooding and ponding to a depth of approximately 3 feet.

Los Angeles County Flood Control District flood overflow delineations on U.S. Geological Survey maps indicate a history of flooded streets and streams in Burbank; however, minimal damage has occurred due to the construction of up-graded drainage facilities and flood protection structures.

Mud flow mapping was incorporated into the DFIRM for this city.

During a February 1992 storm, localized flooding was observed in the following locations in the City of Burbank:

1. In the area west of the Lockheed Drain and Burbank Western Flood Control Channels, east of Victory Boulevard, north of the southern branch of the Southern Pacific Railroad (SPRR), and south of Burbank Boulevard. Channel overflows flowed down Lake Street and ponded north of the SPPR tracks prior to returning to the Burbank Western Flood Control Channel.

2. Lockheed Drain overtopped upstream of an existing railroad spur bridge and flowed south down Griffith Park Drive to Burbank Boulevard. The overflow then flowed east along Burbank Boulevard until joining the flood flows described above.

3. Overflow through the existing railroad trestle weir located upstream of Clybourn Street.

4. No other significant flooding problems have been documented. The Los Angeles County Flood Control District (LACFCD) has prepared a deficiency analyses study (Los Angeles County Flood Control District, August 1982) that identifies several other potential flood-hazard areas.

City of Calabasas

Results of the mapping study were not previously summarized in the effective FIS report for the City of Calabasas; therefore, no flood protection measures are provided.

City of Cerritos

Results of the mapping study were not previously summarized in the effective FIS report for the City of Cerritos; therefore, no flood protection measures are provided.

City of Claremont

Results of the mapping study were not previously summarized in the effective FIS report for the City of Claremont; therefore, no flood protection measures are provided.

Mud flow mapping was incorporated into the DFIRM for the City of Claremont.

City of Commerce

Results of the mapping study were not previously summarized in the effective FIS report for the City of Commerce; therefore, no flood protection measures are provided.

City of Covina

Results of the mapping study were not previously summarized in the effective FIS report for the City of Covina; therefore, no flood protection measures are provided.

Mud flow mapping was incorporated into the DFIRM for the City of Covina.

City of Cudahy

Results of the mapping study were not previously summarized in the effective FIS report for the City of Cudahy; therefore, no flood protection measures are provided.

City of Culver City

The City of Culver City has an extensive history of floods and flooding. Sources of flooding include the Ballona Creek channel and associated tributaries, as well as drainage channels originating in the Baldwin Hills and surrounding cities.

The Los Angeles County Flood Control District's flood overflow maps indicate a history of flooded streets and low-lying areas along the streams of Culver City that resulted from major storms discussed above.

City of Diamond Bar

Results of the mapping study were not previously summarized in the effective FIS report for the City of Diamond Bar; therefore, no flood protection measures are provided.

City of Duarte

The City of Duarte is identified as a non-flood prone community

Mud flow mapping was incorporated into the DFIRM for the City of Duarte.

City of El Monte

The City of El Monte is identified as a non-flood prone community

City of El Segundo

Results of the mapping study were not previously summarized in the effective FIS report for the City of El Segundo; therefore, no flood protection measures are provided.

City of Glendale

Results of the mapping study were not previously summarized in the effective FIS report for the City of Glendale; therefore, no flood protection measures are provided.

Mud flow mapping was incorporated into the DFIRM for the City of Glendale.

City of Glendora

Results of the mapping study were not previously summarized in the effective FIS report for the City of Glendora; therefore, no flood protection measures are provided.

Mud flow mapping was incorporated into the DFIRM for the City of Glendora.

City of Hawaiian Gardens

Results of the mapping study were not previously summarized in the effective FIS report for the City of Hawaiian Gardens; therefore, no flood protection measures are provided.

City of Hawthorne

The City of Hawthorne is identified as a non-flood prone community

City of Hermosa Beach

Results of the mapping study were not previously summarized in the effective FIS report for the City of Hermosa Beach; therefore, no flood protection measures are provided.

City of Hidden Hills

Results of the mapping study were not previously summarized in the effective FIS report for the City of Hidden Hills; therefore, no flood protection measures are provided.

City of Huntington Park

The City of Huntington Park is identified as a non-flood prone community

City of Industry

Results of the mapping study were not previously summarized in the effective FIS report for the City of Industry; therefore, no flood protection measures are provided.

Mud flow mapping was incorporated into the DFIRM for the City of Industry.

City of Inglewood

Results of the mapping study were not previously summarized in the effective FIS report for the City of Inglewood; therefore, no flood protection measures are provided.

City of Irwindale

Results of the mapping study were not previously summarized in the effective FIS report for the City of Irwindale; therefore, no flood protection measures are provided.

City of La Canada Flintridge

The City of La Canada Flintridge is identified as a non-flood prone community.

Mud flow mapping was incorporated into the DFIRM for the City of La Canada Flintridge.

City of La Habra Heights

Results of the mapping study were not previously summarized in the effective FIS report for the City of La Habra Heights; therefore, no flood protection measures are provided.

Mud flow mapping was incorporated into the DFIRM for the City of La Habra Heights.

City of La Mirada

Los Angeles County Flood Control District flood overflow maps indicate a history of flooded streets and natural watercourses in La Mirada. This flooding resulted from major storms of March 1938, January'1956, January and February 1969, February 1978, March 1980, February 1983, and January 1994. La Mirada Creek is an unimproved watercourse which flows southwest through the City. Between Santa Gertrudes Avenue and Stamy Road, the channel runs into La Mirada Creek Park. The park has been designed as a greenbelt flood plain management area and the 1-Percent Annual Chance discharge is contained within city-owned park property. Downstream of Stamy Road, the floodflows follow the natural watercourse alignment of La Mirada Creek. Between Stamy Road and Imperial Highway, the existing development is rural-residential and the flood plain is occupied by horse corrals and small barns. The water ponds upstream of Imperial Highway inundate approximately 3 acres of undeveloped property. Between Imperial Highway and La Mirada Boulevard, the flows continue through a miniature golf course and a residential development. The residential structures are located on high ground substantially above the flood plain. Downstream of La Mirada Boulevard, the watercourse traverses an open field which is part of Biola College. An existing flood control channel, downstream of the field, collects floodwaters, which are ultimately conveyed to North Fork Coyote Creek.

Watersheds of less than one square mile within the City have historically caused flooding in developed low-lying areas. These areas are located in the vicinity of the intersection of Valeda Drive and De Alcala Drive, between Goldendale Drive and Telegraph Road, the eastern end of Capella Street, the intersection of San Feliciano Drive and Figueras Road, the intersection of Crosswood Road and Pemberton Drive, the intersection of Borda Drive and San Ardo Drive, and north of the Atchison, Topeka, and Santa Fe Railway near Castellon Road.

City of La Puente

Results of the mapping study were not previously summarized in the effective FIS report for the City of La Puente; therefore, no flood protection measures are provided.

City of La Verne

Results of the mapping study were not previously summarized in the effective FIS report for the City of La Verne; therefore, no flood protection measures are provided.

Mud flow mapping was incorporated into the DFIRM for the City of La Verne.

City of Lancaster

Lancaster is situated on the alluvial floodplain of the Antelope Valley. Consequently, the type of flooding experienced in the city is typical of that experienced by communities developed on alluvial fans. Flood flows discharge from the mountainous canyons onto the desert floor, where, due to the lack of well-incised streambeds, it spreads out in uncontrolled patterns.

Flood discharges have overflowed in normally dry streambeds, resulting in heavy damage as floodwaters pass through developed areas. During the period of comparatively recent record, floods of major proportions have occurred. The office of the County Engineer has identified the areas in which moderate to severe flooding was observed during the heavy storms of 1938, 1965, 1969, 1978, 1980, 1983, 1994 on flood overflow maps. Flooding from Little Rock Creek was experienced in the eastern portion of. the city. During these floods, widespread damage to orchards, irrigation systems, buildings, and roads occurred.

City of Lawndale

The City of Lawndale is identified as a non-flood prone community

City of Lomita

The City of Lomita is identified as a non-flood prone community

City of Malibu

Results of the mapping study were not previously summarized in the effective FIS report for the City of Malibu; therefore, no flood protection measures are provided.

City of Manhattan Beach

Results of the mapping study were not previously summarized in the effective FIS report for the City of Manhattan Beach; therefore, no flood protection measures are provided.

City of Maywood

The City of Maywood is identified as a non-flood prone community.

City of Monrovia

The City of Monrovia is identified as a non-flood prone community.

Mud flow mapping was incorporated into the DFIRM for the City of Monrovia.

City of Monterey Park

Results of the mapping study were not previously summarized in the effective FIS report for the City of Monterey Park; therefore, no flood protection measures are provided.

City of Norwalk

Results of the mapping study were not previously summarized in the effective FIS report for the City of Norwalk; therefore, no flood protection measures are provided.

City of Palmdale

The type of flooding in the city is typical of that experienced by communities developed on alluvial fans. Flood flows discharge from the mountainous canyons onto the desert floor, where, due to the lack of well incised streambeds, water spreads out in uncontrolled patterns. Intense, short-duration summer thunderstorms are not uncommon and have created flooding in downstream areas.

The principal flood problems for both the Little Rock and Big Rock Washes can be attributed to three factors: the very flat topography, the absence of well-defined natural channels, and the lack of a developed flood control system. In the steeper upstream reaches of both washes, water is confined mostly to the main channel. Flooding problems occur when the flows reach the valley floor where the channels flatten out. This allows the flows to spread out over great distances inundating the surrounding areas.

In some instances, flooding from different sources converges in specific drainage areas of the city. In the east-central part of the city, flooding studied by approximate methods originates in the north, east of Amargosa Creek, and converges with flooding studied by detailed methods that originate in the foothills to the south.

Flood discharges have overflowed normally dry streambeds, resulting in heavy damage as floodwaters travel through developed areas. During the period of comparatively recent record, floods of major proportions have occurred. The office of the County Engineer has identified the areas in which moderate to severe flooding was observed during heavy storms in 1938, 1965, and 1969 on flood overflow maps. During these floods, widespread damage to orchards, irrigation systems, buildings, and roads occurred.

Thunderstorms have caused localized damage in various portions of the valley, particularly along the foothills of the San Gabriel Mountains to the south and southwest of the city.

Mud flow mapping was incorporated into the DFIRM for the City of Palmdale.

City of Palos Verdes Estates

Results of the mapping study were not previously summarized in the effective FIS report for the City of Palos Verdes Estates; therefore, no flood protection measures are provided.

City of Pasadena

The City of Pasadena is identified as a non-flood prone community.

Mud flow mapping was incorporated into the DFIRM for the City of Pasadena.

City of Pomona

Results of the mapping study were not previously summarized in the effective FIS report for the City of Pomona; therefore, no flood protection measures are provided.

Mud flow mapping was incorporated into the DFIRM for the City of Pomona.

City of Rancho Palos Verdes

Results of the mapping study were not previously summarized in the effective FIS report for the City of Rancho Palos Verdes; therefore, no flood protection measures are provided.

Mud flow mapping was incorporated into the DFIRM for the City of Rancho Palos Verdes.

City of Redondo Beach

The watersheds of Redondo Beach are relatively small with storm flows either draining directly into the ocean or accumulating in numerous small sumps. The Los Angeles County Flood Control District flood overflow maps indicate a history of flooded streets and sumps in the community which resulted from the major storms of 1938, 1965, 1969, 1978, 1980, 1983, and 1994.

Flooding caused by the 1-percent annual chance flood is limited to street rights of way, areas of shallow flooding less than one foot deep, and ponding areas. Shallow flooding occurs along Avenue I between South Elena and Esplanade Avenues; along Julia Avenue between Camino Real and South Juanita Avenue; between Del Amo, Diamond, Garnsey, and Vincent Streets; between Vincent Street, South Irena Avenue, Spencer Street, and El Rondo; between Anita Street, North Prospect Avenue, Agate Street, and Harkness Lane; along Carnegie Lane between Blossom and Green Lanes; between Aviation Way and Artesia and Aviation Boulevards; between Gibson Avenue, Deland Boulevard, Dow Avenue, and Manhattan Beach Boulevard; at the intersection of the Atchinson, Topeka, and Santa Fe Railway and Inglewood Avenue; and along Compton Boulevard between Freeman and Aviation Boulevards.

The southern California coastline is exposed to waves generated by winter and summer storms originating in the Pacific Ocean. It is not uncommon for these storms to cause 15-foot breakers. The occurrence of such a storm event in combination with high astronomical tides and strong winds can cause a significant wave runup and allow storm waves to attack higher than normal elevations along the coastline. When this occurs, shoreline erosion and coastal flooding frequently result in damage to inadequately protected structures and facilities located along low-lying portions of the county shoreline.

Brief descriptions of several significant storms provide historic information to which coastal flood hazards and the projected flood depths can be compared.

September 16, 1910

On September 16, 1910, a heavy sea and high ground swells undermined homes in the Long Beach area. The ocean began to erode the sidewalks which stretch from the Long Beach Bath House to Seaside Park at high tide that afternoon and, in a short period of time, over a mile of the bulkhead and sidewalk were destroyed. Efforts were made to check the destruction of the waves by building temporary bulkheads along the waterfront at the most exposed points; however, these measures proved ineffective until the tide began to recede late in the evening.

December 7-12, 1934

Another recurrence of waves was reported from December 7th through December 12th. Two large openings were made through the rock-mound breakwater at Santa Monica, indicating that the force of the waves was sufficient to displace very heavy granite rocks.

August 21, 1934

On August 21, 1934, waves of a reported height exceeding 30 feet broke with tremendous force along the coast from Laguna to Malibu. At Venice, the seaward end of the pier was destroyed by the heavy seas. The pier at the entrance to the Playa del Rey Lagoon was weakened by the loss of piling. At Hermosa Beach, considerable sand in front of Long Beach was washed away. Basements of seaside cottages along 100 miles of beach were filled with sand, some to a depth of 5 feet. An unusually heavy sea surged over the Santa Monica breakwater carrying some of the rocks away and doing some damage to the pier by destroying a few of the piles. Breakers 15 feet high were reported at Santa Monica.

September 1934

A recurrence of destructive waves, similar to those of August 1934, broke along the coast centering northward in the Long Beach area. Damage was reported at Malibu where portions of the Roosevelt Highway were flooded due to waters backed up at a storm drain project under construction. In addition, the Pine Avenue Pier in Long Beach was destroyed. Structures along the pike were endangered and temporary protection devices were installed. No damage was reported at either San Pedro or Santa Monica.

September 24, 1939

On September 24th and 25th, a tropical cyclone occurred along the entire southern California coastline. The storm resulted in a 20 degree drop in temperatures throughout Southern California. The gales and rain caused death, disrupted power lines, temporarily destroyed main railroad systems, closed highways, and flooded homes.

The winds, reaching a velocity of 65 miles per hour, caused considerable damage. Eight large homes along the waterfront at Sunset Beach were destroyed. In Long Beach, plate-glass windows were shattered by the fierce winds. Some Pacific Electric trackage was destroyed at Hermosa Beach. Phone and power lines were down at Sunset Beach. Disruption of phone service was heaviest at Bellflower, Hynes-Clearwater, and the Artesia area. Homes along the shore from Malibu to Huntington Beach were damaged heavily by pounding seas and the high wind. In addition, the storm caused the grounding of all airplanes at airports in the Los Angeles area.

The Hamilton, a large storm basin, overflowed its banks and flooded houses and stores. Families in the surrounding district were evacuated from their homes. Schools were closed because of flooded streets. As the stormwaters rushed seaward from the uplands, homes in the residential districts of the lowlands and beach cities were flooded.

Many small boats were washed ashore and several were wrecked when the high waves dashed them upon breakwaters or rocky shores. Early estimates indicated that at least ten yachts and barges sank or were wrecked upon breakwaters and sands. At Santa Monica, the 227-foot fishing barge Minne A was washed ashore.

Five deaths were reported. Two died at Los Angeles Harbor, two at Long Beach, and one at Newport Beach. At Burbank, one woman drowned and others were injured when a boat overturned.

Catalina Island reported a 50 mile per hour wind at Diamond Point.

December 25, 26, and 27, 1940

Twenty- and thirty-foot waves undermined residences and portions of the Strand at Redondo Beach. Two houses collapsed and five blocks of ocean-front walk were destroyed. In addition, 25-foothigh breakers undermined a house and store 50 feet landward of the normal high-tide mark.

At Belmont Peninsula, Long Beach, 70 homes were threatened to be cut off from the mainland by intense wave action.

May 22, 1960

Resurgent seismic-triggered ocean waves stemming from Chilean earthquakes destroyed dock facilities and hundreds of small craft. Damage was estimated at upwards of one million dollars. Hardest hit was the Los Angeles-Long Beach Harbor complex, where a series of tidal currents surged back and forth through narrow Cerritos Channel, wreaking havoc among the yacht anchorages. Some 300 yachts and small boats were torn from their slips, and early estimates indicated that from 15 to 30 had been sunk.

Monumental traffic jams occurred in the Los Angeles/Long Beach Harbor area coincident with suspension of ferry service and closing of the Terminal Island bridges. The surge was estimated at 8 and 9 feet high at times.

March 27, 1964

Ten-foot waves, set in motion by a violent Alaskan earthquake, damaged the unsheltered coast of Santa Catalina Island. No damage was reported on the sheltered side of the island where Avalon Bay and the isthmus anchorage are located.

At Marina del Rey, the rise was measured at 52 inches in the harbor and 5 feet at the entrance during low tide.

Winter 1977-1978

A combination of high astronomical tides, strong onshore winds, and high storm waves resulted in significant coastal flooding along the coastline of Los Angeles County. High tides and waves were responsible for 1 to 1.8 million dollars in private property losses to homes located along beaches in Malibu; $80,000 in damages to the Santa Monica Pier; $150,000 in damages to the Long Beach Harbor; and $140,000 in damages to a bicycle path in El Segundo. Other smaller losses resulting from wave damages occurred at Leo Carillo State Beach, Redondo Beach, Avalon, and other areas along the county shoreline.

City of Rolling Hills Estates

Results of the mapping study were not previously summarized in the effective FIS report for the City of Rolling Hills Estates; therefore, no flood protection measures are provided.

City of Rolling Hills

The City of Rolling Hills is identified as a non-flood prone community.

Mud flow mapping was incorporated into the DFIRM for the City of Rolling Hills.

City of Rosemead

Results of the mapping study were not previously summarized in the effective FIS report for the City of Rosemead; therefore, no flood protection measures are provided.

City of San Dimas

Results of the mapping study were not previously summarized in the effective FIS report for the City of San Dimas; therefore, no flood protection measures are provided.

Mud flow mapping was incorporated into the DFIRM for the City of San Dimas.

City of San Fernando

Results of the mapping study were not previously summarized in the effective FIS report for the City of San Fernando; therefore, no flood protection measures are provided.

City of San Gabriel

The City of San Gabriel is identified as a non-flood prone community.

City of San Marino

The City of San Marino is identified as a non-flood prone community.

City of Santa Clarita

Los Angeles County Flood Control District flood-overflow maps indicate a history of flooding in this area from major storms during 1934, 1938, 1941, 1943, 1952, 1956, separate storm events in January and February 1969, February and March 1978, and 1980, 1983, 1992, and 1994. These events demonstrate that the City of Santa Clarita is susceptible to flood damage. Of particular concern are mudflows that frequently occur in the foothill areas during intense rainfall, usually following brush fires in the upstream watershed. This hazard has not been addressed in this study.

During the 1969 storms in the Santa Clarita Valley, much damage was caused by erosion and sedimentation of the natural watercourses. The most significant damage to private property was the destruction of a zoological compound located in the Santa Clara River floodplain.

City of Santa Monica

Results of the mapping study were not previously summarized in the effective FIS report for the City of Santa Monica; therefore, no flood protection measures are provided.

City of Sierra Madre

The City of Sierra Madre is identified as a non-flood prone community.

Mud flow mapping was incorporated into the DFIRM for the City of Sierra Madre.

City of Signal Hill

Results of the mapping study were not previously summarized in the effective FIS report for the City of Signal Hill; therefore, no flood protection measures are provided.

City of South El Monte

The City of South El Monte is identified as a non-flood prone community.

City of South Pasadena

The City of South Pasadena is identified as a non-flood prone community.

City of Temple City

The City of Temple City is identified as a non-flood prone community.

City of Torrance

The LACFCD flood overflow map at a scale of 1: 24, 000 (Los Angeles County Flood Control District, 1993) indicate a history of flood streets, sumps, and general flooding among Dominguez Channel in Torrance, which resulted from the major storms of March 1938, February 1941, January 1952, January 1956, and January 1969. The flooding problems were related to the inadequacy of local drainage facilities.

The city is also exposed to potential coastal high hazard caused by storm surge and wave runup from the Pacific Ocean.

City of Vernon

The City of Vernon is identified as a non-flood prone community.

City of Walnut

Results of the mapping study were not previously summarized in the effective FIS report for the City of Walnut; therefore, no flood protection measures are provided.

Mud flow mapping was incorporated into the DFIRM for the City of Walnut.

City of West Covina

Results of the mapping study were not previously summarized in the effective FIS report for the City of West Covina; therefore, no flood protection measures are provided.

City of West Hollywood

The major causes of flooding in West Hollywood are short-duration, high intensity storms. Los Angeles County Flood Control District flood overflow maps indicate a history of flooding from the major storms of January 1934, March 1938, February 1941, January 1943, January 1952, and January 1956. A more recent storm, January 1969, was the worst storm recorded for the Los Angeles Basin.

City of Westlake Village

Results of the mapping study were not previously summarized in the effective FIS report for the City of Westlake Village; therefore, no flood protection measures are provided.

2.4 Flood Protection Measures

Los Angeles County

A complex drainage system has been constructed to alleviate flooding in Los Angeles County. The major components of the Los Angeles County flood control system are the Los Angeles River, the San Gabriel River, Rio Hondo, Ballona Creek, and Dominguez Channel. In addition, numerous other storm drains, channels and debris basins have been constructed by the U.S. Army Corps of Engineers, local agencies, and private developers. Responsibility for maintaining the majority of this system, which serves the incorporated cities as well as unincorporated county territory, lies with the Los Angeles County Flood Control District. Generally, the larger drainage systems mentioned above are designed to contain a 1-percent annual chance flood event.

The major drainage systems in the western and northern portions of the county are largely unimproved, although developed areas generally contain drainage systems providing a level of protection less than that of a 1-percent annual chance event. Development in these areas, which includes the Malibu area, and the Santa Clarita and Antelope Valleys, is less dense than that of the Los Angeles basin, but is rapidly reaching the point of complete build-out in some areas.

Although a number of drainage systems have been constructed to protect areas of development, environmental concerns, and a desire to retain “natural” channels that retain environmental functions, recharge capability, and water quality improvement qualities make extensive flood control channel development unlikely. Therefore, it appears that most areas of the County will have to be protected from flood hazard by exercising sensible flood plain management. Current floodplain management measures include the reviewing of new developments before permits are issued and the undertaking of additional studies designed to supplement this Flood Insurance Study.

City of Agoura Hills

The major drainage systems in the western portion of the county are largely unimproved. Development in these areas, which includes the Malibu area, is far more sparse than in the Los Angeles basin. Although a few drainage systems have been constructed to protect portions of the existing development, lack of funding and environmental concerns make extensive flood control work unlikely. Therefore, for the foreseeable future, it appears that most future development will have to be protected from flood hazard by exercising sensible floodplain management. Current floodplain management measures include the reviewing of new developments before permits are issued.

City of Alhambra

The City of Alhambra is identified as a non-flood prone community.

City of Arcadia

The City of Arcadia is identified as a non-flood prone community.

City of Artesia

The City of Artesia is identified as a non-flood prone community.

City of Avalon

Currently, there are no flood protection devices or measures that protect the City from damaging floods, other than the presence of small drainage ditches and natural channels.

City of Azusa

Results of the mapping study were not previously summarized in the effective FIS report for the City of Azusa; therefore, no flood protection measures are provided.

City of Baldwin Park

Results of the mapping study were not previously summarized in the effective FIS report for the City of Baldwin Park; therefore, no flood protection measures are provided.

City of Bell Gardens

Results of the mapping study were not previously summarized in the effective FIS report for the City of Baldwin Park; therefore, no flood protection measures are provided.

City of Bell

The City of Bell is identified as a non-flood prone community.

Cities of Bellflower, Carson, Compton, Downey, Gardena, Lakewood, Long Beach, Los Angeles, Lynwood, Montebello, Paramount, Pico Rivera, Santa Fe Springs, South Gate, and Whittier.

The Los Angeles County Flood Control District, in conjunction with the Corps of Engineers, have built a series of dams, reservoirs, debris basins, and channel and storm drain systems, to minimize flooding in the Los Angeles River basin and its tributaries. Responsibility for maintaining most of the system lies with the LACFCD.

The Los Angeles River is the major flood control system affecting these cities. The current flood control channel was designed to convey flood waters safely through the County to its outlet on the Pacific Ocean at Long Beach. The current channel was modified in the 1990's to carry an event larger than a 1-percent chance flood.

Components of the system protecting these cities includes the Hansen and Sepulveda Flood Control Dams, 15 major channels within the City of Los Angeles, including the Los Angeles River, Pacoima Wash, Tujunga Wash, Sawtelle-Westwood Flood Control System, and Ballona Creek systems. Additionally, the Los Angeles County Flood Control District has constructed 111 debris basins, additional major flood control channels in the San Fernando Valley, the Ballona Creek system, which collects flood flows from West Los Angeles and discharges into the Pacific Ocean, and the Laguna Dominquez Flood Control System, which drains the southern portion of these cities and a portion of the Harbor area into San Pedro Bay. Moreover, the City of Los Angeles operates and maintains approximately 1,100 miles of open channels and underground drains. The Los Angeles County Flood Control District has constructed and is responsible for the operation and maintenance of approximately 1,000 miles of storm-drain bond issue projects within the city. The City of Los Angeles and the Los Angeles County Flood Control District operate and maintain 13 pumping plants in the Harbor, San Fernando Valley, and West Los Angeles areas to alleviate inundation of low-lying areas during storms.

In addition, the City of Long Beach has constructed seawalls and levees around the piers in Long Beach Harbor to keep the seawater out of the areas where subsidence has occurred.

The extension of the Detached Federal Breakwater by the USACE to its present terminus opposite the mouth of San Gabriel River in 1946 has eliminated progressive beach erosion. Concrete bulkheads were constructed on Naples Islands by a Works Progress Administration project in the 1930s. In 1967, the City of Long Beach added a reinforced concrete cap approximately 18 inches high to these walls, raising the top to an elevation of 9.0 feet. The city has also constructed several pump plants in the vicinity of Naples Island and Long Beach Harbor.

The only major nonstructural flood protection measure is the Public Warning System for severe weather conditions and tsunamis, operated by the National Oceanic and Atmospheric Administration through its National Weather Service, in cooperation with various State, county, and local officials. This system can provide some measure of flood protection by alerting coastal residents to take necessary precautions in the event of a tsunami or major storm.

The City of Santa Fe Springs is currently protected by the San Gabriel River, Coyote Creek channel (both located outside the corporate limits), and the Coyote Creek - North Fork. The Los Angeles County Flood Control District has constructed several local storm drain projects providing relief to flood-prone areas. Milan Creek upstream of Marquardt Avenue (outside the corporate limits) is permanently improved. However, downstream of Marquardt Avenue, the channel remains unimproved.

The City of Whittier is currently protected by a series of small drainage channels and storm drain systems, as well as the larger system of La Mirada Creek, where it passes through the southeast corner of Whittier. The Los Angeles County Flood Control District has constructed several local storm-drain projects, providing relief to flood-prone areas by controlling the 1-percent annual chance flood event. The U.S. Army Corps of Engineers has constructed levees along the San Gabriel River, west and north of Whittier. These levees control the 1-percent annual chance flood event downstream of Whittier Narrows Flood Control Basin.

City of Beverly Hills

Results of the mapping study were not previously summarized in the effective FIS report for the City of Beverly Hills; therefore, no flood protection measures are provided.

City of Bradbury

The City of Bradbury is identified as a non-flood prone community.

City of Burbank

The City of Burbank is protected by the Los Angeles River and the Burbank Western Flood Control Channel. The Los Angeles River and Burbank Western Flood Control Channels are currently capable of conveying the 1-percent annual chance flood event. In addition, the Los Angeles County Flood Control District has constructed several debris basins, major channels, and numerous local storm drain projects, including the Lockheed Storm Drain, to provide relief to flood-prone areas. Most channels and storm drains built within the city are capable of controlling discharges associated with the 1-percent annual chance event; however, several areas do not have this level of protection and shallow flooding is, therefore, not uncommon.

Burbank has also adopted flood plain management regulations incorporating building and safety standards as well as ordinances controlling construction in the floodplain.

The Lockheed Drain Channel is a constructed storm-drain channel. Upstream of Clybourn Avenue the channel is an excavated earthen section with a levee on the north side of the channel. Downstream of Clybourn Avenue the channel is either in a closed conduit (reinforced-concrete pipe or reinforced-concrete box section) or is a rectangular reinforced concrete open channel section. Bridge crossings of the rectangular section consist of a reinforced concrete slab over the rectangular channel section.

Immediately upstream of Clybourn Avenue, a multiple-pipe spillway structure has been constructed to convey excess discharge under the SPRR. This structure replaces an open-channel trestle-type structure and is intended to spill excess flows to the area south of the Lockheed Drain Channel, thereby preventing overtopping of the levee located along the north side of the drain and the railroad embankment on the south side of the drain. As part of this restudy, the railroad embankment on the south side of the Lockheed Drain Channel was evaluated as if it were a levee. However, in this restudy it was determined that as a result of replacing the former open-channel facility with the current multiple-pipe structure, the south-side embankment will not have the minimum 3 feet of freeboard during a 1-percent annual chance flood event as outlined in Section 65.10 of FEMA publication "National Flood Insurance Program and Related Regulations" (Federal Emergency Management Agency, October 1, 1994). As part of this restudy, the levee system along the north bank of the Lockheed Drain Channel and the embankment along the south bank were analyzed as providing protection during a 1-percent annual chance flood event and as failing during a 1-percent annual chance flood event. The guidelines found in Section 65.10 of "National Flood Insurance Program and Related Regulations" were applied where it was assumed that the levee or railroad embankment may not exist due to the lack of requisite freeboard or structural and soil data that would confirm the adequacy of the existing levee or railroad embankment. Analyses were performed alternatively assuming the facilities to be in place.

Analyses were also performed for the following facilities, as above, based on the guidelines found in Section 65.10 of "National Flood Insurance Program and Related Regulations":

1. The SPRR embankments, from just upstream of Naomi Street to Buena Vista Street and from Lincoln Street to Parish Place, did not meet the minimum freeboard requirements.

2. The existing masonry walls around the City of Burbank electrical substation at Lincoln Street.

3. The subdivision masonry wall located between the City of Burbank substation at Lincoln Street and Parish Place.

The base (1-percent annual chance) flood elevations (BFEs) shown on the FIRM and Flood Profiles for the Lockheed Drain Channel represent the results of the analyses performed with the above facilities being in place during a 1-percent annual chance flood event. The Zone X areas delineated along the south overbank in the vicinity of Frederick Street and Parish Place represent the results of the analyses that were performed assuming that the above facilities were not in place during a 1-percent annual chance flood event.

City of Calabasas

Results of the mapping study were not previously summarized in the effective FIS report for the City of Calabasas; therefore, no flood protection measures are provided.

City of Cerritos

Results of the mapping study were not previously summarized in the effective FIS report for the City of Cerritos; therefore, no flood protection measures are provided.

City of Claremont

Results of the mapping study were not previously summarized in the effective FIS report for the City of Claremont; therefore, no flood protection measures are provided.

City of Commerce

Results of the mapping study were not previously summarized in the effective FIS report for the City of Commerce; therefore, no flood protection measures are provided.

City of Covina

Results of the mapping study were not previously summarized in the effective FIS report for the City of Covina; therefore, no flood protection measures are provided.

City of Cudahy

Results of the mapping study were not previously summarized in the effective FIS report for the City of Cudahy; therefore, no flood protection measures are provided.

City of Culver City

The City of Culver City is protected by the Ballona Creek Channel, Centinela Creek Channel, Sawtelle-Westwood Storm Drain Channel, and Benedict Canyon Channel, in addition to numerous local storm drain projects providing relief to flood-prone areas. Benedict Canyon is below ground for its entire study length.

City of Diamond Bar

Results of the mapping study were not previously summarized in the effective FIS report for the City of Diamond Bar; therefore, no flood protection measures are provided.

City of Duarte

The City of Duarte is identified as a non-flood prone community.

City of El Monte

The City of El Monte is identified as a non-flood prone community.

City of El Segundo

Results of the mapping study were not previously summarized in the effective FIS report for the City of El Segundo; therefore, no flood protection measures are provided.

City of Glendale

Results of the mapping study were not previously summarized in the effective FIS report for the City of Glendale; therefore, no flood protection measures are provided.

City of Glendora

Results of the mapping study were not previously summarized in the effective FIS report for the City of Glendora; therefore, no flood protection measures are provided.

City of Hawaiian Gardens

Results of the mapping study were not previously summarized in the effective FIS report for the City of Hawaiian Gardens; therefore, no flood protection measures are provided.

City of Hawthorne

The City of Hawthorne is identified as a non-flood prone community.

City of Hermosa Beach

Results of the mapping study were not previously summarized in the effective FIS report for the City of Hermosa Beach; therefore, no flood protection measures are provided.

City of Hidden Hills

Results of the mapping study were not previously summarized in the effective FIS report for the City of Hidden Hills; therefore, no flood protection measures are provided.

City of Huntington Park

The City of Huntington Park is identified as a non-flood prone community.

City of Industry

Results of the mapping study were not previously summarized in the effective FIS report for the City of Industry; therefore, no flood protection measures are provided.

City of Inglewood

Results of the mapping study were not previously summarized in the effective FIS report for the City of Inglewood; therefore, no flood protection measures are provided.

City of Irwindale

Results of the mapping study were not previously summarized in the effective FIS report for the City of Irwindale; therefore, no flood protection measures are provided.

City of La Canada Flintridge

The City of La Canada Flintridge is identified as a non-flood prone community.

City of La Habra Heights

Results of the mapping study were not previously summarized in the effective FIS report for the City of La Habra Heights; therefore, no flood protection measures are provided.

City of La Mirada

The City of La Mirada is protected from flood flows by the Los Angeles River system, and the flood control facility of Coyote Creek, which generally follows the eastern corporate limits. Also, the Los

Angeles County Flood Control District has constructed several local storm drains providing relief to flood-prone areas.

City of Puente

Results of the mapping study were not previously summarized in the effective FIS report for the City of Puente; therefore, no flood protection measures are provided.

City of La Verne

Results of the mapping study were not previously summarized in the effective FIS report for the City of La Verne; therefore, no flood protection measures are provided.

City of Lancaster

Flooding conditions within the City of Lancaster have been improved with the installation of flood control structures by various agencies and property owners. Major public and private improvements, such as the Antelope Valley Freeway (State, Routes 14 and 138), the Union (former Southern) Pacific Railroad, and the California Aqueduct, have incorporated provisions for the passage of flood flows. During construction of the Antelope Valley Freeway, an interceptor drain was constructed for Amargosa Creek. The drain starts at Avenue K and continues northward along the east side of the freeway through the city. The drain will contain a 1-percent annual chance flood.

City of Lawndale

The City of Lawndale is identified as a non-flood prone community.

City of Lomita

The City of Lomita is identified as a non-flood prone community.

City of Malibu

Results of the mapping study were not previously summarized in the effective FIS report for the City of Malibu; therefore, no flood protection measures are provided.

City of Manhattan Beach

Results of the mapping study were not previously summarized in the effective FIS report for the City of Manhattan Beach; therefore, no flood protection measures are provided.

City of Maywood

The City of Maywood is identified as a non-flood prone community.

City of Monrovia

The City of Monrovia is identified as a non-flood prone community.

City of Monterey Park

Results of the mapping study were not previously summarized in the effective FIS report for the City of Monterey Park; therefore, no flood protection measures are provided.

City of Norwalk

Results of the mapping study were not previously summarized in the effective FIS report for the City of Norwalk; therefore, no flood protection measures are provided.

City of Palmdale

Flooding conditions within the City of Palmdale have been improved with the installation of smaller flood control systems by various agencies and property owners. Major public and private improvements, such as the Antelope Valley Freeway (State Route 14), the Union (former Southern) Pacific Railroad, and the California Aqueduct (located south of Palmdale), have provided for the passage of flood flows.

City of Palos Verdes Estates

Results of the mapping study were not previously summarized in the effective FIS report for the City of Pomona; therefore, no flood protection measures are provided.

City of Pasadena

The City of Pasadena is identified as a non-flood prone community.

City of Pomona

Results of the mapping study were not previously summarized in the effective FIS report for the City of Pomona; therefore, no flood protection measures are provided.

City of Rancho Palos Verdes

Results of the mapping study were not previously summarized in the effective FIS report for the City of Rancho Palos Verdes; therefore, no flood protection measures are provided.

City of Redondo Beach

The City of Redondo Beach is protected by a system of drainage channels and storm drain systems.

Major structural modifications have been made along the 74 miles of coastline in Los Angeles County. Over 50 miles of seawalls and revetments have been constructed to halt erosion and to absorb the impact of wave forces. In addition, 41 groins, 9 breakwaters, and 6 jetties have been constructed to serve a number of purposes, including flood protection.

The only major countywide nonstructural flood protection measure is the Public Warning System for severe weather conditions and tsunamis, operated by the National Oceanic and Atmospheric Administration through its National Weather Service, in cooperation with various State, county, and local officials.

This system can provide some measure of flood protection by alerting the coastal residents to take necessary precautions in the event of a tsunami or major storm.

In addition, the City of Redondo Beach as well as other coastal communities in the County are participating in either the emergency or regular phase of the National Flood Insurance Program.

City of Rolling Hills Estates

Results of the mapping study were not previously summarized in the effective FIS report for the City of Rolling Hills Estates; therefore, no flood protection measures are provided.

City of Rolling Hills

The City of Rolling Hills is identified as a non-flood prone community.

City of Rosemead

Results of the mapping study were not previously summarized in the effective FIS report for the City of Rosemead; therefore, no flood protection measures are provided.

City of San Dimas

Results of the mapping study were not previously summarized in the effective FIS report for the City of San Dimas; therefore, no flood protection measures are provided.

City of San Fernando

Results of the mapping study were not previously summarized in the effective FIS report for the City of San Fernando; therefore, no flood protection measures are provided.

City of San Gabriel

The City of San Gabriel is identified as a non-flood prone community.

City of San Marino

The City of San Marino is identified as a non-flood prone community.

City of Santa Clarita

The major drainage systems in and around the City of Santa Clarita are currently undergoing major change. Numerous developments within the City are protected by facilities constructed to convey the 1-percent chance flood event. No comprehensive flood control system as yet exists. Environmental concerns and funding limitations make the construction of a large concrete flood control channel system unlikely. Therefore, sound floodplain management may remain a primary means of limiting flood hazards to new development. Current floodplain management measures include reviewing new development before permits are issued and performing additional studies designed to supplement this Flood Insurance Study.

City of Santa Monica

Results of the mapping study were not previously summarized in the effective FIS report for the City of Santa Monica; therefore, no flood protection measures are provided.

City of Sierra Madre

The City of Sierra Madre is identified as a non-flood prone community.

City of Signal Hill

Results of the mapping study were not previously summarized in the effective FIS report for the City of Signal Hill; therefore, no flood protection measures are provided.

City of South El Monte

The City of South El Monte is identified as a non-flood prone community.

City of South Pasadena

The City of Pasadena is identified as a non-flood prone community.

City of Temple City

The City of Temple City is identified as a non-flood prone community.

City of Torrance

The City of Torrance is currently protected by a series of small drainage channels and storm drain systems. The Dominguez Channel and several local storm drain projects, provide relief to flood-prone areas.

FLOOD INSURANCE STUDY

LOS ANGELES COUNTY, CALIFORNIA

AND INCORPORATED AREAS

VOLUME 2 OF 4

Community Name	Community Number	Community Name	Community Number	Community Number	Community Name	Community Number	Community Number
LOS ANGELES COUNTY, UNINCORPORATED AREAS	065043	DIAMOND BAR, CITY OF	060741	LAWNDALE, CITY OF*	060134	SAN DIMAS, CITY OF	060154
AGOURA HILLS, CITY OF	065072	DOWNEY, CITY OF	060645	LOMITA, CITY OF*	060135	SAN FERNANDO, CITY OF*	060628
ALHAMBRA, CITY OF*	060095	DUARTE, CITY OF	065026	LONG BEACH, CITY OF	060136	SAN GABRIEL, CITY OF*	065055
ARCADIA, CITY OF	065014	EL MONTE, CITY OF*	060658	LOS ANGELES, CITY OF	060137	SAN MARINO, CITY OF*	065057
ARTESIA, CITY OF*	060097	EL SEGUNDO, CITY OF	060118	LYNWOOD, CITY OF	060635	SANTA CLARITA, CITY OF	060729
AVALON, CITY OF	060098	GARDENA, CITY OF	060119	MALIBU, CITY OF	060745	SANTA FE SPRINGS, CITY OF	060158
AZUSA, CITY OF	065015	GLENDALE, CITY OF	065030	MANHATTAN BEACH, CITY OF	060138	SANTA MONICA, CITY OF	060159
BALDWIN PARK, CITY OF*	060100	GLENDORA, CITY OF	065031	MAYWOOD, CITY OF*	060651	SIERRA MADRE, CITY OF	065059
BELL GARDENS, CITY OF	060656	HAWAIIAN GARDENS, CITY OF*	065032	MONROVIA, CITY OF	065046	SIGNAL HILL, CITY OF*	060161
BELL, CITY OF*	060101	HAWTHORNE, CITY OF*	060123	MONTEBELLO, CITY OF	060141	SOUTH EL MONTE, CITY OF*	060162
BELLFLOWER, CITY OF	060102	HERMOSA BEACH, CITY OF	060124	MONTEREY PARK, CITY OF*	065047	SOUTH GATE, CITY OF	060163
BEVERLY HILLS, CITY OF*	060655	HIDDEN HILLS, CITY OF	060125	NORWALK, CITY OF	060652	SOUTH PASADENA, CITY OF*	065061
BRADBURY, CITY OF	065017	HUNTINGTON PARK, CITY OF*	060126	PALMDALE, CITY OF	060144	TEMPLE CITY, CITY OF	060653
BURBANK, CITY OF	065018	INDUSTRY, CITY OF	065035	PALOS VERDES ESTATES, CITY OF	060145	TORRANCE, CITY OF	060165
CALABASAS, CITY OF	060749	INGLEWOOD, CITY OF*	065036	PARAMOUNT, CITY OF	065049	VERNON, CITY OF*	060166
CARSON, CITY OF	060107	IRWINDALE, CITY OF*	060129	PASADENA, CITY OF	065050	WALNUT, CITY OF	065069
CERRITOS, CITY OF	060108	LA CANADA FLINTRIDGE, CITY OF	060669	PICO RIVERA, CITY OF	060148	WEST COVINA, CITY OF	060666
CLAREMONT, CITY OF	060109	LA HABRA HEIGHTS, CITY OF	060701	POMONA, CITY OF	060149	WEST HOLLYWOOD, CITY OF	060720
COMMERCE, CITY OF	060110	LA MIRADA, CITY OF	060131	RANCHO PALOS VERDES, CITY OF	060464	WESTLAKE VILLAGE, CITY OF	060744
COMPTON, CITY OF	060111	LA PUENTE, CITY OF*	065039	REDONDO BEACH, CITY OF	060150	WHITTIER, CITY OF	060169
COVINA, CITY OF	065024	LA VERNE, CITY OF	060133	ROLLING HILLS ESTATES, CITY OF*	065054		
CUDAHY, CITY OF	060657	LAKEWOOD, CITY OF	060130	ROLLING HILLS, CITY OF	060151		
CULVER CITY, CITY OF	060114	LANCASTER, CITY OF	060672	ROSEMEAD, CITY OF	060153		

*Non-floodprone communities

September 26, 2008

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
06037CV002A

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study (FIS) may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

Selected Flood Insurance Rate Map (FIRM) panels for the community contain information that was previously shown separately on the corresponding Flood Boundary and Floodway Map (FBFM) panels (e.g. floodways, cross sections). In addition, former flood hazard zone designations have been changed as follows:

Old Zone	New Zone
A1 through A30	AE
V1 through V30	VE
B	X (Shaded)
C	X (Unshaded)

Part or all of this FIS may be revised and republished at any time. In addition, part of this FIS may be revised by the Letter of Map Revision process, which does not involve republication or redistribution of the FIS. It is, therefore, the responsibility of the user to consult with community officials and to check the community repository to obtain the most current FIS components.

Initial Countywide FIS Effective Date: September 26, 2008

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Exhibit 1 - Flood Profiles (continued)

<u>Volume 4</u>

PUBLISHED SEPARATELY:

Flood Insurance Rate Map Index

Flood Insurance Rate Map

City of Vernon

The City of Vernon is identified as a non-flood prone community.

City of Walnut

Results of the mapping study were not previously summarized in the effective FIS report for the City of Walnut; therefore, no flood protection measures are provided.

City of West Covina

Results of the mapping study were not previously summarized in the effective FIS report for the City of West Covina; therefore, no flood protection measures are provided.

City of West Hollywood

The City of West Hollywood is currently protected by a series of small drainage channels and storm drain systems. Plans are underway to upgrade the flood protection measures exercised in West Hollywood. The Los Angeles County Flood Control District maintains the majority of the drainage system.

City of Westlake Village

Results of the mapping study were not previously summarized in the effective FIS report for the City of Westlake Village; therefore, no flood protection measures are provided.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the County, standard hydrologic and hydraulic modeling methodologies were used to determine the flood hazard data required for this FIS. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 2-, 1-, or 0.2-percent annual chance period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 1-Percent Annual Chance flood (1-percent chance of annual exceedance) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the county at the time of completion of this FIS. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for the flooding sources studied in detail affecting the County.

Many of the incorporated community within, and the unincorporated areas of Los Angeles County, have a previously printed FIS report. The hydrologic analyses described in those reports have been compiled and are summarized below.

Because many of the communities affected by the Los Angeles River and its tributaries were removed from the regulatory floodplain based on completion of the Los Angeles County Drainage Area

(LACDA), the discussion in this FIS for numerous communities is based on the revised analyses conducted by the Corps of Engineers, and reviewed and certified by the USACE and FEMA, for that project. Information on the methods used to determine peak discharge-frequency relationships for the streams restudied as part of this countywide FIS is shown below.

Depending on the availability of hydrologic data, numerous different approaches were used throughout the County. These are discussed in the following paragraphs.

Los Angeles County

Antelope Valley (not including the communities of Lancaster and Palmdale).

The U.S. Army Corps of Engineers, Los Angeles District, developed discharge-frequency relationships for the Antelope Valley. The U.S. Army Corps of Engineers using the log-Pearson Type III frequency analysis computed the 1-percent annual chance peak flow rates for Little Rock Creek and Big Rock Creek. The gage for Little Rock Creek, located at Little Rock Reservoir, has operated since 1931 and records flow from a drainage area of approximately 48 square miles. The gage located at the mouth of Big Rock Creek has been operated since 1923 and records flow from a drainage area of approximately 23 square miles.

The remaining streams tributaries to the Antelope Valley are ungaged. Therefore, discharge-frequency curves were developed by the U.S. Army Corps of Engineers from the Little Rock Creek and Big Rock Creek curves. An average of the two curves was developed using standard deviation and average skew coefficient of the two gages. The U.S. Army Corps of Engineers Standard Project Flood peak discharge at the concentration points was used as the basis for transposing the frequency curves to ungaged streams.

For the summer peak discharges in the Antelope Valley desert region, the U.S. Army Corps of Engineers determined from gages on nine streams that the major events were independent with relatively short records. Therefore, the peak discharges were considered collectively as a single flood record representative of the region.

To develop a summer storm discharge-frequency curve at any ungaged location, the Standard Project Flood was used as the basis for transposing the frequency curves.

The Los Angeles County Flood Control District employed the U.S. Army Corps of Engineers study as a data base to develop yield-versus-area curves for the 10-, 2-, 1-, and 0.2-percent annual chance frequency flow rates for the concentration points. These curves were used to determine the peak flow rates for intermediate points along the major watercourses and for adjacent watersheds.

Santa Clarita Valley (not including the City of Santa Clarita)

Much of the hydrologic data for this portion of the County was also supplied by the U.S. Army Corps of Engineers. For watersheds greater than 20 square miles, the U.S. Army Corps of Engineers formula for the geometric mean flood was used to predict 1-percent annual chance frequency peak flow rates. For drainage areas less than 20 square miles, this formula was modified slightly to yield runoff values more closely related to observed values using engineering judgment. This modification was reviewed by the Los Angeles District office of the U.S. Army Corps of Engineers.

Malibu Area

Streams in the Malibu area that have Los Angeles County Flood Control District gage records sufficient for frequency analysis are Malibu Creek, Station F130-R; Zuma Creek, Station F53-R; and Topanga Canyon, Station F548-R. The peak flow rates were computed at these locations using log-Pearson Type

III frequency analysis. Following this analysis, the peak flow rates were also computed using the Regional Runoff Frequency Equations developed by the Los Angeles County Flood Control District. These regional runoff frequency equations were developed through the multiple-linear regression analysis of the peak flow data of 48 gaging stations in Los Angeles County. Comparison of the results obtained indicated that the log-Pearson Type III analysis of the stream gages in the Malibu area produced higher peak flow rates than the Regional Runoff Frequency Equations. Therefore, the ratio of the flow rates predicted by the two methods was computed at each gage. Flow rates were then computed for the remaining points in the watershed by multiplying the regional equation flow rate by the appropriate ratio. The ratio used was determined by comparing the watershed being analyzed to those analyzed by the log-Pearson Type III analysis to determine which one was most similar.

Los Angeles Basin

The remaining portions of unincorporated territory are located in the Los Angeles basin and were analyzed in conjunction with the incorporated cities on a drainage area basis. For streams with gages of sufficient length of reliable record, log-Pearson Type III analysis was used to determine 1-percent annual chance flood flow rates. The flow rates for the remaining streams were calculated by the Regional Runoff Frequency Equations developed by the District.

The flow rates used in the Los Angeles County study do not reflect the substantial amount of mud and debris flows which can be generated by a burned watershed. Therefore, it should be emphasized that the results of the study do not reflect the true degree of flood and mudflow hazard to the community.

Due to the configuration of the channels and overbanks, storage can cause floods to pond or break away from the channels resulting in an inverse discharge-drainage area relationship to exist along portions of Zuma, Ramirez, Escondido, Topanga, and Lobo Canyons, and Medea and Triunfo Creeks.

Analyses were carried out to establish the peak elevation-frequency relationships for each flooding source studied in detail.

Coastal flood hazard areas subject to inundation by the Pacific Ocean were determined on the basis of water-surface elevations established from regression relations defined by Thomas. These regression relations were defined as a practical method for establishing inundation elevations at any site along the southern California mainland coast. They were defined through analysis of water-surface elevations established for 125 locations in a complex and comprehensive model study by Tetra Tech, Inc.. The regression relations establish wave run-up and wave set-up elevations having 10-, 1-, and 0.02-percent chances of occurring in any year and are sometimes referred to as the 10-, 100-, and 500-year flood events, respectively.

Wave run-up elevations were used to determine flood hazard areas for sites along the open coast that are subject to direct assault by deep-water waves. Runup elevations range with location and local beach slope and were computed at 0.5-mile intervals, or more frequently in areas where the beach profile changes significantly over short distances. Areas with ground elevations 3.0 feet or more below the 1-percent annual chance wave run-up elevation are subject to velocity hazard.

Wave setup elevations determined from the regression equations on the basis of location along the coast were used to identify flood hazard areas along bays, coves, and areas sheltered from direct action of deep-water waves.

City of Agoura Hills

Streams in the Malibu area that have Los Angeles County Flood Control District gage records sufficient for frequency analysis are Malibu Creek, Station F130-R; Zuma Creek, Station F53-R; and Topanga

Canyon, Station F548-R. The peak flow rates were computed at these locations using log-Pearson Type III frequency analysis (U.S. Water Resources Council, March 1976). Following this analysis, the peak flow rates were also computed using the Regional Runoff Frequency Equations developed by the Los Angeles County Flood Control District (Los Angeles County Flood Control District, November 1977). These regional runoff frequency equations were developed through the multiple-linear regression analysis of the peak flow data of 48 gaging stations in Los Angeles County. Comparison of the results obtained indicated that the log-Pearson Type III analysis of the stream gages in the Malibu area produced higher peak flow rates than the Regional Runoff Frequency Equations. Therefore, the ratio of the flow rates predicted by the two methods was computed at each gage. Flow rates were then computed for the remaining points in the watershed by multiplying the regional equation flow rate by the appropriate ratio. The ratio used was determined by comparing the watershed being analyzed to those analyzed by the log-Pearson Type III analysis to determine which one was most similar.

The flow rates used in this study do not reflect the substantial amount of mud and debris flows which can be generated by a burned watershed. Therefore, it should be emphasized that the results of the study do not reflect the true degree of flood and mudflow hazard to the community.

The 1-percent annual chance flood discharges used for the 1998 revision to the Agoura Hills FIS were developed by the Los Angeles County Flood Control District (Los Angeles County, Construction Drawings PM 100203, September 6, 1979 and Construction Drawings PM 7982, August 17, 1979) and Simons, Li & Associates, Inc., using Los Angles County "Capital Flood" metholodgy (Simons, Li & Associates, Inc., October 7, 1992).

City of Avalon

There are no gaged streams in the Avalon watershed; therefore, regional run-off frequency equations developed by the Los Angeles County Flood Control District were used to calculate flow rates based on runoff frequency. These regional runoff frequency equations were developed through the multiple-linear regression analyses of the peak flow data of 48 stream gaging stations within the county. Runoff data from the 48 gaging stations were first analyzed to obtain peak flows of the selected recurrence intervals at the gage sites. These peak values were then regressed against a number of physical parameters of the drainage basins.

Two of the important parameters included in the regional runoff frequency equations are rainfall intensity and runoff coefficients.

Rainfall records maintained by the City of Avalon, Harbor Department, for the period from 1947 through 1973 were used in the rainfall analysis for this study. A log-Pearson probability distribution analysis of the rainfall records was used to arrive at the 2-percent annual chance flood, 24-hour amount. This value is 5.02 inches and is similar to rainfall in the J rainfall zone. The analysis indicated that the distribution of rainfall at the Avalon gage over a 24-hour period is similar to the J rainfall zone distribution; therefore, the J rainfall zone intensity-duration curves were used to arrive at the 2-percent annual chance flood, 1-hour duration intensity. This value is 0.75 inch per hour and was used in the regional runoff frequency equation.

The district categorized and experimentally established runoff coefficient graphs for numerous areas of homogeneous runoff characteristics. To apply the appropriate runoff coefficients for this study, it was first necessary to determine the characteristics of the watersheds tributary to Avalon.

The study contractor was provided with a Soil Conservation Survey map for the eastern end of Santa Catalina Island. The survey specifically covered the Avalon watershed area. Watershed areas were categorized by soil type, texture, permeability, effective depth, and erodibility.

Examination of the soil map indicates that the tributary watersheds are composed of medium texture topsoil of moderate to shallow effective depth, low to moderately low infiltration rates, and moderate erodibility. The runoff characteristics of these watersheds compare very closely with watersheds found on the county mainland along the Santa Monica Mountain Range. This area is described as rough, broken, and stony, nonagricultural land, and is classified as Soil Type No. 022, for which the study contractor has runoff coefficient graphs. The graph was used to obtain the runoff coefficient of 0.624 at a rainfall intensity of 2 inches per hour. This value was used in the regional runoff frequency equations. The rest of the parameters used in the regional run-off frequency equation were obtained from topographic maps and other information on file with the Los Angeles County Flood Control District, and are in accordance with standard practice.

Coastal flood hazard areas in Avalon were analyzed using a complex hydrodynamic model which considered the effects of storm generated waves/swells and their transformation due to shoaling, refraction and frictional dissipation. Limited fetch distances preclude the City of Avalon from being directly exposed to severe storm-induced surge flooding. Locally generated storm waves combined with astronomical tide is the major cause of flooding along coastal areas in the vicinity of Avalon. Analysis of wave effects included a statistical analysis of historical local wind data to obtain the 10-, 2-, 1-, and 0.2-percent annual chance floods maximum wind magnitudes. Wave characteristics were then computed for the various wind recurrence intervals. Using the methodology cited above, the wave runup and setup elevations were calculated based on the wave characteristics. The wave runup and setup elevations were then statistically combined with the astronomical tide to yield the final coastal flooding conditions.

Wave runup elevations were used to determine flood hazard areas for sites along the open coast that are subject to direct assault by deep-water waves. Runup elevations range with location and local beach slope. Areas with ground elevations 3.0 feet or more below the 1-perecent annual chance wave runup elevation are subject to velocity hazard.

Wave setup elevations, determined on the basis of location along the coast, were used to identify flood hazard areas along bays, coves, and areas sheltered from direct action of deep-water waves. For this study, no wave setup elevations are shown.

Cities of Bellflower, Carson, Compton, Downey, Gardena, Lakewood, Long Beach (flooding from terrestrial sources only), Lynwood, Paramount, Pico Rivera, Santa Fe Springs, South Gate, Whittier

Hydrologic data for the Los Angeles River and the Rio Hondo were obtained from the USACE. The basis of the hydrologic data was HEC-1 and HEC-5 computer models. The HEC-1 model was calibrated for each subbasin using observed flow data where applicable. In addition, frequency-discharge calculations were made to compare the USACE results. The results were based on statistical analysis of stream gage data obtained from the LACFCD. The data were analyzed using the criteria in Bulletin 17-B.

The 1-Percent Annual Chance breakout hydrology for the Los Angeles River lower reach and the Rio Hondo were also obtained from the USACE. The peak values given in the LACDA report were used for hydraulic calculations in the overbank areas.

The timing of the breakouts on the left levee of the Rio Hondo at Beverly Boulevard and Stewart and Gray Road and the left levee of the Los Angeles River at Fernwood Avenue (Century Freeway) was also considered in determining the peak flow rate in the left overbank downstream of the Century Freeway. The USACE has determined that the peaks on the Rio Hondo breakouts do not occur at the same time as the peak on the Los Angeles River breakout. Therefore, downstream of the Century Freeway, the peak flow rate in the left overbank from the Rio Hondo breakouts is not combined with the peak flow rate from the breakout near the Century Freeway. Only the peak flow from the Los Angeles River breakout is used since it has a larger magnitude.

City of Burbank

Regional Runoff Frequency Equations developed by the Los Angeles County Flood Control District were used to calculate flow rates for the Burbank Western Flood Control Channel in the City of Burbank, based on runoff frequency for the ungaged flood sources. These Regional Runoff Frequency Equations were developed through the multiple-linear regression analyses of the peak flow data of 48 gaging stations operated by the Los Angeles County Flood Control District within Los Angeles County. Runoff data from these stations were first analyzed to obtain peak flows of the selected recurrence intervals at the gage sites. These peak values were then regressed against a number of physical parameters of the drainage basins.

The Los Angeles River Flood Control Channel, which traverses the city's southern corporate limits, and the Burbank Western Flood Control Channel are the only gaged streams in the Burbank study area. The 1-percent annual chance peak flow rate for the Los Angeles River Flood Control Channel was computed using the log-Pearson Type III frequency analysis, and discharges associated with this event were found to be contained within the channel within the City. One of the 48 gaging stations operated by the Los Angeles County Flood Control District within Los Angeles County is located at Tujunga Avenue on the Burbank Western Flood Control Channel. It has been operated since 1950 and has a drainage area of approximately 401 square miles. The gage records for this location were considered inaccurate for frequency analysis purposes because of the residential development that has occurred in the watershed over the past 20 years. Therefore, Regional Runoff Frequency Equations developed by the Los Angeles County Flood Control District were used to calculate flow rates based on runoff frequency, and 1-percent annual chance flood discharges were found to be contained within the channel.

The flow rates used in this study do not include the substantial amount of mud and debris flows which could be generated from a burned watershed.

For the January 20, 1999 revision, the USACE HEC-1 computer program (U.S. Department of the Army, Corps of Engineers, Hydrologic Engineering Center, September 1990) was used to establish peak discharges having recurrence intervals of 10- and 1-percent annual chance. The parameters used were developed based on site conditions and in accordance with the guidelines contained in Natural Resources Conservation Service (NRCS) (formerly the Soil Conservation Service) Technical Release No. 55, "Urban Hydrology For Small Watersheds" (U.S. Department of the Interior, 1976).

Drainage areas were delineated on U.S. Geological Survey (USGS) 7.5-minute series topographic maps at a scale of 1:24,000, with a contour interval of 40 feet (U.S. Department of the Interior, 1966, Photorevised 1972), of the area based on previous studies by the LACFCD (Los Angeles County Flood Control District, August 1982).

The NRCS dimensionless unit-hydrograph option within HEC-1 was used. Times of concentration and lag were determined using NRCS methodology and criteria. Losses were determined using the NRCS curve-number method, in accordance with Technical Release No. 55 guidelines. Land use was determined from City of Burbank mapping and field reconnaissance. A 24-hour nested balanced storm was used with precipitation values determined from statistics developed by the California Department of Water Resources (California Department of Water Resources, 1986) for the Burbank Valley Pump recording rain gage. The 1-percent annual chance precipitation for this gage ranged from 0.40 inch for 5 minutes to 1.51 inches for 1 hour to 7.44 inches for 24 hours.

Flows were routed and combined using the channel-storage (modified-Puts) and Muskingum-Cunge channel-routing methods within the HEC-1 model.Discharges were determined for 10- and 1- percent annual chance return periods. The 10-percent annual chance discharges were compared with discharges determined by the LACFCD and loss rates were adjusted so the discharges would agree within 1 to 5 percent. The 1-percent annual chance discharges within the channel are limited by channel capacity.

City of Culver City

The gaged streams tributary to Culver City are the Ballona Creek Channel and the Sawtelle-Westwood Storm Drain Channel. The 1-percent annual chance peak flow rates for these streams were computed using the log-Pearson Type III frequency analysis. The U.S. Army Corps of Engineers, Los Angeles District, performed the analysis of Ballona Creek Channel. The gage, located at Sawtelle Boulevard, has been operated since 1927 and records flows from a drainage area of approximately 89 square miles. The flow rates were modified due to cultural changes in the watershed (i.e., agricultural to urbanized). The study contractor performed frequency analysis for the gage on Sawtelle-Westwood Channel. The gage, located at Culver Boulevard, has been operated since 1951 and records flows from a drainage area of approximately 23 square miles. Benedict Canyon Channel is completely underground through Culver City.

The remaining streams tributary to Culver City are ungaged. Therefore, regional runoff frequency equations developed by the Los Angeles County Flood Control District were used to calculate flow rates based on runoff frequency. These regional runoff frequency equations were developed through the multiple linear regression analyses of the peak flow data of 48 stream gaging stations within Los Angeles County. Runoff data from the 48 gaging stations were first analyzed to obtain peak flows of the selected recurrence intervals at the gage sites. These peak values were then regressed against a number of physical parameters of the drainage basins.

As a result of these analyses, it was determined that the 1-percent annual chance flood discharges for Ballona Creek Channel, Sawtelle-Westwood Storm Drain Channel, Benedict Canyon Channel, and Centinela Creek Channel were contained in the channels except for Ballona Creek Channel in the vicinity of the northeast corporate limits near Washington Boulevard. The 0.2-percent annual chance flood event was not studied for channel segments that contain the 1-percent annual chance flood peak discharge.

City of La Mirada

There are no gaged streams in the watersheds tributary to La Mirada Creek; therefore, regional runoff frequency equations developed by the study contractor were used to calculate flow rates based on runoff frequency. These regional runoff frequency equations were developed through the multiple-linear regression analyses of the peak flow data of 48 stream gaging stations within Los Angeles County. Runoff data from the 48 gaging stations were first analyzed to obtain peak flows of the selected recurrence intervals at the gage sites. These peak values were then regressed against a number of physical parameters of the drainage basins.

City of Lancaster

The U.S. Army Corps of Engineers, Los Angeles District, developed discharge-frequency relationships for streams in the Antelope Valley and the City of Lancaster. The 1-percent annual chance peak flow rates for Little Rock Creek and Big Rock Creek were computed using log-Pearson Type III frequency analyses. The analysis for Little Rock Creek was based on the stream gage located at Little Rock Reservoir, south of the City of Palmdale, which has been in operation since 1931 and records streamflow from a drainage area of approximately 49 square miles. The gage located at the mouth of Big Rock

Creek, southwest of the City of Palmdale, has been in operation since 1923 and records flows from a drainage area of approximately 23 square miles.

Amargosa Creek, Amargosa Creek Tributary, and Portal Ridge Wash are ungaged. Therefore, discharge-frequency curves were developed by the U.S. Army Corps of Engineers from the Little Rock Creek and Big Rock Creek frequency curves. An average of the two curves was developed using standard deviation and average skew coefficient of the two gages. The U.S. Army Corps of Engineers Standard Project Flood peak discharge at the concentration points was used as the basis for transposing the frequency curves to ungaged streams originating in the San Gabriel Mountains.

For the summer peak discharges in the Antelope Valley desert region, the U.S. Army Corps of Engineers determined from the gages of nine streams that the major events were independent with relatively short gage records. Therefore, the peak discharges recorded at each of the gages were considered collectively as a single flood record representative of the region. To develop a summer storm discharge-frequency curve at any engaged location, the Standard Project Flood was used as the basis for transposing the frequency curves.

The Los Angeles County Flood Control District employed the U.S. Army Corps of Engineers study as a data base to develop yield versus area curves for the 10-, 2-, 1-, and 0.2-percent annual chance flow rates for the concentration points. These curves were used to determine the peak flow rates for intermediate points along the major watercourses and for adjacent watersheds.

City of Long Beach (Coastal Flooding only; terrestrial flooding covered under Cities of Bellflower, et al., above)

Coastal flooding in the City of Long Beach, as analyzed for the original study of the City, originates from San Pedro and Alamitos Bays. This flooding is attributed to the following mechanisms:

1. Swell runup from intense offshore winter storms in the Pacific
2. Tsunamis from the Aleutian-Alaskan and Peru-Chile Trenches
3. Runup from wind waves generated by landfalling storms
4. Swell runup from waves generated off Baja California by tropical cyclones
5. Effects of landfalling tropical cyclones

The influence of the astronomical tides on coastal flooding is also incorporated in each of the previously mentioned mechanisms. A flood producing event from any of these mechanisms is considered to occur with a random phase of the astronomical tide. Each of these mechanisms is considered to act alone, so that the joint occurrence of any combination of the above mechanisms in a flooding event is considered to be irrelevant to the determination of flood elevations with return periods of less than 0.02-percent annual chance.

For each mechanism, the frequency of occurrence of causative events, as well as the probability distribution of flood elevations at a given location due to the ensemble of events were determined using methods discussed in "Methodology for Coastal Flooding in Southern California." A brief outline follows.

Winter Swell

The statistics of flooding due to winter swell runup were determined using input data provided by the Navy Fleet Numerical Weather Center (FNWC). These input data consist of daily values of swell heights, periods, and directions at three deep water locations beyond the continental shelf bordering the study area. The data are inclusive from 1951 to 1974, and were computed by FNWC using input from ship observations, meteorological stations, and synoptic surface meteorological charts of the Pacific

Ocean. For the original study, the incoming swells provided by FNWC were classified into 12 direction sectors of 10 degrees band width each. (Exposure of the study area to winter swells was confined to a 120 degree band, from directions 220° to 340°T). Within each sector, 10 days of swell height and period values were selected from the 24 years of FNWC data to represent extreme flood producing days. The selection criteria were guided by Hunts formula for runup. The 120 days at each of the three deepwater stations were merged to obtain a master list of 161 extreme runup producing days. For each of 161 days, the input swell provided by FNWC was refracted across the continental shelf and converted to runup at selected locations in the study area. The techniques used and data required are described in Section 3.2. Of the 161 days, a number of groups of consecutive days could be identified.

Each such group of days is considered to represent one event only; the largest runup from each group of days was selected as the maximum runup for that event. As a result of refraction and island sheltering effects, a number of the input swells produced no significant runup at certain locations. Therefore, the number of extreme runup events is less than 161. The average number of events in the study area is approximately 40. For each location in the study area, the runup for the extreme events were fitted to a Weibull distribution to obtain a probability distribution of runup from winter swell. The Weibull distribution was found to be best suited for representing runup statistics. Because extreme winter swell runup lasts for at least one day, the maximum runup must be considered to USACExist with the maximum high tide.

Regarding the extreme runup values as a statistical sample only, the influence of the astronomical tides was included by convolving the probability distribution of runup with the probability distribution of daily "high tides. The latter was obtained from standard tide prediction procedures using the harmonic constants at the nearest available tide gage for which such data exists as supplied by the Tidal Prediction Branch of the National Oceanic and Atmospheric Administration. At each location, the frequency of occurrence of extreme events is determined by the number of runup values used in the Weibull curve fit. The number of years over which these occur is 24. The product of the frequency occurrence with the complement of cumulative probability distribution of the runup-plus-tide (convolved) distribution gives the exceedence frequency curve for flood elevations due to winter swell runup.

Tsunamis

Elevation-frequency curves for tsunami flooding were obtained from information supplied by the USACE's Waterways Experiment Station (WES). The use of the results of the WES study were directed by FEMA.

In the WES study, the statistics of tsunami elevations along the coastline were derived by synthesizing data on tsunami source intensities, source dimensions, and frequencies of occurrence along the Aleutian-Alaskan and Peru-Chile Trenches. As a result, 75 different tsunamis, each with a known frequency of occurrence, were generated and propagated across the Pacific Ocean using a numerical hydrodynamic model of tsunamis. At a number of locations in the study area, these 75 tsunami time signatures were each added to the tidal time signature at the nearest tide gage location for which harmonic constants for tide computations are available. One year of tidal signature was generated from the harmonic constants. A given tsunami signature was then combined with the tide signature and the maximum of tsunami plus tide for the combination recorded. To simulate the occurrence of the tsunami at random phases of the tide, the tsunami signature was repeatedly combined to the tide signature starting at random phases over the entire year of the tide signature. Each combination produces a maximum tsunami-plus tide elevation with a frequency of occurrence equal to the frequency of occurrence of the particular tsunami signature used, divided by the total number of such combinations for that particular tsunami. The process was repeated for all 75 tsunamis and the elevation frequency curve for tsunami flooding was thus established.

Wind Waves From Landfalling Storms

The source of data for wind waves is the same as that for winter swell, the FNWC (1951 through 1974) data. The stations for which daily height, period, and direction data are available are also the same as for winter swells. The FNWC wind-wave data are directly correlated to local wind speeds. For obtaining runup statistics, the FNWC daily wave data were converted to daily runup data using the method outlined in Section 3.2. The daily runup data were then fitted to a Weibull distribution and convolved with the tide in the same manner as for winter swells.

Tropical Cyclone Swell

Runup from swell generated by tropical cyclones off Baja California was computed using the techniques discussed in Section 3.2. To establish the statistics of hurricane swell runup, the following procedure was used. Data concerning tropical cyclone tracks were obtained from the National Climatic Center (NCC). The data comprise 12-hourly positions of eastern North Pacific tropical cyclones from 1949 to 1974. This was supplemented by data on tropical cyclone tracks from the period 1975 to 1978, as reported in the Monthly Weather Review.

Besides position data, storm intensities at each 12-hourly position are also given. The intensity classifications are based on estimated maximum wind speeds. The intensity categories are tropical depression (less than 35 knot winds), tropical storm (less than 65 knot winds), and hurricane (at least 65 knot winds). Storms with tropical depression status were considered to generate negligible swell and omitted from this study. Data on actual maximum wind speeds were available from the NCC only from 1973 to 1977. These were used as the basis for obtaining values to represent maximum wind speeds from each of the two intensity classifications associated with the track data. Data on storm radii were derived from North American Surface Weather Charts by analysis of pressure fields of tropical cyclones off Baja California. These were used to define typical radius of maximum winds for each of two relevant intensity classes. For each tropical cyclone between 1949 and 1918, the hurricane wind waves were computed using the mean radius and maximum wind speeds established for each intensity class along with the track data. The swell and resultant runup were computed using the techniques described in Section 3.2. For each tropical cyclone and each location of interest in the study area, a time history of swell runup was determined. These were added to time histories of the local astronomical tide in a procedure analogous to that used in determining tsunami plus tide effects. The exceedence frequencies of tropical cyclone swell runup were computed in a manner similar to that used for tsunamis.

Landfalling Tropical Cyclones

The frequency of landfalling tropical cyclones in southern California is extremely low. During those years covered by the NCC tape of eastern North Pacific tropical cyclones (1949 to 1974), no tropical cyclone hit southern California. A longer period of record was used to estimate the frequency of an event such as the Long Beach 1939 storm. A study by Pyke was used to compile a list of landfalling tropical cyclones along the coast of southern California. The study was a result of extensive investigation of historical records such as precipitation and other weather and meteorological data. The study spanned the period from 1889 to 1977 and showed only 5 or 6 identifiable landfalling tropical cyclones, of which the 1939 Long Beach event was the strongest, and only one in the tropical storm category. The others were all weak tropical depressions (with maximum winds of less than 35 knots). The low frequency event, once in 105 years over approximately 360 miles of coastline, coupled with an impact diameter of approximately 60 miles, implies that for any given location, the return period of a landfalling tropical cyclone is about 600 years. Therefore, landfalling tropical cyclones were not considered in the original study.

At each location within the study area, the exceedence frequencies at a given elevation due to the various flood-producing mechanisms were summed to give the total exceedence frequency at the flood elevation.

City of Los Angeles

The following streams within the City of Los Angeles have Los Angeles County Flood Control District records sufficient for frequency analysis purposes: Aliso Creek, Station F152B-R, at Nordhoff Street; Big Tujunga Wash, Station F213-R, located 2 miles above the mouth of the canyon; Los Angeles River, Station F300-R, located at Tujunga Avenue and Station F57C-R, located at the confluence with Arroyo Seco; Sawtelle Channel, Station F301-R, located 141 feet upstream of Culver Boulevard; Ballona Creek, Station F38C-R, located 530 feet upstream of Sawtelle Boulevard; and Compton Creek, Station F37B-R, located at Greenleaf Boulevard. The 1-percent annual chance frequency peak flow rates for these streams were computed using the log-Pearson Type III frequency analyses.

The remaining streams in the Los Angeles study area are ungaged; therefore, regional runoff frequency equations developed by the Los Angeles County Flood Control District were used to calculate flow rates based on runoff frequency. These regional runoff frequency equations were developed through the multiple-linear regression analyses of the peak flow data of 48 stream-gaging stations within Los Angeles County. Runoff data from the 48 gaging stations were first analyzed to obtain peak flows of the selected recurrence intervals at the gage sites. These peak values were then regressed against a number of physical parameters of the drainage basins.

The flow rates used in the Los Angeles study do not include the substantial amount of mud and debris flows that could be generated from a burned watershed. Therefore, it should be-emphasized that the results of this study may not reflect the true degree of flood hazard in the community.

Coastal flood hazard areas subject to inundation by the Pacific Ocean were determined on the basis of water-surface elevations established from regression relations defined by Thomas. These regression relations were defined as a practical method for establishing inundation elevations at any site along the southern California mainland coast. They were defined through analysis of water-surface elevations established for 125 locations in a complex and comprehensive model study by Tetra Tech, Inc.. The regression relations establish wave runup and wave setup elevations that have 10-, 1-, and 0.02 –percent chances of occurring in any year and are sometimes referred to as the 10-, 100-, and 500-year flood events, respectively.

Wave runup elevations were used to determine flood hazard areas for sites along the open coast that are subject to direct assault by deep-water waves. Runup elevations range with location and local beach slope and were computed at 0.5-mile intervals, or more frequency in areas where the beach profile changes significantly over short distances. Areas with ground elevations 3.0 feet or more below the 1-percent annual chance wave runup elevation are subject to velocity hazard.

Wave setup elevations determined from the regression equations on the basis of location along the coast were used to identify flood hazard areas along bays, coves, and areas sheltered from direct action of deep-water waves.

City of Montebello

The only gaged stream in the Montebello study area is located on Drainage District Improvement No. 23, upstream of the Rio Hondo Channel. In the original study, this gage was found unsatisfactory for frequency analysis purposes due to diversions in the watershed, substantial residential development, and the effect of backwater from the Rio Hondo Channel. Therefore, Regional Runoff Frequency Equations developed by the LACFCD were used to calculate flow rates based on runoff frequency. These Regional Runoff Frequency Equations were developed through the multiple-linear regression analyses of the peak flow data of 48 stream gaging stations within Los Angeles County. Runoff data from the 48 gaging stations were first analyzed by obtaining peak flows of the selected recurrence intervals at the gage sites. These peak values were then regressed against a number of physical parameters of the drainage basins.

The flow rates used in the original study do not include the substantial amount of mud and debris flow that could be generated from a burned watershed. Therefore, it should be emphasized that the results of the study do not reflect the mud and debris flow hazard in the community.

For the areas of the City of Montebello affected by the Los Angeles River/Rio Hondo system, hydrology was generated using the methodologies outlined in the section on the Cities of Bellflower, et al., above.

The timing of the breakouts on the left levee of the Rio Hondo at Beverly Boulevard and Stewart and Gray Road and the left levee of the Los Angeles River at Fernwood Avenue (Century Freeway) was also considered in determining the peak flow rate in the left overbank downstream of the Century Freeway. The USACE has determined that the peaks on the Rio Hondo breakouts do not occur at the same time as the peak on the Los Angeles River breakout. Therefore, downstream of the Century Freeway, the peak flow rate in the left overbank from the Rio Hondo breakouts is not combined with the peak flow rate from the breakout near the Century Freeway. Only the peak flow from the Los Angeles River breakout is used since it has a larger magnitude.

City of Palmdale

Discharge-frequency relationships for the City of Palmdale were developed by the USACE, Los Angeles District. In their study, the 1-percent annual chance peak flow rates for Little Rock Wash and Big Rock Wash were computed using the log-Pearson Type III frequency analysis. The gage located at Little Rock Reservoir, south of Palmdale, has operated since 1931 and records reflect flow from a drainage area of approximately 48 square miles. The gage located at the mouth of Big Rock Wash, southwest, has been operated since 1923 and records flows from a drainage area of approximately 23 square miles.

Amargosa Creek, Amargosa Creek Tributary, Anaverde Creek, and Anaverde Creek Tributary are ungaged. Therefore, discharge-frequency curves were developed by the USACE from Little Rock Wash and Big Rock Wash curves. An average of the two curves was developed using the standard deviation and average skew coefficient of the two gages. The USACE Standard Project Flood peak discharge at the concentration points was used as the basis for transposing the frequency curves to ungaged streams.

For the summer peak discharges in the Antelope Valley desert region, the USACE determined from gages on nine streams that the major events were independent with relatively short records. Therefore, the peak discharges were considered collectively as a single flood record representative of the region. To develop a summer storm discharge-frequency curve at any ungaged location, the Standard Project Flood was used as the basis for transposing the frequency curves.

The LACFCD used the USACE study as a data base to develop yield-versus-area curves for the 10-, 2-, 1-, and 0.2-percent annual chance flow rates for the concentration points. These curves were used to determine the peak flow rates for intermediate points along the major watercourses and for adjacent watersheds.

For the March 30, 1998 revision, the 1-percent annual chance discharges were calculated using regional regression equations developed by FEMA. The FEMA regression equation for the 1-percent annual chance discharges is:

$Q = 660\ A^{0.62}$;

where A is the total contributing watershed in square miles.

This equation was developed from data for 41 gaging stations in the South Lohonton-Colorado Desert (SLCD) region, as defined in the U.S. Geological Survey (USGS) Water Resources Investigations 77-21, "Magnitude and Frequency of Floods in California" (U.S. Department of the Interior, Geological Survey, June 1977). Anaverde Creek is in the SLCD region. The above equation is applicable for estimating flood discharges for Anaverde Creek because three gaging stations in the vicinity of Anaverde Creek were included in the regression analysis.

City of Redondo Beach

The watersheds of Redondo Beach are relatively small and there are no gaged streams in the study area. Therefore, the 1-percent annual chance peak flow rates were determined by use of the Los Angeles County Flood Control District Primary Regional Run-Off Frequency Equation for ungaged streams. Where 1-percent annual chance flood discharges exceeded the drain capacities, a field review and calculations of street capacities were made. At several locations, localized sumps were found where the existing drains do not adequately convey the 1-Percent Annual Chance flows or where drains do not exist. The excess flows create ponding conditions and the Los Angeles County Flood Control District Regional Normalized Hydrograph Equations were used to determine the volumes of ponding water. Where necessary, the volumes were reduced by reservoir routing the flows through the ponding areas.

The principal source of coastal flooding in Redondo Beach is from the Pacific Ocean and its landward intrusions such as Alamitos and Marina del Rey.

Coastal flooding is attributed to the following mechanisms:

6. Swell runup from intense offshore winter storms in the Pacific
7. Tsunamis from the Aleutian-Alaskan and Peru-Chile trenches
8. Runup from wind waves generated by landfalling storms
9. Swell runup from waves generated off Baja California by tropical cyclones
10. Effects of landfalling tropical cyclones

The influence of the astronomical tides on coastal flooding is also incorporated in each of the above mechanisms. A flood-producing event from any of the above mechanisms is considered to occur with a random phase of the astronomical tide. Each of the above mechanisms are considered to act alone. This is the joint occurrence of any combination of the above mechanisms in a flooding event is considered to be irrelevant to the determination of flood elevations with return periods of less than 0.2-percent annual chance.

For each mechanism, the frequency of occurrence of causative events as well as the probability distribution of flood elevations at a given location due to the ensemble of events was determined according to the methodology given in "Methodology for Coastal Flooding in Southern California." A brief outline of it is presented in the section on the City of Los Angeles, above.

City of Santa Clarita

Much of the hydrologic data used in this FIS study for the City of Santa Clarita was taken from a report prepared by the U.S. Army Corps of Engineers. For watersheds greater than 20 square miles, the USACE formula for the geometric mean flood was used to predict 1-percent annual chance peak flow rates. For drainage areas less than 20 square miles, this formula was modified slightly to yield runoff values more closely related to observed values and engineering judgment. This modification was reviewed by the Los Angeles District Office of the USACE.

City of Santa Fe Springs

Floods impacting the City of Santa Fe Springs are generated from watersheds on the southwesterly side of the Puente Hills, located to the north of Santa Fe Springs. The only gaged streams in the Santa Fe Springs study area are the San Gabriel River and Coyote Creek (both located outside the corporate limits). The 1-percent annual chance peak flow rates for these streams were computed using log-Pearson Type III frequency analyses.

The analysis of the San Gabriel River is based on the Los Angeles County Flood Control District Stream Gage No. F 262E-R, which is located approximately 1400 feet upstream of Florence Avenue near the western corporate limits. This gage has a drainage area of 216 square miles and 43 years of record. However, only the past 16 years of record were used for the frequency analysis, and they were compiled following completion of the Santa Fe and Whittier Narrows Dams, which are major flood control facilities located 15 miles and 5 miles upstream of the gage, respectively. The 1-percent annual chance peak discharge for the San Gabriel River at Florence Avenue was determined to be 13,000 cubic feet per second (cfs). The design capacity of the channel at this location is 19,000 cfs. Therefore, it was determined that no flooding from the San Gabriel River affects the city. The analysis for Coyote Creek - North Fork was based on the Los Angeles County Flood Control District Stream Gage No. 3208, which is located on the main branch of Coyote Creek at Centralia Street. This gage is located 4 miles downstream of Santa Fe Springs, has a drainage area of 110 square miles, and has 34 years of record. The 1-percent annual chance peak discharge is approximately 10,000 cfs as compared to design capacity of 42,000 cfs for Coyote Creek downstream of the City of Santa Fe Springs. It was also determined that no flooding from Coyote Creek and Coyote Creek - North Fork affect the city.

The remaining streams in the Santa Fe Springs study area are ungaged; therefore, regional runoff-frequency equations developed by the Los Angeles County Flood Control District were used to calculate flow rates based on runoff frequency. These regional runoff-frequency equations were developed through the multiple-linear regression analyses of the peak flow data of 48 stream gaging stations within Los Angeles County. Runoff data from the 48 gaging stations were first analyzed to obtain peak flows of the selected recurrence intervals at the gage sites. These peak values were then regressed against a number of physical parameters of the drainage basins.

City of Torrance

Flood conveyance channels within the City of Torrance are relatively small, and stormflows either accumulate in numerous small sumps, drain directly into the Pacific Ocean or are tributary to Dominguez Channel. Dominquez Channel is the only gaged watershed in the City of Torrance. However, the gage has an insufficient length of record for frequency analysis purposes. Dominquez Channel was analyzed through a comparison with Compton Creek, a gaged stream in an adjacent watershed outside of the corporate limits with similar hydrologic and hydraulic characteristics. The 1-percent annual chance peak flow for Compton Creek was computed using the log-Pearson Type III frequency analysis method. The ratio of the 1-percent annual chance peak flow for Compton Creek to the peak flow recorded in Compton Creek during the major storm of 1969 was applied to the 1969 peak flow in Dominguez Channel to obtain an approximate 1-percent annual chance peak flow for Dominguez Channel. This peak flow was estimated to be 12,500 cubic feet per second (cfs). Because the available channel capacity is 17,000 cfs, it was concluded that Dominguez Channel has ample capacity to convey the 1-percent annual chance discharge, and no further analysis was necessary.

The remaining watersheds tributaries to the City of Torrance are ungaged. Therefore, regional runoff frequency equations developed by the Los Angeles County Flood Control District were used to calculate flow rates based on runoff frequency. These regional runoff frequency equations were developed through the multiple-linear regression analyses of the peak flow data of 48 stream gaging stations within Los

Angeles County. Runoff data from the 48 gaging stations were first analyzed to obtain peak flows of the selected recurrence intervals at the gage sites. These peak values were then regressed against a number of physical parameters of the drainage basins.

City of West Hollywood

Regional runoff frequency equations developed by the Los Angeles County Flood Control District were used to calculate peak discharges for the City of West Hollywood.

City of Whittier

There are no gaged streams in the watersheds draining the City of Whittier; therefore, Regional Runoff Frequency Equations developed by the Los Angeles County Flood Control District were used to calculate flow rates based on runoff frequency. These Regional Runoff Frequency Equations were developed through the multiple-linear regression analyses of the peak-flow data of 48 gaging stations operated by the Los Angeles County Flood Control District within Los Angeles County. Runoff data from these stations were first analyzed in order to obtain peak flows of the selected recurrence intervals at the gage sites. These peak values were then regressed against a number of physical parameters of the drainage basins.

The flow rates used in this study do not include the substantial amount of mud and debris flows which could be generated from a burned watershed. Therefore, it should be emphasized that the study does not reflect this type of flood hazard in the community.

Peak inflow volumes determined for the ponding areas studied by detailed methods in Torrance are shown in Table 6, "Summary of Inflow Volumes."

Table 6 - SUMMARY OF INFLOW VOLUMES

Flooding Source and Location	Drainage Area (sq. mi.)	Peak Inflows (cfs) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Surface Runoff – Deep Ponding Area					
Southwest of the intersection of Carson Street and Madrona Avenue	0.3	50	110	140	210
At intersection of Doris Way and Reese Road	0.5	160	350	450	700
Surface Runoff – Ponding Area					
At intersection of Anza Avenue and Spencer Street	0.1	10	20	25	40
Northwest of Sepulveda Boulevard and Madrona Avenue	0.3	60	140	180	280

At intersection of California Street and Alaska Avenue	0.7	190	250	270	330
At intersection of Amsler Street and Dormont Avenue	6.2	1,330	2,950	3,760	5,880

A summary of the drainage area-peak discharge relationships for all the streams studied by detailed methods is shown in Table 7, "Summary of Peak Discharges."

Table 7 - SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. mi.)	Peak Discharges (cfs) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
3,500 feet Northeast of the Intersection of Via Montana and Country Club Drive	0.7	--	--	600	--
At the Intersection of Alameda Avenue and Main Street	1.2	--	--	750	--
At the Intersection of Chestnut and Lake Streets	1.3	--	--	670	--
Amargosa Creek					
At Outlet of Ritter Ranch Detention Pond	23.8	--	--	1,856	--
At Vineyard Ranch	26.5	--	--	2,063	--
At Elizabeth Lake Ford Crossing	28.6	--	--	2,288	--
At 25th Street West Bridge	30.0	--	--	2,341	--
At 10th Street West	32.0	--	--	2,364	--
Amargosa Creek Tributary					
Intersection of Avenue L and 3rd Street East	2.4	150	420	560	1,000
Intersection of Avenue I and Spearman Avenue	7.2	310	900	1,220	2,400

Table 7 - SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. mi.)	Peak Discharges (cfs) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Avenue M and Valleyline Drive	1.8	120	340	460	850
Anaverde Creek					
1.85 Miles Downstream of California Aqueduct	15.66	--	--	3,630	--
1.47 Miles Downstream of California Aqueduct	12.79	--	--	3,200	--
Antelope Freeway	16.35	--	--	3,730	--
1.85 miles Downstream of California Aqueduct	15.66	--	--	3,630	--
1.47 miles Downstream of California Aqueduct	12.79	--	--	3,200	--
0.75 miles Downstream of California Aqueduct	11.79	--	--	3,050	--
California Aqueduct	8.25	--	--	2,440	--
Anaverde Creek Tributary					
Division Street between Avenue P and Avenue P-8	1.4	300	1,100	1,600	3,000
Antelope Valley					
Amargosa Creek at 90th Street West	6.9	580	2,000	3,100	4,500

Table 7 - SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. mi.)	Peak Discharges (cfs)			
		10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Amargosa Creek Approximately Midway between 20th Street West and 10th Street West	32.7	1,800	3,300	5,000	10,100
West of Antelope Valley Freeway North of Avenue H	147	2,000	5,600	8,400	18,000
East of Antelope Valley Freeway North of Avenue H	206	3,000	9,000	13,000	30,000
Avenue F at Sierra Highway	206	3,000	9,000	13,000	30,000
Anaverde Creek East of Antelope Valley Freeway	16	700	2,100	3,000	6,400
West of Sierra Highway at Avenue P-8	19	700	2,100	3,100	6,600
West of 136th Street East at Avenue W-8	2.4	440	1,500	1,900	3,900
165th Street East Approximately 4,000 feet South of Pearblossom Highway	1.0	370	1,300	1,600	3,100
3,000 feet East of 165th Street East and 4.000 feet South of Pearbloosom Highway	7.3	500	1,700	2,300	4,700
Acton Canyon Road, Escondido Canyon Road, and Crown Valley Road	20.3	--	--	3,421	6,052

Table 7 - SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. mi.)	Peak Discharges (cfs)			
		10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Acton Canyon at Intersection of Crown Valley Road and Acton Avenue	20.3	--	--	3,421	6,052
Agua Dulce Canyon Approximately 5,600 feet Upstream of Darling Road	10.3	--	--	3,509	6,360
Agua Dulce Canyon Approximately 800 feet Upstream of Escondido Canyon Road	14.3	--	--	4,401	7,977
Sand Canyon Approximately 800 feet Upstream of Placerita Canyon Road	6.4	--	--	4,371	5,961
Sand Canyon Approximately 2,900 feet Downstream of Placerita Canyon Road	7.3	--	--	4,908	6,693
Sand Canyon Approximately 250 feet Downstream of Iron Canyon Confluence	10.1	--	--	6,372	8,689
Iron Canyon Approximately 2,000 feet Upstream of Sand Canyon Road	2.8	--	--	2,078	2,833
Oak Springs Canyon Approximately 100 feet Upstream of Union Pacific Railroad (former Southern Pacific Railroad)	5.7	--	--	2,703	4,054
At intersection of Sixth Street and Quincy Avenue	1.0	271	598	763	1,194

Table 7 - SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. mi.)	Peak Discharges (cfs) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Avalon Canyon					
At Cross Section A	3.65	859	1,895	2,419	3,785
At Cross Section G	1.83	440	971	1,239	1,938
Ballona Creek Channel					
At intersection of Adams Boulevard and Genesee Avenue	16.7	2,100	4,700	6,000	9,400
Big Rock Wash					
At mouth, Southwest	23.0	--	--	15,000	--
Chatsworth Area					
Vicinity of Santa Susanna Pass Road and Santa Susanna Avenue	1.46	450	990	1,300	2,000
Cheseboro Creek					
1,100 feet Upstream of Driver Avenue	7.6	2,169	4,779	6,088	9,551
Hacienda Creek					

Table 7 - SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. mi.)	Peak Discharges (cfs) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Cross Section A	1.46	626	1,381	1,762	2,758
Harbor Area					
North of Carson Street Between Vermont and Berendo Avenues	0.35	74	164	209	327
Hidden Springs Area					
Mill Creek (Cross Section B)	14.8	2,274	5,019	6,405	10,024
Industry Area					
Vicinity of Brea Canyon Road and Lycoming Street	3.85	952	2,102	2,682	4,197
Iron Canyon					
Approximately 2,000 feet Upstream of Sand Canyon Road	2.8	--	--	2,078	2,833
Kagel Canyon Area					
Kagel Canyon Channel (Cross Section A)	2.04	490	1,081	1,380	2,159

Table 7 - SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. mi.)	Peak Discharges (cfs) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Little Tujunga Wash Approximately 3,000 feet Upstream of the City of Los Angeles Corporate Limits	17.9	2273	5,019	6,405	10,022
La Mirada Area					
Mystic Street, Vicinity of Parkinson Avenue	0.31	81	179	228	357
La Mirada Creek					
At Ocaso Avenue	4.6	610	1,340	1,700	2,670
Approximately 1100 feet Downstream of La Mirada Boulevard	5.0	610	1,350	1,720	2,690
Ladera Heights Area					
Vicinity of La Cienega Boulevard and Slauson Avenue	0.53	138	305	389	609
Lindero Canyon					
700 feet Downstream of Thousand Oaks Boulevard	4.1	1,369	3,024	3,858	6,037
At Reyes Adobe Road	3.4	1,290	2,847	3,632	5,685

Table 7 - SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. mi.)	Peak Discharges (cfs) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Little Rock Wash					
Little Rock Reservoir	48.0	--	--	20,000	--
Lockheed Drain Channel					
Approximately 150 feet Downstream of Hollywood Way	0.90	--	--	965	--
Approximately 300 feet Upstream of Lima Street	1.44	--	--	1,635	--
At Ontario Street	1.82	--	--	2,054	--
Approximately 100 feet Downstream of Naomi Street	1.89	--	--	2,026	--
Approximately 300 feet Downstream of Victory Place	2.48	--	--	2,410	--
Approximately 100 feet Downstream of Burbank Boulevard	3.73	--	--	2,910	--
Lopez Canyon Area					
Lopez Canyon Channel (Cross Section A)	1.78	682	1,506	1,922	3,007
Los Angeles River					

Table 7 - SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. mi.)	Peak Discharges (cfs) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
At Compton Creek	808	92,900	133,000	142,000	143,000
At Imperial Highway	752	89,400	126,000	140,000	156,000
Malibu Area					
Trancas Creek Upstream of Pacific Coast Highway (Cross Section A)	8.6	2,499	5,518	7,040	11,106
Zuma Canyon (Cross Section A)	8.9	2,024	4,469	5,705	8,925
Zuma Canyon (Cross Section W)	8.4	2,079	4,590	5,858	9,167
Ramirez Canyon (Cross Section B)	3.3	1,066	2,352	3,000	4,696
Ramirez Canyon (Cross Section I)	2.8	1,150	2,540	3,240	5,070
Escondido Canyon (Cross Section B)	3.2	958	2,116	2,700	4226
Escondido Canyon (Cross Section F)	1.7	986	2176	2778	4,346
Malibu Creek (Cross Section A)	109.6	14183	31,648	40,544	63,934
Malibu Creek (Cross Section B)	109.2	14,183	31,648	40,544	63,934

Table 7 - SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. mi.)	Peak Discharges (cfs)			
		10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Unnamed Canyon (Serra Retreat Area) (Cross Section C)	0.4	281	619	791	1,237
Las Flores Canyon (Cross Section F)	4.1	1,758	3,882	4,954	7,752
Topanga Canyon (Cross Section H)	19.6	4,095	9,040	11,537	18,054
Topanga Canyon (Cross Section M)	15.0	5,404	11,930	15,223	23,882
Topanga Canyon (Cross Section Q)	14.5	5,208	11,499	14,672	22,960
Topanga Canyon (Cross Section T)	7.3	2,560	5,656	7,215	11,289
Topanga Canyon (Cross Section V)	7.0	2,364	5,222	6,601	10,422
Topanga Canyon (Cross Section X)	5.5	1,862	4,113	5,247	8,210
Topanga Canyon (Cross Section AG)	0.3	259	572	729	1,141
Santa Maria Canyon (Cross Section C)	3.1	1,070	2,333	3,016	4,719
Old Topanga Canyon (Cross Section E)	1.7	567	1,253	1,597	2,499
Old Topanga Canyon (Cross Section H)	0.8	251	554	706	1,104
Garapito Canyon (Cross Section A)	2.9	996	2,171	2,807	4,392

Table 7 - SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. mi.)	Peak Discharges (cfs)			
		10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Garapito Canyon (Cross Section E)	2.0	675	1,470	1,910	2,974
Cold Creek (Cross Section A)	8.1	2,280	5,019	6,406	10,023
Cold Creek (Cross Section C)	7.8	2,280	5,041	6,432	10,066
Cold Creek (Cross Section G)	5.7	1,734	3,826	4,881	7,640
Dark Canyon (Cross Section A)	1.2	753	1,600	2,118	3,314
Lobo Canyon (Cross Section B)	3.8	1,572	3,473	4,429	6,932
Lobo Canyon (Cross Section C)	2.5	1,625	3,588	4,579	7,166
Stokes Canyon (Cross Section B)	2.9	1,089	2,403	3,067	4,799
Stokes Canyon (Cross Section C)	2.4	934	2,062	2,631	4,117
Dry Canyon (Cross Section C)	1.1	527	1,104	1,484	2,323
Dry Canyon (Cross Section M)	0.8	490	1,083	1,382	2,162
Dry Canyon (Cross Section T)	0.4	242	534	681	1,065
Cheseboro Creek (Cross Section B)	7.6	2,169	4,779	6,088	9,551

Table 7 - SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. mi.)	Peak Discharges (cfs) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Palo Comado Creek (Cross Section E)	4.1	1,159	2,562	3,268	5,113
Palo Comado Creek (Cross Section J)	3.5	1,074	2,374	3,028	4,738
Palo Comado Creek (Cross Section K)	3.2	1,032	2,279	2,908	4,551
Las Virgenes Creek (Cross Section D)	14.3	3,591	7,928	10,165	15,832
Las Virgenes Creek (Cross Section H)	12.2	3,542	7,822	9,980	15,619
Liberty Canyon (Cross Section E)	1.4	938	2,072	2,645	4,140
Medea Canyon (Cross Section B)	24.6	5,794	12,788	16,319	25,537
Medea Canyon (Cross Section H)	23.0	6,174	13,628	17,389	25,537
Medea Canyon (Cross Section K)	22.2	6,363	14,074	17,925	28,049
Medea Canyon (Cross Section P)	6.3	2,558	5,647	7,204	11,272
Lindero Canyon (Cross Section C)	6.7	1,725	3,809	4,860	7,604
Lindero Canyon (Cross Section E)	4.1	1,369	3,024	3,858	6,037
Lindero Canyon (Cross Section H)	3.8	1,343	2,965	3,783	5,920

Table 7 - SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. mi.)	Peak Discharges (cfs) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Lindero Canyon (Cross Section M)	3.4	1,290	2,847	3,632	5,685
Lindero Canyon (Cross Section N)	3.1	1,258	2,776	3,542	5,545
Triunfo Creek (Cross Section B)	28.7	4,781	11,396	14,898	24,298
Triunfo Creek (Cross Section E)	28.3	4,846	11,544	15,090	24,606
Malibu Lake	64.6	11,859	26,556	34,043	53,712
Medea Creek					
Downstream of Venture Highway	6.3	2,560	2,645	7,200	11,270
Approximately 950 feet Upstream of Canwood Street	--	--	--	6,720	--
Approximately 1,100 feet Upstream of Kanan Road	--	--	--	5,960	--
At Thousand Oaks Boulevard	--	--	--	5,946	--
Approximately 1,700 feet Downstream of Laro Drive	4.1	--	--	5,320	
Approximately 575 feet Downstream of Fountainwood Street	3.9	--	--	5,240	--

Table 7 - SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. mi.)	Peak Discharges (cfs) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Just Upstream of Fountainwood Street	3.4	--	--	4,700	--
Mint Canyon					
Downstream of Sierra Highway Crossing	29.3	--	--	8,300	14,581
Downstream of Vasquez Canyon Road	26.8	--	--	7,896	14,179
Approximately 2,600 feet Downstream of Davenport Road	19.9	--	--	6,691	12,604
Newhall Canyon					
Approximately 800 feet Upstream of Railroad Canyon	5.2	--	--	3,224	4,396
Approximately 650 feet Upstream of Railroad Canyon	6.2	--	--	3,390	5,424
Approximately 650 feet Downstream of Railroad Canyon	7.3	--	--	3,892	6,228
Oak Springs Canyon					
Approximately 100 feet Upstream of Union Pacific Railroad (former Southern Pacific Railroad)	5.7	--	--	2,703	4,054

Table 7 - SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. mi.)	Peak Discharges (cfs)			
		10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Overland Flow					
North of Florence Avenue and East of Pioneer Boulevard	1.34	270	596	760	1,190
North of Lakeland Road, 1000 feet East of Bloomfield Avenue	0.42	68	151	192	301
Marquardt Avenue, 1400 feet North of Rosecrans Avenue	2.09	411	907	1,158	1,812
Palo Comado Creek					
At Fairview Place	3.5	1,074	2,374	3,028	4,738
Placerita Creek					
Approximately 575 feet Downstream of San Fernando Road	9.3	--	--	5,321	7,981
Approximately 2,900 feet Upstream of San Fernando Road	8.6	--	--	4,988	7,482
Approximately 2,000 feet Upstream of Quigley Canyon Road	7.1	--	--	4,085	6,313
Approximately 850 feet Downstream of Antelope Valley Freeway	6.3	--	--	3,546	5,673

Table 7 - SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. mi.)	Peak Discharges (cfs) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Ponding					
At Intersection of Mines Avenue and Taylor Avenue	0.5	120	250	330	510
Savage Creek at Intersection of York Avenue and Mar Vista Street	0.9	260	570	730	1,150
Turnbull Canyon at intersection of Painter Avenue and Camilla Street	1.0	250	540	690	1,080
Portal Ridge Wash					
Intersection of Avenue H and Antelope Valley Freeway	147.0	1,600	5,000	7,200	16,000
Rio Honda					
At Stewart and Gray Road	132	35,600	41,000	39,300	40,200
At Beverly Boulevard	113	33,800	37,50	38,000	38,400
At Outflow from Whittier Narrows Dam	110	33,500	36,500	36,500	36,500
San Fernando Valley District					
San Fernando					

Table 7 - SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. mi.)	Peak Discharges (cfs) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Pacoima Wash, Approximately 150 feet Downstream of Shablow Avenue	31.07	1,900	5,600	8,100	12,100
Lockheed Drain Channel, Approximately 450 feet Upstream of Clybourn Avenue	0.42	278	--	448	--
Lakeview Terrace					
Little Tujunga Canyon, Approximately 1,600 feet Upstream of Foothill Boulevard	20.29	2,700	6,000	7,700	12,200
Kagel Canyon, Approximately 650 feet Upstream of Osborne Avenue	2.04	490	1,100	1,400	12,200
Sunland					
Big Tujunga Canyon, Approximately 1,200 feet Upstream of Foothill Boulevard and Tujuna Valley Street	34.57	8,100	24,700	36,500	62,600
Big Tujunga Canyon, Upstream of Wheatland Avenue	43.25	9,300	26,800	38,900	66,000

Table 7 - SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. mi.)	Peak Discharges (cfs) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Sylmar					
East Side of Golden State Freeway South of Sierra Highway	0.22	50	120	150	240
Weldon Canyon, Approximately 1,570 feet Downstream of Sierra Highway and San Fernando Road	1.47	410	900	1,150	1,800
Van Nuys					
Victory Boulevard, Vicinity of Hayvenhurst Avenue	0.73	90	200	250	390
Porter Ranch					
Mayerling Street, Northwest of Shoshone Avenue	0.19	40	100	120	190
Vicinity of Sesnon Boulevard	0.10	30	60	70	120
Granada Hills					
Superior Street, West of Paso Robles Avenue	0.53	90	200	260	400
Vicinity of Balboa Boulevard and Citronia Street	0.53	90	200	260	400

Table 7 - SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. mi.)	Peak Discharges (cfs) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Sepulveda					
RosUSACE Boulevard at Haskell Avenue	0.84	160	360	460	720
Haskell Avenue North of Union Pacific Railroad (former Southern Pacific Railroad)	1.0	230	500	640	1,000
Chatsworth					
Vicinity of Chatsworth Street and Corbin Avenue	0.85	220	480	610	960
Vicinity of Variel Avenue and Chatsworth Street	13.43	2,100	4,700	6,000	9,300
Vicinity of Canoga Avenue and Devonshire Street	0.77	230	510	650	1,000
Vicinity of Valley Circle Boulevard and Lassen Street	0.75	220	480	600	950
Vicinity of Topanga Canyon Boulevard and Lassen Street	0.25	50	120	150	230
Vicinity of Farrolone Avenue and Lassen Street	0.42	100	220	280	440
Vicinity of Topanga Canyon Boulevard and Santa Susana Place	0.10	20	50	60	100

Table 7 - SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. mi.)	Peak Discharges (cfs) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Vicinity of Santa Susana Pass Road and Santa Susana Avenue	1.46	450	990	1,300	2,000
Woodland Hills					
Vicinity of Mulholland Drive and Ventura Freeway	2.27	490	1,100	1,400	2,200
Vicinity of Saltillo Street and Canoga Avenue	0.32	100	250	300	500
Sherman Oaks					
Magnolia Boulevard at Haskell Avenue	1.23	360	800	1,000	1,600
San Gabriel River					
Whittier Narrows Flood Control Basin At Siphon Road	524.0	--[2]	--[2]	90,000	--[3]
Sand Canyon					
Approximately 250 feet Downstream of Confluence with Iron Canyon	10.1	--	--	6,372	8,689
Approximately 2,900 feet Downstream of Placerita Canyon Road	7.3	--	--	4,908	6,693

-- Data Unknown

[2] Discharge not determined because 1% Annual Chance Flood is contained within Whittier Narrows Flood Control Basin

[3] Not Required by the Federal Insurance Administration

Table 7 - SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. mi.)	Peak Discharges (cfs) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Approximately 800 feet Upstream of Placerita Canyon Road	6.4	--	--	4,371	5,961
Sand Canyon Lateral					
At Robinson Ranch Road	0.9	--	--	1,480	--
Santa Clara River					
Approximately 2,600 feet Upstream of Los Angeles Aqueduct	235.4	--	--	15,182	26,369
At Sand Canyon Road	179.4	--	--	8,408	13,849
Santa Clarita Valley					
Santa Clara River Approximately 3,500 feet Upstream of Arrastre Canyon Road	67.7	--	--	8,408	13,849
Santa Clara River 7,600 feet Upstream of Oak Springs Canyon	172.7	--	--	13,412	22,588
Santa Clara River at Sand Canyon Road	179.4	--	--	13,934	23,467

Table 7 - SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. mi.)	Peak Discharges (cfs) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Mint Canyon 3,600 feet Downstream of Vasquez Canyon Road	26.8	--	--	7,896	14,179
Mint Canyon 1,600 feet Downstream of Sierra Highway Crossing	29.3	--	--	8,300	14,581
Mint Canyon Approximately 2,600 feet Downstream of Davenport Road	19.9	--	--	6,691	12,604
Vasquez Canyon Approximately 1,373 feet Upstream of Vasquez Canyon Road	4.2	--	--	2,851	5,009
Bouquet Canyon Approximately 4,500 feet Upstream of Vasquez Canyon Road	38.6	--	--	11,303	23,161
Placerita Creek Approximately 850 feet Downstream of Antelope Valley Freeway	6.3	--	--	3,546	5,673
Placerita Creek Approximately 2,000 feet Upstream of Quigley Canyon Road	7.1	--	--	4,085	6,313

Table 7 - SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. mi.)	Peak Discharges (cfs)			
		10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Placerita Creek Approximately 2,900 feet upstream of Quigley Canyon Road	8.6	--	--	4,988	7,482
Placerita Creek Approximately 575 feet Upstream of San Fernando Road	9.3	--	--	5,321	7,981
Newhall Creek Approximately 800 feet Downstream of Sierra Highway	5.2	--	--	3,224	4,396
Newhall Creek Approximately 650 feet Upstream of Railroad Canyon	6.2	--	--	3,390	5,424
Newhall Creek Approximately 650 feet Downstream of Railroad Canyon	7.3	--	--	3,892	6,228
Railroad Canyon Approximately 350 feet upstream of San Fernando Road	1.2	--	--	835	1,253
South Fork Santa Clara River Approximately 600 feet Downstream of Golden State Freeway	12.8	--	--	8,417	13,596

Table 7 - SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. mi.)	Peak Discharges (cfs)			
		10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Wildwood Canyon Approximately 600 feet Upstream of Intersection of Valley Street and Maple Street	0.23	--	--	172	279
South Fork Santa Clara River Approximately 500 feet Downstream of Wiley Canyon Road	12.9	--	--	8,483	13,704
Santa Clara River Approximately 2,600 feet Upstream of Los Angeles Aqueduct	235.4	--	--	15,182	26,369
Approximately 1,800 feet South of Intersection of San Fernando Road and Magic Mountain Parkway	1.9	--	--	1,437	2,495
Bouquet Canyon Approximately 2,600 feet Upstream of Bouquet Canyon Road	32.1	--	--	11,117	22,707
Plum Canyon Approximately 2,350 feet Upstream of Bouquet Canyon Road	3.4	--	--	1,942	3,453
Haskell Canyon Approximately 1,300 feet Downstream of Headworks	6.7	--	--	5,363	10,516

Table 7 - SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. mi.)	Peak Discharges (cfs) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Haskell Canyon Approximately 6,400 feet Upstream of Confluence with Bouquet Canyon	10.4	--	--	7,268	14,072
Dry Canyon Approximately 2,000 feet Upstream of San Francisquito Road	5.5	--	--	5,235	10,470
San Martinez-Chiquito Canyon Approximately 1,000 feet Upstream of Chiquito Canyon Road (Lower Crossing)	4.7	--	--	4,659	8,607
San Martinez-Chiquito Canyon Approximately 400 feet Upstream of Chiquito Canyon Road (Upper Crossing)	3.1	--	--	3,112	5,705
San Martinez-Chiquito Canyon Approximately 250 feet Downstream of Verdale Street	1.1	--	--	1,205	2,208
Halsey Canyon Approximately 1,150 feet Downstream of Halsey Canyon Road	7.3	--	--	5,544	10,163

Table 7 - SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. mi.)	Peak Discharges (cfs) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Halsey Canyon Approximately 550 feet Downstream of Romero Canyon Road	5.9	--	--	4,523	8,292
Castaic Creek Approximately 2,100 feet Upstream of Confluence with Charlie Canyon	16.8	--	--	11,805	22,326
Violin Canyon Approximately 2,000 feet Downstream of Interstate Highway 5	10.5	--	--	9,421	17,818
Gorman Creek Approximately 250 feet North of Interstate Highway 5 Overcrossing Gorman Road	3.8	--	--	1,713	3,221
Elizabeth Canyon Approximately 2,300 feet Downstream of Elizabeth Lake Pine Canyon Road	7.7	--	--	3,455	7,176
Pine Canyon Approximately 1,200 feet Upstream of Lake Hughes Road	6.4	--	--	2,969	6,166
Dowd Canyon at Calle Corona Extended	3.9	--	--	2,982	5,963
San Francisquito Canyon at Spunky Road	2.7	--	--	2,140	4,281

Table 7 - SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. mi.)	Peak Discharges (cfs) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Santa Fe Springs Area					
Vicinity of Rivera Road and Vicki Drive	0.38	80	176	225	352
Shallow Flooding					
Turnbull Canyon in the Vicinity of Broadway and Alta Drive	1.0	250	540	690	1,080
At intersection of Ripley Avenue and Rindge Lane	N/A	61	135	172	270
At Gould Avenue between Ford and Goodman Avenues	0	66	146	186	291
At intersection of Vincent Street and South Irena Avenue	N/A	68	149	190	298
At intersection of Camino Real and South Juanita Avenue	10	50	111	141	221
At intersection of Avenue H and Massena Avenue	5[1]	154	340	434	679
South Fork Santa Clara River					
Approximately 500 feet downstream of Wiley Canyon Road	12.9	--	--	8,483	13,704

Table 7 - SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. mi.)	Peak Discharges (cfs) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Approximately 600 feet downstream of Golden State Freeway	12.8	--	--	8,417	13,596
Surface Runoff at Intersection of Garfield Avenue and Beverly Boulevard	2.9	820	1,810	2,310	3,610
Vicinity of Rosewood Avenue and Huntley Drive	1.06	670	1,479	1,888	3,329
West Los Angeles and Central Districts					

-- Data Unknown

[1] Pump Capacity

N/A Not Applicable

Flooding Source and Location	Drainage Area (sq. mi.)	10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Happy Lane	1.73	640	1,400	1,800	2,800
Laurel Canyon Boulevard at Hollywood Boulevard	1.91	600	800	1,160	2,100
West Hollywood					
Genesse Avenue North of Hollywood Boulevard	1.00	370	820	1,000	1,600
Third Street, Vicinity of La Cienga Boulevard	5.10	1,600	3,500	4,500	7,200
Fifth Street, Vicinity of Orlando Avenue	5.66	1,600	3,600	4,500	7,100

Table 7 - SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. mi.)	Peak Discharges (cfs) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Beverly Boulevard, Vicinity of Spaulding Avenue	4.02	730	1,600	2,100	2,900
Third Street, Vicinity of Fairfax Avenue	6.13	1,500	3,200	4,100	6,800
Hollywood					
Santa Monica Boulevard, Vicinity of Mariposa Avenue	2.79	940	2,100	2,700	4,200
South of Hollywood Freeway, Vicinity of Kenmore Avenue	3.20	830	1,800	2,300	3,700
Third Street at Kenmore Avenue	3.43	800	1,800	2,300	3,500
Madison Avenue at Monroe Street	0.54	160	350	440	690
Silver Lake					
Griffith Park Boulevard at Tracy Street	0.64	220	490	620	970
Between Hyperion Avenue and Griffith Park Boulevard, North of Fountain Avenue	0.91	290	650	830	1,300
Myra Avenue, Vicinity of Del Mar Avenue	1.80	490	1,110	1,400	2,200

Table 7 - SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. mi.)	Peak Discharges (cfs) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Silver Lake Boulevard East of Virgil Avenue	1.27	420	900	1,100	1,800
Westlake					
Vicinity of Wilshire Boulevard West of Hoover Street	1.40	360	790	1,000	1,600
Hancock Park					
Sixth Street, Vicinity of Alexandria Avenue	8.09	2,100	4,600	5,900	9,200
Lucerne Boulevard at Francis Avenue	0.26	70	160	200	320
Olympic Boulevard at Hudson Avenue	0.56	130	290	370	570
Vicinity of Western Avenue and 11th Street	3.48	670	1,300	1,600	2,500
Vicinity of Bronson Avenue and Country Club Drive	18.07	3,700	7,900	9,600	14,000
Vicinity of West Boulevard and Dockweiler Street	18.76	3,600	7,600	9,300	13,600
Vicinity of San Vicente and Pico Boulevards	18.91	3,500	7,400	9,000	13,100
Vicinity of Highland Avenue and St. Elmo Drive	20.21	3,600	7,700	9,300	13,700

Table 7 - SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. mi.)	Peak Discharges (cfs) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Arlington Avenue, Vicinity of 37th Place	0.73	440	990	1,400	2,500
Victoria Avenue, Vicinity of Jefferson Boulevard	1.17	320	1,100	1,400	2,600
Chesapeake Avenue, Viciniy of Exposition Boulevard	7.97	1,100	2,400	3,000	3,700
Harcourt Avenue, Vicinity of Westhaven Street	0.53	160	350	450	700
Park La Brea					
Wilshire Boulevard, Vicinity of Crescent Heights Avenue	6.62	1,500	3,300	4,200	6,600
Vicinity of Orange Drive and Pickford Street	24.67	4,400	9,500	11,800	17,700
Vicinity of Whitworth Drive and La Cienega Boulevard	17.13	3,400	7,600	9,700	15,200
Venice Boulevard, Vicinity of Fairfax Avenue	18.44	3,400	7,500	9,500	14,900
Redondo Boulevard, Vicinity of Santa Monica Freeway	1.16	300	670	860	1,300
Redondo Boulevard, Vicinity of Roseland Street	14.53	2,000	4,400	5,700	9,100
Houser Boulevard, Vicinity of La Cienega Boulevard	14.76	1,900	4,300	5,500	8,800
Fairfax Avenue, Vicinity of La Cienga Boulevard	16.67	2,100	4,700	6,000	9,600

Table 7 - SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. mi.)	Peak Discharges (cfs) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
West Los Angeles					
Balsam Avenue, Vicinity of Olympic Boulevard	1.19	290	550	660	940
Manning Avenue, Vicinity of Tennessee Avenue	3.40	530	1,300	1,700	2,600
Between Westwood Boulevard and Overland Avenue, Vicinity of Exposition Boulevard	4.00	190	1,200	1,500	2,700
Roundtree Road, Vicinity of Manning Avenue	0.72	500	740	840	1,100
Century City					
Northwest of Santa Monica Boulevard and Avenue of the Stars	0.49	400	590	700	900
Bel Air Estates					
Stone Canyon Road South of Somma Way	0.66	480	710	800	1,100
Stone Canyon Road South of Bellagio Road	1.02	630	940	1,100	1,400
Beverly Glen Boulevard North of Sunset Boulevard	1.18	700	1,000	1,200	1,600

Table 7 - SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. mi.)	Peak Discharges (cfs) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Brentwood					
North of San Vicente Boulevard, West of Westgate Avenue	0.21	60	140	180	280
Northeast of Sunset Boulevard and Barrington Avenue	0.24	230	340	390	520
Pacific Palisades					
Rustic Canyon, Approximately 1,030 feet Downstream (South) of Sunset Boulevard	5.67	700	1,500	2,000	3,100
Westchester					
Approximately 300 feet East of Sepulveda Boulevard and 1,300 feet North of 74th Street	1.39	310	690	880	1,400
Sepulveda Boulevard South of San Diego Freeway	1.39	310	690	880	1,400
Arizona Avenue North of Arizona Circle	1.65	340	740	950	1,500
Hyde Park					

Table 7 - SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. mi.)	Peak Discharges (cfs) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Halldale Avenue, Vicinity of 65th Street	1.20	300	660	850	1,300
Wilton Place, Vicinity of Gage Avenue	3.29	770	1,600	1,900	3,000
South of Southwest Drive, Vicinity of Van Ness Avenue	4.15	730	1,600	2,100	3,200
Harbor District					
Harbor Lake, Southeast of Vermont Avenue and Pacific Coast Highway	18.97	3,200	7,000	8,900	14,000
Denker Avenue, Vicinity of 204th Street	0.28	60	130	170	260
West Hollywood Area					
Vicinity of Rosemead Avenue and Huntley Drive	1.06	670	1,479	1,888	3,329
Vicinity of Pan Pacific Auditorium	4.02	730	1,600	3,600	4,500
Whittier Area					
Vicinity of Turnbull Canyon Road	1.0	246	543	692	1,084
Whittier Narrows Flood Control Basin	524	--[2]	--[2]	90,000	--[3]

Table 7 - SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. mi.)	Peak Discharges (cfs) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Windsor Hills Area					
Vicinity of La Brea and Slauson Avenues	0.25	67	147	188	294

[2] Discharge not determined because 1% Annual Chance Flood is contained within Whittier Narrows Flood Control Basin

[3] Not Required by the Federal Insurance Administration

A summary of breakout discharge is shown in Table 8, "Summary of Breakout Discharges."

Table 8 - SUMMARY OF BREAKOUT DISCHARGES

Flooding Source and Location	Breakout Discharges (cfs) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Compton Creek				
Upstream of the Confluence of Compton Creek and Los Angeles River, Right Overbank	--	--	14,800	--
Los Angeles River				
At Fernwood Avenue	--	--	75,200	--
Left Overbank	--	--	57,000	--
Right Overbank	--	--	18,200	--
At Wardlow Road	--	--	45,400	--
Left Overbank	--	--	14,200	--
Right Overbank	--	--	31,200	--
Rio Honda				
At Beverly Boulevard, Left Overbank	--	--	13,700	--
At Stewart and Gray Road	--	--	2,790	--
Left Overbank	--	--	1,395	--
Right Overbank	--	--	1,395	--

Table 8 - SUMMARY OF BREAKOUT DISCHARGES

Flooding Source and Location	Breakout Discharges (cfs)			
	10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Upper Los Angeles River				
At Broadway, Left Overbank	--	--	100	--

-- Data Unknown

Elevations for floods of the selected recurrence intervals on the Pacific Ocean are showing Table 9, “Summary of Elevations.”

Table 9 - SUMMARY OF ELEVATIONS

Flooding Source and Location	10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Los Angeles River	7.3	7.8	9.9	15.6
Los Cerritos Channel	6.9	7.5	8.7	12.2
Pacific Ocean				
San Pedro Bay	7.4	7.9	10.0	15.7
San Pedro Bay	7.0	7.6	8.8	12.3
San Pedro Bay	8.9	--	8.9	--
Alamitos Bay	7.0	7.6	8.8	12.3
Swimming Lagoon	7.4	7.9	10.0	15.7
At King Harbor	6.9	6.9	6.9	8.3
At Pleasure Pier	8.9	--	8.9	--
At Pleasure Pier	10.3	11.2	11.6	12.3
Ponding 600 feet East of Bloomfield Avenue North of Lakeland Road	139.8	142.8	143.8	143.8
Ponding 1,000 feet East of Bloomfield Avenue North of Lakeland Road	116.8	148.3	148.8	149.8
Ponding at Marquardt Avenue 1,400 feet North of Rosecrans Avenue	83.8	85.8	86.8	88.8

Table 9 - SUMMARY OF ELEVATIONS

Flooding Source and Location	10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Ponding from Savage Creek				
Intersection of York Avenue and Mar Vista Street	382.8	382.8	382.8	382.8
Ponding from Turnbull Canyon				
Intersection of Painter Avenue and Camilla Street	411.8	419.8	420.8	421.8
San Gabriel River				
At Whittier Narrows Flood Control Basin	213.8	222.8	222.8	231.8
Shallow Flooding				
Intersection of Ripley Avenue and Rindge Lane	--	62.9	64.9	68.9
At Gould Avenue between Ford and Goodman Avenues	83.4	91.4	95.9	105.9
Intersection of Vincent Street and South Irena Avenue	81.9	82.9	83.6	84.9
Intersection of Camino Real and South Juanita Avenue	120.5	121.9	122.9	124.3
Intersection of Avenue H and Massena Avenue	61.4	64.4	65.4	67.4
Surface Runoff – Deep Ponding Area				

Table 9 - SUMMARY OF ELEVATIONS

Flooding Source and Location	10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Southwest of the Intersection of Carson Street and Madrona Avenue	60.1	66.1	68.8	74.8
Intersection of Doris Way and Reese Road	61.6	64.8	65.8	67.7
Surface Runoff – Ponding Area				
Intersection of Anza Avenue and Spencer Street	82.6	83.4	83.8	84.9
Northeast of Sepulveda Boulevard and Madrona Avenue	77.3	78.4	78.8	79.5
Intersection of California Street and Alaska Avenue	78.7	80.1	80.8	81.6
Intersection of Mines Avenue and Taylor Avenue	186.7	188.8	188.8	188.8

-- Data Unknown

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were performed to provide estimates of the flood elevations of the selected recurrence intervals. Users should be aware that flood elevations shown on the Flood Insurance Rate Map (FIRM) represent rounded whole-foot elevations and may not exactly reflect the elevations shown on the Flood Profiles or in the Floodway Data tables in the FIS report. Flood elevations shown on the FIRM are primarily intended for flood insurance rating purposes. For construction and/or floodplain management purposes, users are cautioned to use the flood elevation data presented in this FIS in conjunction with the data shown on the FIRM.

The elevations have been determined for the 10-, 2-, 1-, and 0.2-percent annual chance floods for the flooding sources studied by detailed methods.

Cross sections were determined from topographic maps and field surveys. All bridges, dams, and culverts were field surveyed to obtain elevation data and structural geometry. All topographic mapping used to determine cross sections are referenced in Section 4.1.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the FIRM.

The hydraulic analyses for this FIS were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

All elevations are referenced to the National Geodetic Vertical Datum of 1988 (NAVD 88).

Los Angeles County

Santa Clarita and Antelope Valley

Preliminary flood elevations were determined by routing peak discharges through the county using the boundaries of the alluvial fans, historical records, and field reviews. Topographic and cross section data were compiled from existing topographic maps and from topographic maps prepared by the County Engineer for use in the Antelope Valley Flood Study. Features that cause changing flow depths, such as changing ground slope or obstructions, were considered. In all cases, the changes in flow depth caused by these features were deemed to be insignificant, and backwater calculations were not used. Roughness coefficients (Manning's "n") for overland flow conditions were estimated by field inspection of the areas under investigation. The Manning's "n" values ranged from 0.03 in the channels to 0.06 in the overbanks.

The preliminary flood elevations were field reviewed for verification of actual field conditions. Features such as local obstructions or depressions which would affect flood elevations or depths were noted, and flood elevations were revised accordingly, based on engineering judgment. Average depths of flooding were assigned based on standard normal-depth calculations through irregular cross sections. In many instances, the assigned average depth is not representative of the true degree of flood hazard. This occurs when average depths are based on a wide cross section which encompasses one or more low-flow drainage courses. The actual depth of flooding and, consequently, the true flood hazard will be greater adjacent to the drainage course. In some locations in the Santa Clarita Valley, the low-flow drainage course has been designated Zone A to reflect both the more severe hazard and that no development will take place. The adjacent flood plain is then given a shallow flooding designation based on average depth across the entire cross section.

Water-surface profiles were not prepared because the 1-percent annual chance flooding in the Antelope and Santa Clarita Valleys are not readily associated with channel flooding and flood profiles. Therefore, flooding limits were established through the use of available topography and field reviews.

Flood elevations for flooding sources in areas of little existing development and low potential for future development were determined by approximate methods based on Flood Hazard Boundary Maps, field reviews, and historical records.

Malibu Area

Flooding sources in the Malibu area typically are well-incised streams with relatively high velocities. Flood profiles have been prepared for all flooding sources studied in detail except for the downstream portion of Malibu Creek. In this instance, shallow flooding designations were assigned in. accordance with FEMA criteria.

Peak discharges were routed through the Malibu area considering the capacities of existing flood control systems. Capacities of these systems were obtained from design records or were computed using Manning's Equation. Topographic and cross section data were compiled from existing topographic maps and field surveys. Features which cause change in flow depths, such a changing ground slope or obstructions, were considered in determining water-surface elevations. Roughness coefficients (Manning's "n") were estimated by field inspection of the areas under investigation. Manning's "n" values ranged from 0.03 in the channels to 0.05 in the overbanks.

Los Angeles Basin

The pockets of unincorporated territory within Los Angeles County were analyzed with the various city Flood Insurance Studies on a drainage-area basis. Where applicable, flood profiles were prepared using the same procedure as for the Malibu area of the study. With the exception of Kagel Canyon Channel, Mill Creek, Lopez Canyon Channel, and Hacienda Creek, most flooding in these areas consists of shallow flooding in developed areas. Flow depths for shallow flooding areas were calculated using available topographic maps, street plan data, and field surveys. The flow depths were determined using Manning's Equation based on normal-depth assumptions. Features such as changing ground slope or obstructions were considered.

Because the effectiveness of the calculated cross sections is reduced by the presence of obstructions such as buildings or walls, a "wetted perimeter reduction factor" was used in heavily developed areas. This factor is a measure of the percentage of blockage across the cross sectional area and has the effect of reducing the flow-carrying capacity of the cross section. This has the effect of raising the calculated water-surface elevation. Manning's "n" values for Kagel Canyon Channel, Mill Creek, Lopez Canyon Channel, and Hacienda Creek ranged from 0.03 in the channels to 0.06 in the overbanks. For shallow flooding areas, a Manning's "n" value of 0.03 was used.

Throughout the county, ponding conditions and reservoirs were analyzed using the Los Angeles County Flood Control District Regional Normalized Hydrograph Equation. This equation determines the volume of water generated by 1-percent annual chance flood discharges. Where necessary, the volumes were reduced by reservoir routing flood flows through ponded areas.

Starting water-surface elevations used in the study were determined from normal-depth calculations adjusted to field conditions.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1).

City of Agoura Hills

Peak discharges were routed through the area considering the capacities of existing flood control systems. Capacities of these systems were obtained from design records or were computed using Manning's Equation. Topographic and cross section data were compiled from existing topographic maps (Los Angeles County Flood Control District, 1968 and U.S. Department of the Interior, Geological Survey, 1967) and field surveys. Features which cause changes in flow depths such as changing ground slope or obstructions were considered in determining water-surface elevations.

Roughness coefficients (Manning's "n") were estimated by field inspection of the areas under investigation. Manning's "n" values ranged from 0.03 in the channels to 0.05 in the overbanks.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1).

Starting water-surface elevations used in this study were determined from normal-depth calculations adjusted to field conditions.

For the 1998 revision to the Agoura Hills FIS, the water-surface elevations for the 1-percent annual chance flood event were computed through the use of the U.S. Army Corps of Engineers (USACE) HEC-2 computer program (U.S. Department of the Army, Corps of Engineers, September 1990) and manual calculations.

At the downstream end of the restudy, from approximately 1,040 feet downstream of Kanan Road to the concrete channel downstream of Kanan Road, the HEC-2 model was developed using cross-section information developed for the previous Flood Insurance Study for the City of Agoura Hills (Federal Emergency Management Agency, December 18, 1986), including cross-section data and workmaps obtained from Los Angeles County (Los Angeles County Department of Public Works, September 4, 1979 and September 25, 1979) and as-built construction drawings provided by Los Angeles County (Los Angeles County, Construction Drawings PM 100203, September 6, 1979 and Construction Drawings PM 7982, August 17, 1979).

For the reinforced-concrete channel from downstream of Kanan Road to Thousand Oaks Boulevard, the 1-percent annual chance discharges are contained under supercritical flow conditions as supported by design calculations submitted by the Los Angeles County Public Works Department, which were prepared by Hale, Haaland & Associates, Inc. (Hale, Haaland & Associates, Inc., February 1979).

For the restudy area upstream of Thousand Oaks Boulevard to the Ventura County line, the analyses were primarily based on the USACE HEC-2 computer model prepared by Simons, Li & Associates, Inc., for the Medea Creek Rehabilitation as part of the Morrison Ranch Project (U.S. Department of Housing and Urban Development, 1978). The as-built-conditions HEC-2 model provided by the City of Agoura Hills was also used (City of Agoura Hills, December 6, 1993). The model was extended downstream approximately 600 feet to tie into the upstream end of the concrete channel at Thousand Oaks Boulevard. This extension was based on the Los Angeles County as-built construction drawings (Los Angeles County, Construction Drawings PM 100203, September 6, 1979 and Construction Drawings PM 7982, August 17, 1979). The downstream starting water surface elevation was based on the Los Angeles County design water surface elevation at the upstream end of the supercritical reinforced-concrete-lined section.

Roughness coefficients (Manning's "n" values) used in the hydraulic analyses along Medea Creek ranged from 0.015 to 0.070 for the channel and from 0.040 to 0.070 for the overbank areas. Roughness coefficients were assigned based on the assumption of little or no channel maintenance.

City of Avalon

Topographic and cross section data were compiled from existing topographic maps, street plan data, and by field survey work. Topographic maps were obtained from the city at scales of 1:2,400, with contour intervals of 2 and 5 feet and 1:6,000, with a contour interval of 10 feet. Plans of all bridges and culverts were reviewed to determine elevation data, hydraulic characteristics, and structural geometry.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1).

Design capacities of storm drains and channels were derived from existing design data for each facility. Where design data were lacking, drain capacities were determined using Manning's Equation based on normal-depth assumptions.

Overland flows were routed through the community considering capacities of all existing drainage facilities. In those areas where storm discharges of the selected recurrence intervals exceeded drain capacities, surface flows existed and field cross sections were used to determine flood depths. Features which cause changing flow depths, such as changing ground slope or obstructions, were considered. In all cases, the changes in flow depth caused by these features were deemed to be insignificant and calculations for backwater were not warranted; therefore, uniform flow characteristics do exist and normal-depth analysis was used.

However, because the hydraulic effectiveness of the cross section is reduced by the presence of many obstructions, such as structures and walls, a wetted perimeter reduction factor was applied to appropriate cross sections. The factor is a measure of the percentage of blockage across the cross sectional area and has the effect of reducing the flow-carrying capacity of the cross section, thus increasing the water-surface elevation of peak discharges.

For determining depths and limits of flooding, the floodplain was divided into 3 study sections: the open area upstream of Tremont Street; the densely developed area between Tremont and Beacon Streets; and the section downstream of Beacon Street.

The section upstream of Tremont Street is characterized by sparse development, and hydraulic calculations were based on this condition. The section between Tremont and Beacon Streets is densely developed, but has a few vacant lots scattered throughout the area. The effect of these vacant lots on the depth of flooding throughout the overall area is negligible. Therefore, the vacant lots were assumed improved, and the wetted perimeter reduction factor was uniformly applied throughout this section. The section downstream of Beacon Street includes a large, open plaza area which was considered as open space in the hydraulic calculations.

Roughness coefficients (Manning's "n") for overland flow conditions were estimated by field inspection at the locations under investigation and ranged from 0.030 to 0.050.

Cities of Bellflower, Carson, Compton, Downey, Gardena, Lakewood, Long Beach (terrestrial flooding sources only), portions of Los Angeles affected by Los Angeles River, Lynwood, Paramount, Pico Rivera, South Gate

Cross section data developed for the backwater analysis of floods affecting these cities were obtained from aerial photogrammetry. The channel cross sections in the upper reaches of the Los Angeles River were developed from as-built plans obtained from the USACE. Elevation data for interstate highways crossing the channel and floodplain were obtained from the USACE and CALTRANS.

The roughness factor (Manning's "n") of 0.016 used for the channel was chosen based on engineering judgment of the design parameters and field observation of the concrete channel.

The roughness factors (Manning's "n") in the overbank areas were adjusted to compensate for the urbanized areas in the floodplain. The adjustment is based on the percentage of blockage parallel and perpendicular to the direction of flow. This factor has the effect of reducing the flow-carrying capacity of the cross section, thus raising the calculated water-surface elevation. The overbanks were divided into industrial and residential for this analysis. Industrial developed cross sections indicated a roughness factor of 0.05 with residential ranging from 0.10 to 0.15. A weighted average was used for cross sections comprised of industrial and residential development.

CALTRANS provided geometrical information for the backwater-producing structures in the lower reach. They include Interstates 405, 91, 710, and 105. Spot elevation data points in conjunction with aerial cross sections were used to determined weir elevations of the SPRR, the Union Pacific Railroad (UPRR), the Atchison Topeka and Santa Fe Railroad (ATSFRR) and ridges of high ground which separate flow paths in the overbank areas.

Expansion and contraction coefficients of 0.3 to 0.5, respectively, were used upstream and downstream of highways and railroads where flows were constricted to underpasses or limited crossing areas. A 1:1 contraction of flow upstream and a 4:1 expansion of flow downstream of the structures was used to define the effective flow areas and non-effective hydraulic "shadows". Cross-sections were modified by the use of encroachment routines and/or modification of cross-section geometry to describe ineffective flow areas.

Starting water-surface elevations used in the USACE computer program, HEC-2, for the overbank areas were based on critical depth, normal depth or depths over weirs.

The 1-percent annual chance peak overbank flow rates developed by the USACE and documented in the LACDA report for the Los Angeles River lower reach and the Rio Hondo were used to determine potential overbank water surface elevations and floodplain limits.

Locations of selected cross sections for the entire study used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1).

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

The following information refers to different flow paths. These flow paths are limited to smaller reaches than the profile flow paths and the names differ from those used to label the profiles.

Los Angeles River Left Overbank

The left overbank of the Lower Los Angeles River is divided into two areas. The first area floods as a result of a levee failure on the Los Angeles River near the Century Freeway. The second area floods as a result of levee failure near Wardlow Road.

The first area extends from the Century Freeway to the Pacific Ocean east of Signal Hill. According to the LACDA report the left levee of the Los Angeles River fails at Fernwood Avenue. The LACDA report assumes that the Century Freeway is not in place. The location of levee failure did not take into account the new freeway. However, recent correspondence with the USACE confirms that the levee failure location should not change significantly with the inclusion of the Century Freeway. Therefore, for the purposes of this Flood Insurance Study, the Century Freeway will be considered "in place." The magnitudes and locations of breakout are given in the LACDA report. The Fernwood Avenue breakout is assumed to be downstream of the Century Freeway. The peak flow rate is reduced through this reach due to attenuation as was done in the LACDA report.

The floodplain analysis in the first area includes three different flow paths. For the reach between the Century Freeway and just upstream of the Artesia Freeway the entire breakout is modeled in one flow path with a discharge of 57,000 cfs. Just upstream of the Artesia Freeway the overbank is divided into two paths. The main flow path with a discharge of 39,700 cfs is west of the UPRR and the second flow path with a discharge of 17,000 cfs is east of the railroad.

Downstream of the Artesia Freeway, the UPRR and Paramount Boulevard are elevated above the adjacent ground and form a barrier for flows draining in the east or west direction. Water may only flow in those directions when it has ponded high enough on either side to flow over the top. In order to analyze this area two separate flow paths have been modeled. The main flow path is west of the UPRR. The secondary flow path is east of Paramount Boulevard. In the second flow path, flow is limited by high ground at Clark Avenue on the east and Paramount Boulevard on the west. The HEC-2 split flow option was used to simulate weir flow over Paramount Boulevard and the UPRR. The weir extended from the Artesia Freeway for approximately 2,500 feet. Downstream of this reach oil berms and high ground block any additional transfer of flow. The flow in the second flow path continues south but is limited from spreading west by the UPRR. Downstream of Del Amo Boulevard the flow paths are permanently divided by Signal Hill. The secondary flow path is prevented from spreading east beyond the high ground near Bellflower Boulevard until it reaches Del Amo Boulevard. Downstream of Del Amo Boulevard the HEC-2 split flow option is used to simulate the transfer of flows east toward the San Gabriel River. Normal depth outflow through the streets is assumed. This area where flow is transferred east to the San Gabriel River is designated as an AO Zone. Between Carson Street and Monlaco Road high ground prevents the further transfer of flow and an island is formed. A separate flow path is modeled adjacent to the San Gabriel River using the results of the split flow analysis. Downstream of the island an effective flow line is used to simulate the spread of the recombining of the flows. The total combined flow then continues south to Los Alamitos Bay.

As previously discussed, the main flow path carries its flow adjacent to the Los Angeles River at the Artesia Freeway. Between the Artesia Freeway and the oil tank berms additional flows are added from the secondary flow path. Downstream of this location the main flow path is confined on the east by the UPRR. Downstream of Washington Street the UPRR turns and runs diagonally toward the Los Angeles River. Because the railroad is elevated, it forces water back in the river. The Los Angeles River levees are assumed to remain in place therefore water is forced over the levees into the river. Critical depth was assumed as the starting water surface elevation. A constriction is formed just downstream of where the UPRR crosses the Los Angeles River which prevents any additional overbank flows. This constriction is caused by Signal Hill.

The second area of the left overbank of the Los Angeles River is flooded downstream of the San Diego Freeway (Interstate 405) due to a levee failure and a breakout discharge of 14,200 cfs in the vicinity of Wardlow Road. Downstream of this breakout the levee is assumed to remain in place and flows are attenuated as described in the LACDA report.

HEC-2 backwater runs were made from the ocean to the San Diego Freeway. These runs indicate that it is possible for water to pond high enough to overtop the Los Angeles River levee and flow back into the main channel. The split flow option (weir flow) in HEC-2 was used to allow water to flow over the levee back into the channel.

Los Angeles River Right Overbank

In the right overbank of the lower Los Angeles River upstream of Del Amo Boulevard, water-surface elevations were determined using HEC-2 and the 1-percent annual chance peak flow rates developed by the USACE for the LACDA report for the breakout at Fernwood Avenue. The actual breakout of 18,200 cfs will be downstream of the Century Freeway as discussed for the Los Angeles River left overbank. Floodplain limits extend upstream of the actual breakout location due to backwater effects. Starting water-surface elevations were determined from critical depth at the Compton Creek levees and the results of the downstream studies at Del Amo Boulevard.

The reach downstream of Del Amo Boulevard to Interstate 405 is affected by breakouts at two different locations: the Compton Creek breakout from the north and the Wardlow Road breakout from the east. The water-surface elevations were determined at each street intersection in the reach between the Los Angeles River and the SPRR assuming normal depth and using Manning's equation. A trial and error process was used to balance the flows going to and from each intersection. Two outflow locations exist for this area. The first is Interstate 405 where flows drain south through the underpasses. The outflow at these underpasses was determined from normal depth calculations. The second outflow location is the SPRR where flows drain west over the SPRR to the Dominguez sink area. The Dominguez sink area is a natural depression with a capacity of approximately 20,000 acre-feet at elevation 20 feet. The outflow over the SPRR was determined from weir flow calculations.

Two separate inflow locations to the Dominguez Sink were analyzed. The first source is the weir flow over the SPRR between Del Amo Boulevard and Interstate 405. The second source of flow to the Dominguez Sink is from a constricted section downstream of Interstate 405, just east of Wilmington Avenue. Weir flow calculations were used to determine the amount of flow to the Dominguez Sink from this source. Water does not pond high enough in the sink to allow flows to drain out of the sink area during the 1-Percent Annual Chance flood.

For the reach upstream of Interstate 405 between the SPRR and the Dominguez Sink the depth of water was determined by using the 1-percent annual chance peak flow rate over the SPRR (with the exception of what drains through Wilmington Avenue). This flow was distributed across the available area resulting in a shallow flooding area with a depth of 3 feet.

The remainder of flow which does not go to the Dominguez Sink continues downstream to the Pacific Ocean. The flow rates obtained by the analyses described above do not result in the same flow rates obtained by the USACE in the LACDA report. The USACE did not take into account the second source of flow to the Dominguez Sink from the constricted section downstream of Interstate 405. Therefore, the flow rates used in this Flood Insurance Study are less than those obtained by the USACE. Once the final peak flow rates were determined, the HEC-2 computer program was used to determine the water-surface elevations.

Rio Hondo Left Overbank

The left overbank of the Rio Hondo extends from the Whittier Narrows Dam to the Century Freeway. Just downstream of Whittier Narrows Dam the overbank floods as a result of the levee failure at Beverly Boulevard. A portion of the breakout is confined to spreading grounds on both sides of the channel and is considered ineffective. The remainder of the flow, 9,020 cubic feet per second (cfs), drains south to the UPRR where it crosses through underpasses at Rosemead Boulevard, Lexington Avenue and Whittier Boulevard. The peak flow rate is reduced throughout this reach due to attenuation as was done in the LACDA report. Percolation basins adjacent to the Rio Hondo and the San Gabriel River are considered ineffective flow areas since these basins may be full at the time of a flood event.

Downstream of the UPRR to the ATSFRR, the overbank is divided into three separate flow paths. One flow path is bounded by the Rio Hondo on the west and a ridge near Rosemead Boulevard on the east. A second flow path is bound by the ridge near Rosemead Boulevard on the west and another ridge near Passons Boulevard on the east. The third flow path is bound by the ridge near Passons Boulevard on the west and the San Gabriel River on the east. High ground between these flow paths prevents the overbank flows from spreading unhindered to the east. The HEC-2 split flow option for weir flow was used to determine the amount of flow which crosses east over the ridges between each cross section and continues south in the overbank.

Most of the water that spreads east to the third flow path, adjacent to the San Gabriel River, overtops the river levees and escapes to the channel. This is possible since these levees are often lower than the adjacent overbank. Along with the HEC-2 split flow option, hand calculations were used to determine the amount of flow which enters the San Gabriel River. Based on the LACDA report and conversations with the USACE, it was determined that adequate capacity existed in the San Gabriel River, above the 1-percent annual chance flows releases from Whittier Narrows Dam, to allow the flows from the Rio Hondo overbank to enter the channel. A total of almost two-thirds of the breakout flows from the Rio Hondo overtop the levees between the dam and the Century Freeway with most of the flows escaping upstream of the ATSFRR.

Once the final flow rates in each path were determined the HEC-2 computer program was used to determine water-surface elevations and floodplain limits. Normal depth calculations were used to determine the depths in the shallow flooding areas.

At the ATSFRR, all the flow remaining in the left overbank crosses at the Rosemead Boulevard underpass. This water then flows south between the Rio Hondo and a ridge of high ground at approximately Passons Boulevard to Interstate 5. At Burke Street, downstream of Slausen Avenue, a small portion of the flow escapes east over the ridge as determined by the HEC-2 split flow weir analysis. The water that flows east over the high ground at Burke Street continues east toward the San Gabriel River and flows over the river levees near the ATSFRR. The San Gabriel River levees in this reach are lower than the adjacent ground which is sloping eastward toward the river. The area between Passons Boulevard and the San Gabriel River is zoned as a shallow flooding area with average depths of 1 foot. This depth was based on normal depth calculations using the elevations of the streets in the direction of flow.

Downstream of Interstate 5 to the Century Freeway a total of three flow paths exist with high ground separating each flow path. The main flow path is adjacent to the Rio Hondo and extends from Interstate 5 to the Century Freeway. At Stewart and Gray Road additional breakouts from the Rio Hondo join the left overbank flows. The second flow path is immediately east of the main flow path between Florence Avenue and the SPRR. A portion of the flows from the first flow path escapes to the second flow path at Florence Avenue. The third flow path begins at Gallatin Road where flows from the first flow path begin to flow over high ground. Flow paths two and three combine downstream of the SPRR. The combined flow from the second and third flow paths extend to the Century Freeway and is adjacent to the San Gabriel River.

At Interstate 5 all flow passes through the openings at Paramount and Lakewood Boulevards. This water then flows south adjacent to the Rio Hondo in the main flow path. Between Interstate 5 and Gallatin Road a small portion of the flow crosses east over high ground near Lakewood Boulevard into the third path. The amount of flow crossing over the high ground was determined using weir flow of the split flow option in the HEC-2 hydraulic model. At Florence Avenue a portion of the flow from the main flow path escapes east into the second flow path. This amount of flow was determined using normal depth calculations for the available street capacity at the known water-surface elevation (from the main flow path HEC-2 runs). Due to high ground adjacent to Burke Street and the southeastern slope of the land, none of the flow that escapes east from the main flow path returns. At Stewart and Gray Road the discharge is reduced to account for attenuation. At this location the additional breakout flows of 1,395 cfs are also added as determined by the USACE. Between the Imperial Highway and the Century Freeway the UPRR crosses diagonally through the main flowpath. The railroad is elevated on fill. This reach was analyzed for two conditions. The first condition assumes the railroad embankment fails and water distributes evenly across the floodplain in one flow path. The second condition assumed the embankment remains in place and flows east of the railroad must pond to the elevation of the railroad embankment before it can cross over to the west. The amount of flow that crosses over the railroad was determined using weir flow of the split flow option in the HEC-2 hydraulic model with the railroad embankment elevations used for the weir crest elevations. HEC-2 backwater runs were made to determine water-surface elevations for the entire main flow path using the flow rates determined above. The HEC-2 runs that resulted in the greater water-surface elevations were used in mapping the floodplains. The starting water-surface elevation used at the Century Freeway was the water-surface elevation obtained from the downstream study of the Los Angeles River left overbank.

In the second flow path the water is confined between high ground to the east and west until it gets downstream of the SPRR. At this point the flows between the second flow path begin combining with the flows in the third flow path. HEC-2 backwater runs were made to determine the water-surface elevations in the second flow path. The starting water-surface elevation was determined using normal depth calculations. In the transition between flow paths 2 and 3 a shallow flooding zone occurs with water depths varying from one to two feet as determined from spot elevations.

Flows from the main path adjacent to the Rio Hondo begin entering the third flow path downstream of Interstate 5. These flows are prevented from continuing east to the San Gabriel River until upstream of Firestone Boulevard. At this point the high ground is reduced and the flows are free to drain to the east and flow against the San Gabriel River levees. Further downstream water from flow path two enters the third flow path and also continues east to the San Gabriel River levees. The HEC-2 backwater analysis indicates that the water-surface elevation is high enough at this point to allow a portion of the flows to flow over the San Gabriel River levee. This was determined using the HEC-2 split flow option for weir flow and the as-built levee elevations on the San Gabriel River levee for the weir elevations. The remaining flow in the overbank continues south to the Century Freeway.

At the Century Freeway the flows in the third flow path (which includes the flows from the second flow path) run into the depressed freeway section and drain west toward the Los Angeles River where they combine with flows from the main flow path and cross over into the left overbank adjacent to the Los Angeles River. At this same location another breakout occurs on the Los Angeles River. The magnitude of the breakout of the Los Angeles River is much greater than that of the Rio Hondo breakouts. The peaks of the two breakouts occur at different times according to the USACE, therefore, only the larger breakout amount from the Los Angeles River is used to analyze the floodplain limits and depths downstream of the Century Freeway.

Rio Hondo Right Overbank

Upstream of the Los Angeles River-Rio Hondo confluence a triangle is formed which is flooded from a breakout of the right Rio Hondo levee at Stewart and Gray Road. The Los Angeles River levees upstream of the confluence are certified by the USACE.

In order for water to get back into the channels (Rio Hondo or Los Angeles River) it must pond behind the levees at the confluence then flow over them. Water-surface elevations were determined using the HEC-2 model.

City of Burbank

In order to compute water-surface elevations within the City of Burbank, peak discharges were routed through the community considering capacities of existing flood control facilities. At locations where peak discharges exceeded the available drainage system capacity, field reviews and cross section data were used to determine depths of the overland flows. Capacities of channels and storm drains were obtained from design records or were derived from available data using Manning's equation based on normal depth assumptions. Topographic and cross section data were compiled from existing topographic maps, field reviews, and street plan data on file at the Los Angeles County Flood Control District.

Water-surface profiles were not prepared because the 1-percent annual chance flooding in Burbank is not readily associated with channel flooding and flood profiles.

Roughness coefficients (Manning's "n") for overland flow conditions were estimated by field inspection of the areas under investigation, and values ranging from 0.014 to 0.050 were used.

Country Club Drive in Sunset Canyon acts as a channel for storm runoff, and depths calculated are based on normal depth assumptions indicating supercritical flow. However, it was concluded that the combined effects of variations in channel roughness, short-radius curves, and debris will cause the flows to be at critical depth and, therefore, the flooding limits in Sunset Canyon were based on critical depth calculations.

Features which cause changing flow depths, such as changing around slope or obstructions, were considered. In all cases, the changes in flow depth caused by these features were deemed to be insignificant and backwater calculations were not used. However, because the effectiveness of the calculated cross sections are reduced by the presence of obstructions, such as buildings and walls, a wetted perimeter reduction factor was applied. The factor is a measure of the percentage of blockage across the cross sectional area and has the effect of reducing the flow-carrying capacity of the cross section, thus increasing the water-surface elevation of peak discharges.

To analyze pondinq conditions, the Los Angeles County Flood Control District's Regional Normalized Hydrograph Equation was used to determine the volume of water generated by the 1-percent annual chance flood event. Where necessary, the volume was reduced by reservoir routing floodflows through the ponded areas.

For the January 20, 1999 revision, water-surface elevations were computed through the use of the USACE HEC-2 computer program (U.S. Department of the Army, Corps of Engineers, Hydrologic Engineering Center, September 1990). The parameters used were as follows:

1. Channel cross sections and structure dimensions were obtained from as-built plans for the Lockheed Drain Channel (Federal Works Agency, November 1944).

2. Cross sections in the overbank areas were determined from City of Burbank topographic mapping at a scale of 1"=100', with a contour interval of 2 feet (Analytical Surveys, Inc., May 1988), supplemented by grading plans (City of Burbank, March 1991 and Lockheed Engineering and Science Co., October 1993) and field-reconnaissance surveys.

3. The roughness coefficient (Manning's "n" value) for various lined portions of the channel was set at 0.020. All other values were based on field inspection. Earthen channel "n" values were set at 0.035. Overbank "n" values ranged from 0.020 to 0.045, and were determined using the procedure developed by the USGS (U.S. Department of the Interior, Geological Survey, October 1977). Building blockages were estimated from the City's topographic mapping (Analytical Surveys, Inc., May 1988) and field-reconnaissance surveys. These values ranged between 0.100 and 0.150.

4. Starting water-surface elevations were calculated using the slope-area method.

5. All culverts and bridges were modeled on assumed unobstructed flow. Bridges were modeled using the HEC-2 special-culvert or normal-bridge methods. For the long pipe conduit that begins at Clybourn Avenue, an elevation discharge rating curve was determined by manual calculation and was used for the HEC-2 analyses.

6. HEC-2 split-flow routines, based on a weir discharge coefficient of 2.6, were used to determine channel overflows.

The boundaries of the 1-percent annual chance flood were delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using aerial topographic mapping at a scale of 1"=100', with a contour interval of 2 feet, that was prepared for this restudy (Analytical Surveys, Inc., May 1988). The sheet-flow areas where flooding depths are less than 1 foot are designated Zone X. Areas where flooding depths exceed 1 foot are designated Zone AE and the calculated 100-year BFEs are designated on the Flood Insurance Rate Map.

City of Culver City

Peak discharges for locations within the City of Culver City were routed through the community considering where peak discharges exceeded the available drainage system capacity, field reviews and cross section data were used to determine depths of the overland flows. Capacities of channels and storm drains were obtained from design records or were derived from available data using Manning's equation based on normal depth assumptions. Topographic and cross section data were compiled from existing topographic maps and street plan data.

Features that cause changing flow depths, such as changing ground slope or obstructions, were considered. In all cases, the changes in flow depth caused by these features were deemed to be insignificant, and backwater calculations were not used. However, because the effectiveness of the calculated cross sections are reduced by the presence of obstructions, such as buildings and walls, a wetted perimeter reduction factor was applied. The factor is a measure of the percentage of blockage across the cross sectional area and has the effect of reducing the flow-carrying capacity of the cross section, thus increasing the water-surface elevations of peak discharges.

Roughness coefficients (Manning's "n") for overland flow conditions were estimated by field inspection of the areas under investigation, and a value of 0.040 was used throughout the study.

Water-surface profiles were not prepared because the 1-percent annual chance flooding in Culver City is not readily associated with channel flooding and flood profiles. Therefore, flooding limits and depth were established through the use of available topography and field reviews.

Shallow flooding, resulting from inadequate drainage and having an average depth of 1 foot, occurs on the east side of Ballona Creek Channel in the vicinity of the intersection of Adams and Washington Boulevards. Also, shallow flooding with depths less than 1 foot occurs along the western border of Hannum Avenue, in the northeast section of the Fox Hills Mall.

City of La Mirada

The peak discharges for floods of the selected recurrence intervals within the City of La Mirada were routed through the community with consideration given to the capacities of existing flood-control facilities. At locations review and cross section data were used to determine depths of the overland flow. Capacities of channels and storm drains were obtained from design records or were derived from available data using Manning's Equation, based on normal depth assumptions. Topographic and cross section data were compiled from existing topographic maps, street plan data, and field reviews. Features which cause changing flow depths, such as changing ground slope or obstructions, were considered. In all cases, the changes in flow depth caused by these features were deemed to be insignificant and backwater calculations were not used. However, because the effectiveness of the calculated cross section is reduced by the presence of obstructions, such as buildings and walls, a wetted perimeter reduction factor was applied. The factor is a measure of the percentage of blockage across the cross sectional area and has the effect of reducing the flow-carrying capacity of the cross section, thus increasing the water-surface elevation of peak discharges.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1).

Roughness coefficients (Manning's "n") for overland flow conditions were estimated by field inspection; values ranged from 0.025 to 0.030 for both channel and overbank areas.

To analyze ponding conditions, the Regional Normalized Hydrograph Equation of the Los Angeles County Flood Control District was used to determine the volume of water generated during a 1-percent annual chance flood event. Where necessary, the volumes were reduced by reservoir-routing flood flows through the ponded areas.

Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals (Exhibit 1).

City of Lancaster

The preliminary flood depths within the City of Lancaster were determined by routing peak discharges through the community using the boundaries of the alluvial fans, historical records, and field reviews. Average depths of flooding were assigned based on standard hydraulic calculations through irregular cross sections. In many instances, the assigned average depth is not representative of the true degree of flood hazard. This occurs when average depths are based on a wide cross section which encompasses one or more low-flow drainage courses. The actual depth of flooding, and, consequently, the true flood hazard, will be greater adjacent to the drainage course.

Features that cause changing flow depths, such as changing ground slope or obstructions, were considered. In all cases, the changes in flow depth caused by these features were deemed to be insignificant, and backwater calculations were not used.

Topographic and cross section data were compiled from existing topographic maps and from topographic maps prepared by the County Engineer.

Roughness coefficients (Manning's "n") for overland flow conditions were estimated by field inspection of the areas under investigation, and a value of 0.04 was used throughout.

Water-surface profiles were not prepared because the 1-percent annual chance flooding in Lancaster is not readily associated with channel flooding, and flood profiles are not applicable.

City of Long Beach

Analyses of the hydraulic characteristics of flooding from oceanic sources were carried out to provide estimates of the elevations of floods of selected recurrence intervals along each of the shorelines. The discussion of flood hydraulics from terrestrial sources is covered in the section on the Cities of Bellflower, et al., above.

In order to obtain runup values for the various flood producing mechanisms, data on offshore bathymetry and beach profiles were obtained from U.S. Coast and Geodetic Survey and National Oceanic and Atmospheric Administration bathymetric charts; USGS topographic maps; surveys of beach profiles conducted by the USACE, Los Angeles District; and from aerial photographs of the study area.

City of Los Angeles

Analysis of the City of Los Angeles included all those issues related to the study of communities within the Los Angeles River watershed, and are covered under the Cities of Bellflower, at al. above. Areas outside the influence of the Los Angeles River are discussed below.

Peak discharges were routed through the City considering capacities of existing flood-control facilities. At locations where peak discharges exceeded the available drainage system capacity, field reviews and cross section data were used to determine depths of the overland flows. Capacities of channels and storm drains were obtained from design records or were derived from available data using Manning's equation based on normal-depth assumptions. Topographic and cross section data were compiled from existing topographic maps, street plan data, and field surveys.

Features that cause change in flow depths, such as changing ground slope or obstructions, were considered. In all cases, the changes in flow depth caused by these features were deemed to be insignificant, and backwater calculations were not used. However, because the effectiveness of the calculated cross sections is reduced by the presence of obstructions, such as buildings and walls, a "wetted perimeter reduction factor" was applied. The factor is a measure of the percentage of blockage across the cross sectional area and has the effect of reducing the flow-carrying capacity of the cross section, thus increasing the water-surface elevation.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed, selected cross section locations are also shown on the FIRM.

Roughness coefficients (Manning's "n") for overland flow conditions were estimated by field inspection of. the areas under investigation, and values of 0.030 and 0.040 were used throughout as appropriate. Values of 0.065, 0.055, and 0.035 were used as Manning's "n" in the hydraulic analyses of the natural watercourses.

Starting water-surface elevations were determined from normal-depth calculations.

Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals (Exhibit 1). No profiles are shown for Pacoima, Little Tujunga, aid Big Tujunga Washes because of the unpredictability of the location of the stream across the width of the alluvial fan.

To analyze ponding conditions, the Los Angeles County Flood Control District regional normalized hydrograph equation was used to determine the volumes of water generated by the 1-percent annual chance discharges. Where necessary, the volumes were reduced by reservoir routing floodflows through the ponded areas.

One of the mapped areas of shallow flooding is along the upper reaches of Browns Creek, which results from shallow overbank flows. During the 1-percent annual chance flood event, the water will leave the improved channel because the bridges will become plugged with debris due to the lack of a debris retention facility upstream.

Big Tujunga, Little Tujunga, and Pacoima Washes exit the San Gabriel Mountains on alluvial fans. The potential limits of flooding were delineated by determining the boundaries of the alluvial fans. The depths were assigned using mean depth at critical slope through the irregular cross sections.

Harbor Lake (previously known as Bixby Slough) was analyzed by comparing the inflow to the lake with the outflow from the lake to San Pedro Bay. Outflow is limited by the capacity of a large underground culvert, Project No. 1103.

City engineers have indicated that an inland strip along the beach, northwest of Ballona Creek outlet, has historically been subject to shallow flooding because, during major storms, the drains serving the area have not functioned at high tide.

City of Montebello

Analysis of the City of Montebello included all those issues related to the study of communities within the Los Angeles River watershed, and are covered under the Cities of Bellflower, at al. above. Areas outside the influence of the Los Angeles River are discussed below.

The 1-percent annual chance peak discharge for the original study was routed through the community considering capacities of existing flood-control facilities. At locations where peak discharges exceeded the available drainage system capacity, field reviews and cross section data were used to determine depths of the overland flows. Capacities of channels and storm drains were obtained from design records or were derived from available data using Manning's Equation based on normal depth assumptions. Topographic and cross section data were compiled from existing topographic maps.

Features that cause changing flow depths, such as changing ground slope or obstructions, were considered. In all cases, the changes in flow depth caused by these features were deemed to be insignificant, and backwater calculations were not used. However, because the effectiveness of the calculated cross sections is reduced by the presence of obstructions, such as buildings and walls, a "wetted perimeter reduction factor" was applied. The factor is a measure of the percentage of blockage across the sectional area and has the effect of reducing the flow-carrying capacity of the cross section, thus increasing the water-surface elevation of peak discharges.

Roughness coefficients (Manning's "n") for overland flow conditions were estimated by field inspection of the areas under investigation and values of 0.015 and 0.020 were used.

As a result of these calculations, it was determined that shallow flooding with depths of 1 foot and less than 1 foot would occur in the vicinity of Garfield Avenue.

To analyze ponding conditions, the LACFCD Regional Normalized Hydrograph Equation was used to determine the volume of water generated by the 1-percent annual chance discharge. Where necessary, the volume was reduced by reservoir routing floodflows through the ponded areas.

The volume of water generated by the 1-percent annual chance flood at Whittier Narrows Dam is contained within the reservoir area. The USACE has entered into lease agreements with private owners for use of the reservoir lands. These individual owners could be eligible for flood insurance; and, at the FIA's instructions, the reservoir area has been mapped showing 1-percent annual chance flood boundaries only. It was not deemed necessary to determine 0.2-percent annual chance discharges or elevations.

Field investigation was the method used to study approximate areas.

City of Palmdale

The preliminary flood depths for Amargosa Creek, Amargosa Creek Tributary, Anaverde Creek, and Anaverde Creek Tributary were determined by routing peak discharges through the community using the boundaries of the alluvial fans, historical records, and field reviews. Average depths of flooding were assigned based on standard hydraulic calculations through irregular cross sections. In many cases, the assigned average depth is not representative of the true degree of flood hazard. This situation occurs where average depths are based on a wide cross section which encompasses one or more lowflow drainage courses. The actual depth of flooding and, consequently, the true flood hazard will be greater adjacent to the drainage course.

Features that cause changing flow depths, such as changing ground slope or obstructions, were considered. In all cases, the changes in flow depth caused by these features were deemed to be insignificant, and backwater calculations were not used.

Topographic and cross-section data were compiled from topographic maps prepared by the County Engineer.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). Selected cross section locations are also shown on the Flood Insurance Rate Map.

Flood depths for Big Rock Wash and Little Rock Wash were determined utilizing the U.S. Army Corps of Engineers HEC-2 step-backwater computer program. Cross-sections used in the backwater computations were derived from photogrammetric compilation of aerial photographs, flown in November 1984 January 1985, at a scale of 1:14,400. Topographic mapping was compiled at a scale of one (1) inch equals 400 feet, with a four foot contour interval. Bridges were field surveyed to obtain elevation data and structural geometry.

Starting water-surface elevations were based on approximate hydraulic computations using Manning's equation. Roughness coefficients (Manning's "n") values, were estimated using S.C.S. Guidelines, field investigations, and engineering judgment. For overland flow conditions on Amargosa Creek and Tributary, Anaverde Creek and Tributary, as "n" value of 0.04 was used throughout. Big Rock Wash channel "n" value was 0.05, and an "n" value of 0.05 was used for the overbanks. The "n" values used for Little Rock Creek Wash were 0.03 for the channel, and 0.05 for the overbanks.

Flood depths in the western portion of the city resulting from the flooding of an unnamed tributary from Ritter Ridge northwest of the city and a small segment of Anaverde Creek in western Palmdale, were determined by approximate methods based on the Flood Hazard Boundary Map published by the Federal Insurance Administration, field reviews, historical records, and the Los Angeles County Flood Overflow Maps.

For the March 30, 1998 revision, the water-surface elevations were computed through the use of the U.S. Army Corps of Engineers (USACE) HEC-2 computer program (U.S. Army, Corps of Engineers, Hydrologic Engineering Center, November 1976, Updated May 1984). The HEC-2 model was developed using topographic maps obtained from the State of California Department of Water Resources (State of California, Department of Water Resources, April 9, 1990) and field measurements at road crossings.

Channel and overbank cross sections were determined from State of California Department of Water Resources topographic mapping at a horizontal scale of 400 feet, with a 4-foot contour interval (State of California, Department of Water Resources, April 9, 1990), as well as field measurements.

Manning’s “n” roughness values were established based on a field observations and USACE and USGS guidelines and criteria. Channel roughness values used ranged from 0.035 to 0.060 and overbank roughness values used ranged from 0.035 to 0.075.

Contraction and expansion coefficients of 0.1 and 0.3 were used for open-channel sections. Contraction and expansion coefficients at culverts and bridges ranged from 0.4 to 0.6.

The downstream starting water-surface elevation was determined using the HEC-2 slope-area method, starting approximately 1,100 feet downstream of State Route 14, the downstream study limit.

Supercritical flow conditions can occur in some channel reaches. Subcritical analyses were conducted to determine base (1-percent annual chance flood) flood elevations (BFEs) for all stream reaches.

City of Redondo Beach

The hydraulic analysis of the small channels that exist in much of the City of Redondo beach were performed by the methodologies discussed under the section on the City of La Mirada, above.

Hydraulic analyses of the shoreline characteristics of the flooding sources studied in detail within the City of Redondo beach were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along each of the shorelines. The limit of runup was used to designate flood zones.

To obtain runup values for the various flood-producing mechanisms, data on offshore bathymetry and beach profiles were obtained from the U.S. Coast and Geodetic Survey and the National Oceanic and Atmospheric Administration bathymetric charts, U.S. Geological Survey topographic maps, surveys of beach profiles conducted by the U.S. Army Corps of Engineers, Los Angeles District, and from aerial photographs of the study area.

To analyze ponding conditions, the Los Angeles County Flood Control District Regional Normalized Hydrograph Equation was used to determine the volume of water generated by the 1-percent annual chance flood event. Where necessary, the volumes were reduced by reservoir routing floodflows through the ponded areas.

City of Santa Clarita

Preliminary flood elevations in the City of Santa Clarita were determined by routing peak discharges through the community using the boundaries of alluvial fans, flood overflow maps, and field reviews. Topographic and cross section data were compiled from existing topographic and floodplain boundary maps. Features that cause changing flow depths, such as changing ground slope or obstructions, were considered. In all cases, the changes in flow depth caused by these features were deemed to be insignificant, and backwater calculations were not used.

Roughness coefficients (Manning's "n") for overland flow conditions were estimated by field inspection of the areas under investigation. The Manning's "n" values used were 0.03 in the channels and 0.06 in the overbanks.

The preliminary flood elevations were field reviewed for verification of actual conditions. Features that would affect flood elevations or depths were noted, and flood elevations were revised accordingly, based on engineering judgment. Average depths of flooding were assigned based on standard normal-depth calculations through irregular cross sections. In many instances, the assigned average depth is not representative of the true degree of flood hazard. This occurs when average depths are based on a wide cross section that encompasses one or more low-flow drainage courses. The actual depth of flooding (and consequently, the true flood hazard) will be greater when located adjacent to the drainage course. In some locations in the Santa Clarita Valley, the low-flow drainage course has been designated Zone A to reflect a more severe flood hazard and to prohibit development. The adjacent floodplain is then given a shallow flooding designation based on average depth across the entire cross section.

Water-surface profiles were not prepared because the 1-percent annual chance flooding in the Santa Clarita Valley is not readily associated with channel flooding and flood profiles. Therefore, flooding limits were established using available topography and field reviews.

City of Santa Fe Springs

Peak discharges were routed through the community considering capacities of existing flood-control facilities. At locations where peak discharges exceeded the available drainage system capacity, field reviews and cross section data were used to determine depths of the overland flows. Capacities of channels and storm drains were either obtained from design records or were derived from available data using Manning's equation based on normal depth assumptions. Topographic and cross section data were compiled from existing topographic maps at a scale of 1:24,000, with a contour interval of 5 feet, street plan data, and field surveys.

Water-surface profiles were prepared for the natural watercourse north of the intersection of Pioneer Boulevard and Florence Avenue (shown as Flowline No. 1 on the map) by use of normal depth analysis. Features which cause changes in flow depths, such as changing ground slope or obstructions, were considered. In all cases, the changes in flow depth caused by these features were deemed to be insignificant and backwater calculations were not used. However, because the effectiveness of the calculated cross sections are reduced by the presence of obstructions, such as buildings and walls, a wetted perimeter reduction factor was applied. This factor is a measure of the percentage of blockage across the cross sectional area and has the effect of reducing the flow-carrying capacity of the cross section, thus increasing the water-surface elevation of peak discharges.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1).

Roughness coefficients (Manning's "n") for overland flow conditions were estimated by field inspection, and a value of 0.030 was used throughout.

Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals (Exhibit 1).

Starting water-surface elevations were determined by use of the broad-crested weir formula.

To analyze ponding conditions, the Los Angeles County Flood Control District's Regional Normalized Hydrograph Equation was used to determine the volumes of water generated by the 1-percent annual chance discharges. Where necessary, the volumes were reduced by reservoir routing flood flows through the ponded areas.

City of Torrance

Peak discharges were routed through the community, considering capacities of existing flood-control facilities. At locations where peak discharges exceeded the avai1able drainage system capacity, field surveys, field reviews, and cross section data were used to determine depths of the overland flow:;. Capacities of channel and storm drains were obtained from design records or were derived from available data using Manning's equation based on normal depth assumptions. Topographic and cross section data were compiled from existing topographic maps at scales of 1:24,000 with contour intervals of 5 and 20 feet, and 1:480, with a contour interval of 2 feet, field surveys, and street plan data.

Features that cause changing flow depths, such as changing ground slope or obstructions, were considered. In all cases, the changes in flow depth caused by these features were deemed to be insignificant, and backwater calculations were not used.

To analyze ponding conditions, the Los Angeles County Flood Control District's regional normalized hydrograph equation was used to determine the volume of water generated by the 1-percent annual chance flood peak discharge. Where necessary, the volumes were reduced by reservoir routing floodflows through the ponded areas.

Water-surface profiles were not prepared because the 1-percent annual chance flooding in Torrance is not associated with channel flooding and flood profiles.

An approximate coastal high-hazard analysis was conducted for this study. Flooding due to storm surge and wave runup was approximated by adding 3 feet to the highest tide observed in the Los Angeles area. The highest tide observed was taken from observations at Los les .titer Harbor by the U.S. Coast and Geodetic Survey, during the period from 1941 through 1959. The highest tide observed during that period was 4.9 feet. The city's coastline has been designated as beach land by the County of Los Angeles, which will preclude any substantial development of the beach below an elevation of 7.9 feet. Because there are no existing structures and no likelihood of structures being built in the future below an elevation of 7.9 feet along the Torrance coastline, only an approximate coastal high-hazard area has been shown.

City of West Hollywood

Throughout the City, ponding conditions and reservoirs were analyzed using the Los Angeles County Flood Control District Regional Normalized Hydrograph Equation. This equation determines the volume of water generated by the 1-percent annual chance flood event. Where necessary, the volumes were reduced by reservoir routing flood flows through ponded areas.

Flow depths for shallow flooding areas were calculated using available topographic maps, street-plan data, and field surveys. The flow depths were determined using Manning's Equation based on normal-depth assumptions. Features such as changing ground slope or obstructions were considered.

Because the effectiveness of the calculated cross sections is reduced by the presence of obstructions such as buildings or walls, a "wetted perimeter reduction factor" was used in heavily developed areas. This factor is a measure of the percentage of blockage across the cross sectional area and has the effect of reducing the flow-carrying capacity of the cross section. This has the effect of raising the calculated water-surface elevation.

Starting water-surface elevations used in the study were determined from normal-depth calculations adjusted to field conditions. The Manning's "n" value of 0.03 was used to determine flood depths.

City of Whittier

Analyses of the hydraulic characteristics of streams in the community were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along each stream studied in the community.

The 1-percent annual chance peak discharges were routed through the community considering capacities of existing flood-control facilities. At locations where peak discharges exceeded the available drainage-system capacity, field reviews and cross section data were used to determine depths of the overland flows. Capacities of channels and storm drains were obtained from design records or were-derived from available data by using Manning's equation based on normal-depth assumptions. Topographic and cross section data were compiled from existing topographic maps and street plan data.

Features which cause changing flow depths, such as changing ground slope or obstructions, were considered. In all cases, the changes in flow depth caused by these features were considered to be insignificant, and backwater calculations were not used. However, because the effectiveness of the calculated cross sections is reduced by the presence of obstructions such as buildings and walls, a wetted perimeter reduction factor was applied. The factor is a measure of the percentage of blockage across the cross sectional area and has the effect of reducing the flow-carrying capacity of the cross section, thus increasing the water-surface elevation of peak discharges.

Roughness coefficients (Manning's "n") for overland flow conditions were estimated by field inspection of the areas under investigation, and a value of 0.03 was used throughout the study. As a result of these calculations, it was determined that shallow flooding with depths of 1 foot occurs in the vicinity of Painter Avenue and Camilla Street.

Water-surface profiles were not prepared because the 1-percent annual chance flooding in Whittier is not readily' associated with channel flooding.

In order to analyze ponding conditions, the Los Angeles County Flood Control District's Regional Normalized Hydrograph Equation was used to determine the volume of water generated by the 1-percent annual chance flood discharge. Where necessary, the volume was reduced by reservoir routing floodflows through the ponded areas.

The volume of water generated by the 1-percent annual chance flood at Whittier Narrows Dam is contained within the reservoir area. The U.S. Army Corps of Engineers has entered into lease agreements with private owners for use of the reservoir lands. These individual owners could be eligible for flood insurance; and, at the Federal Insurance Administration's instructions, the reservoir area has been studied for the 1-percent chance flood only. It was not deemed necessary to determine 0.2-percent annual chance flood discharges or elevations.

Flood elevations for the city's landfill site, the Friendly Hills County Club golf course, and La Mirada Creek were determined by field investigation and engineering judgment.

During the analysis, 1-percent annual chance shallow flooding was determined along streets having inadequate drainage facilities.

Roughness factors (Manning's "n") used in the hydraulic computations were chosen by engineering judgment and were based on field observations of the streams and floodplain areas. Roughness factors for all streams studied by detailed methods are shown in Table 10, "Manning's "n" Values."

Table 10 - MANNING'S "n" VALUES

Stream	Left Overbank "n"	Channel "n"	Right Overbank "n"
Amargosa Creek	0.04	0.04	0.04
Anaverde Creek	0.04	0.04	0.04
Avalon Canyon	0.030 – 0.050	0.030 – 0.050	0.030 – 0.050
Big Rock Wash	0.05	0.05	0.05
Cheseboro Creek	0.05	0.03	0.05
Cold Creek	0.05	0.03	0.05
Dark Canyon	0.05	0.03	0.05
Dry Canyon	0.05 – 0.06	0.03	0.05 – 0.06
Escondido Canyon	0.05	0.03	0.05
Flow along Empire Avenue	0.014 – 0.050	0.014 – 0.050	0.014 – 0.050
Flowline No. 1	0.030	0.030	0.030
Garapito Creek	0.05	0.03	0.05
Hacienda Creek	0.06	0.03	0.06
Kegal Canyon	0.035 – 0.065	0.035 – 0.065	0.035 – 0.065
La Mirada Creek	0.025 – 0.030	0.025 – 0.030	0.025 – 0.030
Lake Street Overflow	0.014 – 0.050	0.014 – 0.050	0.014 – 0.050
Las Flores Canyon	0.05	0.03	0.05
Las Virgenes Creek	0.05	0.03	0.05
Liberty Canyon	0.05	0.03	0.05
Lindero Canyon above Confluence with Medea Creek	0.05	0.03	0.05
Lindero Canyon above Spillway above Lake Lindero	0.05	0.03	0.05
Little Rock Wash – Profile A	0.05	0.03	0.05
Little Rock Wash – Profile B	0.05	0.03	0.05
Little Rock Wash – Profile C	0.05	0.03	0.05
Lobo Canyon	0.05	0.03	0.05
Lockheed Drain Channel	0.014 – 0.050	0.014 – 0.050	0.014 – 0.050
Lopez Canyon Channel	0.06	0.03	0.06

Table 10 - MANNING'S "n" VALUES

Stream	Left Overbank “n”	Channel “n”	Right Overbank “n”
Los Angeles River Left Overbank Path 2	0.05 – 0.15	0.016	0.05 – 0.15
Los Angeles River Right Overbank Path 1	0.05 – 0.15	0.016	0.05 – 0.15
Los Angeles River Right Overbank Path 2	0.05 – 0.15	0.016	0.05 – 0.15
Malibu Creek	0.05	0.03	0.05
Medea Creek	0.05	0.03	0.05
Medea Creek (above Ventura Freeway)	0.03	0.05	0.03
Mill Creek	0.06	0.03	0.06
North Overflow	0.014 – 0.050	0.014 – 0.050	0.014 – 0.050
Old Topanga Canyon	0.05	0.03	0.05
Overflow Area of Lockheed Drain Channel	0.030 – 0.040	0.030 – 0.040	0.030 – 0.040
Overflow Area of Lockheed Storm Drain	0.014 – 0.050	0.014 – 0.050	0.014 – 0.050
Palo Comando Creek	0.05	0.03	0.05
Ramirez Canyon	0.05	0.03	0.05
Rio Honda Left Overbank Path 3	0.05 – 0.15	0.05 – 0.15	0.05 – 0.15
Rio Honda Left Overbank Path 5	0.05 – 0.15	0.05 – 0.15	0.05 – 0.15
Rio Honda Left Overbank Path 6	0.05 – 0.15	0.05 – 0.15	0.05 – 0.15
Rustic Canyon	0.035 – 0.065	0.035 – 0.065	0.035 – 0.065
Santa Maria Canyon	0.05	0.03	0.05
Stokes Canyon	0.05	0.03	0.05
Topanga Canyon	0.05	0.03	0.05
Trancas Creek	0.05	0.03	0.05
Triunfo Creek	0.05	0.03	0.05
Unnamed Canyon (Serra Retreat Area)	0.05	0.03	0.05
Upper Los Angeles River Left Overbank	0.05 – 0.15	0.05 – 0.15	0.05 – 0.15
Weldon Canyon	0.035 – 0.065	0.035 – 0.065	0.035 – 0.065
Zuma Canyon	0.05	0.03	0.05

Refraction

Refraction computations were conducted to trace the evolution of winter swell and tropical cyclone swell from their source to the 60-foot depth contour. A large grid (200 by 250 miles) covering the coastal water of southern California with 1,000 by 1,000-foot grid spacing was used for the refraction calculations. Standard raytracing procedures were used to trace rays inward from the deep ocean grid boundaries. Ray spacing was chosen at 1,000 feet to provide adequate density of ray coverage. Wave heights at the 60-foot contour were computed using the principle of wave energy flux conservation between neighboring rays. One set of refraction computations was performed for each selected event from the list of extreme winter swells and the list of tropical cyclones off Baja California. The winter swell input values were obtained for the FNWC tape for the selected days of extreme events. The values at the three FNWC stations were the basis for linear interpolation to obtain input values in between them. For swell generated by tropical cyclones, the tropical cyclone swell procedure was used to provide input to the refraction program.

Wave Runup

Shoreward of the 60-foot contour, wave runup was determined for each beach profile of interest by adapting to composite beaches the standard empirical runup formulas valid for uniformly sloping beaches. The results of the refraction calculations were used as input. The beach profiles selected were assumed to be locally one-dimensional in order to apply the empirical runup formulas. However, the influence of incident wave directions, refraction, and shoaling effects were also taken into consideration. Wave heights within the surf zone were also computed using empirical formulas to establish the zone where waves exceed 3 feet.

Computed elevations for wave runup, wave setup, and other inundation hazard characteristics are shown in Table 11, "Summary Elevations for Wave Runup and Wave Setup."

Table 11 - SUMMARY OF ELEVATIONS FOR WAVE RUNUP AND WAVE SETUP

	Wave Runup Elevation[1] (feet)			Wave Setup Elevation[1] (feet)		
Flooding Source and Location	10-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance	10-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Pacific Ocean						
At Will Rogers Beach, Approximately 400 feet South of the Intersection of Tramonto Drive and Porto Marina Way	14.3	19	22.1	--	--	--
At Will Rogers Beach, Approximately 300 feet South of the Intersection of Breve Way and Porta Marina Way	13.4	17.5	20.4	--	--	--
At Will Rogers Beach, at Sunset Boulevard Extended	11.3	13.9	16.5	--	--	--
At Will Rogers Beach at Temescal Canyon Road Extended	10.9	13.3	15.8	--	--	--
At Will Rogers Beach, Approximately 900 feet South of the Intersection of Beirut Avenue and Via De Las Olas	11	13.5	16	--	--	--
At Will Rogers Beach at Entrada Drive Extended	12	15.1	17.8	--	--	--
At Venice Beach at Washington Street Extended	12	15.1	17.8	--	--	--
At Marina Del Ray Entrance Channel and Ballona Creek	--	--	--	7.7	8.9	11.1
At Dockweiler Beach, at Culver Boulevard Extended	11.3	14	16.6	--	--	--
At Dockweiler Beach, at Beaumont Street Extended	11.9	14.9	17.6	--	--	--
At Dockweiler Beach, at Foutainbleau Street Extended	12.5	15.9	18.7	--	--	--
At Dockweiler Beach, at Ipswich Street Extended	13.7	18	21	--	--	--

Table 11 - SUMMARY OF ELEVATIONS FOR WAVE RUNUP AND WAVE SETUP

	Wave Runup Elevation[1] (feet)			Wave Setup Elevation[1] (feet)		
Flooding Source and Location	10-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance	10-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
At Dockweiler Beach, Approximately 900 feet Northwest of the Intersection of Imperial Highway and Vista Del Mar	13.1	17.1	19.9	--	--	--
At Dockweiler Beach, Approximately 5,000 feet Northwest of the Corporate Limits	12.8	16.1	18.9	--	--	--
At Dockweiler Beach, Approximately 4,100 feet Northwest of the Corporate Limits	12	15.2	17.9	--	--	--
Along Dockweiler Beach, Approximately 3,400 feet Northwest of the Corporate Limits	11.5	14.2	16.8	--	--	--
Along Dockweiler Beach, Approximately 2,400 feet Northwest of the Corporate Limits	10.9	13.3	15.8	--	--	--
Along Dockweiler Beach, Approximately 1,000 feet Northwest of the Corporate Limits	11.5	14.3	16.9	--	--	--
Along Dockweiler Beach, Approximately 100 feet Northwest of the Corporate Limits	12.1	15.3	18.1	--	--	--
At Corporate Limits, at Royal Palms Beach, Approximately 1,000 feet Northwest of Shad Place Extended	14.1	18.7	21.7	--	--	--
At Royal Palms Beach, at Anchovy Avenue Extended	12.9	16.7	19.5	--	--	--
At Whites Point	12.3	15.7	18.4	--	--	--
At Beach, at Weymouth Avenue Extended	13.5	17.7	20.6	--	--	--
At Point Fermin Beach, at	12.3	15.7	18.4	--	--	--

Table 11 - SUMMARY OF ELEVATIONS FOR WAVE RUNUP AND WAVE SETUP

	Wave Runup Elevation[1] (feet)			Wave Setup Elevation[1] (feet)		
Flooding Source and Location	10-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance	10-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Barbara Street Extended						
At Point Fermin Beach, at Cabrillo Avenue Extended	13.8	18.2	21.2	--	--	--
Approximately 1,000 feet North of Point Fermin along Beach	17.4	24.7	28.3	--	--	--
At Beach, at Carolina Street Extended	16.5	22.7	26.1	--	--	--
At Beach, at Pacific Avenue Extended	15.5	21	24.3	--	--	--
At Cabrillo Beach, at 40th Street Extended	14.1	18.7	21.7	--	--	--
At Los Angeles Harbor	--	--	--	7.7	8.9	11.1
Catalina Avenue Extended at Beach	7.3	7.9	8.2	--	--	--
Approximately 1,500 feet North of Catalina Avenue Extended along Beach	8.8	10	10.7	--	--	--
At Hamilton Beach	7.9	8.8	9.2	--	--	--
At Sequit Point	11.5	14.3	16.9	--	--	--
At Arroyo Sequit Mouth	10.7	13	15.5	--	--	--
Approximately 800 feet East of Arroyo Sequit Mouth along Beach	11.5	14.3	17	--	--	--
Approximately 800 feet South of the Intersection of Nicholas Beach Road and Pacific Coast Highway	12	15.2	17.8	--	--	--
Approximately 2,400 feet West of Los Alisos Canyon Creek Mouth along Beach	14.3	19	22	--	--	--
At Los Alisos Canyon Creek Mouth	12	15.1	17.8	--	--	--
Approximately 900 feet Southeast of the Intersection of Encinal Canyon Road and Pacific	12.3	15.7	18.4	--	--	--

Table 11 - SUMMARY OF ELEVATIONS FOR WAVE RUNUP AND WAVE SETUP

	Wave Runup Elevation[1] (feet)			Wave Setup Elevation[1] (feet)		
Flooding Source and Location	10-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance	10-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Coast Highway along Beach						
At Encinal Canyon Creek Mouth	12.9	16.7	19.5	--	--	--
Approximately 250 feet South of the Intersection of Seal Level Drive and Roxanne Beach Road	10.9	13.3	15.8	--	--	--
At Lechuza Point	15.5	20.8	24.3	--	--	--
At Steep Hill Canyon Creek Mouth	13.1	17	19.9	--	--	--
At Trancas Creek	10.9	13.3	15.8	--	--	--
Approximately 200 feet West of Point Dume	12.4	16	18.8	--	--	--
At Point Dume	15.5	20.8	24.3	--	--	--
At Dume Cove, Approximately 500 feet Southeast of the Intersection of Dume Drive and Cliffside Drive	13.1	16.9	19.9	--	--	--
At Dume Cove, Approximately 400 feet South of the Intersection of Fernhill Drive and Cliffside Drive	12.1	15.3	18.1	--	--	--
At Dume Cove, Approximately 750 feet South of the Intersection of Grayfox Street and Cliffside Drive	13.1	16.9	19.9	--	--	--
At Paradise Cove, at Walnut Canyon	12.4	15.8	18.6	--	--	--
At Paradise Cove, Approximately 2,000 feet Northeast of Walnut Canyon Creek Mouth along Beach	15.8	20.8	24.3	--	--	--
At Paradise Cove, at Ramirez Canyon Mouth	11.5	14.3	16.9	--	--	--
At Escondido Beach, at Escondido Canyon Mouth	10.7	12.9	15.5	--	--	--
At Escondido Beach, Approximately 200 feet East of	11.5	14.3	16.9	--	--	--

Table 11 - SUMMARY OF ELEVATIONS FOR WAVE RUNUP AND WAVE SETUP

	Wave Runup Elevation[1] (feet)			Wave Setup Elevation[1] (feet)		
Flooding Source and Location	10-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance	10-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
the Intersection of Latigo Shore Place and Latigo Shore Drive						
Approximately 500 feet West of Solstice Canyon Creek Mouth along Beach	13.9	18.3	21.3	--	--	--
At Solstice Canyon Creek Mouth	12.1	15.3	18.1	--	--	--
At Corral Beach, at Corral Canyon Creek Mouth	11.3	13.9	16.4	--	--	--
At Corral Beach, Approximately 250 feet South of the Intersection of Malibu Road and Pacific Coast Highway	13	16.9	19.6	--	--	--
Approximately 1,500 feet East of Corral Canyon Creek Mouth along Beach	13	16.9	19.6	--	--	--
At Puerco Beach, Approximately 200 feet South of the Intersection of Puerco Canyon Road and Malibu Road	11.3	13.9	16.4	--	--	--
At Puerco Beach, at Puerco Canyon Creek Mouth	13	16.9	19.6	--	--	--
At Amarillo Beach, Approximately 2,200 feet East of Marie Canyon Creek Mouth along Beach	11.3	13.9	16.4	--	--	--
At Amarillo Beach, Approximately 3,000 feet East of Marie Canyon Creek Mouth Along Beach	13	16.9	19.6	--	--	--
At Malibu Beach, Approximately 850 feet Southwest of Intersection of Malibu Road and Malibu Colony Drive	11.3	13.9	16.4	--	--	--
At Malibu Creek Mouth	10.6	12.8	15.2	7.7	8.9	11.1
At Las Flores Canyon Mouth	11.3	13.9	16.4	--	--	--
Approximately 2,500 feet East of Las Flores Canyon Mouth along Beach	11.6	14.5	17.1	--	--	--

Table 11 - SUMMARY OF ELEVATIONS FOR WAVE RUNUP AND WAVE SETUP

	Wave Runup Elevation[1] (feet)			Wave Setup Elevation[1] (feet)		
Flooding Source and Location	10-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance	10-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Approximately 1,500 feet West of Piedra Gorda Canyon Creek Mouth along Beach	11.4	14.2	16.8	--	--	--
Approximately 100 feet South of the Intersection of Budwood Motorway and Pacific Coast Highway	11.9	14.9	17.6	--	--	--
At Topanga Canyon Mouth	11.4	14.1	16.7	--	--	--
At Marina Del Ray	--	--	--	7.7	8.9	11.1

[1] Average Elevations Given; Elevations May Vary Within the Area Cited

-- Data Not Computed

Tsunamis

Tsunamis were computed using numerical models of the long wave equations describing tsunami behavior. The results were taken from the U.S. Army Corps of Engineers Study which details the method used to compute tsunami behavior.

Tropical Cyclone Swells

Waves generated by a tropical cyclone were determined using the JONSWAP spectrum with empirically derived shape and intensity parameters, which were correlated to radial position and wind speed. A cosine function centered about the local wind direction was used for the directional distribution function of the spectrum. The size of the tropical cyclone was defined by the radius at which the wind speed drops below 35 knots. Details of the node are discussed in "Methodology for Coastal Flooding in Southern California".

Flood elevations in areas studied by approximate methods were based on engineering judgment used in conjunction with topographic maps.

Levee Hazard Analysis

Some flood hazard information presented in prior FIRMs and in prior FIS reports for Los Angeles County and its incorporated communities was based on flood protection provided by levees. Based on the information available and the mapping standards of the National Flood Insurance Program at the time that the prior FISs and FIRMs were prepared, FEMA accredited the levees as providing protection from the flood that has a 1-percent-chance of being equaled or exceeded in any given year. For FEMA to continue to accredit the identified levees with providing protection from the base flood, the levees must meet the criteria of the Code of Federal Regulations, Title 44, Section 65.10 (44 CFR 65.10), titled "Mapping of Areas Protected by Levee Systems."

On August 22, 2005, FEMA issued Procedure Memorandum No. 34 - Interim Guidance for Studies Including Levees. The purpose of the memorandum was to help clarify the responsibility of community officials or other parties seeking recognition of a levee by providing information identified during a study/mapping project. Often, documentation regarding levee design, accreditation, and the impacts on flood hazard mapping is outdated or missing altogether. To remedy this, Procedure Memorandum No. 34 provides interim guidance on procedures to minimize delays in near-term studies/mapping projects, to help our mapping partners properly assess how to handle levee mapping issues.

While 44 CFR Section 65.10 documentation is being compiled, the release of more up-to-date FIRM panels for other parts of a community or county may be delayed. To minimize the impact of the levee recognition and certification process, FEMA issued Procedure Memorandum No. 43 - Guidelines for Identifying Provisionally Accredited Levees on March 16, 2007. These guidelines will allow issuance of preliminary and effective versions of FIRMs while the levee owners or communities are compiling the full documentation required to show compliance with 44 CFR Section 65.10. The guidelines also explain that preliminary FIRMs can be issued while providing the communities and levee owners with a specified timeframe to correct any maintenance deficiencies associated with a levee and to show compliance with 44 CFR Section 65.10.

FEMA contacted the communities within Los Angeles County to obtain data required under 44 CFR 65.10 to continue to show the levees as providing protection from the flood that has a 1-percent-chance of being equaled or exceeded in any given year.

FEMA understood that it may take time to acquire and/or assemble the documentation necessary to fully comply with 44 CFR 65.10. Therefore, FEMA put forth a process to provide the communities with additional time to submit all the necessary documentation. For a community to avail itself of the additional time, it had to sign an agreement with FEMA. Levees for which such agreements were signed are shown on the final effective FIRM as providing protection from the flood that has a 1-percent-chance of being equaled or exceeded in any given year and labeled as a Provisionally Accredited Levee (PAL). Communities have two years from the date of FEMA's initial coordination to submit to FEMA final accreditation data for all PALs. Following receipt of final accreditation data, FEMA will revise the FIS and FIRM as warranted.

FEMA coordinated with the U.S. Army Corps of Engineers, the local communities, and other organizations to compile a list of levees that exist within Los Angeles County. Table 12, "List of Levees Requiring Flood Hazard Revisions" lists all levees shown on the FIRM, to include PALs, for which corresponding flood hazard revisions were made.

Approximate analyses of "behind levee" flooding were conducted for all the levees in Table 12 to indicate the extent of the "behind levee" floodplains. The methodology used in these analyses is discussed below.

The approximate levee analysis was conducted using information from existing hydraulic models (where applicable) and USGS topographic maps.

The extent of the 1-percent-annual-chance flood in the event of levee failure was determined. Base flood elevations and topographic information (where available) were used to estimate an approximate 1-percent-annual-chance floodplain and traced along the contour line representing the base flood elevation. If base flood elevations were not available they were estimated from effective FIRM maps and available information. Topographic features such as highways, railroads, and high ground were used to refine approximate floodplain boundary limits.

Table 12 - LIST OF LEVEES REQUIRING FLOOD HAZARD REVISIONS

Community	Flood Source	Levee Inventory ID	Coordinates Latitude/Longitude	FIRM Panel	USACE Levee
City of Santa Clarita	South Fork Santa Clara River	2	(-118.542, 34.391)	06037C0820F	No
City of Santa Clarita	Santa Clara River	5	(-118.473, 34.415) (-118.471, 33.440)	06037C0840F	No
City of Santa Clarita [1]	South Fork Santa Clara River Placerita Creek Newhall Creek	15	(-119.230, 39.400) (-119.230, 39.410)	06037C0820F	No
City of Compton City of Long Beach	Compton Creek	20b	(-118.209, 33.847) (-118.217, 33.795)	06037C1955F	No
City of Cerritos City of Lakewood City of Hawaiian Gardens City of Long Beach	Coyote Creek	21	(-118.042, 33.895) (-118.090, 33.795)	06037C1990F	No
City of Carson City of Los Angeles	Dominguez Channel	22a	(-118.270, 33.847) (-118.253, 33.830)	06037C1935	No
City of Carson City of Los Angeles	Dominguez Channel	22b	(-118.241, 33.777) (-118.229, 33.812)	06037C1965	No

Table 12 - LIST OF LEVEES REQUIRING FLOOD HAZARD REVISIONS

Community	Flood Source	Levee Inventory ID	Coordinates Latitude/Longitude	FIRM Panel	USACE Levee
City of Bell City of Cudahy City of Southgate City of Vernon	Los Angeles River	25a	(-118.180, 33.994) (-118.174, 33.946)	06037C0100F	Yes
Los Angeles County [2]	Undetermined	28a	(-118.623, 34.794) (-118.588, 34.788)	06037C0100F	No
Los Angeles County [2]	Undetermined	28c	(-117.953, 34.523) (-117.949, 34.523)	06037C0715F	No
Los Angeles County [2]	Undetermined	28d	(-117.828, 34.480) (-117.825, 34.480)	06037C0975F	No
City of Los Angeles [1]	Undetermined	29	(-118.322, 33.982) (-118.313, 33.986)	06037C1780F	No

Table 12 - LIST OF LEVEES REQUIRING FLOOD HAZARD REVISIONS

Community	Flood Source	Levee Inventory ID	Coordinates Latitude/Longitude	FIRM Panel	USACE Levee
City of Bellflower City of Cerritos City of Downey City of Lakewood City of Long Beach City of Norwalk City of Pico Rivera	San Gabriel River	33	(-118.090, 33.795) (-118.056, 34.020)	06037C1664F 06037C1668F 06037C1829F 06037C1830F 06037C1840F 06037C1841F 06037C1980F 06037C1988F 06037C1990F 06037C2076F	No

Several levees within Los Angeles County and its incorporated communities meet the criteria of the Code of Federal Regulations, Title 44, Section 65.10 (44 CFR 65.10), titled “Mapping of Areas Protected by Levee Systems.” Table 13, “List of Certified and Accredited Levees” lists all levees shown on the FIRM that meet the requirements of 44 CFR 65.10 and have been determined to provide protection from the flood that has a 1-percent-chance of being equaled or exceeded in any given year.

Table 13 – LIST OF CERTIFIED AND ACCREDITED LEVEES

Community	Flood Source	Levee Inventory ID	Coordinates Latitude/Longitude	FIRM Panel	USACE Levee
City of Carson	Compton Creek	20b	(-118.209, 33.847) (-118.204, 33.842)	06037C1955F	No
City of Long Beach City of Southgate City of Paramount	Los Angeles River	25b	(-118.174, 33.946) (-118.205, 33.765)	06037C1668F 06037C1664F 06037C1830F 06037C1820F 06037C1840F 06037C1980F 06037C1990F 06037C1988F 06037C2076F	No
City of Bell Gardens City of Commerce City of Downey City of Montebello City of Pico Rivera City of Southgate	Rio Hondo River	31	(-118.084, 34.020) (-118.175, 33.932)	06037C1663F 06037C1664F 06037C1810F 06037C1820F 06037C1830F	No

3.3 Vertical Datum

All FIS reports and FIRMs are referenced to a specific vertical datum. The vertical datum provides a starting point against which flood, ground, and structure elevations can be referenced and compared. Until recently, the standard vertical datum in use for newly created or revised FIS reports and FIRMs was the National Geodetic Vertical Datum of 1929 (NGVD). With the finalization of the North American Vertical Datum of 1988 (NAVD), many FIS reports and FIRMs are being prepared using NAVD as the referenced vertical datum.

All flood elevations shown in this FIS report and on the FIRM are referenced to NAVD 88. Structure and ground elevations in the community must, therefore, be referenced to NAVD 88. It is important to note that adjacent communities may be referenced to NGVD. This may result in differences in Base (1-percent-annual-chance) Flood Elevations (BFEs) across the corporate limits between the communities.

Flood elevations shown in this FIS report and on the FIRM are referenced to the NAVD 88. These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. For information regarding conversion between the NGVD and NAVD, visit the National Geodetic Survey website at www.ngs.noaa.gov, or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Springs, MD 20910-3282
(301) 713-3242

Temporary vertical monuments are often established during the preparation of a flood hazard analysis for the purpose of establishing local vertical control. Although these monuments are not shown on the FIRM, they may be found in the Technical Support Data Notebook (TSDN) associated with the FIS report and FIRM for this community. Interested individuals may contact FEMA to access these data.

The conversion factor for each stream studied by detailed methods is shown below in Table 14, “Stream Conversion Factor.”

Table 14 - STREAM CONVERSION FACTOR

Stream Name	Elevation (feet NAVD above NGVD)
Amargosa Creek	+2.8
Anaverde Creek	+2.8
Avalon Canyon	+2.8
Big Rock Wash	+2.8
Cheseboro Creek	+2.9
Cold Creek	+2.9
Dark Canyon	+2.9
Dry Canyon	+2.9

Table 14 - STREAM CONVERSION FACTOR

Stream Name	Elevation (feet NAVD above NGVD)
Escondido Canyon	+2.9
Flow Along Empire Avenue	+2.8
Flowline No. 1	+2.8
Garapito Creek	+2.9
Hacienda Creek	+2.8
Kagel Canyon	+2.8
La Mirada Creek	+2.8
Lake Street Overflow	+2.8
Las Flores Canyon	+2.9
Las Virgenes Creek	+2.9
Liberty Canyon	+2.9
Lindero Canyon above confluence with Medea Creek	+2.9
Lindero Canyon above Lake Lindero	+2.9
Little Rock Wash - Profile A	+2.8
Little Rock Wash - Profile B	+2.8
Little Rock Wash - Profile C	+2.8
Lobo Canyon	+2.9
Lockheed Drain Channel	+2.8
Lopez Canyon Channel	+2.8
Los Angeles River left overbank path 2	+2.8
Los Angeles River right overbank path 1	+2.8
Los Angeles River right overbank path 2	+2.8
Malibu Creek	+2.9
Medea Creek	+2.9
Medea Creek (above Ventura Freeway)	+2.9
Mill Creek	+2.8
North Overflow	+2.8
Old Topanga Canyon	+2.9
Overflow Area of Lockheed Drain Channel	+2.8
Overflow Area of Lockheed Storm Drain	+2.8
Palo Comando Creek	+2.9
Ramirez Canyon	+2.9
Rio Hondo River left overbank path 3	+2.8
Rio Hondo River left overbank path 5	+2.8

Table 14 - STREAM CONVERSION FACTOR

Stream Name	Elevation (feet NAVD above NGVD)
Rio Hondo River left overbank path 6	+2.8
Rustic Canyon	+2.8
Santa Maria Canyon	+2.9
Stokes Canyon	+2.9
Topanga Canyon	+2.9
Trancas Creek	+2.9
Triunfo Creek	+2.9
Unnamed Canyon (Serra Retreat Area)	+2.9
Upper Los Angeles River left overbank	+2.8
Weldon Canyon	+2.9
Zuma Canyon	+2.9

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. To assist in this endeavor, each FIS provides 1-percent annual chance floodplain data, which may include a combination of the following: 10-, 2-, 1-, and 0.2-percent annual chance flood elevations; delineations of the 1- and 0.2-percent annual chance floodplains; and 1-percent annual chance floodway. This information is presented on the FIRM and in many components of the FIS, including Flood Profiles, Floodway Data tables, and Summary of Elevation tables. Users should reference the data presented in the FIS as well as additional information that may be available at the local community map repository before making flood elevation and/or floodplain boundary determinations.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1-percent annual chance flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent annual chance flood is employed to indicate additional areas of flood risk in the county. For the streams studied in detail, the 1- and 0.2-percent annual chance floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at scales of 1:480, 1:1,200, 1:4,800, 1:6,000, and 1:24,000 with contour intervals of 2, 5, 10, and 25 feet. The flood boundaries were then refined through field investigations and street-plan and profile data supplied by the county. At some locations where topographic maps did not supply adequate information, field surveys were made to allow better evaluation of flooding limits.

The 1- and 0.2-percent annual chance floodplain boundaries are shown on the FIRM. On this map, the 1-percent annual chance floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A, AE, V, and VE), and the 0.2-percent annual chance floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 1- and 0.2-percent annual chance floodplain boundaries are close together, only the 1-percent annual chance floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

For the streams studied by approximate methods, only the 1-percent annual chance floodplain boundary is shown on the FIRM.

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the NFIP, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 1-percent annual chance floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 1-percent annual chance flood can be carried without substantial increases in flood heights. Minimum federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this FIS are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this study were computed for certain stream segments on the basis of equal-conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated for selected cross sections (see Table 15, Floodway Data). In cases where the floodway and 1-percent annual chance floodplain boundaries are either close together or collinear, only the floodway boundary is shown.

Near the mouths of streams studied in detail, floodway computations are made without regard to flood elevations on the receiving water body. Therefore, "Without Floodway" elevations presented in the Floodway Data Table for certain downstream cross sections are lower than the regulatory flood elevations in that area, which must take into account the 1-percent annual chance flooding due to backwater from other sources.

Encroachment into areas subject to inundation by floodwaters having hazardous velocities aggravates the risk of flood damage, and heightens potential flood hazards by further increasing velocities. A listing of stream velocities at selected cross sections is provided in the Floodway Data table. In order to reduce the risk of property damage in areas where the stream velocities are high, the community may wish to restrict development in areas outside the floodway.

Los Angeles County

In this study, Trancas, Malibu, Garapito, Cold, Cheseboro, Palo Comado, Las Virgenes, Medea, Lindero, Triunfo, Mill, and Hacienda Creeks; Zuma, Ramirez, Escondido, Unnamed (Serra Retreat Area), Las Flores, Topanga, Santa Maria, Old Topanga, Dark, Logo, Stokes, Dry, and Liberty Canyons; and Lopez Canyon and Kagel Canyon Channels have relatively high velocity discharges which have historically eroded the main channel. This results in unpredictable meandering of floodflows and presents a severe hazard to structures located within the floodplain. In addition, flooding depths often preclude practical floodproofing of structures.

City of Agoura Hills

In Agoura Hillls, Cheseboro, Palo Comado, Medea, and Lindero Canyon channels have relatively high-velocity discharges which have historically eroded the main channel. This results in unpredictable meandering of floodflows and presents a severe hazard to structures located within the floodplain. In addition, flooding depths often preclude practical floodproofing of structures. For these reasons the 1-percent annual chance floodplain is designated as the floodway.

No floodways were computed for Medea Creek as part of the 1998 restudy due to the high degree of development in this area. However, the 1-percent annual chance floodplain is designated as the floodway along Medea Creek due to the relatively high velocity discharges.

City of Avalon

In Avalon, this concept of encroachment is not appropriate. In the densely developed area, the 1-foot rise in flood height that would result from allowing encroachment in the floodway fringe would increase the flood hazard to many existing properties. However, development of the few vacant lots between Tremont and Beacon Streets would not increase the base flood elevations because those lots were assumed to be developed for this study. In the open area upstream of Tremont Street, new development would greatly increase the flood hazard to the developed area downstream of Tremont Street, unless a channel was built that would adequately collect and convey the base flood through the city to the ocean. In the reach downstream of Beacon Street, development of the plaza area would increase the base flood and, consequently, the flood hazard to existing properties. For these reasons, it is recommended that the entire Avalon flood plain be designated as the floodway, thus prohibiting development that would cause any increase in water-surface elevation.

Cities of Bellflower, Carson, Compton, Downey, Gardena, Lakewood, Long Beach, Lynwood, Montebello, Paramount, Pico Rivera, South Gate, Whittier

In this study the Los Angeles River channel and the Rio Hondo channel carry generally high velocities. The density of development within overbank areas in these communities affected by potential overflow of the Los Angeles River or Rio Hondo will limit overbank flow to relatively low velocities, due to relatively flat gradients and large open space available within the floodplain encroachments. For these reasons, floodways were not computed for this study.

City of Burbank

A regulatory floodway was not computed because the flooded area is fully developed and the degree of flooding meets the Zones AO and AH shallow flooding criteria.

Floodways for the Lockheed Drain Channel were not determined as part of this restudy. Due to the lack of capacity of the storm-drain channel, floodway limits cannot be defined in the study area because any increase in water surface elevation will result in increased overflows and flooding in other areas.

City of Culver City

The special flood hazard areas in Culver City are areas of shallow flooding; therefore, the concept of a floodway was not applied to this community.

City of La Mirada

The floodway concept was explained to the City Planning Director, at a meeting held on September 11, 1978. The city recognizes this flood hazard area and has already adopted regulatory zoning and building restrictions on a portion of the flooded area. At the intermediate coordination meeting held on October 3, 1978, the City Planning Director indicated that the city is prepared to adopt ordinances to restrict development in the remainder of the flooded area; therefore, the floodway concept was not applied to the City of La Mirada. This has been approved by the Federal Insurance Administration.

City of Los Angeles

The regulatory floodway concept was explained to representatives of the City Engineer. It was emphasized that in natural watercourses in the city, high-velocity flows have historically eroded the main channel and resulted in unpredictable meandering of floodflows. The city recognizes the highly erosive nature of these streams and agrees with the conclusion that, in the case of Weldon, Kagel, and Rustic Canyons, the entire 1-percent annual chance flood plain should be delineated as a floodway. The results of these computations are tabulated at selected cross sections for each stream segment for which a floodway was computed.

The floodway concept was not applied to Big Tujunga, Little Tujunga, or Pacoima Washes where alluvial fan zones are designated. Also, floodways were not computed in areas where flooding is caused by ponding water.

City of Lancaster

For this study, floodways have not been determined because the special flood-hazard areas in Lancaster are areas of alluvial fan shallow flooding, or have poorly defined channels.

City of Palmdale

In areas of high velocities and potential subcritical flow conditions, encroachment analyses were performed to determine floodway boundaries and to limit both the increase in water-surface elevation and energy grade lines to maximum of 1 foot.

The floodplain and floodway boundaries, as determined by hydrologic and hydraulic analyses, have been delineated on the State of California Department of Water Resources horizontal-scale orthophoto topographic mapping at a scale of 1" = 400', with a 5-foot contour interval (State of California, Department of Water Resources, April 9, 1990).

In this restudy, the floodway for Anaverde Creek was computed on the basis of equal-conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated.

Floodplain boundaries were defined based on BFEs as determined by subcritical flow analyses. In channel reaches were subcritical flow conditions could occur, the BFEs were based on critical depth.

High-channel velocities and localized high-overbank velocities should be considered significant floodplain management factors. Channel velocities exceeded potential erosive magnitudes up to a maximum of over 13 feet per second (fps). Overbank velocities reached up to 7 fps.

City of Redondo Beach

The floodway is the channel of a stream plus any adjacent flood plain areas that must be kept free of encroachment in order that the 1-percent annual chance flood may be carried without substantial increases in flood heights. A floodway generally is not applicable in areas where the dominant source of flooding is from coastal waters; thus, no floodway was computed for this study.

City of Santa Clarita

In the Santa Clarita Valley, flood flows sometimes unpredictably meander, presenting a severe hazard to structures located within the floodplains. Therefore, no floodways were computed for this study.

City of Santa Fe Springs

The special flood hazard areas shown with constant elevations on the map are caused by ponding water; therefore, the concept of a floodway was not applicable. The flooding northeast of the intersection of Pioneer Boulevard (Flowline No. 1) is caused by flowing water. The floodway concept was explained to the City Director of Public Works (the City Engineer) at a meeting on April 25, 1978. The city recognizes this flood-hazard area and indicated that development of the property will not be permitted until the flood hazard is removed. Therefore, the floodway concept was not applied at this location.

City of Torrance

The special flood hazard areas in the city are caused by ponding and shallow flooding; therefore, the concept of a floodway was not applied to the community.

City of West Hollywood

For this study, floodways have not been determined because areas studied within the community exhibit shallow flooding.

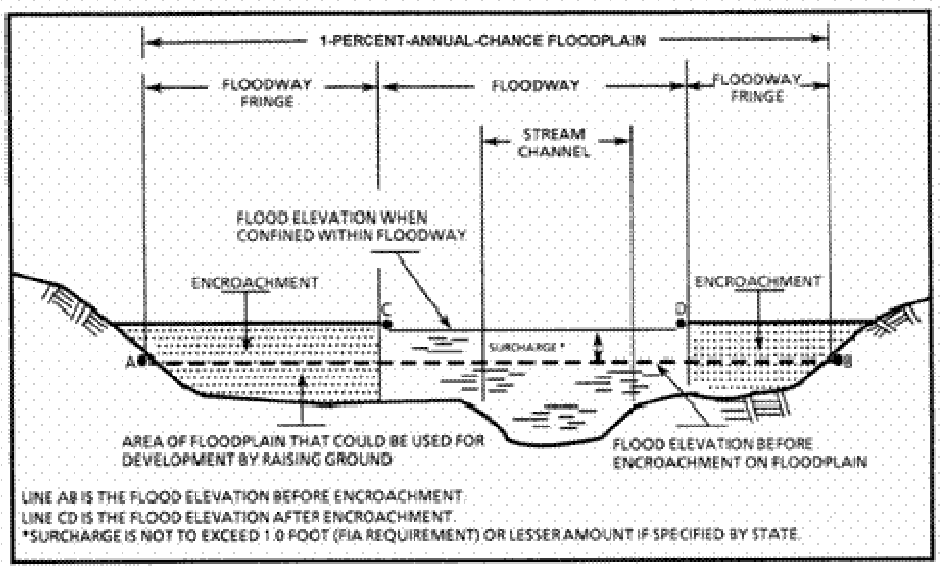

Figure 1 - FLOODWAY SCHEMATIC

The area between the floodway and 1-percent annual chance floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 1-percent annual chance flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 1.

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Anaverde Creek								
A	1,220	104	354	10.5	2,744.4	2,744.4	2,744.4	0.0
B	1,410	105	342	10.9	2,745.2	2,745.2	2,745.2	0.0
C	2,110	310	535	7.0	2,756.3	2,756.3	2,756.4	0.1
D	2,400	285	403	9.3	2,760.6	2,760.6	2,761.0	0.4
E	3,020	579[2]	596	6.3	2,768.9	2,768.9	2,768.9	0.0
F	4,090	257[2]	436	8.6	2,785.3	2,785.3	2,785.9	0.6
G	4,371	480	549	6.8	2,800.2	2,800.2	2,800.7	0.5
H	4,476	480	3,261	1.1	2,801.2	2,801.2	2,801.9	0.7
I	5,251	140	391	9.5	2,803.2	2,803.2	2,803.2	0.0
J	8,501	57[3]	292	12.4	2,859.5	2,859.5	2,859.5	0.0
K	8,871	53[3]	329	11.0	2,869.2	2,869.2	2,869.2	0.0
L	9,261	80[3]	372	9.8	2,875.4	2,875.4	2,875.4	0.0
M	9,711	105[3]	488	7.4	2,879.8	2,879.8	2,880.3	0.5
N	10,191	127[3]	342	9.4	2,886.7	2,886.7	2,886.7	0.0
O	12,251	139[3]	549	5.8	2,905.7	2,905.7	2,905.7	0.0
P	12,581	139[3]	432	7.4	2,907.6	2,907.6	2,907.6	0.0
Q	13,291	220	1,008	3.2	2,914.0	2,914.0	2,914.1	0.1
R	13,561	220	1,401	2.3	2,914.4	2,914.4	2,914.6	0.2
S	13,941	250	997	3.2	2,914.6	2,914.6	2,914.9	0.3
T	14,381	139	333	7.3	2,916.2	2,916.2	2,916.6	0.4
U	18,091	115	812	3.0	2,928.4	2,928.4	2,928.5	0.1
V	18,341	31	300	8.1	2,928.6	2,928.6	2,928.7	0.1
W	18,611	31	272	9.0	2,931.8	2,931.8	2,931.8	0.0

[1] Feet above Division Street
[2] Area of stilling basin -- no floodway determined between sections
[3] Lies entirely outside corporate limits of City of Palmdale

TABLE 15

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CALIFORNIA
AND INCORPORATED AREAS

FLOODWAY DATA

ANAVERDE CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Kagel Canyon								
A	650[2]	100	149	7.23	1,150.8	1,150.8	1,150.8	0.0
Rustic Canyon								
A	4,164[3]	60	216	9.63	192.8	192.8	192.8	0.0
B	4,780[3]	120	243	8.29	204.8	204.8	204.8	0.0
C	5,400[3]	150	149	7.23	219.8	219.8	219.8	0.0
D	6,130[3]	65	230	7.97	235.6	235.6	235.6	0.0
E	7,350[3]	29	180	9.81	259.2	259.2	259.2	0.0
F	8220[3]	49	141	12.01	281.6	281.6	281.6	0.0
Weldon Canyon								
A	1,290[1]	70	210	5.40	1,377.9	1,377.9	1,377.9	0.0

[1] Feet Upstream of Golden State Freeway Bridge
[2] Feet Upstream from Northwest Edge of Osbourne Street
[3] Feet Upstream of Latimer Road

TABLE 15

FEDERAL EMERGENCY MANAGEMENT AGENCY
LOS ANGELES COUNTY, CALIFORNIA
AND INCORPORATED AREAS

FLOODWAY DATA

KAGEL CANYON - RUSTIC CANYON - WELDON CANYON

5.0 INSURANCE APPLICATIONS

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. These zones are as follows:

Flood Insurance Zones

Zone A
Zone A is the flood insurance rate zone that corresponds to the 1-percent annual chance floodplains that are determined in the FIS by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base flood elevations or depths are shown within this zone.

Zone AE
Zone AE is the flood insurance rate zone that corresponds to the 1-percent annual chance floodplains that are determined in the FIS by detailed methods. In most instances, whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AH
Zone AH is the flood insurance rate zone that corresponds to the areas of 1-percent annual chance shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AO
Zone AO is the flood insurance rate zone that corresponds to the areas of 1-percent annual chance shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot depths derived from the detailed hydraulic analyses are shown within this zone.

Zone V
Zone V is the flood insurance risk zone that corresponds to the 1-percent-annual-chance coastal floodplains that have additional hazards associated with storm waves. Because approximate hydraulic analyses are performed for such areas, no Base Flood Elevations are shown within this zone.

Zone VE
Zone VE is the flood insurance rate zone that corresponds to the 1-percent annual chance coastal floodplains that have additional hazards associated with storm waves. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X
Zone X is the flood insurance rate zone that corresponds to areas outside the 0.2-percent annual chance floodplain, areas within the 0.2-percent annual chance floodplain, areas of 1-percent annual chance flooding where average depths are less than 1 foot, areas of 1-percent annual chance flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 1-percent annual chance flood by levees. No BFEs or base flood depths are shown within this zone.

Zone D
Zone D is the flood insurance risk zone that corresponds to unstudied area where flood hazards are undetermined, but possible.

Mud flow mapping was also incorporated into the DFIRM as Zone D.

6.0 FLOOD INSURANCE RATE MAP

The FIRM is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 1-percent annual chance floodplains that were studied by detailed methods, shows selected whole-foot BFEs or average depths. Insurance agents use the zones and BFEs in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols the 1- and 0.2-percent-annual-chance floodplains, floodways, and the locations of selected cross sections used in the hydraulic analyses and floodway computations.

The countywide FIRM presents flooding information for the entire geographic area of Los Angeles County. Previously, FIRMs were prepared for each incorporated community and the unincorporated areas of the county identified as floodprone. The countywide FIRM also includes flood hazard information that was presented separately on Flood Boundary and Floodway Maps, where applicable. Historical data relating to the maps prepared for each community are presented in Table 16, "Community Map History."

7.0 OTHER STUDIES

Los Angeles County

A Flood Hazard Boundary Map for Los Angeles County was published in 1978. In most cases, Special Flood Hazard Areas shown on the Flood Hazard Boundary Map are either located in flood control facilities, are included as Special Flood Hazard Areas on the maps, or were eliminated as a result of this study. Differences in flooding limits can be attributed to the more detailed methods of analysis used in this study. In some instances, Special Flood Hazard Areas shown on the Flood Hazard Boundary Map were found to be adequate to portray approximate flooding limits. In the Malibu area, approximate boundaries have been extended in a few cases. This study supersedes the Flood Hazard Boundary Map for Los Angeles County.

Drainage deficiencies and historical flooding information, on file at the Los Angeles County Flood Control District, were reviewed in the course of the study.

The Flood Insurance Study for Ventura County, California, is in agreement with this study.

This study is in general agreement with the Flood Insurance Studies for San Bernardino County, California, and Orange County, California, with the exception of small approximate areas. These areas were determined to be areas of low development potential and, therefore, were considered insignificant.

City of Agoura Hills

This study was prepared from data used in the preparation of the Flood Insurance Study for Los Angeles County, California, published in December 1980 (Federal Emergency Management Agency, 1980). Currently, areas of Los Angeles County are being revised by FEMA and this study is in agreement with those revisions.

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISION DATE(S)	FLOOD INSURANCE RATE MAP EFFECTIVE DATE	FLOOD INSURANCE RATE MAP REVISION DATE(S)
Agoura Hills, City of	March 4, 1986	None	March 4, 1986	December 18, 1986 August 3, 1998
Alhambra, City of*	June 28, 1974	None	None	None
Arcadia, City of	May 14, 1976	None	September 26, 2008	None
Artesia, City of*	June 28, 1974	None	None	None
Avalon, City of	October 8, 1976	None	September 29, 1978	November 1, 1985
Azusa, City of	June 14, 1974	None	September 26, 2008	None
Baldwin Park, City of*	June 28, 1974	None	May 26, 1978	None
Bell Gardens, City of	September 26, 2008	None	September 26, 2008	None
Bell, City of*	June 28, 1974	None	None	None
Bellflower, City of	June 28, 1974	None	July 6, 1998	None
Beverly Hills, City of*	December 11, 1979	None	None	None
Bradbury, City of	November 21, 1975	None	September 26, 2008	None
Burbank, City of	June 26, 1971	September 26, 1975	January 23, 1981	January 20, 1999

TABLE 16

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA
AND INCORPORATED AREAS

COMMUNITY MAP HISTORY

*Non-floodprone community

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISION DATE(S)	FLOOD INSURANCE RATE MAP EFFECTIVE DATE	FLOOD INSURANCE RATE MAP REVISION DATE(S)
Calabasas, City of	September 26, 2008	None	September 26, 2008	None
Carson, City of	January 14, 1977	None	July 6, 1998	None
Cerritos, City of	June 28, 1974	None	September 26, 2008	None
Claremont, City of	May 24, 1974	None	November 20, 2000	July 2, 2004
Commerce, City of	June 28, 1974	None	September 26, 2008	None
Compton, City of	June 28, 1974	None	July 6, 1998	None
Covina, City of	September 18, 1971	None	September 26, 2008	None
Cudahy, City of	September 26, 2008	None	September 26, 2008	None
Culver City, City of	June 28, 1974	October 31, 1975 September 3, 1976	February 1, 1980	None
Diamond Bar, City of	October 24, 1978 (Los Angeles County)	None	December 2, 1980 (Los Angeles County)	None
Downey, City of	July 6, 1998	None	July 6, 1998	None
Duarte, City of	September 26, 2008	None	September 26, 2008	None
El Monte, City of*	None	None	None	None

TABLE 16

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA
AND INCORPORATED AREAS

COMMUNITY MAP HISTORY

*Non-floodprone community

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISION DATE(S)	FLOOD INSURANCE RATE MAP EFFECTIVE DATE	FLOOD INSURANCE RATE MAP REVISION DATE(S)
El Segundo, City of	October 31, 1975	None	September 26, 2008	None
Gardena, City of	December 5, 1975	None	July 6, 1998	None
Glendale, City of	March 10, 1972	None	September 26, 2008	None
Glendora, City of	April 20, 1972	None	September 26, 2008	None
Hawaiian Gardens, City of	September 25, 1970	None	None	None
Hawthorne, City of*	May 9, 1978	None	None	None
Hermosa Beach, City of	June 28, 1974	None	September 26, 2008	None
Hidden Hills, City of	April 23, 1976	None	September 7, 1984	November 21, 2001 January 19, 2006
Huntington Park, City of*	June 28, 1974	None	None	None
Industry, City of	June 16, 1972	None	September 26, 2008	None
Inglewood, City of*	October 17, 1972	None	None	None
Irwindale, City of*	June 28, 1974	None	None	None
La Canada Flintridge, City of	June 20, 1974	None	September 26, 2008	None

TABLE 16

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA
AND INCORPORATED AREAS

COMMUNITY MAP HISTORY

*Non-floodprone community

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISION DATE(S)	FLOOD INSURANCE RATE MAP EFFECTIVE DATE	FLOOD INSURANCE RATE MAP REVISION DATE(S)
La Habra Heights, City of	September 26, 2008	None	September 26, 2008	None
La Mirada, City of	June 28, 1974	October 10, 1975 December 10, 1976	July 2, 1980	None
La Puente, City of*	October 3, 1975	None	None	None
La Verne, City of	June 14, 1974	None	September 26, 2008	None
Lakewood, City of	July 6, 1998	None	July 6, 1998	None
Lancaster, City of	September 11, 1979	None	January 6, 1982	None
Lawndale, City of*	June 28, 1974	None	None	None
Lomita, City of*	June 28, 1974	None	None	None
Long Beach, City of	July 26, 1974	July 11, 1978	September 15, 1983	July 6, 1998
Los Angeles, City of	December 13, 1977	April 8, 1980	December 2, 1980	February 4, 1987 July 6, 1998
Lynwood, City of	June 28, 1974	November 21, 1975	April 15, 1980	July 6, 1998
Malibu, City of	September 26, 2008	None	September 26, 2008	None
Manhattan Beach, City of	August 6, 1976	None	September 26, 2008	None

TABLE 16

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA
AND INCORPORATED AREAS

COMMUNITY MAP HISTORY

*Non-floodprone community

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISION DATE(S)	FLOOD INSURANCE RATE MAP EFFECTIVE DATE	FLOOD INSURANCE RATE MAP REVISION DATE(S)
Maywood, City of*	None	None	None	None
Monrovia, City of	April 23, 1976	None	September 26, 2008	None
Montebello, City of	June 28, 1974	December 19, 1975	March 18, 1980	None
Monterey Park, City of*	April 20, 1972	None	None	None
Norwalk, City of	September 26, 2008	None	September 26, 2008	None
Palmdale, City of	October 18, 1974	December 24, 1976	January 6, 1982	June 18, 1987 March 30, 1998
Palos Verdes Estates, City of	May 17, 1974	None	September 7, 1984	November 21, 2001 July 2, 2004
Paramount, City of	March 31, 1972	July 1, 1974 May 2, 1975	July 6, 1998	None
Pasadena, City of	May 2, 1972	None	September 26, 2008	None
Pico Rivera, City of	June 28, 1974	None	July 6, 1998	None
Pomona, City of	June 28, 1974	None	September 26, 2008	None
Rancho Palos Verdes, City of	January 28, 1977	None	September 26, 2008	None

TABLE 16

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA
AND INCORPORATED AREAS

COMMUNITY MAP HISTORY

*Non-floodprone community

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISION DATE(S)	FLOOD INSURANCE RATE MAP EFFECTIVE DATE	FLOOD INSURANCE RATE MAP REVISION DATE(S)
Redondo Beach, City of	June 28, 1974	May 21, 1976	September 15, 1983	None
Rolling Hills Estates, City of*	June 28, 1974	None	None	None
Rolling Hills, City of	June 28, 1974	None	September 26, 2008	None
Rosemead, City of	June 28, 1974	None	September 26, 2008	None
San Dimas, City of	June 28, 1974	None	April 1, 1977	June 2, 1978
San Fernando, City of*	None	None	None	None
San Gabriel, City of*	None	None	None	None
San Marino, City of*	None	None	None	None
Santa Clarita, City of	October 24, 1978	None	December 2, 1980	September 29, 1989
Santa Fe Springs, City of	June 28, 1974	October 3, 1975	April 15, 1980	None
Santa Monica, City of	July 26, 1974	None	September 26, 2008	None
Sierra Madre, City of	May 25, 1973	None	September 26, 2008	None

TABLE 16

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA
AND INCORPORATED AREAS

COMMUNITY MAP HISTORY

*Non-floodprone community

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISION DATE(S)	FLOOD INSURANCE RATE MAP EFFECTIVE DATE	FLOOD INSURANCE RATE MAP REVISION DATE(S)
Signal Hill, City of*	June 28, 1974	None	None	None
South El Monte, City of*	June 21, 1974	None	None	None
South Gate, City of	July 6, 1998	None	July 6, 1998	None
South Pasadena, City of*	April 18, 1974	None	None	None
Temple City , City of	September 26, 2008	None	September 26, 2008	None
Torrance, City of	August 2, 1974	December 5, 1975	December 18, 1979	None
Vernon, City of*	None	None	None	None
Walnut, City of	July 16, 1976	None	September 26, 2008	None
West Covina, City of	December 2, 2004	None	December 2, 2004	None
West Hollywood, City of	June 18, 1987	None	June 18, 1987	None
Westlake Village, City of	September 26, 2008	None	September 26, 2008	None
Whittier, City of	June 28, 1974	December 12, 1975	January 16, 1981	None
Los Angeles County (Unincorporated Areas)	October 24, 1978	None	December 2, 1980	November 15, 1985 July 6, 1998 March 30, 1998

TABLE 16

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA
AND INCORPORATED AREAS

COMMUNITY MAP HISTORY

City of Avalon

A Flood Hazard Boundary Map for the City of Avalon was published in 1976. This study supersedes the Flood Hazard Boundary Map.

This study supersedes the 1978 Flood Insurance Study for Avalon.

In 1973, a U.S. Geological Survey Map of Flood-Prone Areas for Santa Catalina Island East was compiled. The flooding shown on that map is approximate and is superseded by this study.

This study is authoritative for the purposes of the NFIP; data presented herein either supersede or are compatible with all previous determinations.

Cities of Bellflower, Carson, Compton, Downey, Gardena, Lakewood, Long Beach, Lynwood, Paramount, Pico Rivera, South Gate

The USACE developed overflow maps for this study area during their Los Angeles County Drainage Area study. Their maps indicate a large floodplain associated with the Los Angeles River and Rio Hondo of that time period. Both flood control channels have been significantly upgraded since the time of study, and the floodplain maps contained herein supersede that study.

City of Burbank

The Los Angeles District of the U.S. Army Corps of Engineers prepared a Flood Insurance Study for Burbank. Due to the use of completely different criteria, discharges arrived at in this Flood Insurance Study for flooding of the 1-percent annual chance flood event are significantly greater than those in the U.S. Army Corps of Engineers study. In addition, Flood Insurance Studies for the unincorporated areas of Los Angeles County and the incorporated City of Los Angeles have been completed. These studies will be in complete agreement with this Flood Insurance Study. A Flood Hazard Boundary Map for the City of Burbank was published by the Federal Insurance Administration on September 26, 1975. Flooding shown on this map conforms to flooding delineated in this study. Minor differences can be attributed to the more detailed methods of analysis used in this study.

City of Culver City

A Flood Hazard Boundary Map for Culver City was published by the Federal Insurance Administration on September 3, 1976. Flooding shown on the Flood Hazard Boundary Map conforms to flooding delineated in this study. Minor differences can be attributed to the more detailed methods of analysis used in this study.

The U.S. Army Corps of Engineers, Los Angeles District, has undertaken an analysis of the Ballona Creek Channel watershed. Their file data includes (1) discharge-frequency curves for the stream gage at Sawtelle Boulevard; (2) channel and bridge capacities; and (3) the magnitude of the 1-percent annual chance frequency flood for various locations along Ballona Creek Channel. The discharge-frequency curves for Ballona Creek Channel were used to evaluate Ballona Creek Channel. The Los Angeles County Flood Control District's findings concur with the U.S. Army Corps of Engineers' results that Ballona Creek Channel has adequate capacity to convey the 1-percent annual chance frequency discharge.

City of La Mirada

A Flood Hazard Boundary Map for the City of La Mirada was published by the Federal Insurance Administration on December 10, 1976. Flooding shown on the Flood Hazard Boundary Map conforms to flooding delineated in this study. Minor differences between the flooding shown on the previous map and the results of this study can be attributed to the more detailed methods of analysis used for this study.

Flood Insurance Studies were prepared for the contiguous Cities of Buena Park, Fullerton, La Habra, and Santa Fe Springs as well as for the unincorporated areas of Orange County, California. These studies are in general agreement with this study.

Drainage deficiencies and historical flooding information are on file at the Los Angeles County Flood Control District, and were reviewed in the course of the study.

Cities of Lancaster and Palmdale

A Flood Hazard Boundary Map for Palmdale was published by the Federal Insurance Administration on' December 24, 1976. Flooding shown on the Flood Hazard Boundary Map conforms to flooding delineated in this study. Differences can be attributed to the more detailed topographic data and extensive field reviews used in this study. Therefore, the Flood Hazard Boundary Map for Lancaster and Palmdale is superseded by this Flood Insurance Study.

The U.S. Army Corps of Engineers, Los Angeles District, has investigated the Antelope Valley watersheds. Their report includes discharge-frequency curves for the stream gages on Little Rock and Big Rock Washes and the magnitude of the 1-percent annual chance frequency flood for various locations throughout Antelope Valley. The discharge-frequency curves for Antelope Valley were used to evaluate the flood hazards in Palmdale. The report is in general agreement with this Flood Insurance Study.

City of Los Angeles

A Flood Hazard Boundary Map for the City of Los Angeles was published on December 13, 1977. The Special Flood Hazard Areas shown on the Flood Hazard Boundary Map are located in flood-control facilities, are included as Special Flood Hazard Areas, or were eliminated as a result of this study. Minor differences in flooding limits can be attributed to the more detailed methods of analysis used in this study. Therefore, this study supersedes the Flood Hazard Boundary Map. This study also supersedes two unpublished reports by the U.S. Army Corps of Engineers dated May 1971 and June 1971.

The USACE developed overflow maps for this study area during their Los Angeles County Drainage Area study. Their maps indicate a large floodplain associated with the Los Angeles River and Rio Hondo of that time period. Both flood control channels have been significantly upgraded since the time of study, and the floodplain maps contained herein supersede that study.

City of Montebello

A Flood Hazard Boundary Map for the City of Montebello was published by the FIA on December 19, 1975. Flooding shown on the Flood Hazard Boundary Map conforms to flooding delineated in the original study. Minor differences between the flooding shown on the Flood Hazard Boundary Map and the results of the original study can be attributed to the more detailed methods used in the original study.

The USACE developed overflow maps for this study area during their Los Angeles County Drainage Area study. Their maps indicate a large floodplain associated with the Los Angeles River and Rio Hondo of that time period. Both flood control channels have been significantly upgraded since the time of study, and the floodplain maps contained herein supersede that study.

City of Redondo Beach

This study supersedes the existing Flood Hazard Boundary Map for the City of Redondo Beach, California.

City of Santa Fe Springs

A Flood Hazard Boundary Map for the City of Santa Fe Springs was published by the Federal Insurance Administration on June 28, 1974. The special flood hazard areas shown on that map are either located in the flood control facilities or are identified on the map. Minor differences in flooding limits can be attributed to the more detailed methods of analysis used in this study.

The Los Angeles County Flood Control District has, on file, information relating to drainage deficiencies and historical flooding in Santa Fe Springs. This information was used in preparation of the present study and is, therefore, in agreement.

The Flood Insurance Studies for all communities bordering Santa Fe Springs were reviewed to ensure that this study is consistent with all other applicable studies.

City of Torrance

A Flood hazard Boundary Map for the City of Torrance was published by the Federal Insurance Administration on December 5, 1975. Flooding shown on the Flood Hazard Boundary Map conforms to flooding delineated in this study. Minor differences can be attributed to the more detailed methods used in the current analysis.

Drainage deficiencies and historical flooding information on file at the Los Angeles County Flood Control District were reviewed during the course of the study.

City of West Hollywood

Since this Flood Insurance Study was prepared directly from the technical data presented in the Los Angeles County Flood Insurance Study and the Flood Insurance Study for the City of Los Angeles, all flood boundaries match.

City of Whittier

The Federal Insurance Administration has previously, published a Flood Hazard Boundary Map for Whittier. However, the present study represents a more detailed analysis.

Flood Insurance Studies have been published for the adjacent Cities of La Habra and Santa Fe Springs. In southwest Whittier, at the corporate limits of Santa Fe Springs, 1-percent annual chance shallow flooding does not exceed the crown, or centerline, of Mulberry Drive. The results of this study are in agreement with the Flood Insurance Studies prepared for these communities.

Toups Corporation supplied hydrologic data and 1-percent annual chance flood boundaries for La Mirada Creek. This information was used in the analysis of La Mirada Creek as it passes through Whittier. The study contractor's findings of flooding of La Mirada Creek are in agreement with information furnished by Toups Corporation.

Information pertaining to revised and unrevised flood hazards for each jurisdiction within Los Angeles County has been compiled into this FIS. Therefore, this FIS supersedes all previously printed FIS Reports, FHBMs, FBFMs, and FIRMs for all of the incorporated and unincorporated jurisdictions within Los Angeles County.

8.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting FEMA, Region IX, Federal Insurance and Mitigation Administration, 1111 Broadway, Suite 1200, Oakland, California 94607-4052.

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FLOOD INSURANCE STUDY

LOS ANGELES COUNTY, CALIFORNIA

AND INCORPORATED AREAS

VOLUME 3 OF 4

Community Name	Community Number	Community Name	Community Number	Community Number	Community Name	Community Number	Community Number
LOS ANGELES COUNTY, UNINCORPORATED AREAS	065043	DIAMOND BAR, CITY OF	060741	LAWNDALE, CITY OF*	060134	SAN DIMAS, CITY OF	060154
AGOURA HILLS, CITY OF	065072	DOWNEY, CITY OF	060645	LOMITA, CITY OF*	060135	SAN FERNANDO, CITY OF*	060628
ALHAMBRA, CITY OF*	060095	DUARTE, CITY OF	065026	LONG BEACH, CITY OF	060136	SAN GABRIEL, CITY OF*	065055
ARCADIA, CITY OF	065014	EL MONTE, CITY OF*	060658	LOS ANGELES, CITY OF	060137	SAN MARINO, CITY OF*	065057
ARTESIA, CITY OF*	060097	EL SEGUNDO, CITY OF	060118	LYNWOOD, CITY OF	060635	SANTA CLARITA, CITY OF	060729
AVALON, CITY OF	060098	GARDENA, CITY OF	060119	MALIBU, CITY OF	060745	SANTA FE SPRINGS, CITY OF	060158
AZUSA, CITY OF	065015	GLENDALE, CITY OF	065030	MANHATTAN BEACH, CITY OF	060138	SANTA MONICA, CITY OF	060159
BALDWIN PARK, CITY OF*	060100	GLENDORA, CITY OF	065031	MAYWOOD, CITY OF*	060651	SIERRA MADRE, CITY OF	065059
BELL GARDENS, CITY OF	060656	HAWAIIAN GARDENS, CITY OF*	065032	MONROVIA, CITY OF	065046	SIGNAL HILL, CITY OF*	060161
BELL, CITY OF*	060101	HAWTHORNE, CITY OF*	060123	MONTEBELLO, CITY OF	060141	SOUTH EL MONTE, CITY OF*	060162
BELLFLOWER, CITY OF	060102	HERMOSA BEACH, CITY OF	060124	MONTEREY PARK, CITY OF*	065047	SOUTH GATE, CITY OF	060163
BEVERLY HILLS, CITY OF*	060655	HIDDEN HILLS, CITY OF	060125	NORWALK, CITY OF	060652	SOUTH PASADENA, CITY OF*	065061
BRADBURY, CITY OF	065017	HUNTINGTON PARK, CITY OF*	060126	PALMDALE, CITY OF	060144	TEMPLE CITY, CITY OF	060653
BURBANK, CITY OF	065018	INDUSTRY, CITY OF	065035	PALOS VERDES ESTATES, CITY OF	060145	TORRANCE, CITY OF	060165
CALABASAS, CITY OF	060749	INGLEWOOD, CITY OF*	065036	PARAMOUNT, CITY OF	065049	VERNON, CITY OF*	060166
CARSON, CITY OF	060107	IRWINDALE, CITY OF*	060129	PASADENA, CITY OF	065050	WALNUT, CITY OF	065069
CERRITOS, CITY OF	060108	LA CANADA FLINTRIDGE, CITY OF	060669	PICO RIVERA, CITY OF	060148	WEST COVINA, CITY OF	060666
CLAREMONT, CITY OF	060109	LA HABRA HEIGHTS, CITY OF	060701	POMONA, CITY OF	060149	WEST HOLLYWOOD, CITY OF	060720
COMMERCE, CITY OF	060110	LA MIRADA, CITY OF	060131	RANCHO PALOS VERDES, CITY OF	060464	WESTLAKE VILLAGE, CITY OF	060744
COMPTON, CITY OF	060111	LA PUENTE, CITY OF*	065039	REDONDO BEACH, CITY OF	060150	WHITTIER, CITY OF	060169
COVINA, CITY OF	065024	LA VERNE, CITY OF	060133	ROLLING HILLS ESTATES, CITY OF*	065054		
CUDAHY, CITY OF	060657	LAKEWOOD, CITY OF	060130	ROLLING HILLS, CITY OF	060151		
CULVER CITY, CITY OF	060114	LANCASTER, CITY OF	060672	ROSEMEAD, CITY OF	060153		

*Non-floodprone communities

September 26, 2008

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
06037CV003A

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study (FIS) may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

Selected Flood Insurance Rate Map (FIRM) panels for the community contain information that was previously shown separately on the corresponding Flood Boundary and Floodway Map (FBFM) panels (e.g. floodways, cross sections). In addition, former flood hazard zone designations have been changed as follows:

Old Zone	New Zone
A1 through A30	AE
V1 through V30	VE
B	X (Shaded)
C	X (Unshaded)

Part or all of this FIS may be revised and republished at any time. In addition, part of this FIS may be revised by the Letter of Map Revision process, which does not involve republication or redistribution of the FIS. It is, therefore, the responsibility of the user to consult with community officials and to check the community repository to obtain the most current FIS components.

Initial Countywide FIS Effective Date: September 26, 2008

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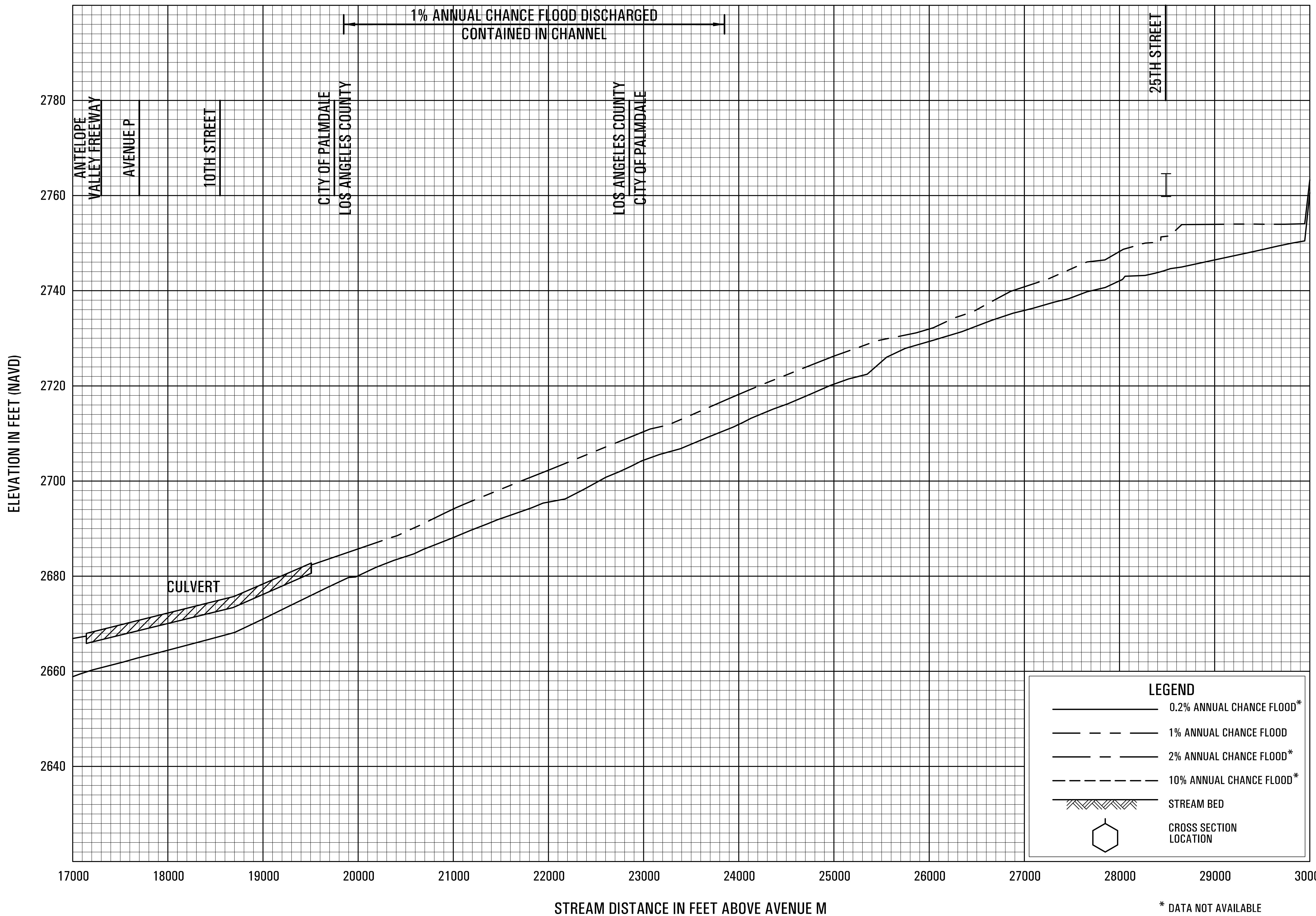


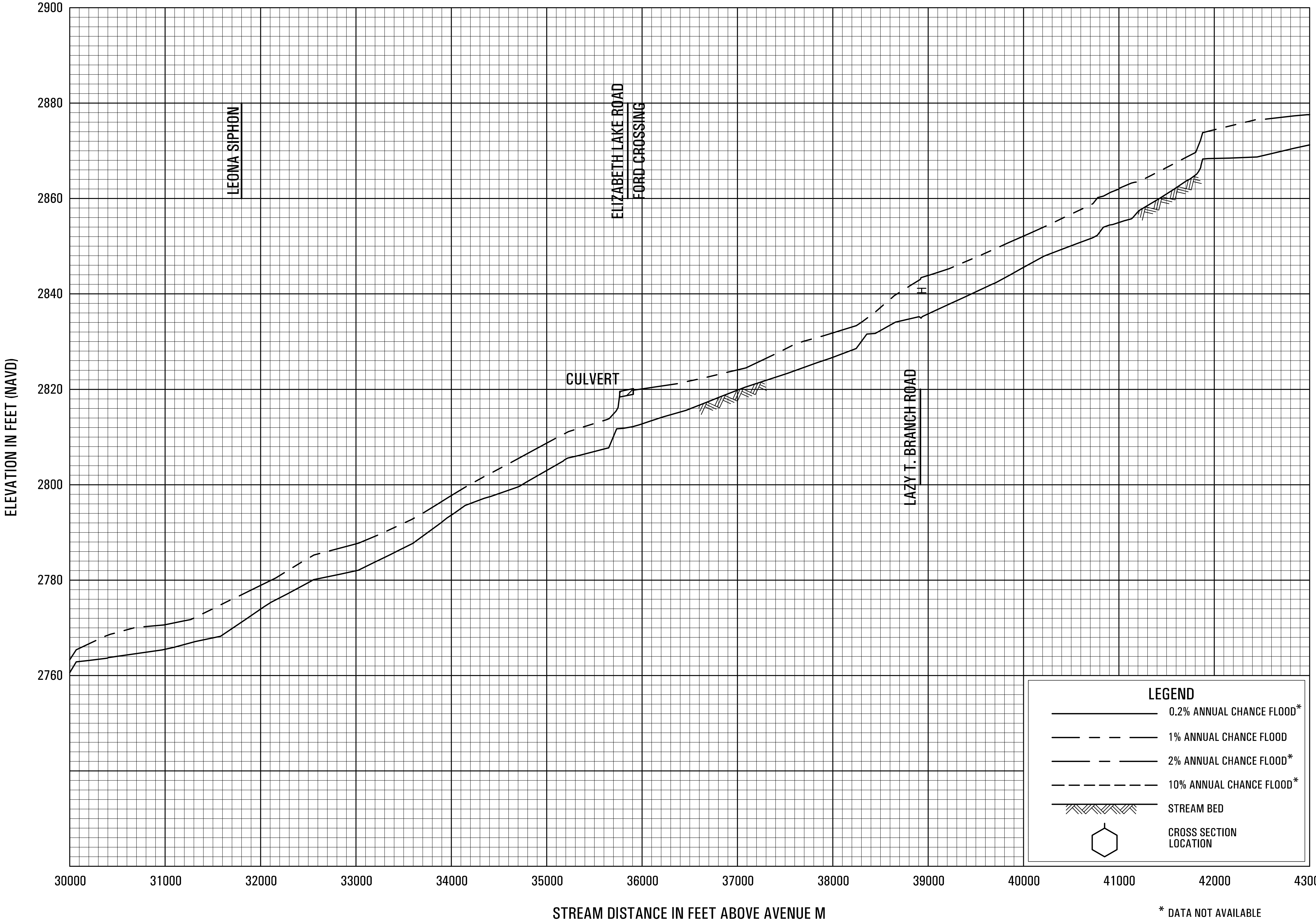
FLOOD PROFILES

AMARGOSA CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



FLOOD PROFILES

AMARGOSA CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS

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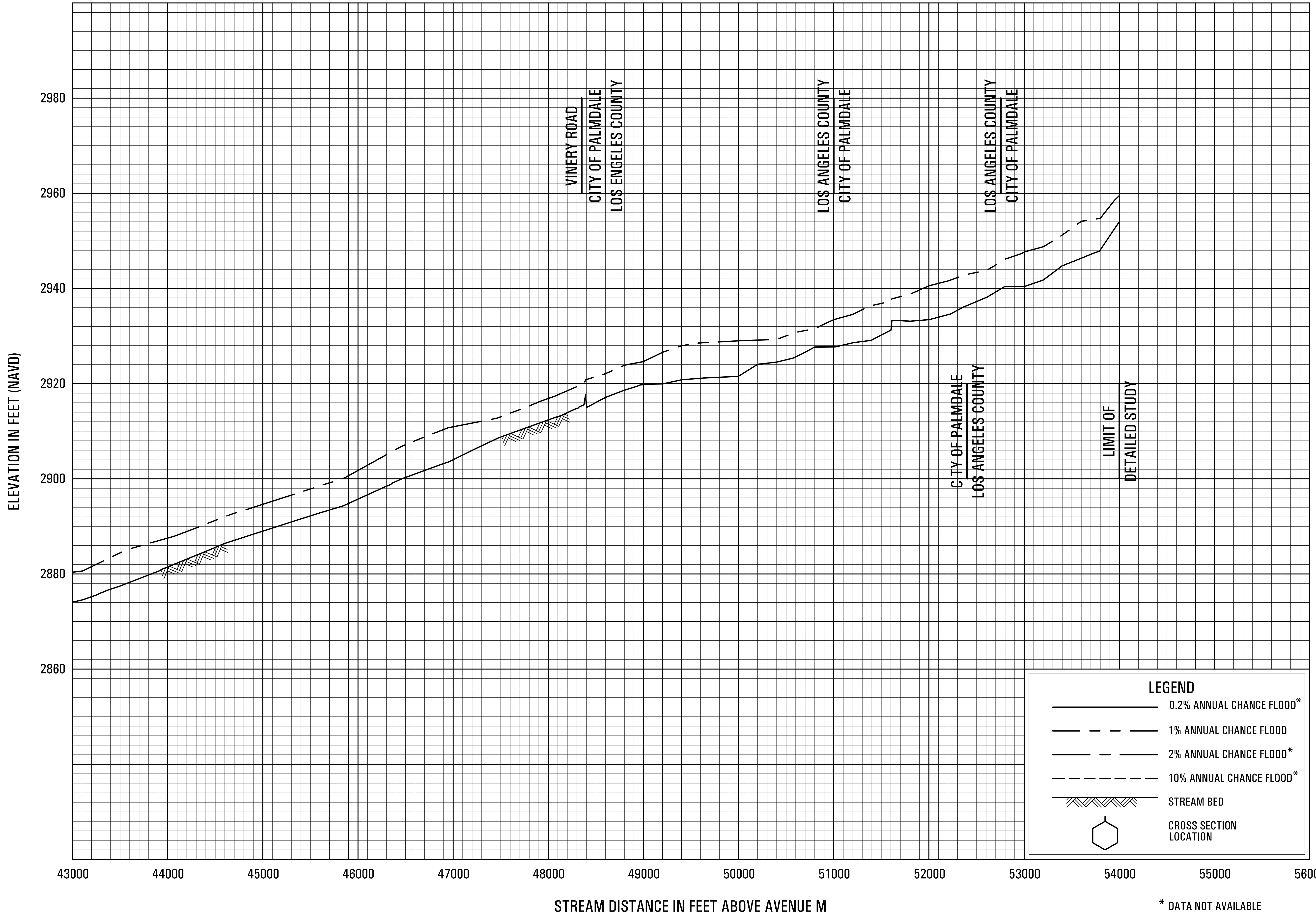


FLOOD PROFILES

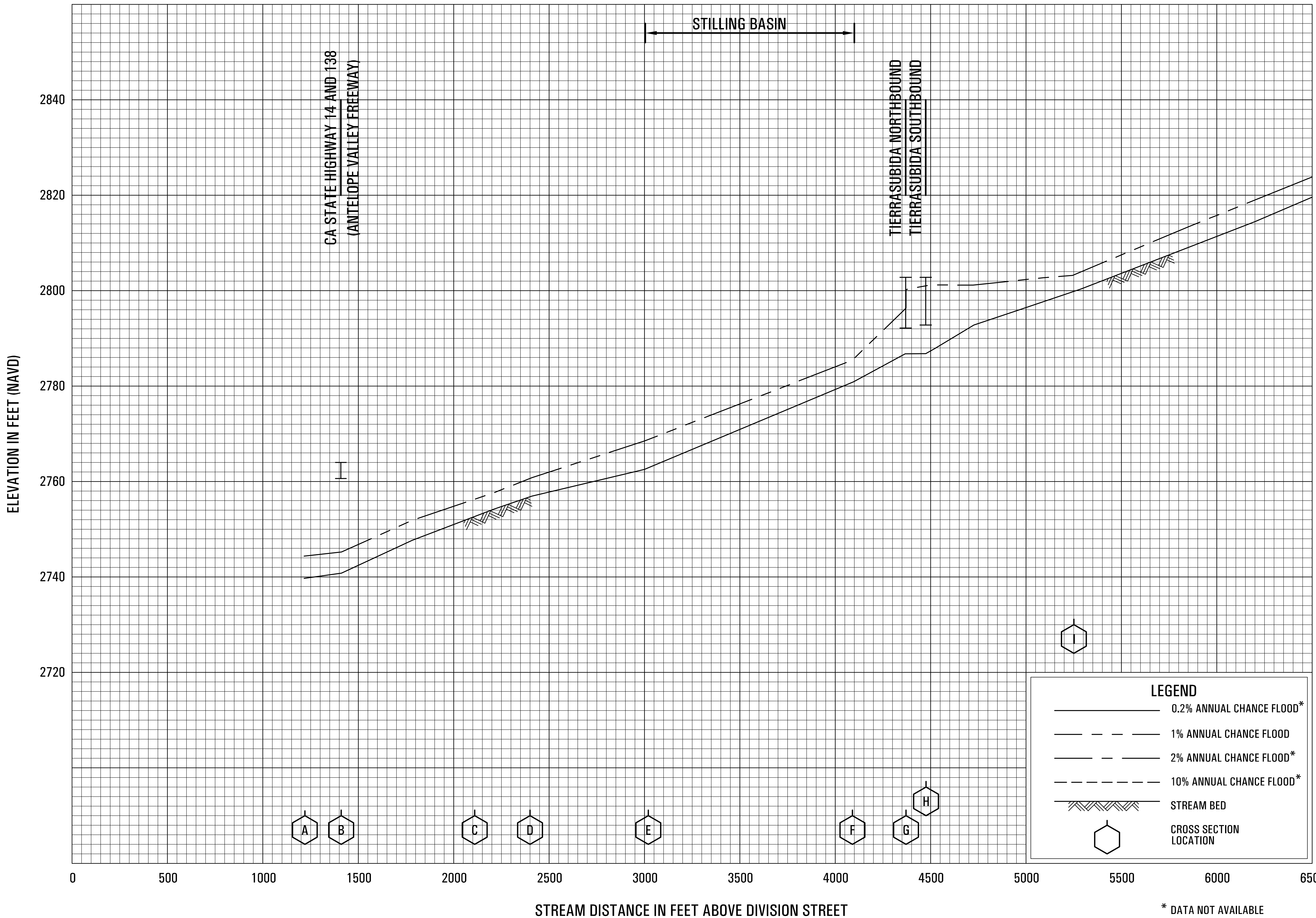
AMARGOSA CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS

03P



FLOOD PROFILES

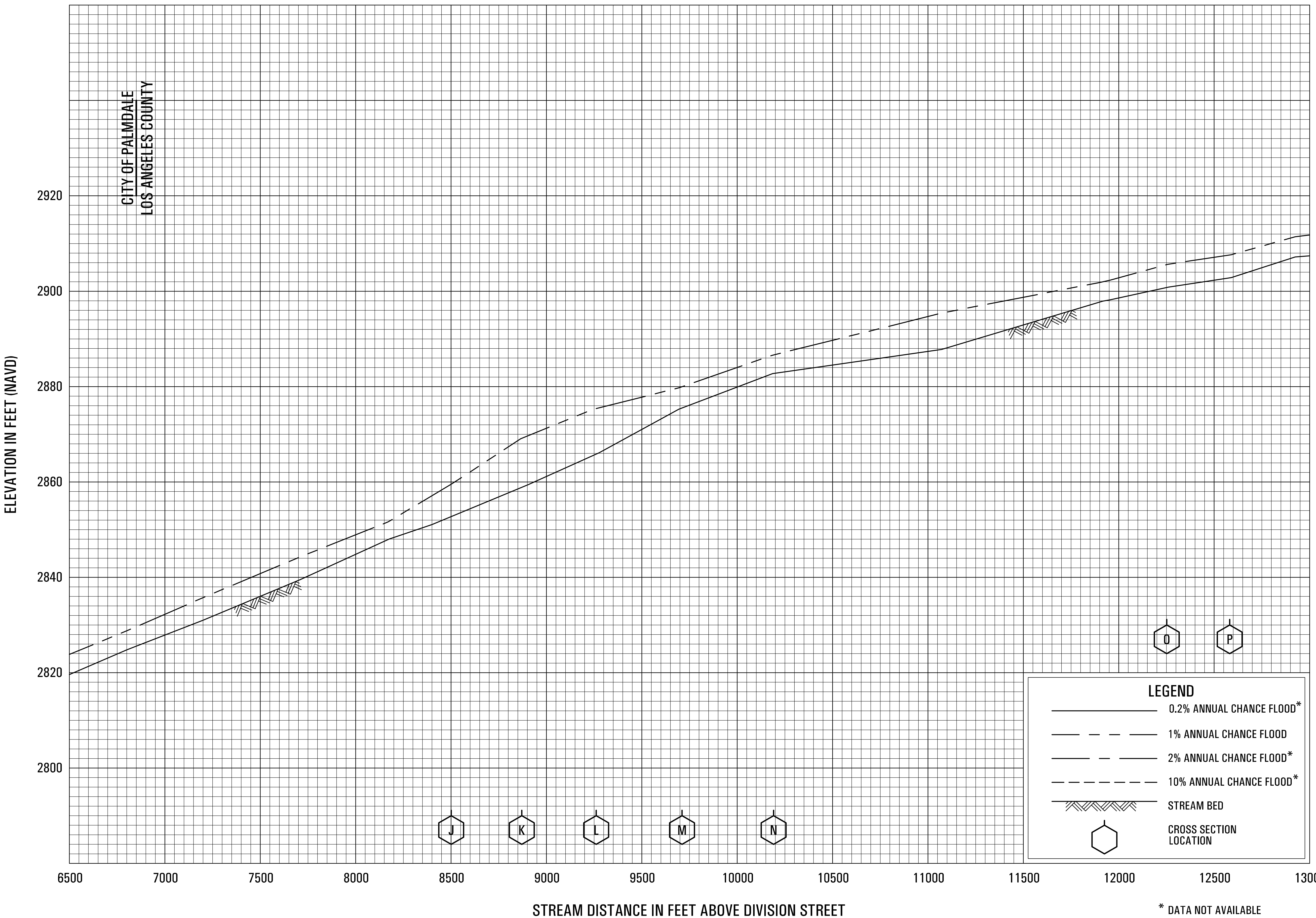
ANAVERDE CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS

04P



FLOOD PROFILES

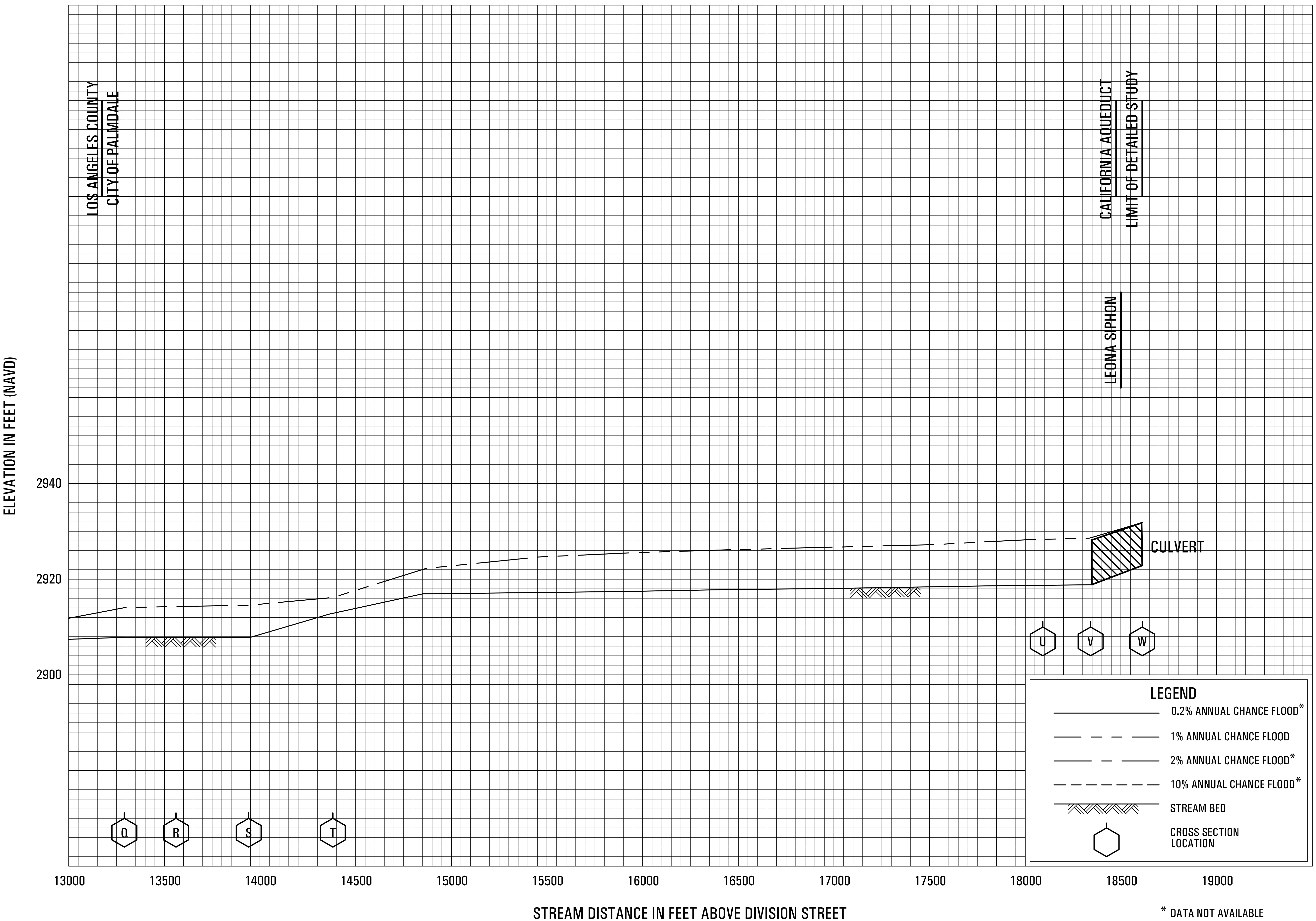
ANAVERDE CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS

05P



FLOOD PROFILES

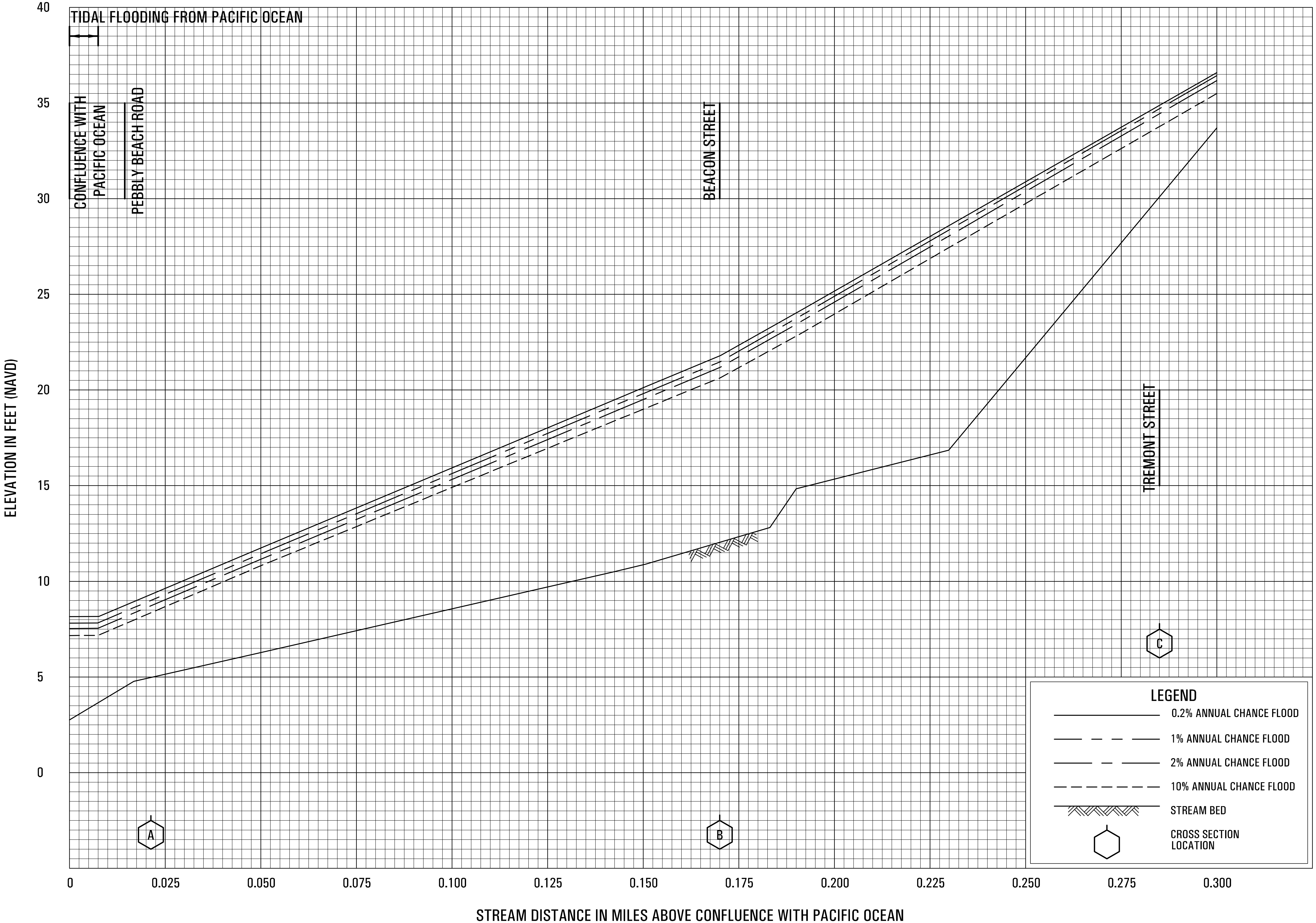
ANAVERDE CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS

06P



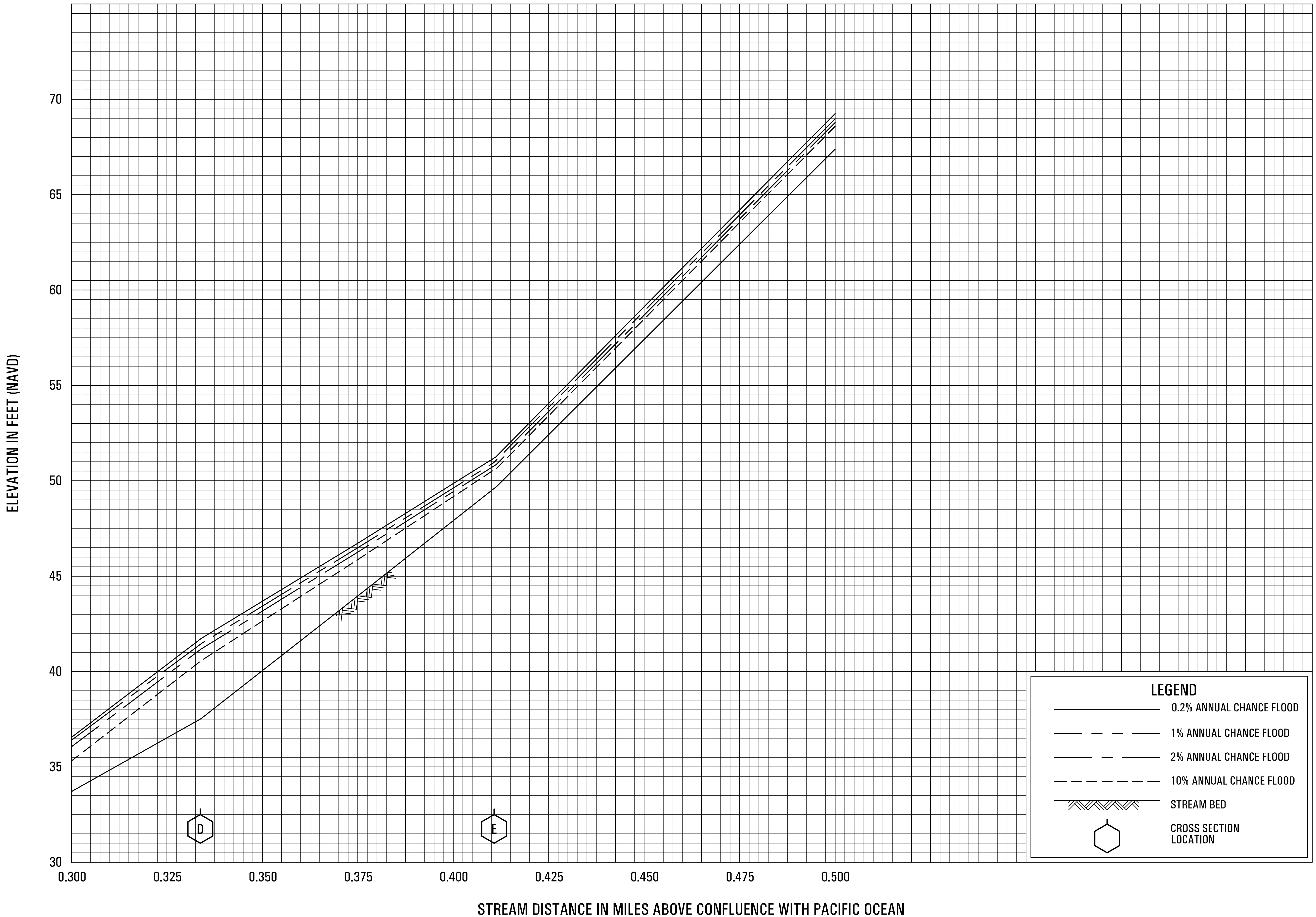
FLOOD PROFILES

AVALON CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



FLOOD PROFILES

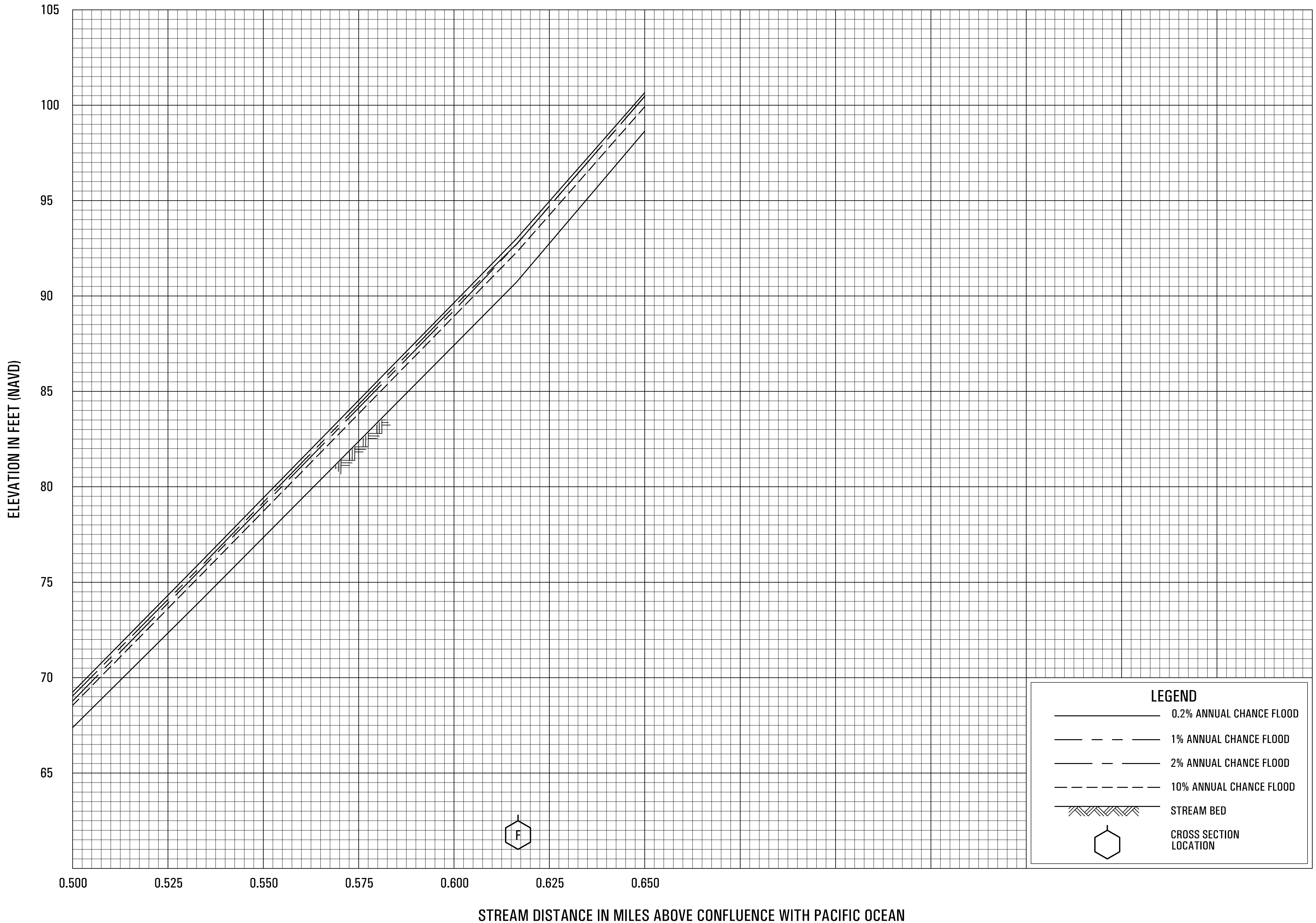
AVALON CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS

08P



FLOOD PROFILES

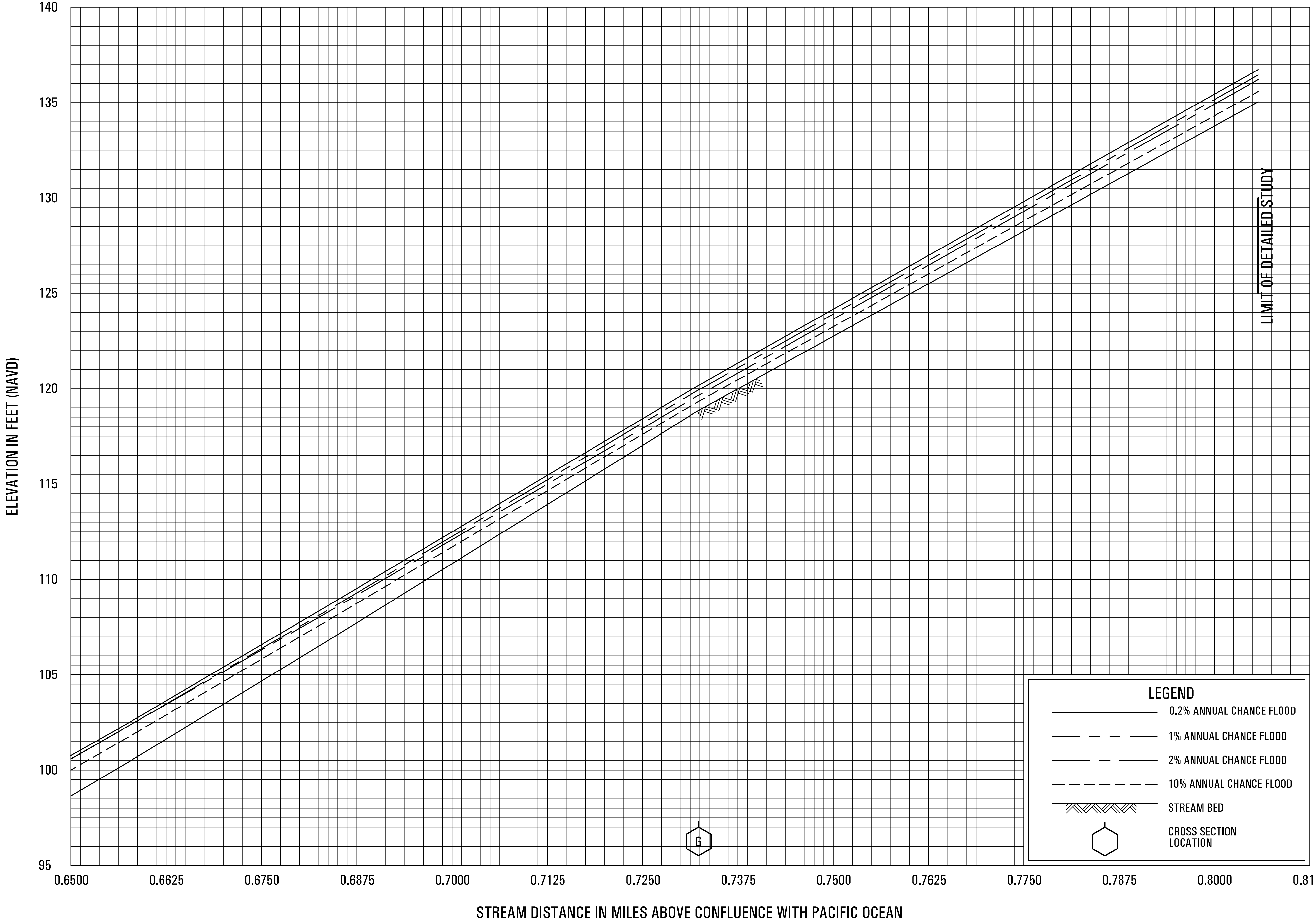
AVALON CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS

09P



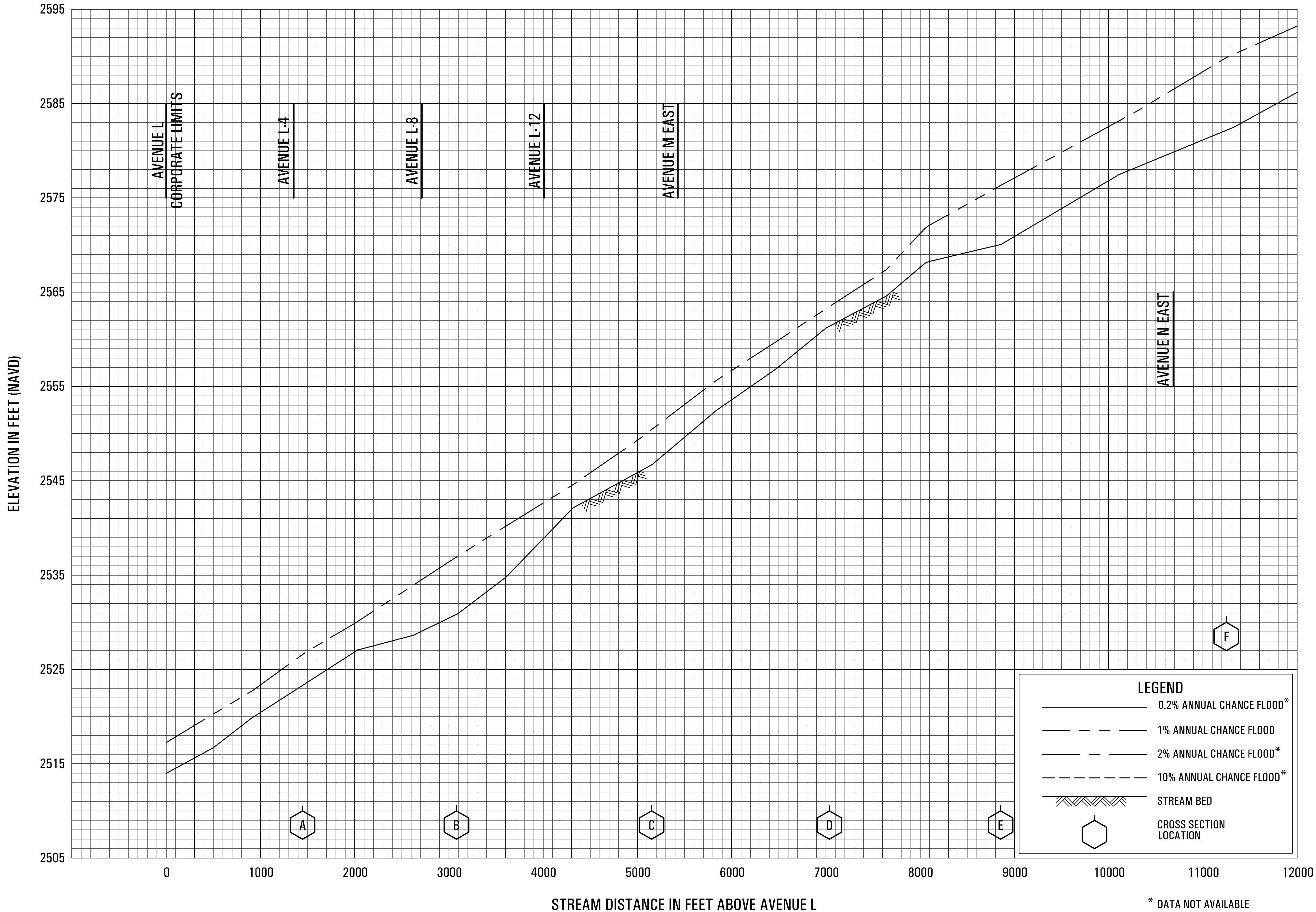
FLOOD PROFILES

AVALON CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



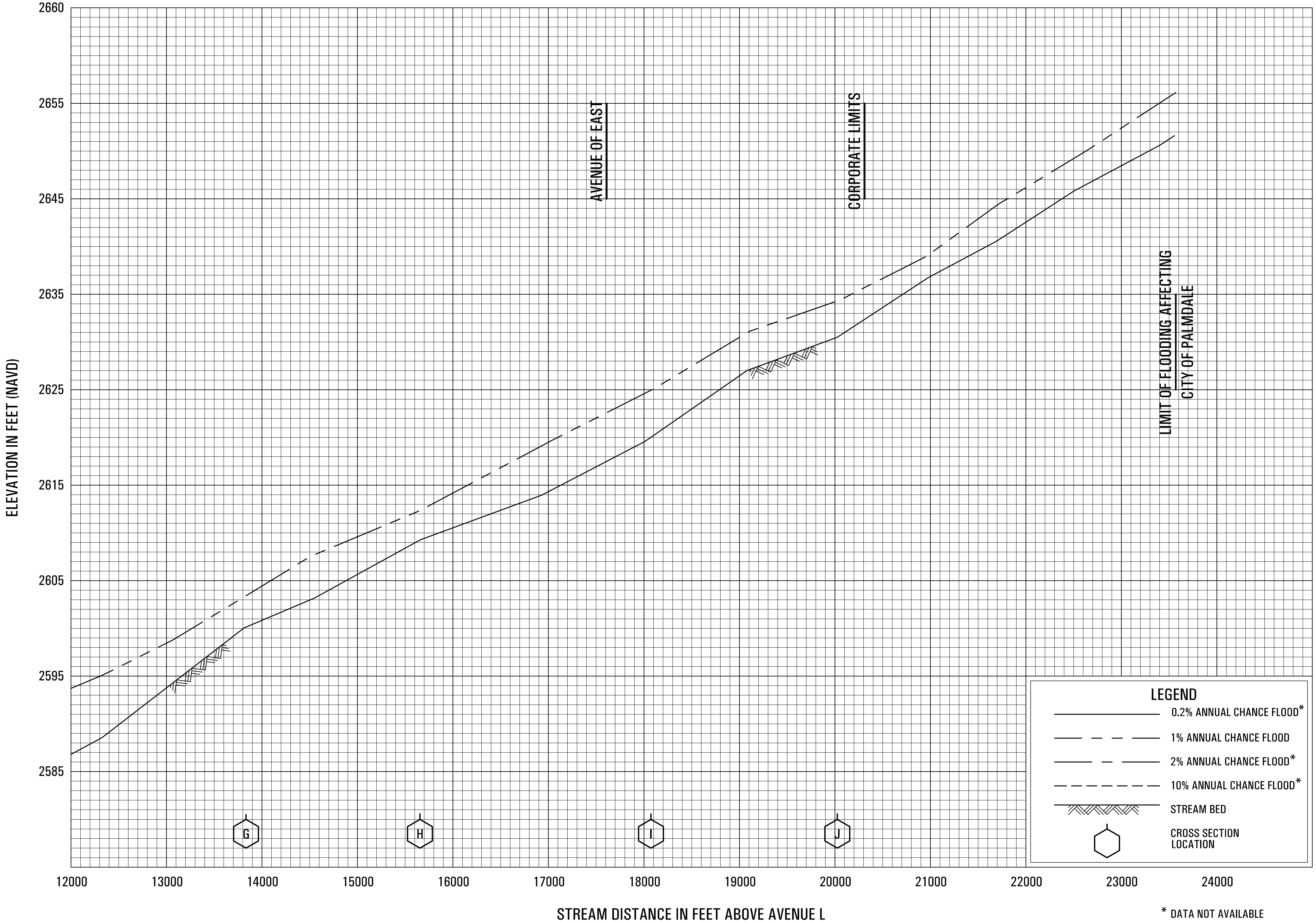
FLOOD PROFILES

BIG ROCK WASH

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



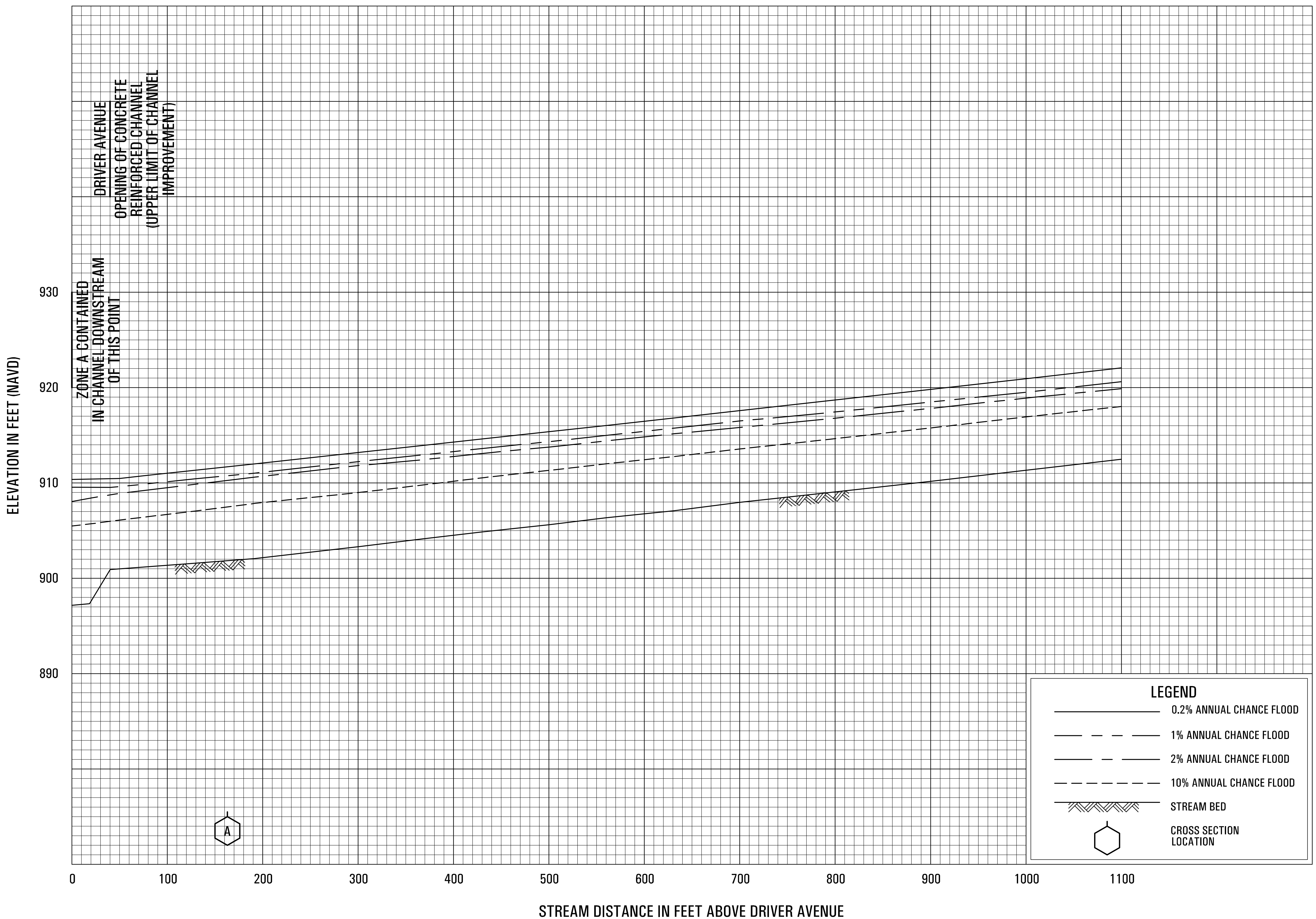
FLOOD PROFILES

BIG ROCK WASH

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



FLOOD PROFILES

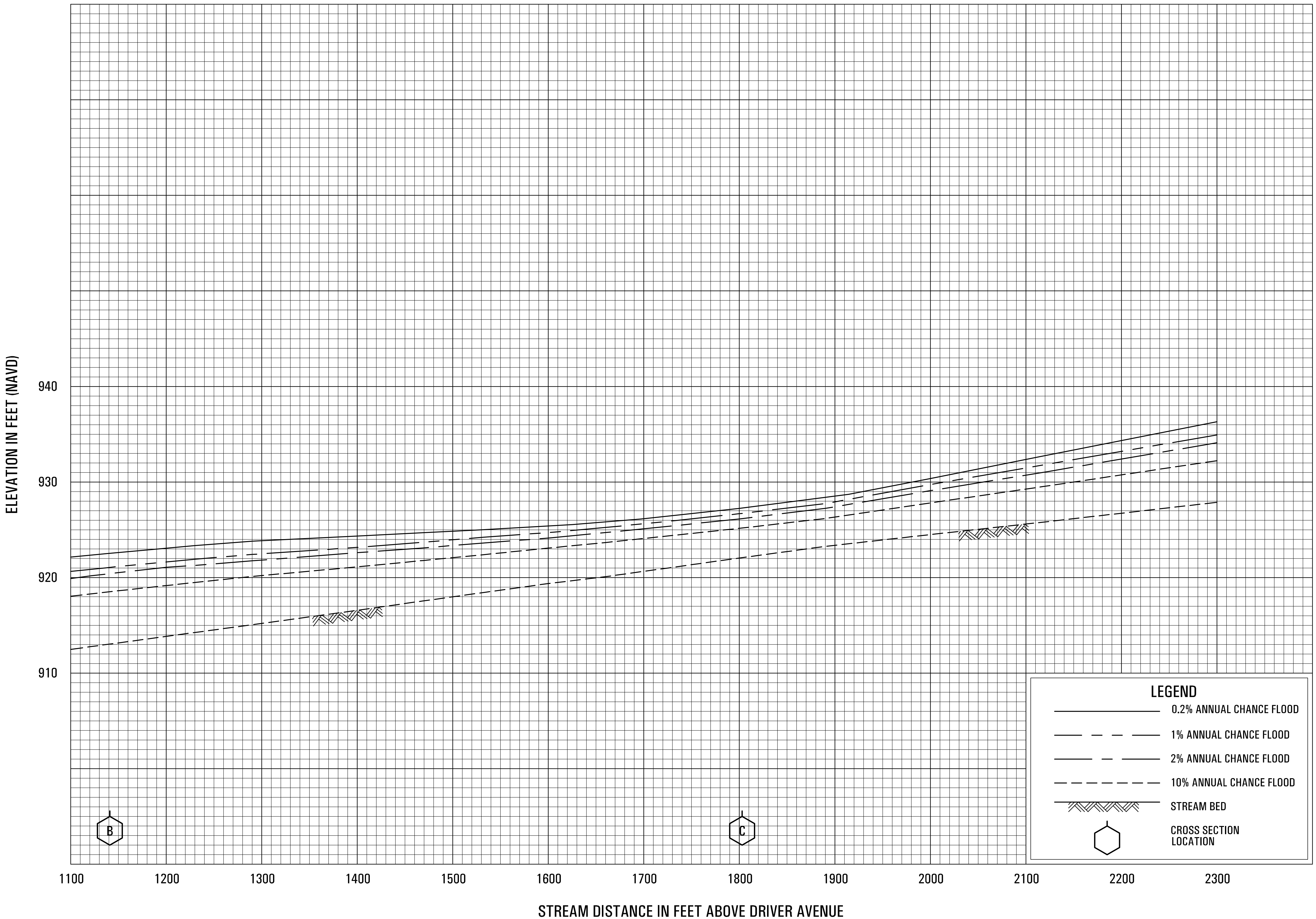
CHESEBORO CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS

13P



FLOOD PROFILES

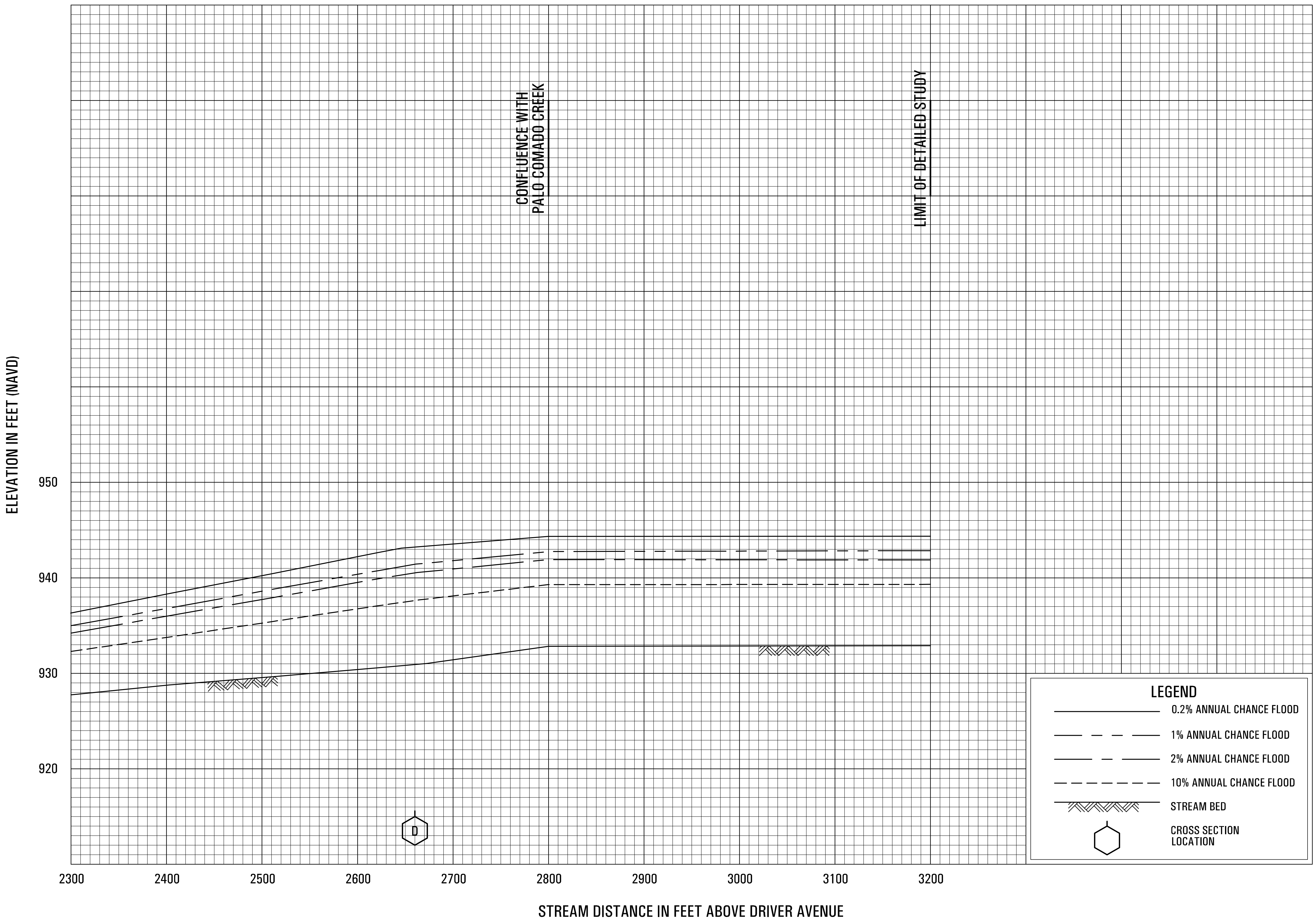
CHESEBORO CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS

14P



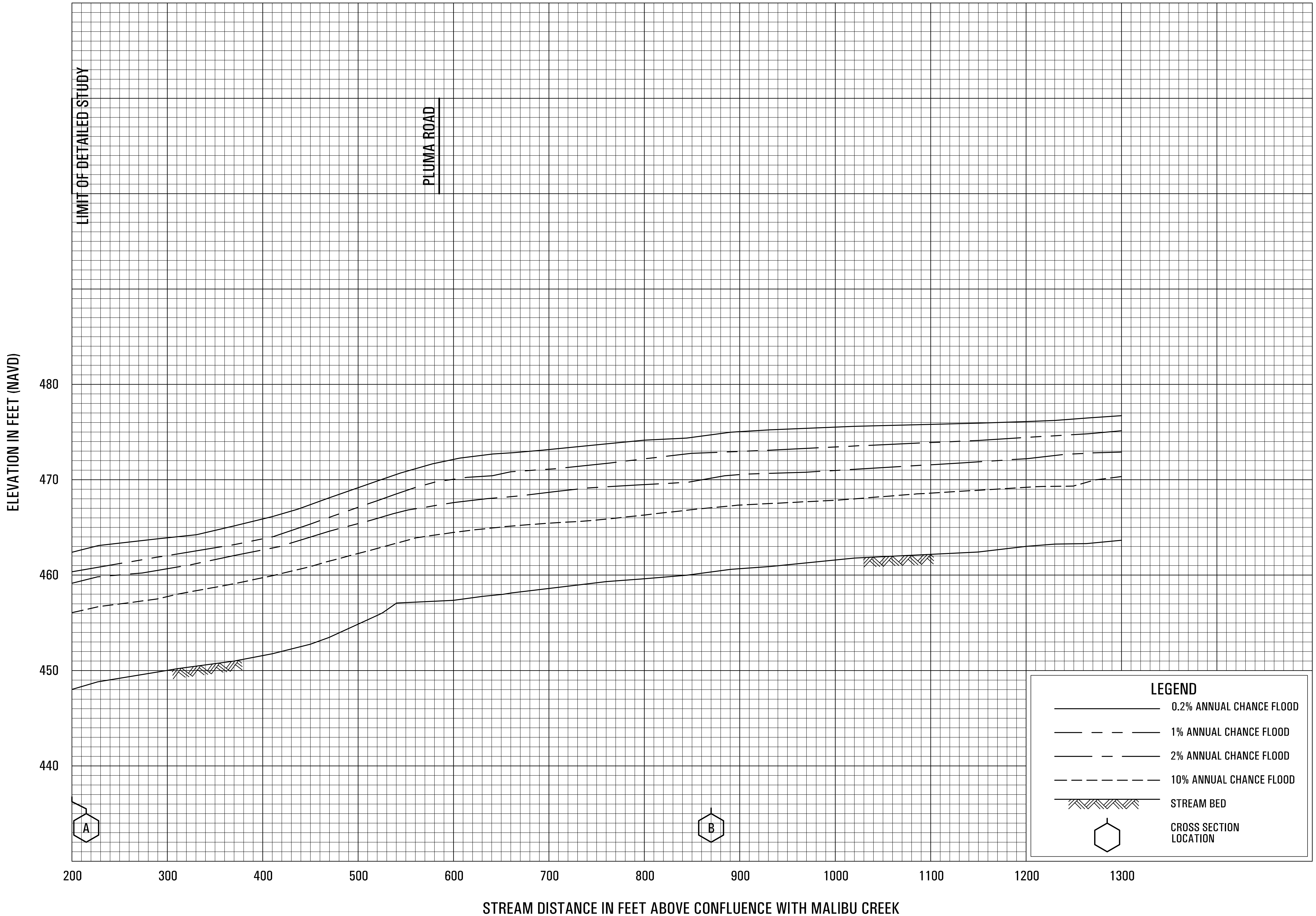
FLOOD PROFILES

CHESEBORO CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



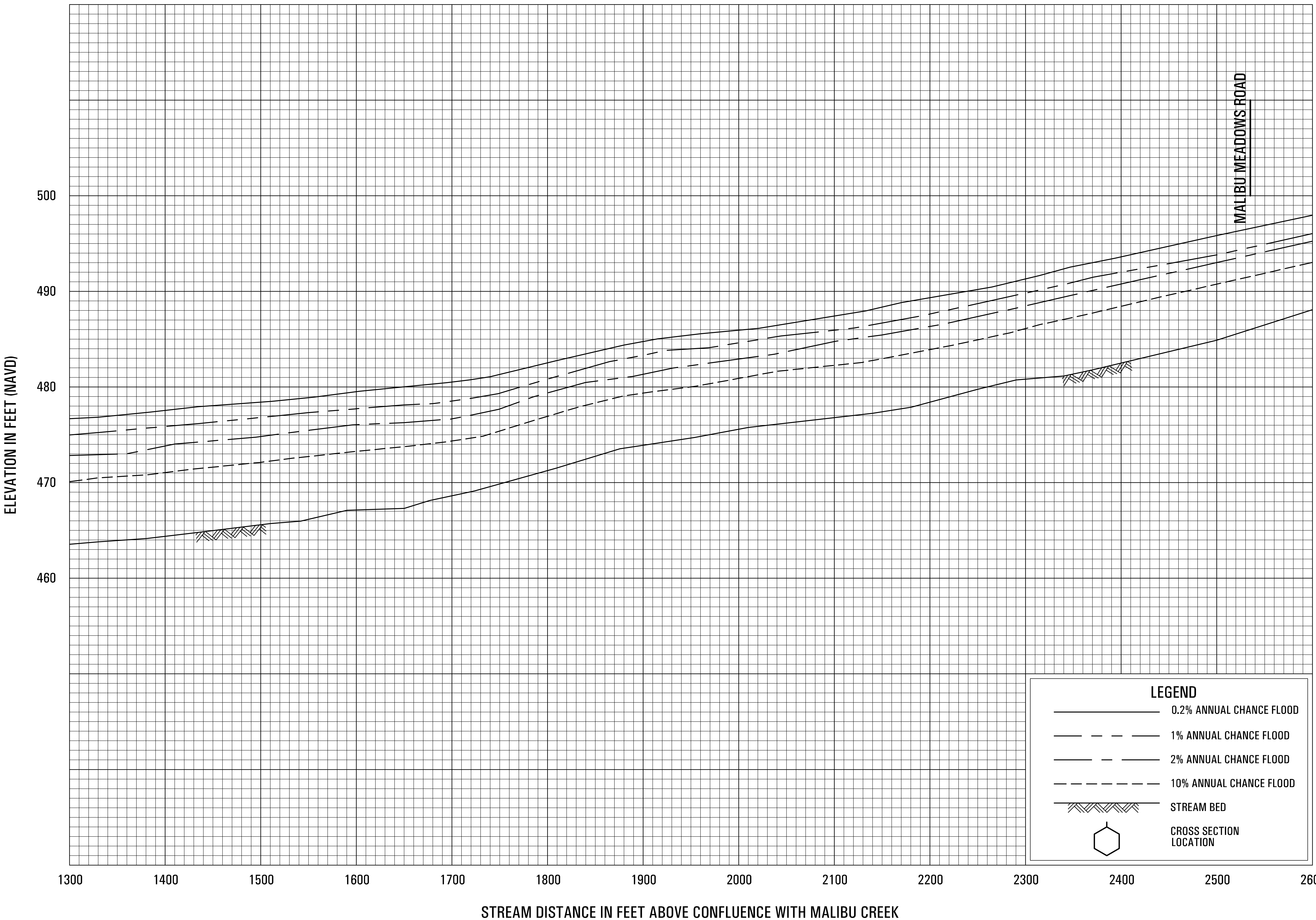
FLOOD PROFILES

COLD CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



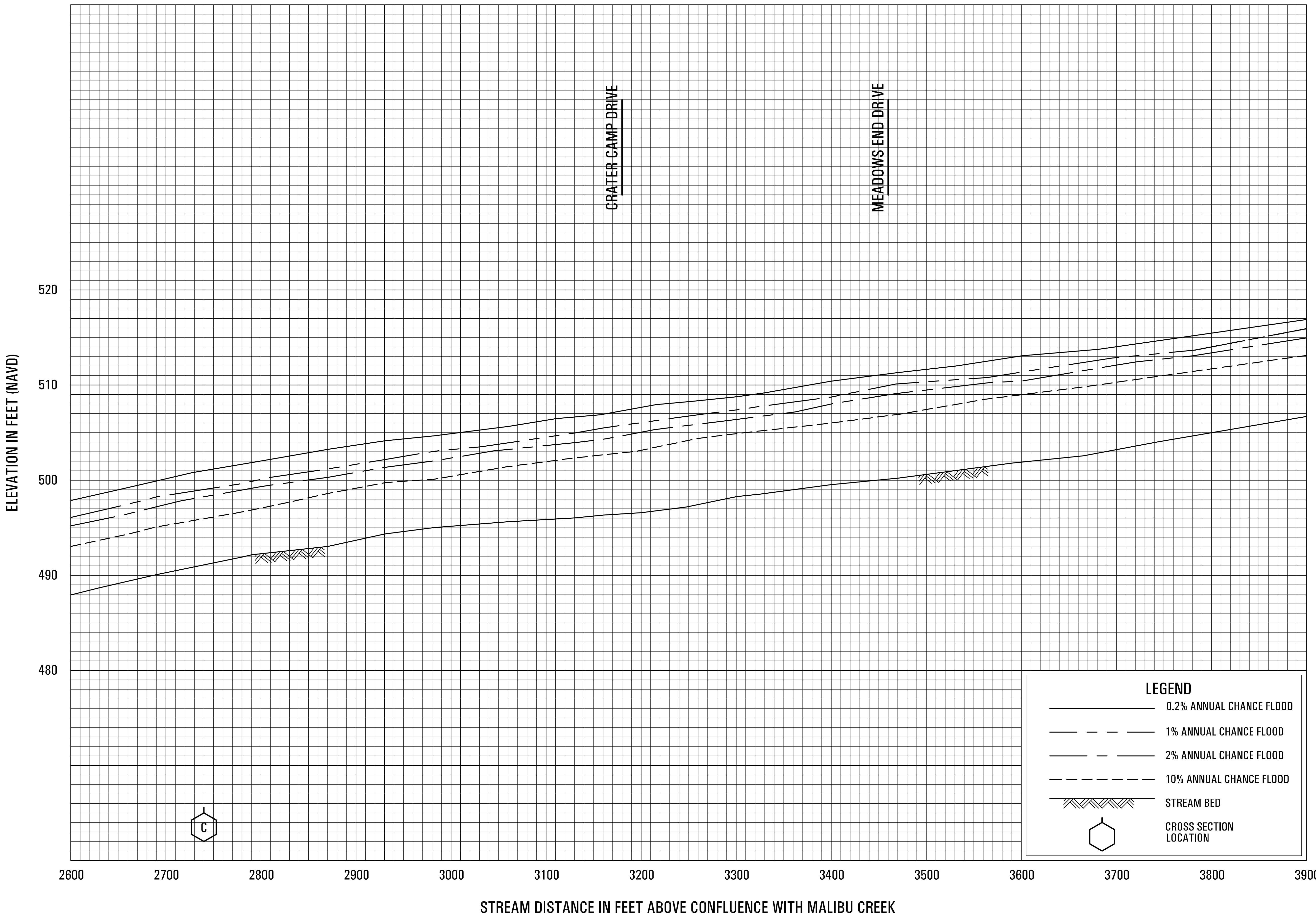
FLOOD PROFILES

COLD CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



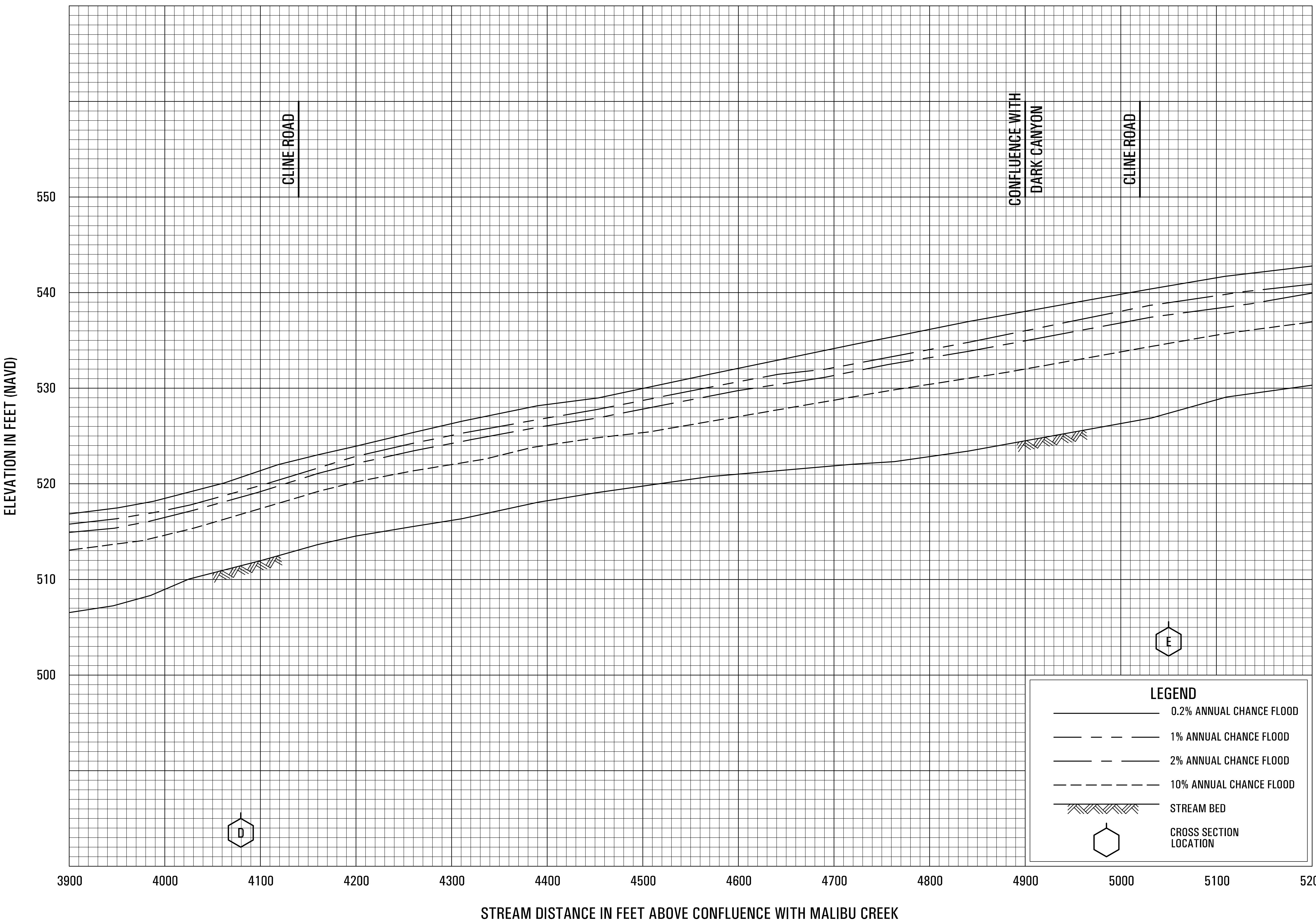
FLOOD PROFILES

COLD CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



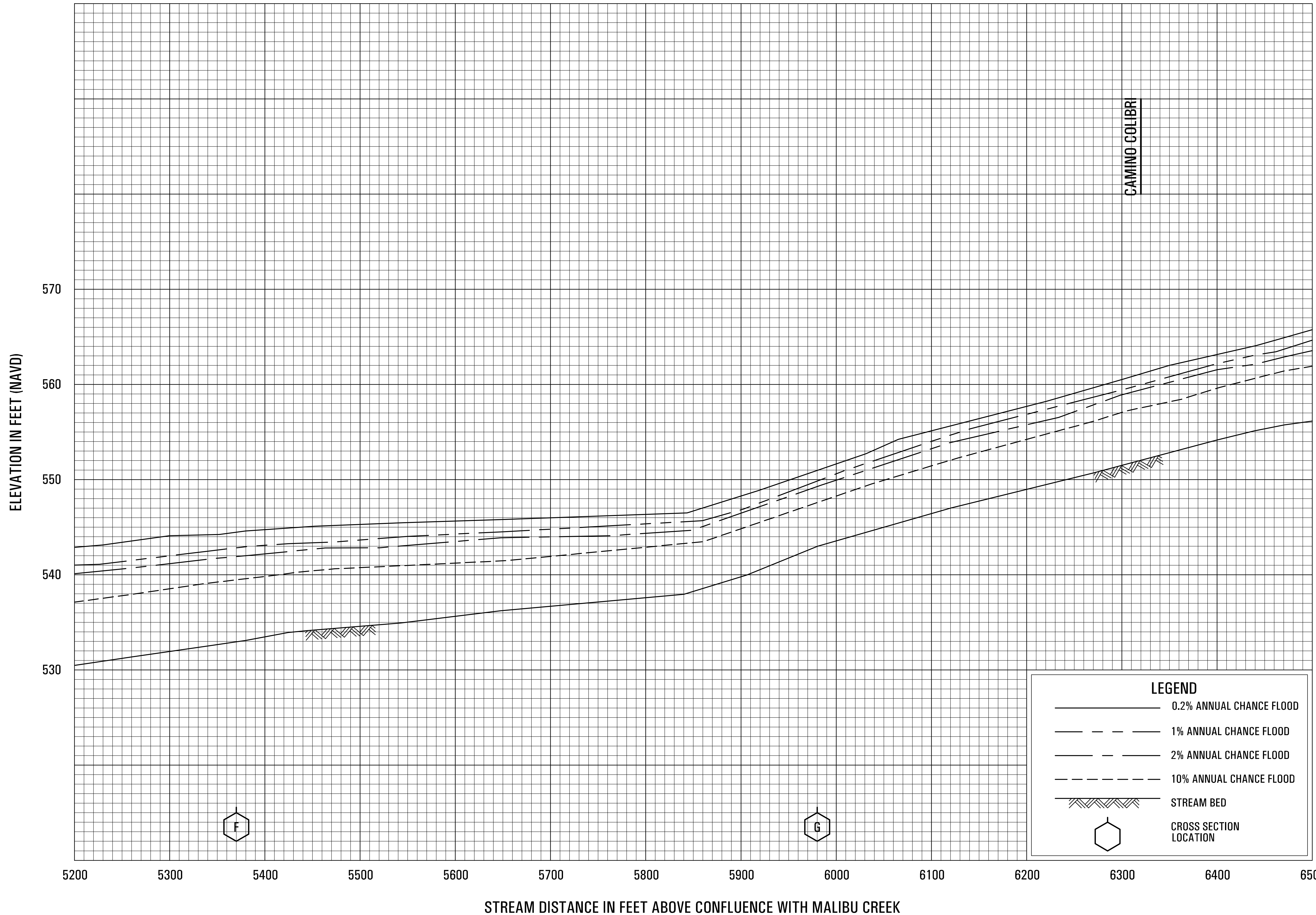
FLOOD PROFILES

COLD CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



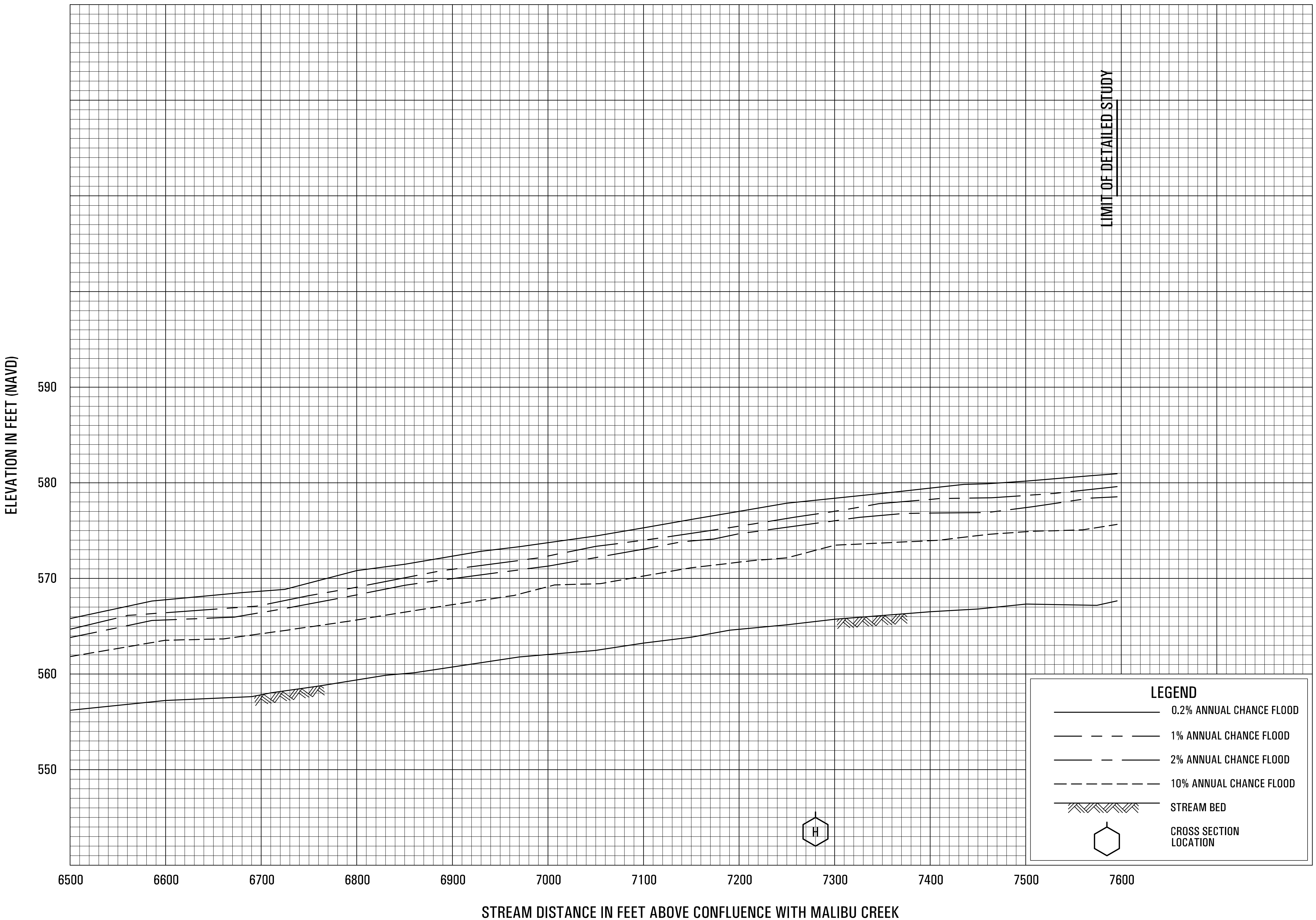
FLOOD PROFILES

COLD CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



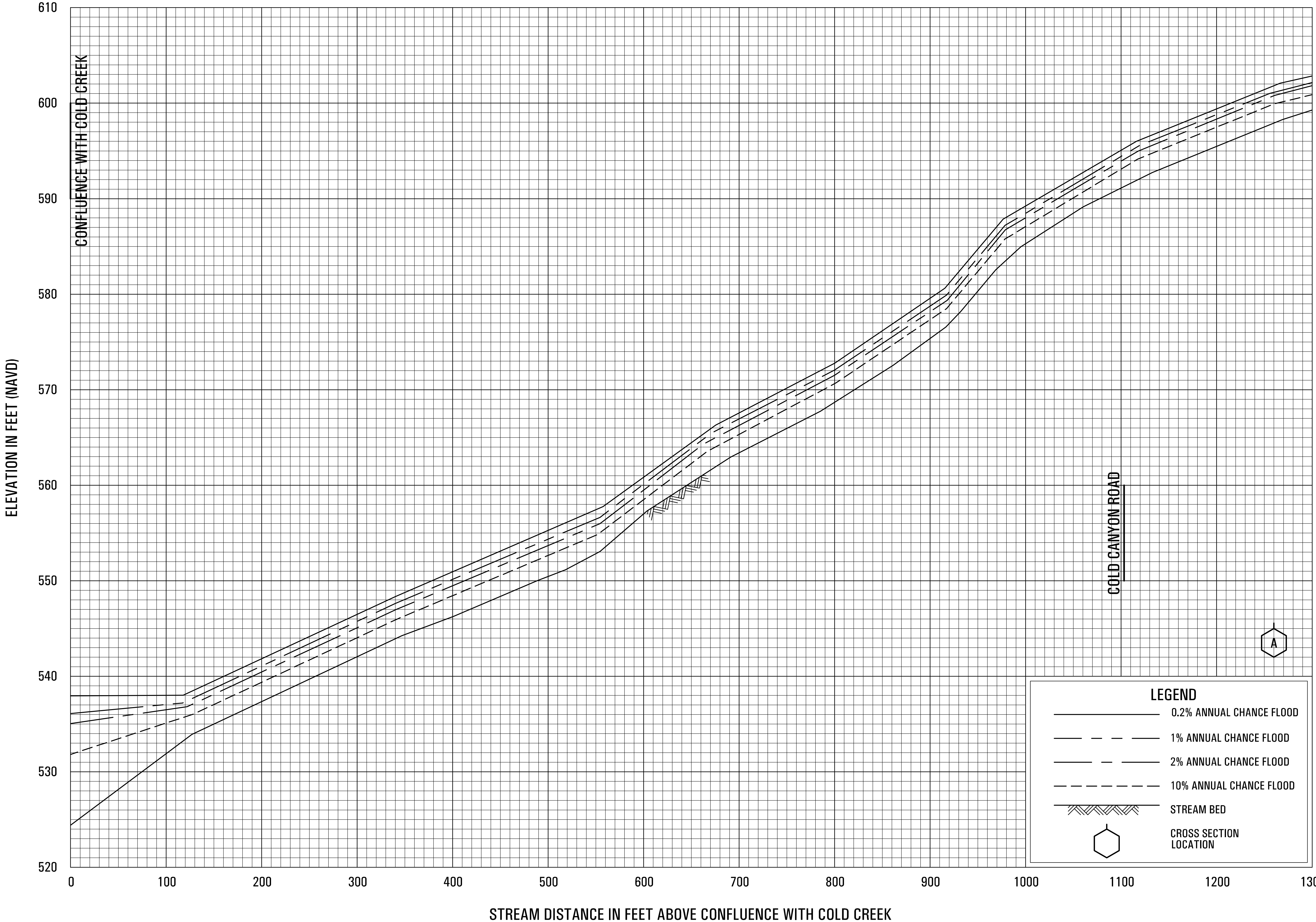
FLOOD PROFILES

COLD CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



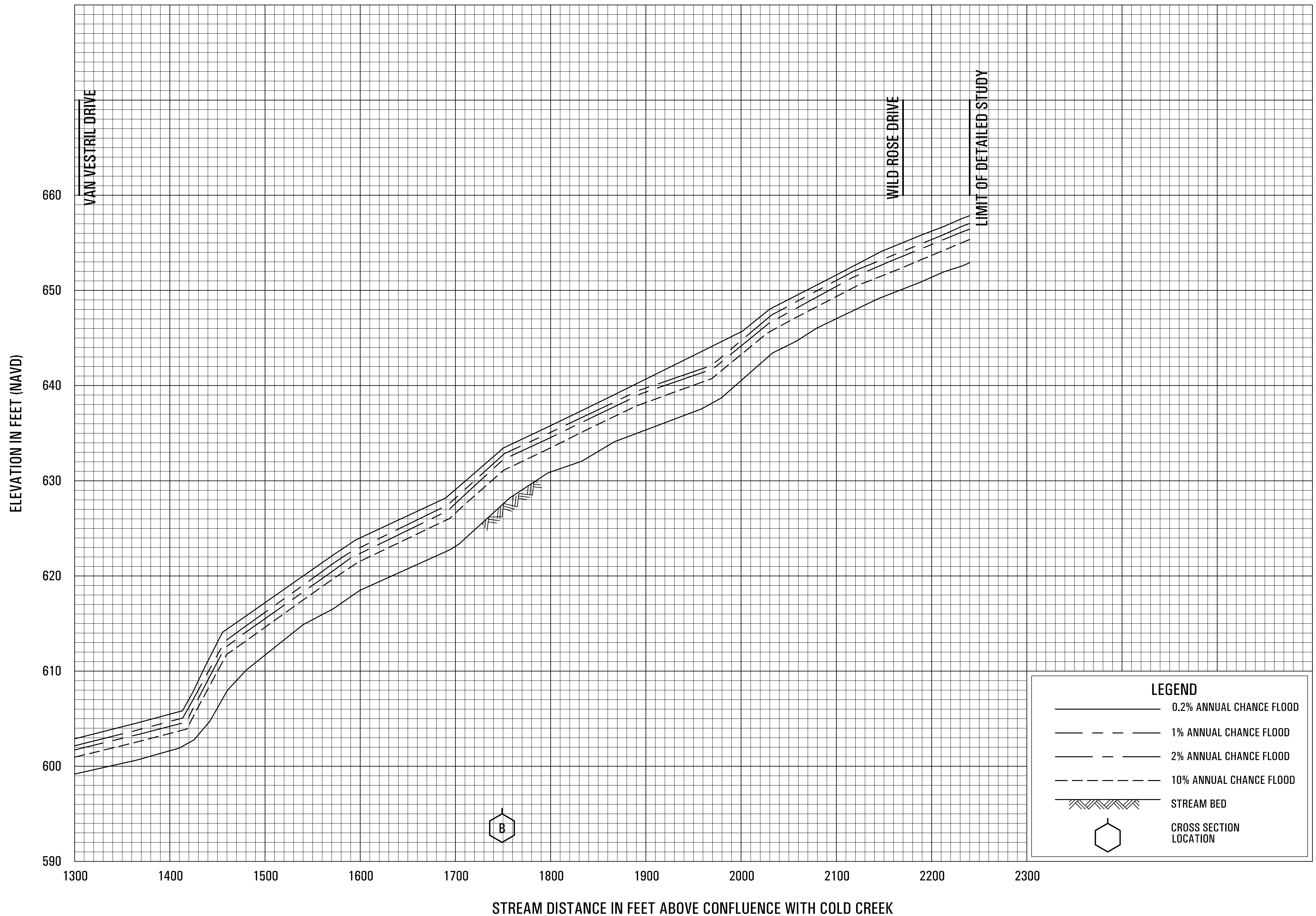
FLOOD PROFILES

DARK CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



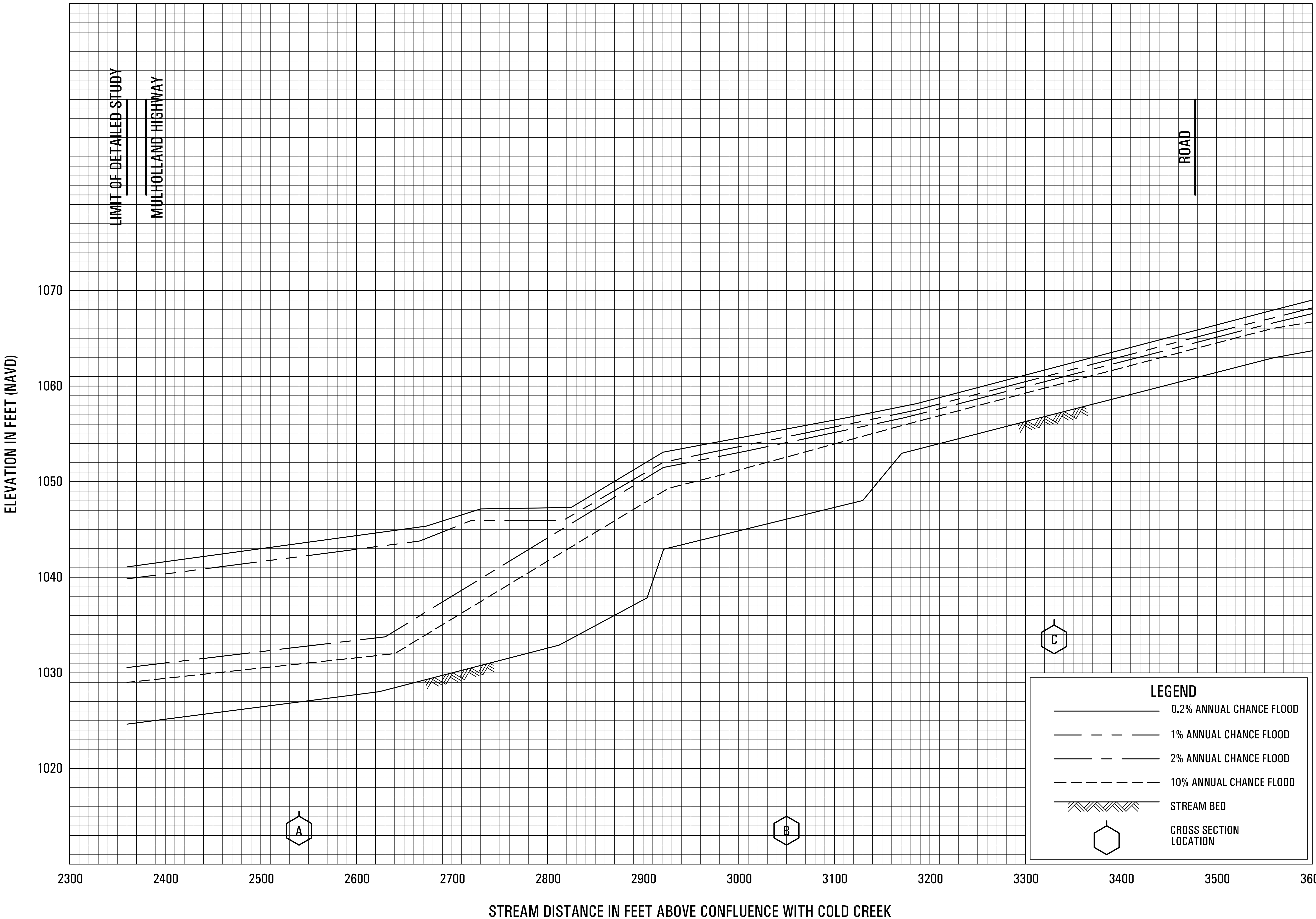
FLOOD PROFILES

DARK CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



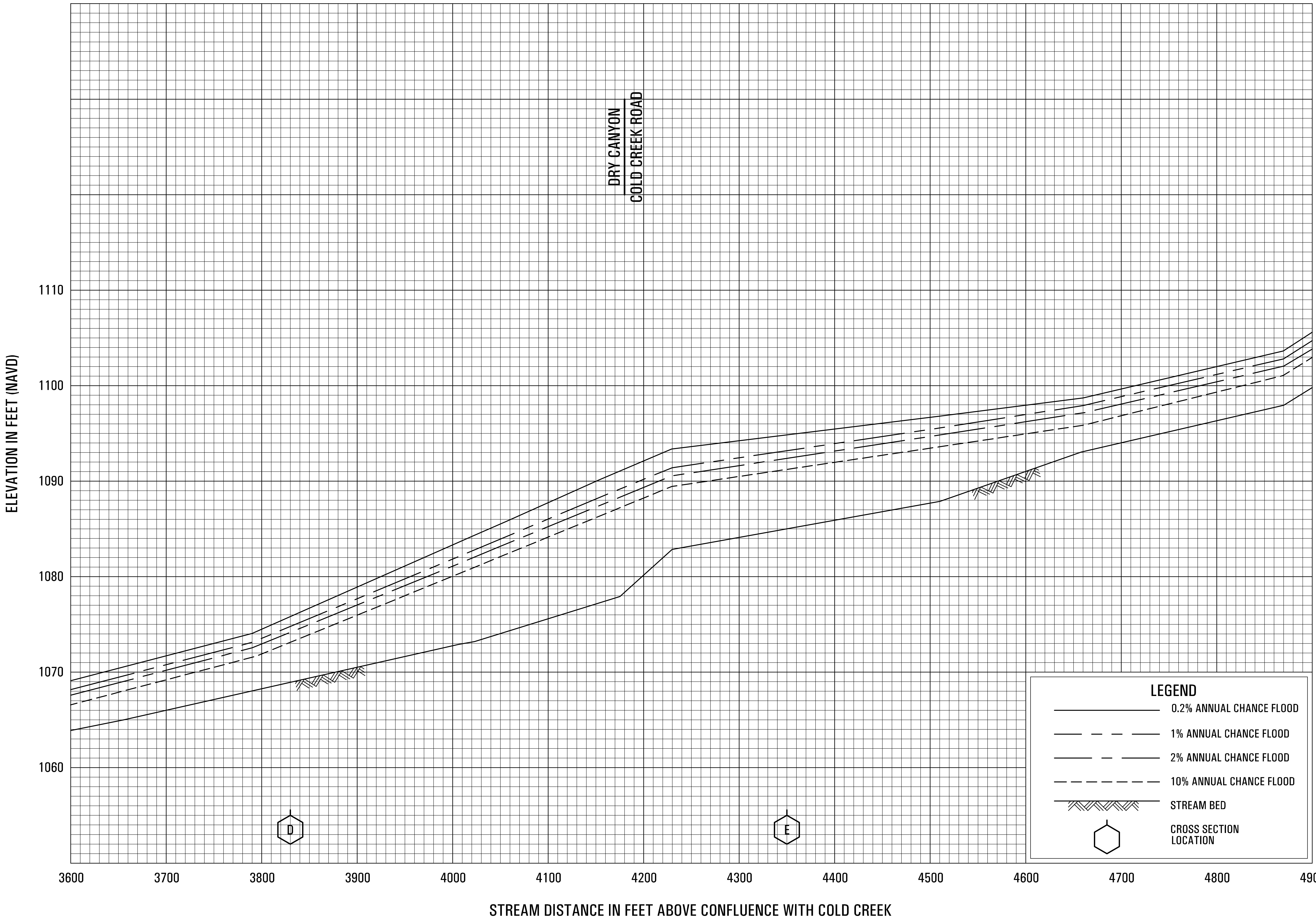
FLOOD PROFILES

DRY CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



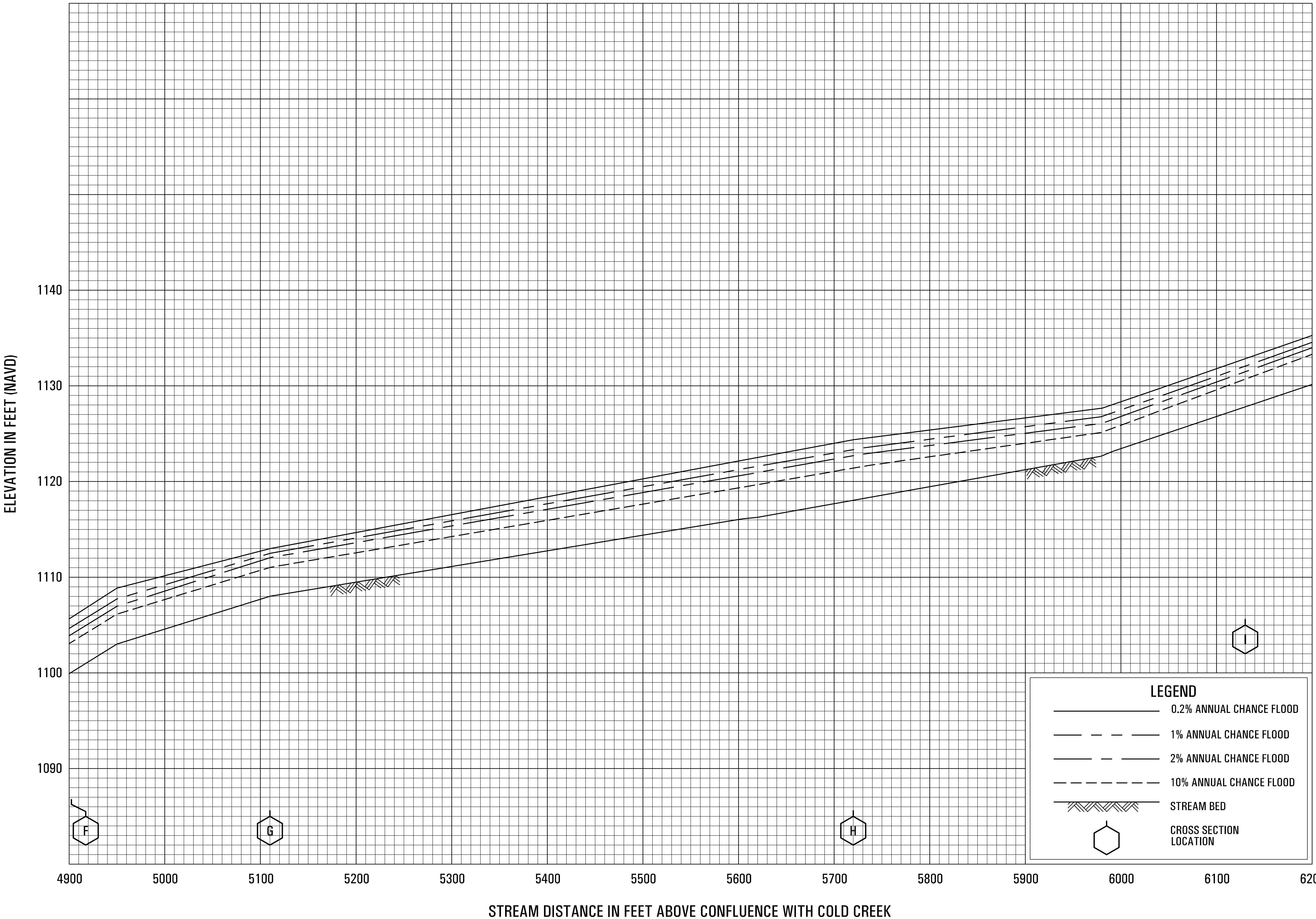
FLOOD PROFILES

DRY CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



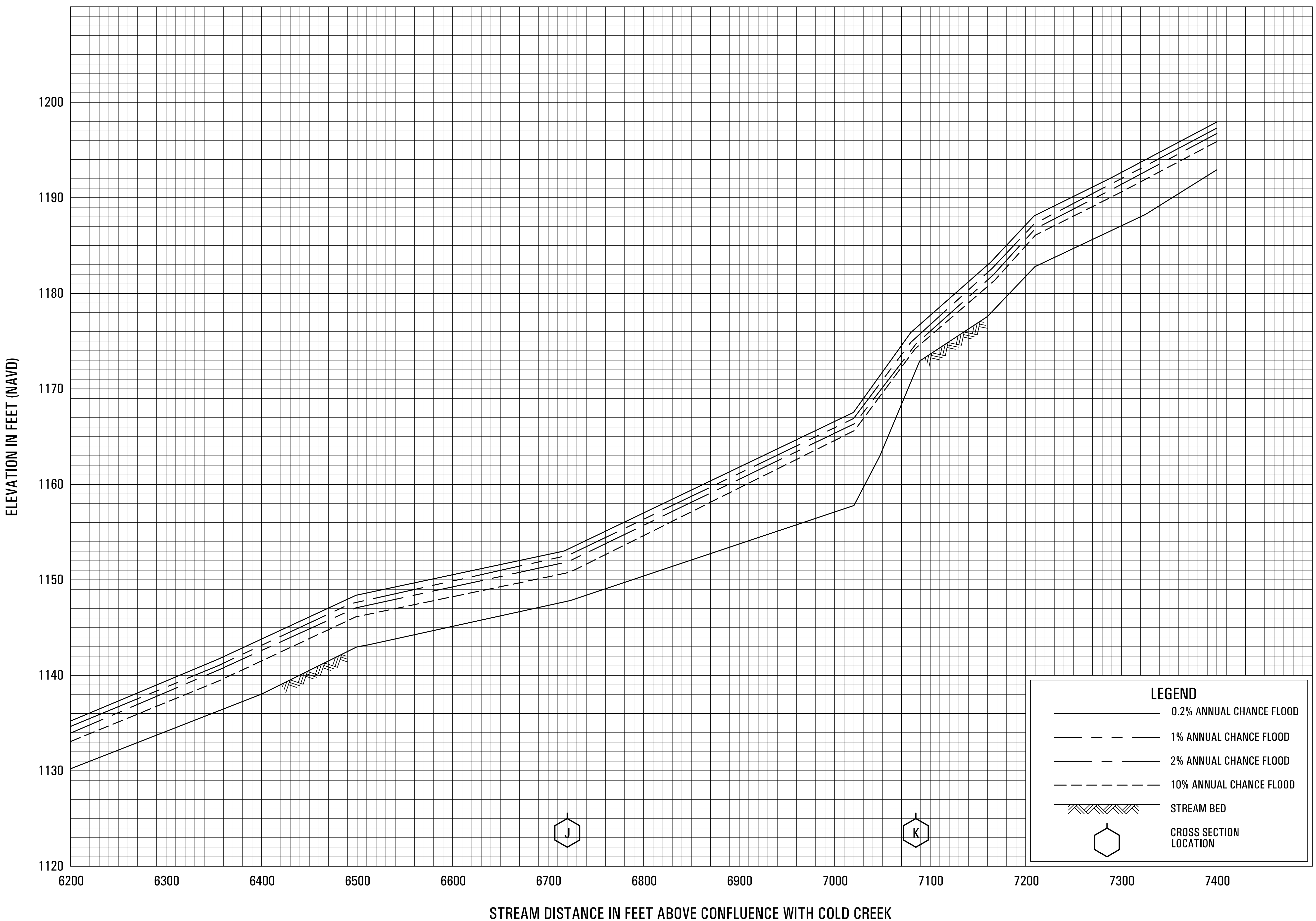
FLOOD PROFILES

DRY CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



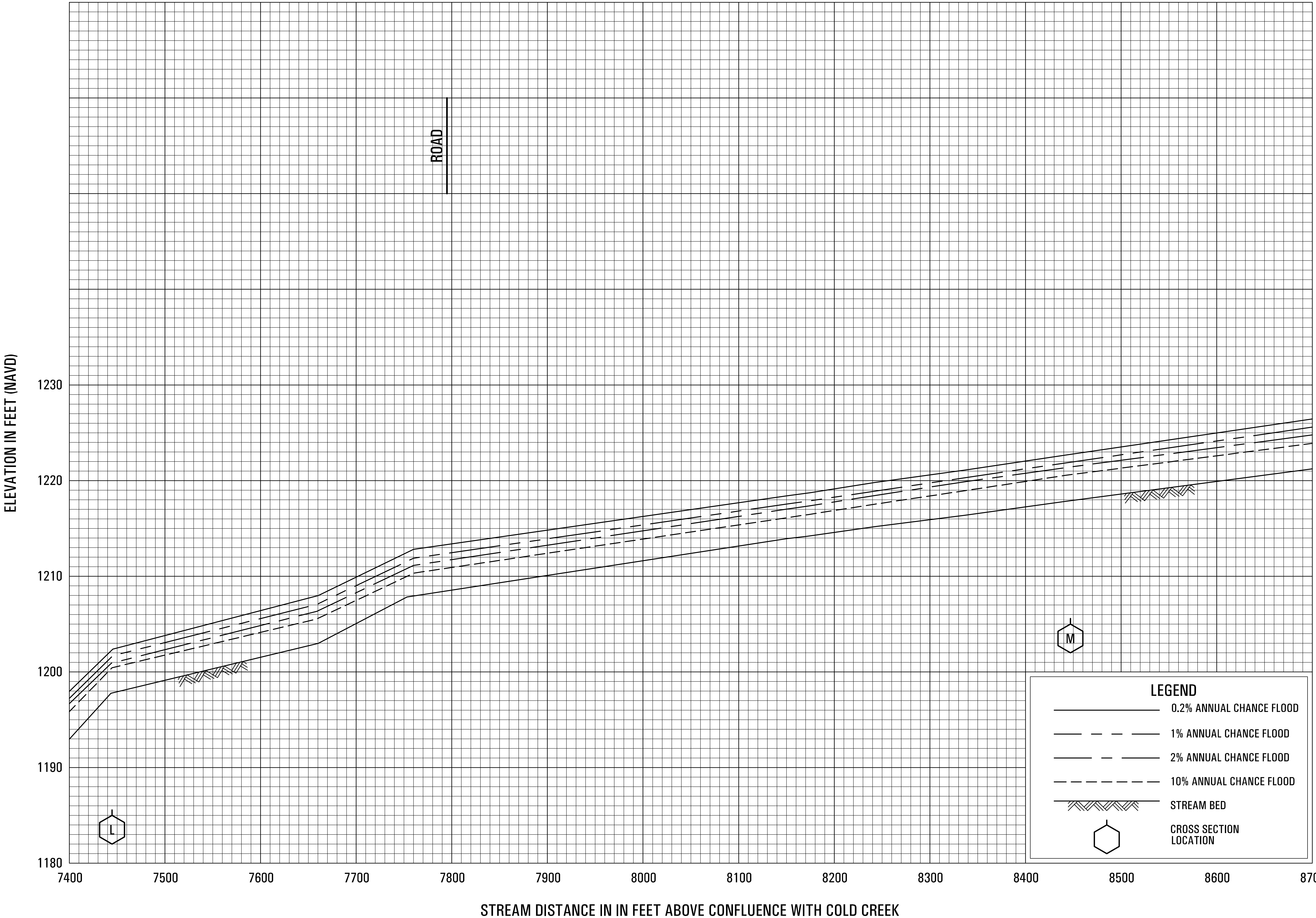
FLOOD PROFILES

DRY CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



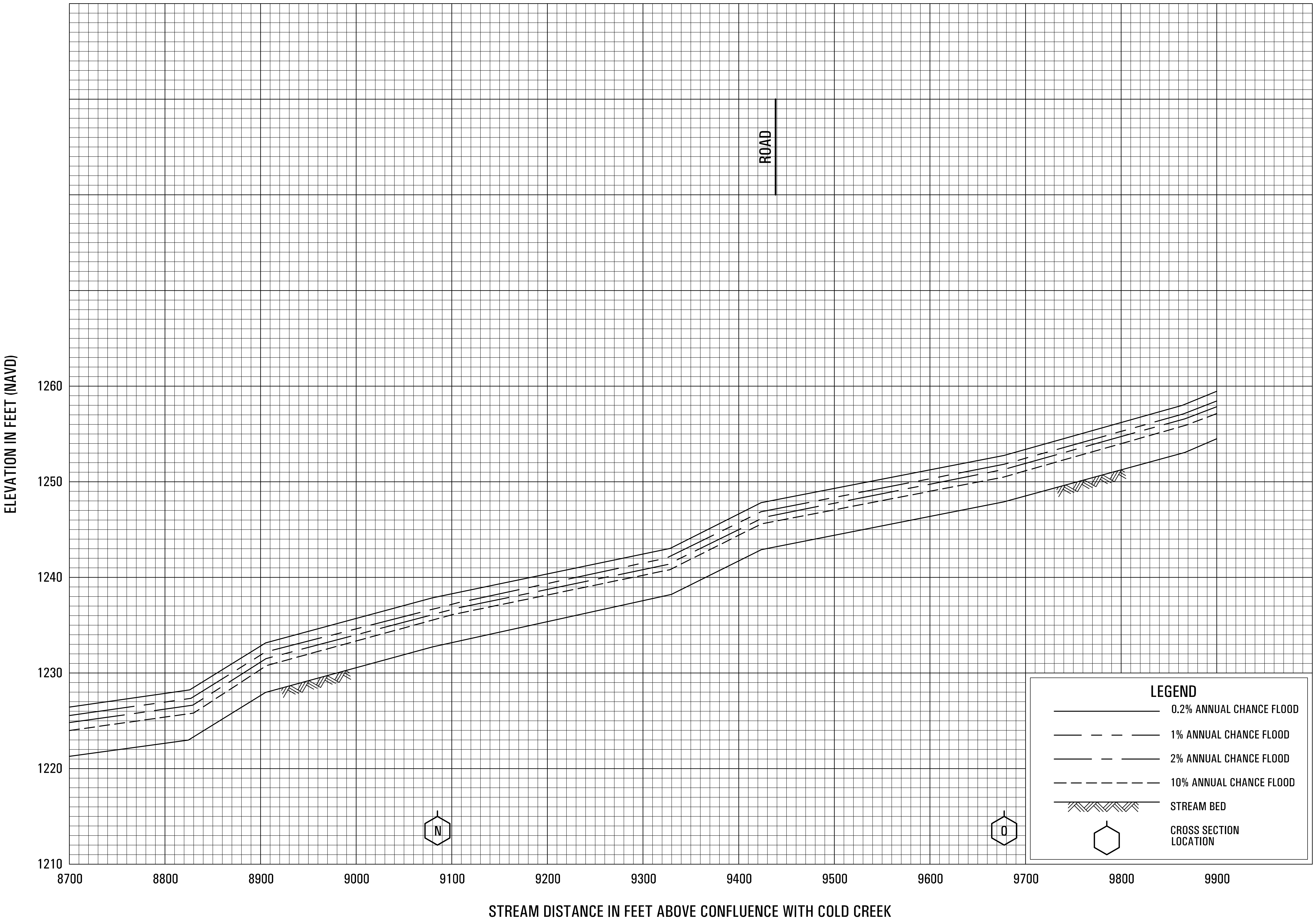
FLOOD PROFILES

DRY CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



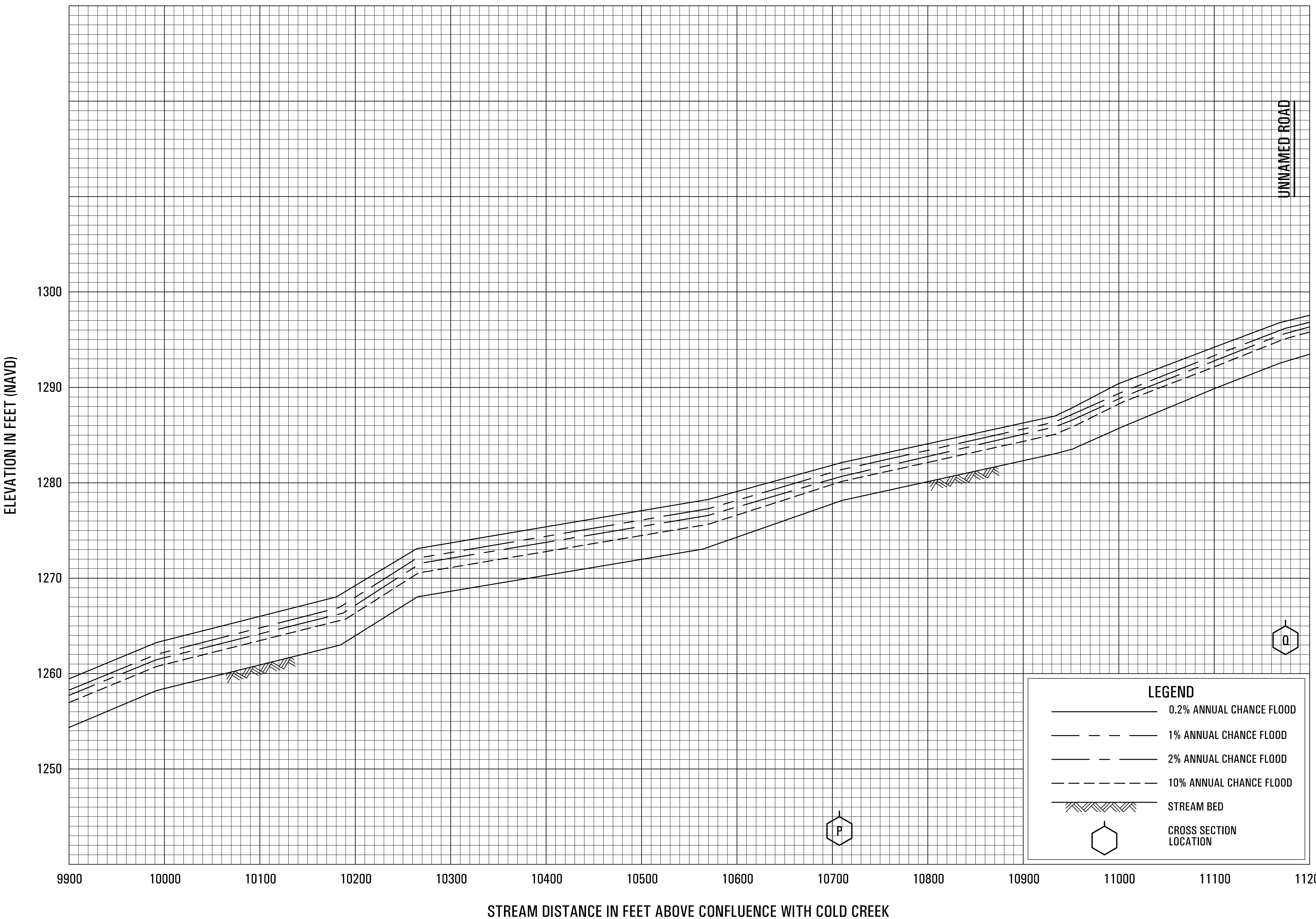
FLOOD PROFILES

DRY CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



FLOOD PROFILES

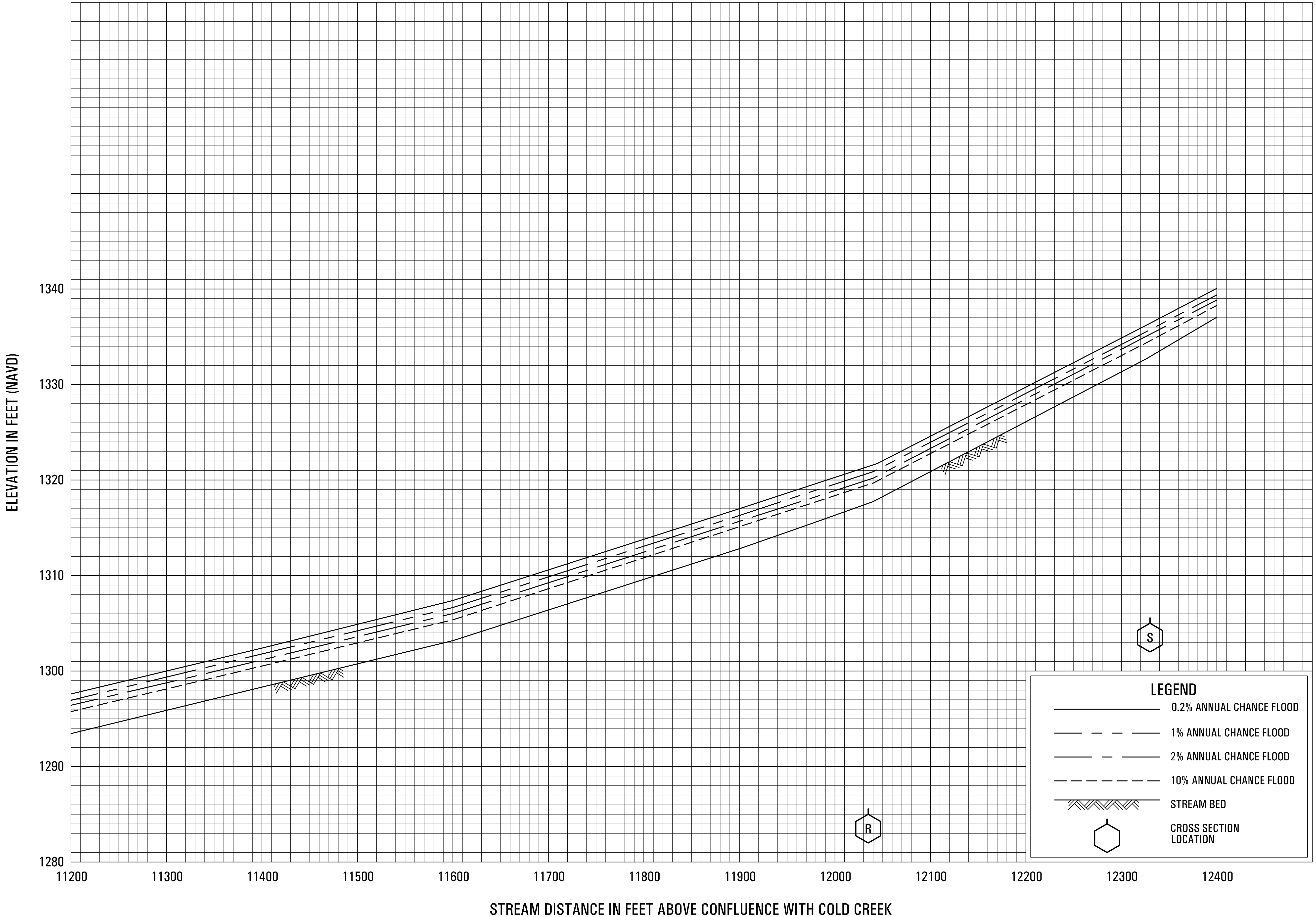
DRY CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS

30P



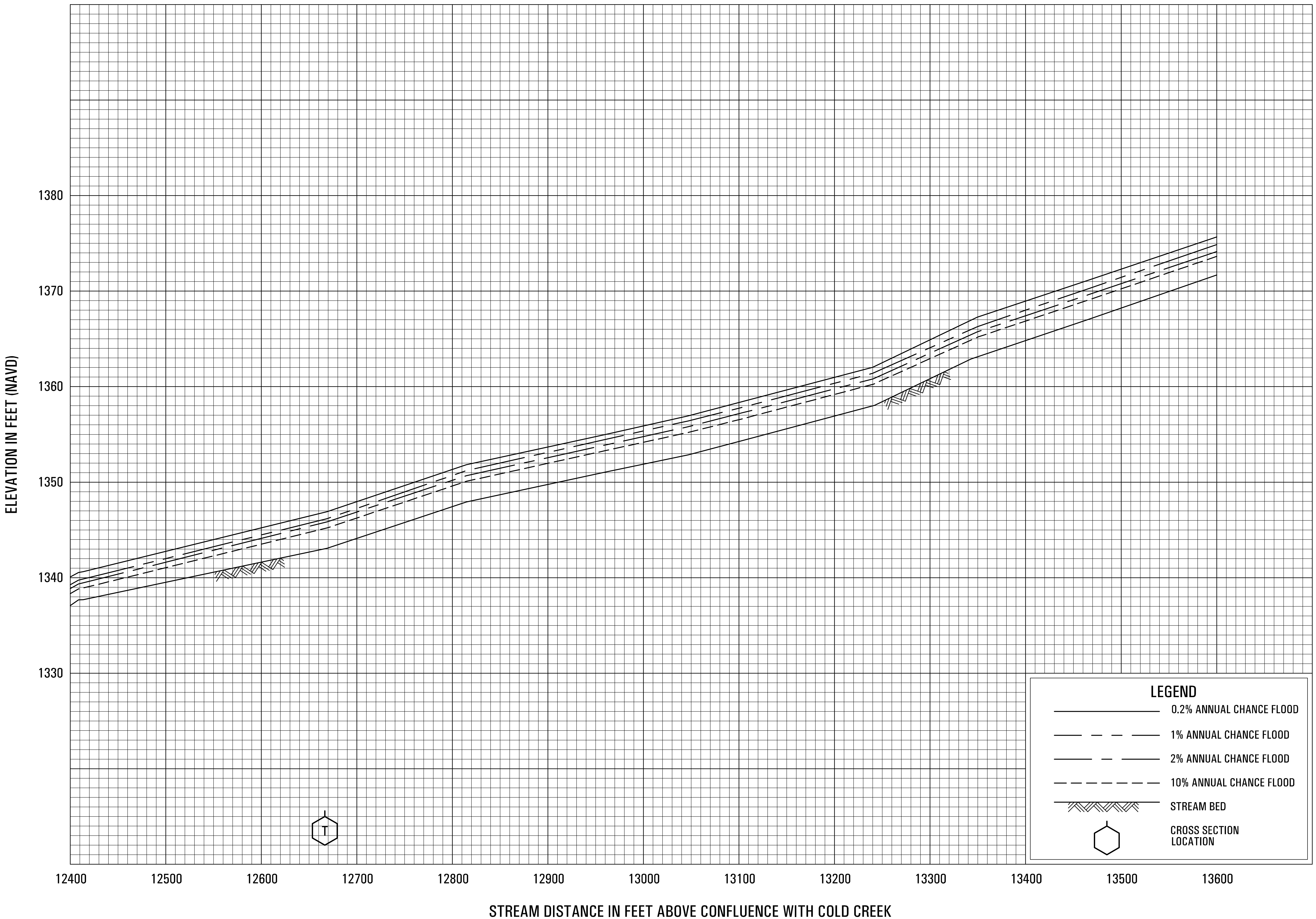
FLOOD PROFILES

DRY CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



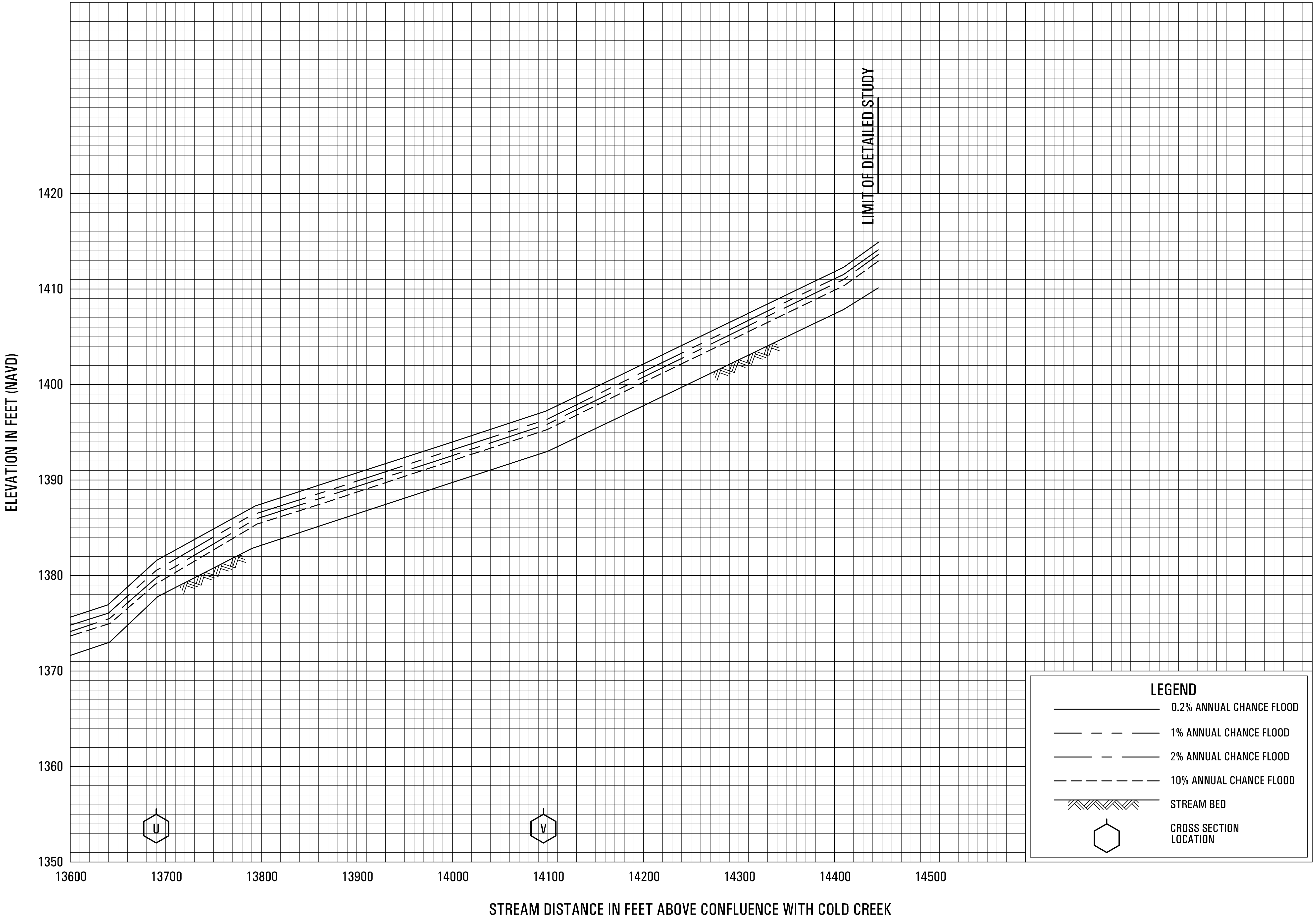
FLOOD PROFILES

DRY CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



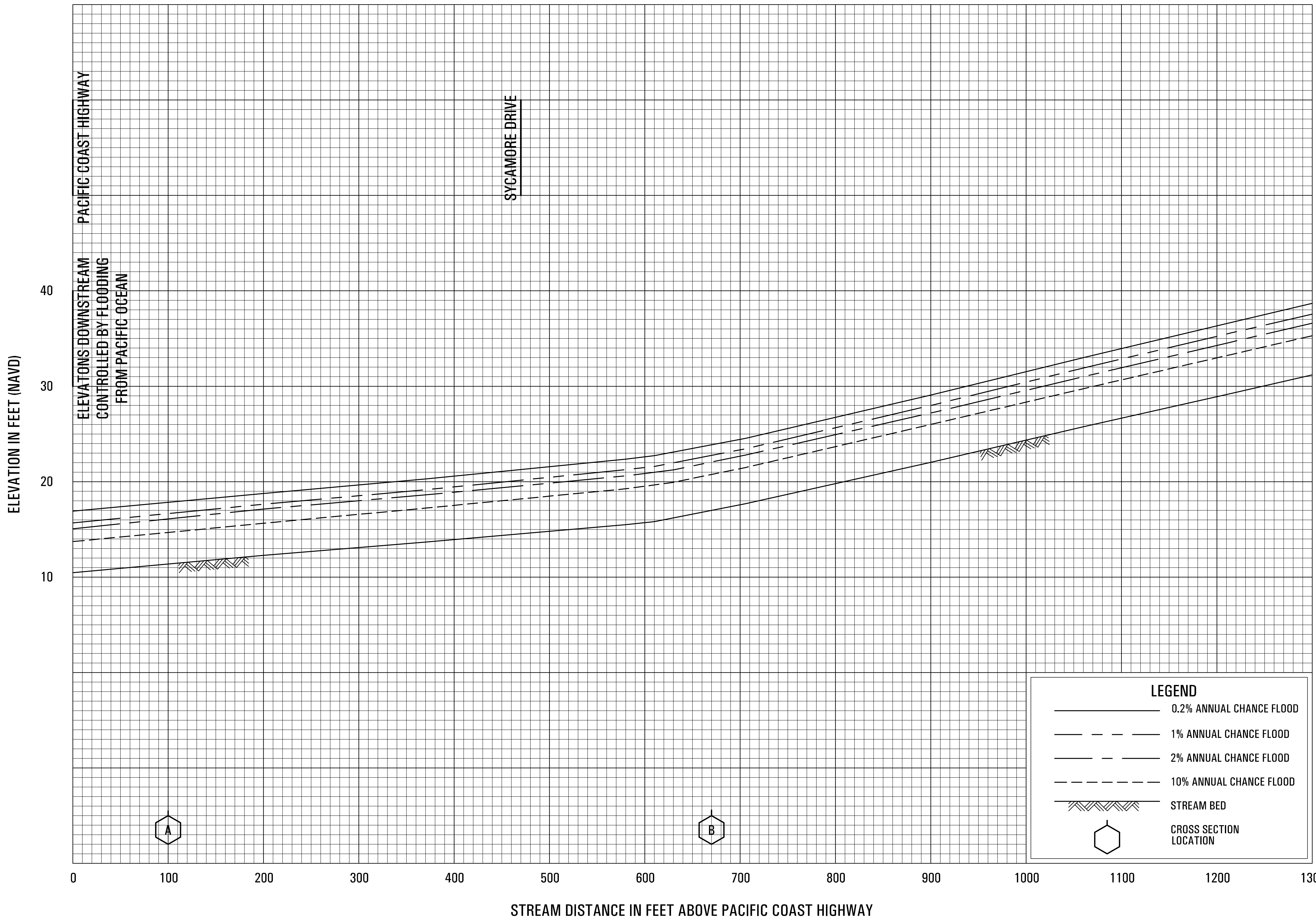
FLOOD PROFILES

DRY CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



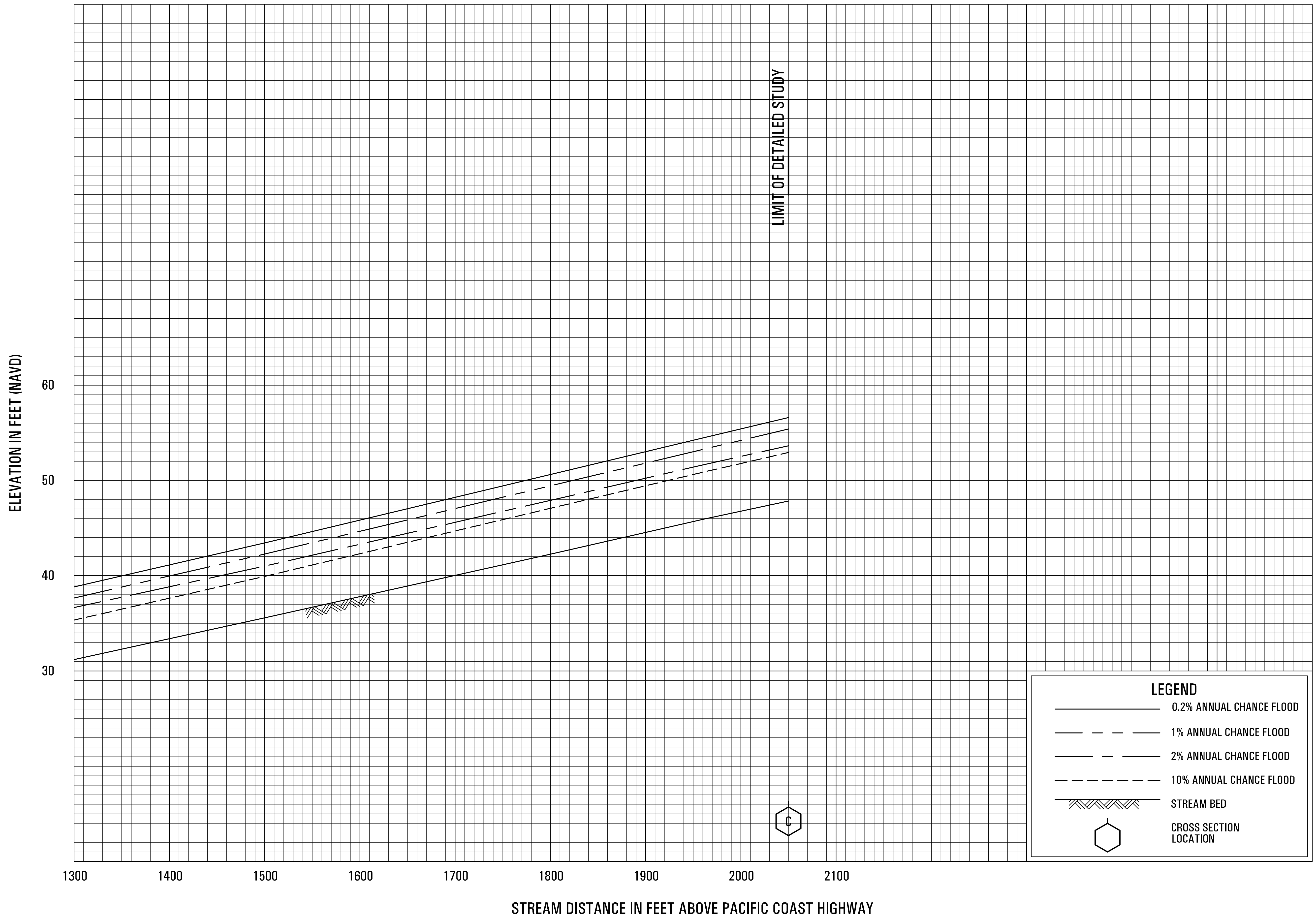
FLOOD PROFILES

ESCONDIDO CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



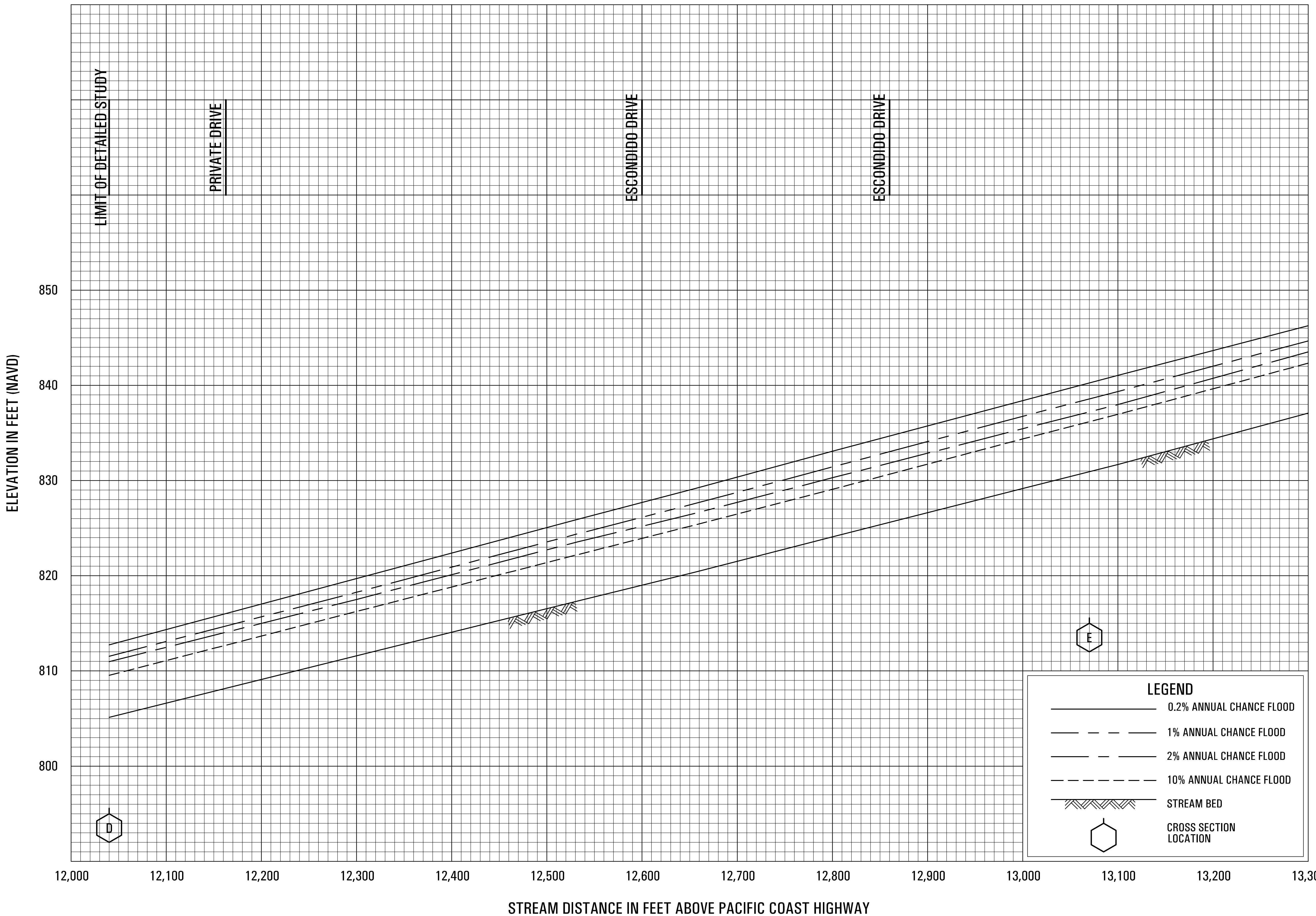
FLOOD PROFILES

ESCONDIDO CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



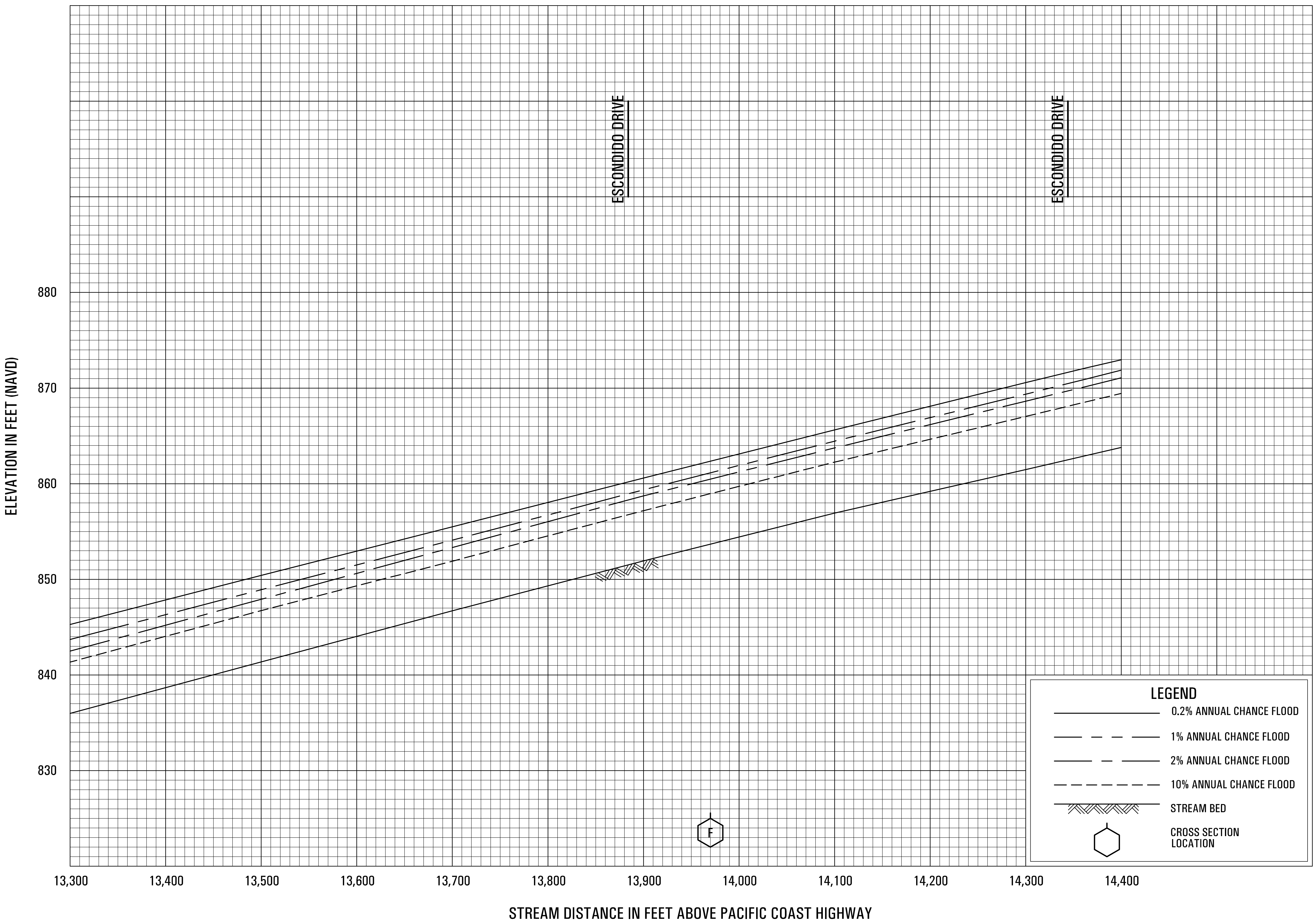
FLOOD PROFILES

ESCONDIDO CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



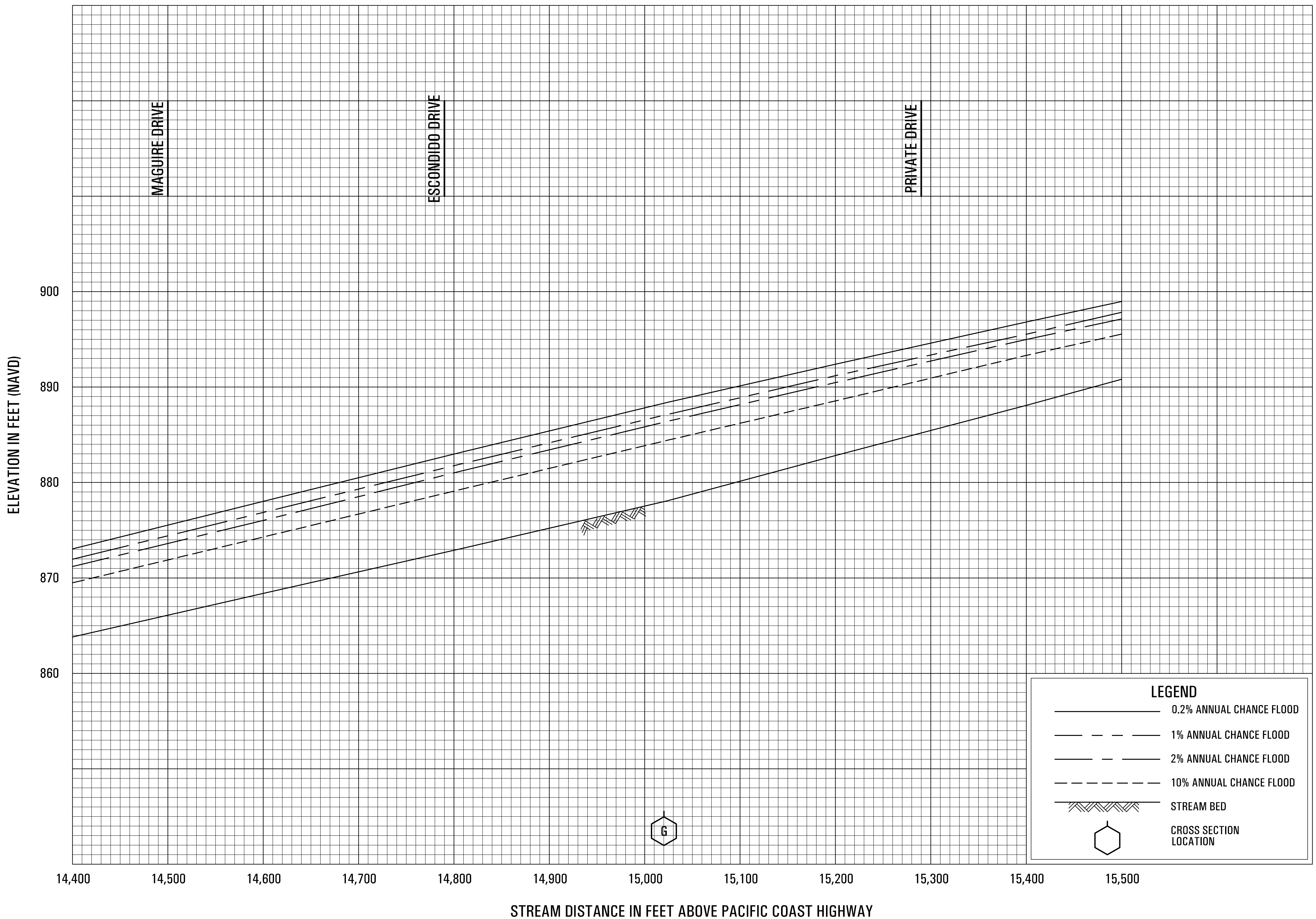
FLOOD PROFILES

ESCONDIDO CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



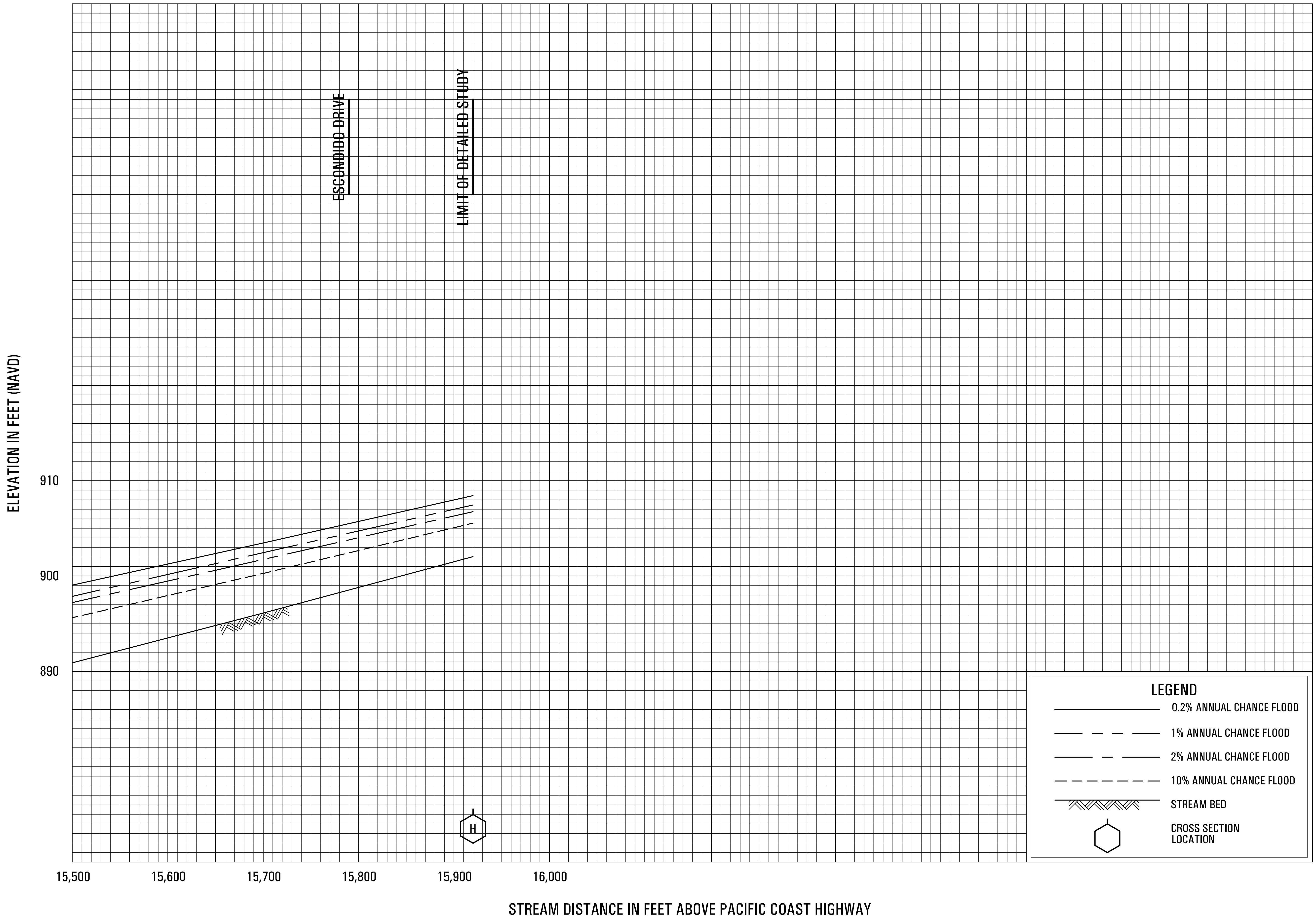
FLOOD PROFILES

ESCONDIDO CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



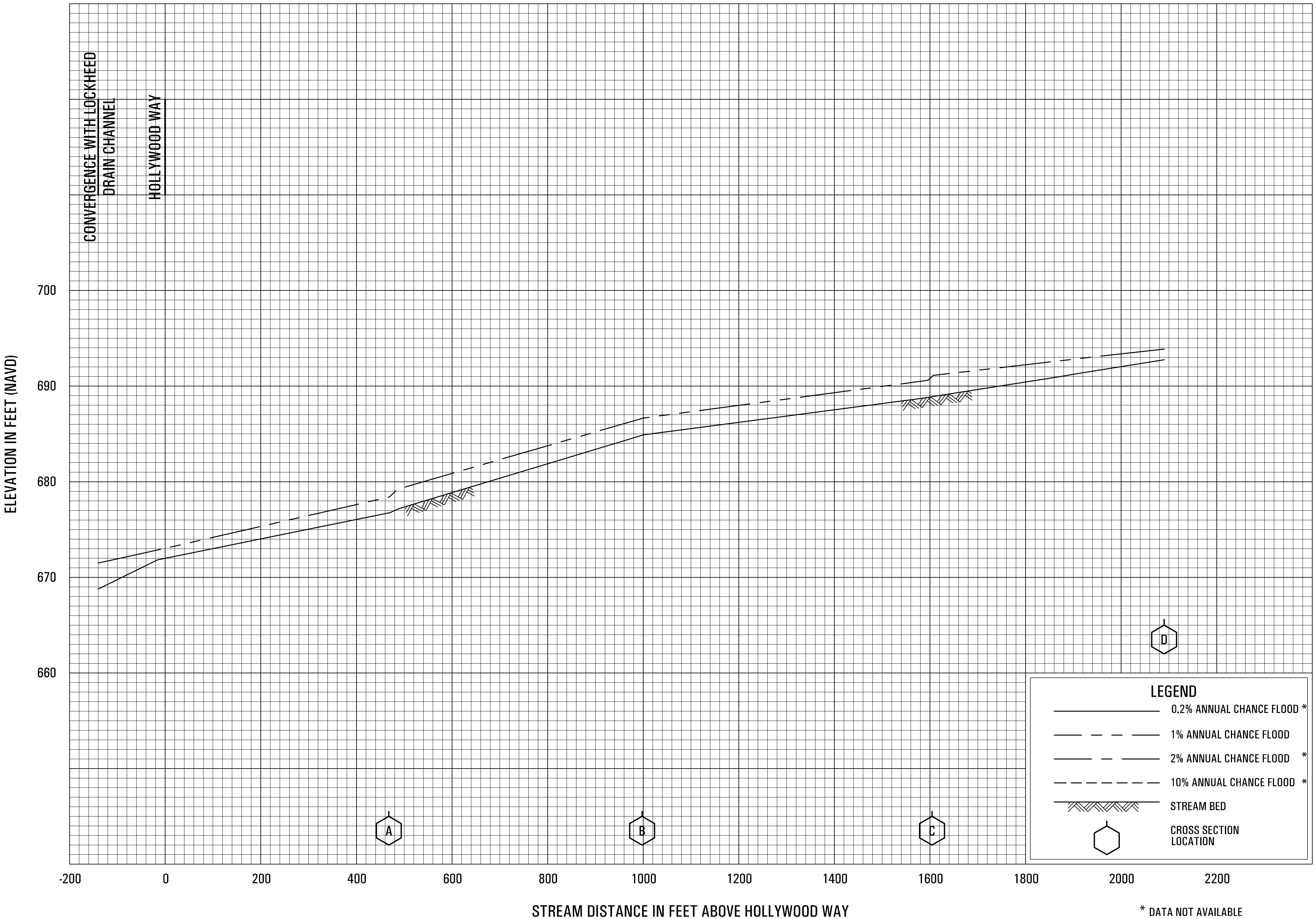
FLOOD PROFILES

ESCONDIDO CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



FLOOD PROFILES

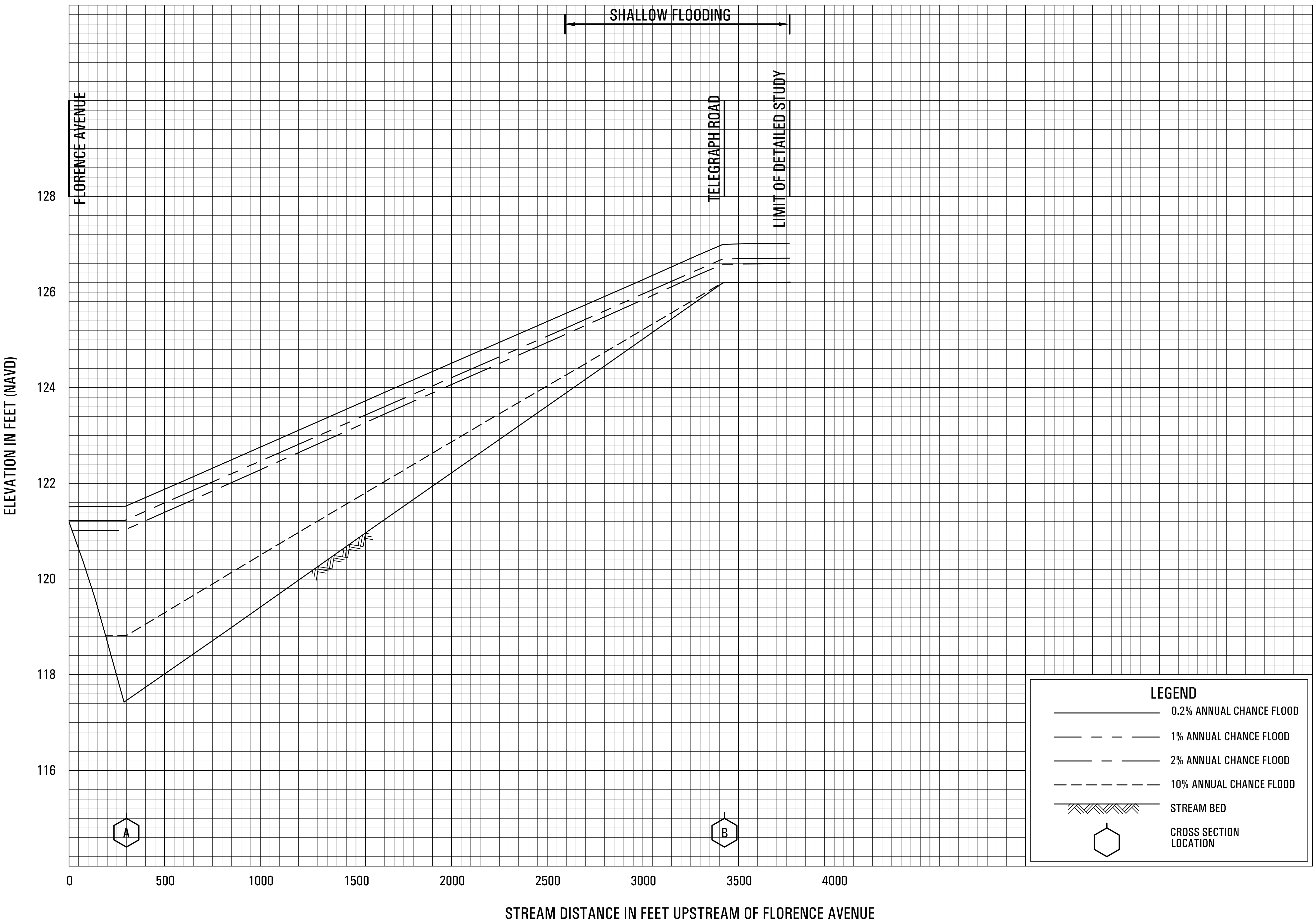
FLOW ALONG EMPIRE AVENUE

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS

40P



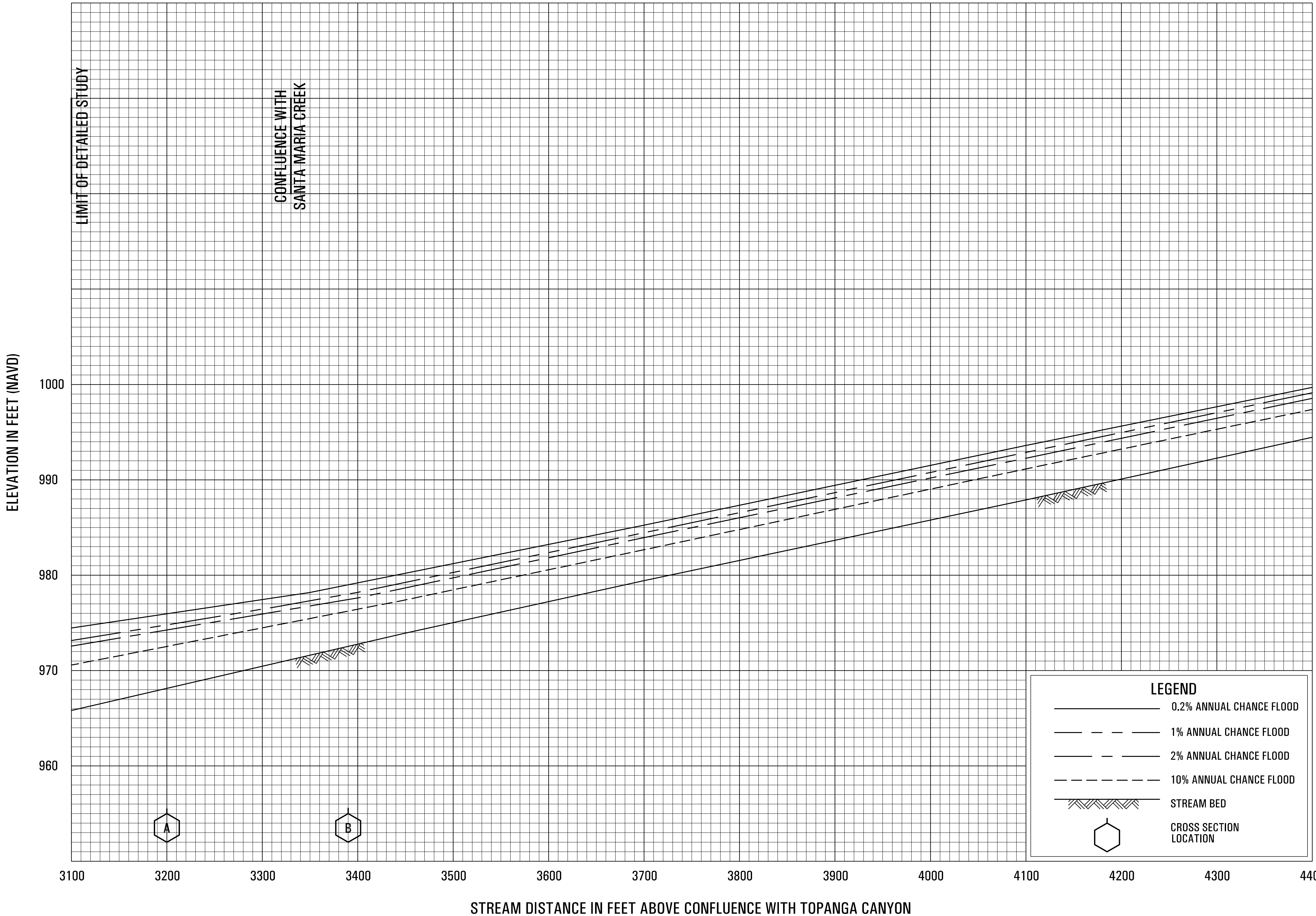
FLOOD PROFILES

FLOWLINE NO.1

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



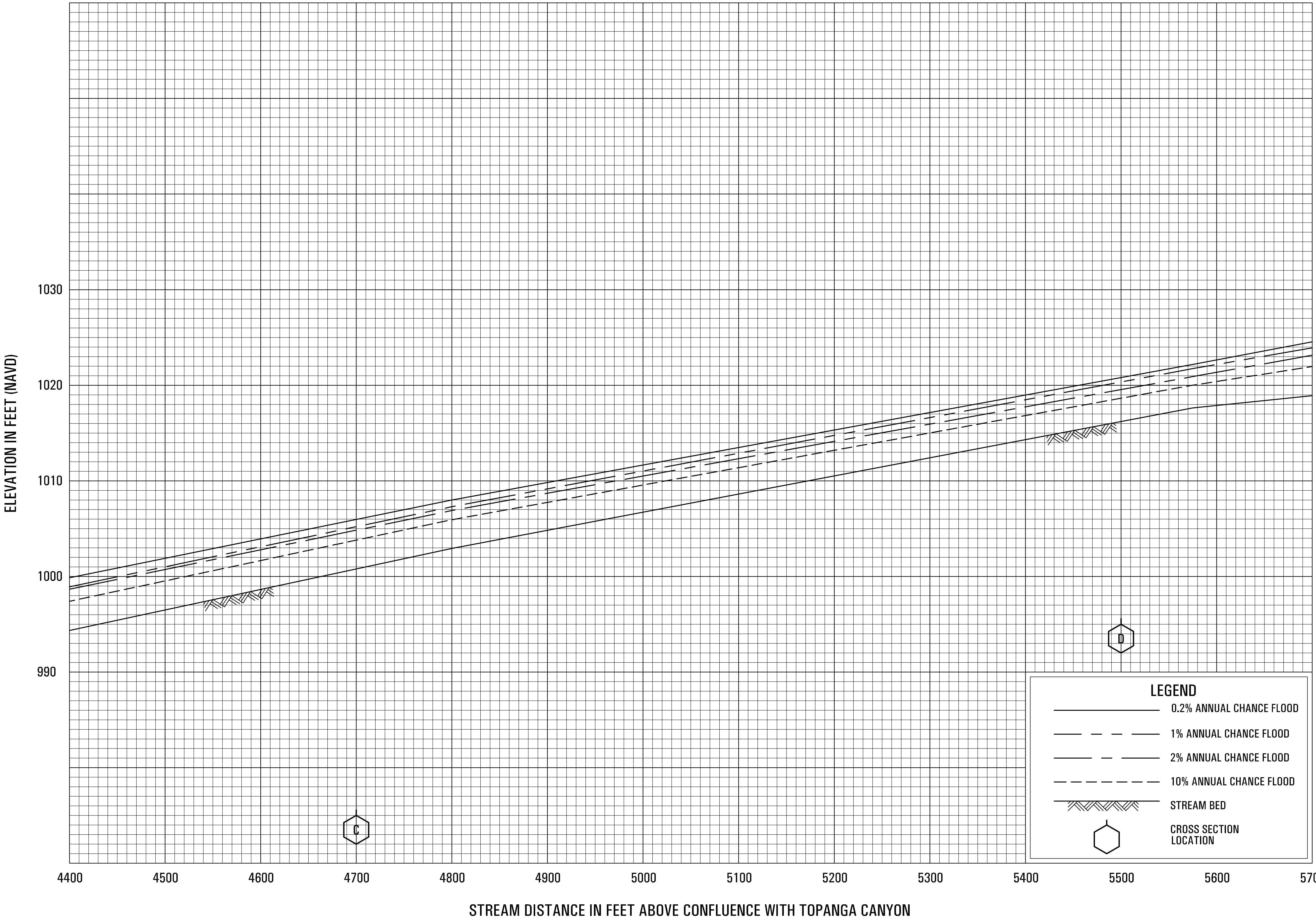
FLOOD PROFILES

GARAPITO CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



FLOOD PROFILES

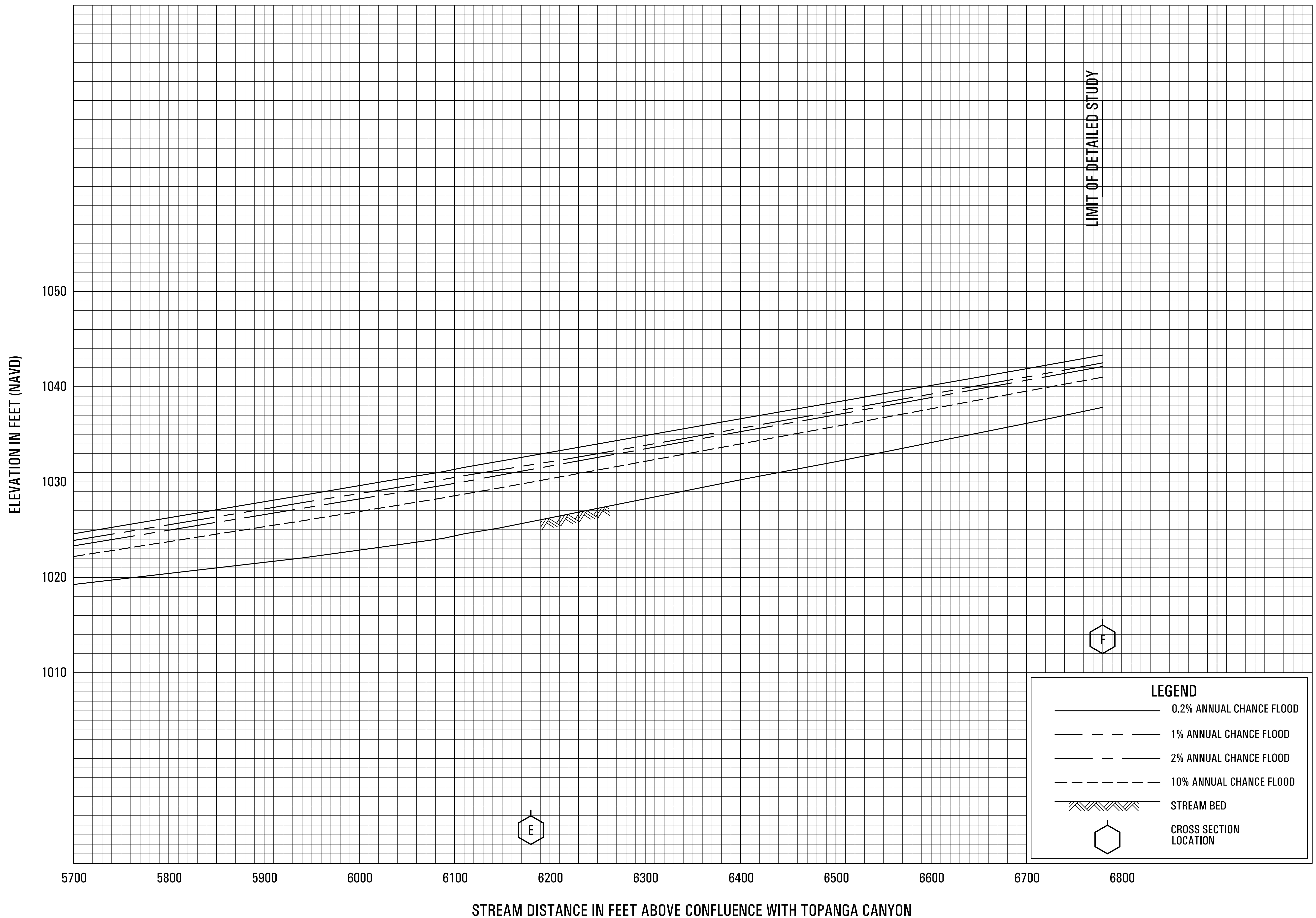
GARAPITO CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS

43P



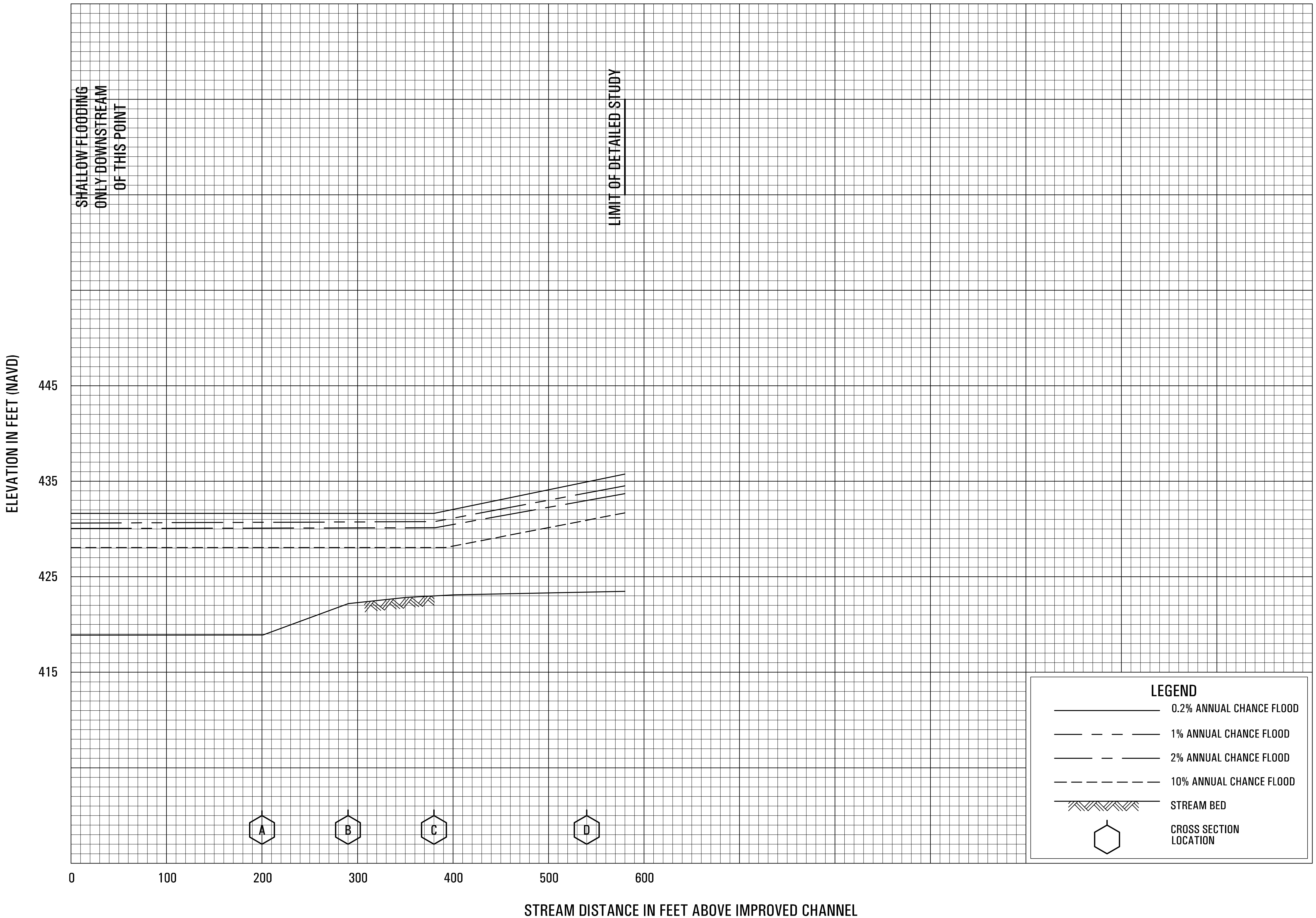
FLOOD PROFILES

GARAPITO CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



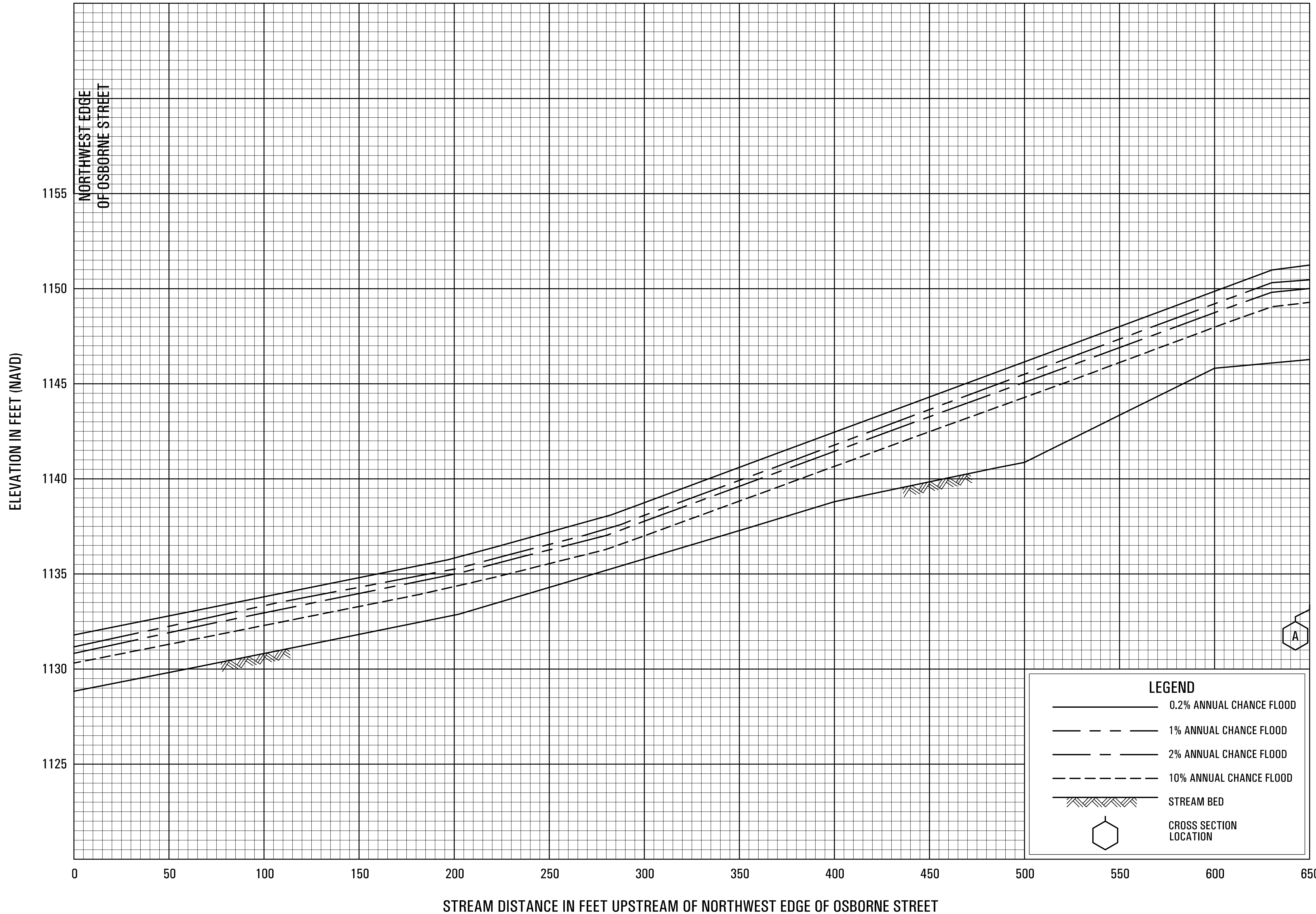
FLOOD PROFILES

HACIENDA CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



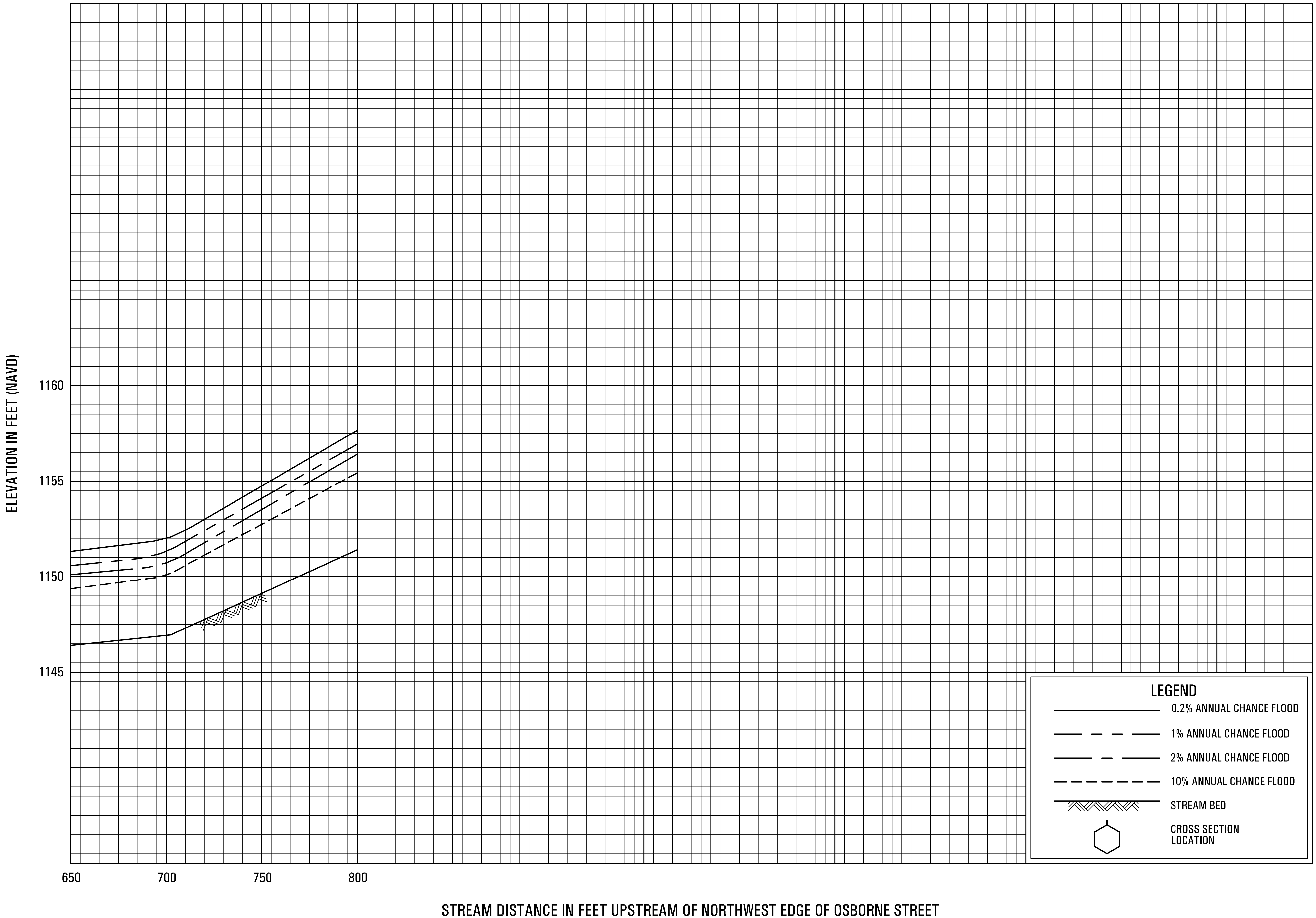
FLOOD PROFILES

KAGEL CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



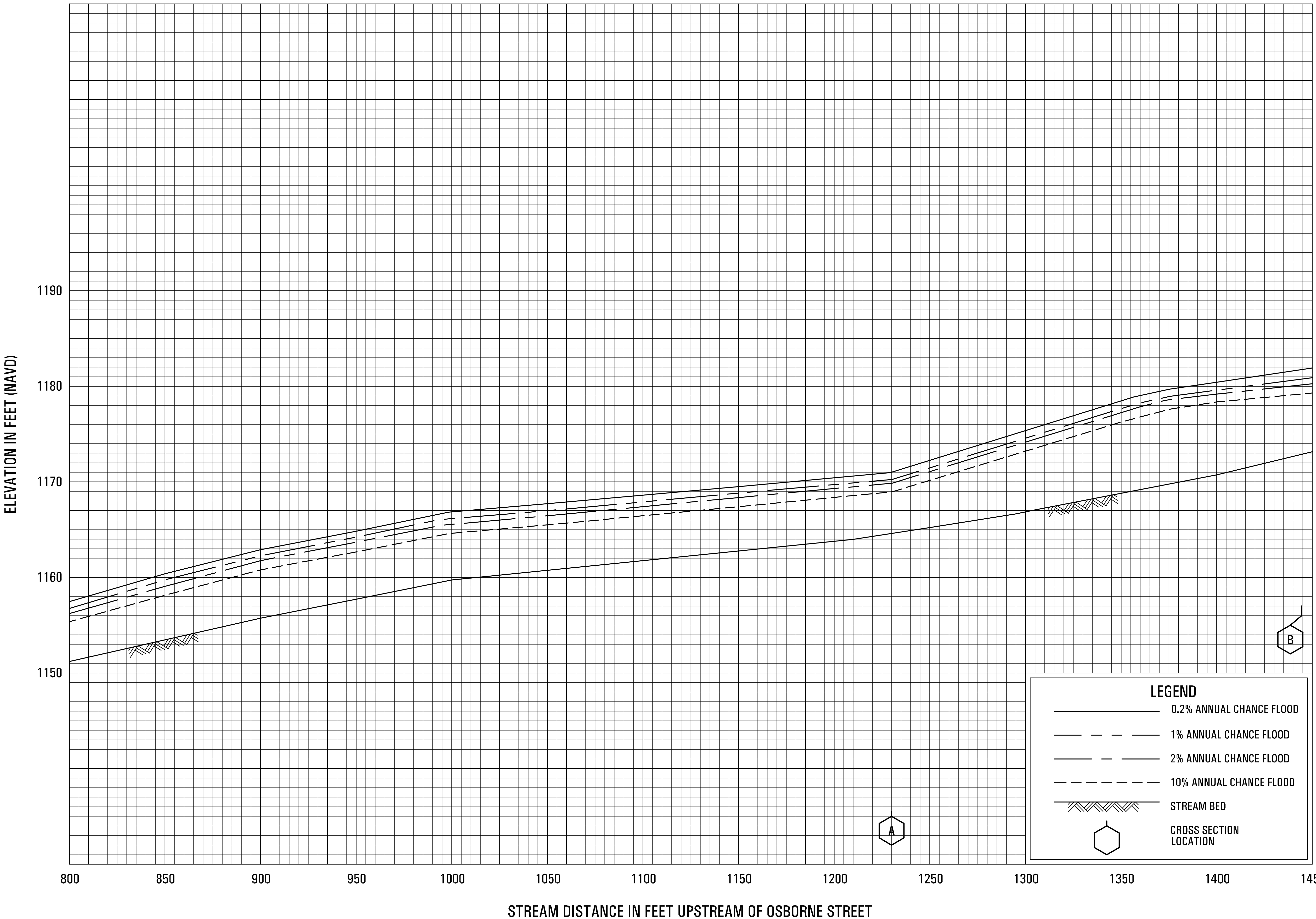
FLOOD PROFILES

KAGEL CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



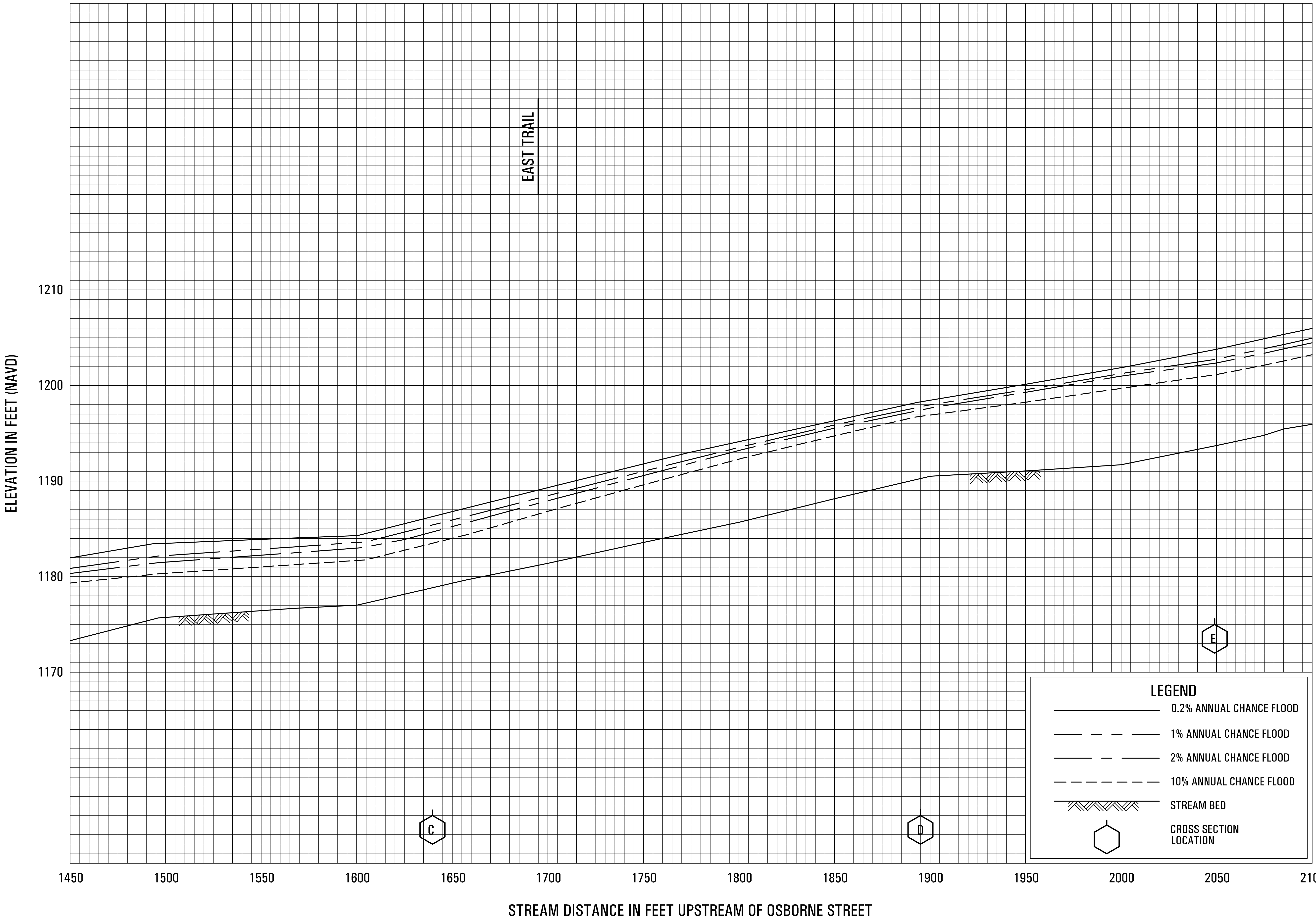
FLOOD PROFILES

KAGEL CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



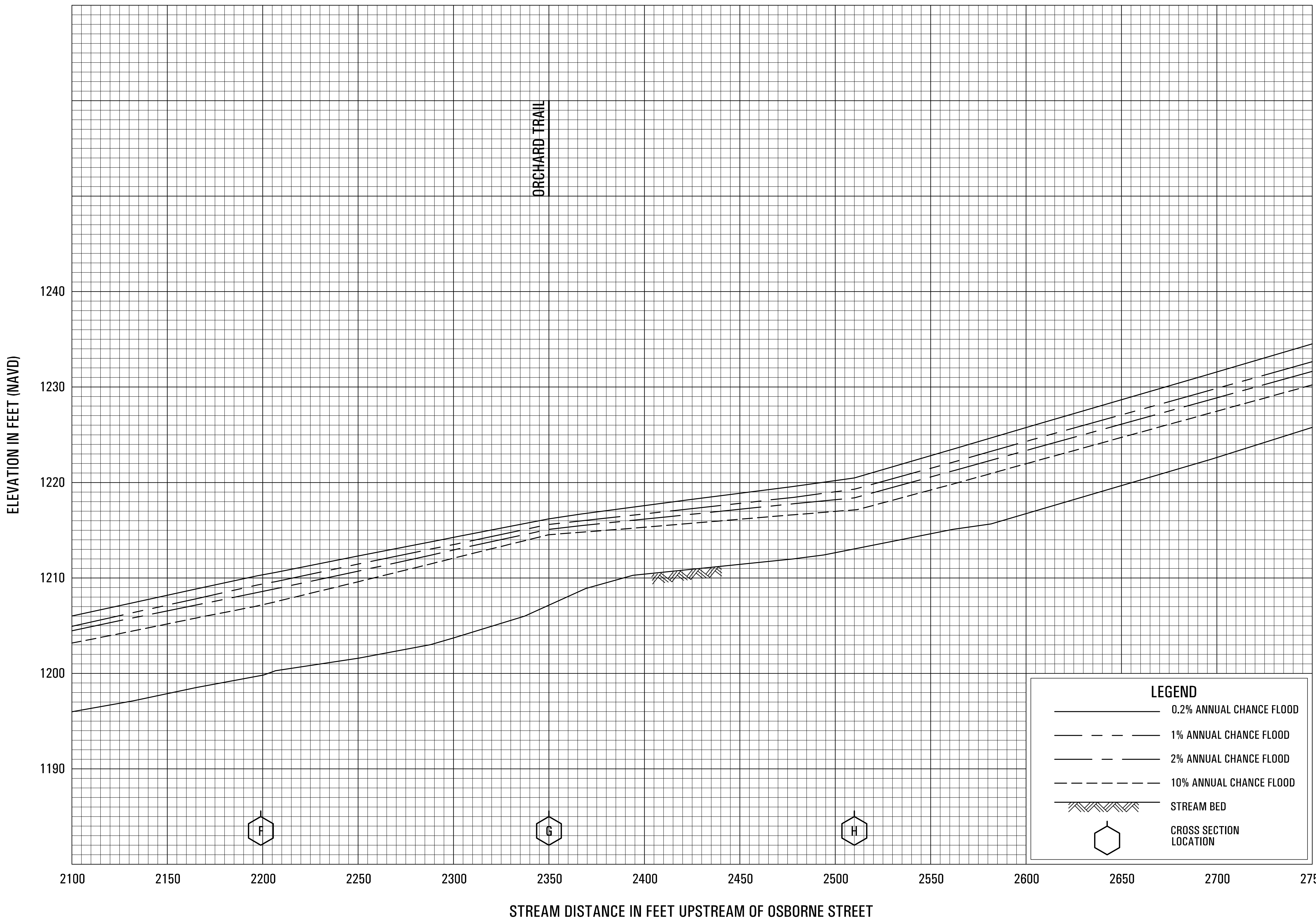
FLOOD PROFILES

KAGEL CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



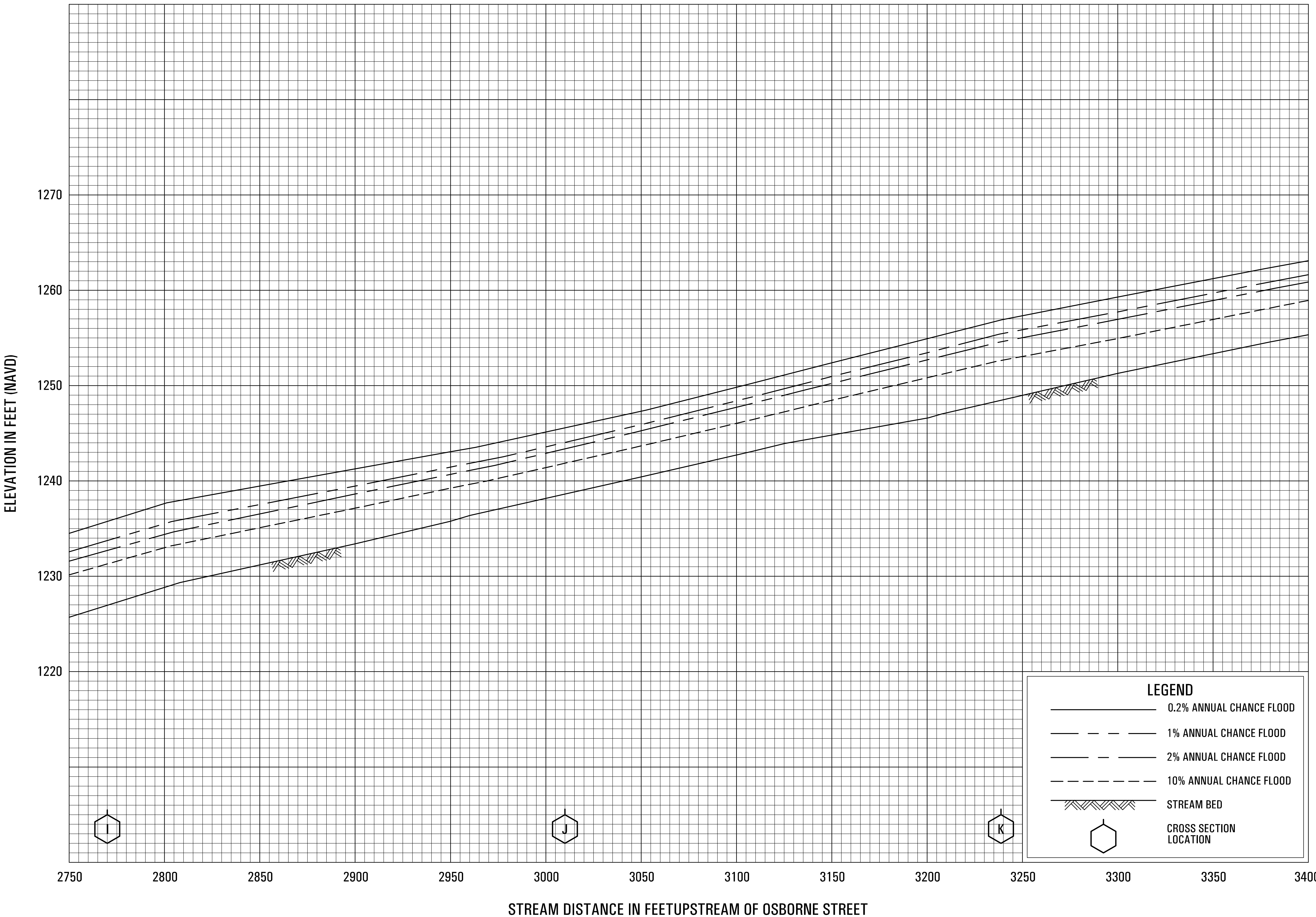
FLOOD PROFILES

KAGEL CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



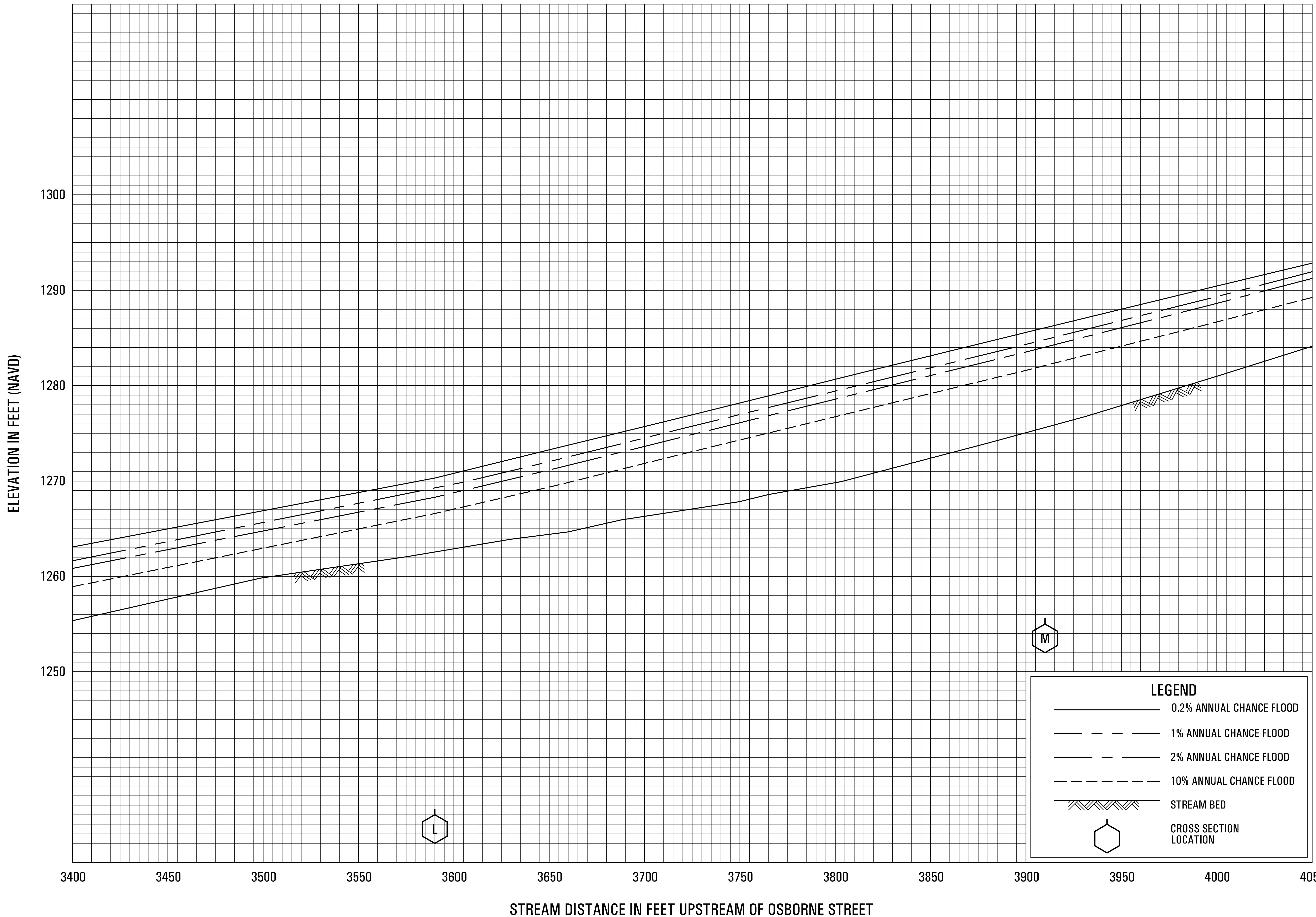
FLOOD PROFILES

KAGEL CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



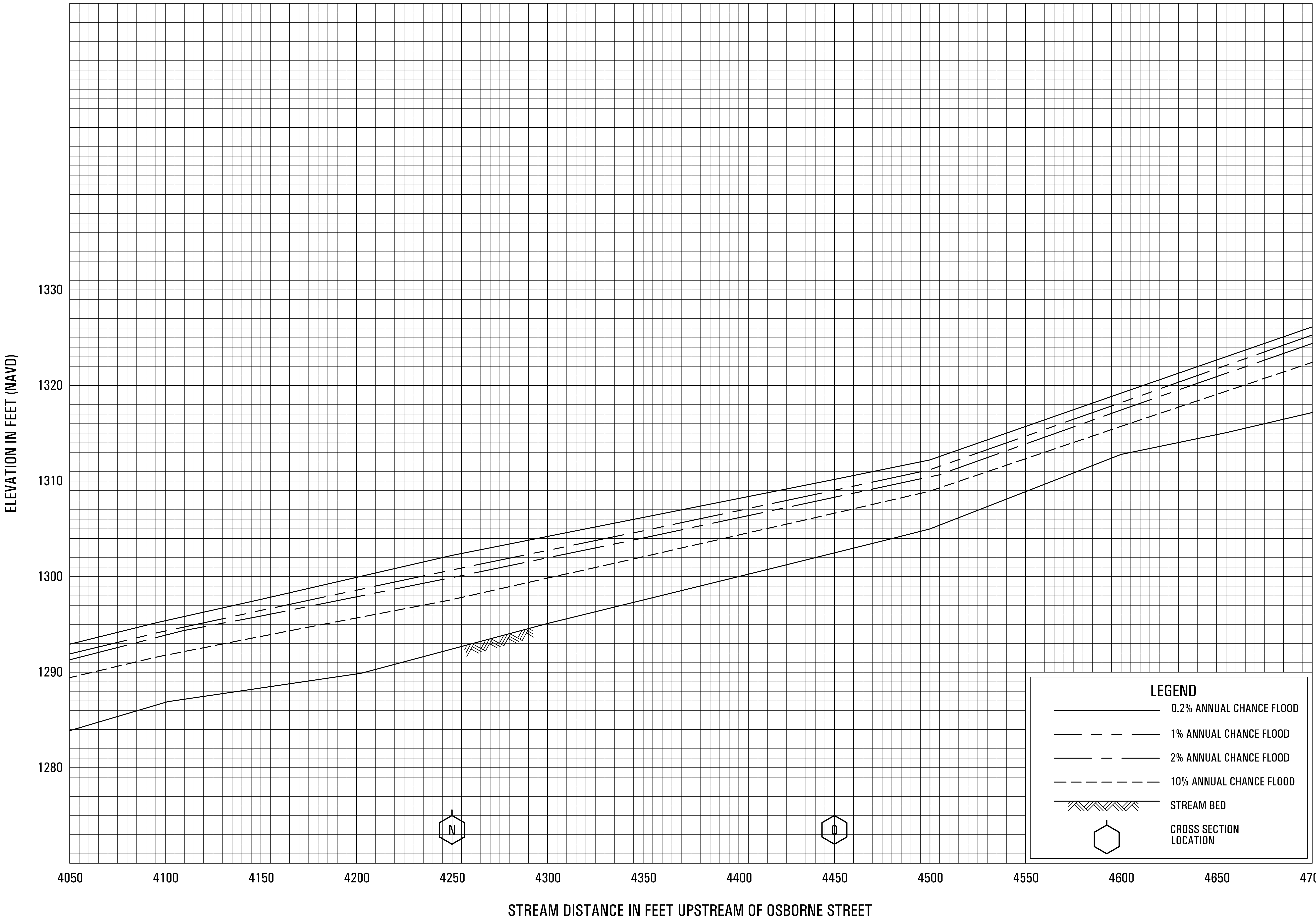
FLOOD PROFILES

KAGEL CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



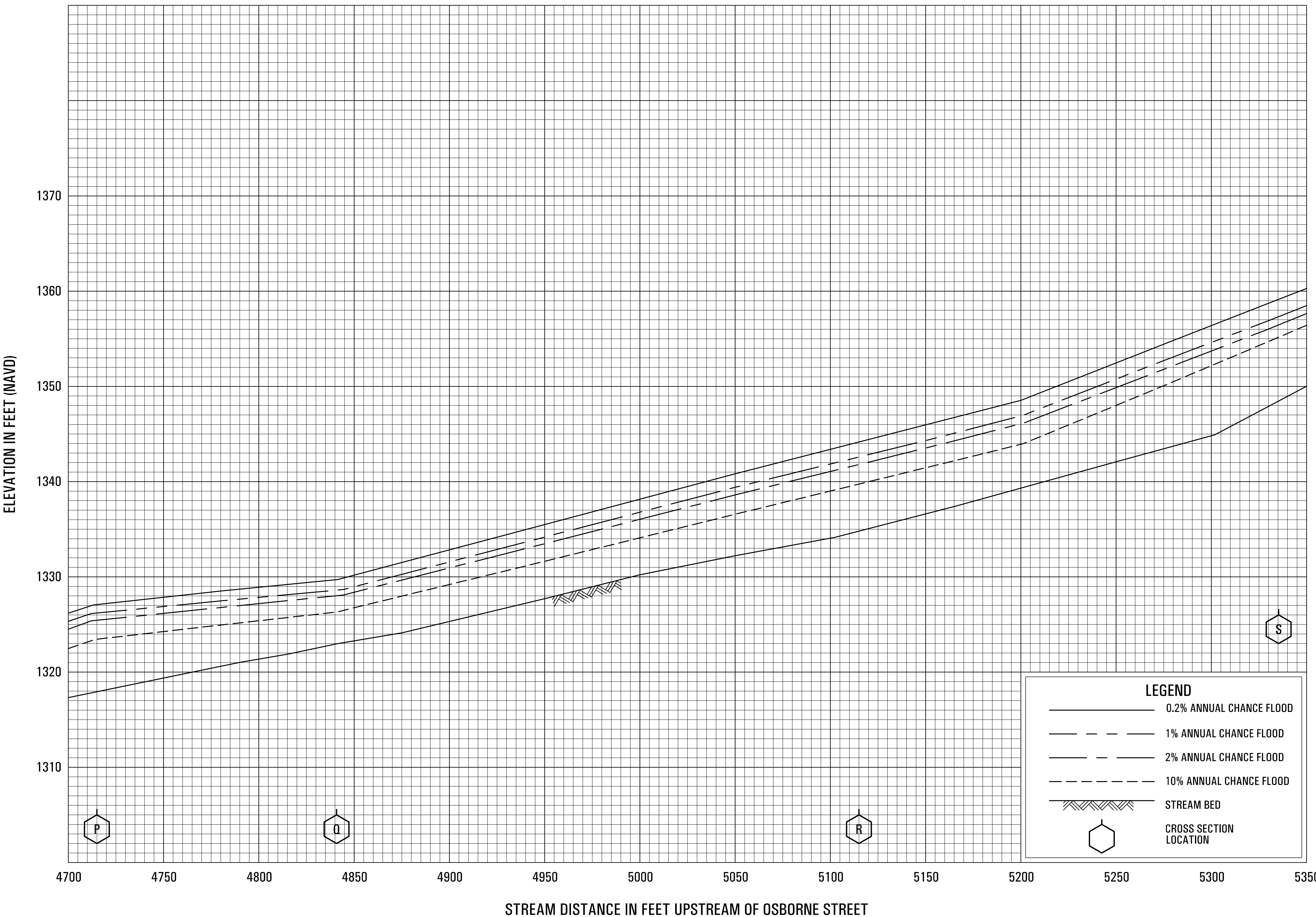
FLOOD PROFILES

KAGEL CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



FLOOD PROFILES

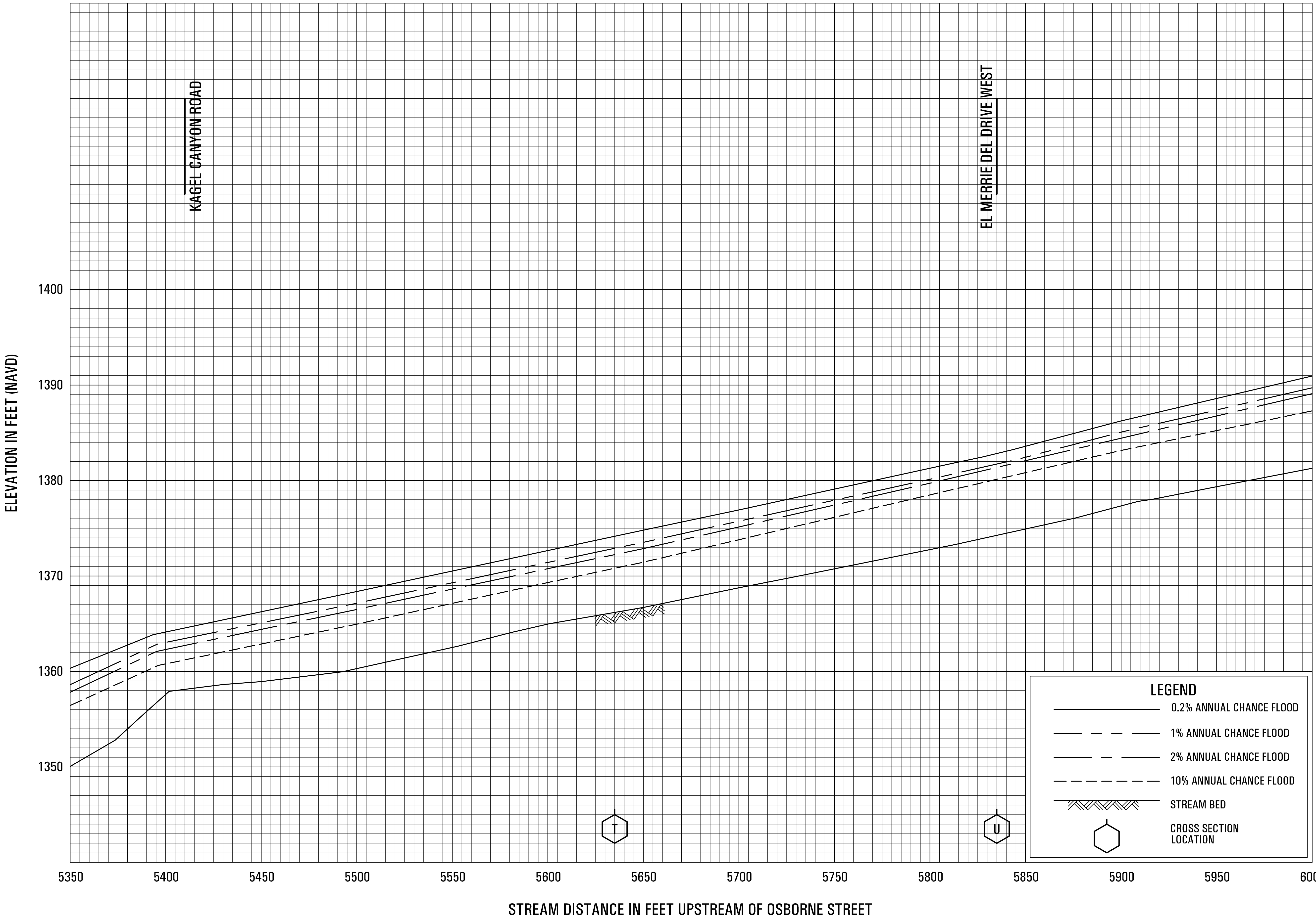
KAGEL CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS

54P



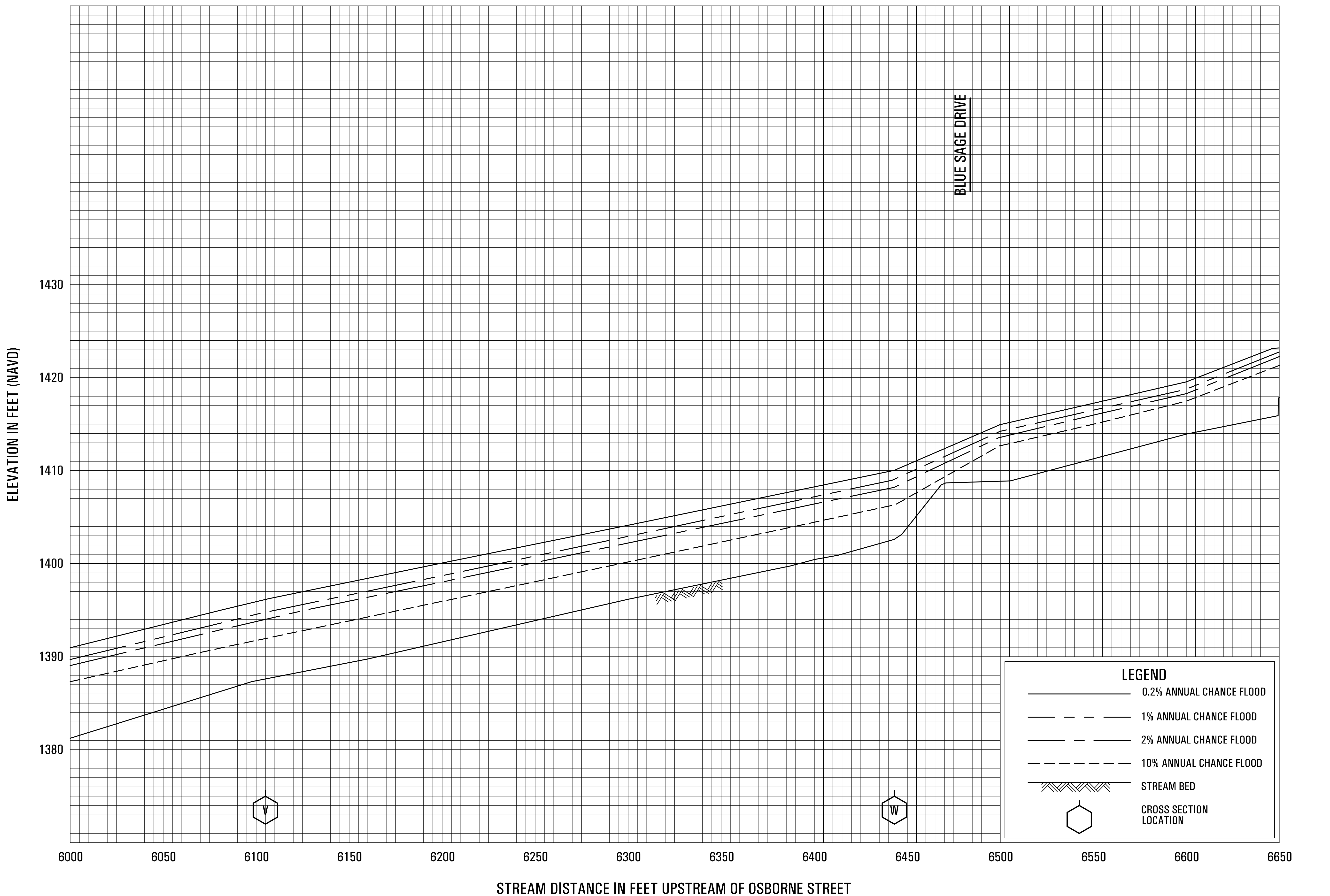
FLOOD PROFILES

KAGEL CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



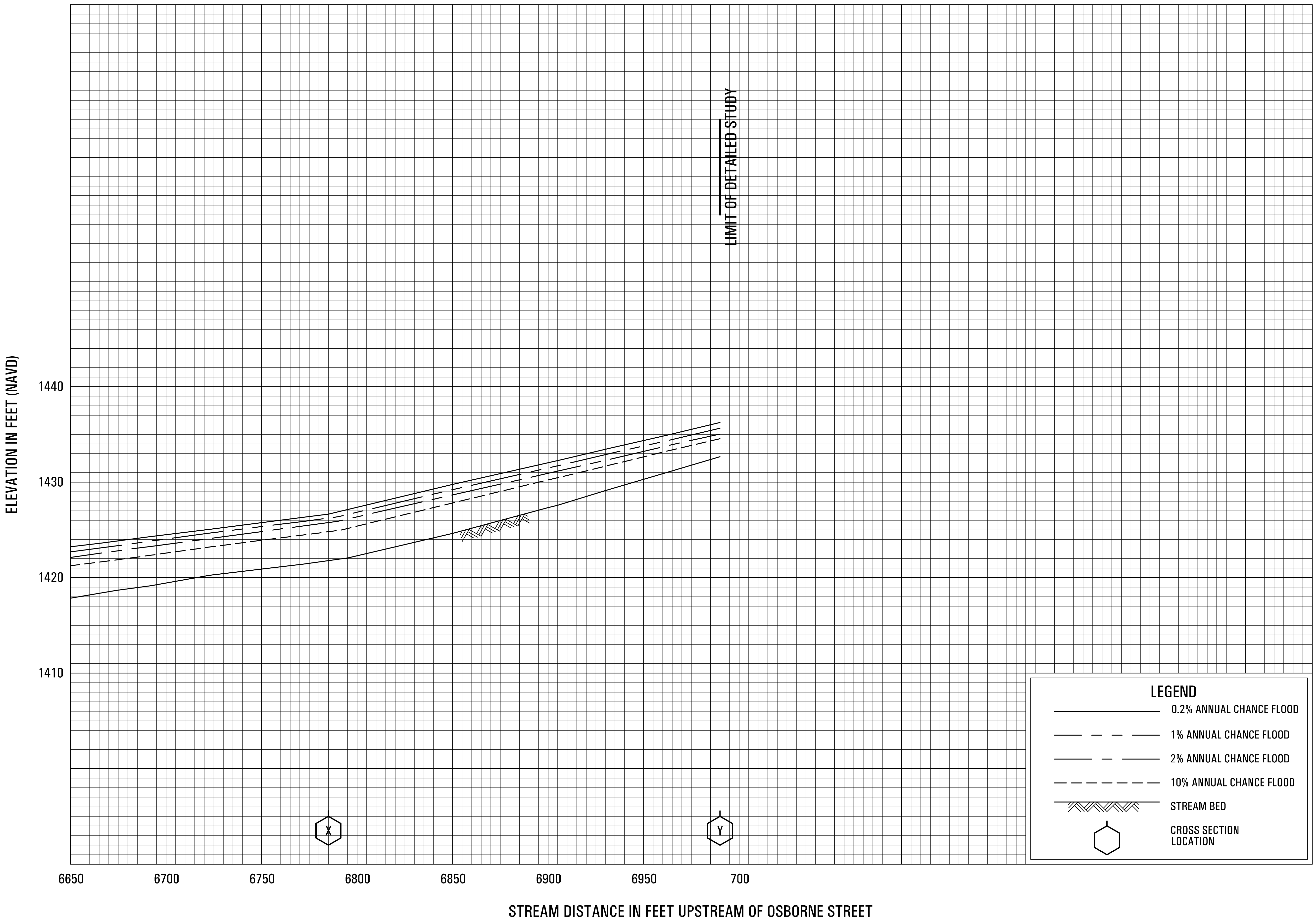
FLOOD PROFILES

KAGEL CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



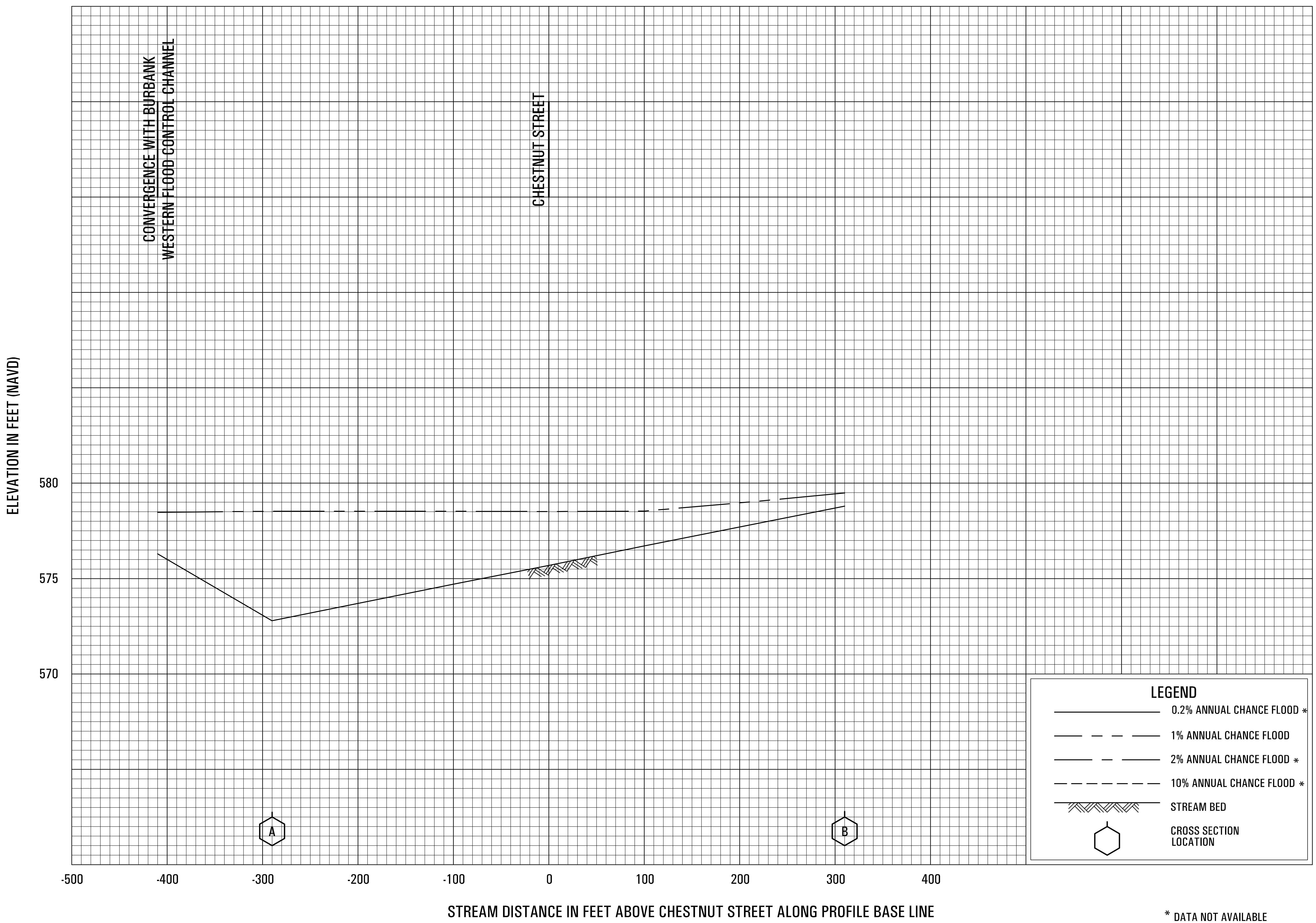
FLOOD PROFILES

KAGEL CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



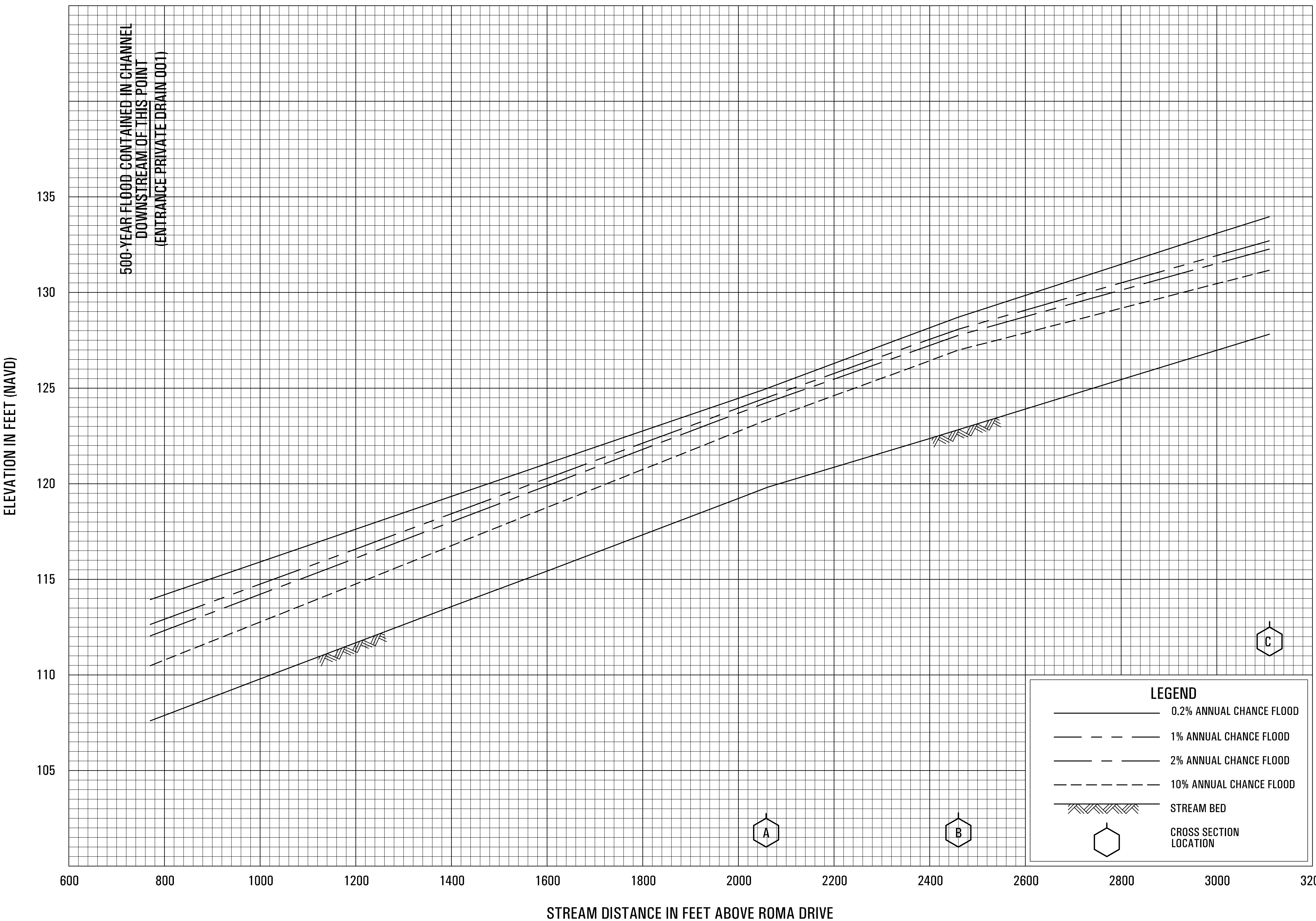
FLOOD PROFILES

LAKE STREET OVERFLOW

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



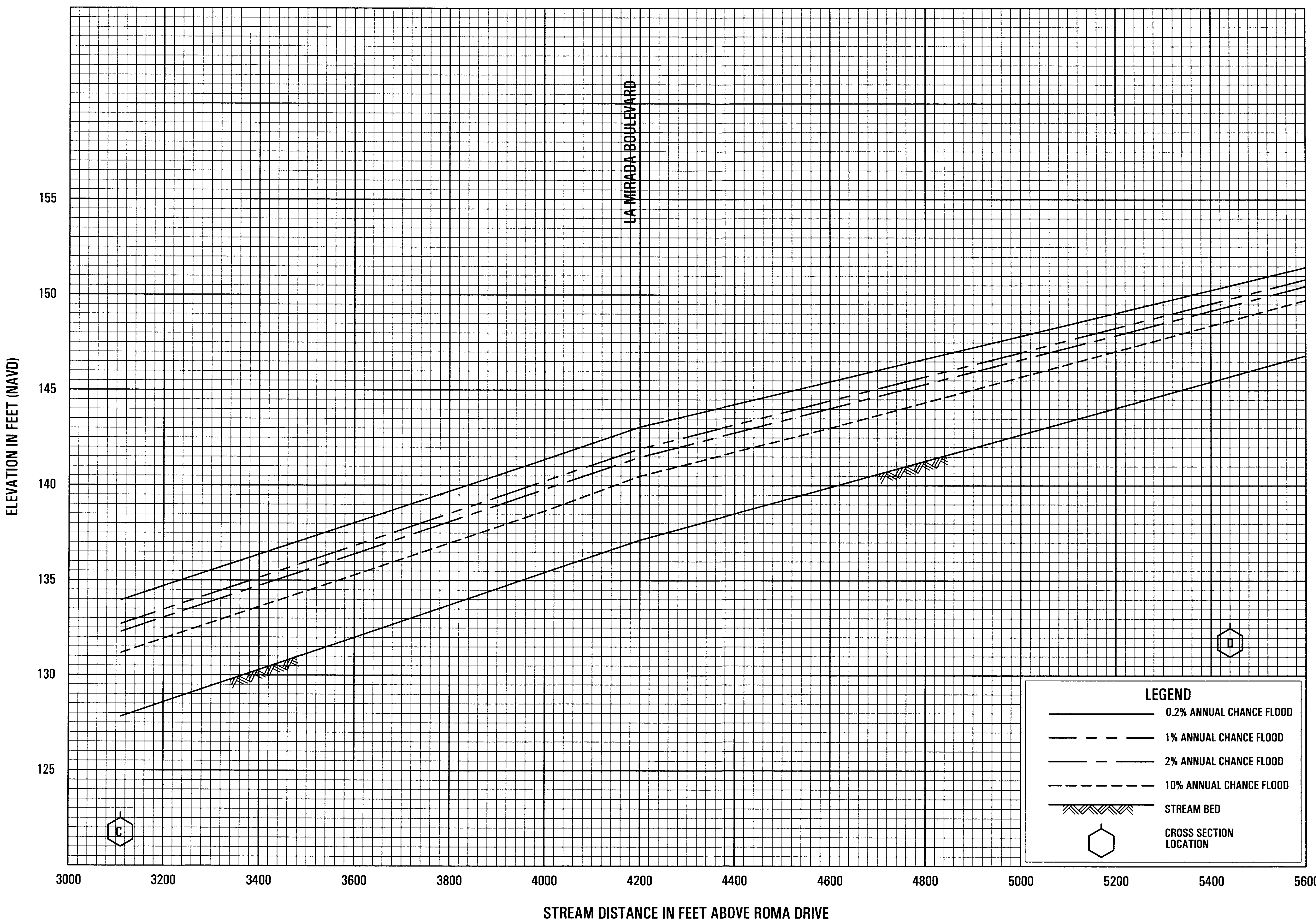
FLOOD PROFILES

LA MIRADA CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



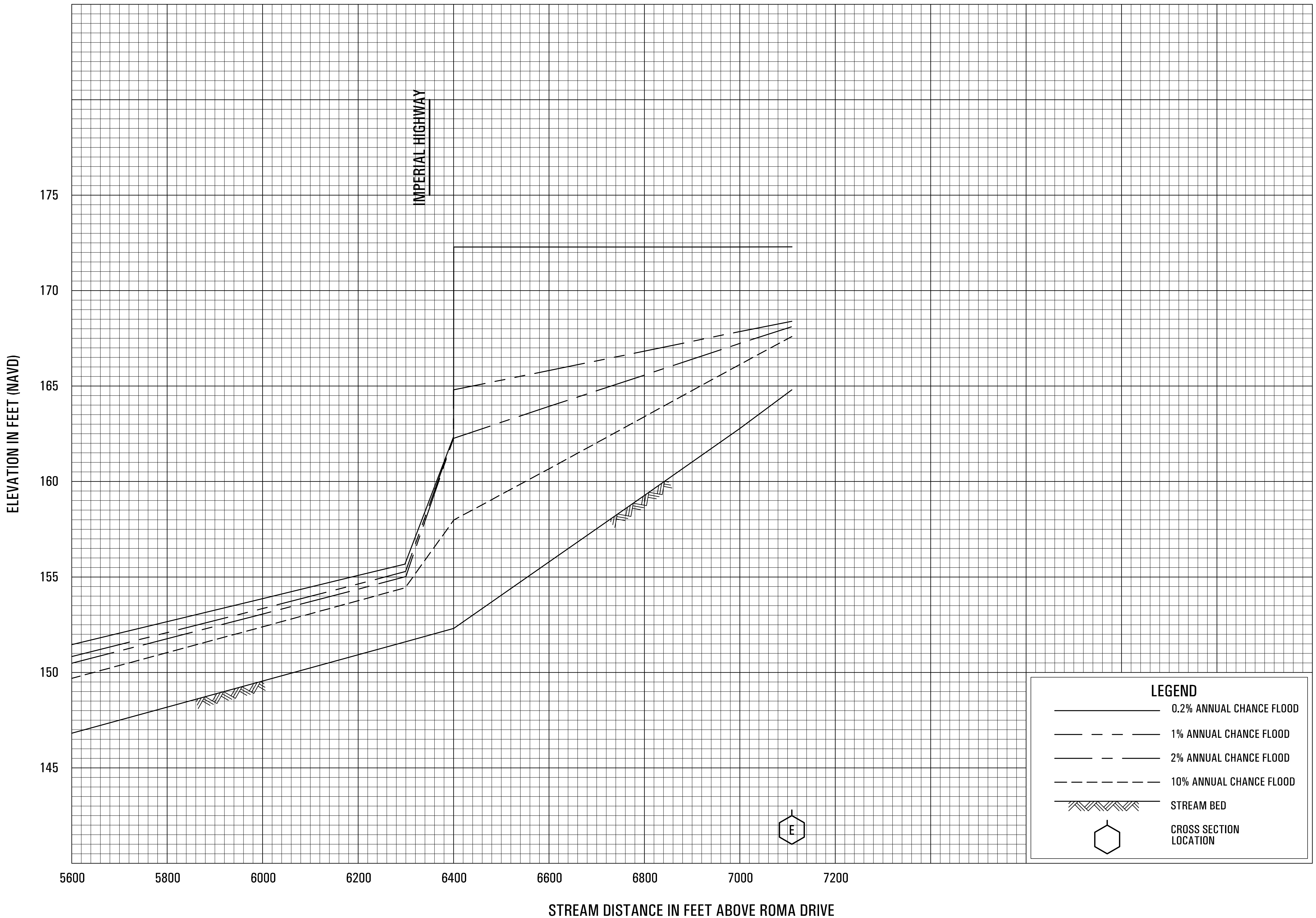
FLOOD PROFILES

LA MIRADA CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



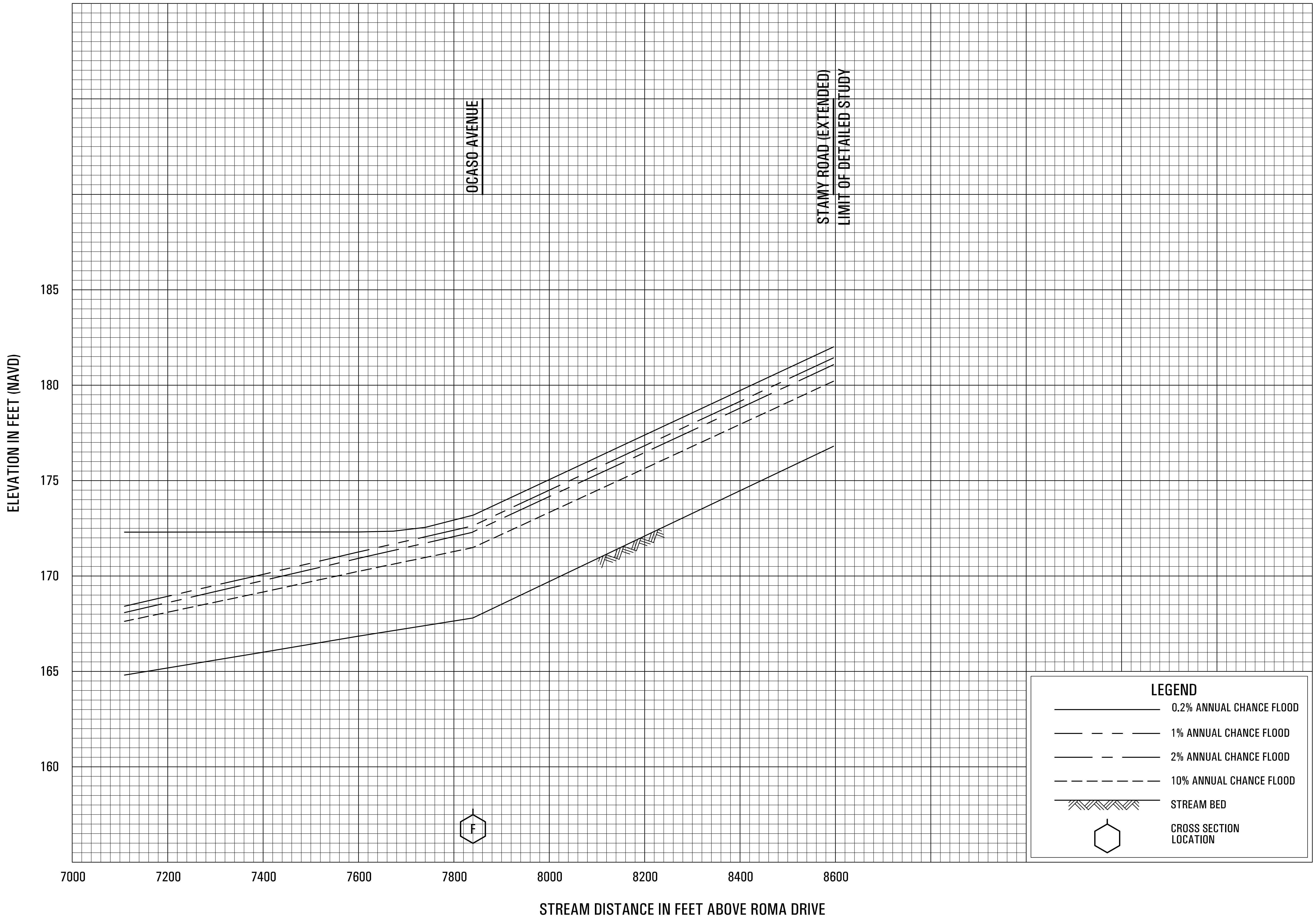
FLOOD PROFILES

LA MIRADA CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



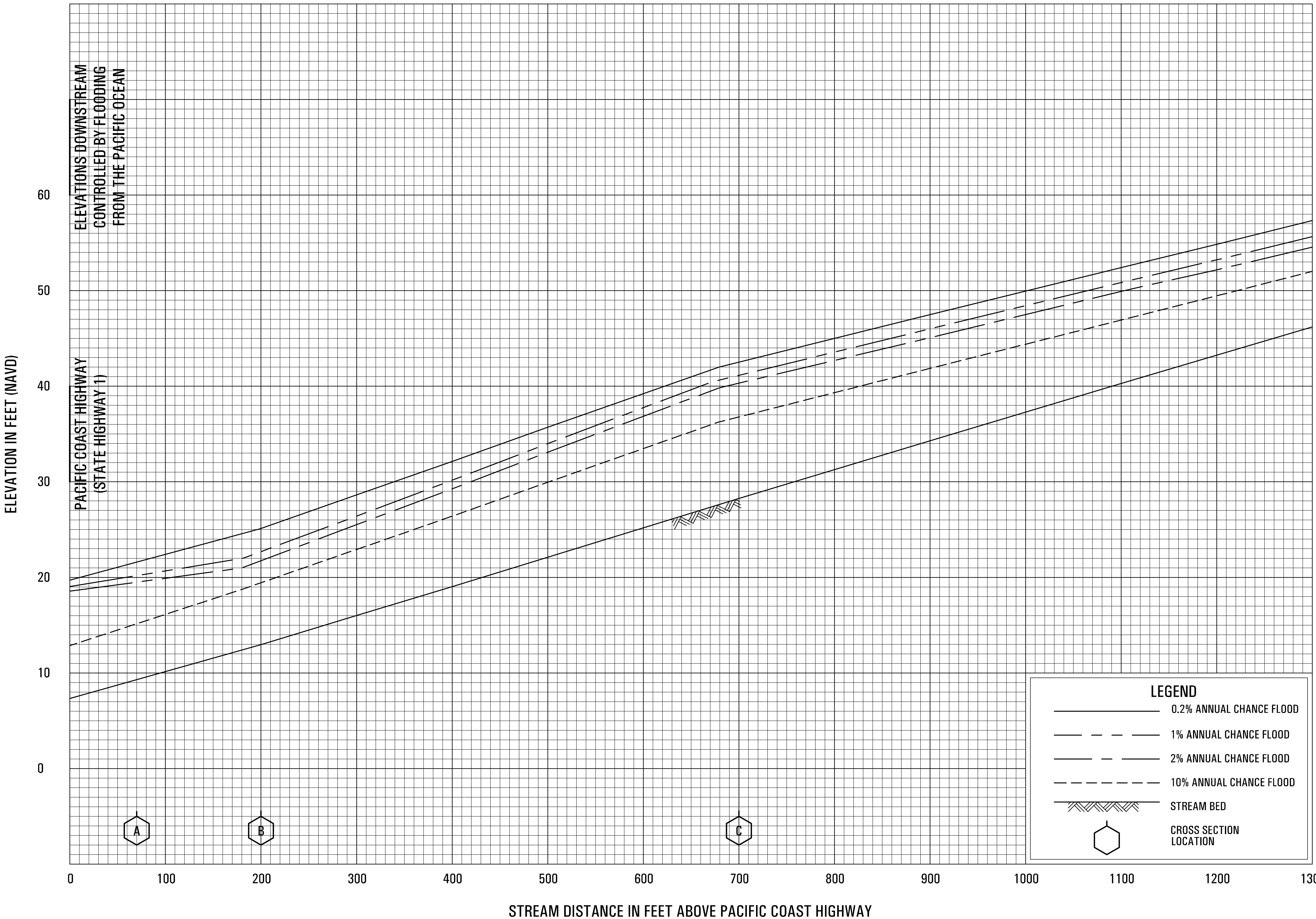
FLOOD PROFILES

LA MIRADA CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



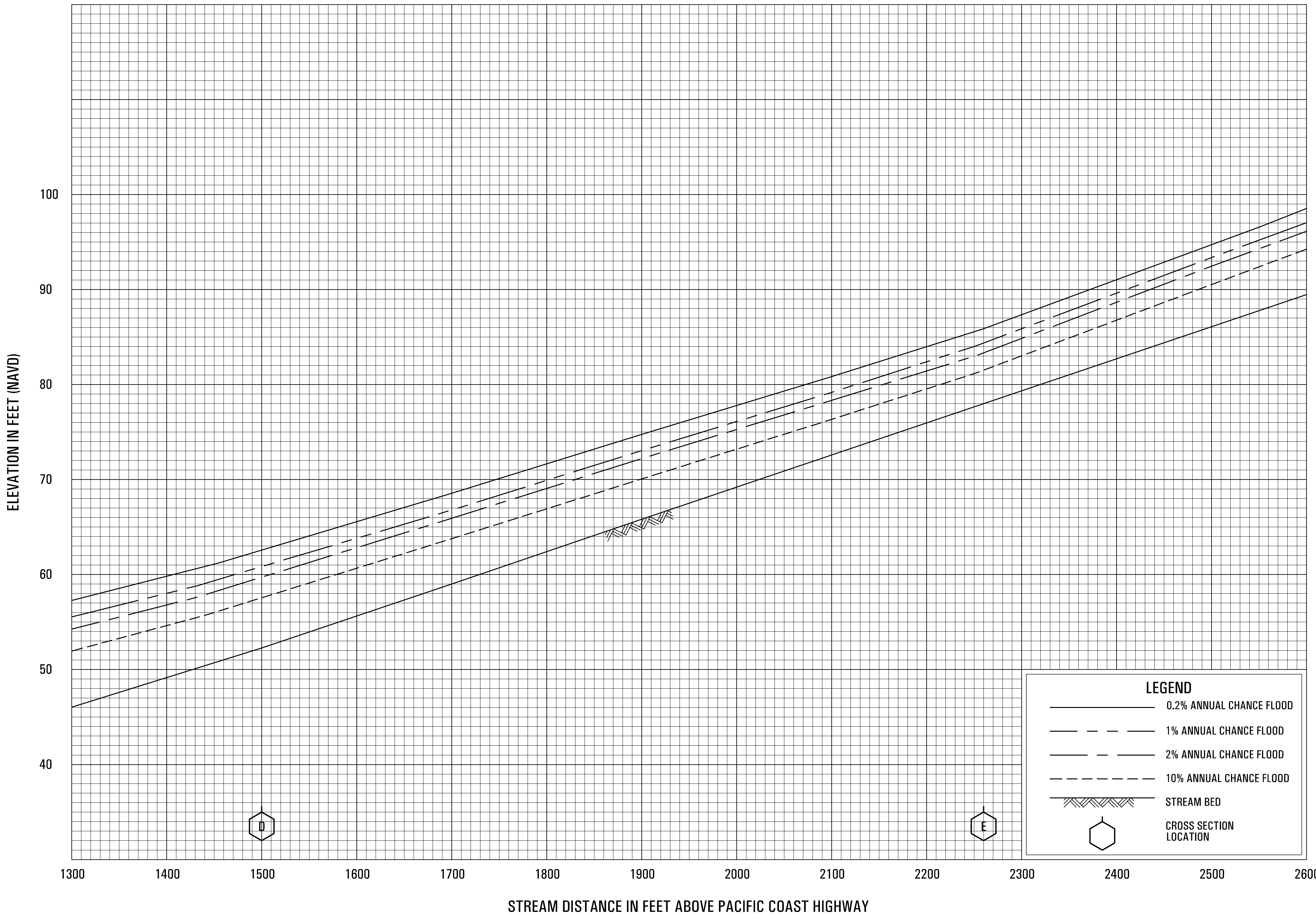
FLOOD PROFILES

LAS FLORES CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



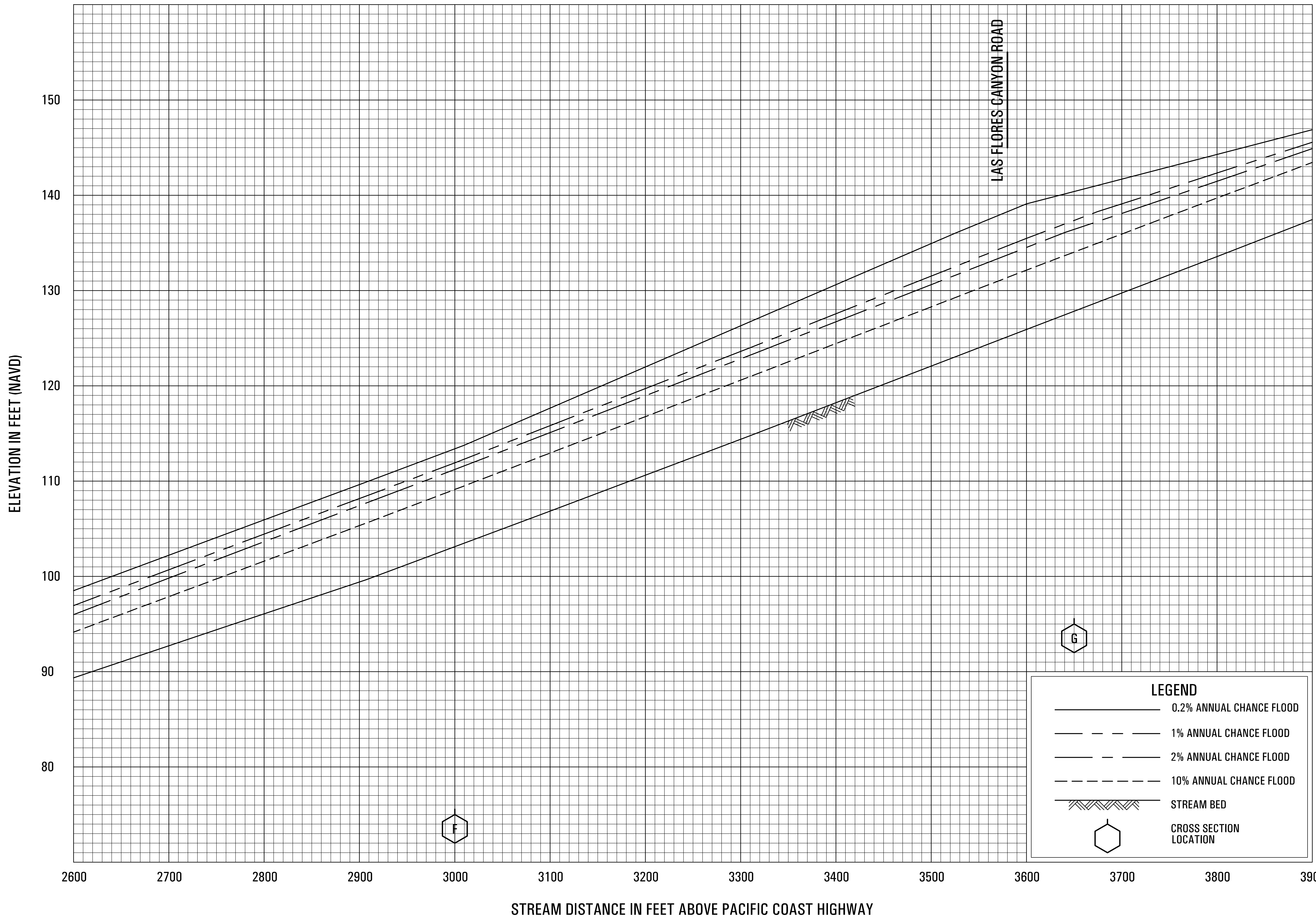
FLOOD PROFILES

LAS FLORES CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



FLOOD PROFILES

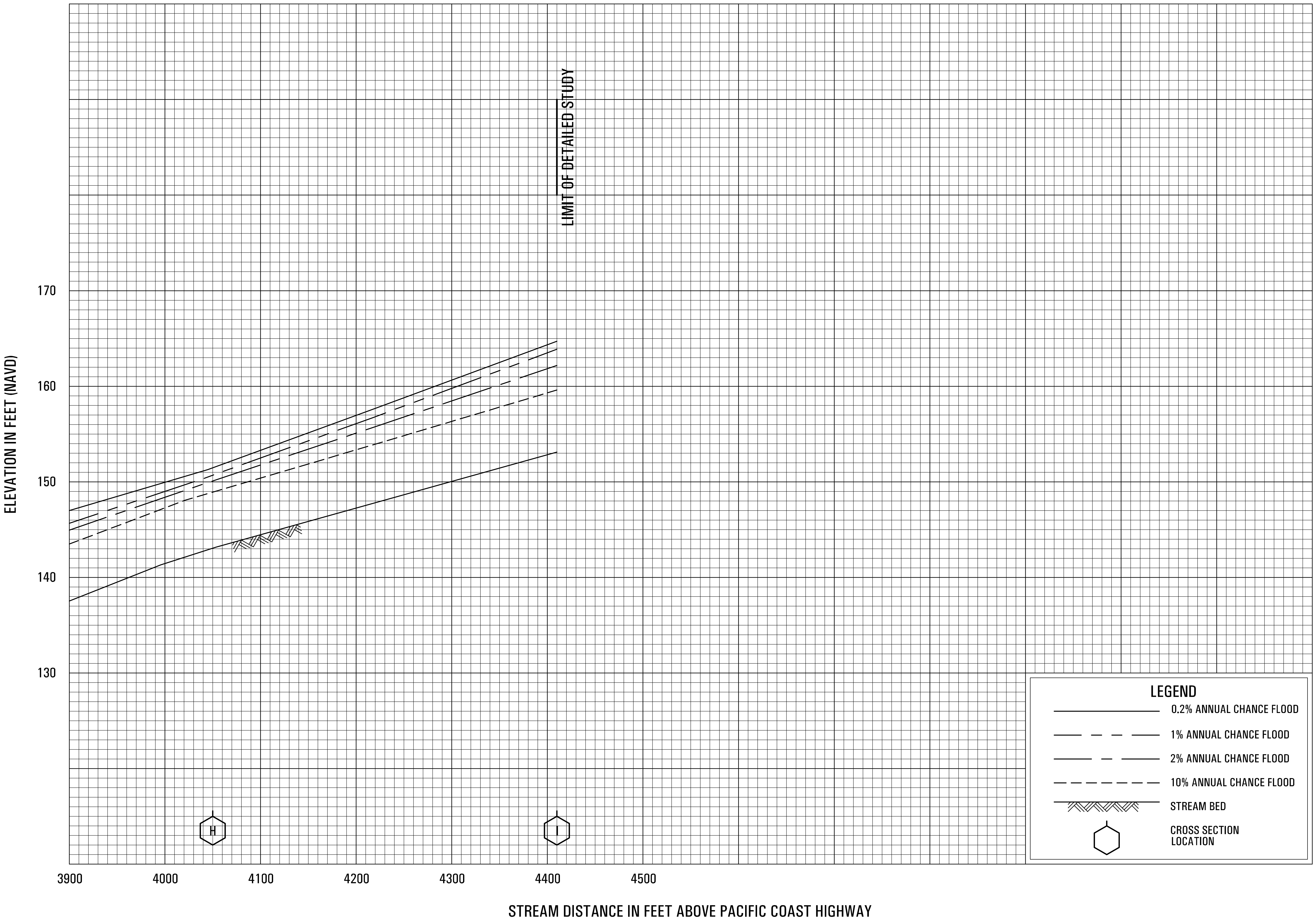
LAS FLORES CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS

65P



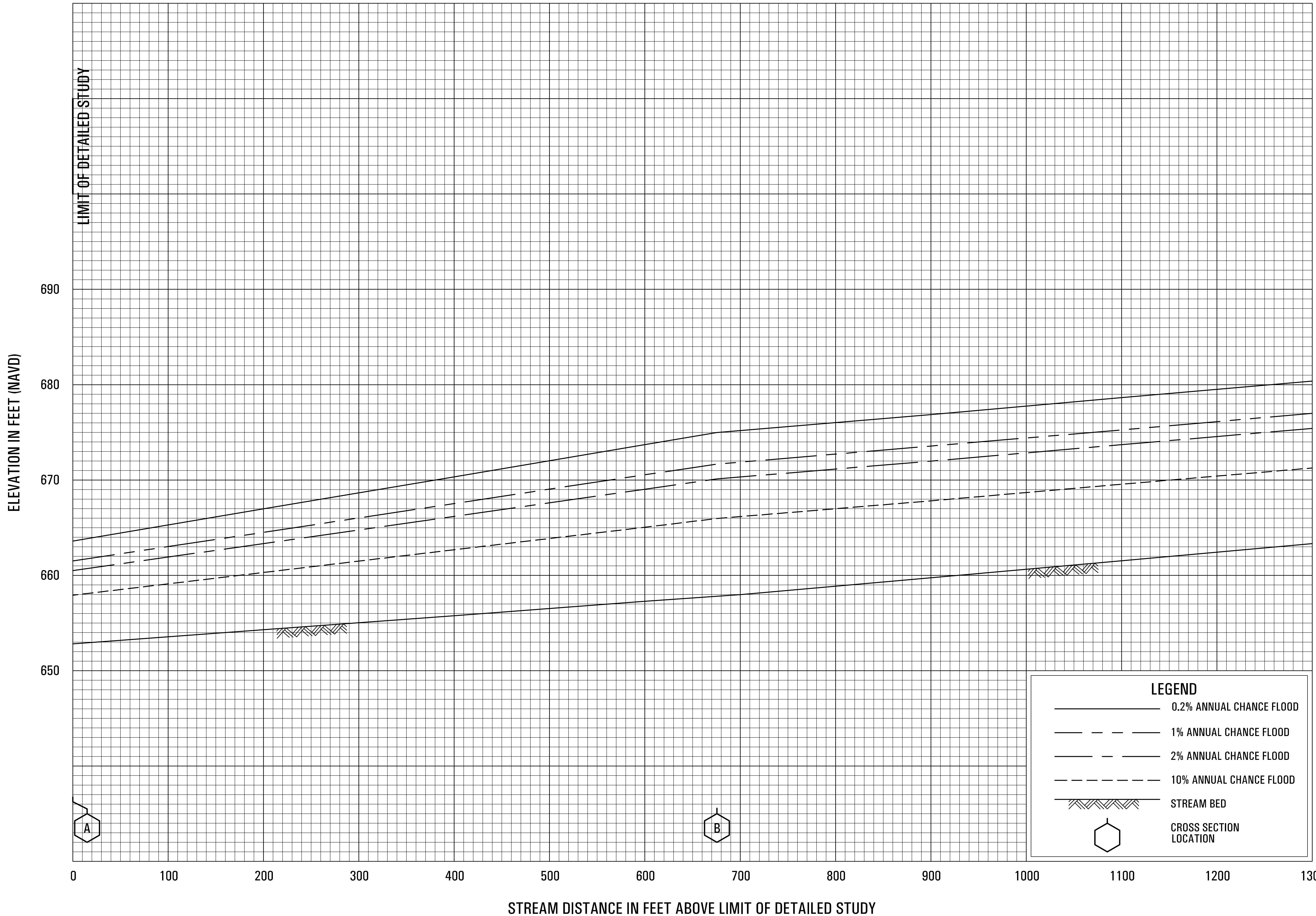
FLOOD PROFILES

LAS FLORES CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



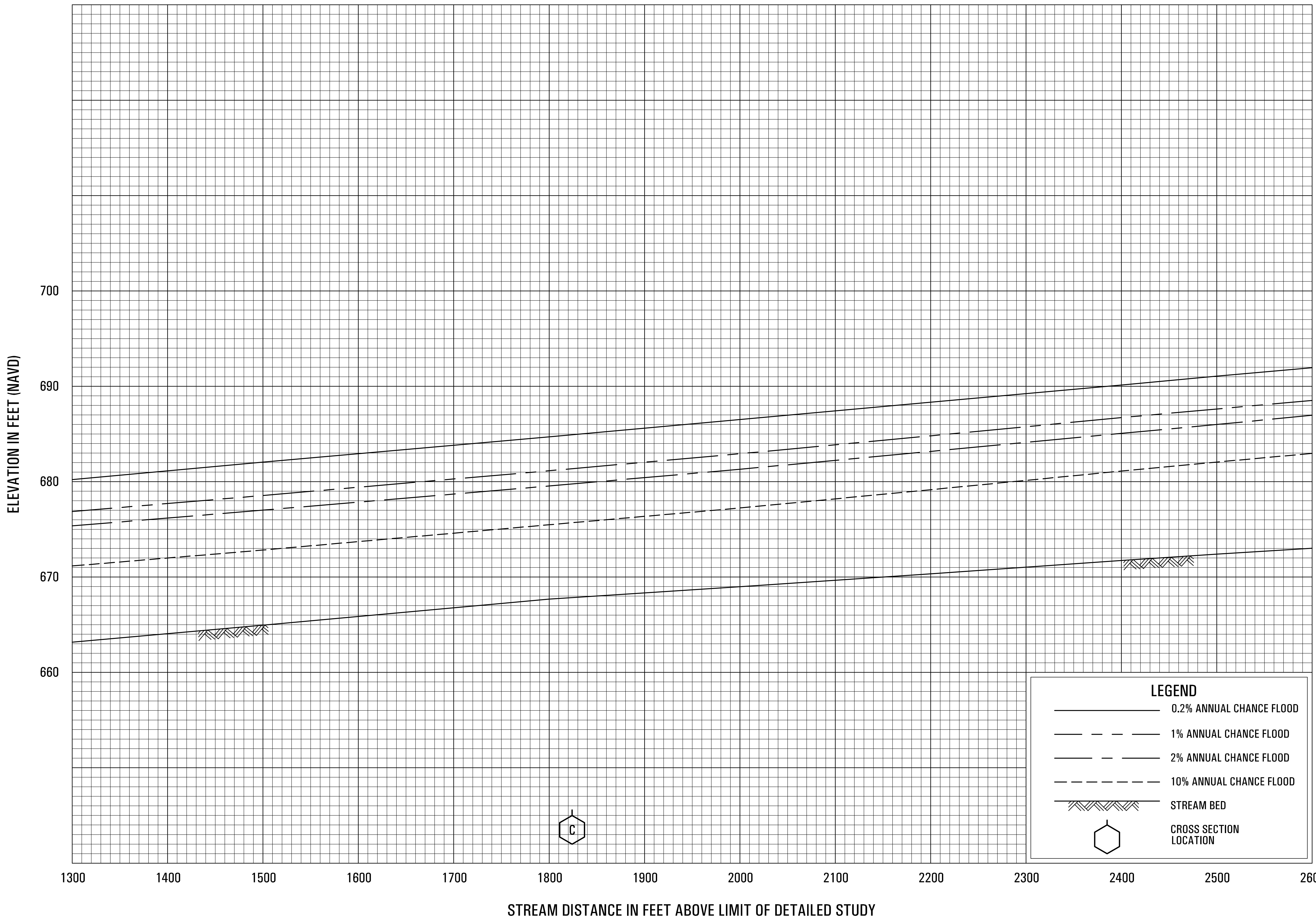
FLOOD PROFILES

LAS VIRGENES CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



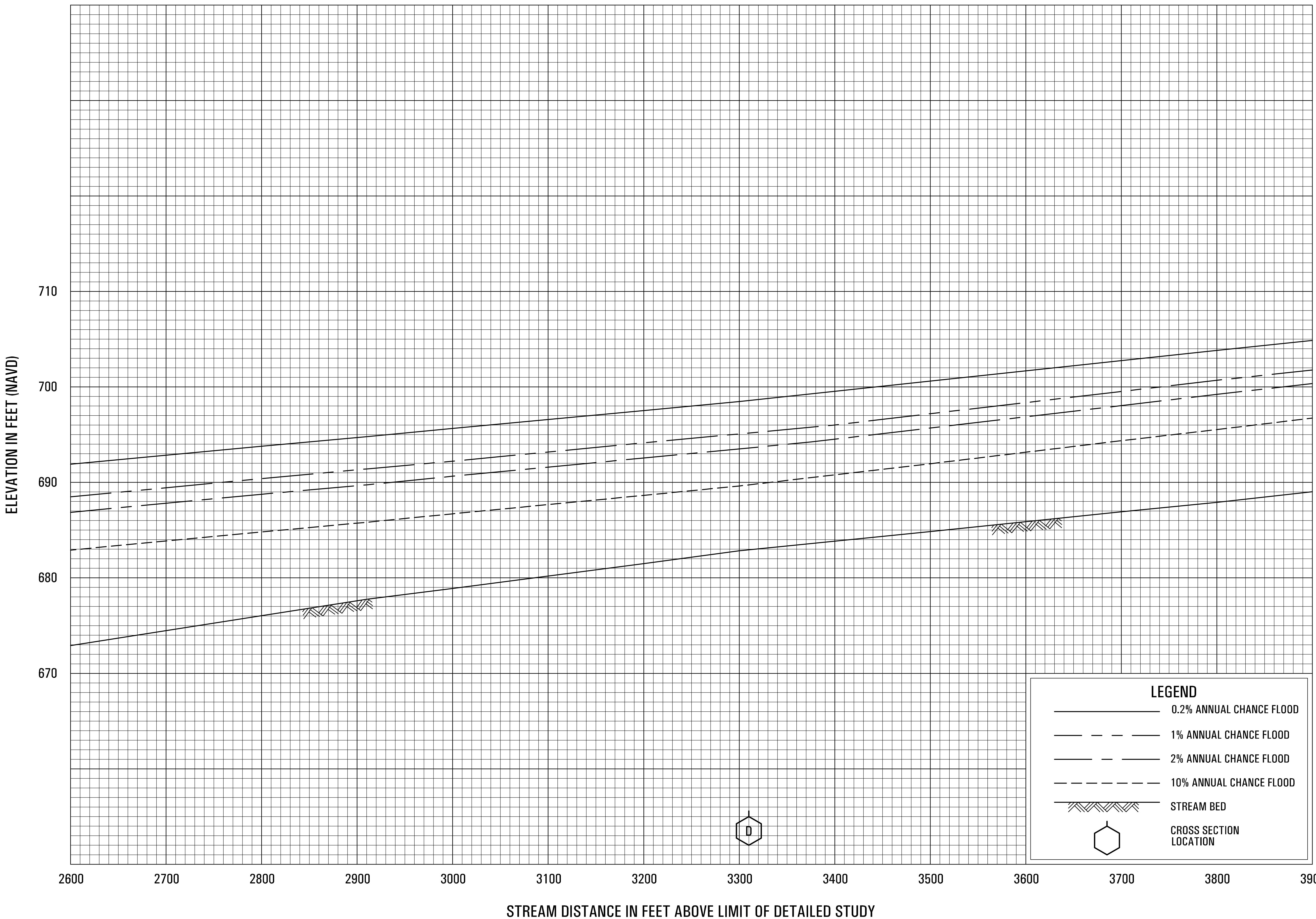
FLOOD PROFILES

LAS VIRGENES CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



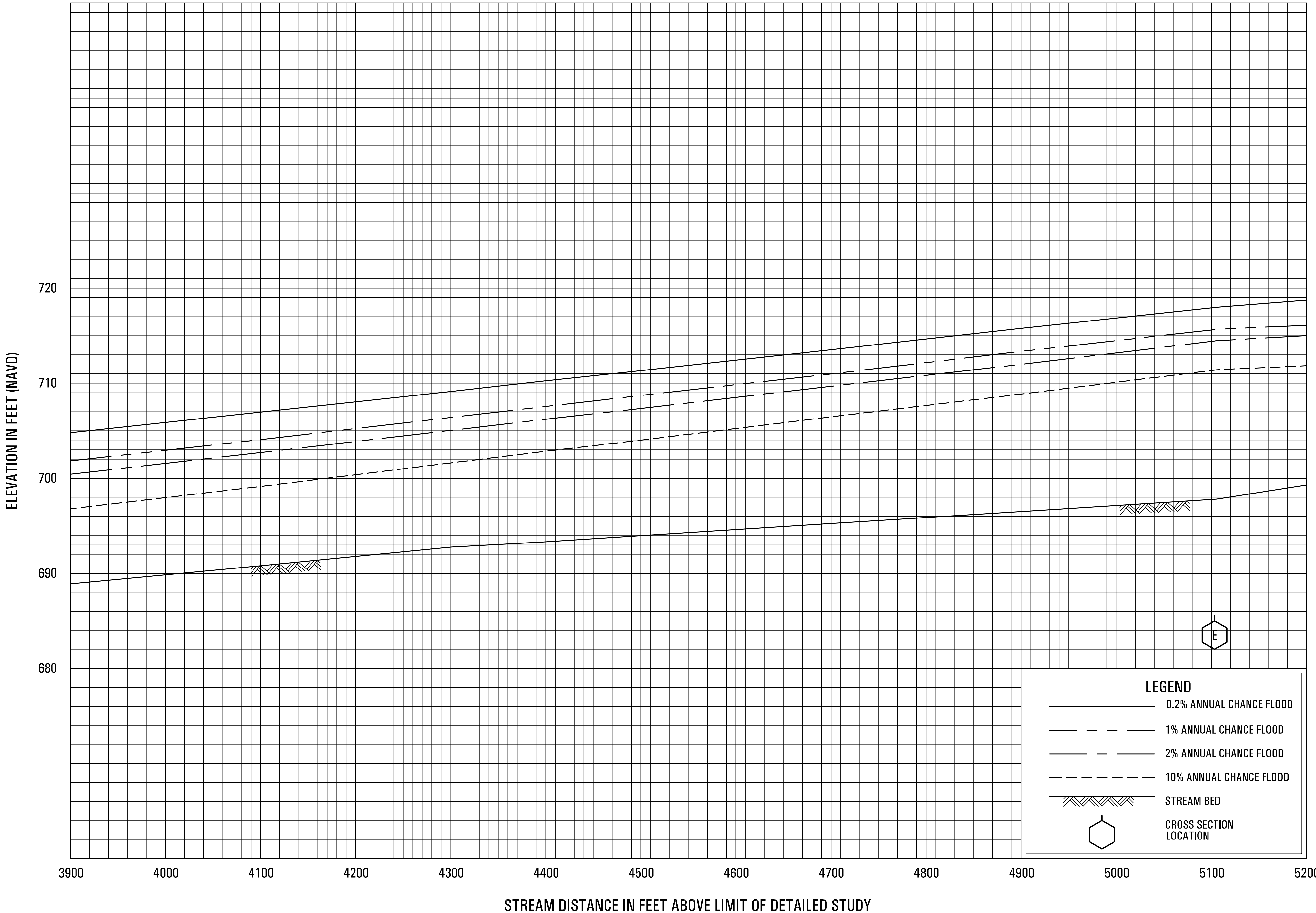
FLOOD PROFILES

LAS VIRGENES CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



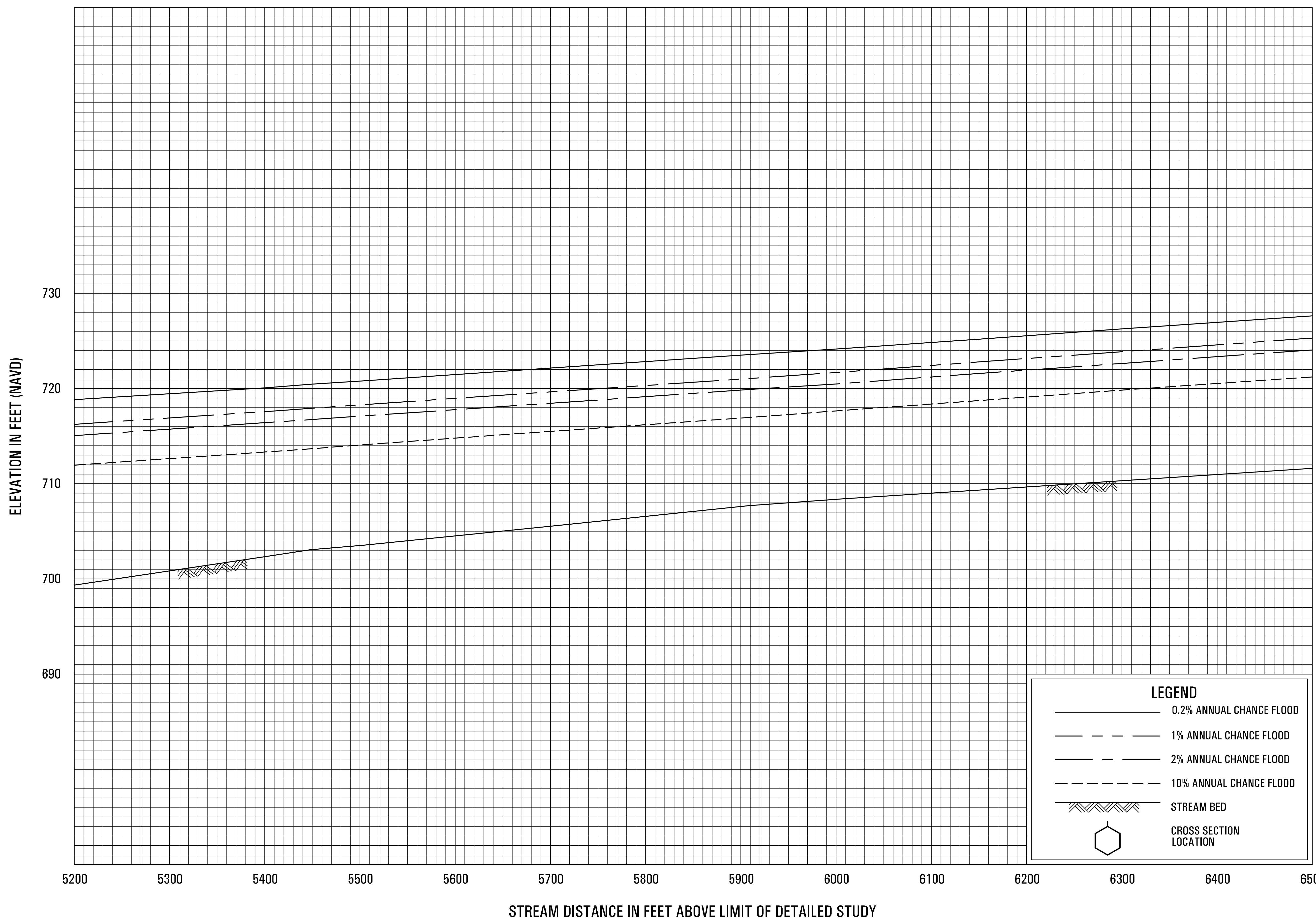
FLOOD PROFILES

LAS VIRGENES CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



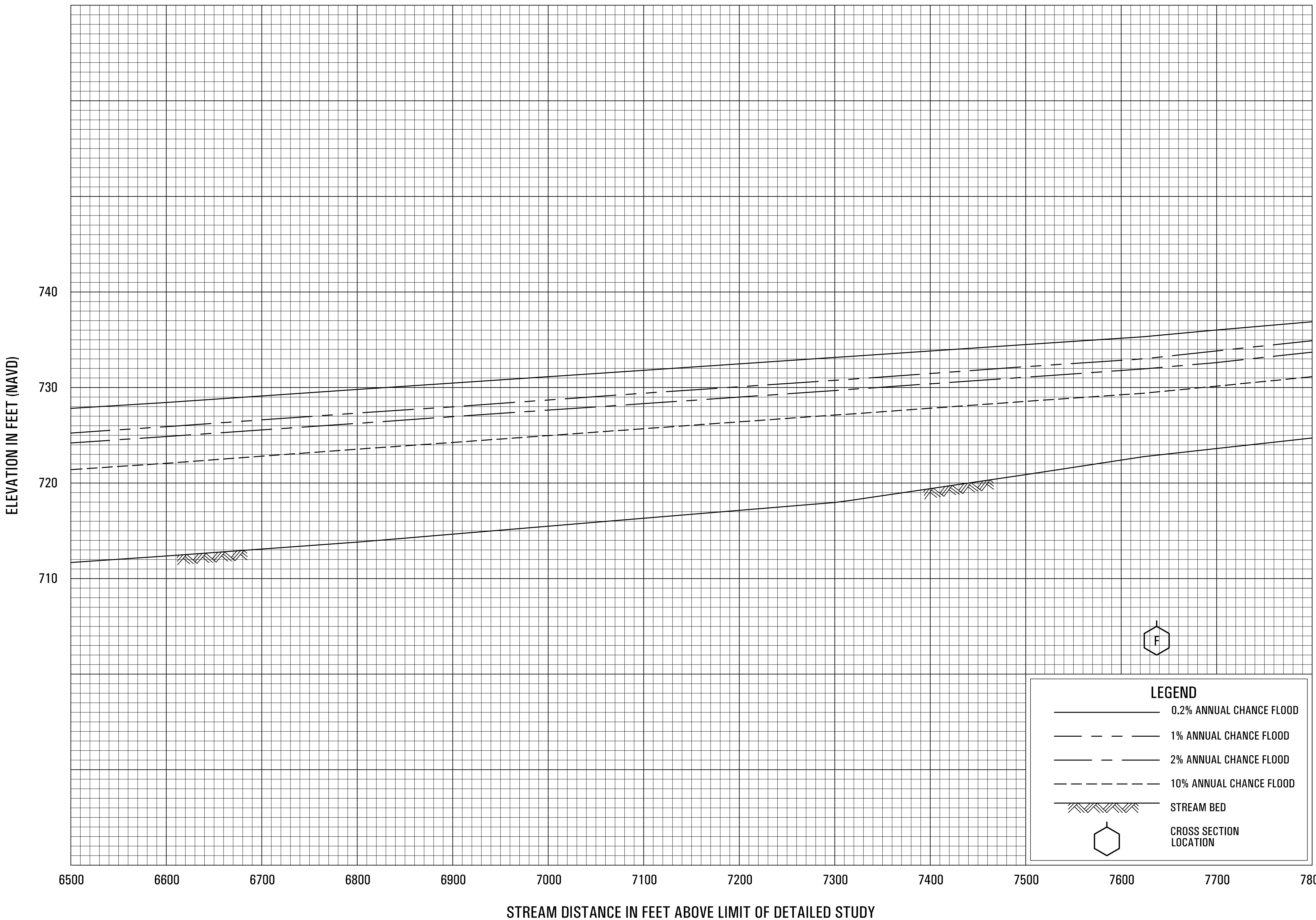
FLOOD PROFILES

LAS VIRGENES CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



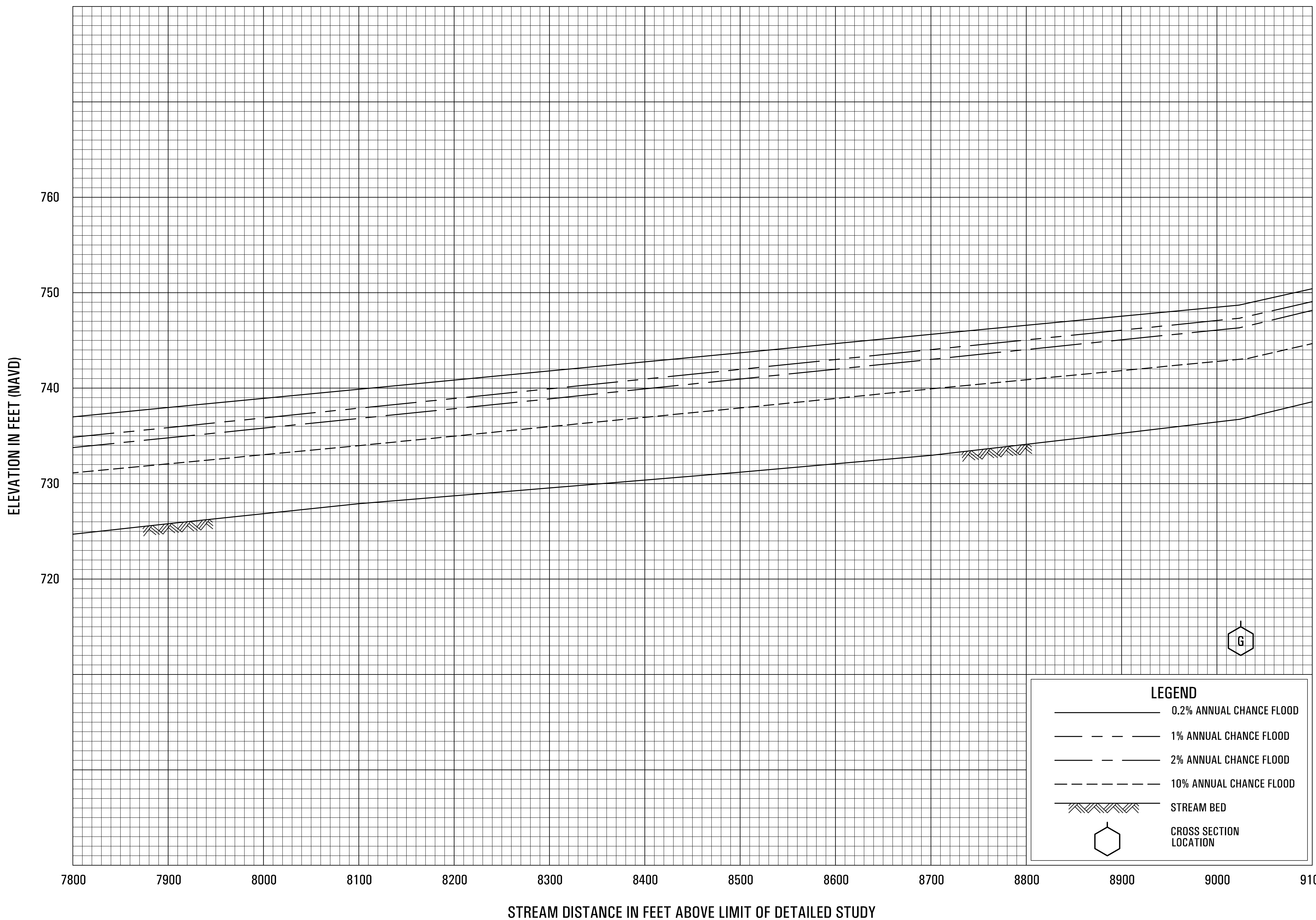
FLOOD PROFILES

LAS VIRGENES CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



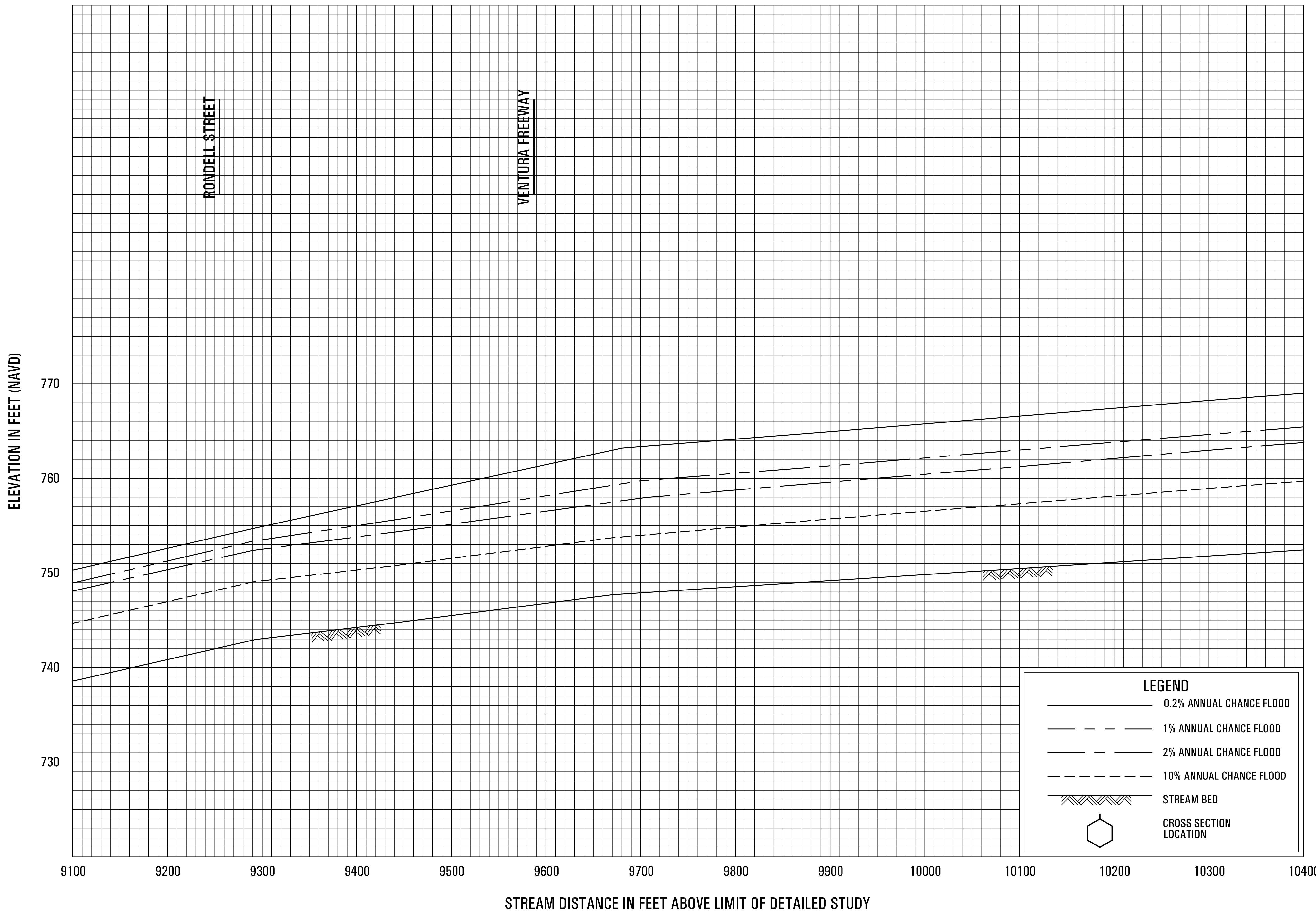
FLOOD PROFILES

LAS VIRGENES CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



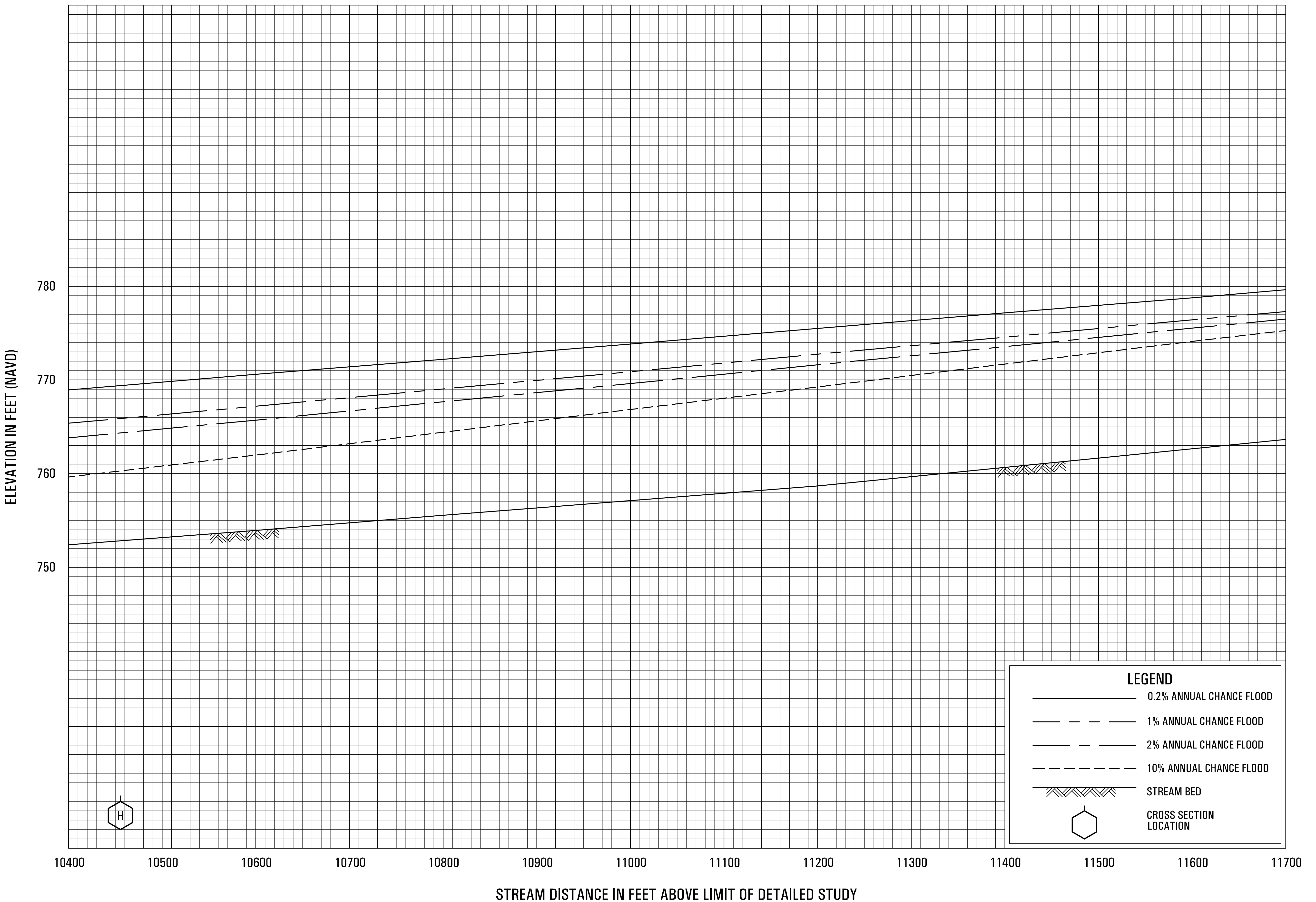
FLOOD PROFILES

LAS VIRGENES CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



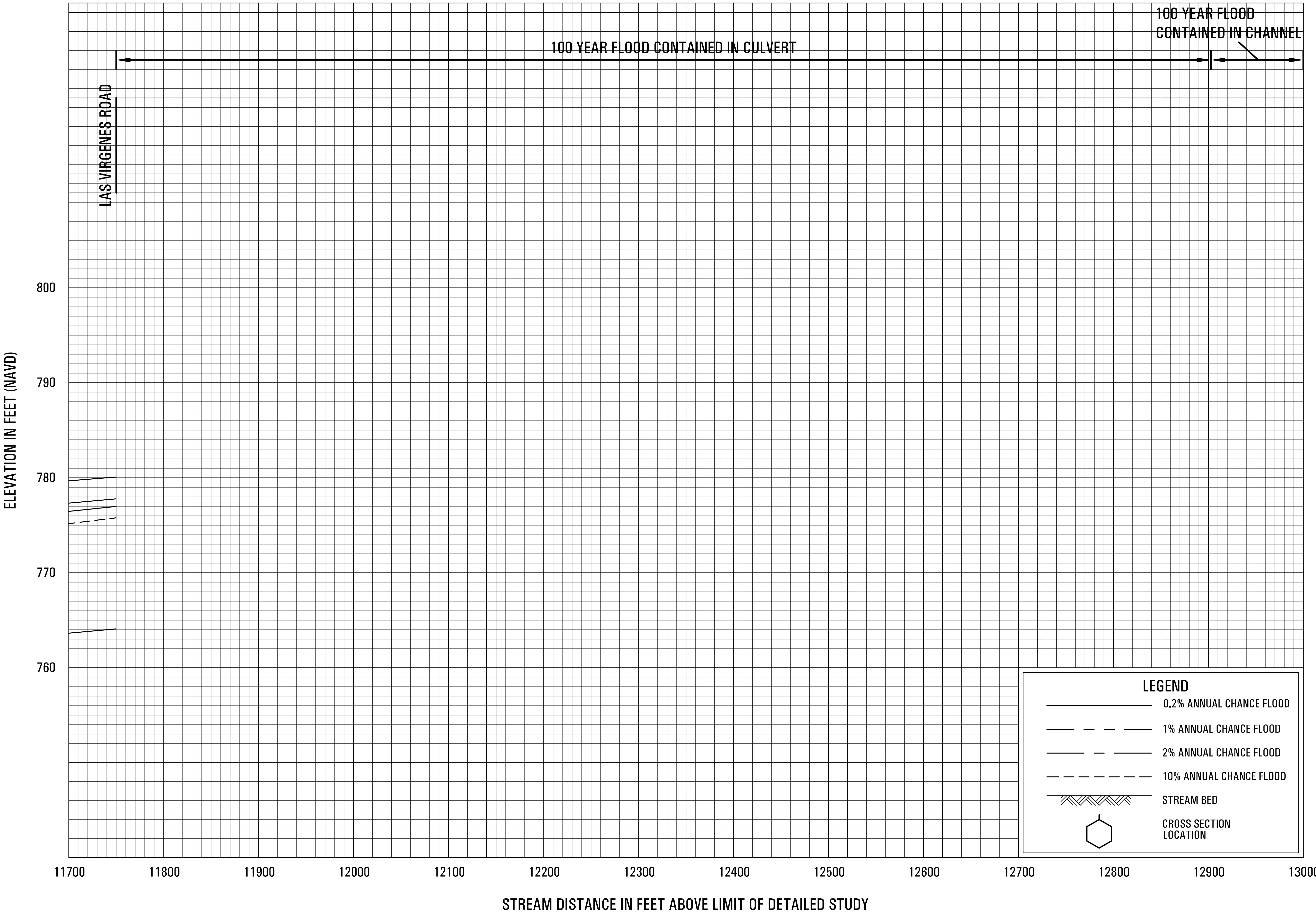
FLOOD PROFILES

LAS VIRGENES CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



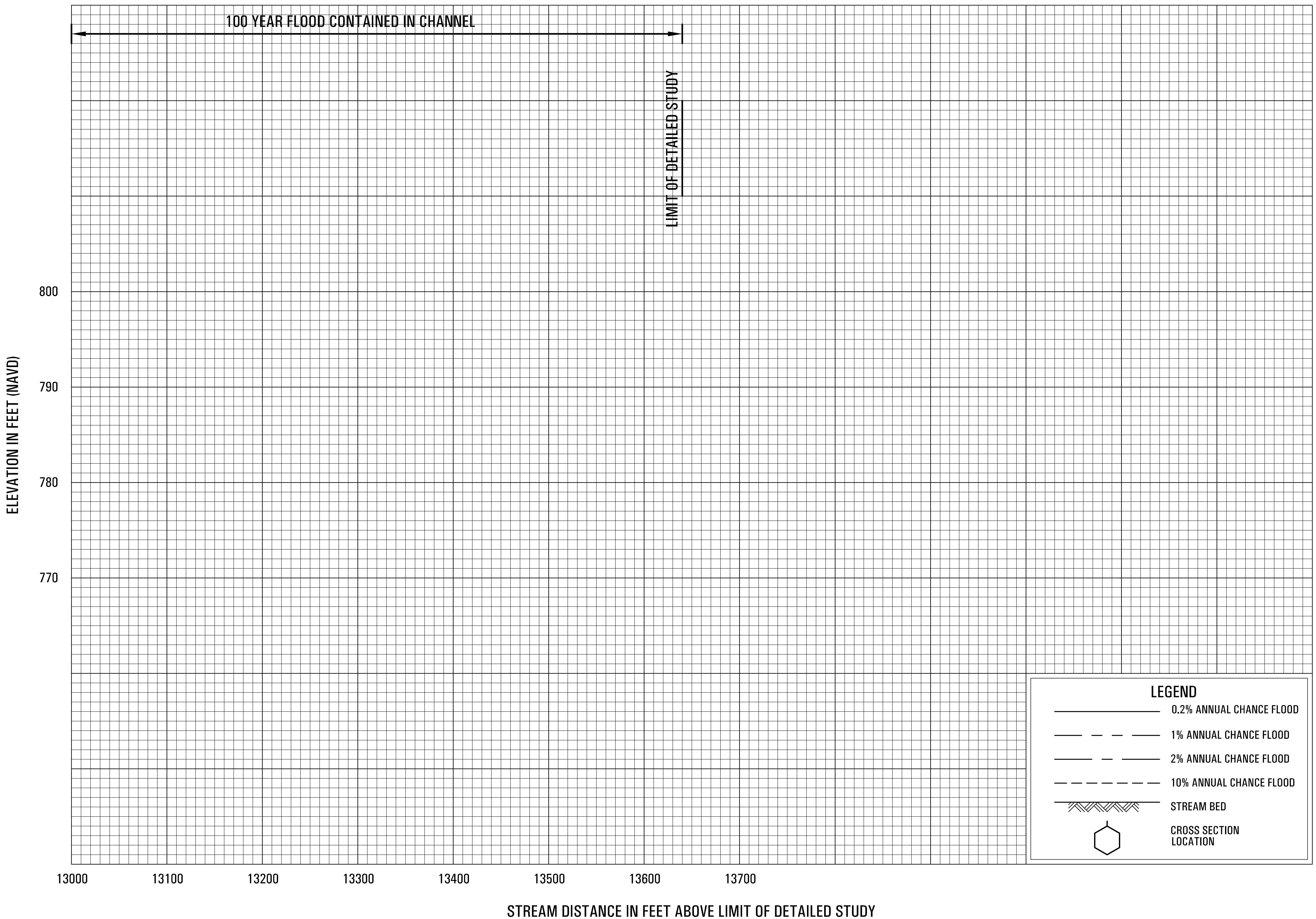
FLOOD PROFILES

LAS VIRGENES CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



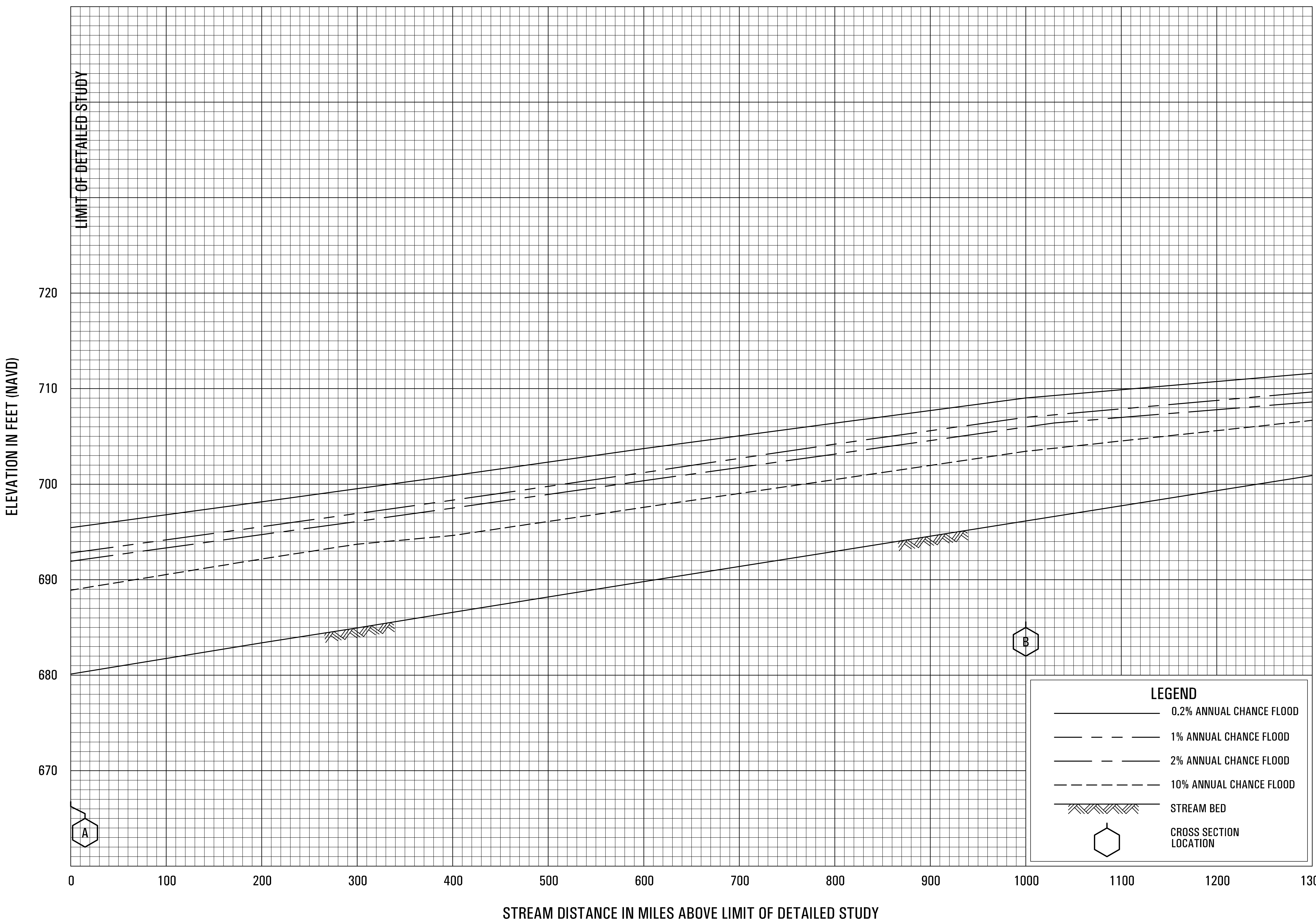
FLOOD PROFILES

LAS VIRGENES CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



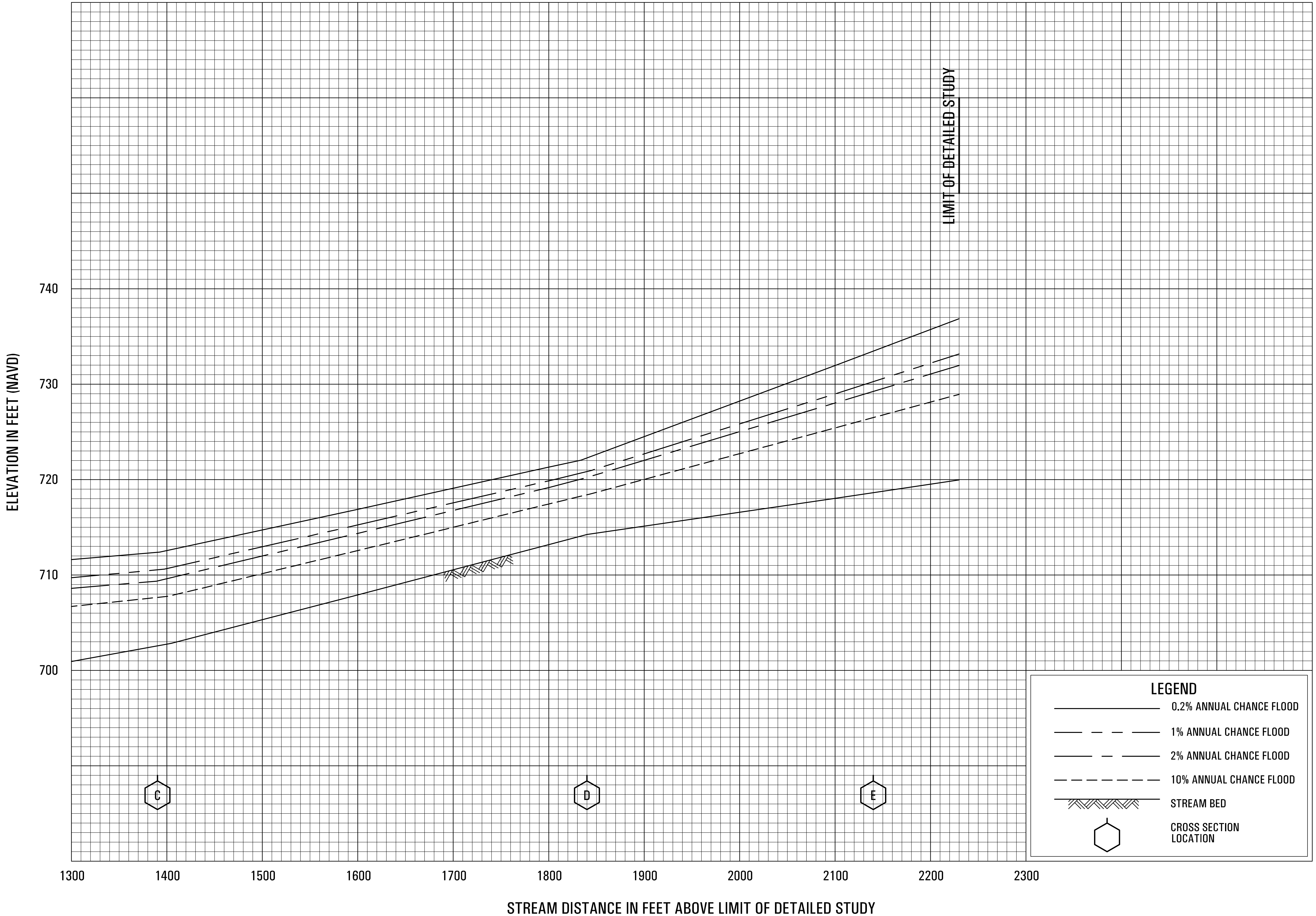
FLOOD PROFILES

LIBERTY CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



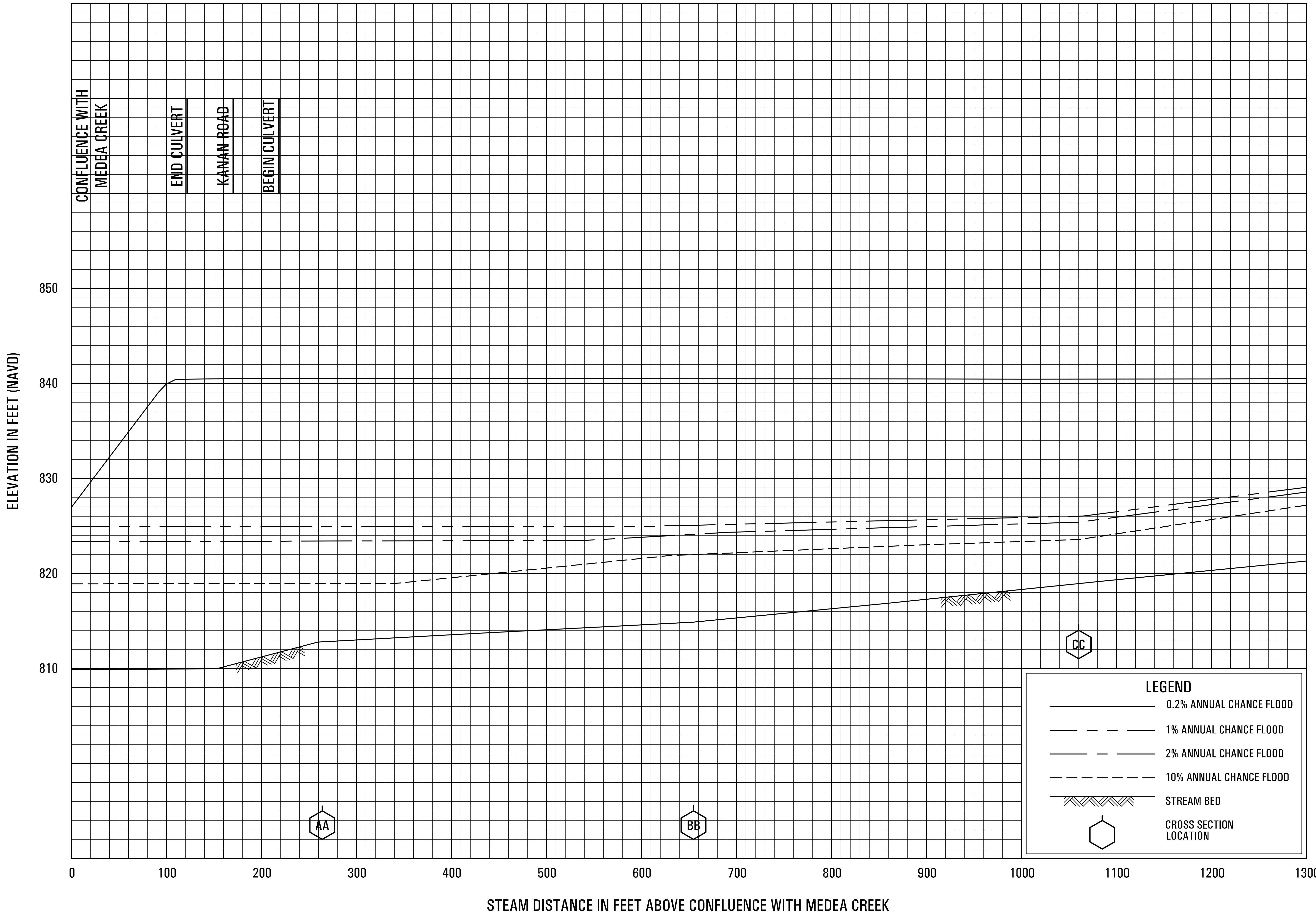
FLOOD PROFILES

LIBERTY CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



FLOOD PROFILES

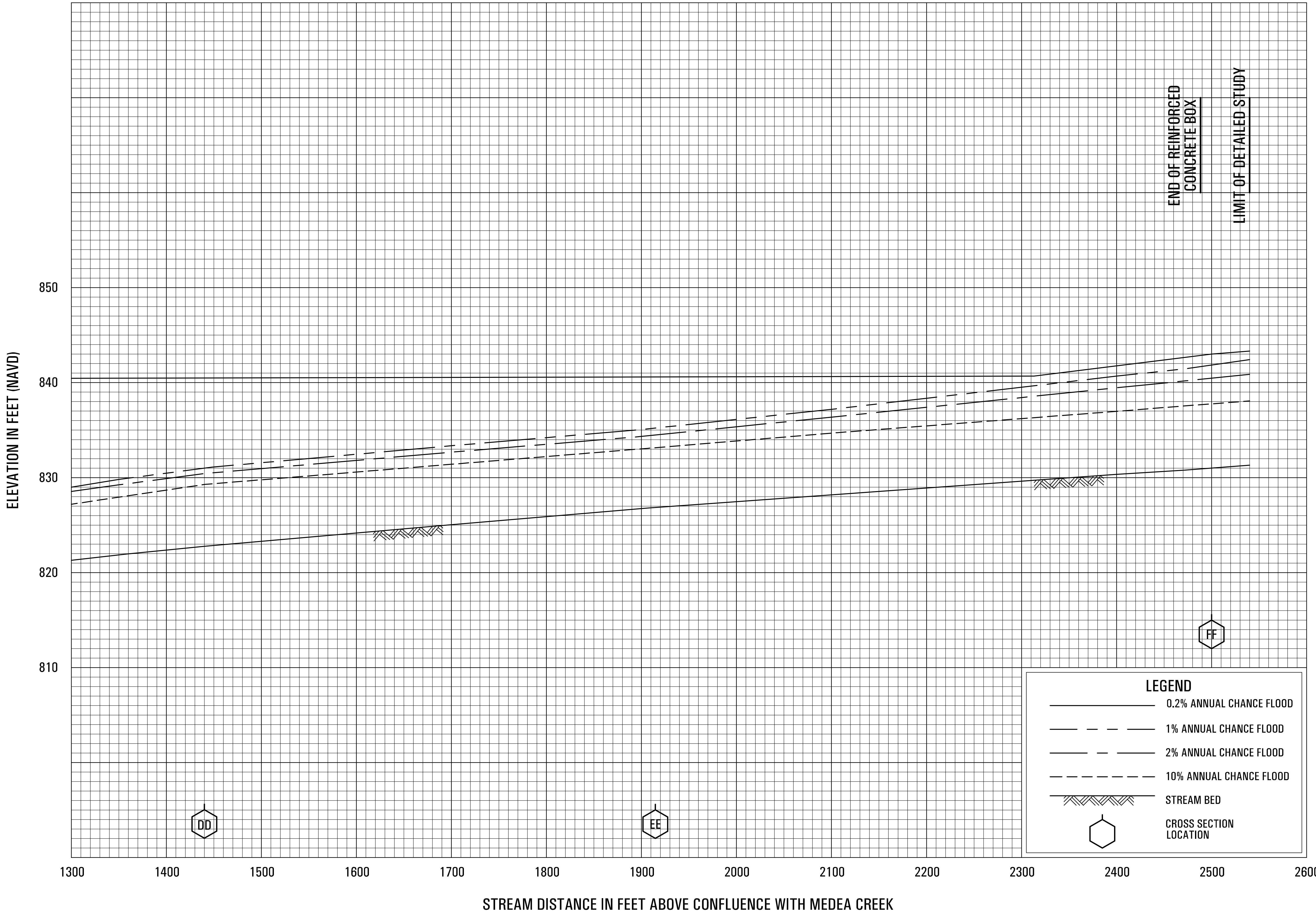
LINDERO CANYON ABOVE CONFLUENCE WITH MEDEA CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS

80P



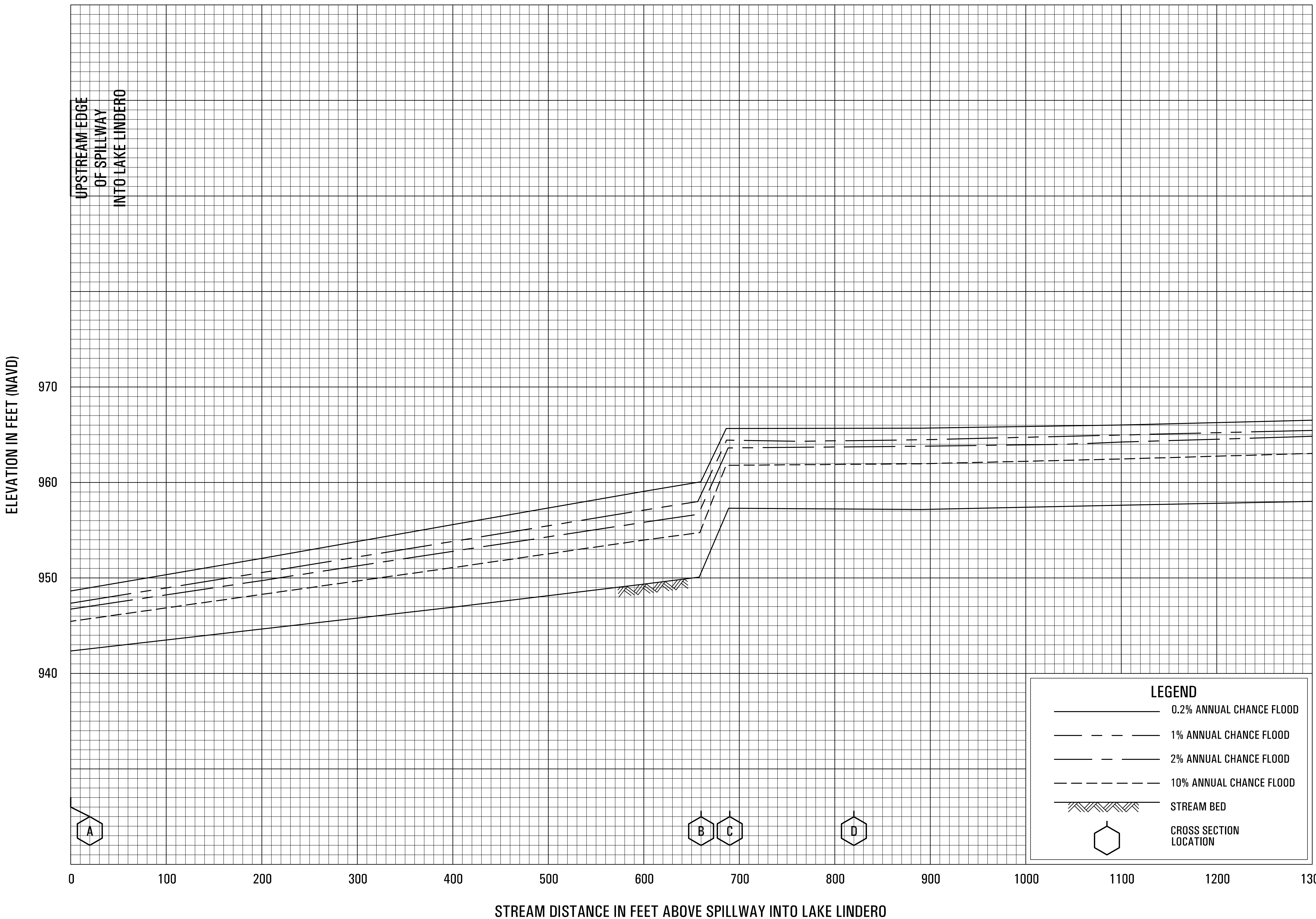
FLOOD PROFILES

LINDERO CANYON ABOVE CONFLUENCE WITH MEDEA CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



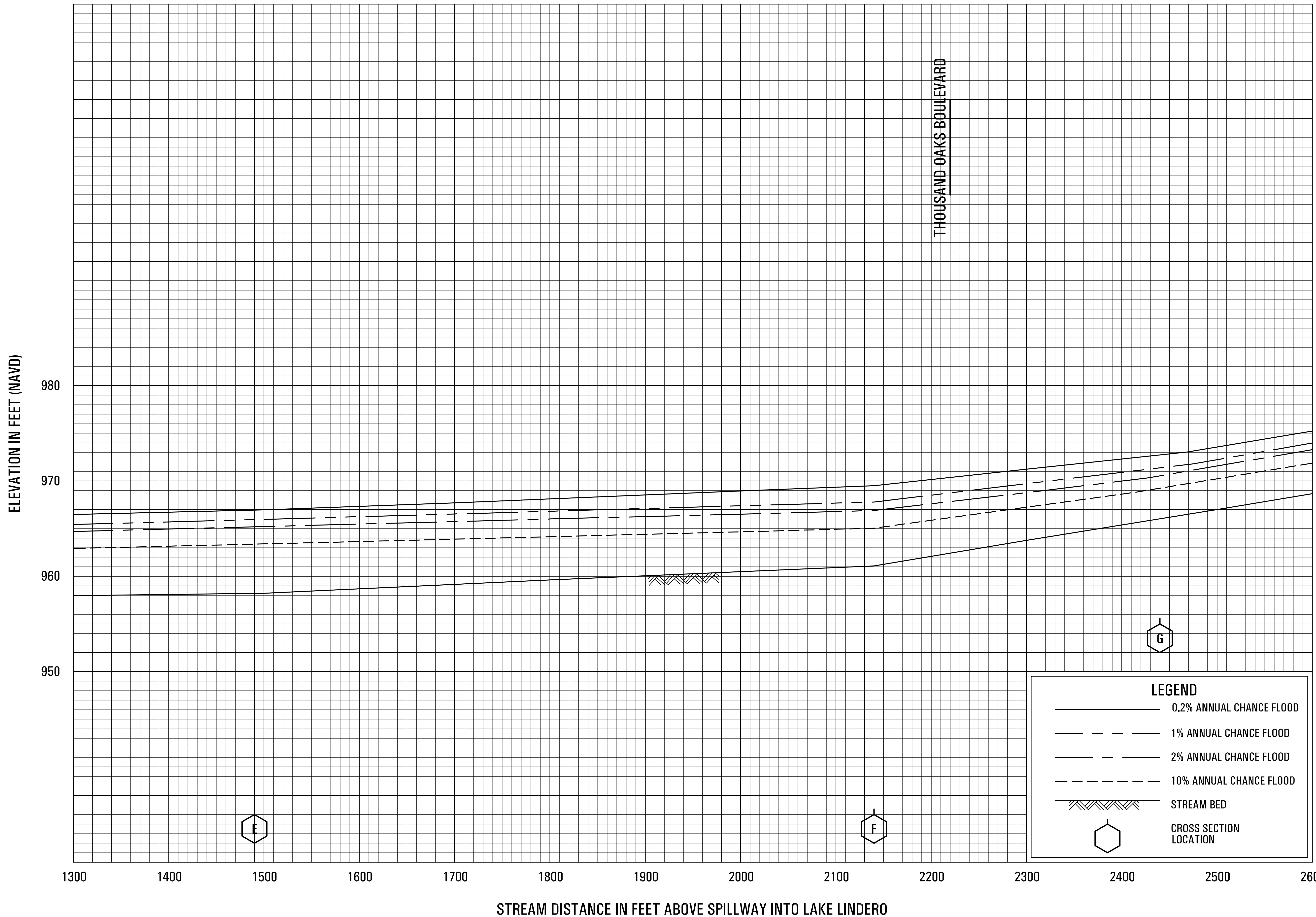
FLOOD PROFILES

LINDERO CANYON ABOVE LAKE LINDERO

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



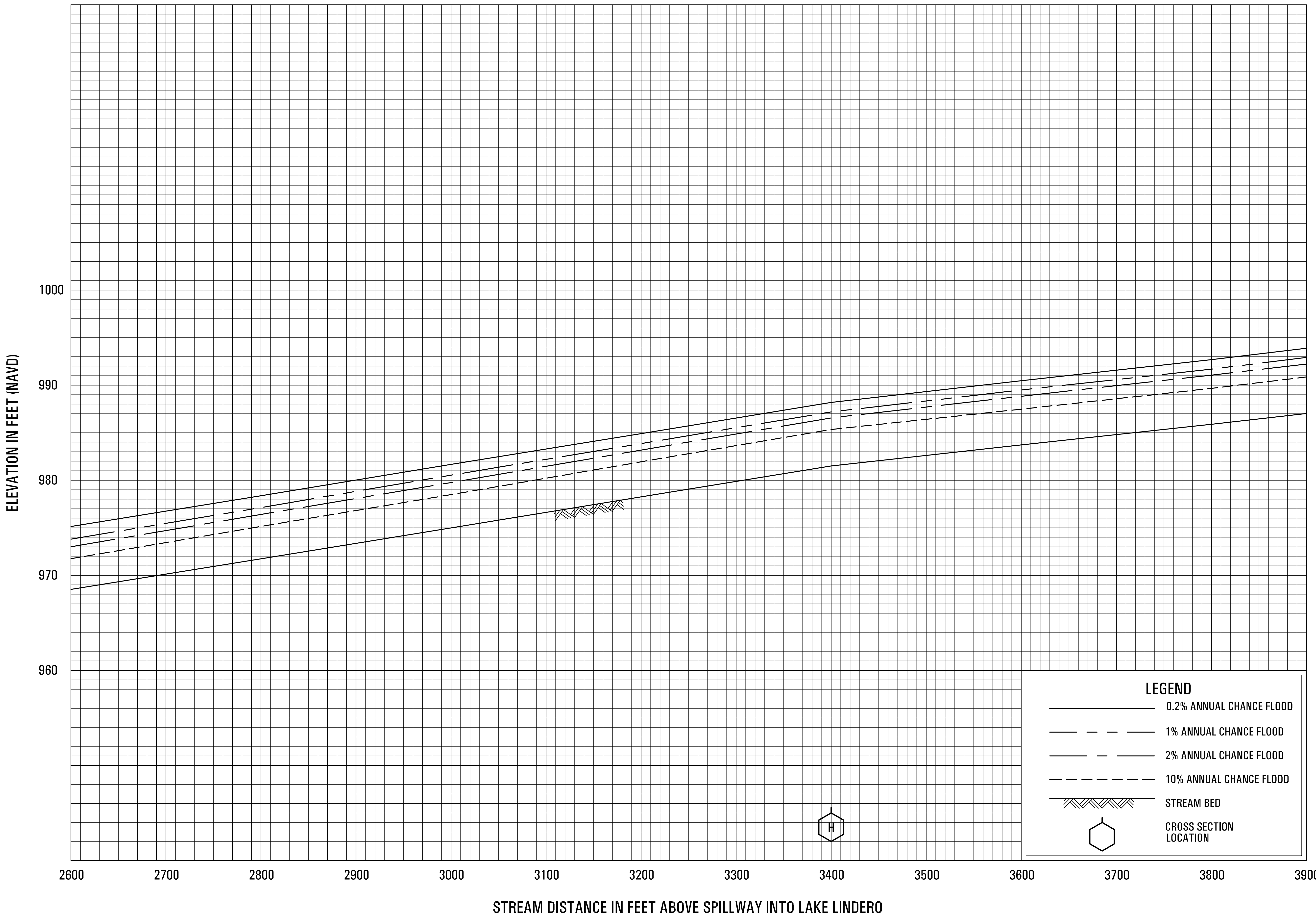
FLOOD PROFILES

LINDERO CANYON ABOVE LAKE LINDERO

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



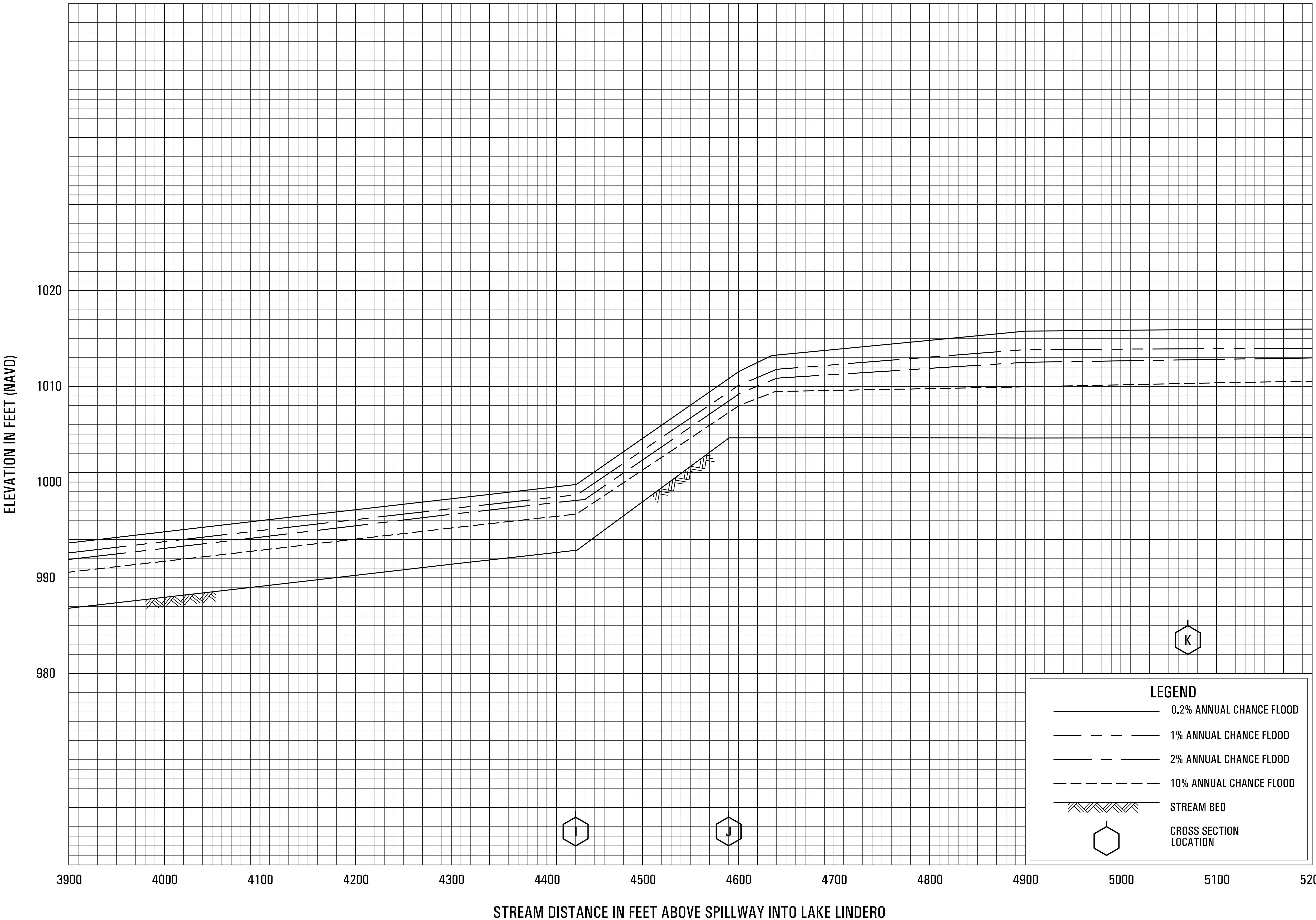
FLOOD PROFILES

LINDERO CANYON ABOVE LAKE LINDERO

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



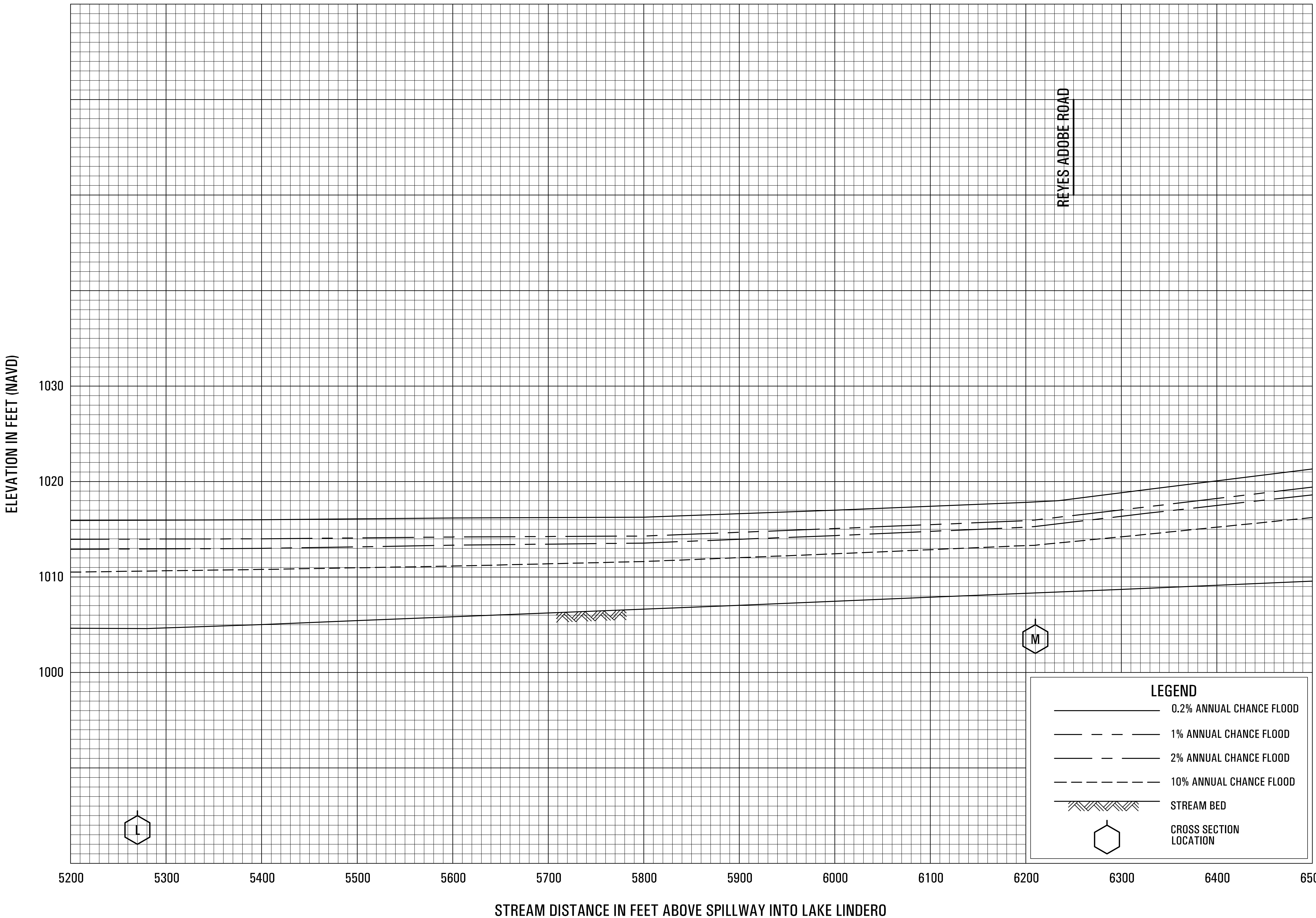
FLOOD PROFILES

LINDERO CANYON ABOVE LAKE LINDERO

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



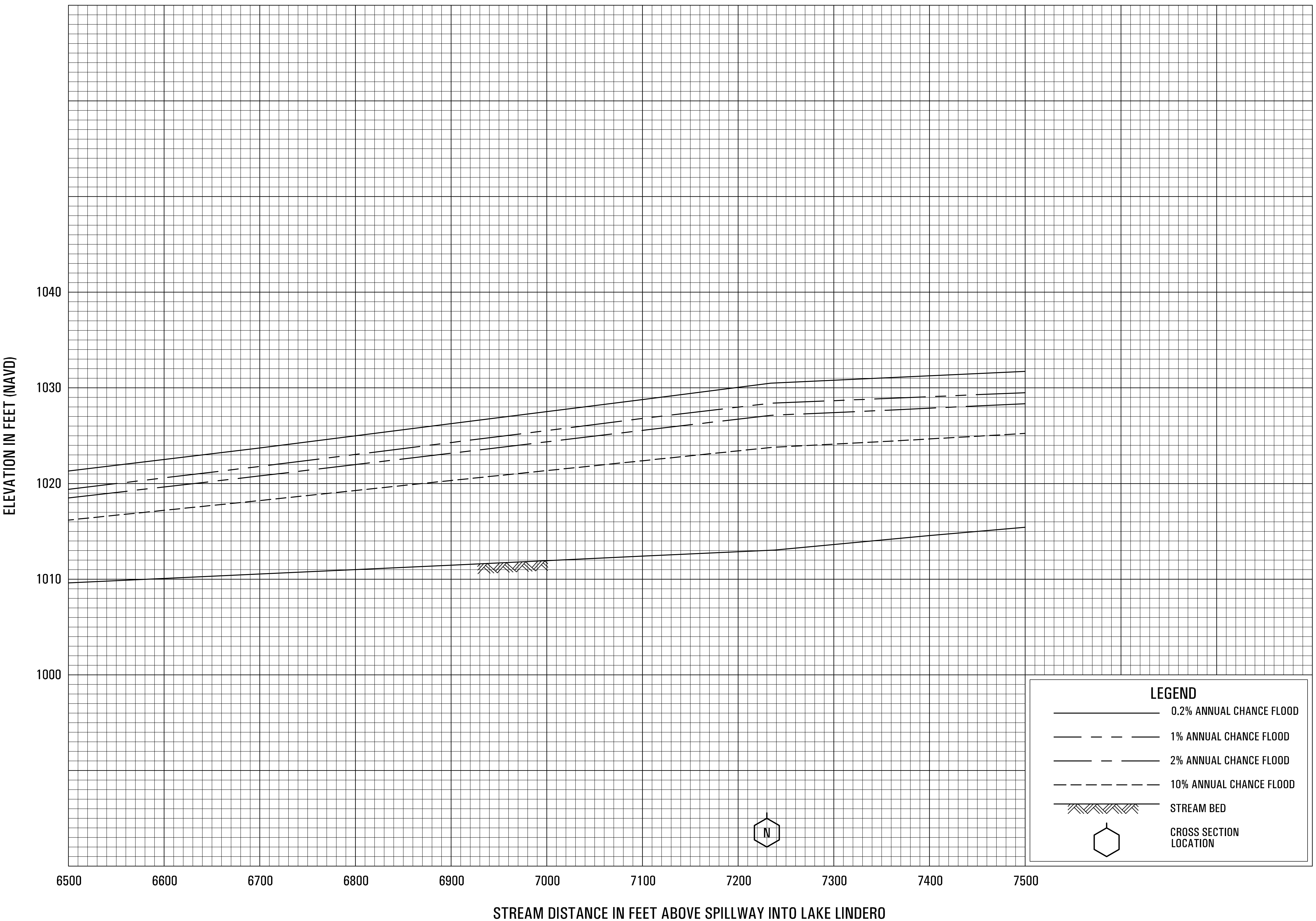
FLOOD PROFILES

LINDERO CANYON ABOVE LAKE LINDERO

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



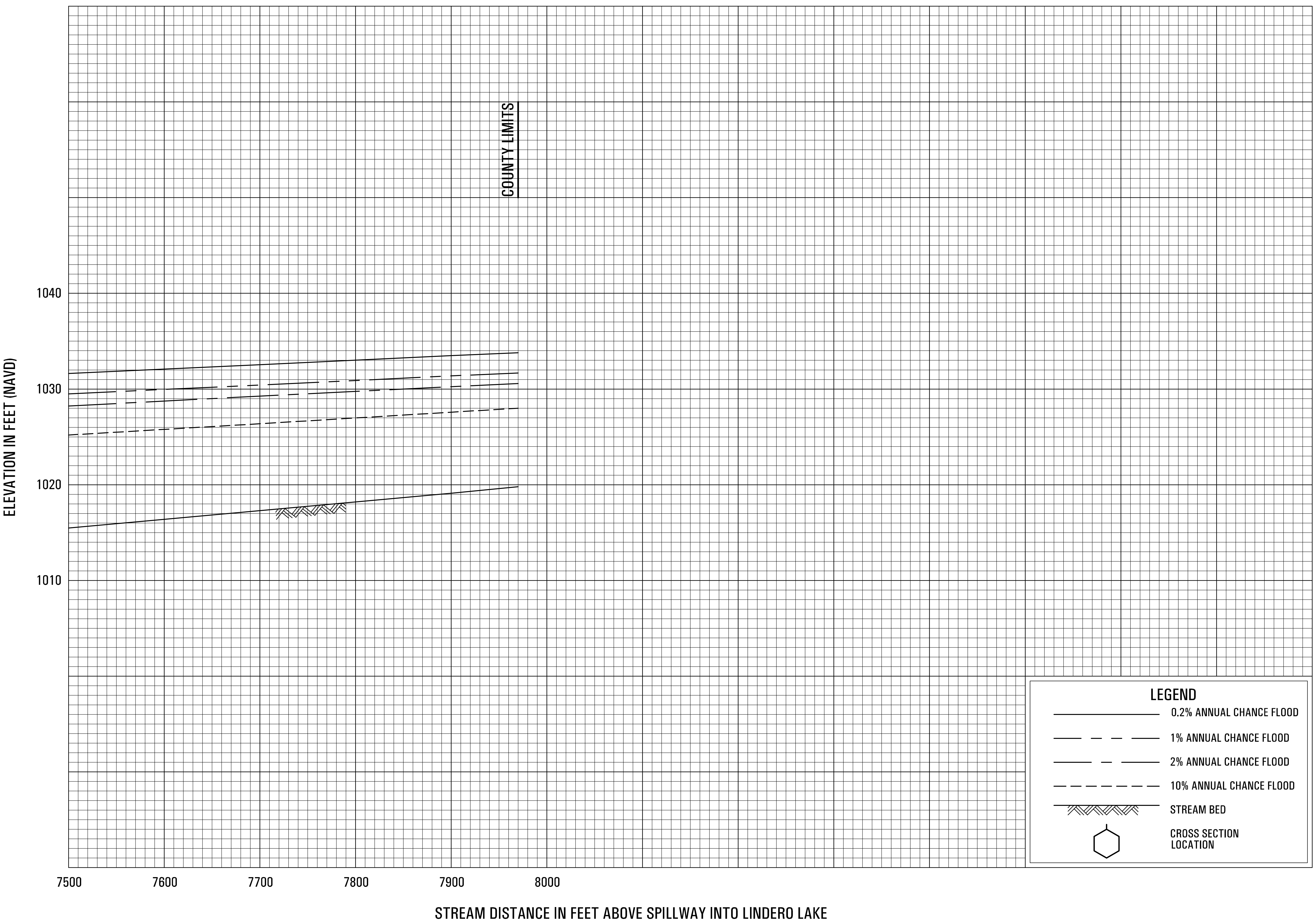
FLOOD PROFILES

LINDERO CANYON ABOVE LAKE LINDERO

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



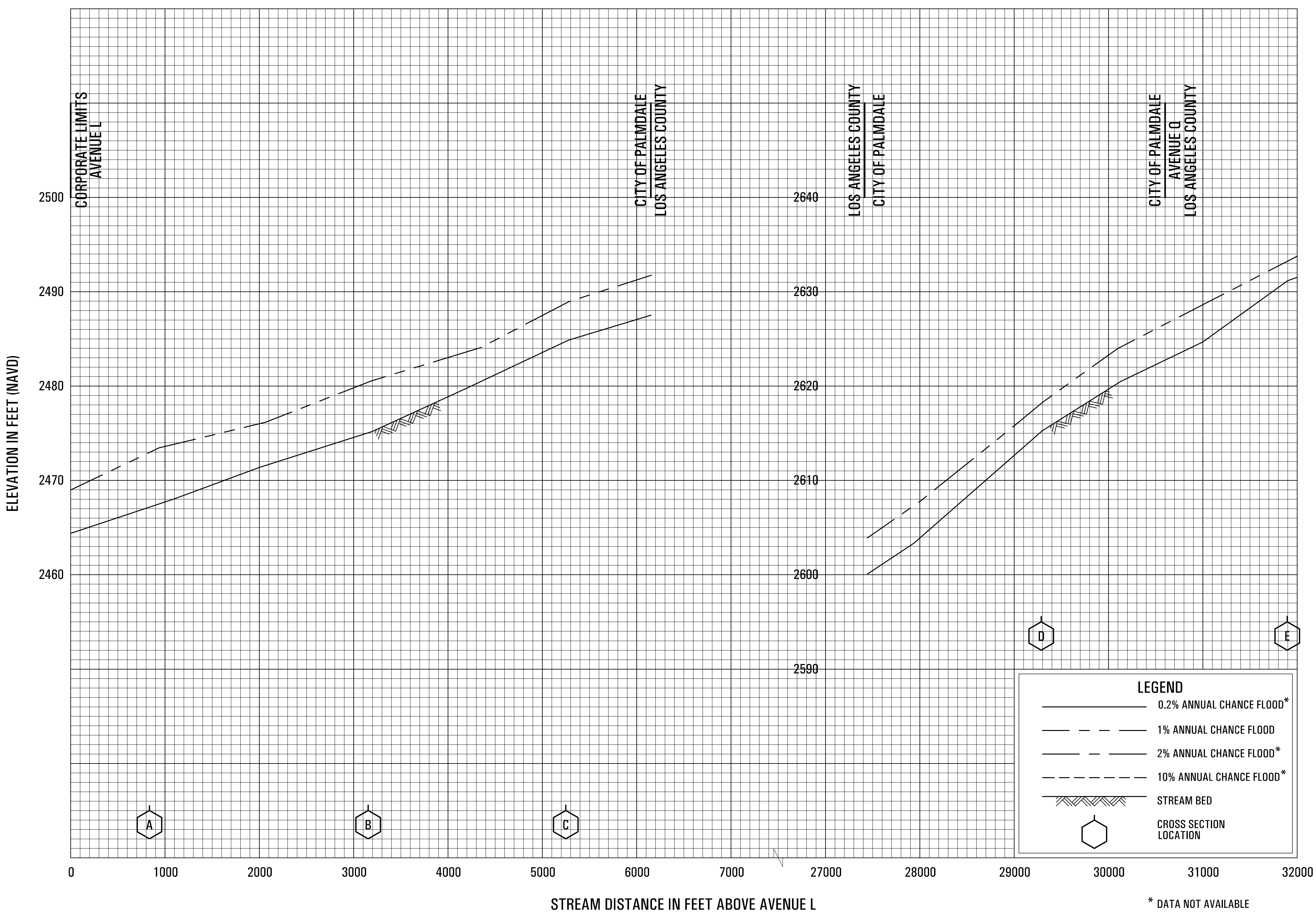
FLOOD PROFILES

LINDERO CANYON SPILLWAY AT LINDERO

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



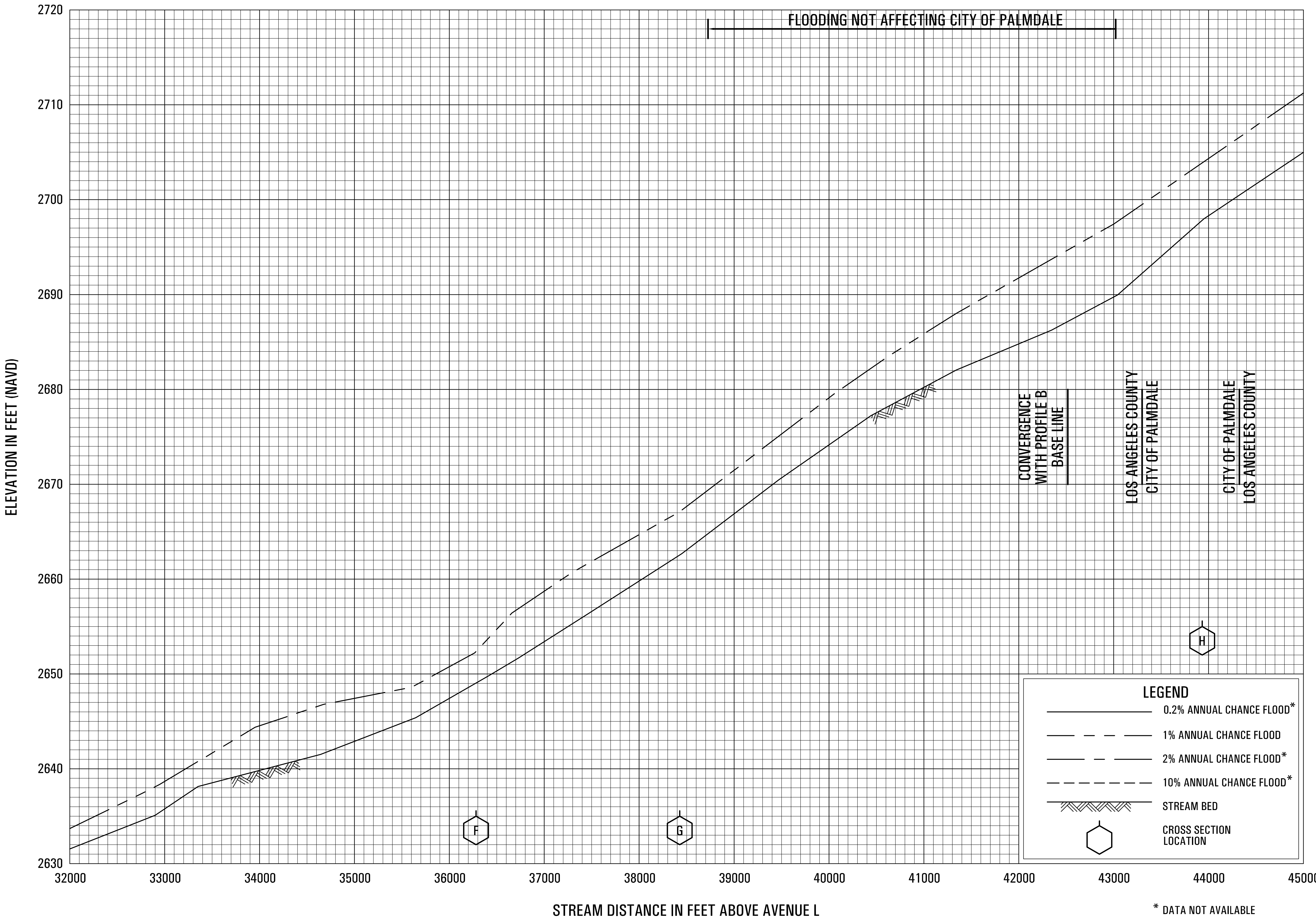
FLOOD PROFILES

LITTLE ROCK WASH - PROFILE A

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



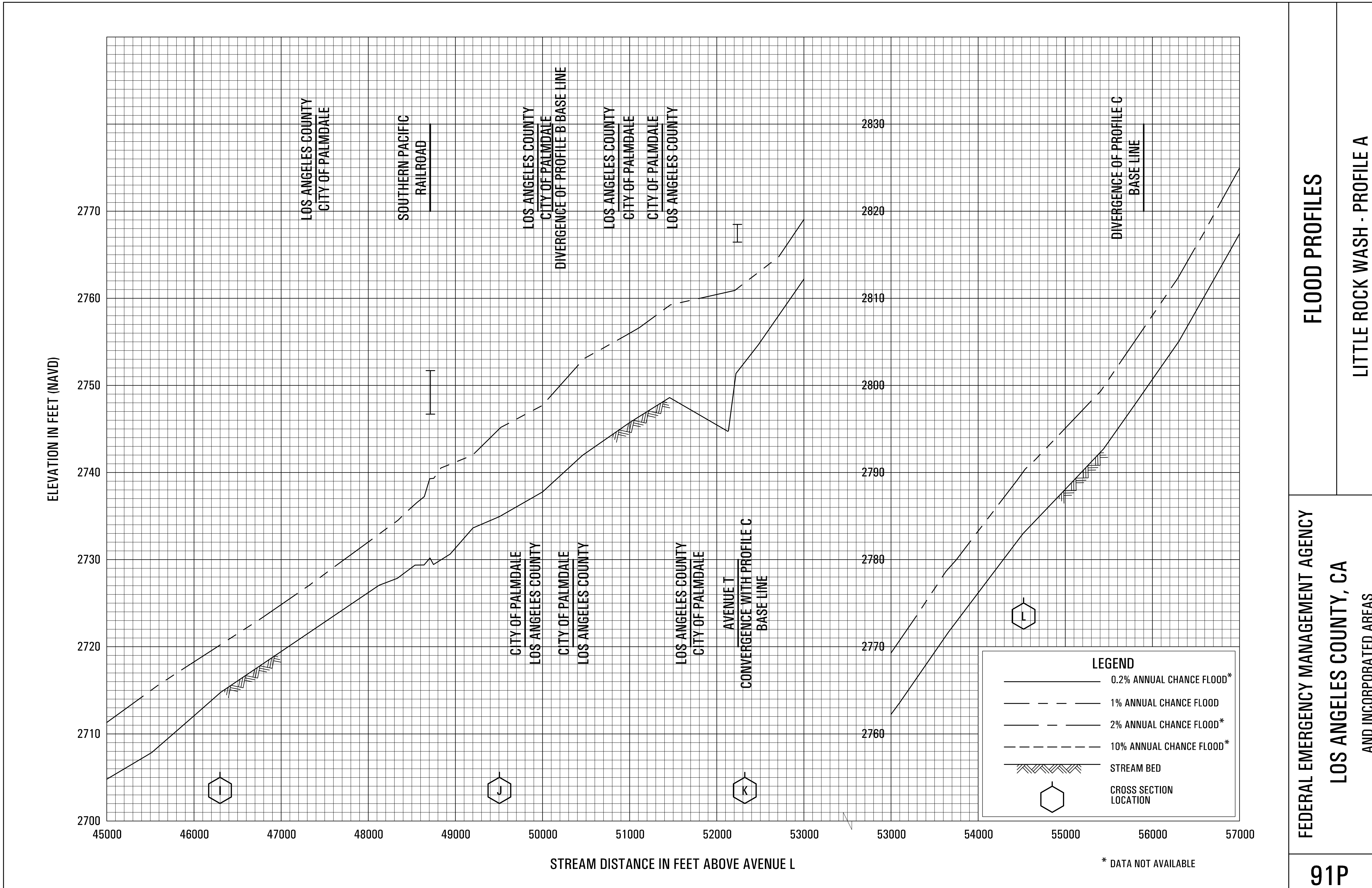
FLOOD PROFILES

LITTLE ROCK WASH - PROFILE A

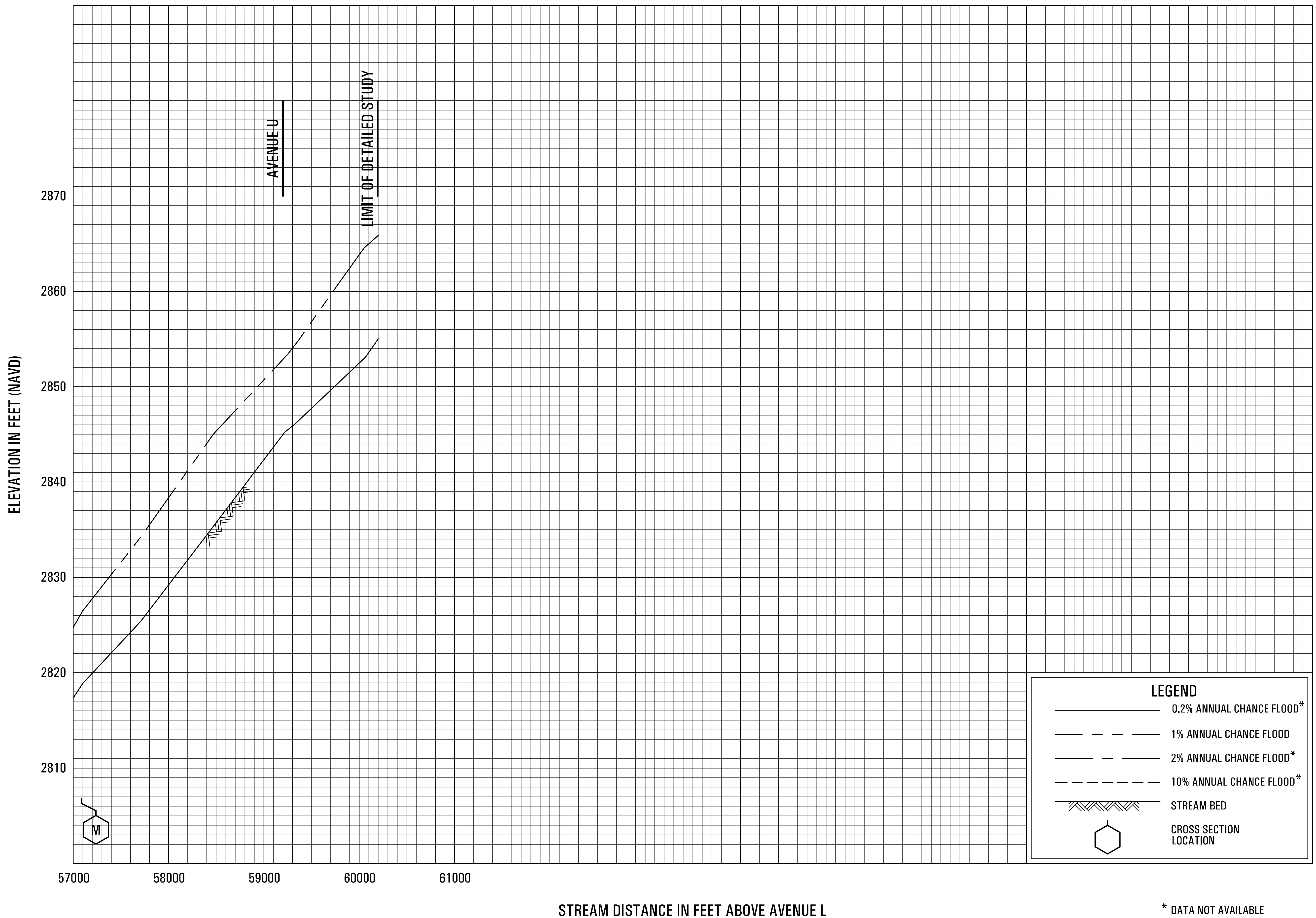
FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



FLOOD PROFILES
LITTLE ROCK WASH - PROFILE A
FEDERAL EMERGENCY MANAGEMENT AGENCY
LOS ANGELES COUNTY, CA
AND INCORPORATED AREAS
ELEVATION IN FEET (NAVD)
STREAM DISTANCE IN FEET ABOVE AVENUE L
LOS ANGELES COUNTY
CITY OF PALMDALE
SOUTHERN PACIFIC RAILROAD
LOS ANGELES COUNTY
CITY OF PALMDALE
DIVERGENCE OF PROFILE B BASE LINE
LOS ANGELES COUNTY
CITY OF PALMDALE
CITY OF PALMDALE
LOS ANGELES COUNTY
CITY OF PALMDALE
LOS ANGELES COUNTY
CITY OF PALMDALE
LOS ANGELES COUNTY
LOS ANGELES COUNTY
CITY OF PALMDALE
AVENUE T
CONVERGENCE WITH PROFILE C BASE LINE
DIVERGENCE OF PROFILE C BASE LINE
I
J
K
L
LEGEND
0.2% ANNUAL CHANCE FLOOD*
1% ANNUAL CHANCE FLOOD
2% ANNUAL CHANCE FLOOD*
10% ANNUAL CHANCE FLOOD*
STREAM BED
CROSS SECTION LOCATION
* DATA NOT AVAILABLE



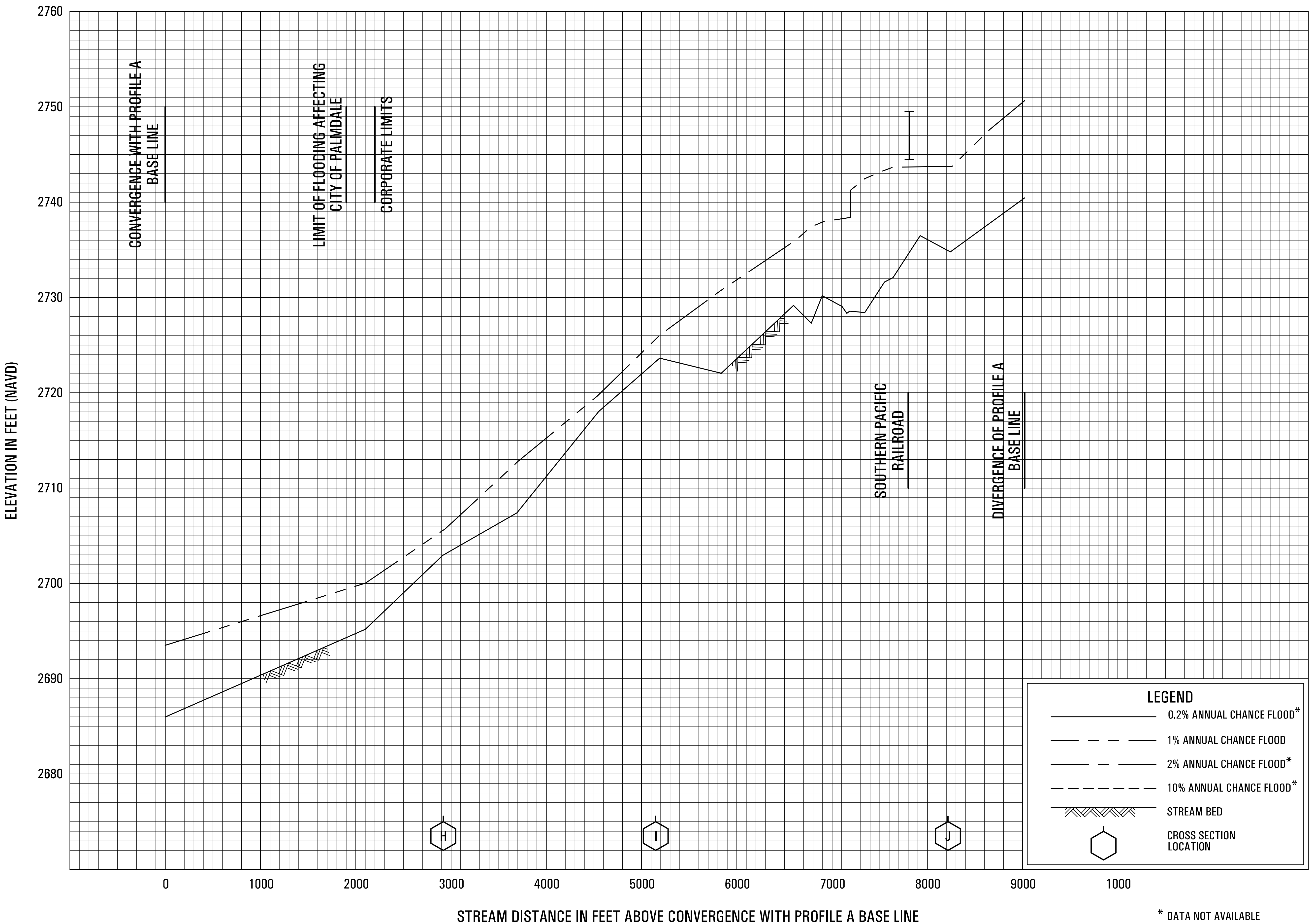
FLOOD PROFILES

LITTLE ROCK WASH - PROFILE A

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



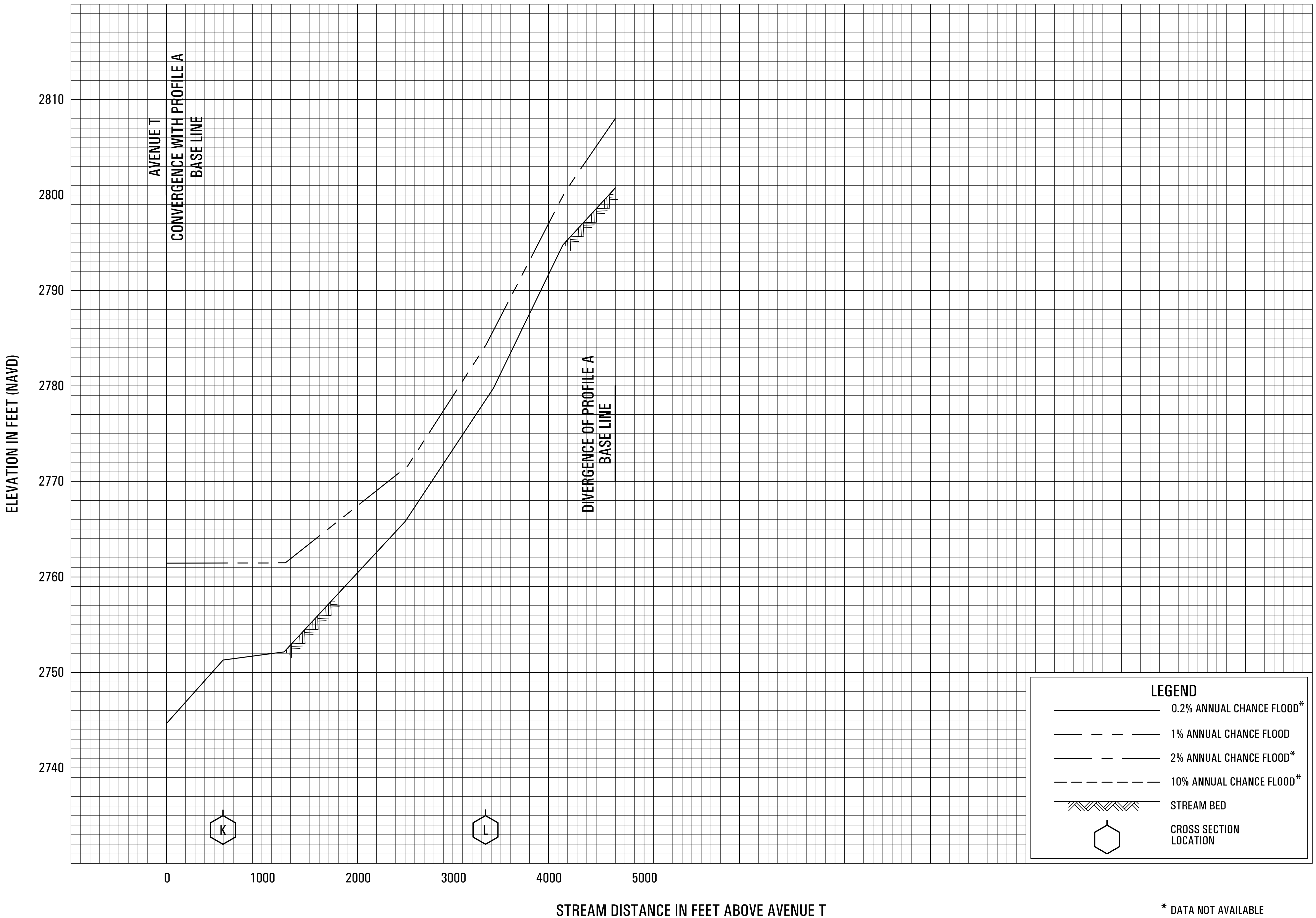
FLOOD PROFILES

LITTLE ROCK WASH - PROFILE B

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



* DATA NOT AVAILABLE

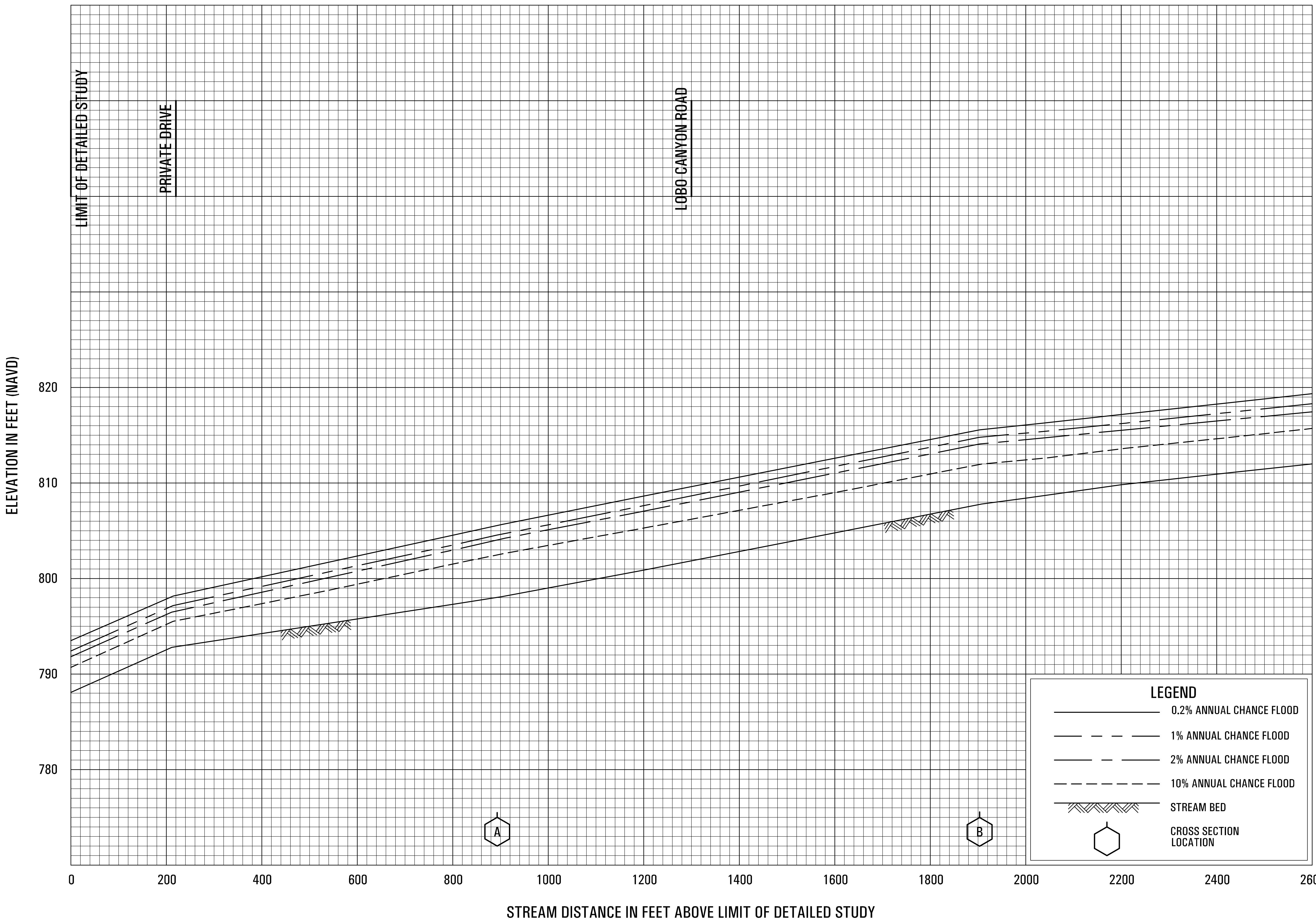
FLOOD PROFILES

LITTLE ROCK WASH - PROFILE C

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



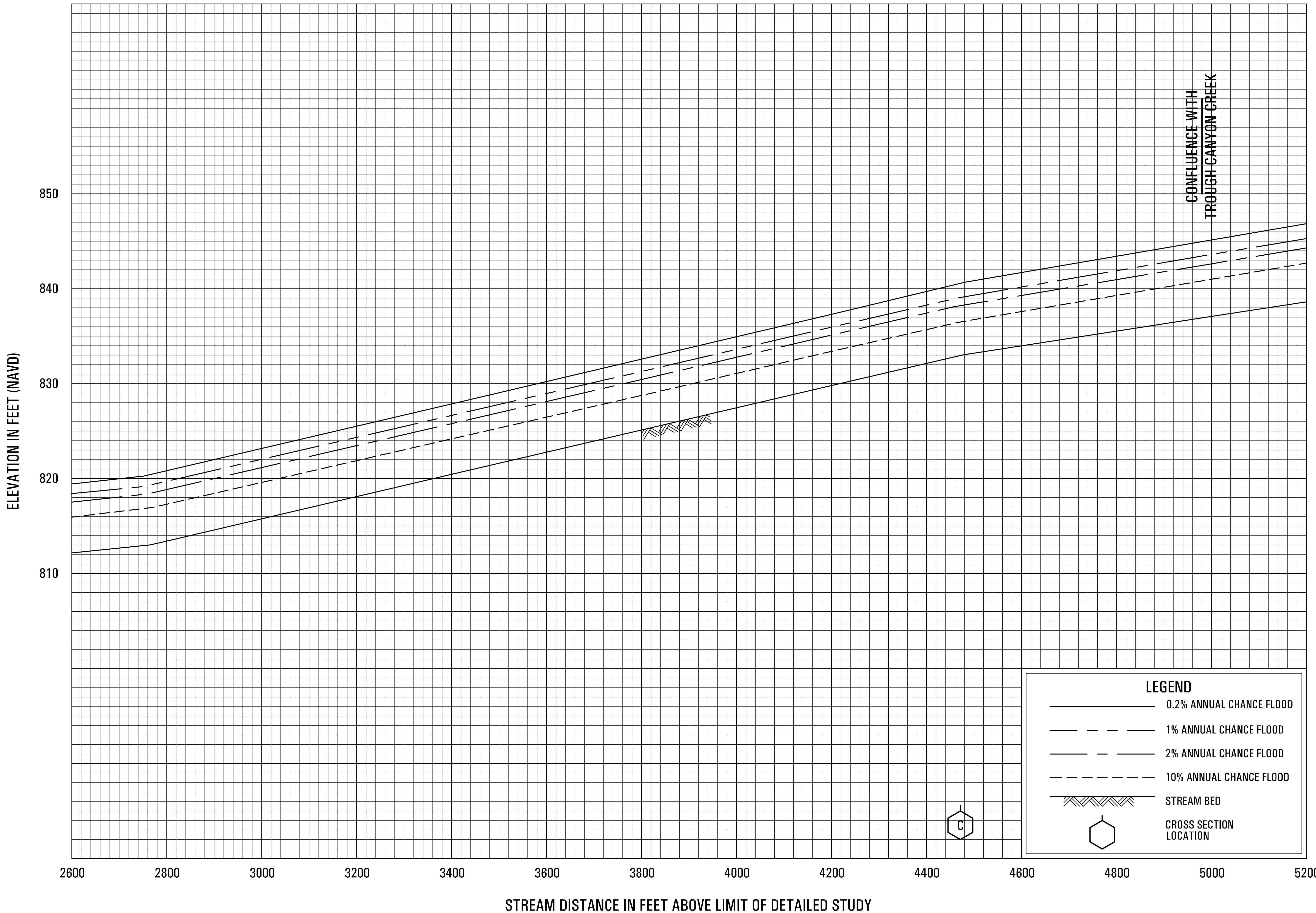
FLOOD PROFILES

LOBO CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



FLOOD PROFILES

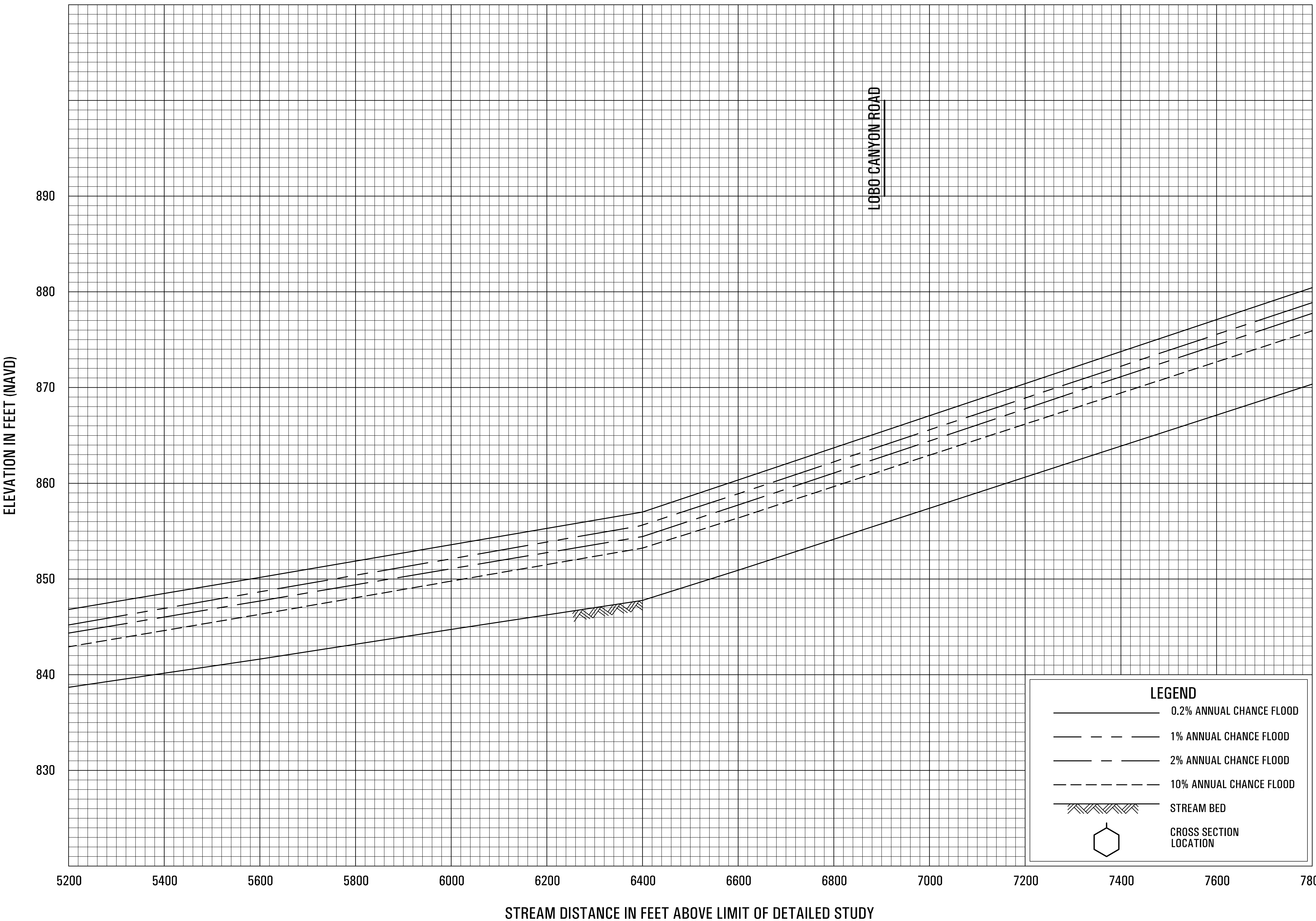
LOBO CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS

96P



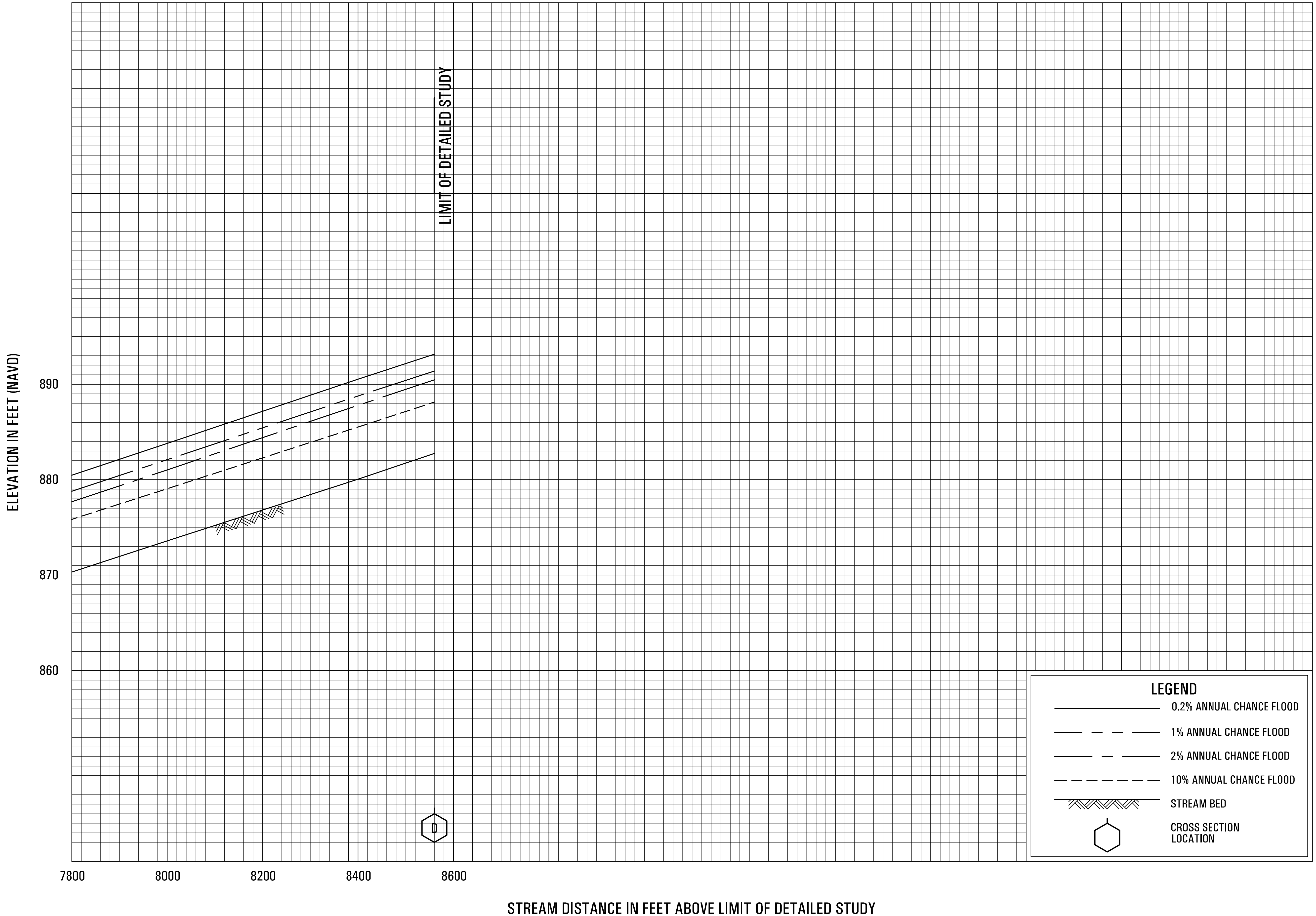
FLOOD PROFILES

LOBO CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



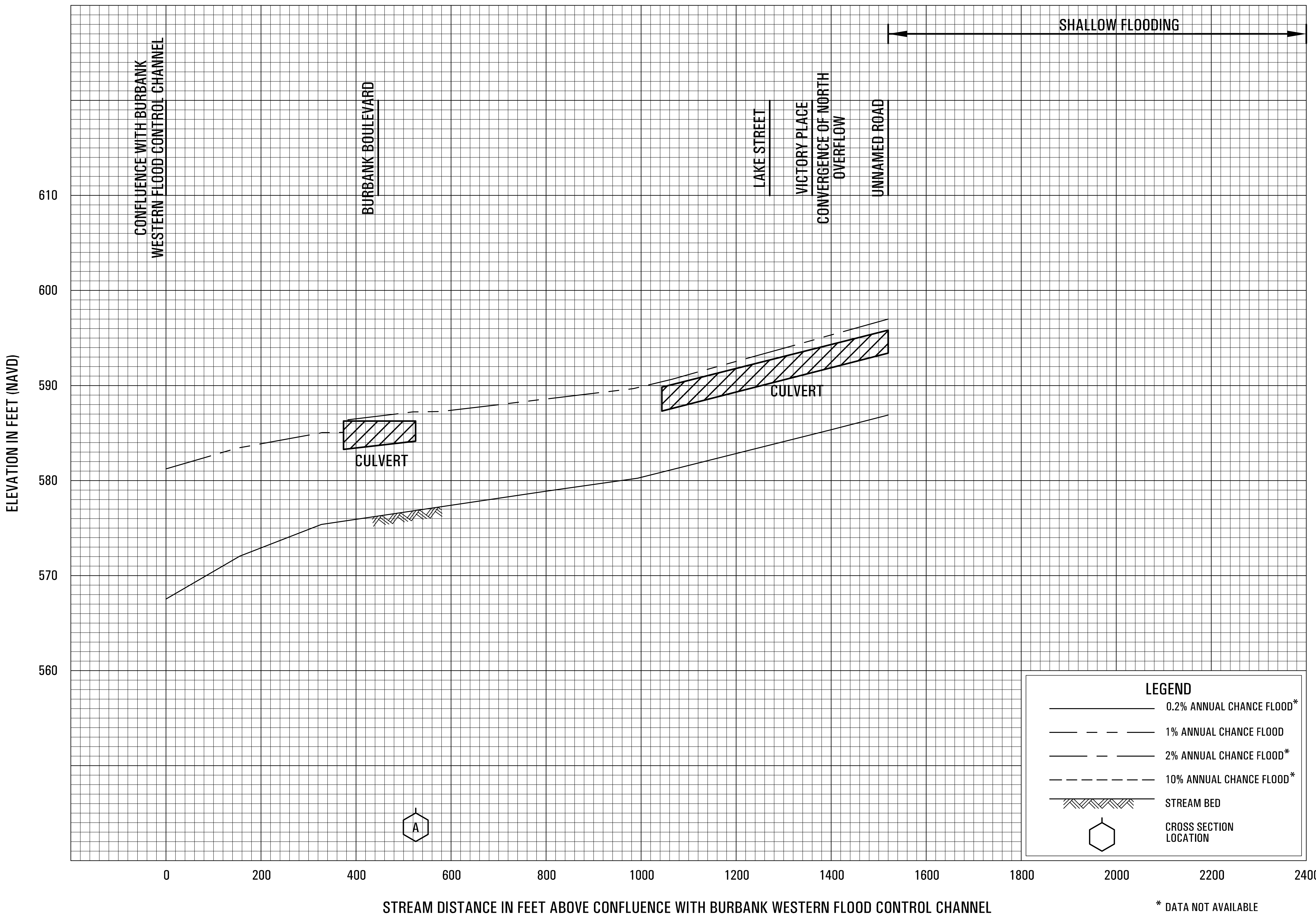
FLOOD PROFILES

LOBO CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



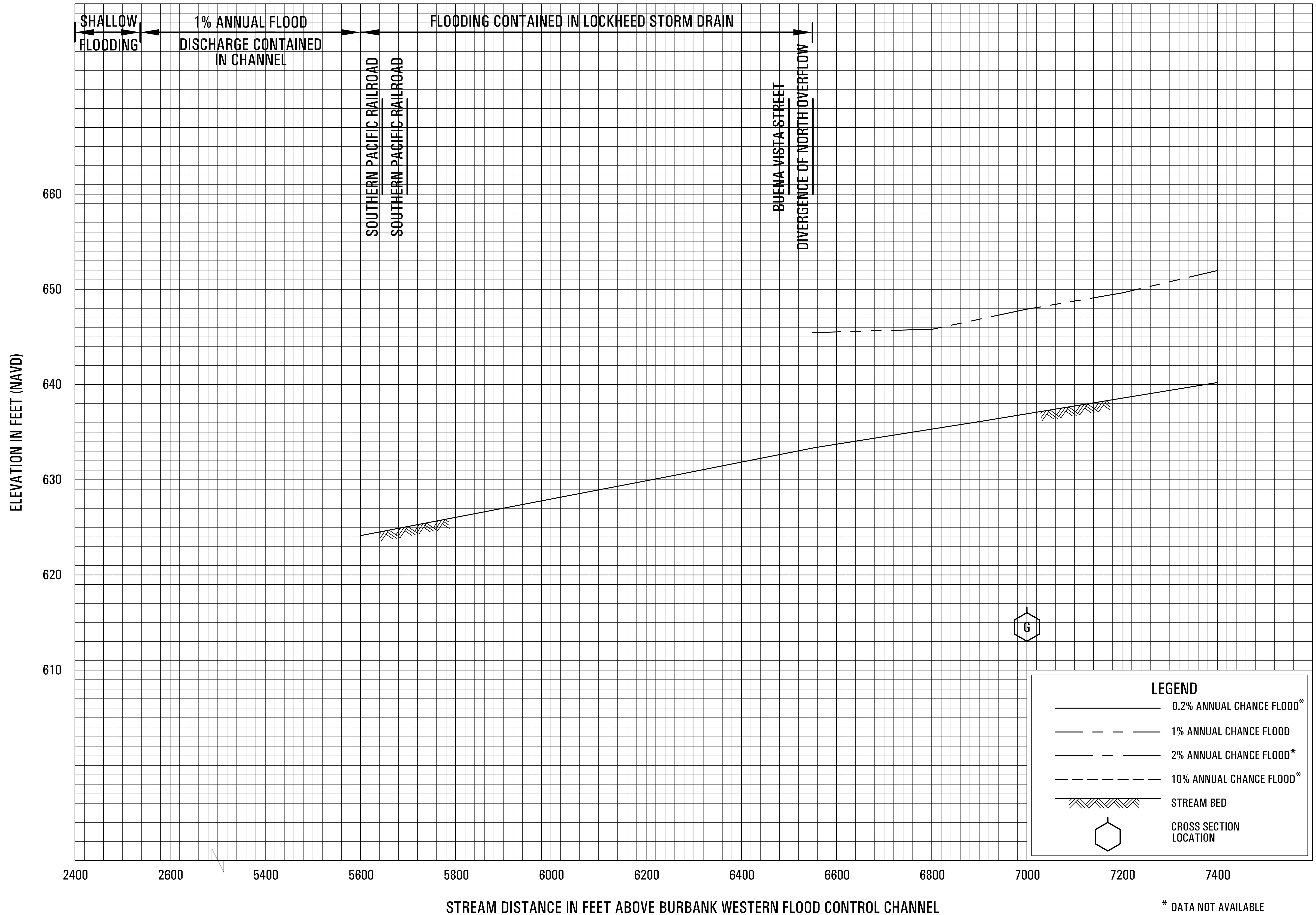
FLOOD PROFILES

LOCKHEED DRAIN CHANNEL

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



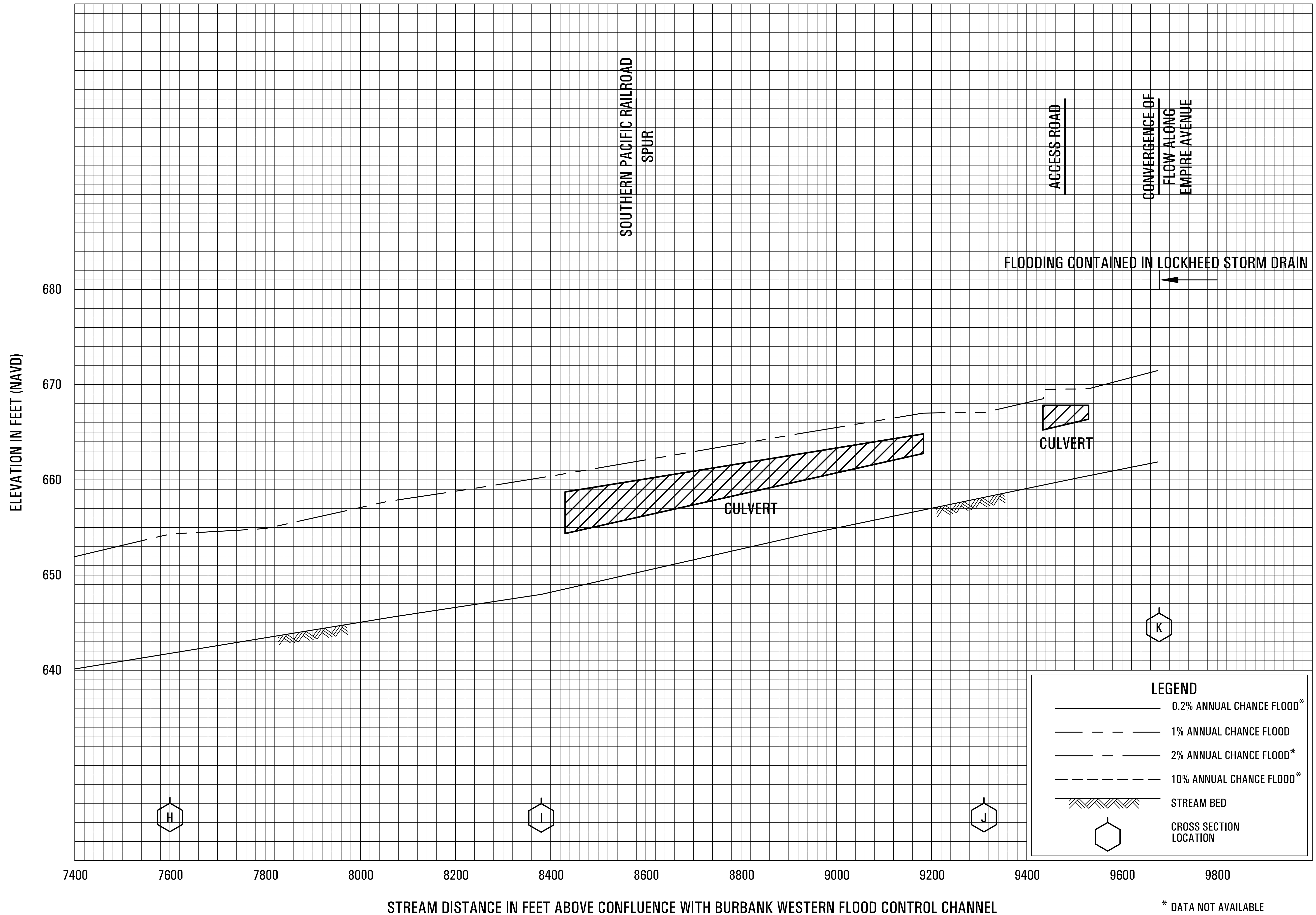
FLOOD PROFILES

LOCKHEED DRAIN CHANNEL

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



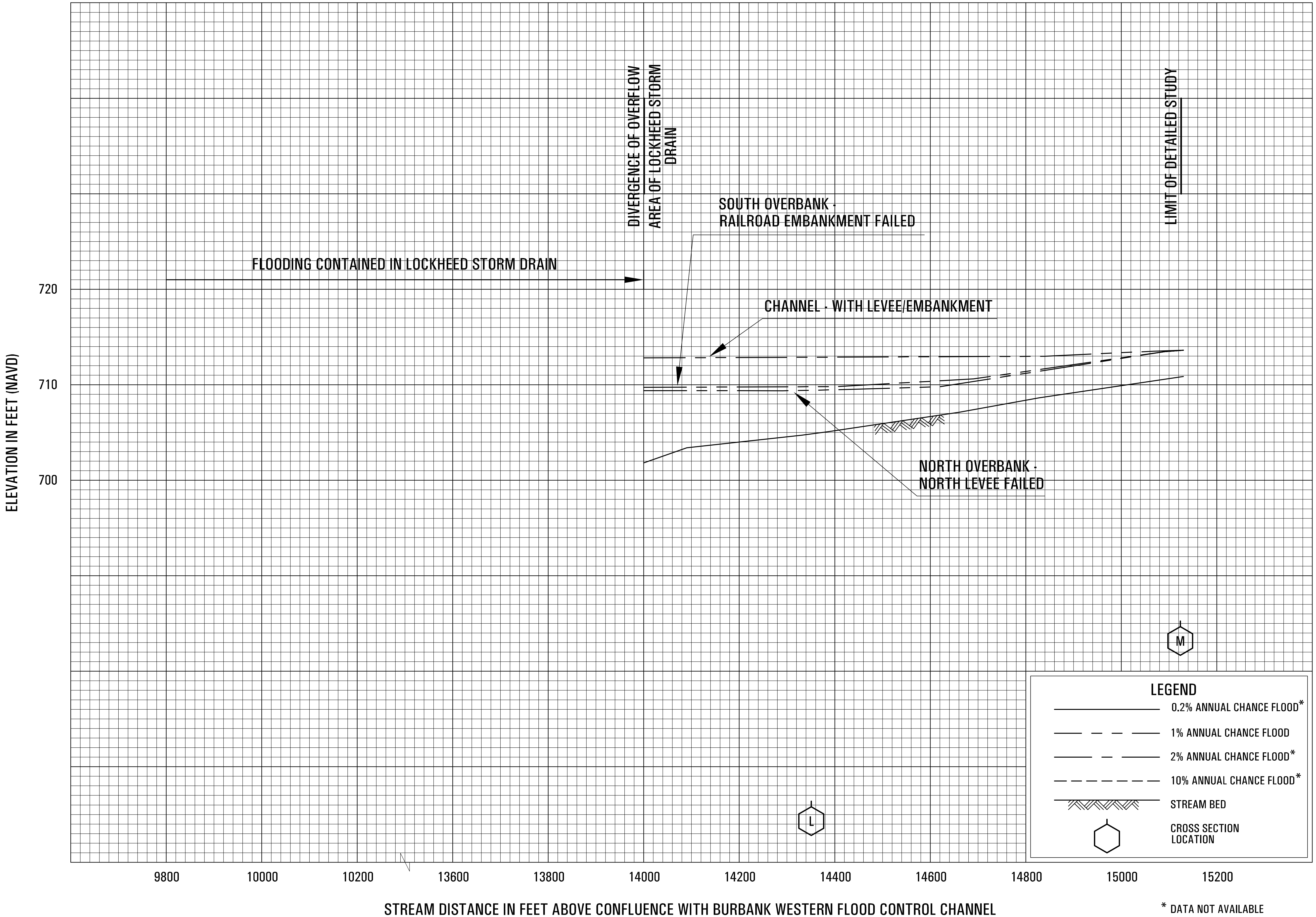
FLOOD PROFILES

LOCKHEED DRAIN CHANNEL

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



FLOOD PROFILES

LOCKHEED DRAIN CHANNEL

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS

FLOOD INSURANCE STUDY

LOS ANGELES COUNTY, CALIFORNIA

AND INCORPORATED AREAS

VOLUME 4 OF 4

Community Name	Community Number	Community Name	Community Number	Community Number	Community Name	Community Number	Community Number
LOS ANGELES COUNTY, UNINCORPORATED AREAS	065043	DIAMOND BAR, CITY OF	060741	LAWNDALE, CITY OF*	060134	SAN DIMAS, CITY OF	060154
AGOURA HILLS, CITY OF	065072	DOWNEY, CITY OF	060645	LOMITA, CITY OF*	060135	SAN FERNANDO, CITY OF*	060628
ALHAMBRA, CITY OF*	060095	DUARTE, CITY OF	065026	LONG BEACH, CITY OF	060136	SAN GABRIEL, CITY OF*	065055
ARCADIA, CITY OF	065014	EL MONTE, CITY OF*	060658	LOS ANGELES, CITY OF	060137	SAN MARINO, CITY OF*	065057
ARTESIA, CITY OF*	060097	EL SEGUNDO, CITY OF	060118	LYNWOOD, CITY OF	060635	SANTA CLARITA, CITY OF	060729
AVALON, CITY OF	060098	GARDENA, CITY OF	060119	MALIBU, CITY OF	060745	SANTA FE SPRINGS, CITY OF	060158
AZUSA, CITY OF	065015	GLENDALE, CITY OF	065030	MANHATTAN BEACH, CITY OF	060138	SANTA MONICA, CITY OF	060159
BALDWIN PARK, CITY OF*	060100	GLENDORA, CITY OF	065031	MAYWOOD, CITY OF*	060651	SIERRA MADRE, CITY OF	065059
BELL GARDENS, CITY OF	060656	HAWAIIAN GARDENS, CITY OF*	065032	MONROVIA, CITY OF	065046	SIGNAL HILL, CITY OF*	060161
BELL, CITY OF*	060101	HAWTHORNE, CITY OF*	060123	MONTEBELLO, CITY OF	060141	SOUTH EL MONTE, CITY OF*	060162
BELLFLOWER, CITY OF	060102	HERMOSA BEACH, CITY OF	060124	MONTEREY PARK, CITY OF*	065047	SOUTH GATE, CITY OF	060163
BEVERLY HILLS, CITY OF*	060655	HIDDEN HILLS, CITY OF	060125	NORWALK, CITY OF	060652	SOUTH PASADENA, CITY OF*	065061
BRADBURY, CITY OF	065017	HUNTINGTON PARK, CITY OF*	060126	PALMDALE, CITY OF	060144	TEMPLE CITY, CITY OF	060653
BURBANK, CITY OF	065018	INDUSTRY, CITY OF	065035	PALOS VERDES ESTATES, CITY OF	060145	TORRANCE, CITY OF	060165
CALABASAS, CITY OF	060749	INGLEWOOD, CITY OF*	065036	PARAMOUNT, CITY OF	065049	VERNON, CITY OF*	060166
CARSON, CITY OF	060107	IRWINDALE, CITY OF*	060129	PASADENA, CITY OF	065050	WALNUT, CITY OF	065069
CERRITOS, CITY OF	060108	LA CANADA FLINTRIDGE, CITY OF	060669	PICO RIVERA, CITY OF	060148	WEST COVINA, CITY OF	060666
CLAREMONT, CITY OF	060109	LA HABRA HEIGHTS, CITY OF	060701	POMONA, CITY OF	060149	WEST HOLLYWOOD, CITY OF	060720
COMMERCE, CITY OF	060110	LA MIRADA, CITY OF	060131	RANCHO PALOS VERDES, CITY OF	060464	WESTLAKE VILLAGE, CITY OF	060744
COMPTON, CITY OF	060111	LA PUENTE, CITY OF*	065039	REDONDO BEACH, CITY OF	060150	WHITTIER, CITY OF	060169
COVINA, CITY OF	065024	LA VERNE, CITY OF	060133	ROLLING HILLS ESTATES, CITY OF*	065054		
CUDAHY, CITY OF	060657	LAKEWOOD, CITY OF	060130	ROLLING HILLS, CITY OF	060151		
CULVER CITY, CITY OF	060114	LANCASTER, CITY OF	060672	ROSEMEAD, CITY OF	060153		

*Non-floodprone communities

September 26, 2008

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
06037CV004A

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study (FIS) may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

Selected Flood Insurance Rate Map (FIRM) panels for the community contain information that was previously shown separately on the corresponding Flood Boundary and Floodway Map (FBFM) panels (e.g. floodways, cross sections). In addition, former flood hazard zone designations have been changed as follows:

Old Zone	New Zone
A1 through A30	AE
V1 through V30	VE
B	X (Shaded)
C	X (Unshaded)

Part or all of this FIS may be revised and republished at any time. In addition, part of this FIS may be revised by the Letter of Map Revision process, which does not involve republication or redistribution of the FIS. It is, therefore, the responsibility of the user to consult with community officials and to check the community repository to obtain the most current FIS components.

Initial Countywide FIS Effective Date: September 26, 2008

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Exhibit 1 - Flood Profiles (continued)

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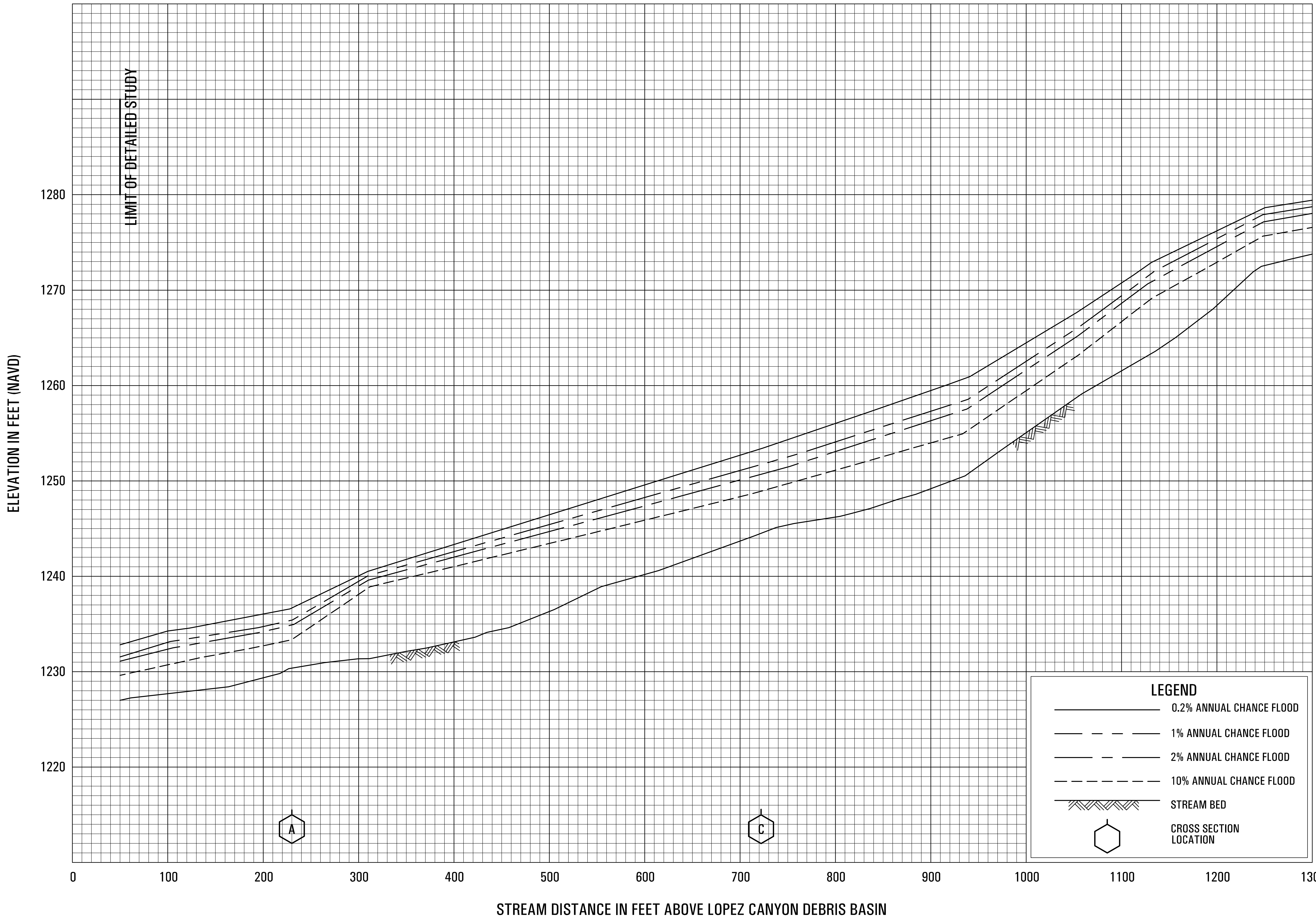


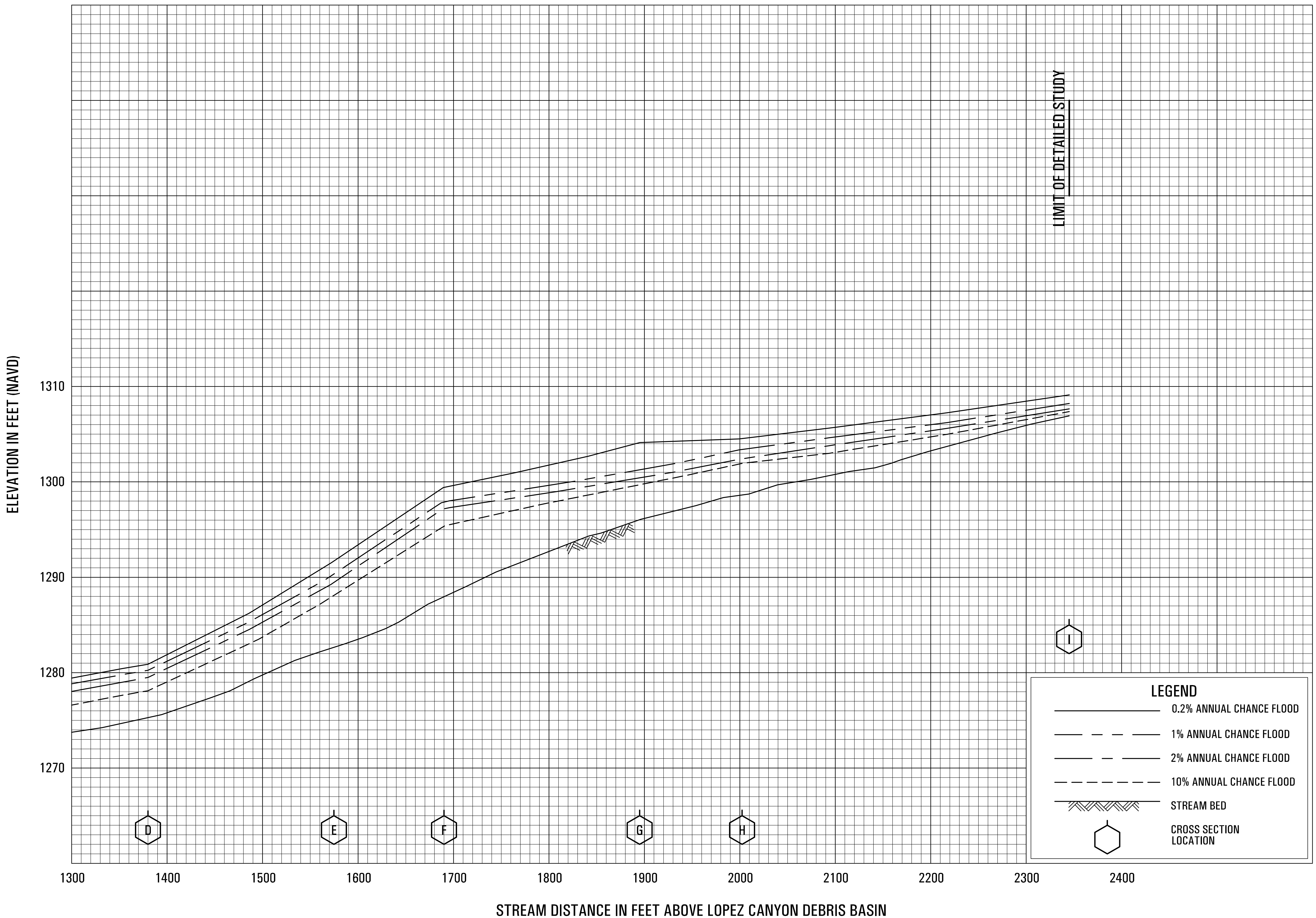
FLOOD PROFILES

LOPEZ CANYON CHANNEL

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



FLOOD PROFILES

LOPEZ CANYON CHANNEL

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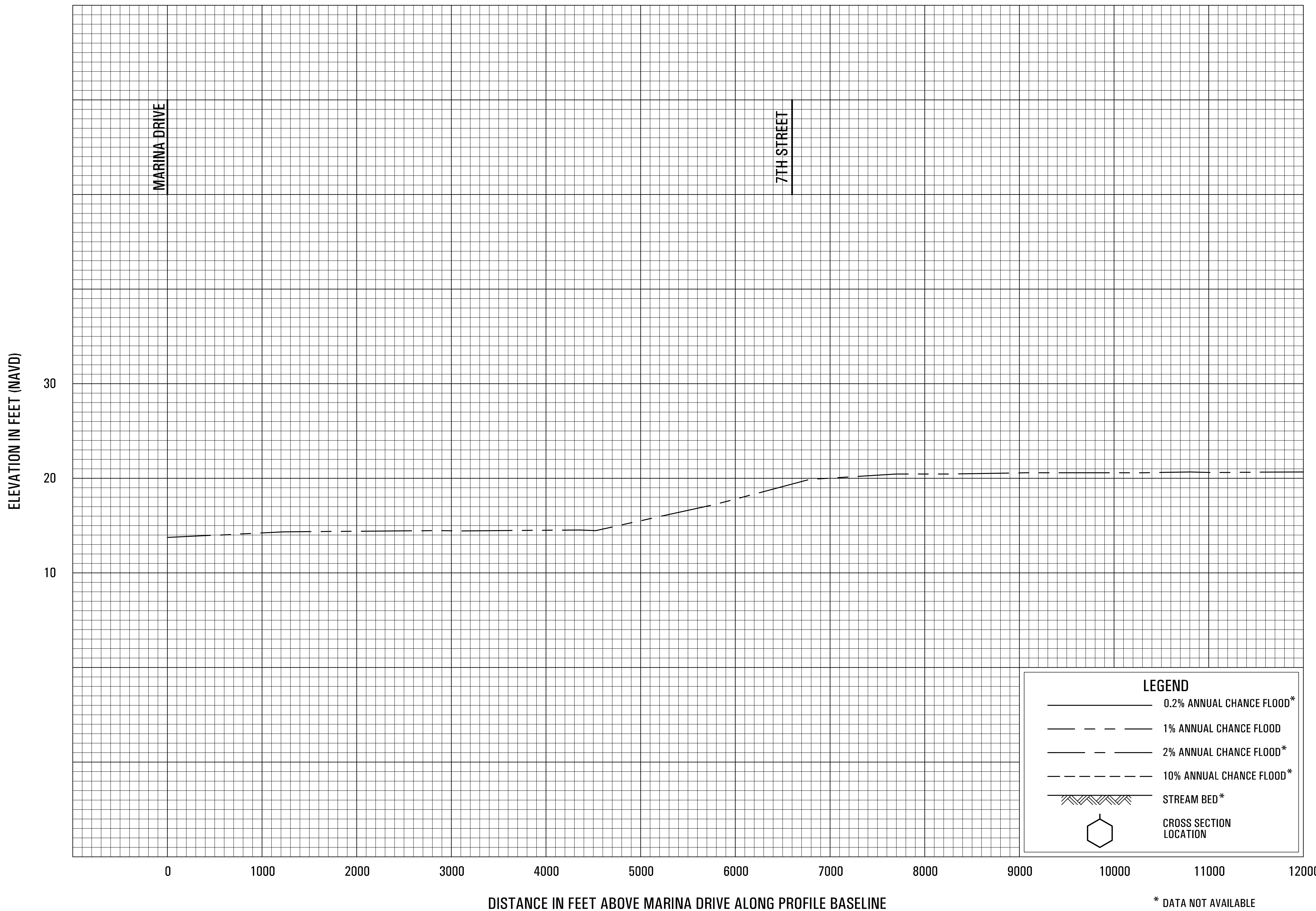
AND INCORPORATED AREAS



FLOOD PROFILES

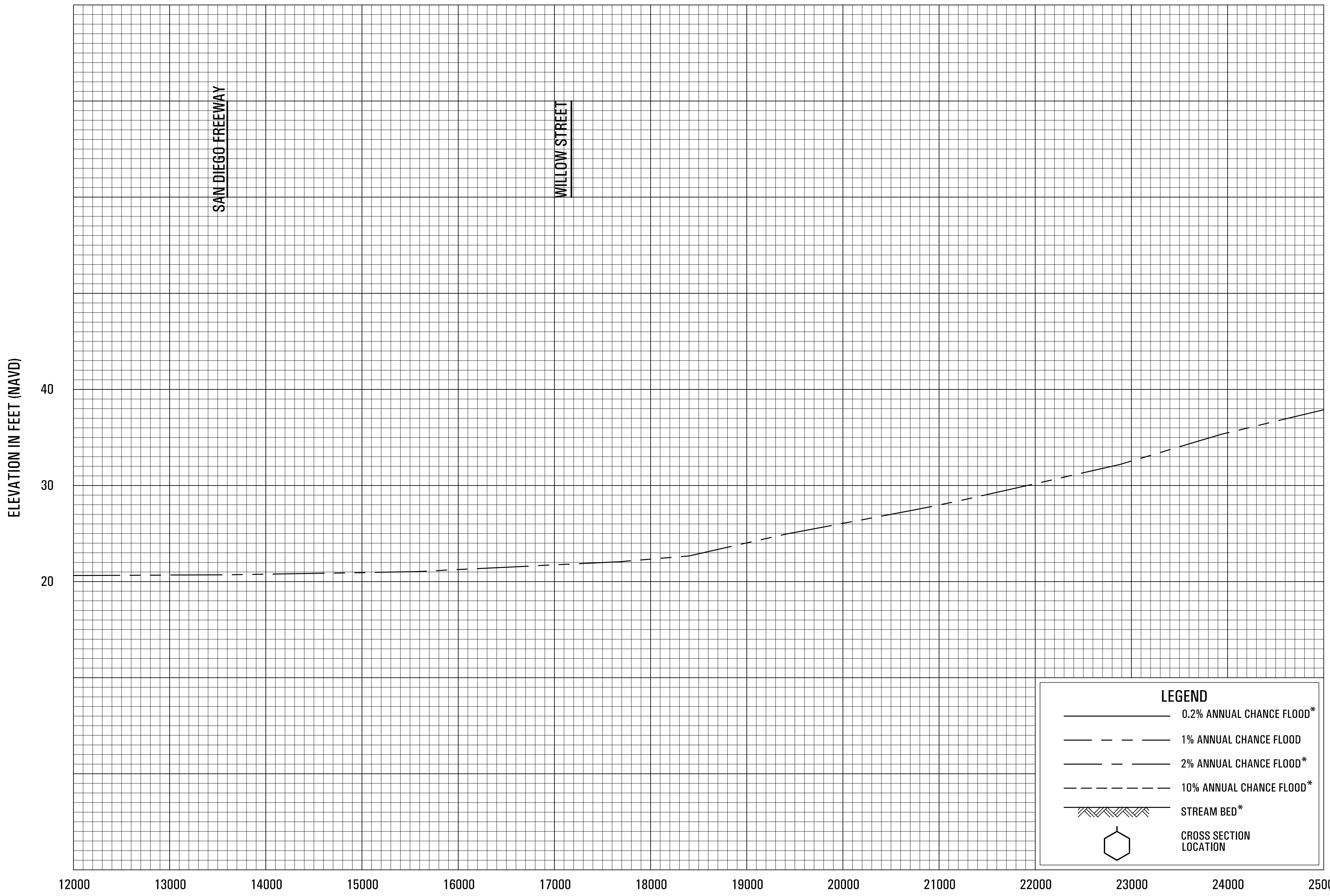
LOS ANGELES RIVER LEFT OVERBANK PATH 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS

105P



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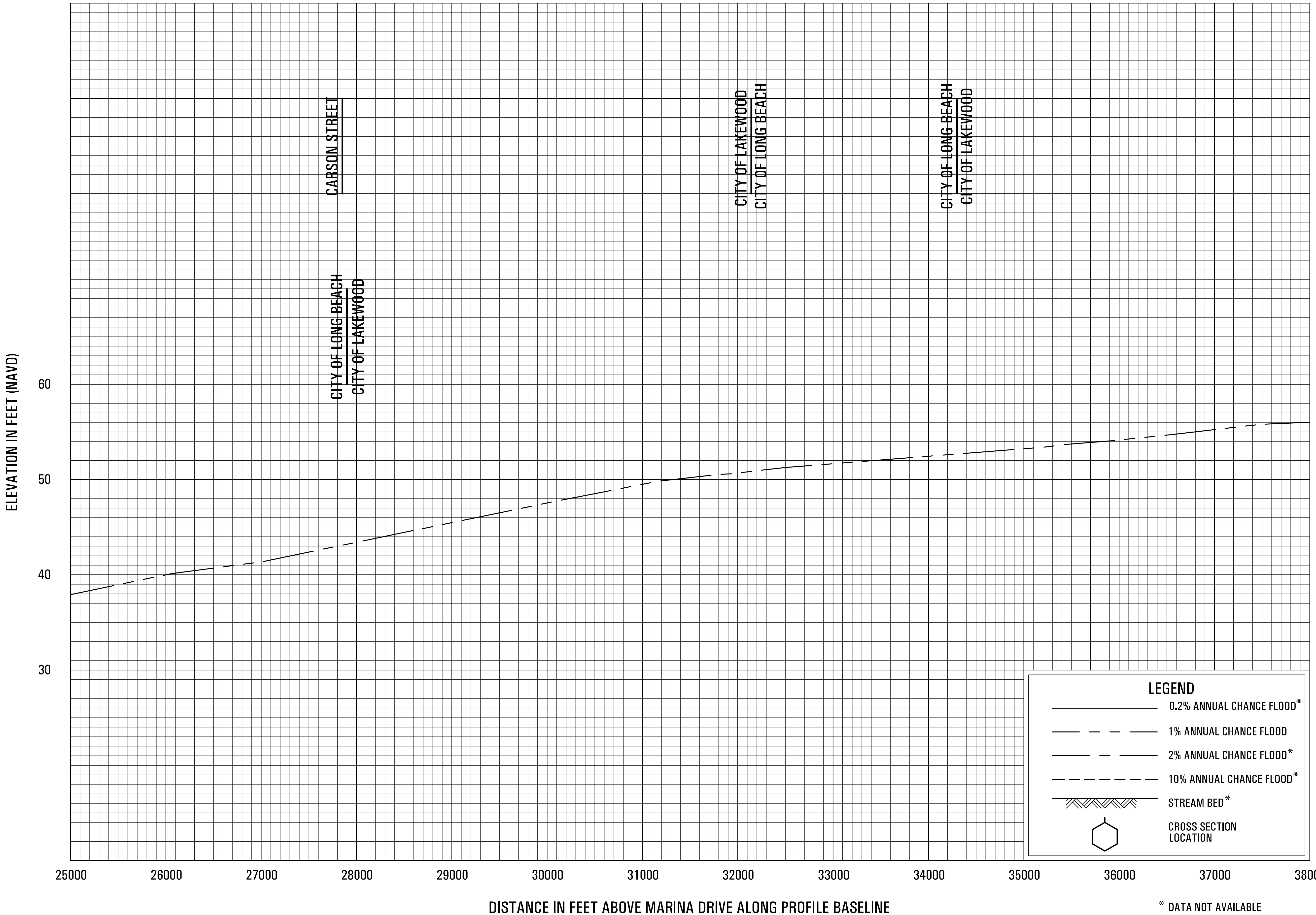
FLOOD PROFILES

LOS ANGELES RIVER LEFT OVERBANK PATH 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



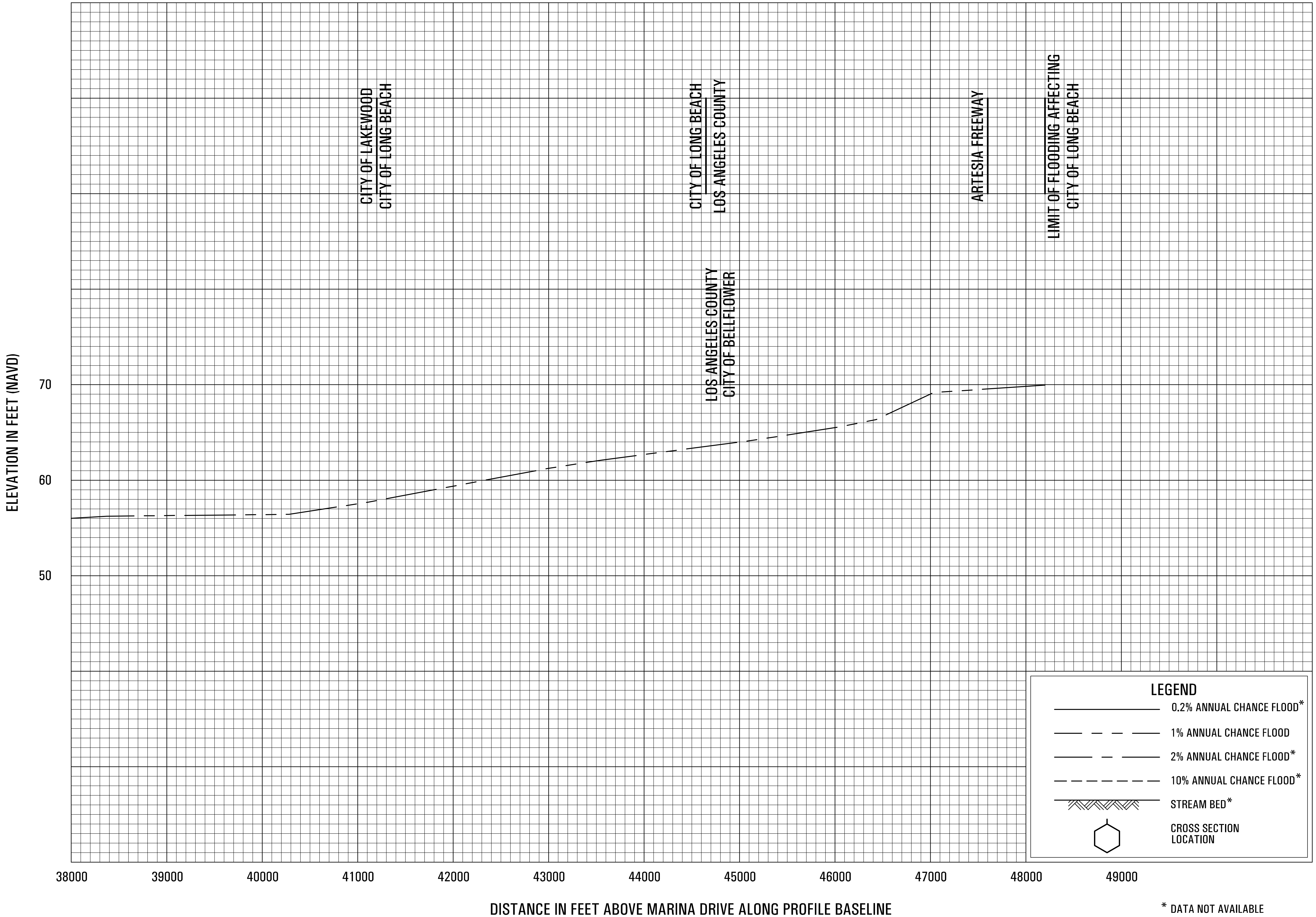
FLOOD PROFILES

LOS ANGELES RIVER LEFT OVERBANK PATH 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



* DATA NOT AVAILABLE

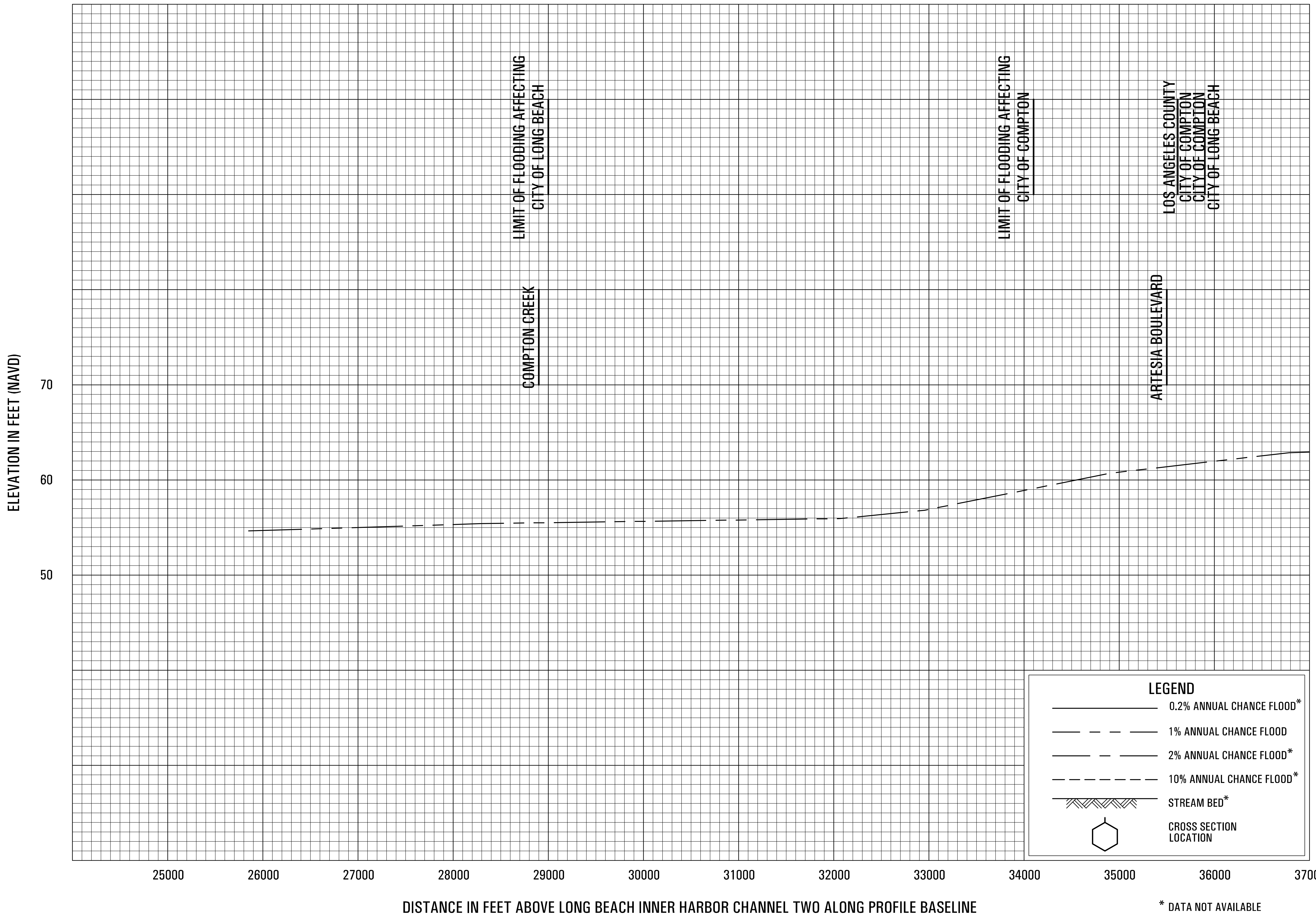
FLOOD PROFILES

LOS ANGELES RIVER LEFT OVERBANK PATH 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



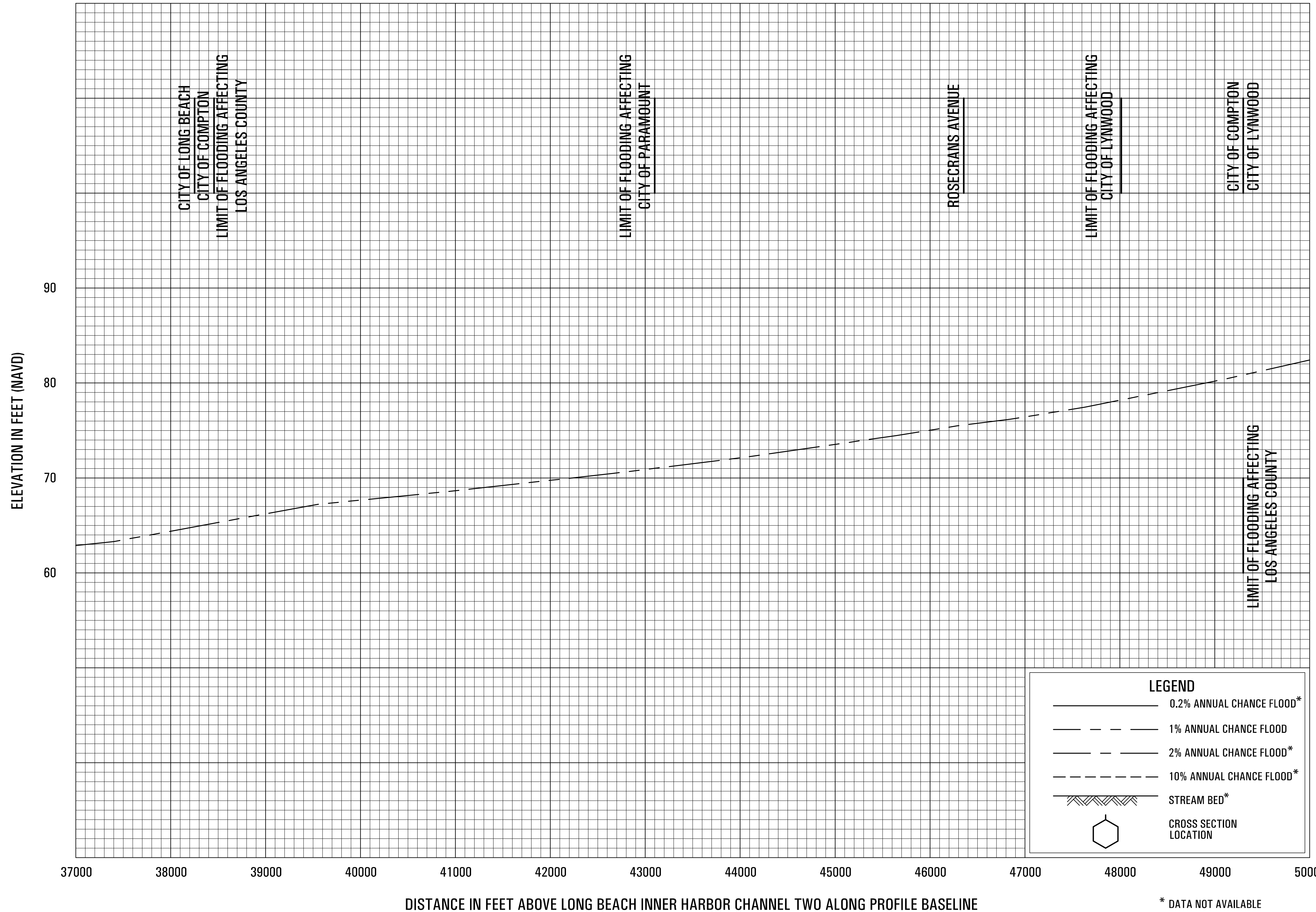
FLOOD PROFILES

LOS ANGELES RIVER RIGHT OVERBANK PATH 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



FLOOD PROFILES

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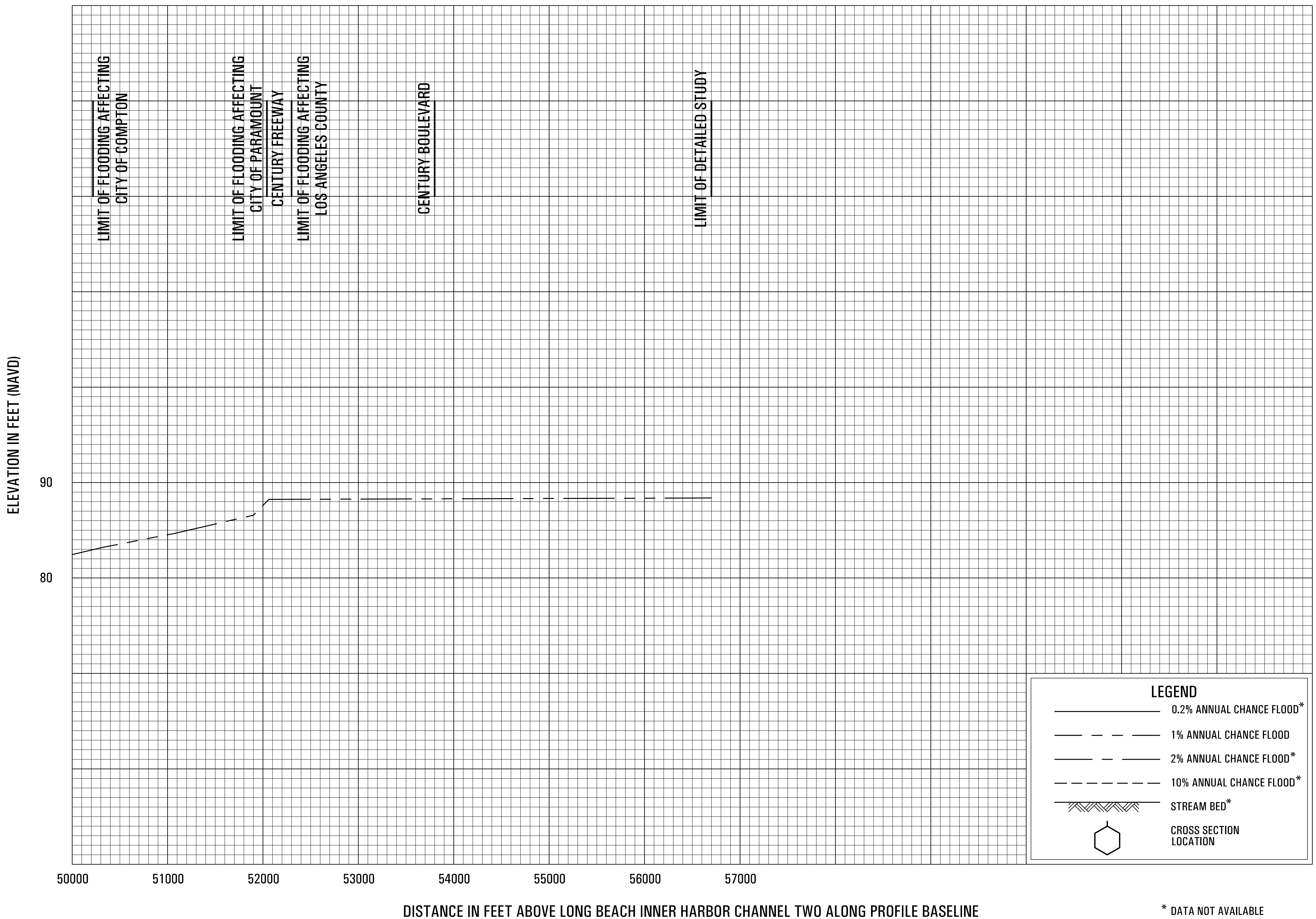
FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



FLOOD PROFILES

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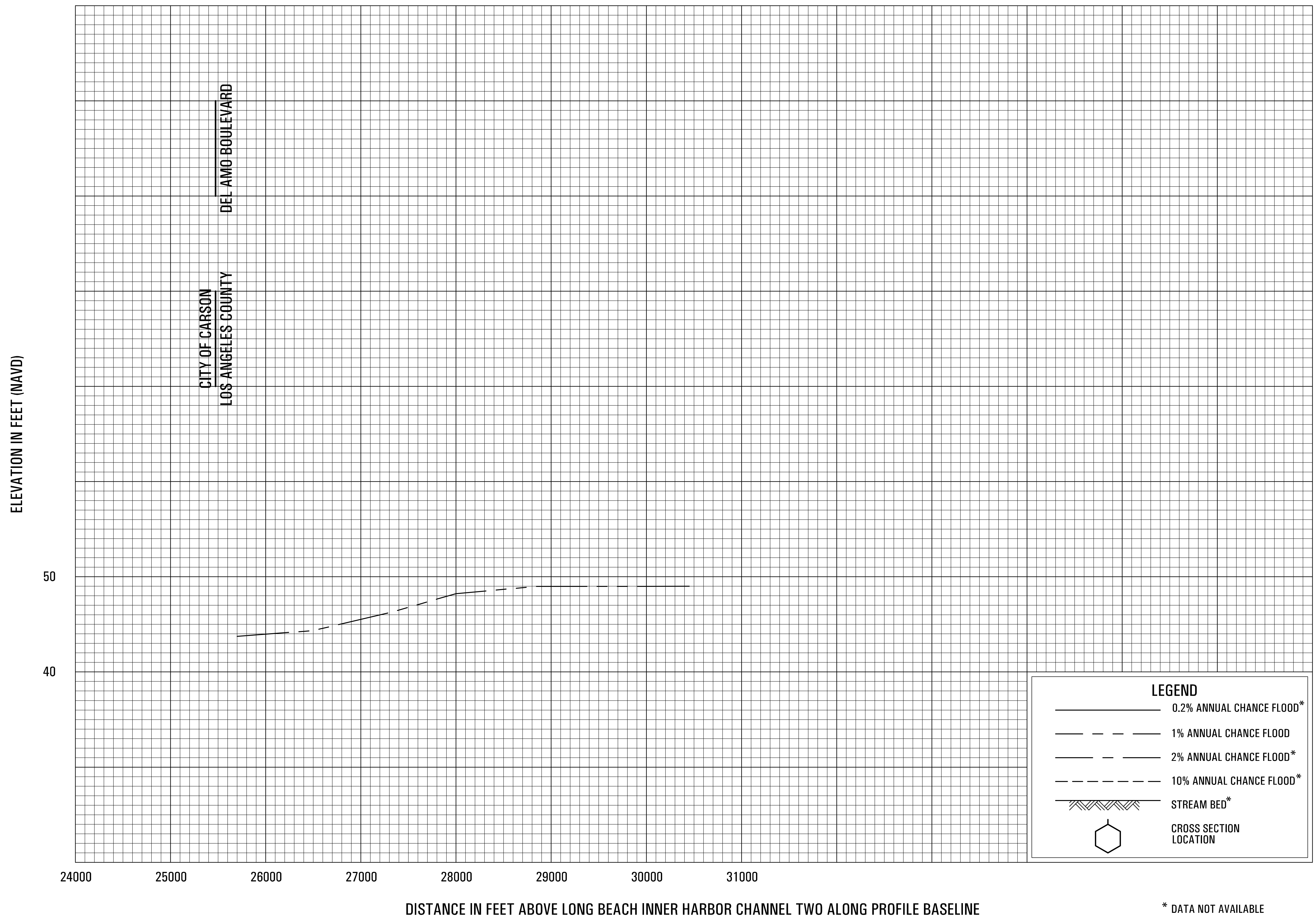
LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



FLOOD PROFILES

LOS ANGELES RIVER RIGHT OVERBANK PATH 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

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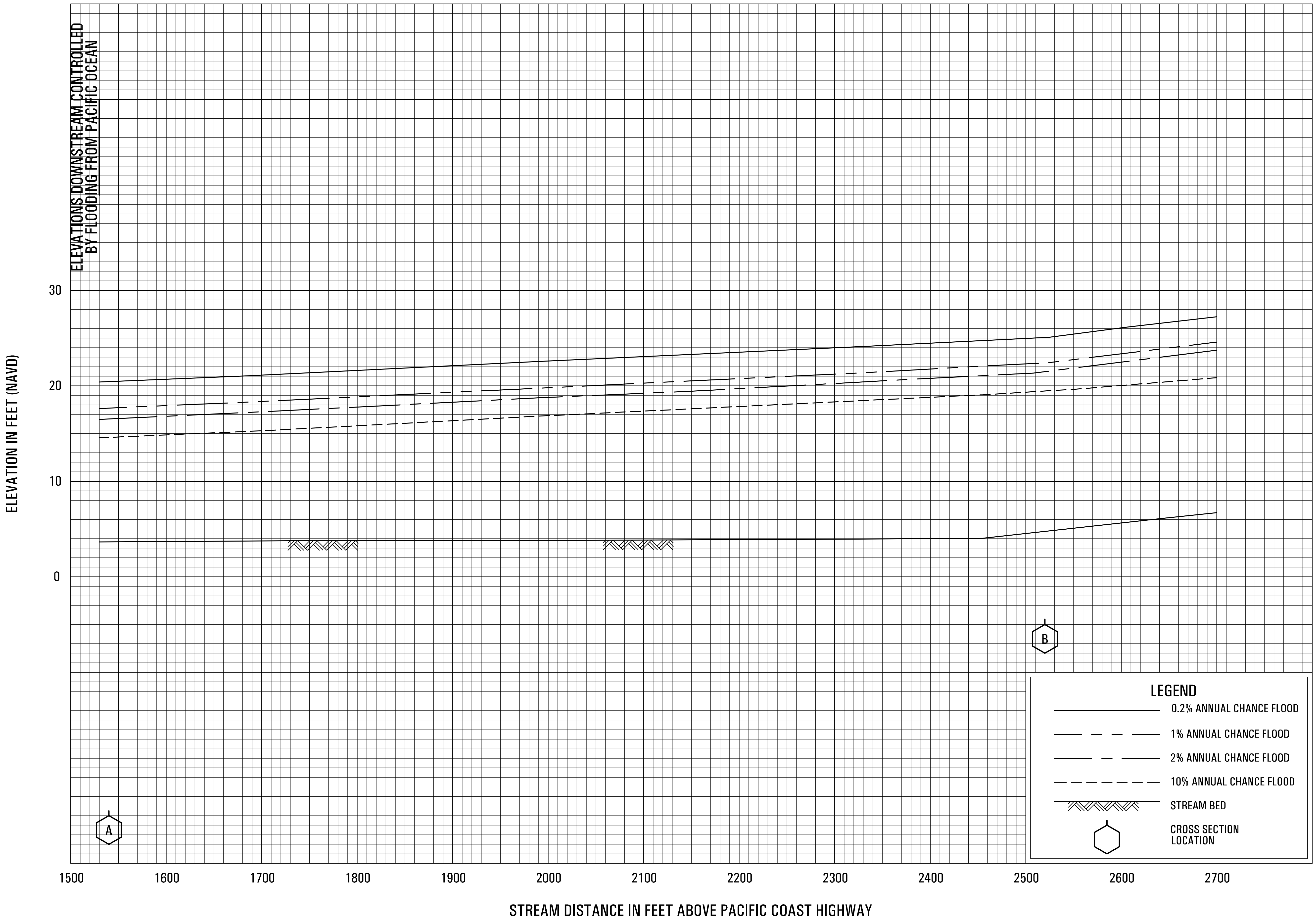
AND INCORPORATED AREAS



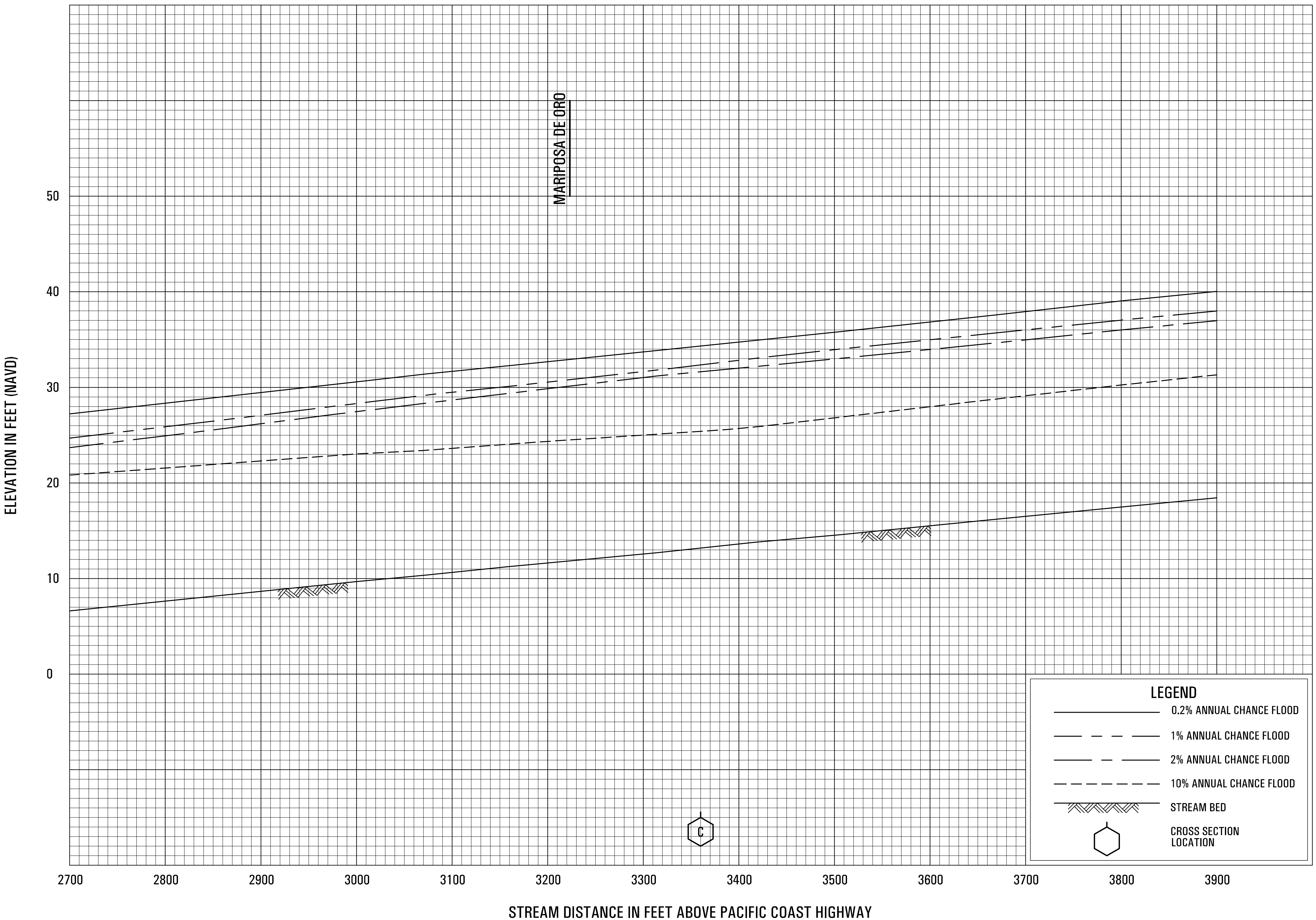
FLOOD PROFILES

MALIBU CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



FLOOD PROFILES

MALIBU CREEK

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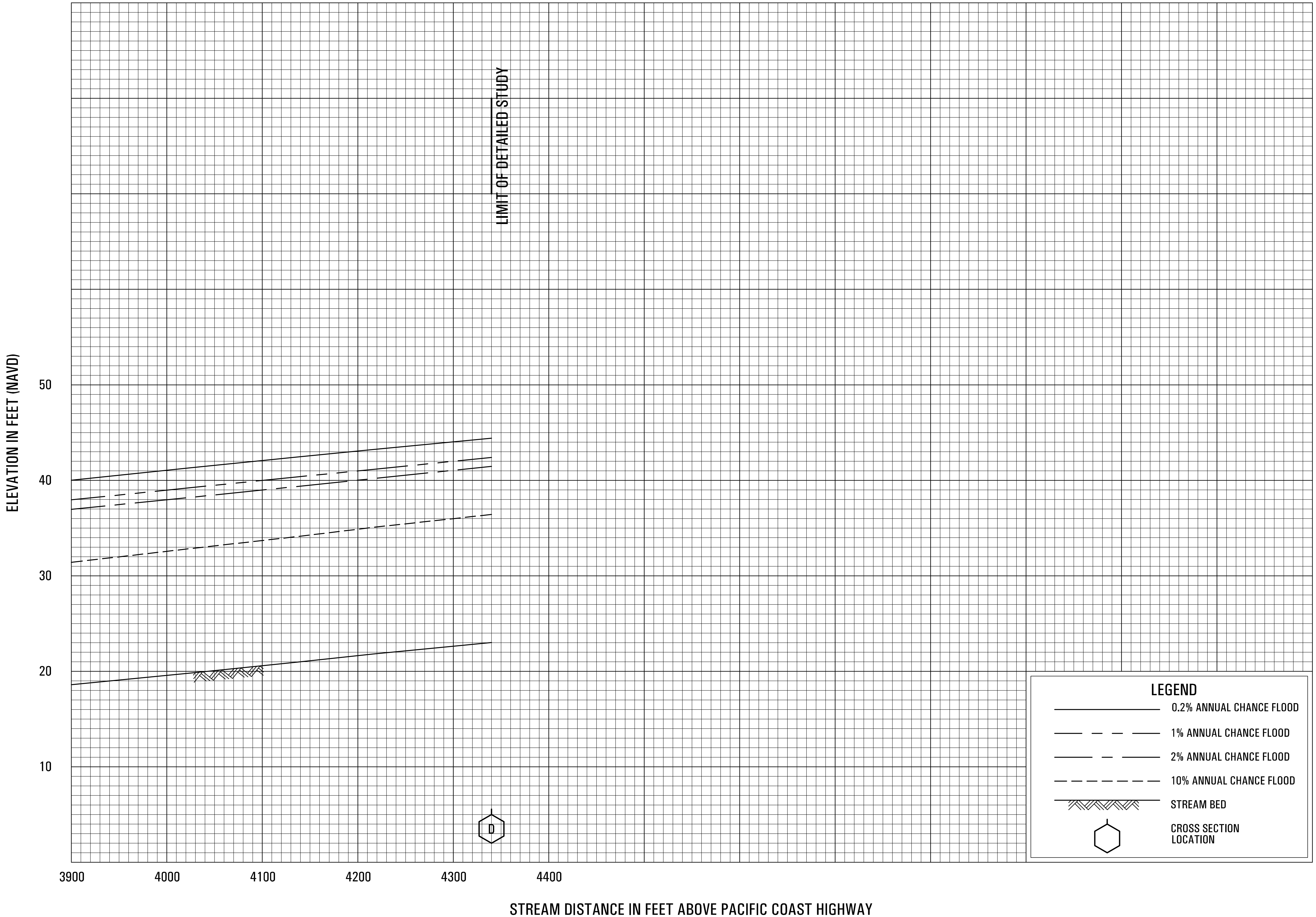
LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



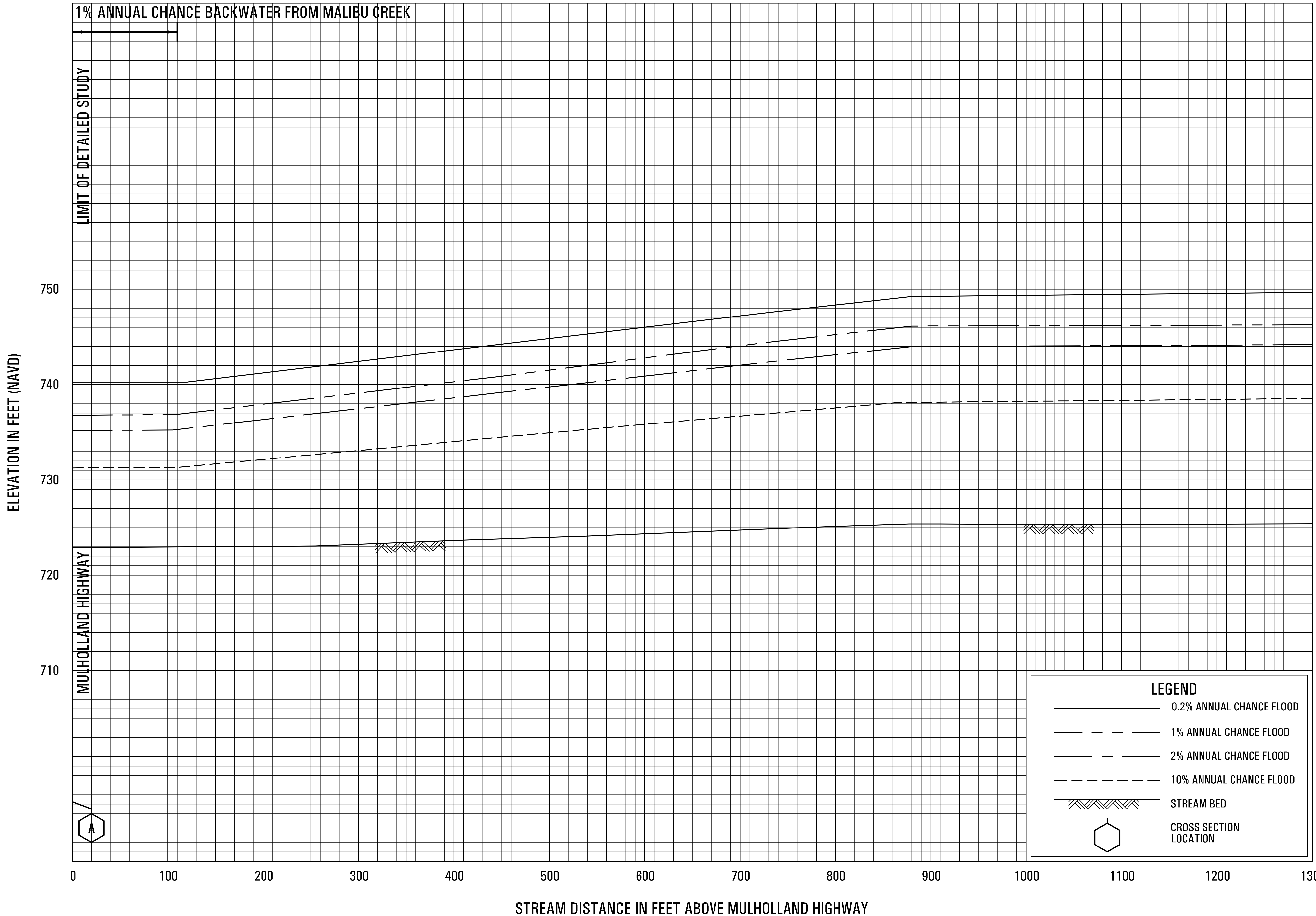
FLOOD PROFILES

MALIBU CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



FLOOD PROFILES

MEDEA CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

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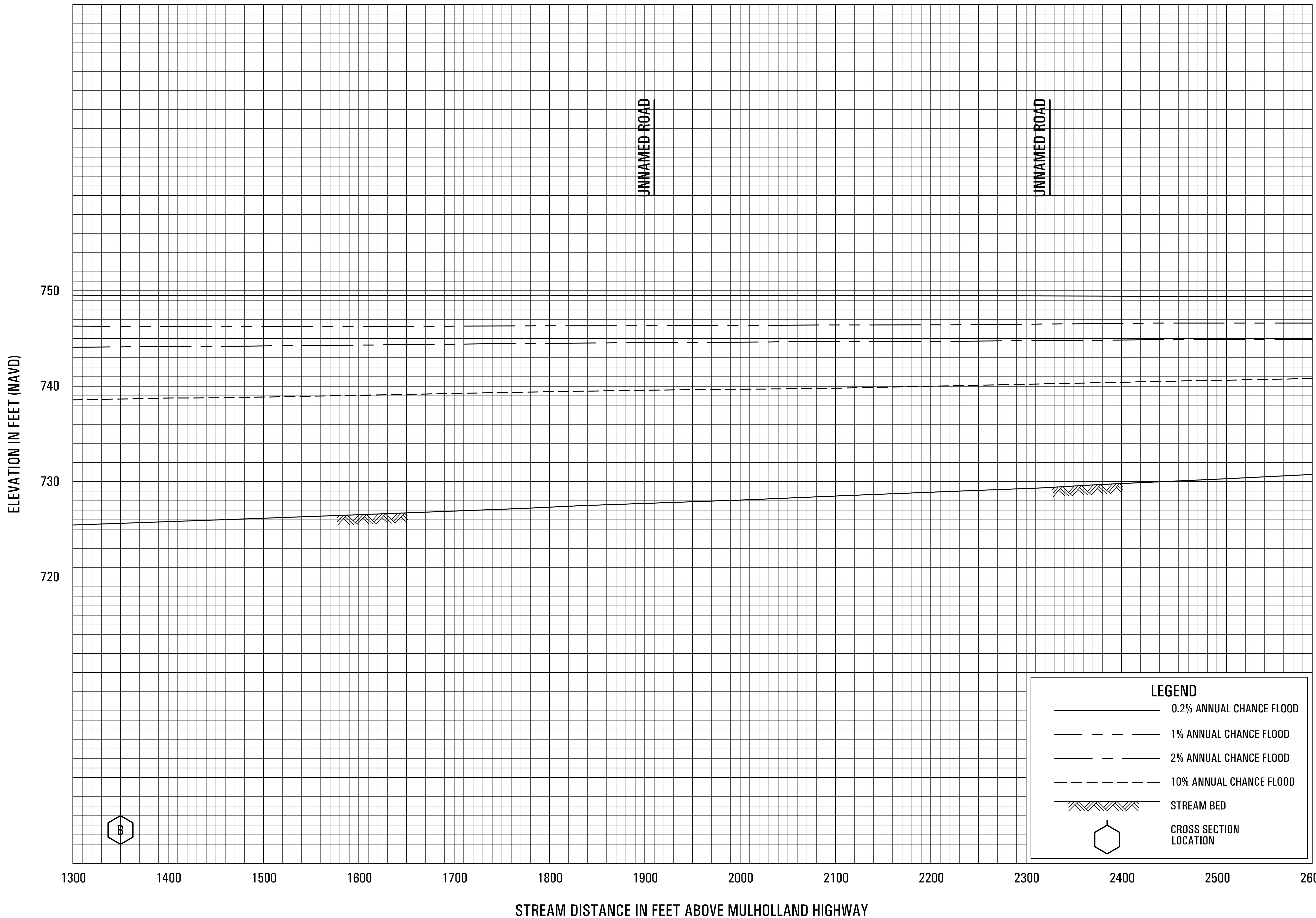

FLOOD PROFILES

MEDEA CREEK

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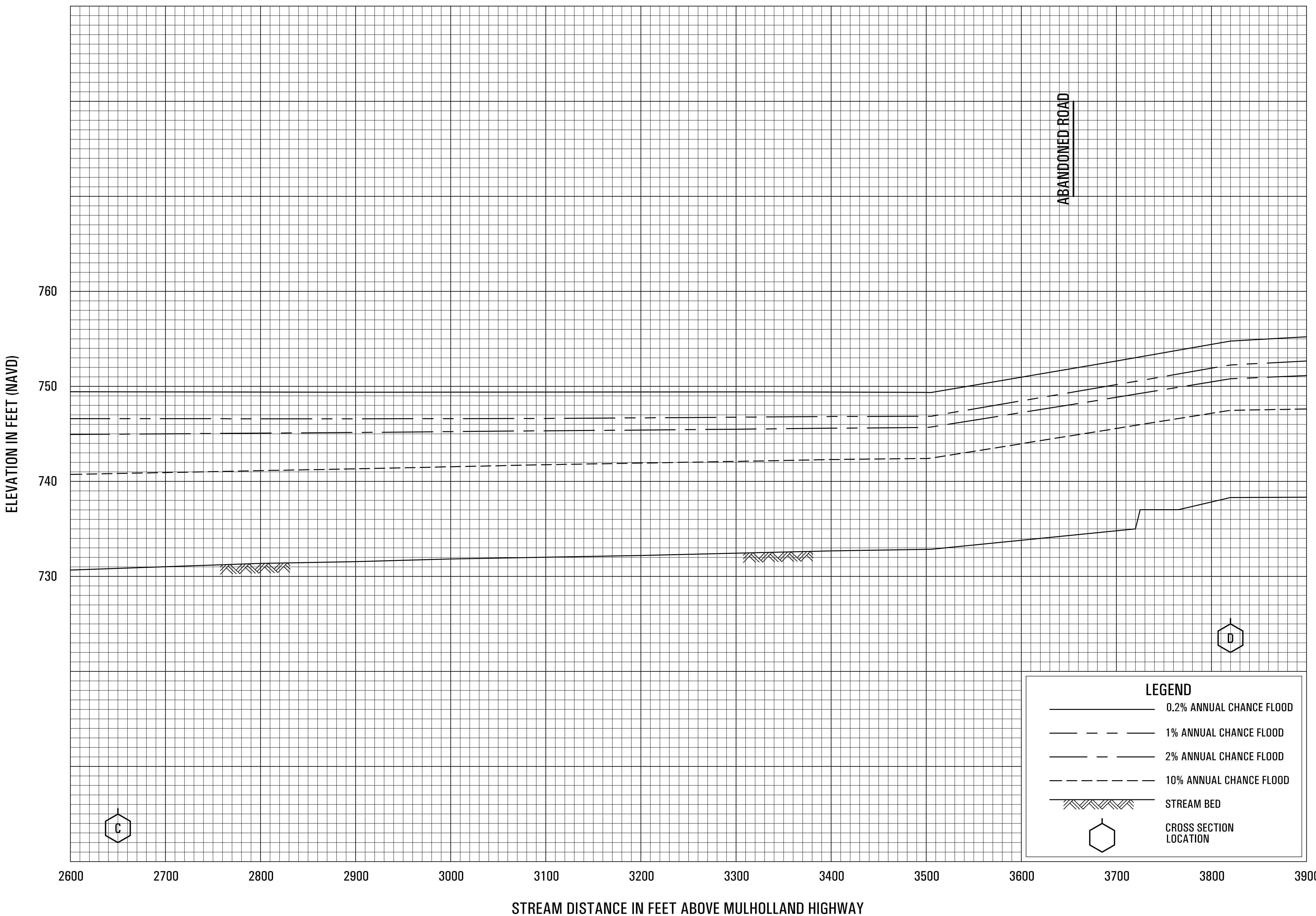

FLOOD PROFILES

MEDEA CREEK

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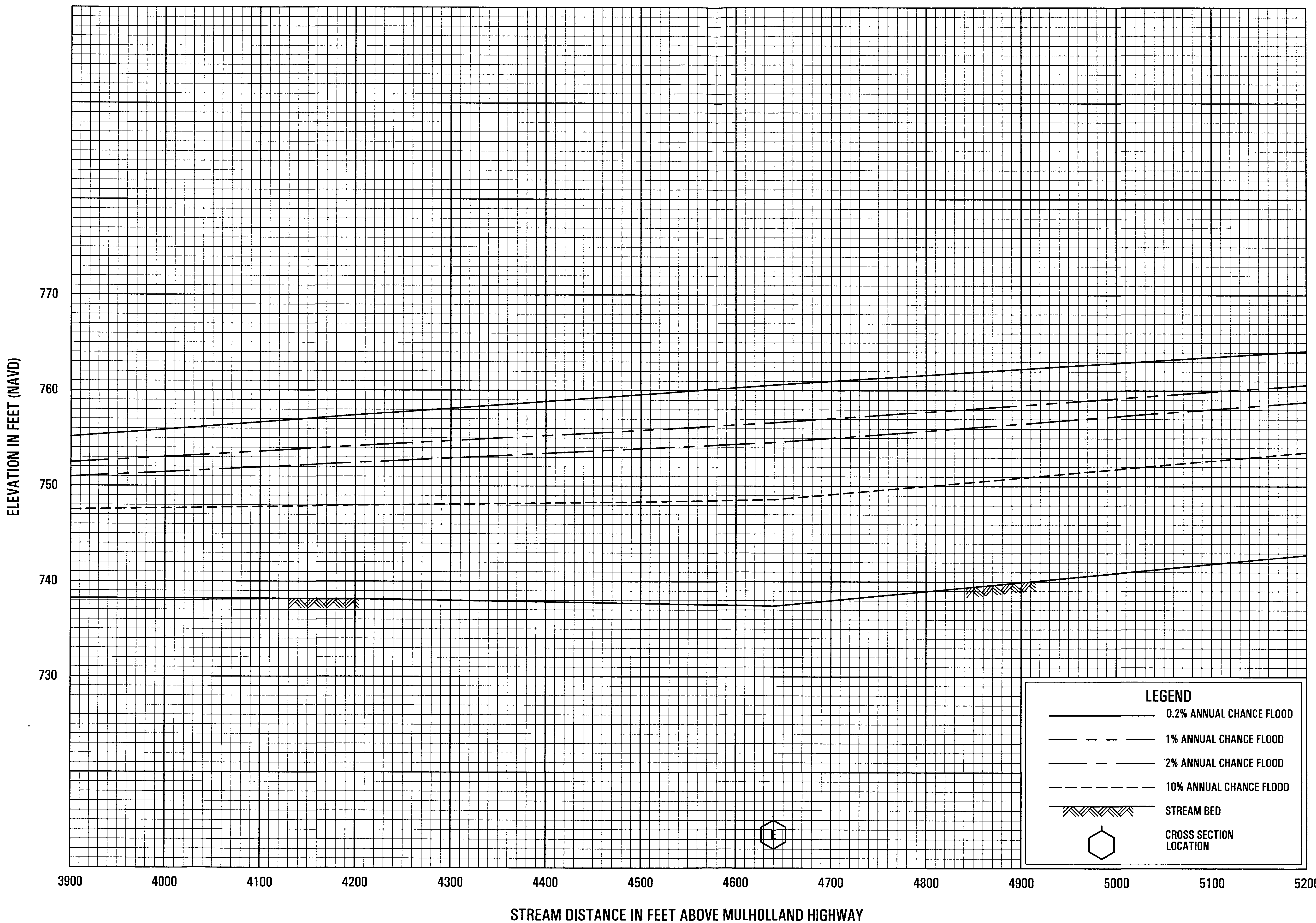

FLOOD PROFILES

MEDEA CREEK

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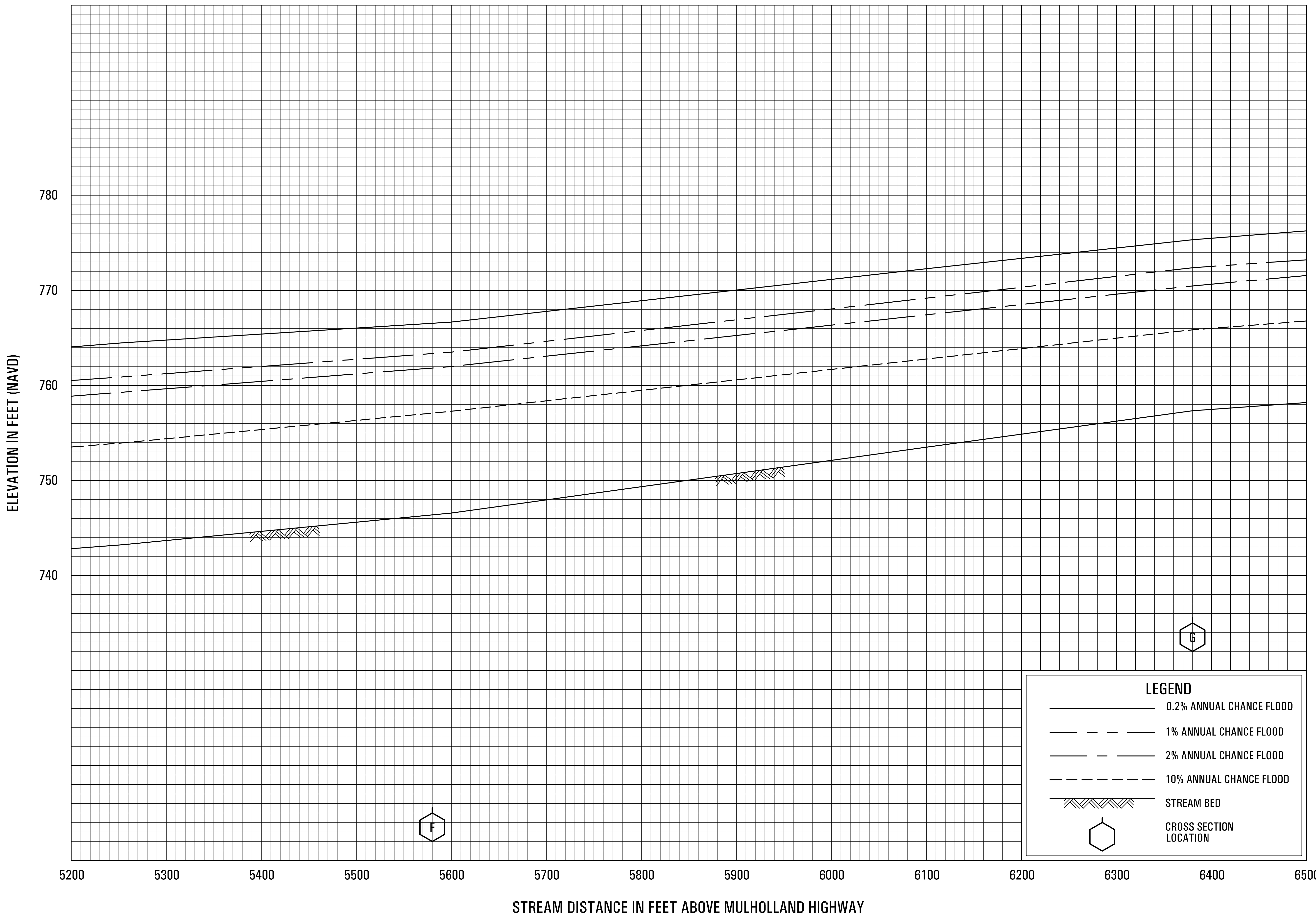

FLOOD PROFILES

MEDEA CREEK

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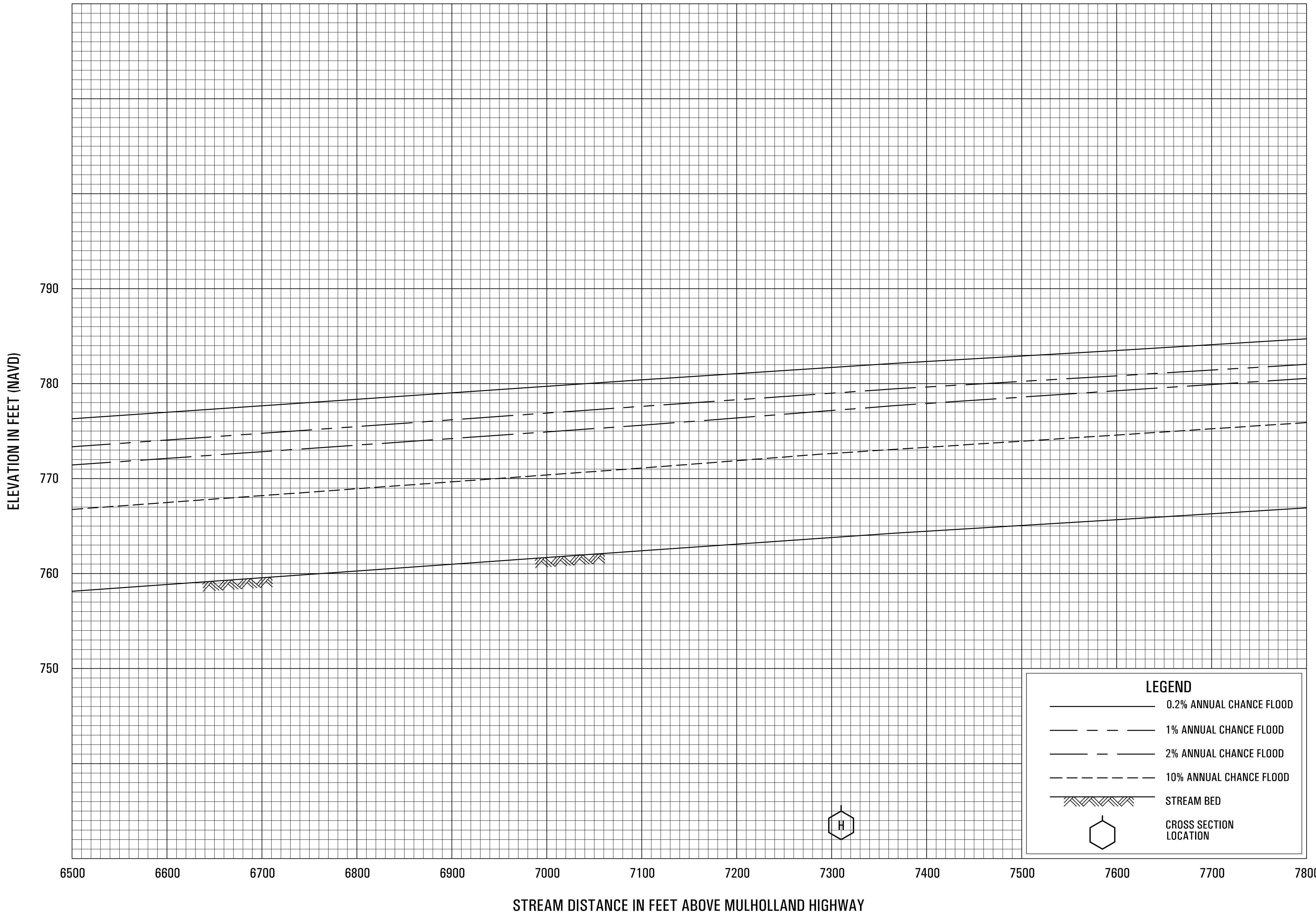

FLOOD PROFILES

MEDEA CREEK

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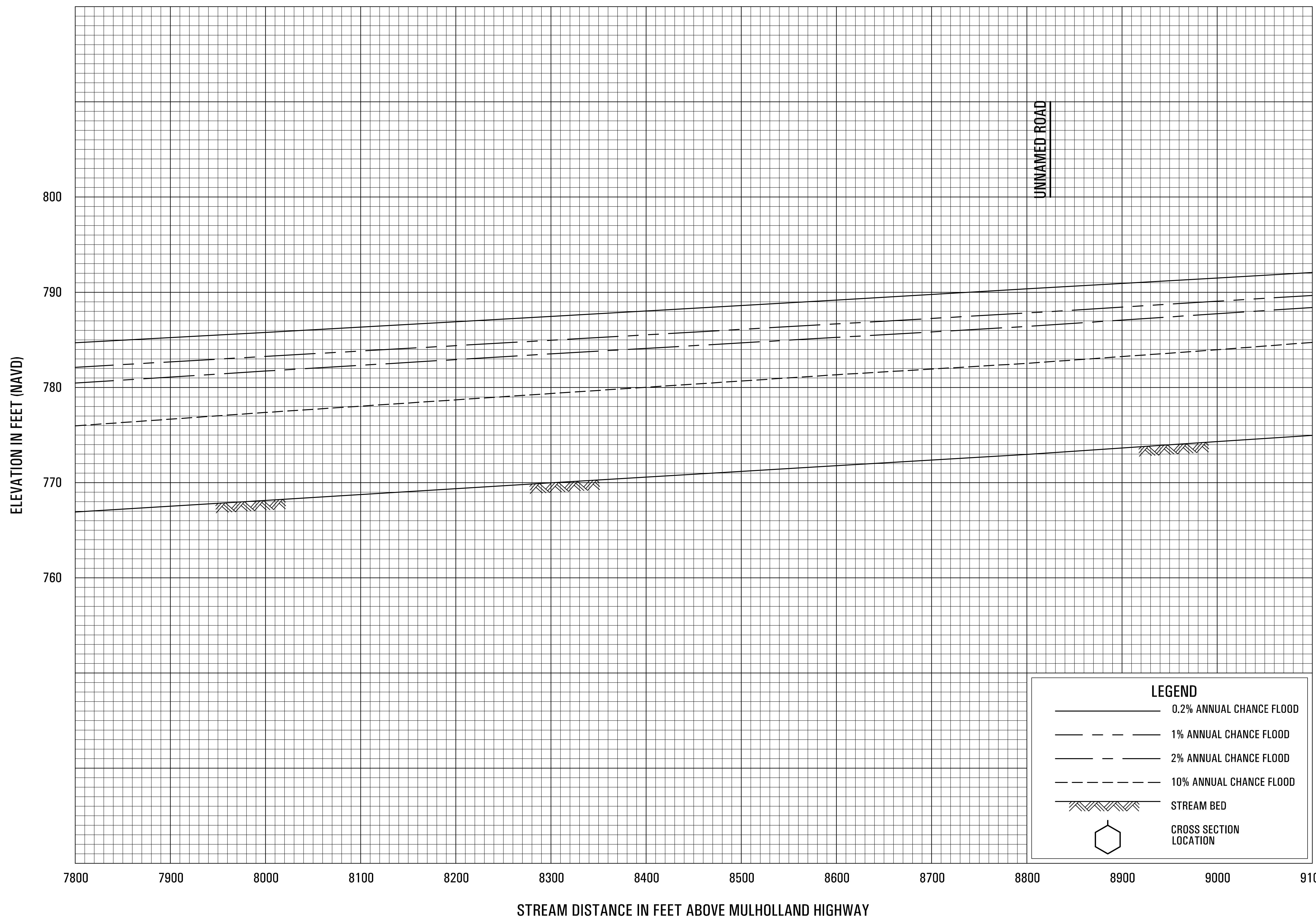


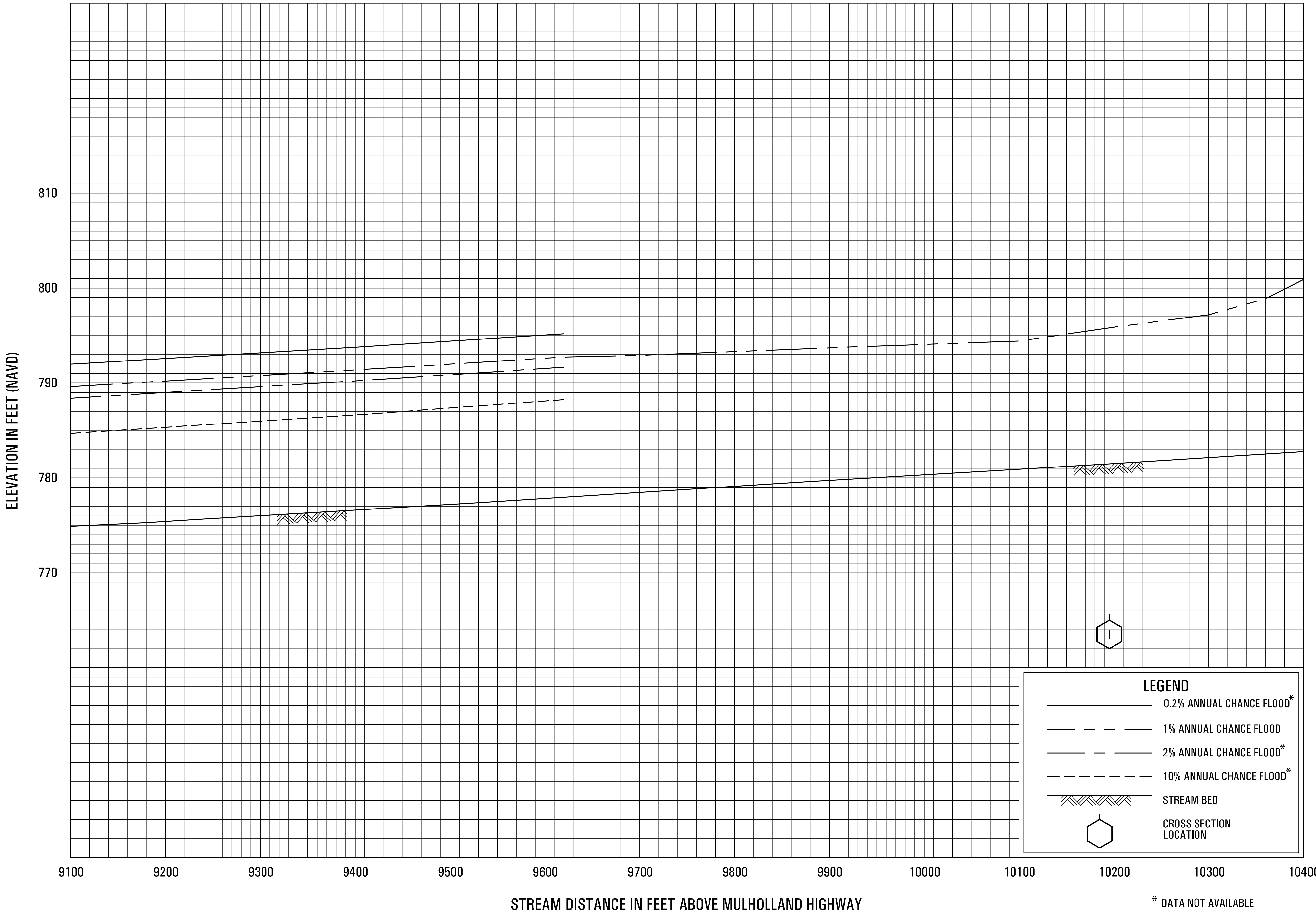
FLOOD PROFILES

MEDEA CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



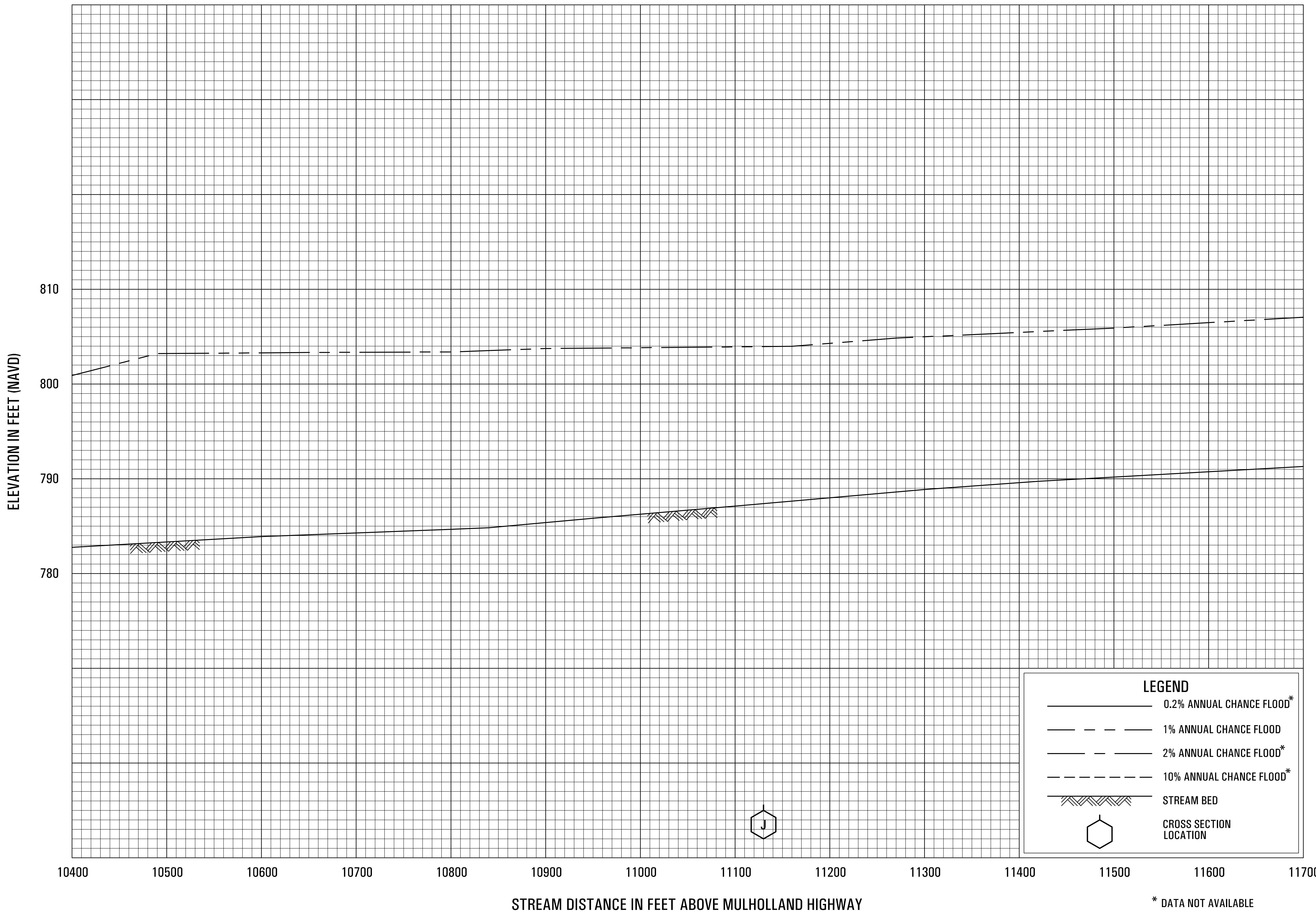
FLOOD PROFILES

MEDEA CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



FLOOD PROFILES

MEDEA CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

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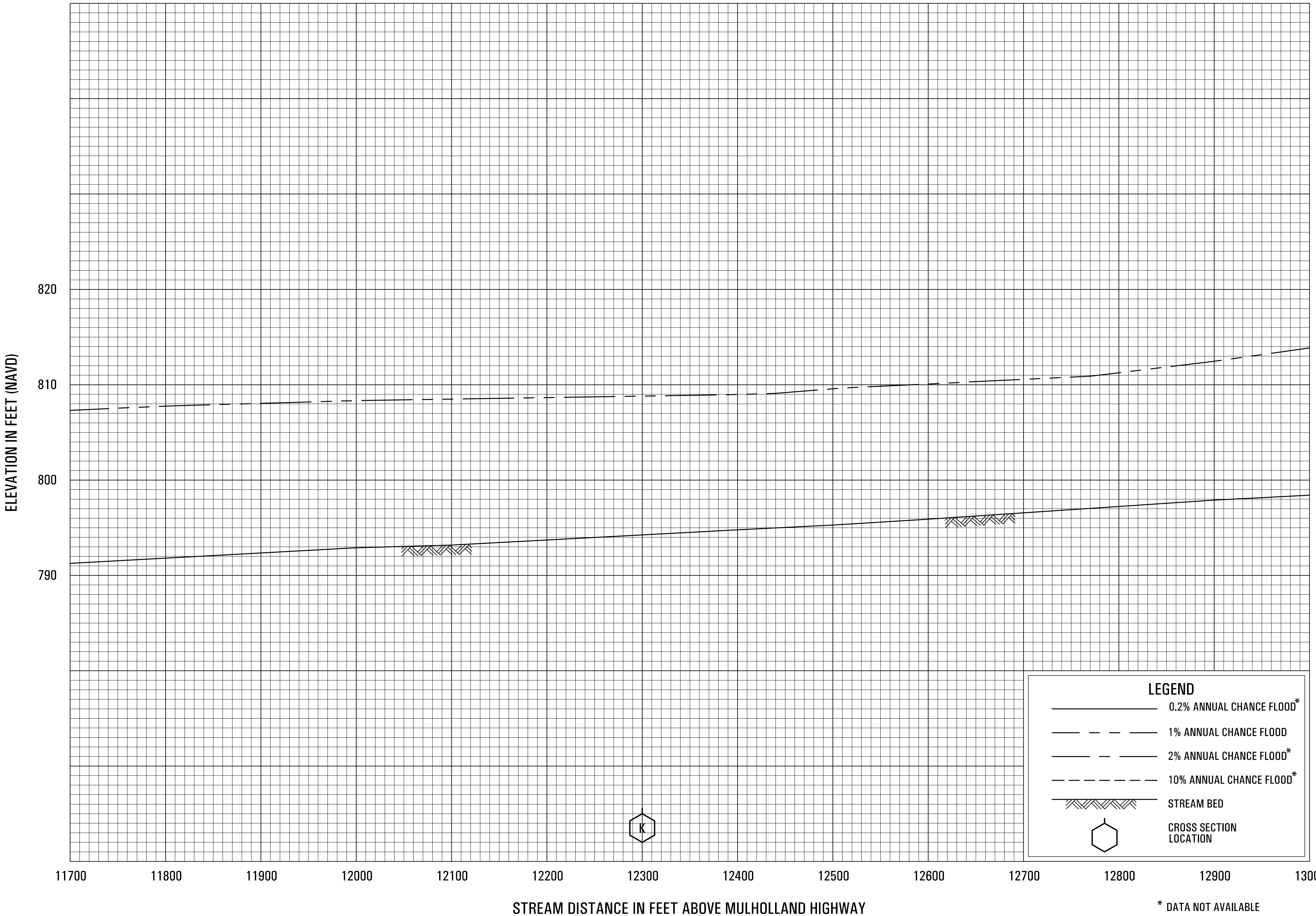

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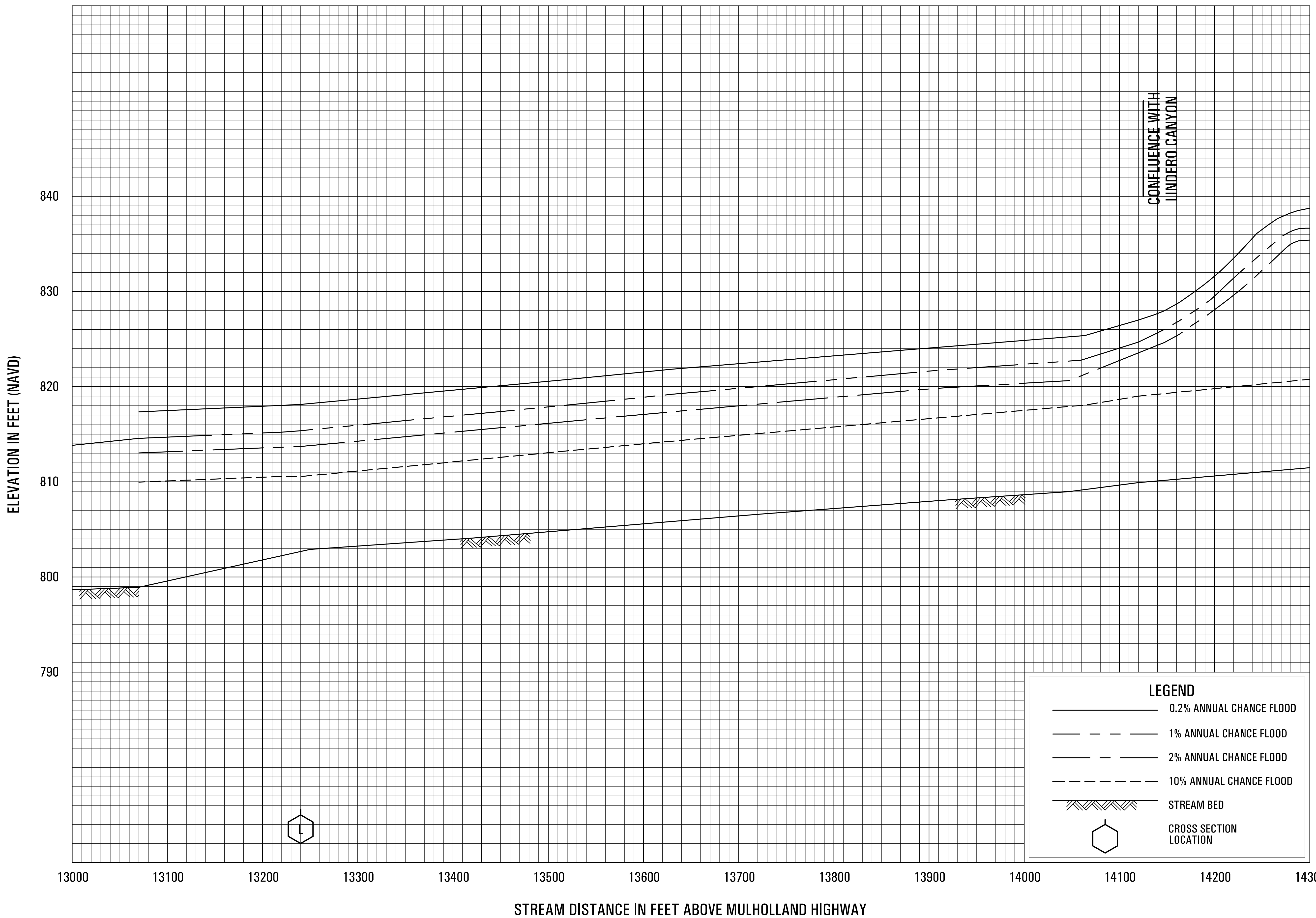
FLOOD PROFILES

MEDEA CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



FLOOD PROFILES

MEDEA CREEK

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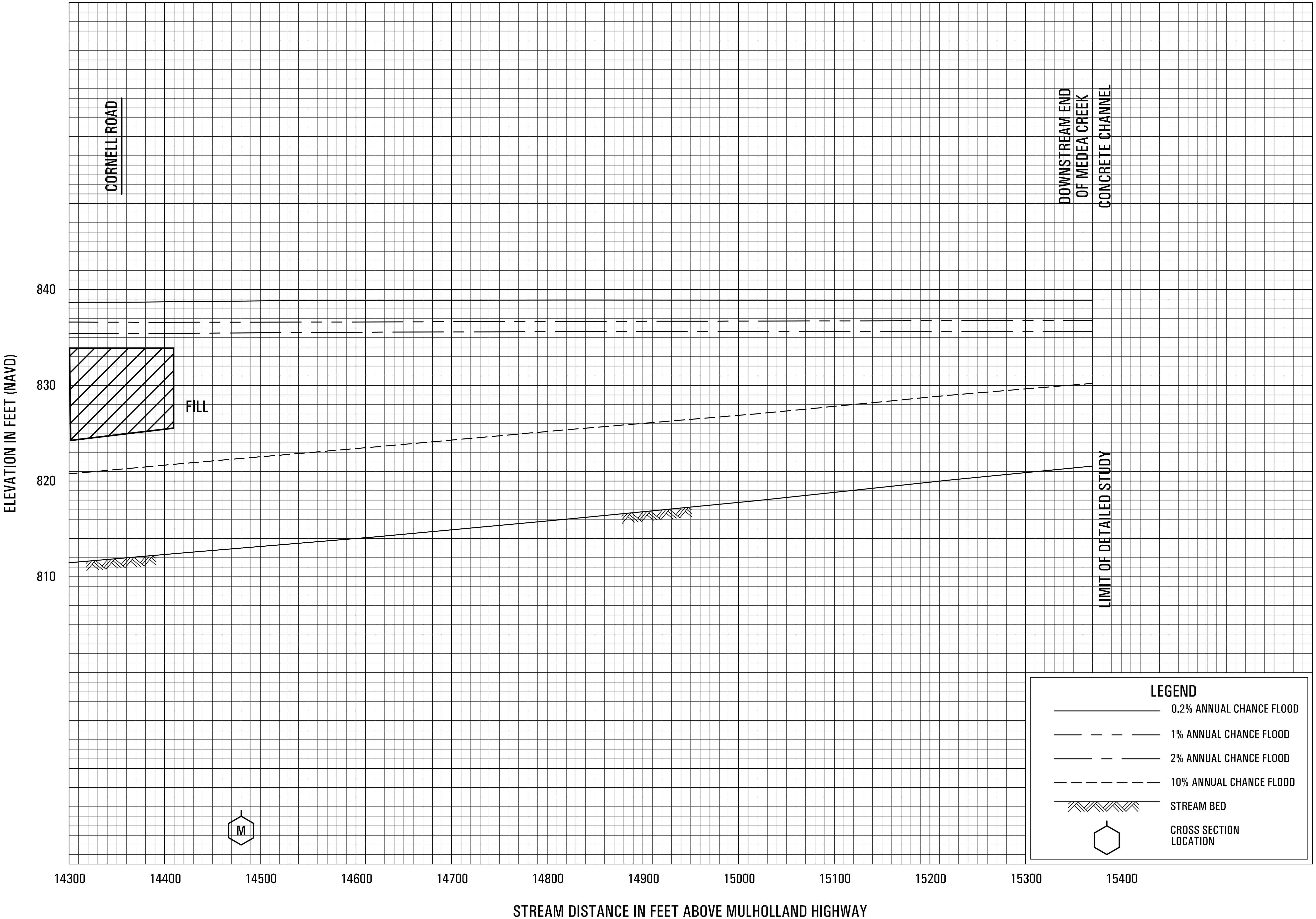

FLOOD PROFILES

MEDEA CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

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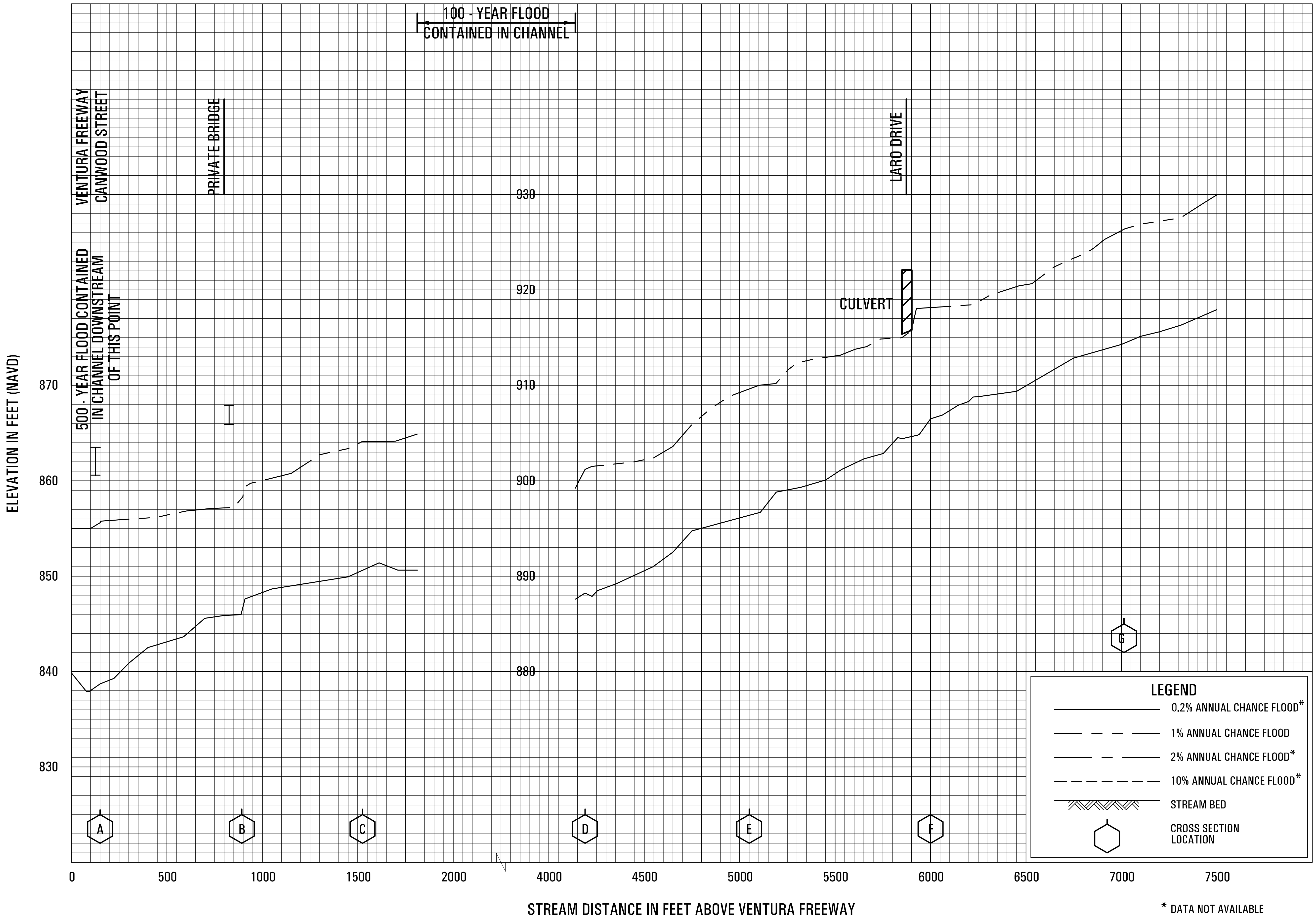

FLOOD PROFILES

MEDEA CREEK (ABOVE VENTURA FREEWAY)

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

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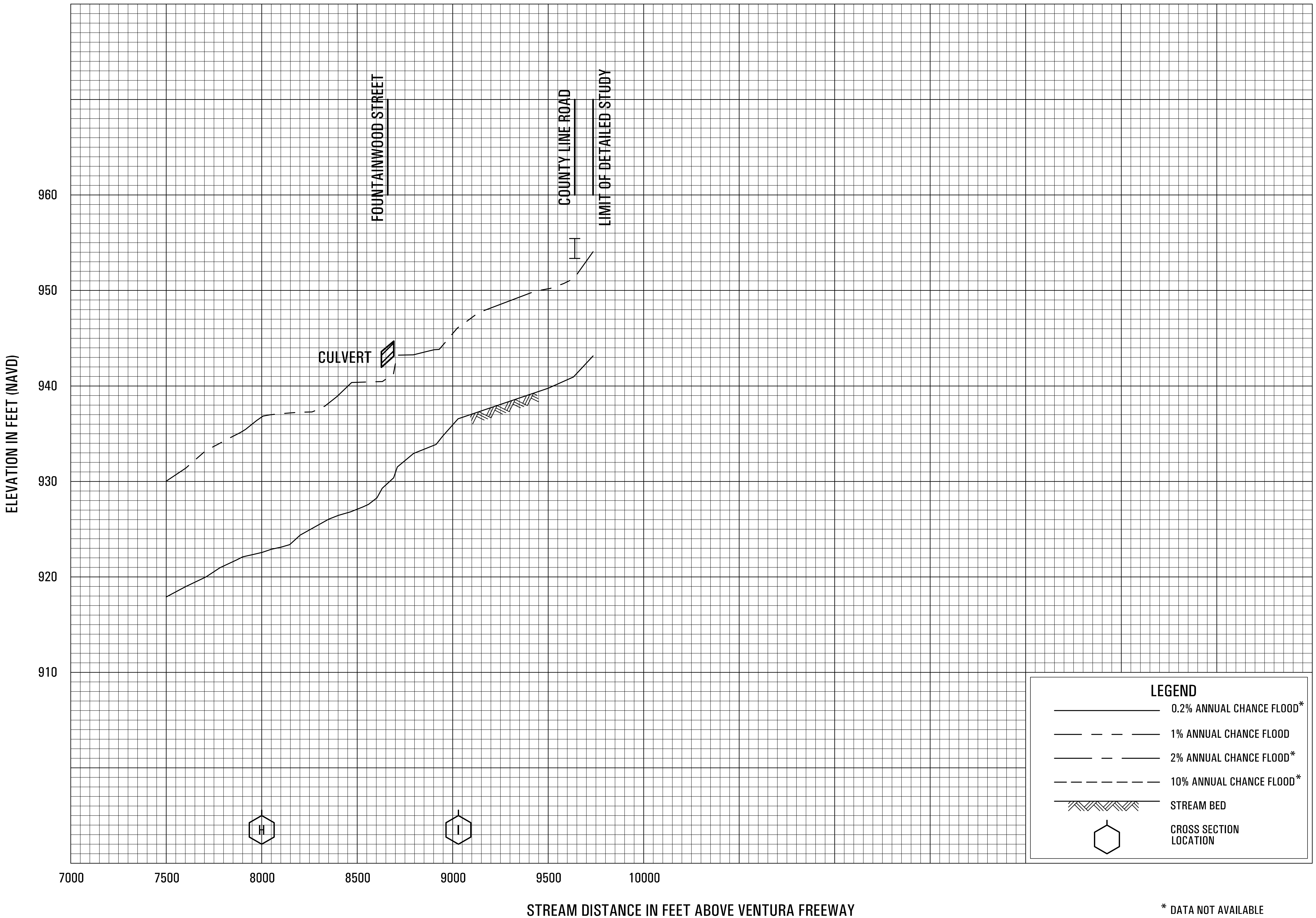

* DATA NOT AVAILABLE

FLOOD PROFILES

MEDEA CREEK (ABOVE VENTURA FREEWAY)

FEDERAL EMERGENCY MANAGEMENT AGENCY

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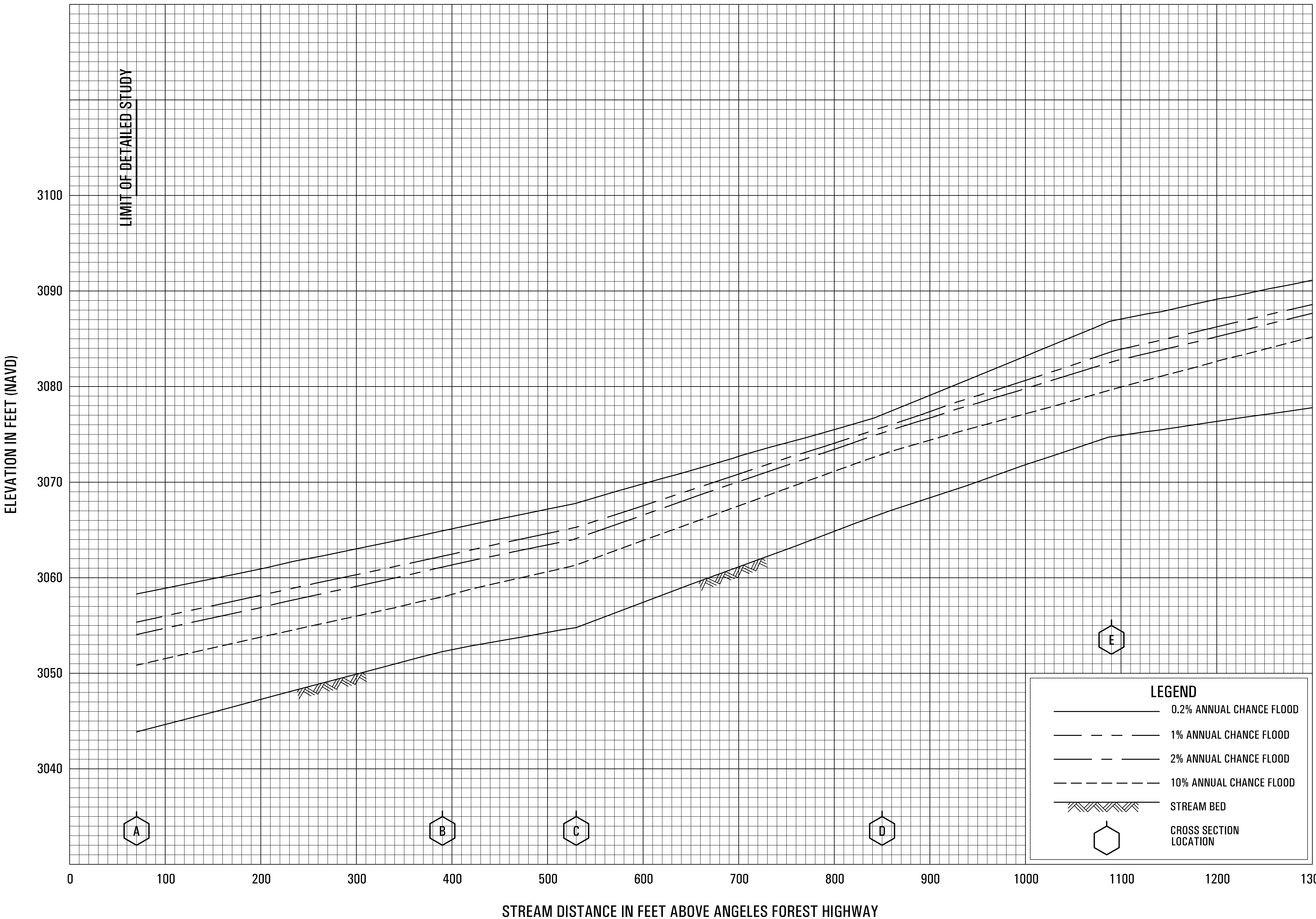

FLOOD PROFILES

MILL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

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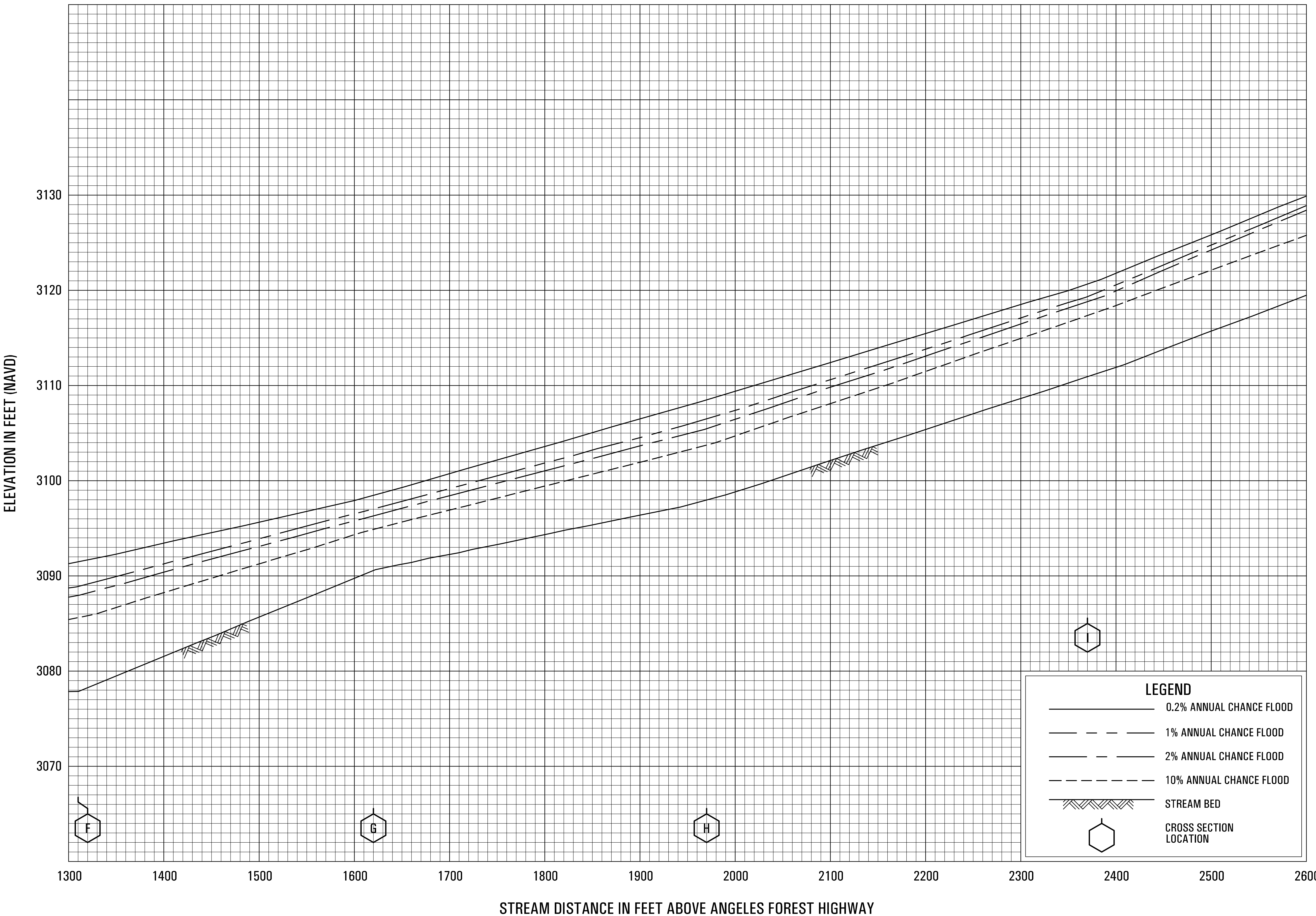

FLOOD PROFILES

MILL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

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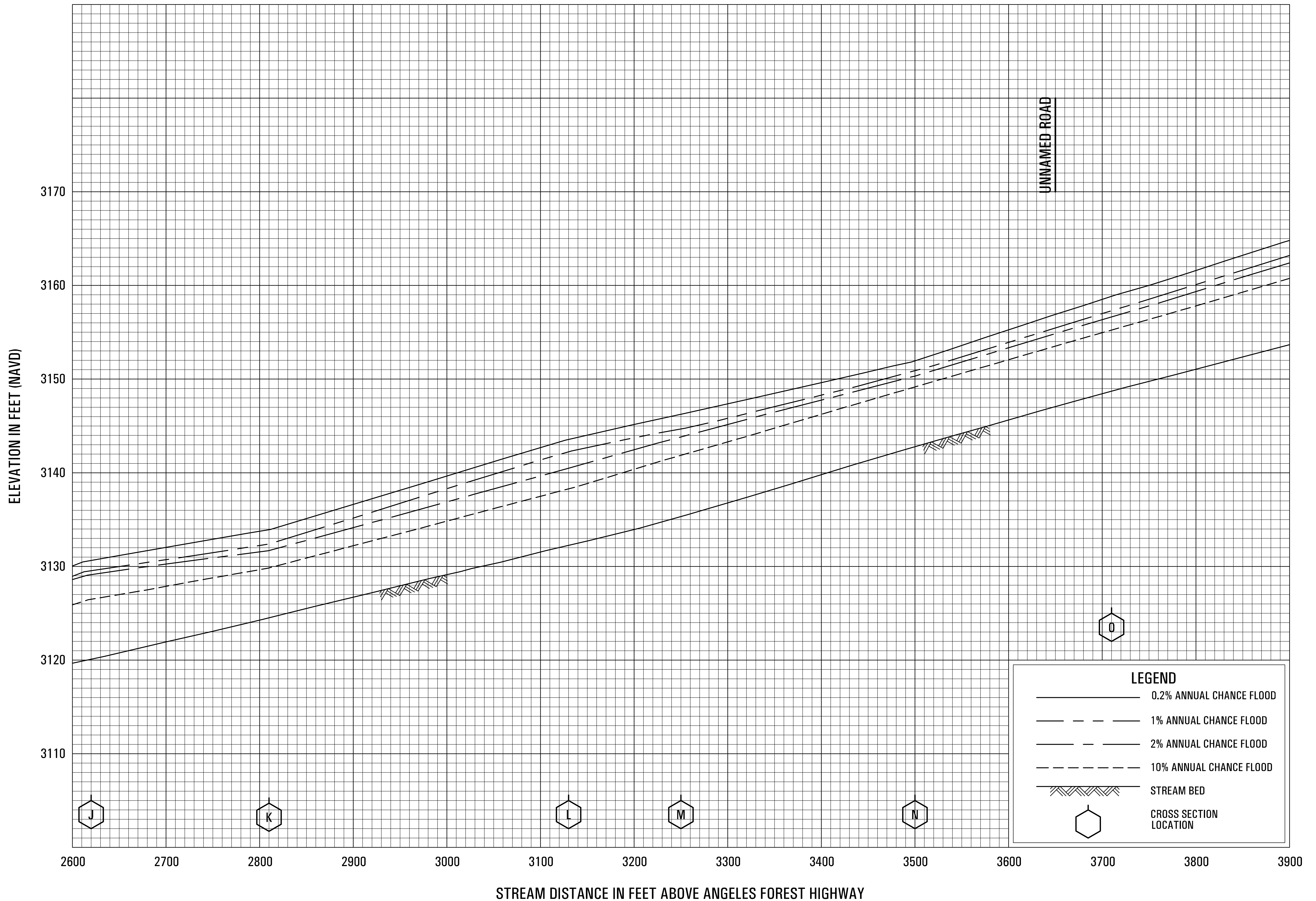


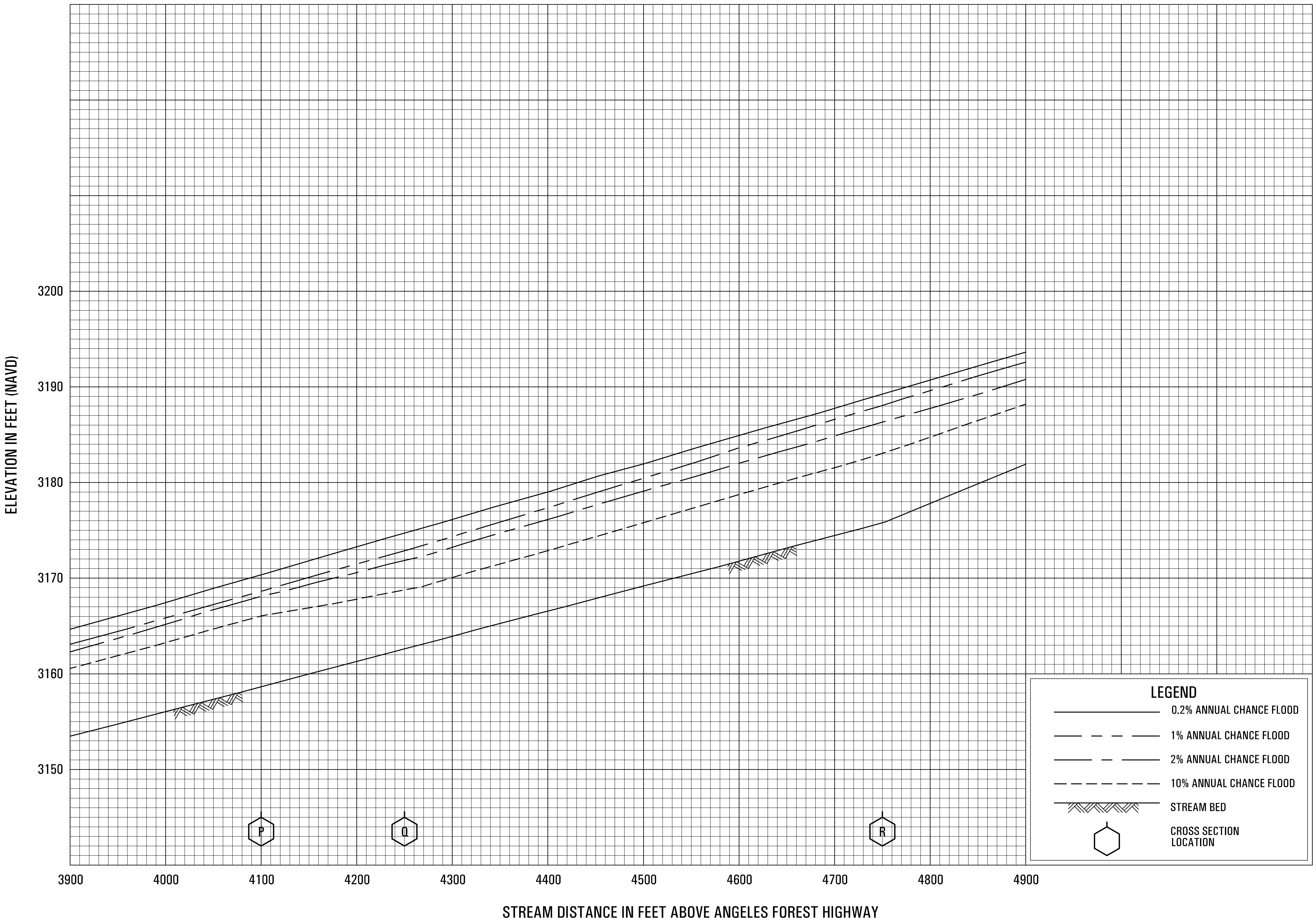
FLOOD PROFILES

MILL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



FLOOD PROFILES

MILL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

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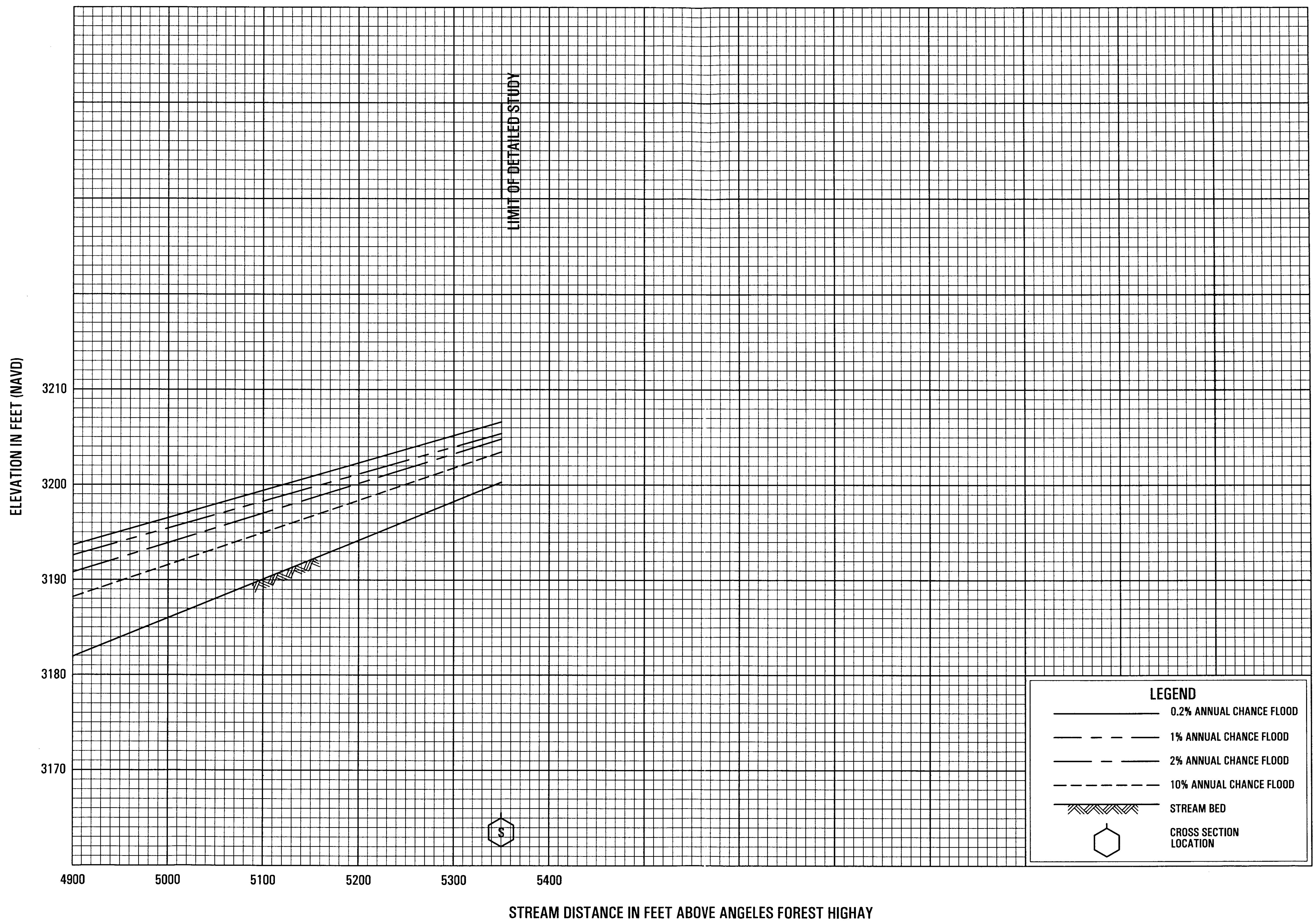

FLOOD PROFILES

MILL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

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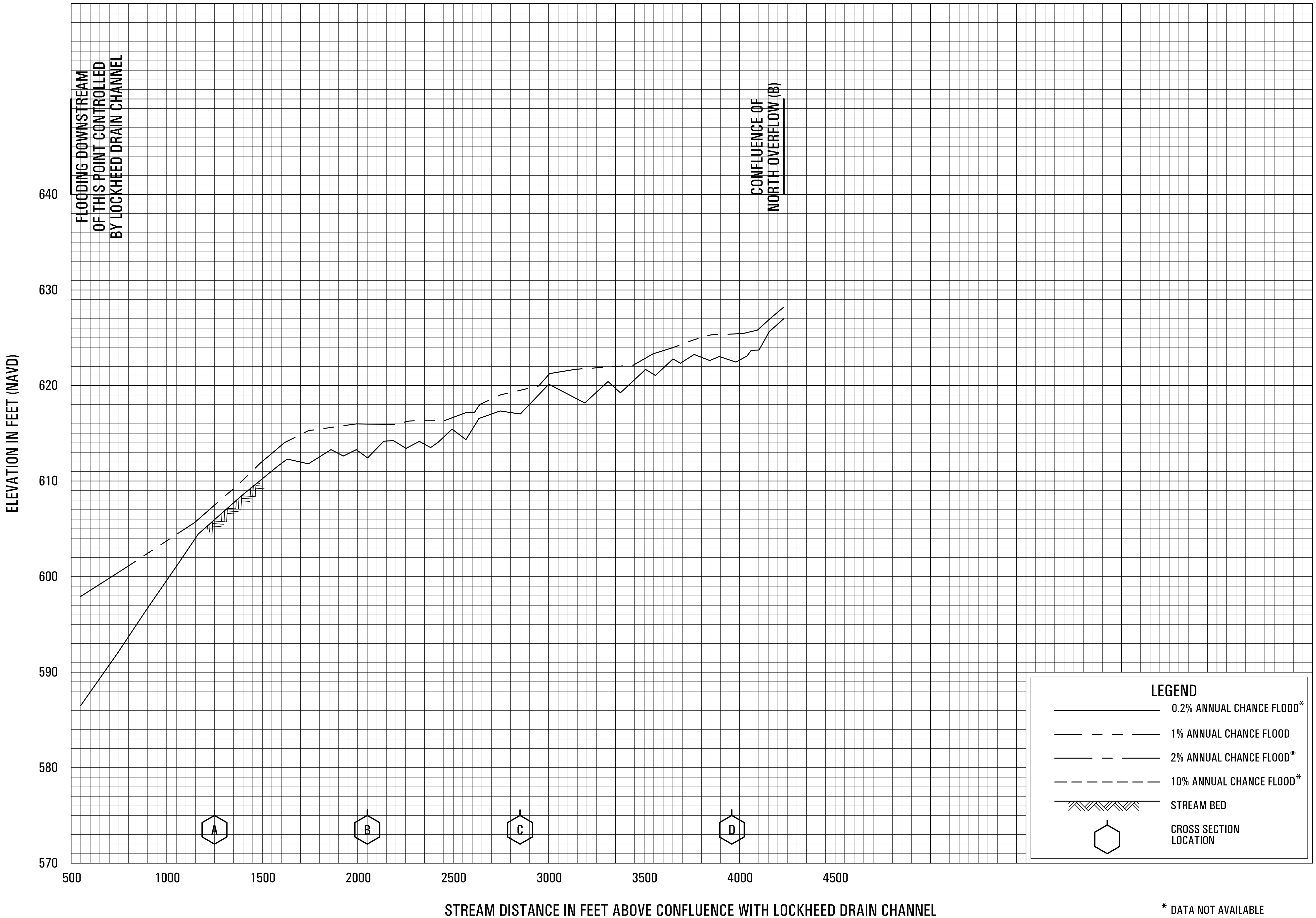


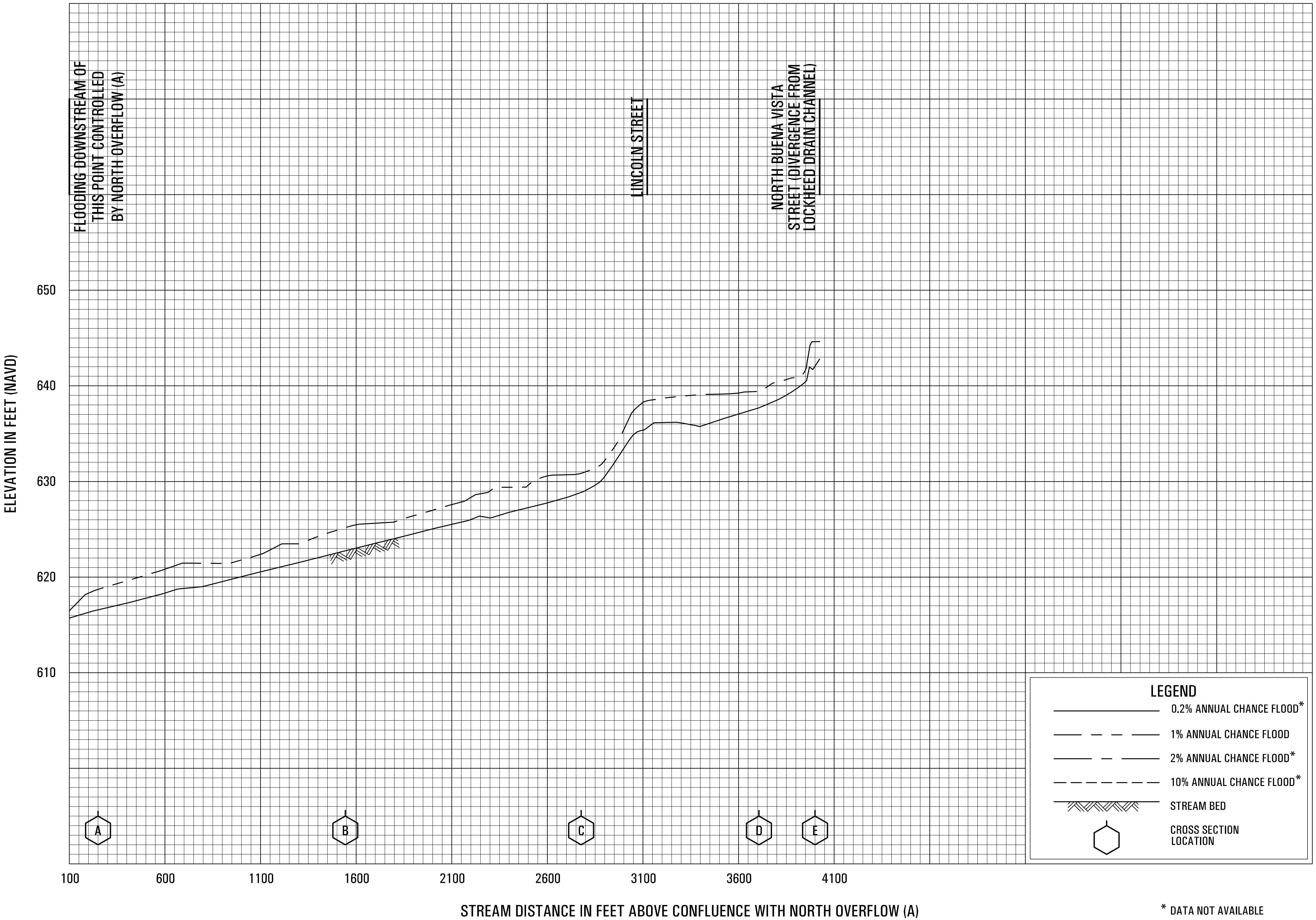
FLOOD PROFILES

NORTH OVERFLOW (A)

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



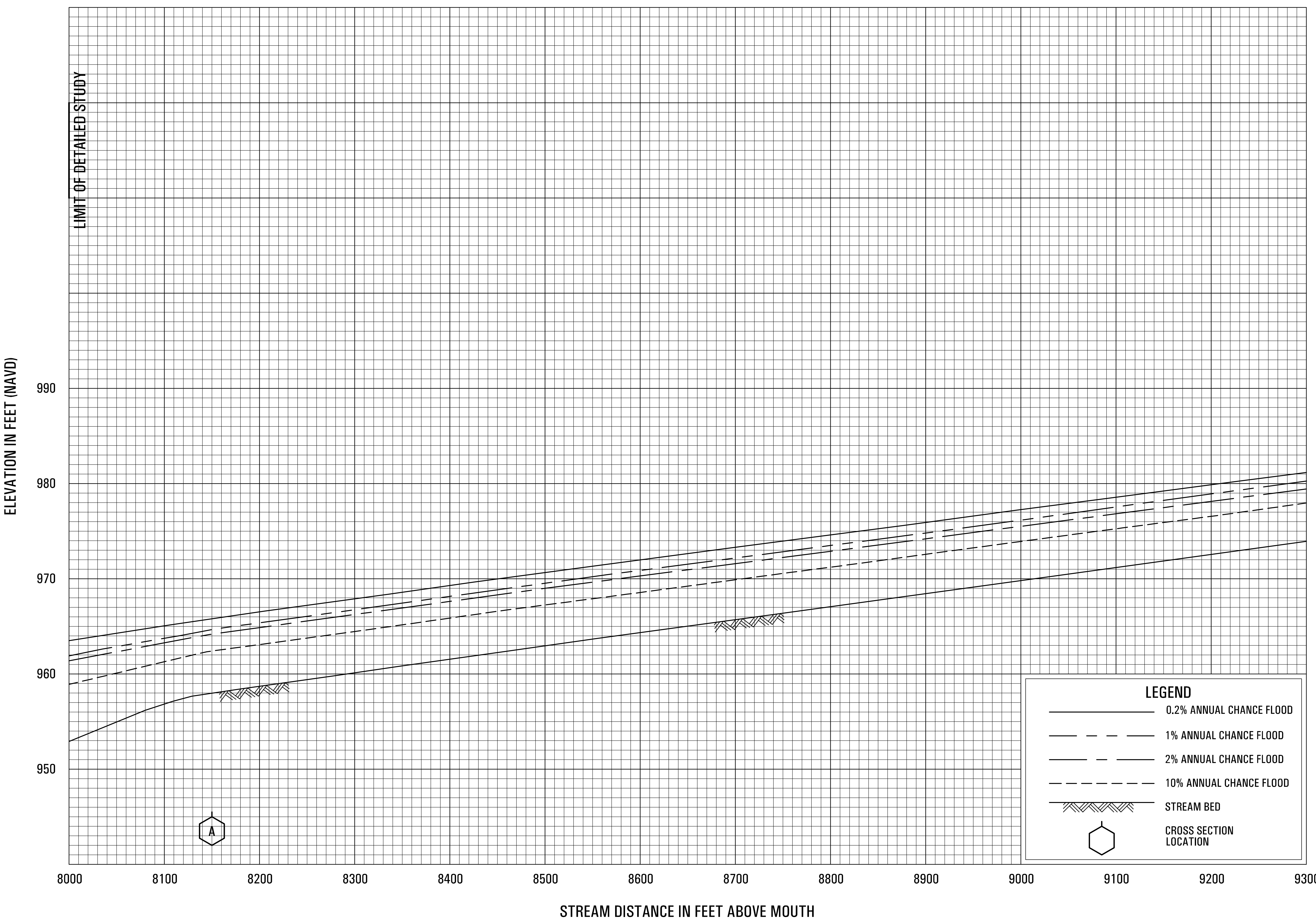
FLOOD PROFILES

NORTH OVERFLOW (B)

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



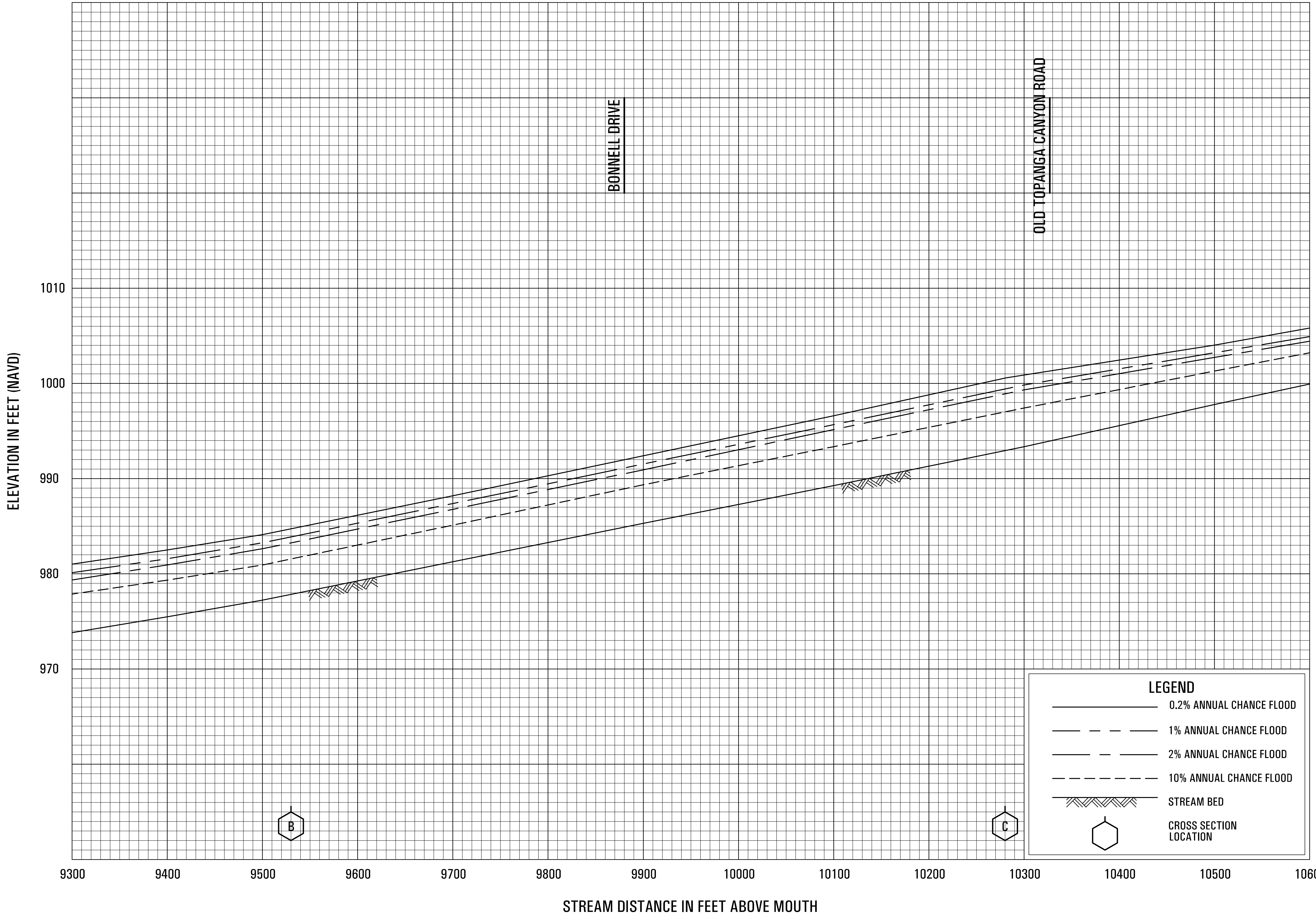
FLOOD PROFILES

OLD TOPANGA CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



FLOOD PROFILES

OLD TOPANGA CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

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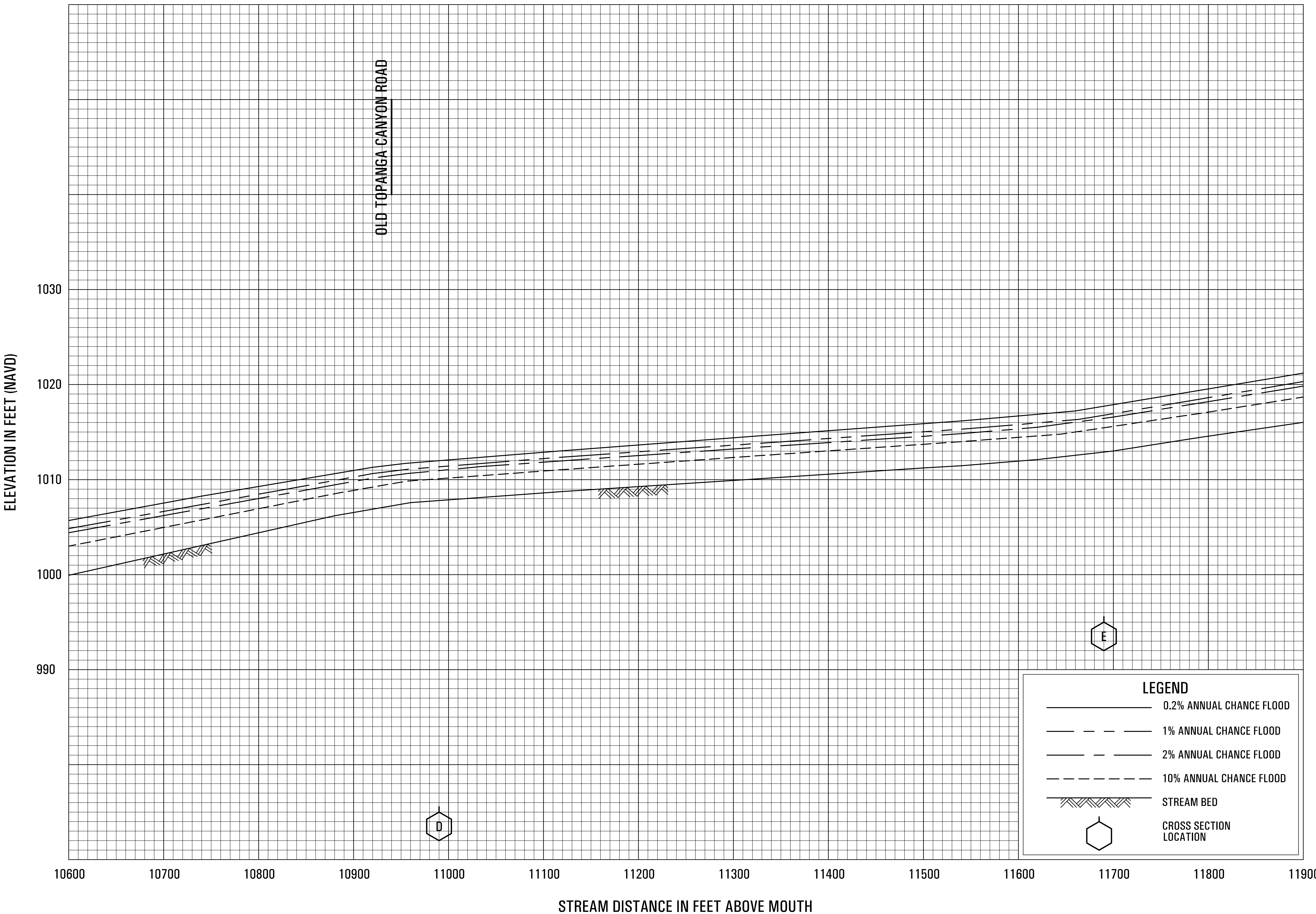
AND INCORPORATED AREAS



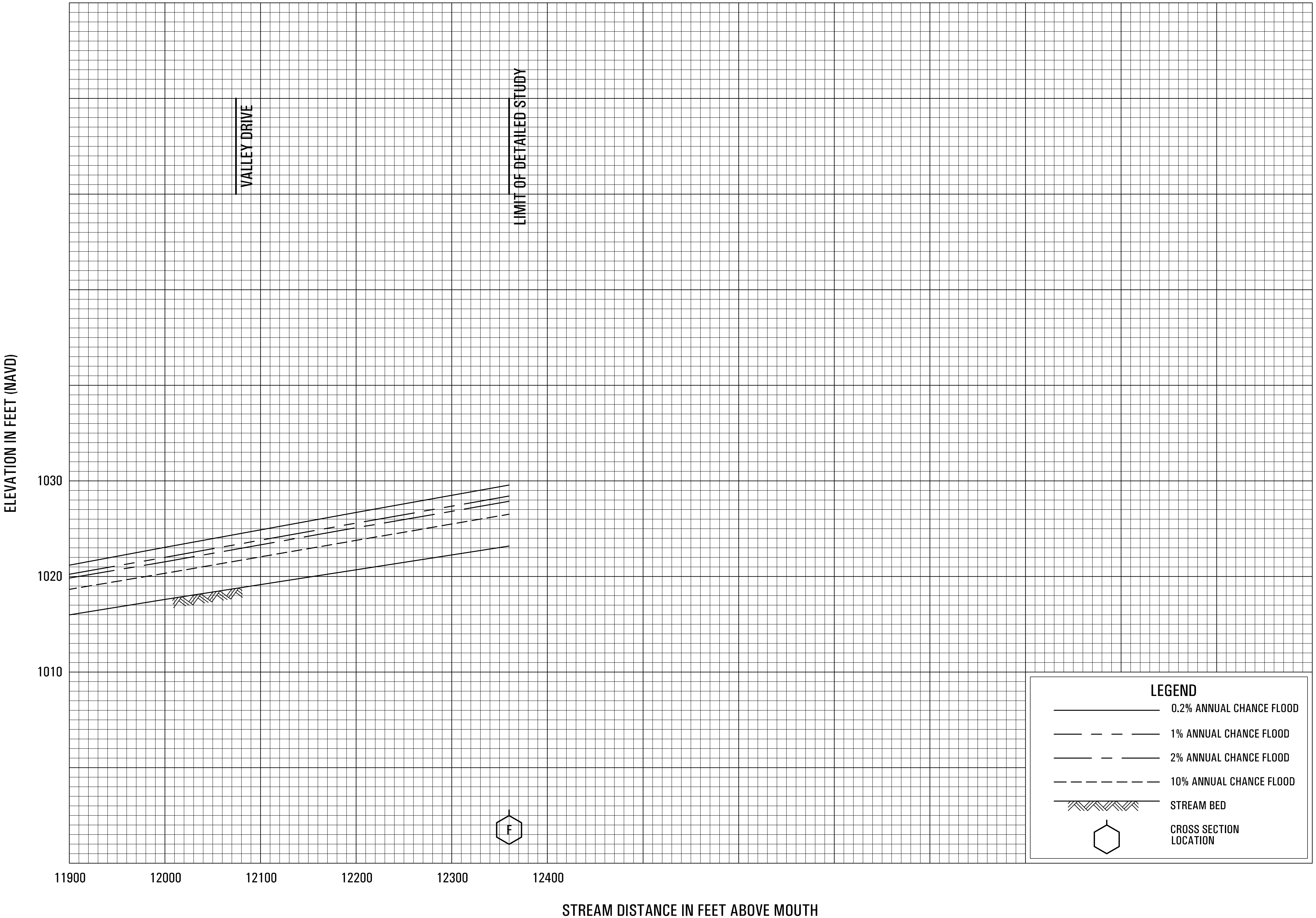
FLOOD PROFILES

OLD TOPANGA CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



FLOOD PROFILES

OLD TOPANGA CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

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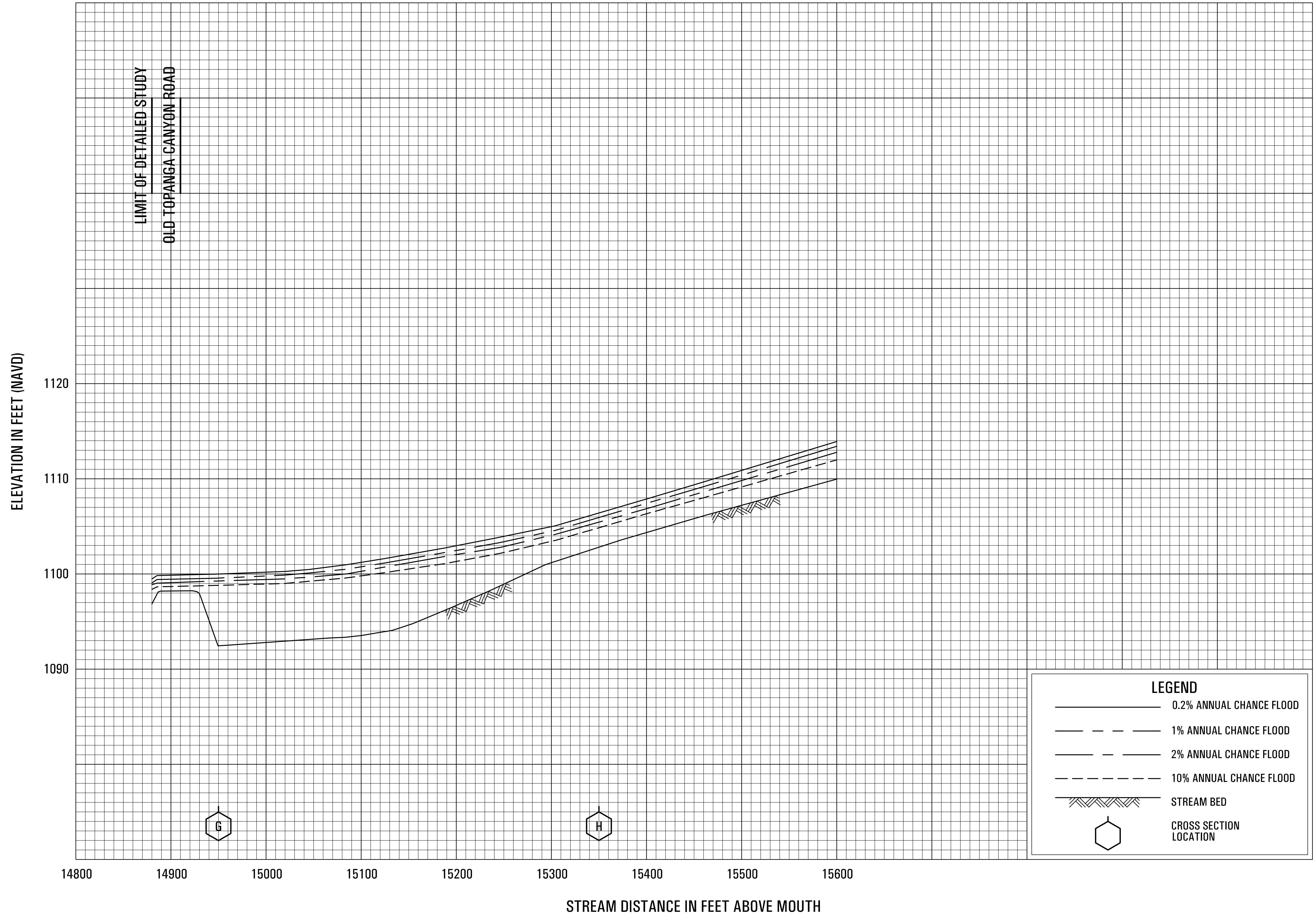

FLOOD PROFILES

OLD TOPANGA CANYON

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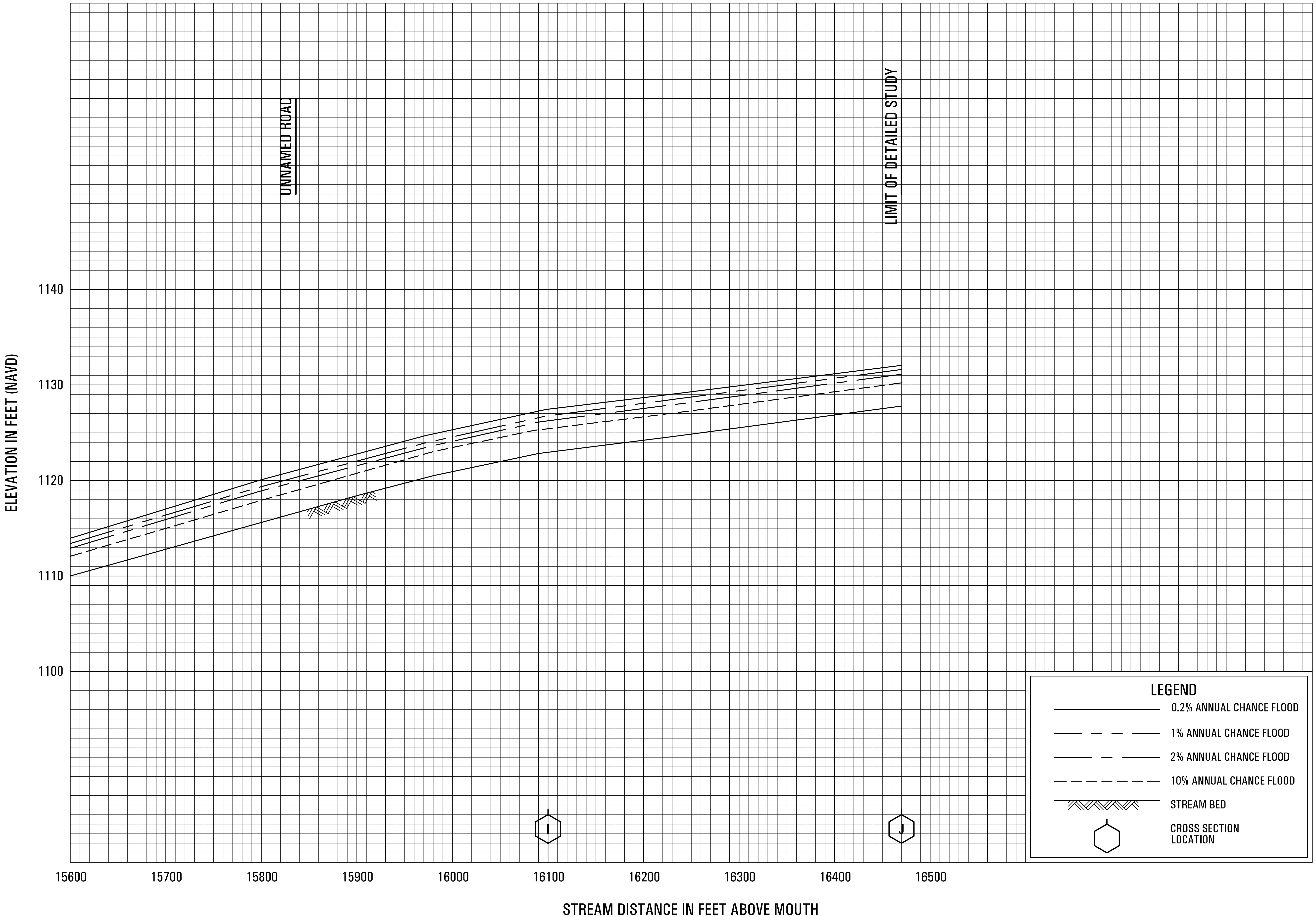

FLOOD PROFILES

OLD TOPANGA CANYON

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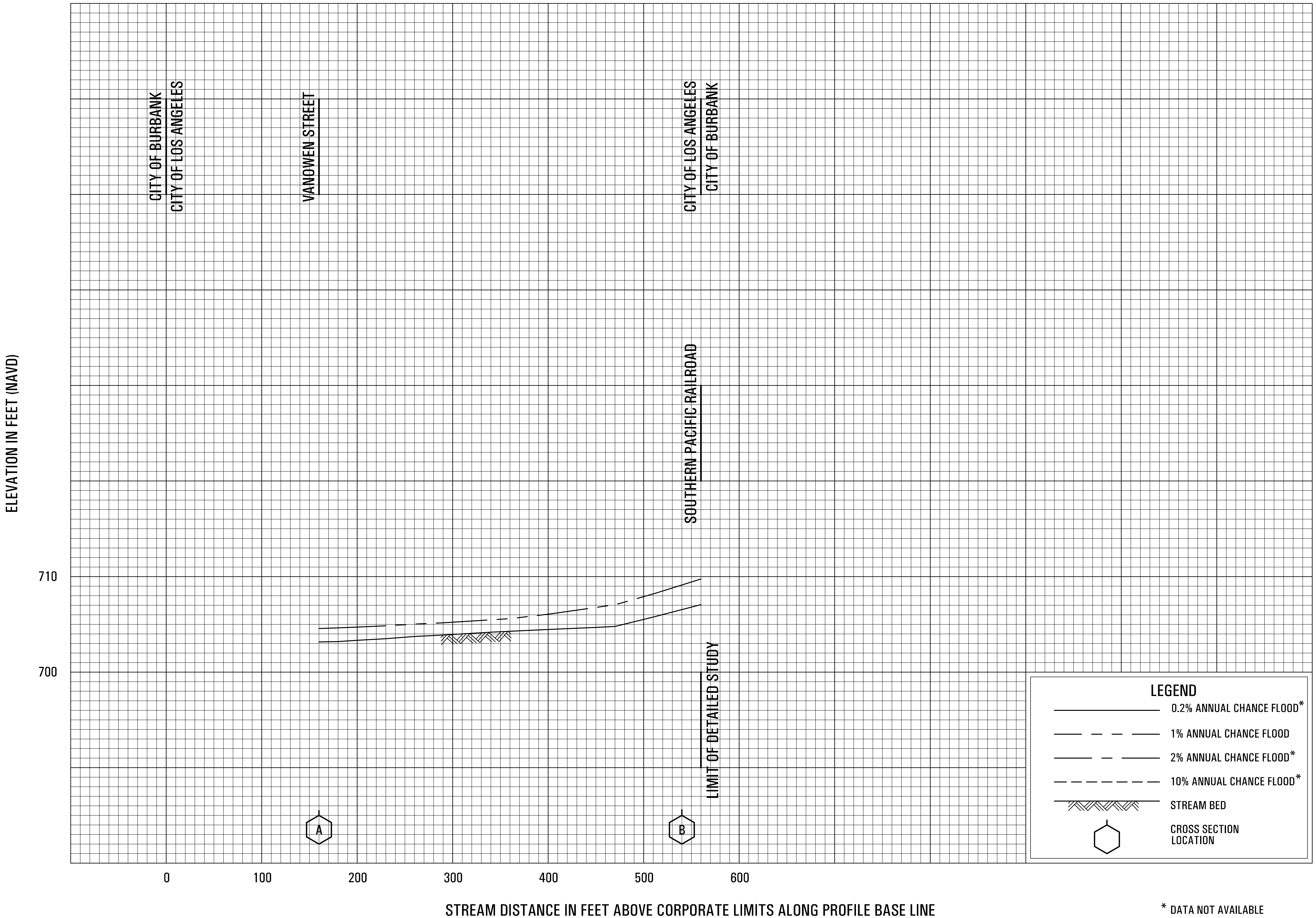
LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



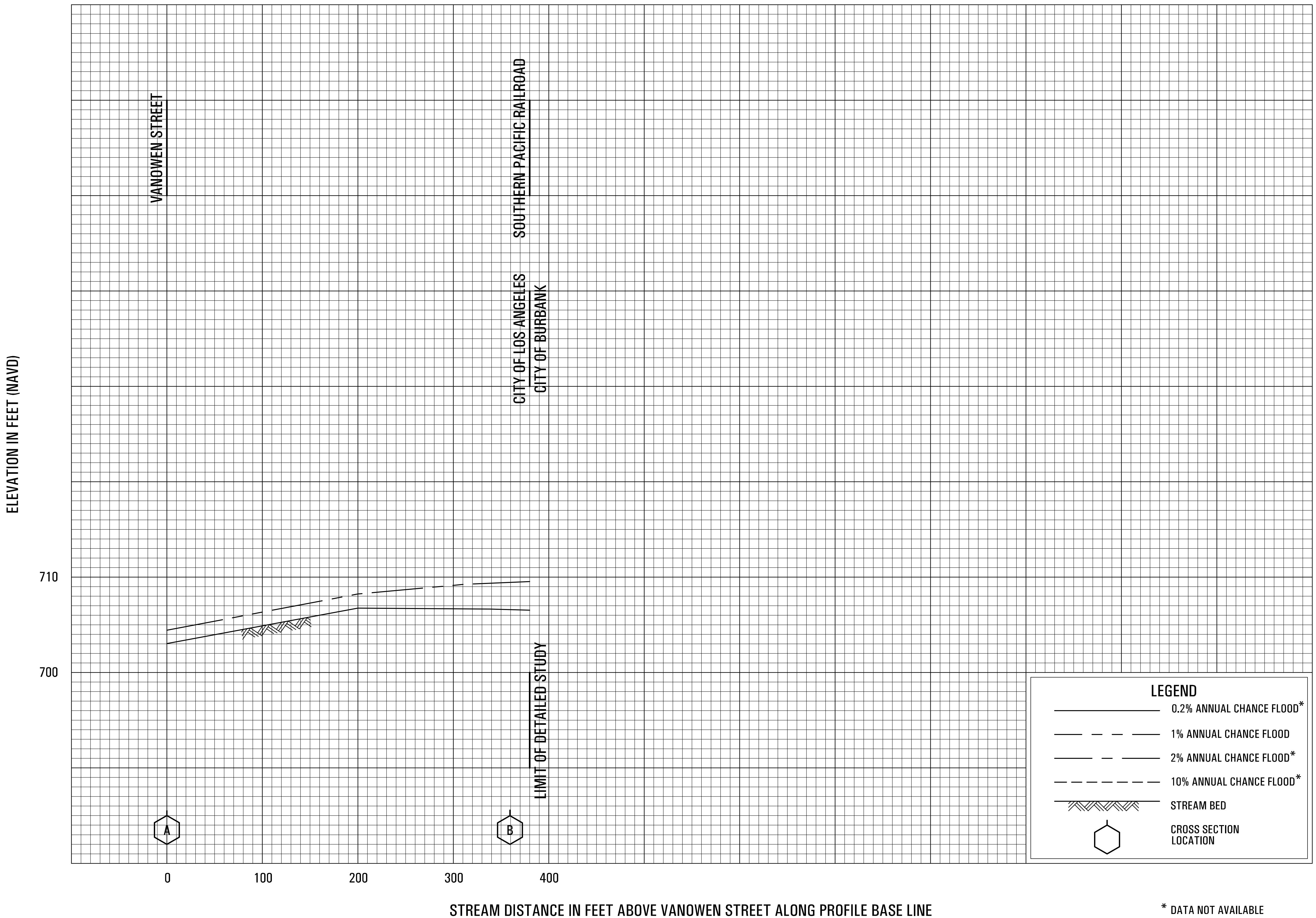
FLOOD PROFILES

OVERFLOW AREA OF LOCKHEED DRAIN CHANNEL

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



* DATA NOT AVAILABLE

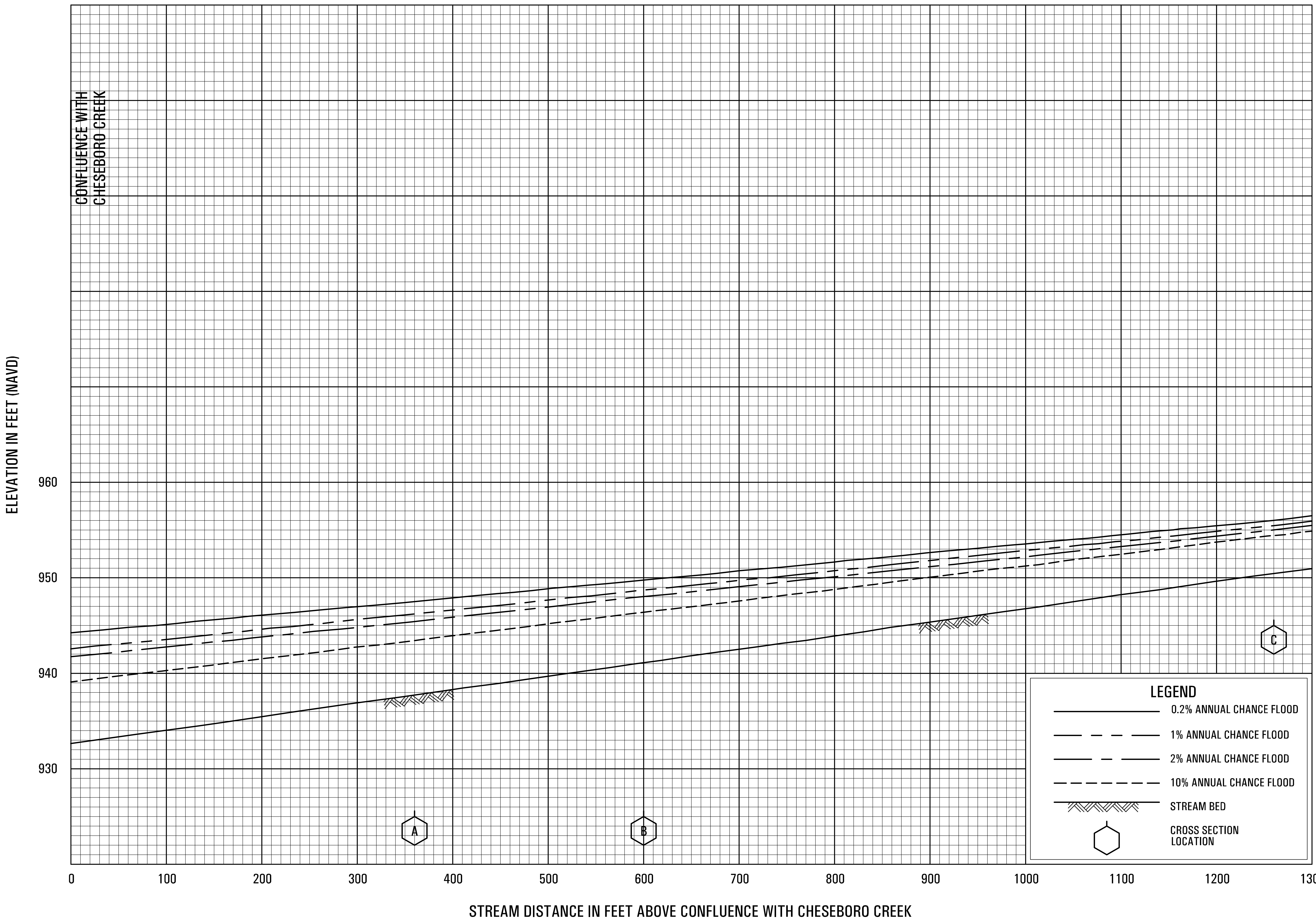
FLOOD PROFILES

OVERFLOW AREA OF LOCKHEED STORM DRAIN

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



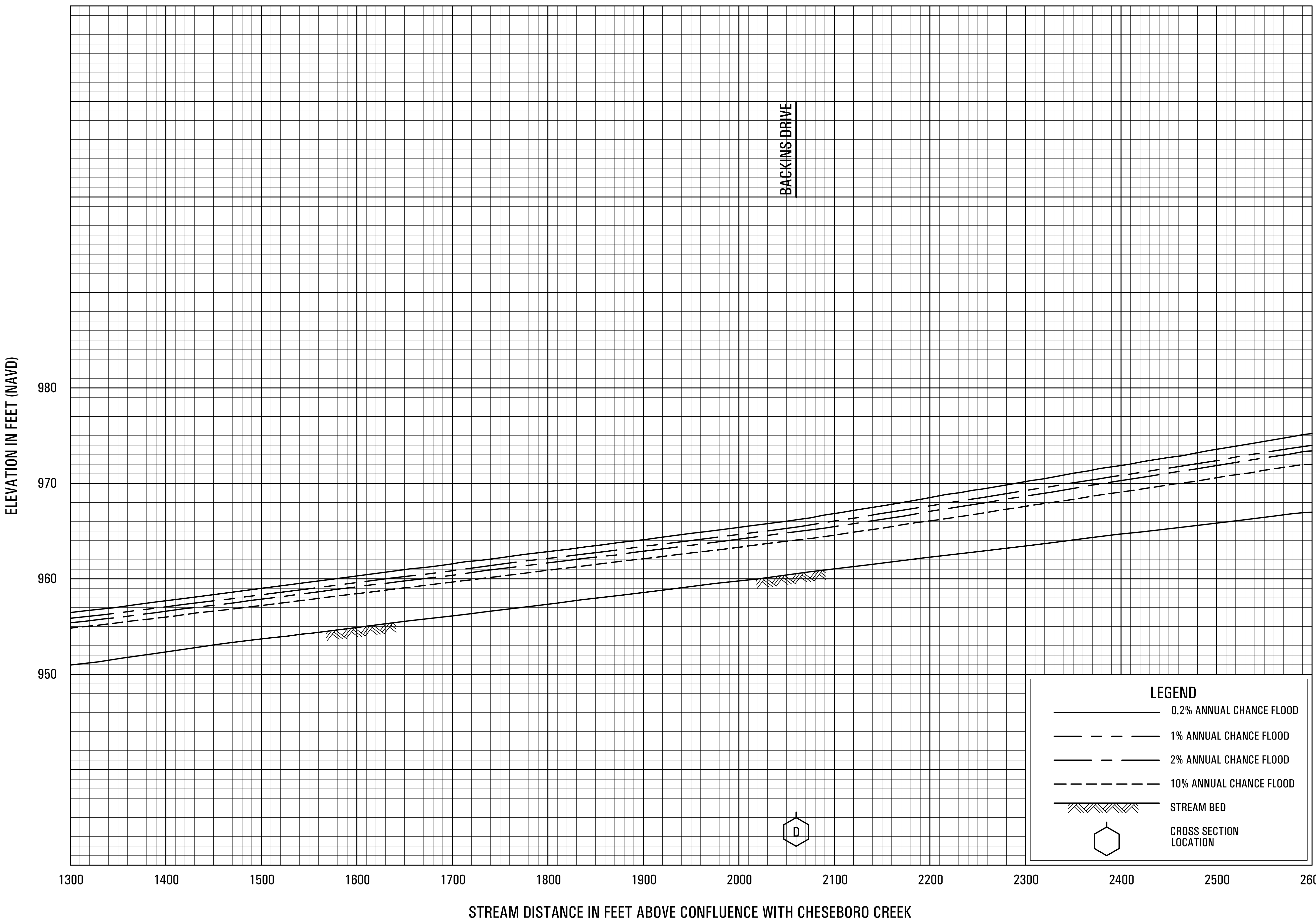
FLOOD PROFILES

PALO COMANDO CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



FLOOD PROFILES

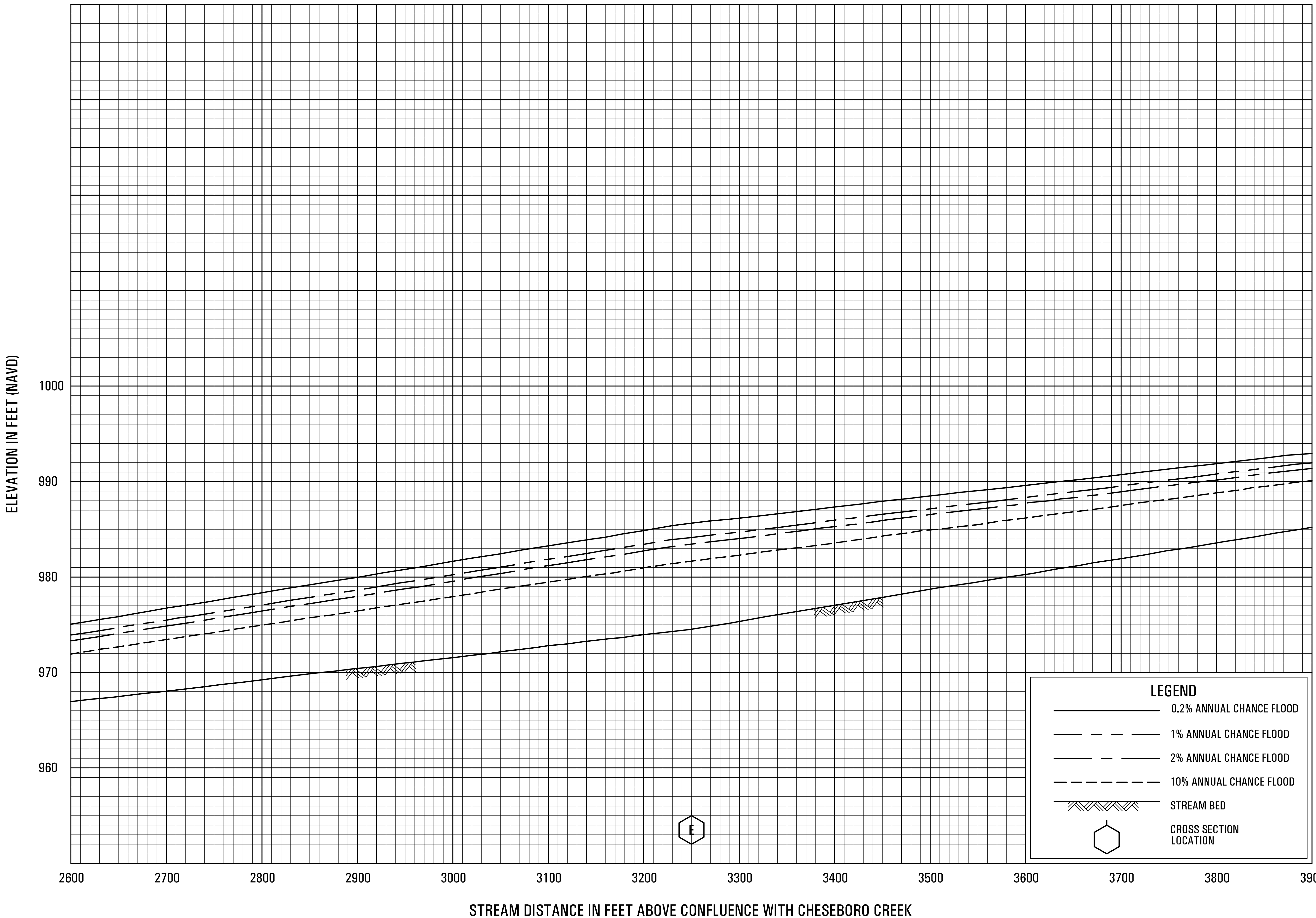
PALO COMANDO CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS

146P



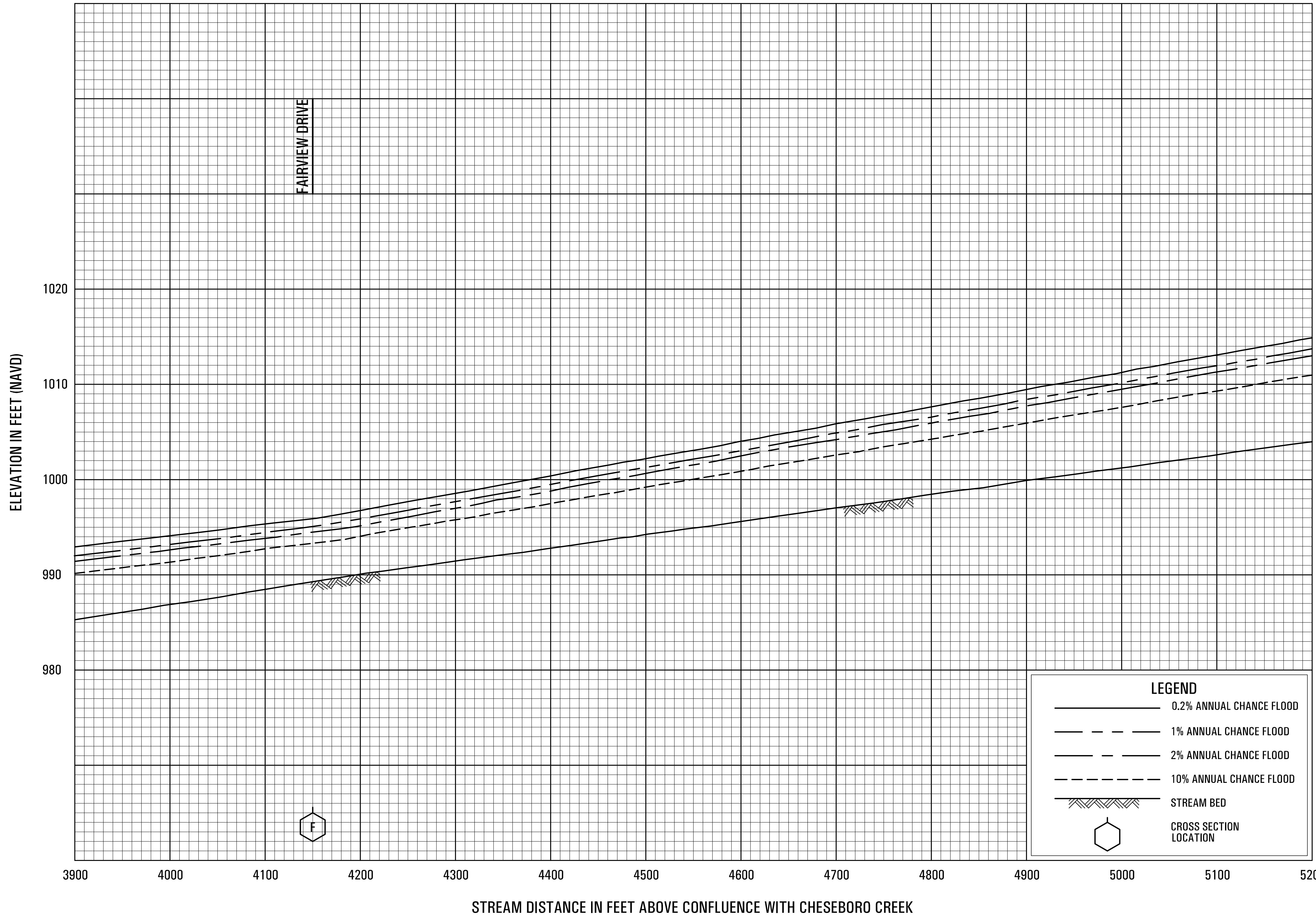
FLOOD PROFILES

PALO COMANDO CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



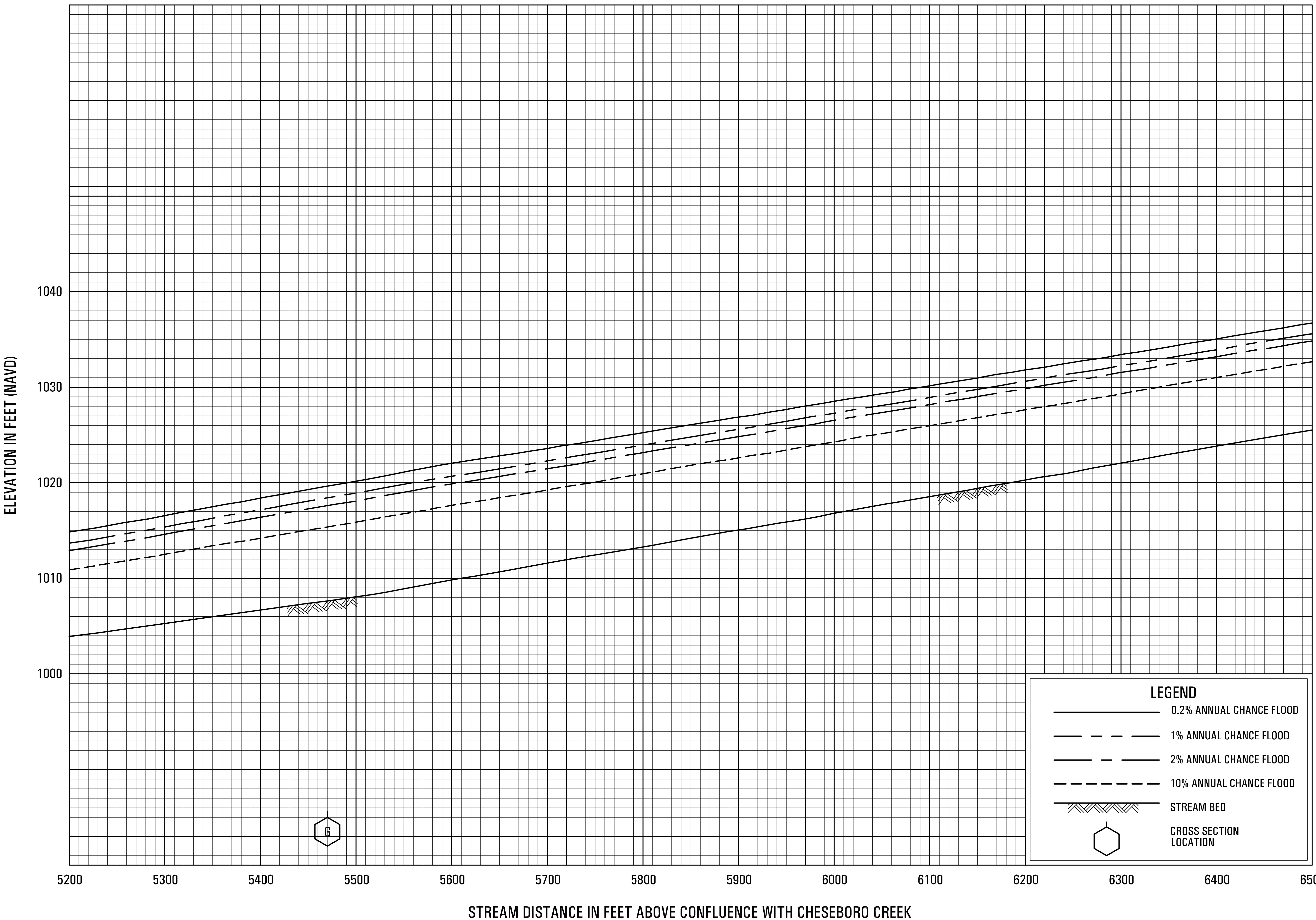
FLOOD PROFILES

PALO COMANDO CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



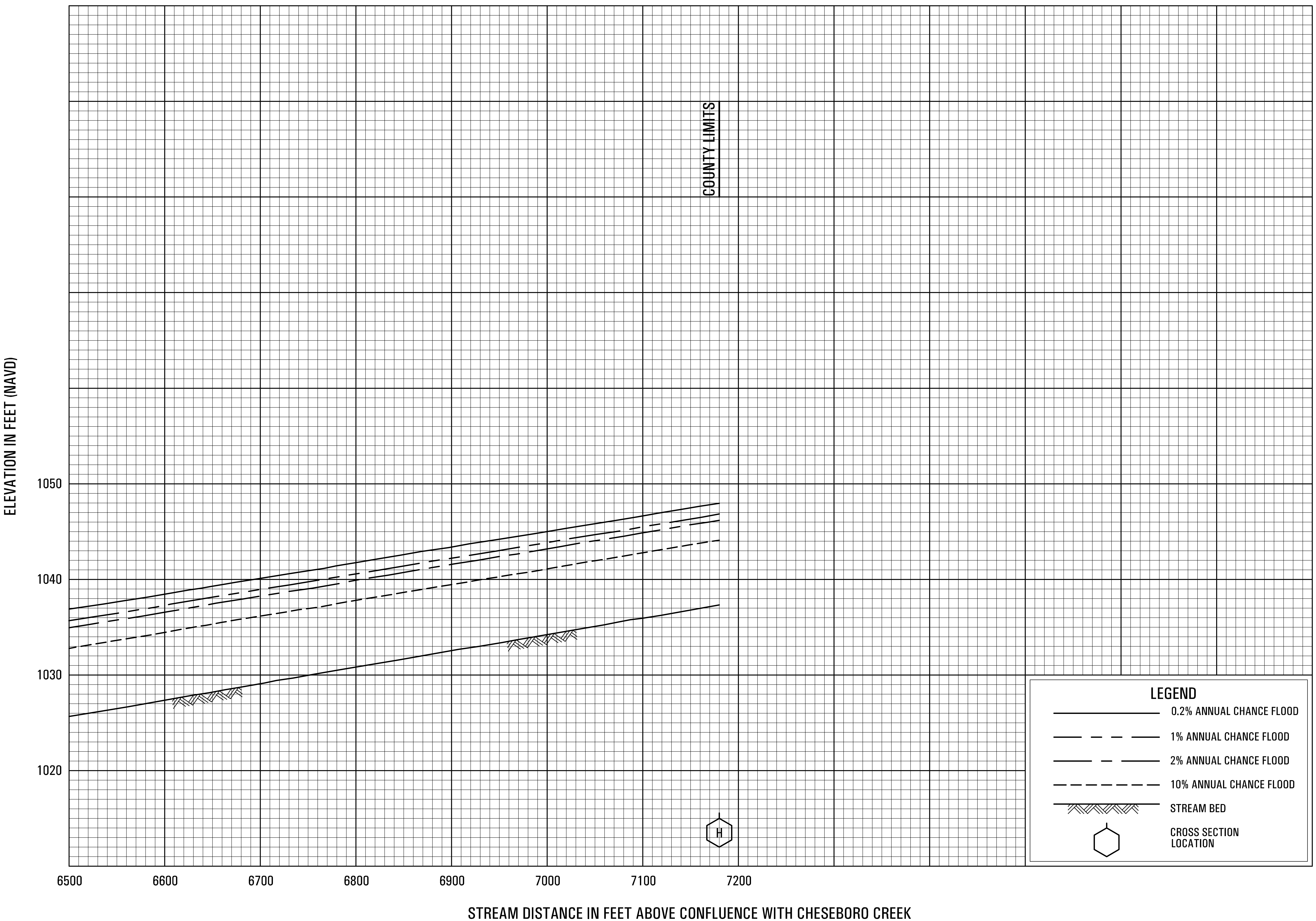
FLOOD PROFILES

PALO COMANDO CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



FLOOD PROFILES

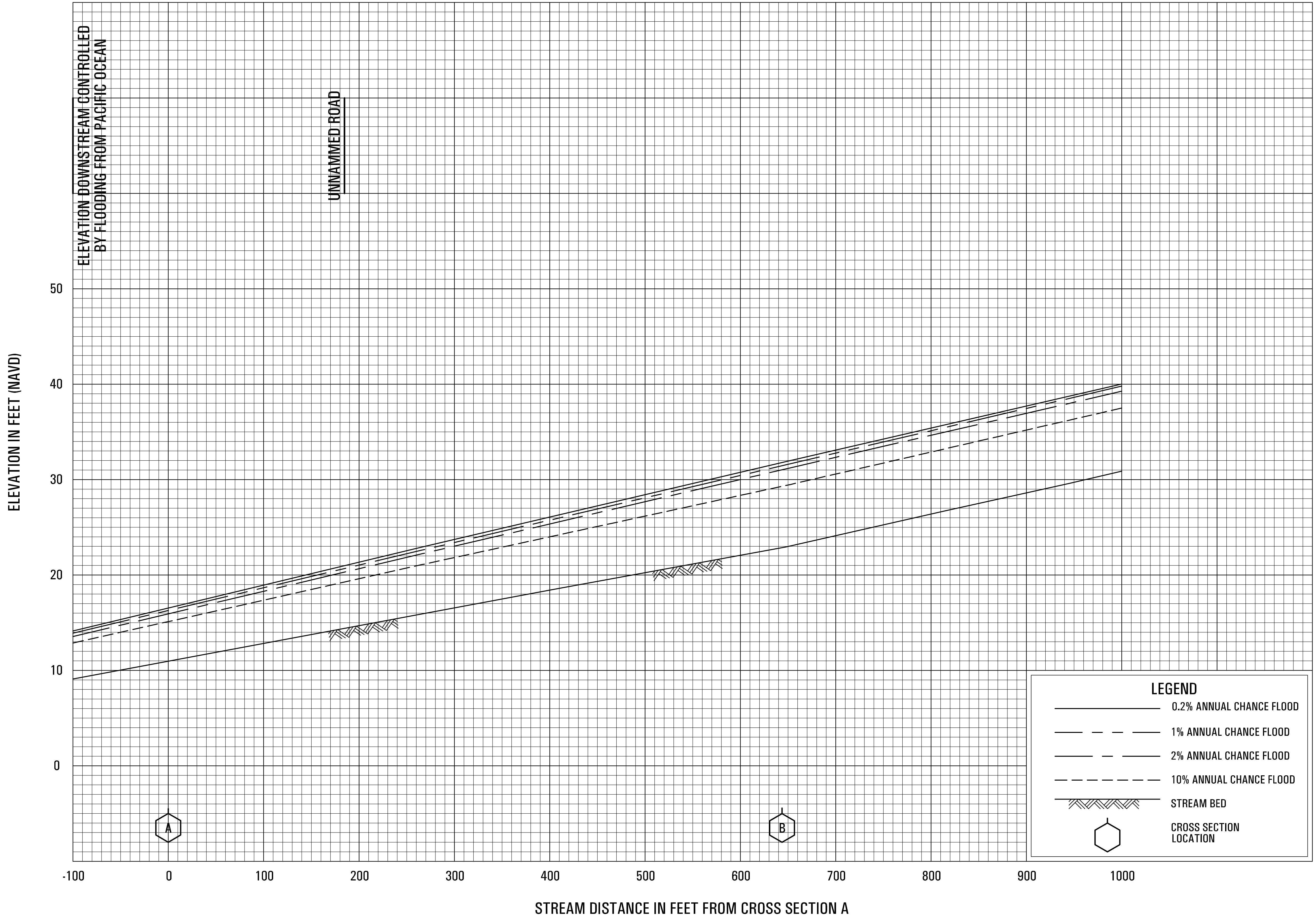
PALO COMANDO CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS

150P



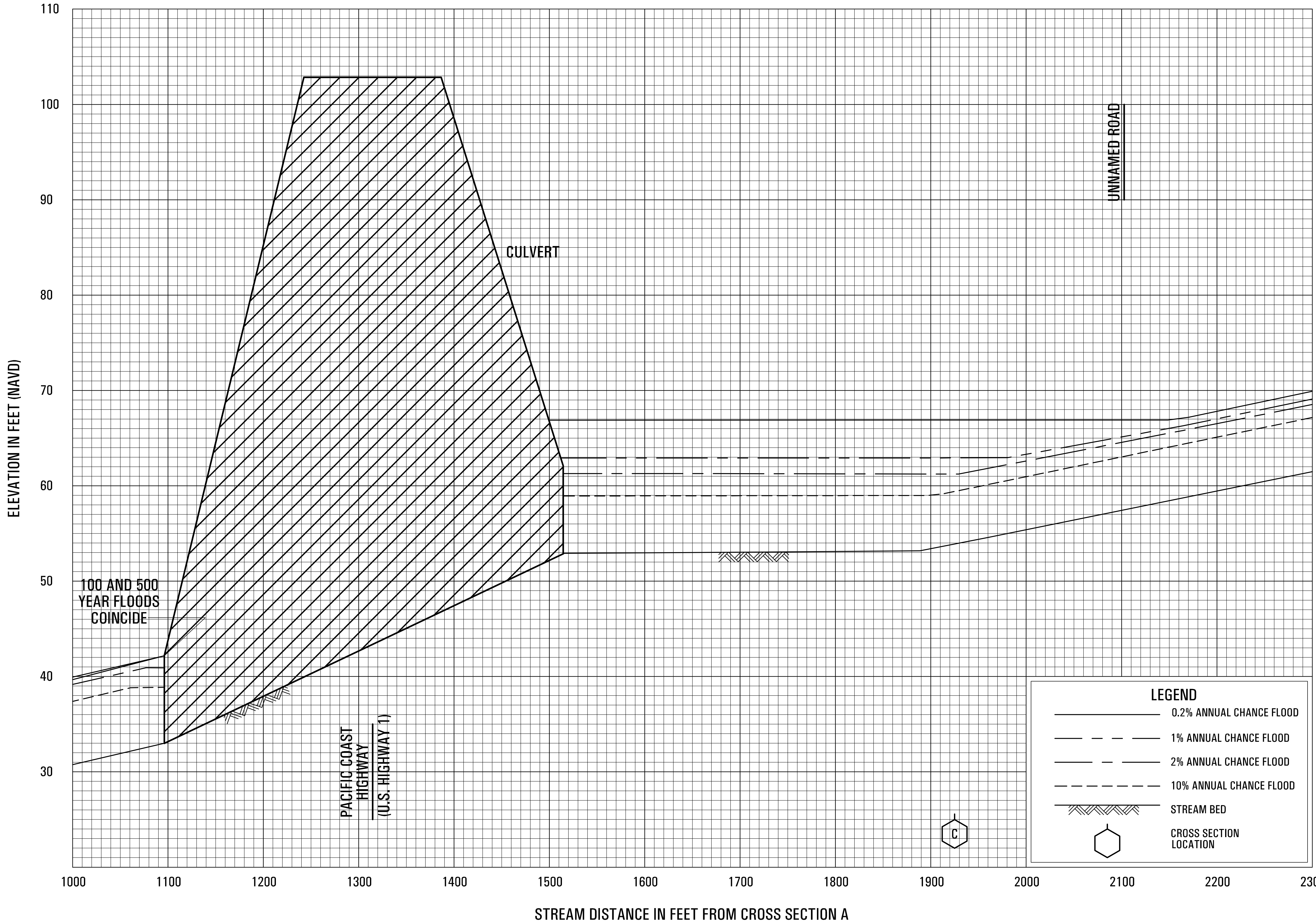
FLOOD PROFILES

RAMIREZ CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



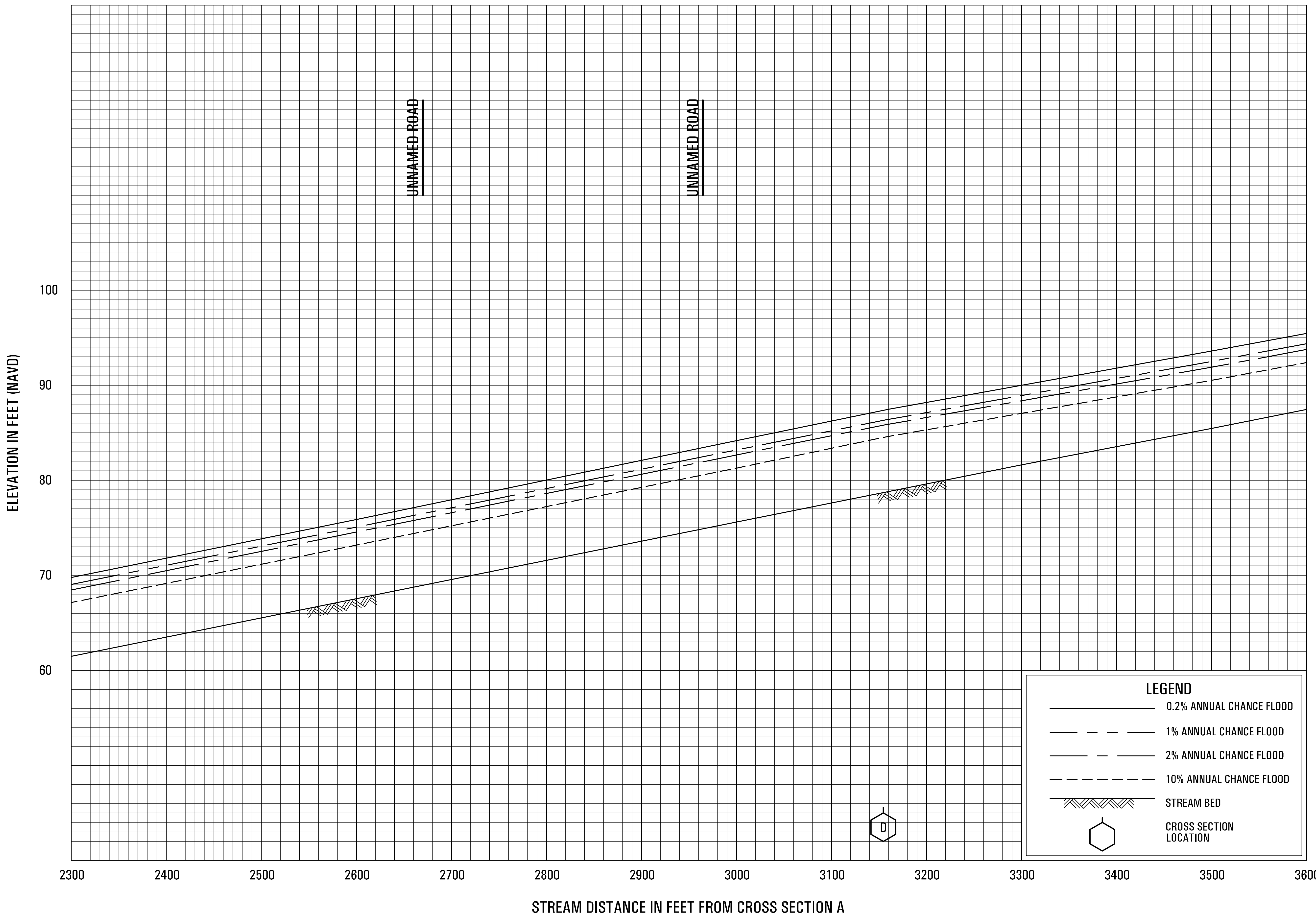
FLOOD PROFILES

RAMIREZ CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



FLOOD PROFILES

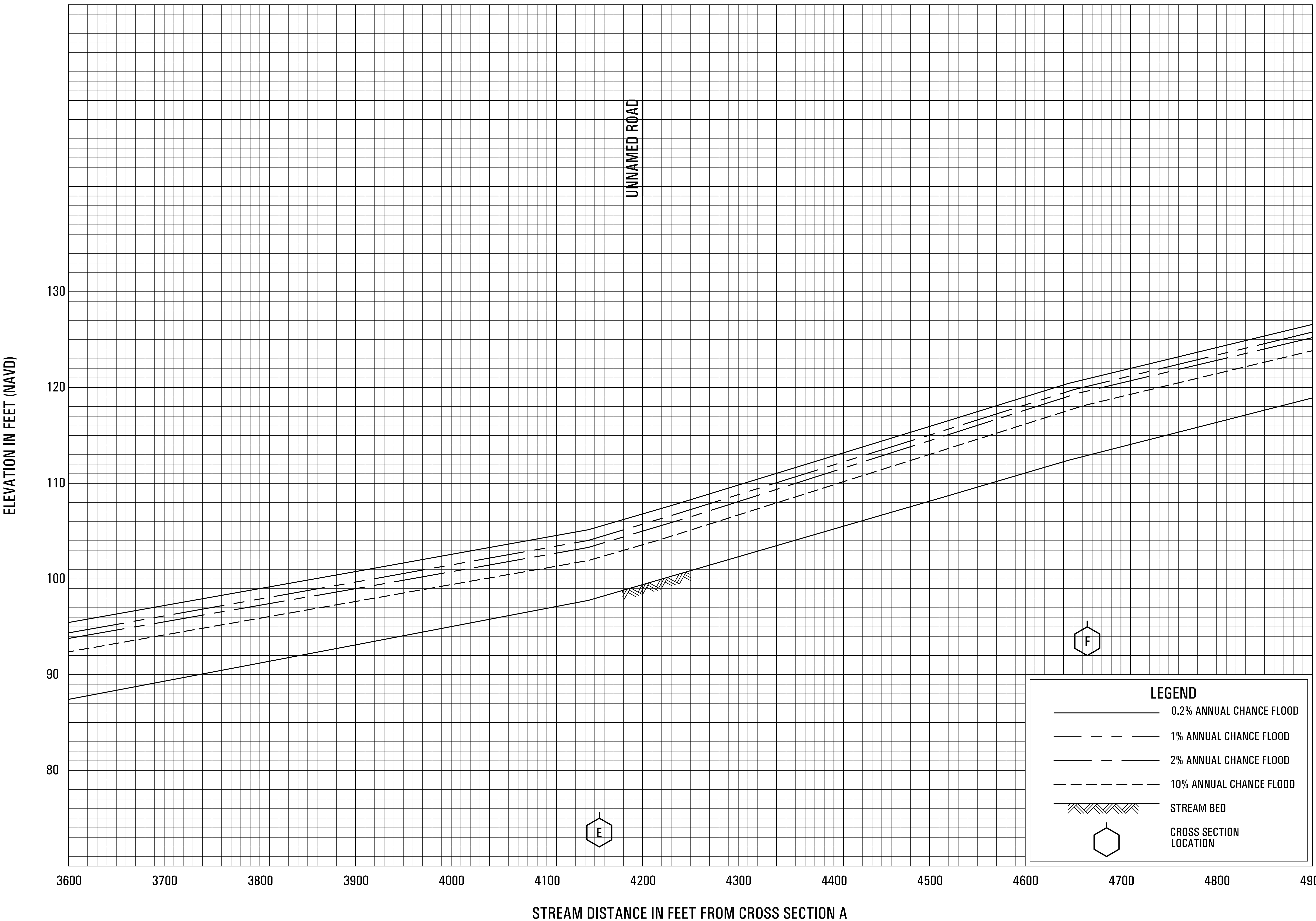
RAMIREZ CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS

153P



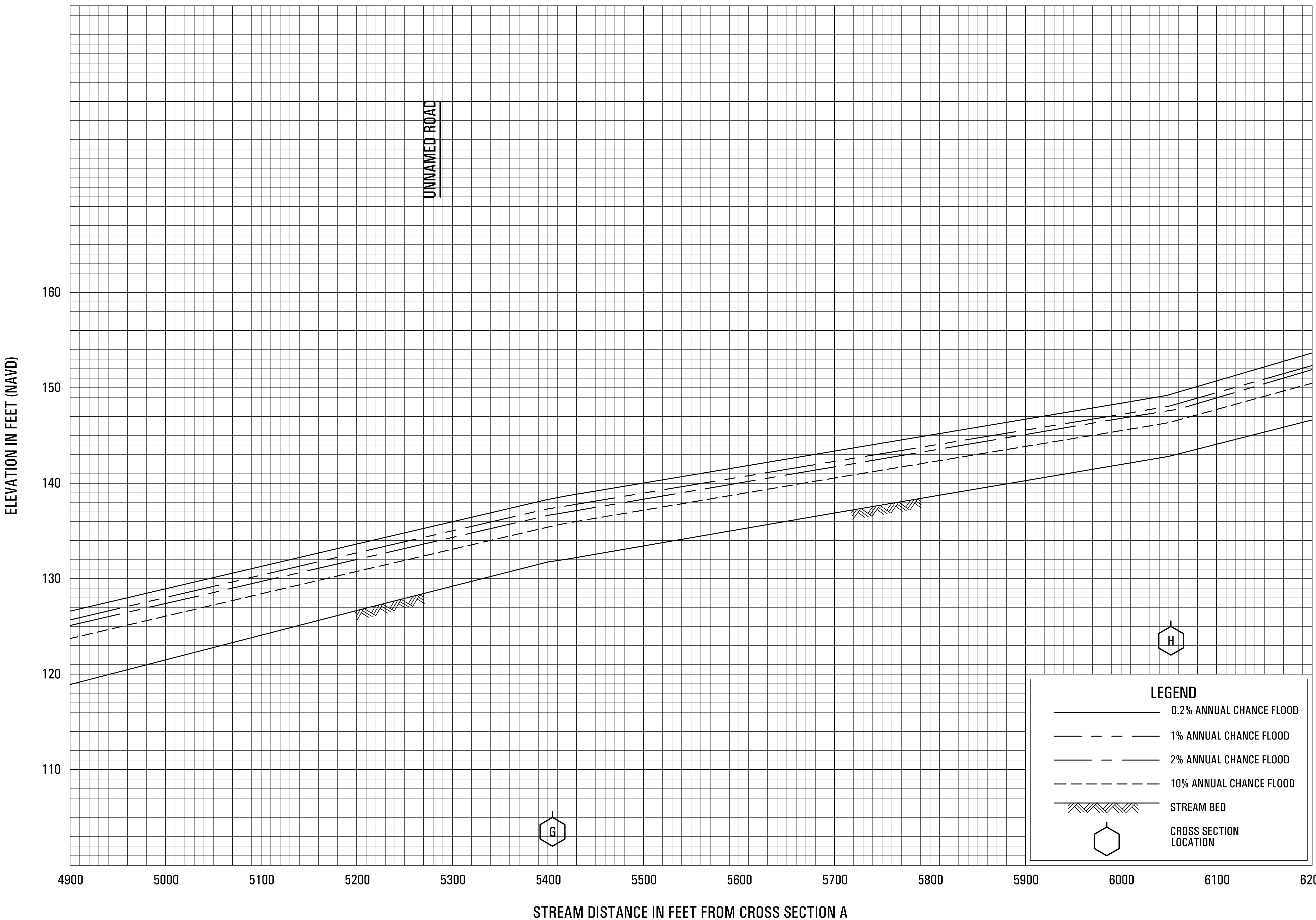
FLOOD PROFILES

RAMIREZ CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



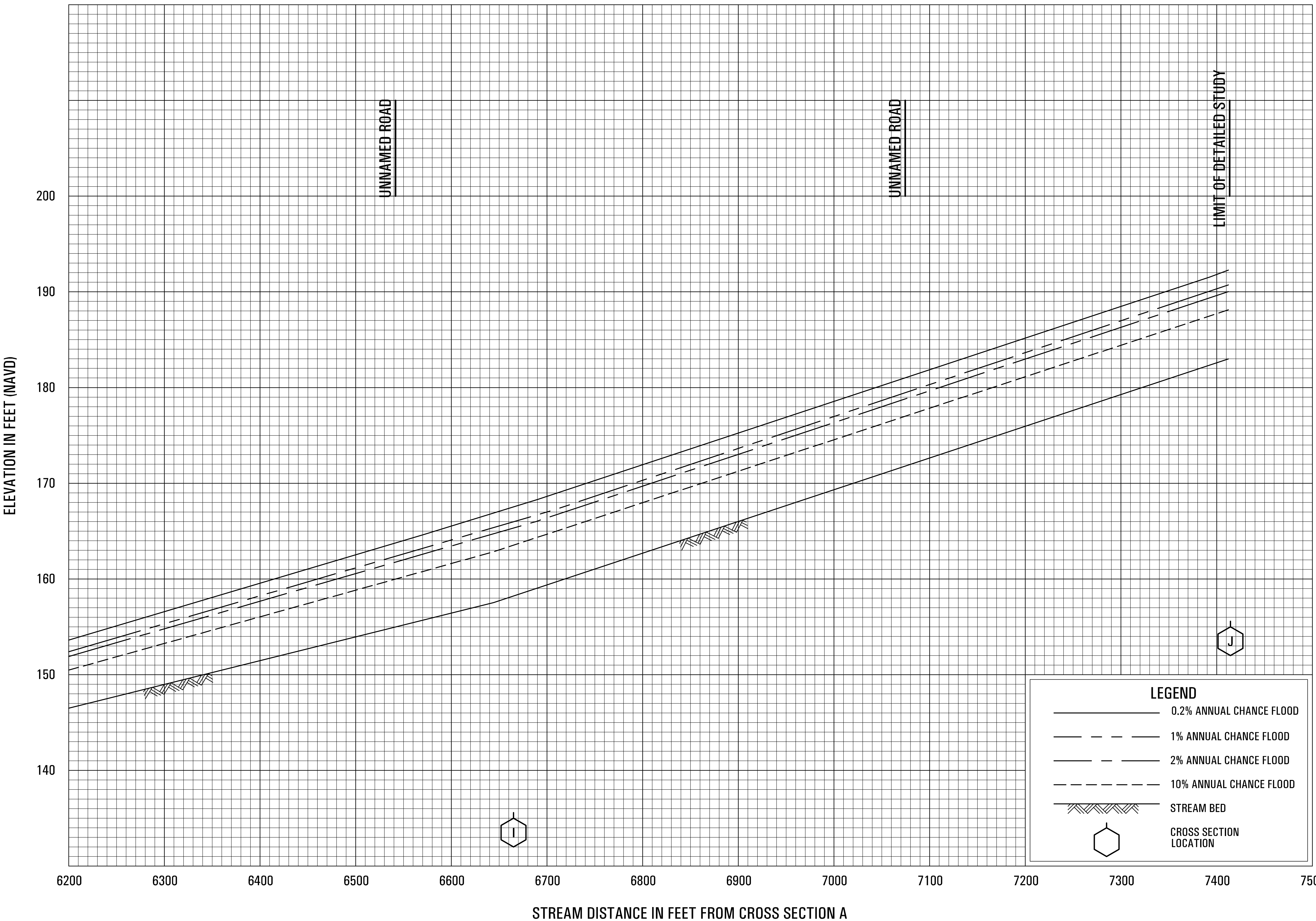
FLOOD PROFILES

RAMIREZ CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



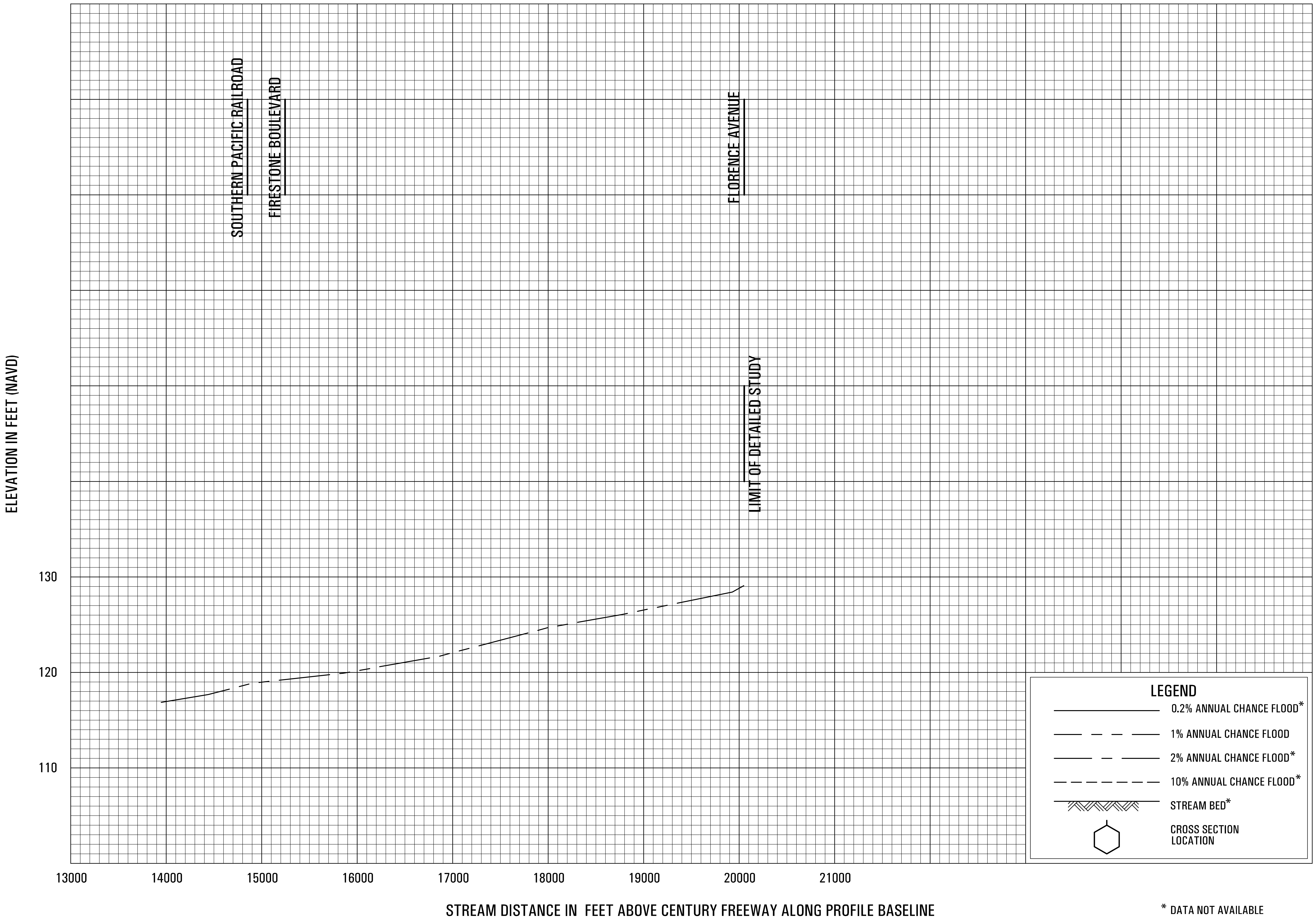
FLOOD PROFILES

RAMIREZ CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



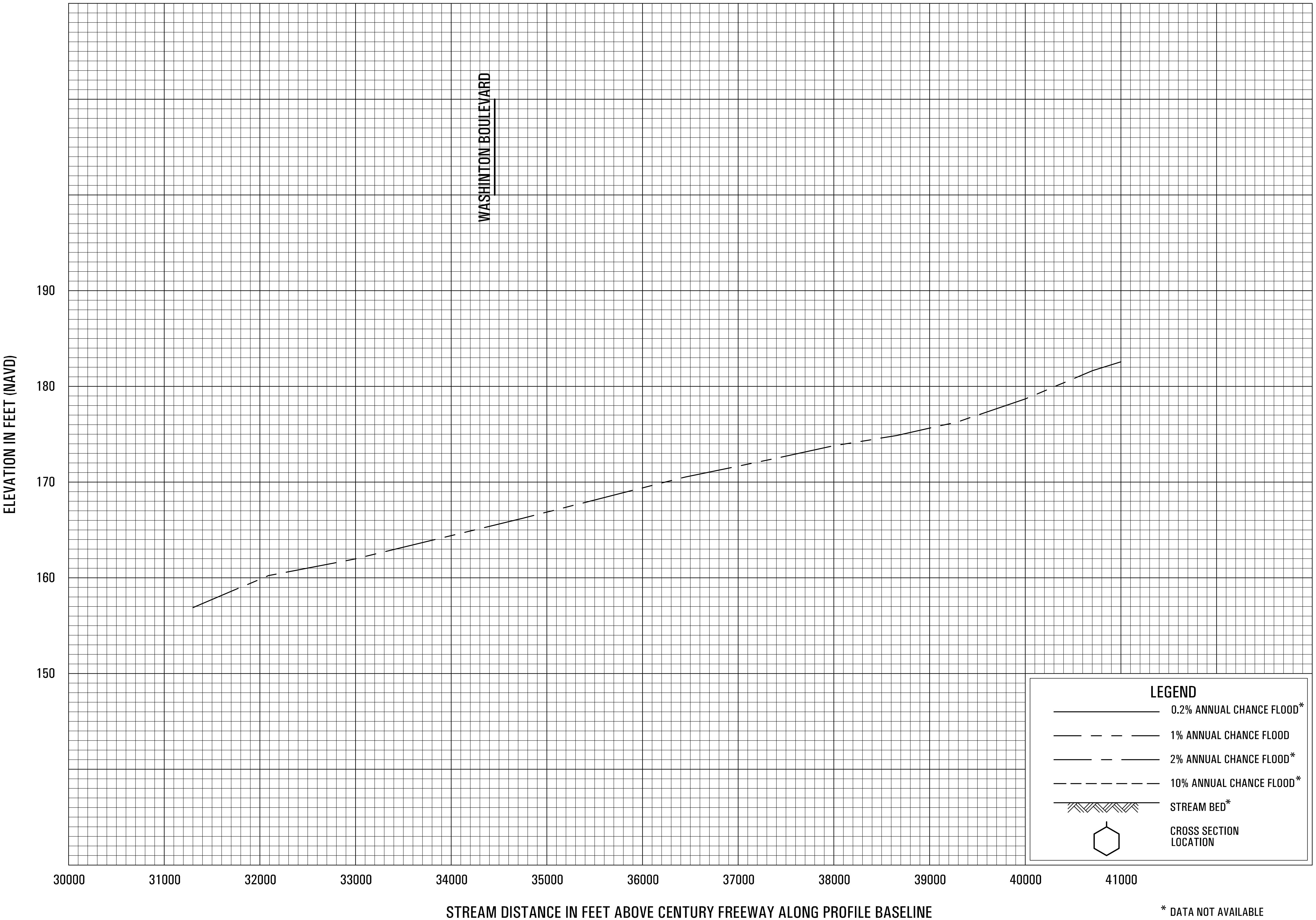
FLOOD PROFILES

RIO HONDO LEFT OVERBANK PATH 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



FLOOD PROFILES

RIO HONDO LEFT OVERBANK PATH 5

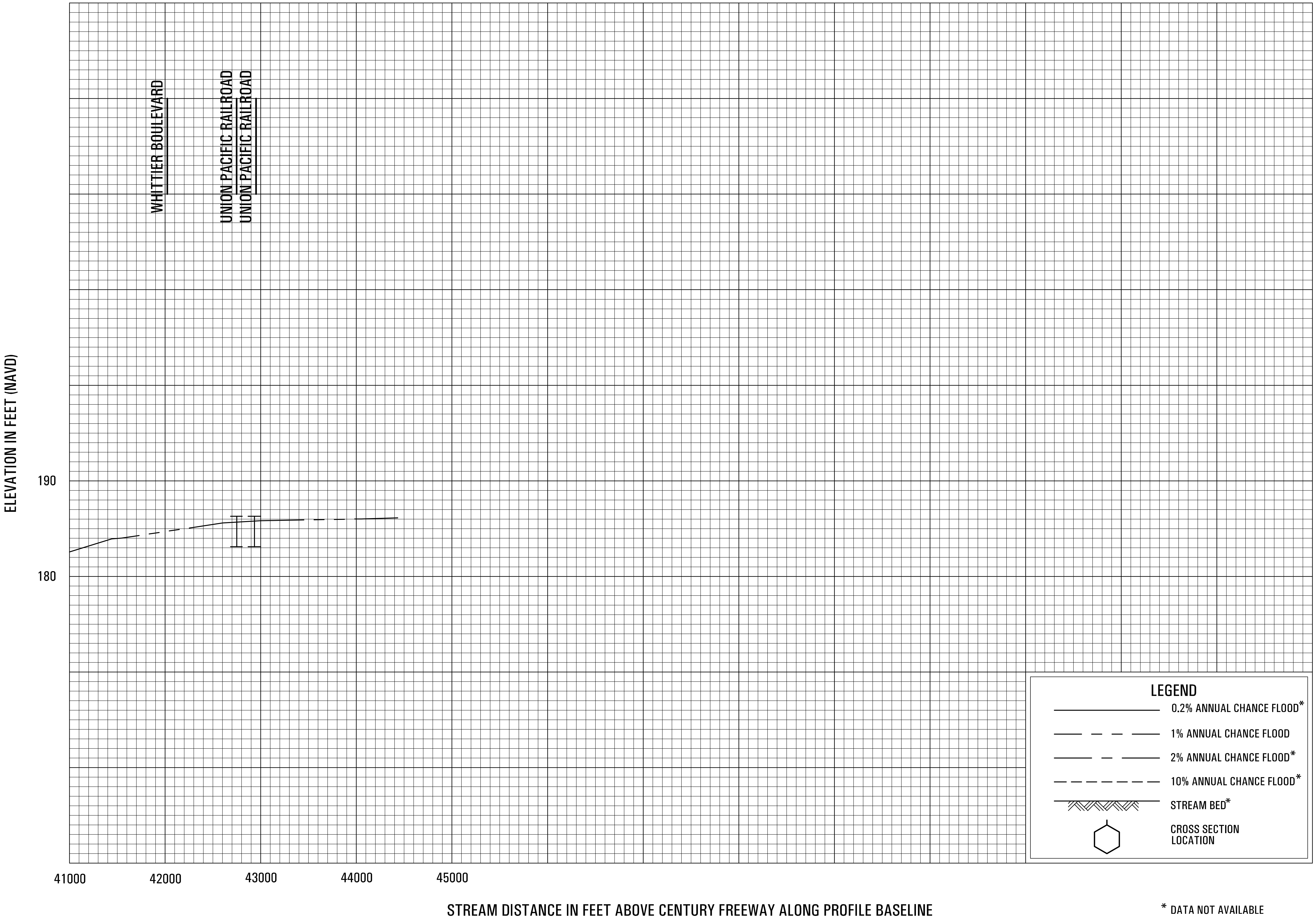
FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS

FLOOD PROFILES

RIO HONDO LEFT OVERBANK PATH 5



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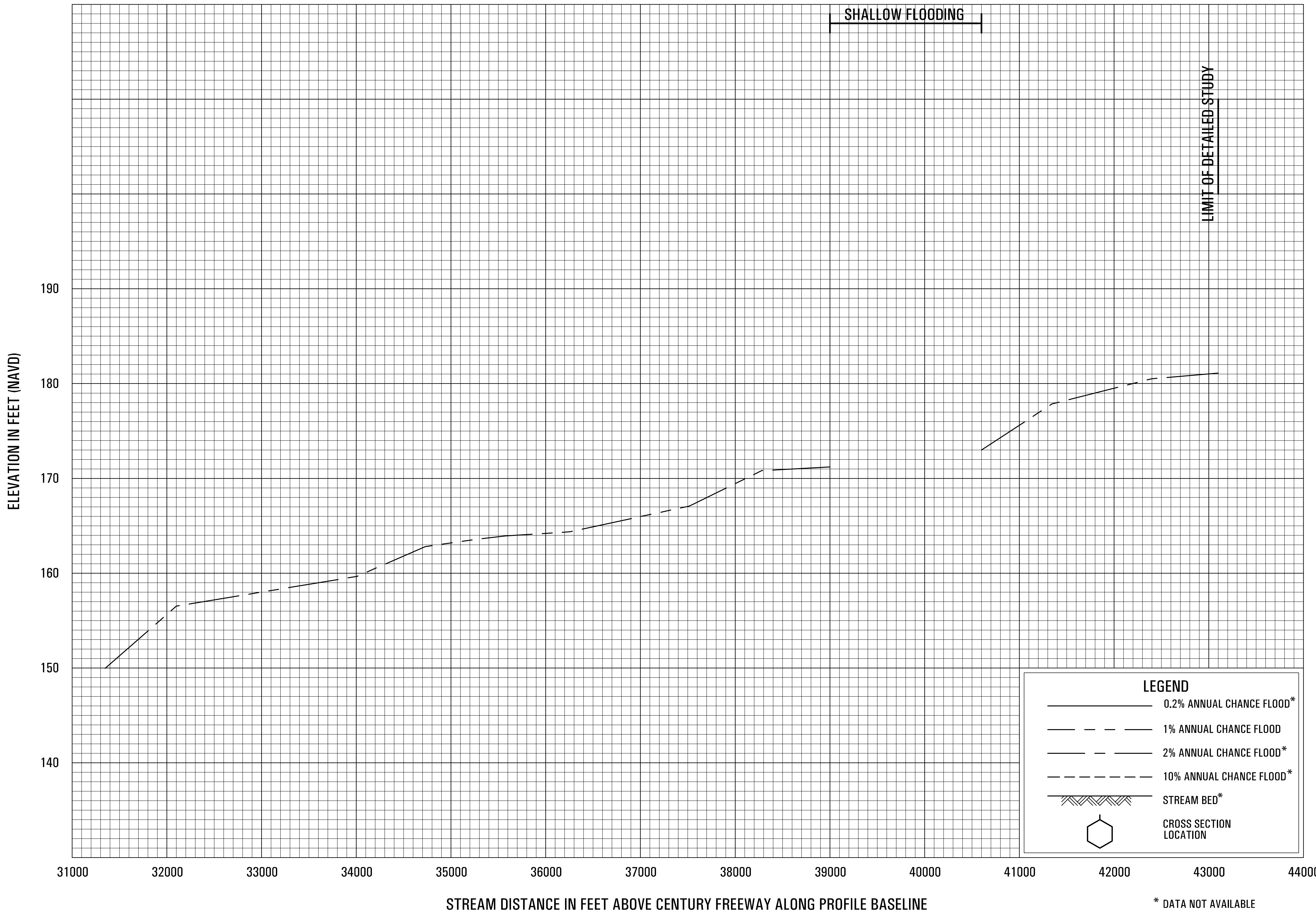
FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



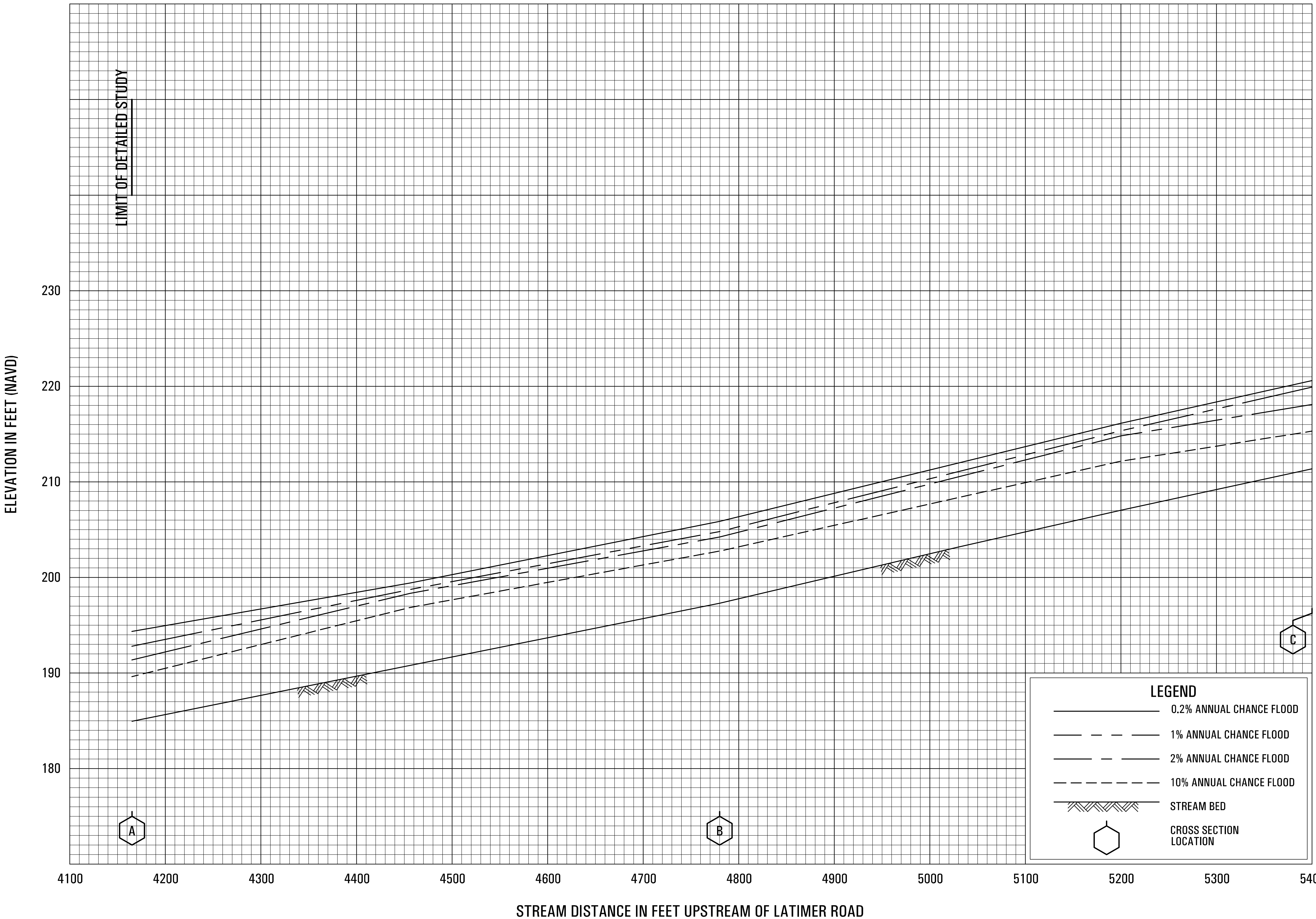
FLOOD PROFILES

RIO HONDO LEFT OVERBANK PATH 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



FLOOD PROFILES

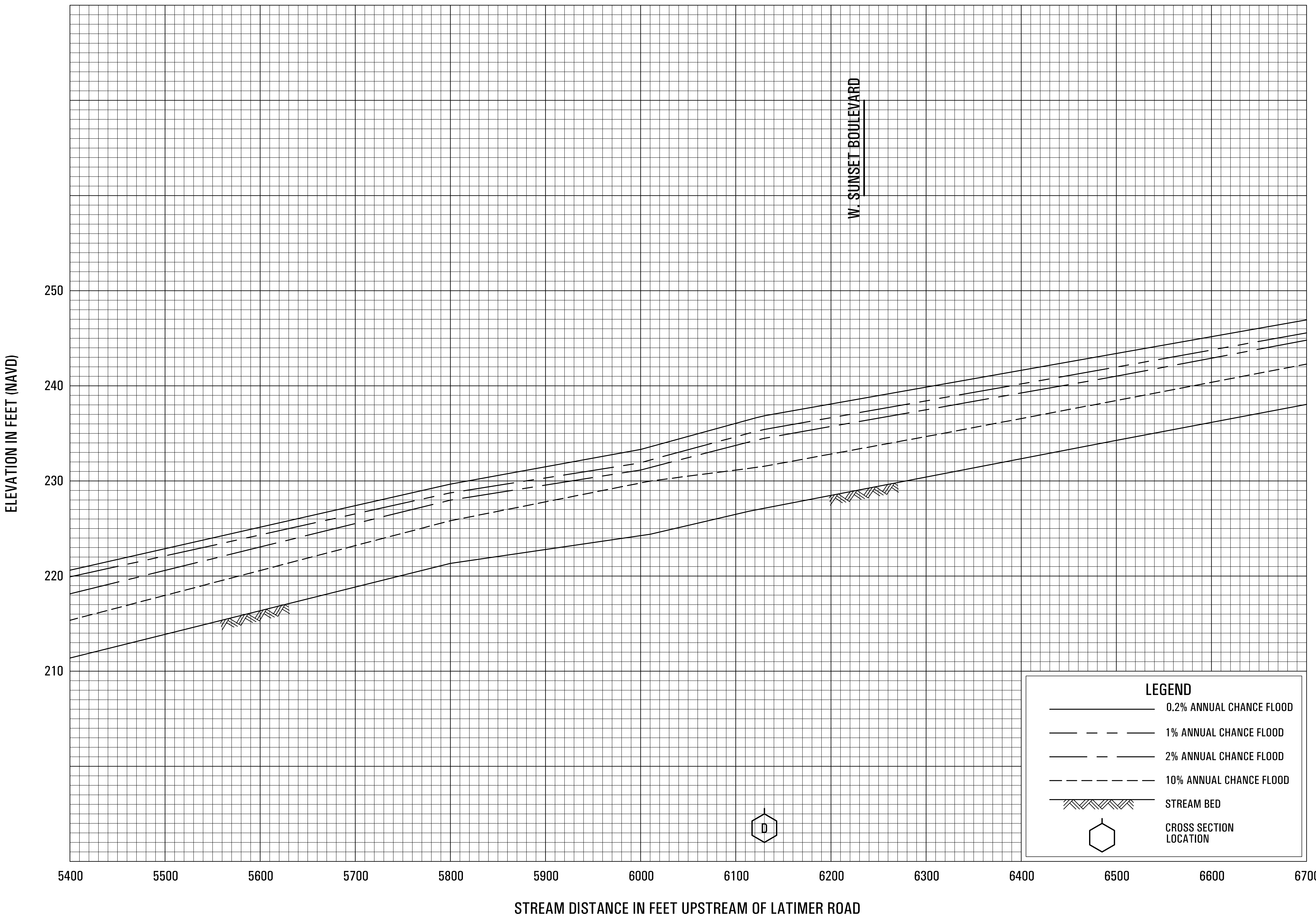
RUSTIC CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS

161P



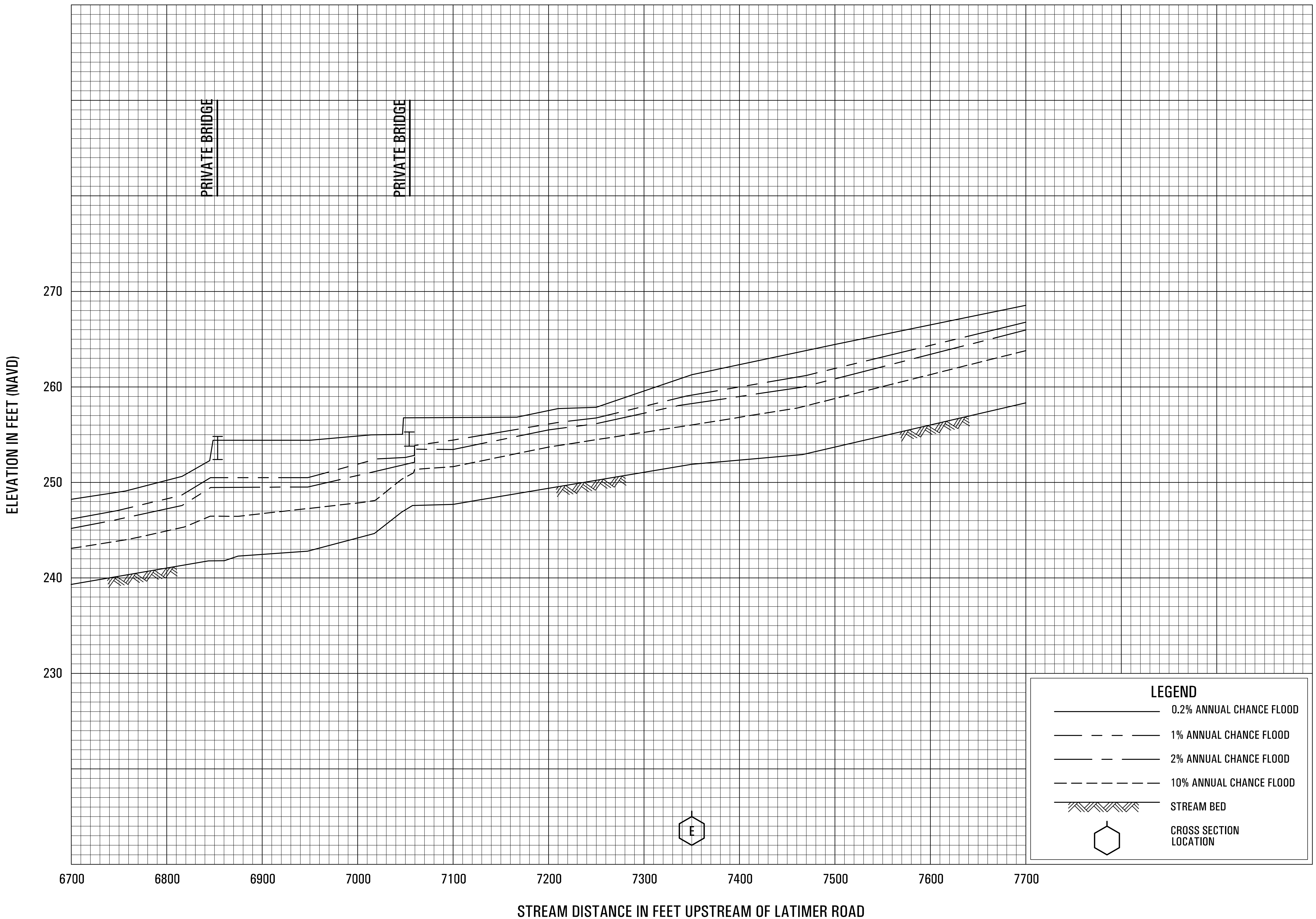
FLOOD PROFILES

RUSTIC CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



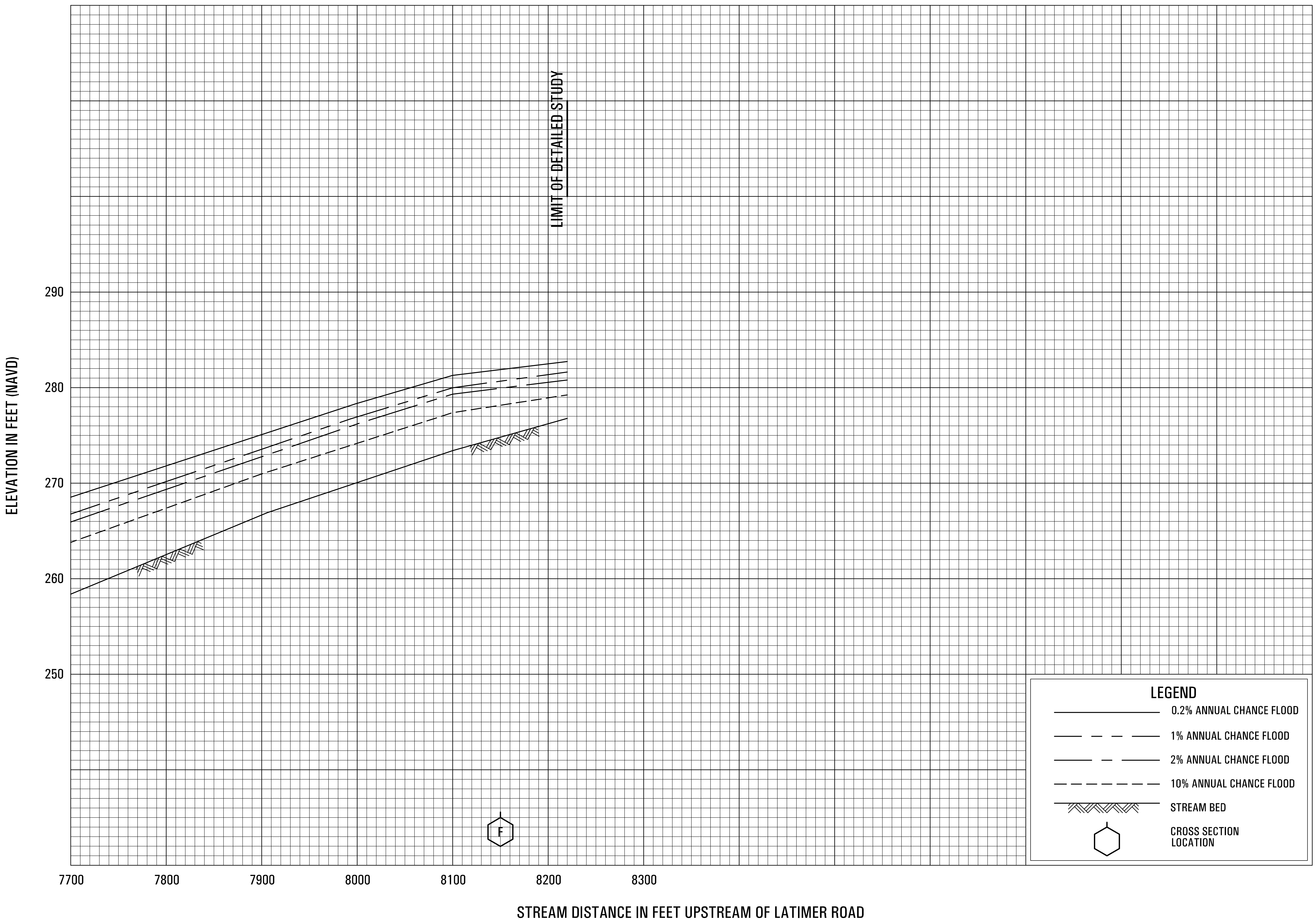
FLOOD PROFILES

RUSTIC CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



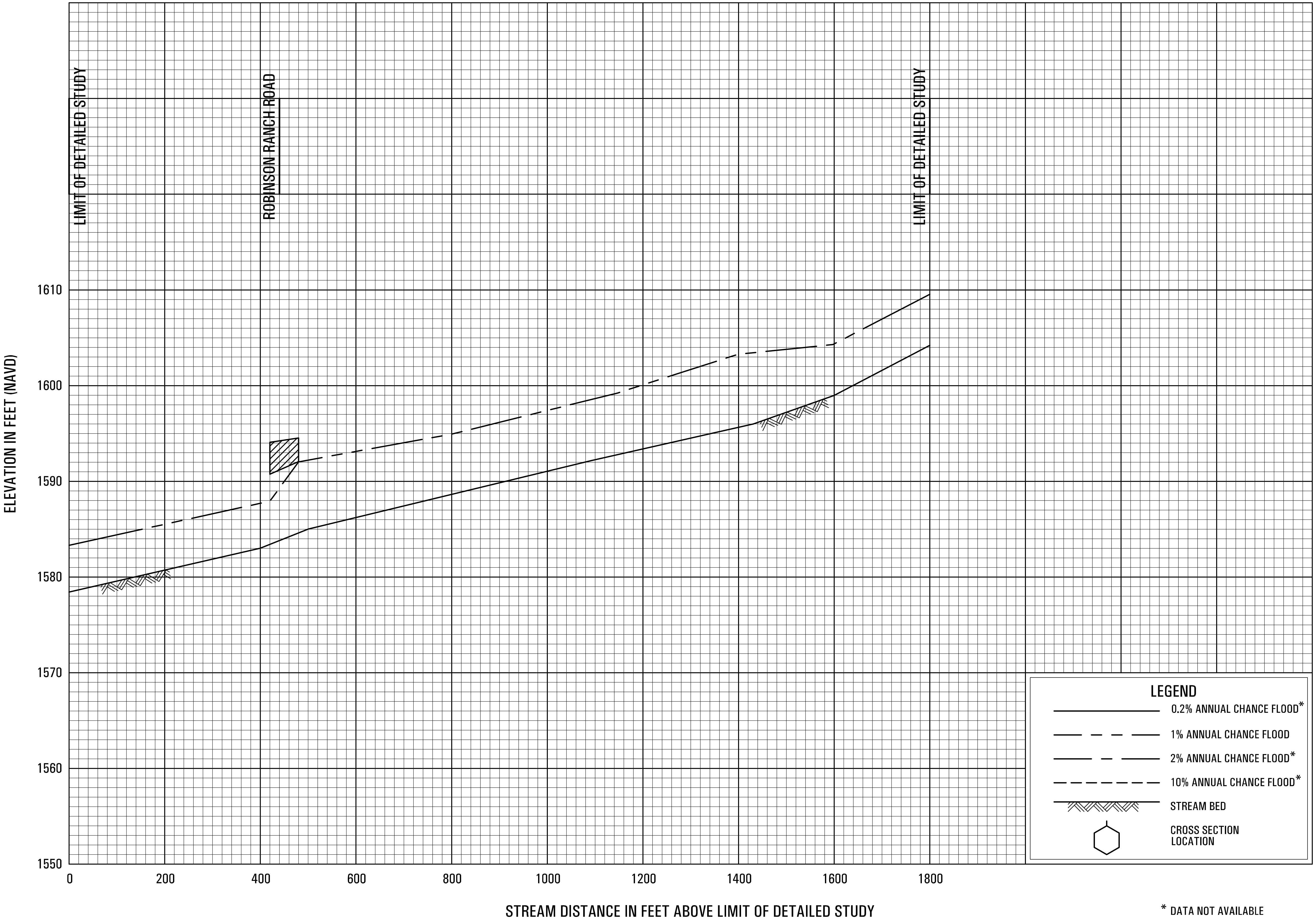
FLOOD PROFILES

RUSTIC CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



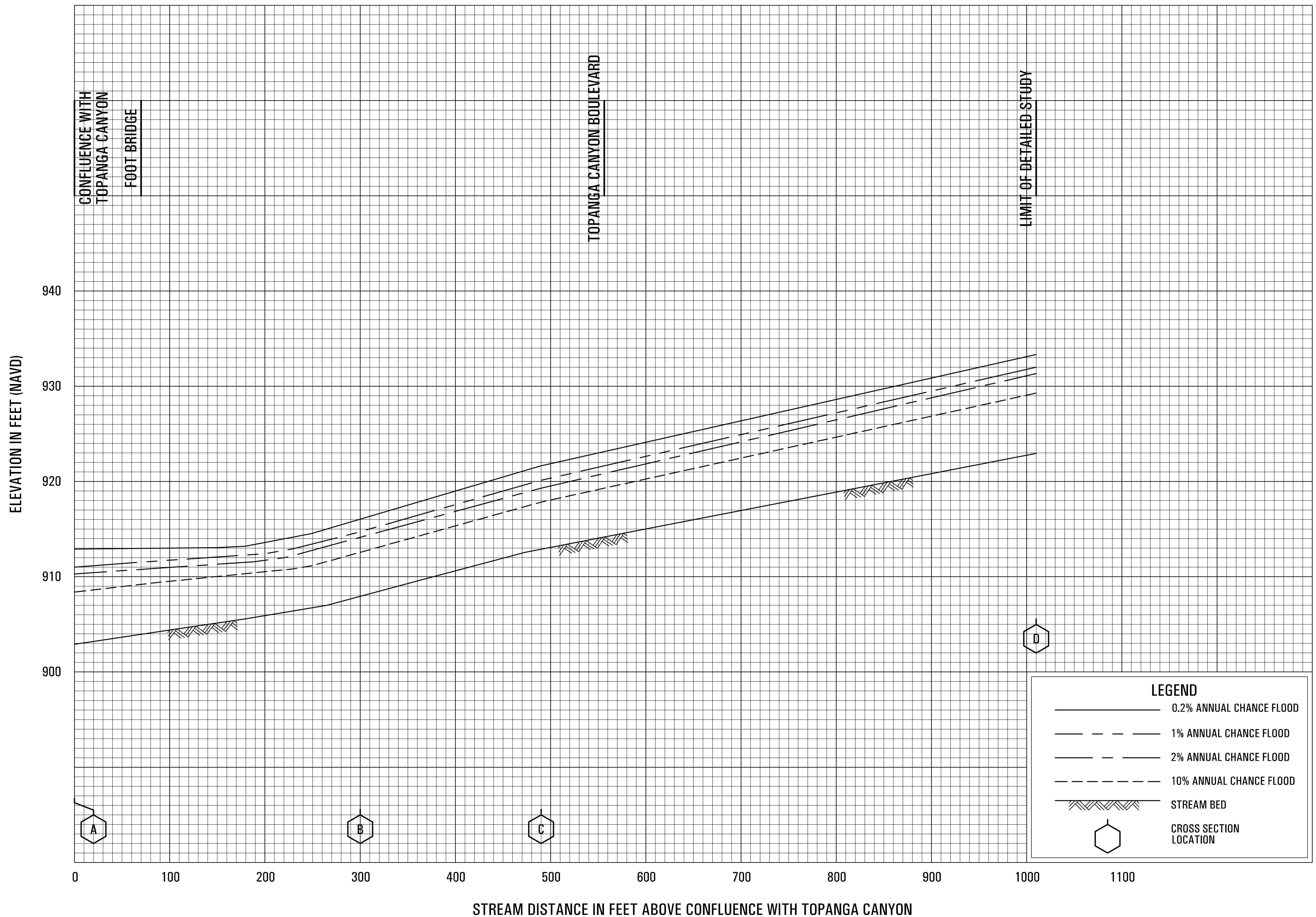
FLOOD PROFILES

SAND CANYON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



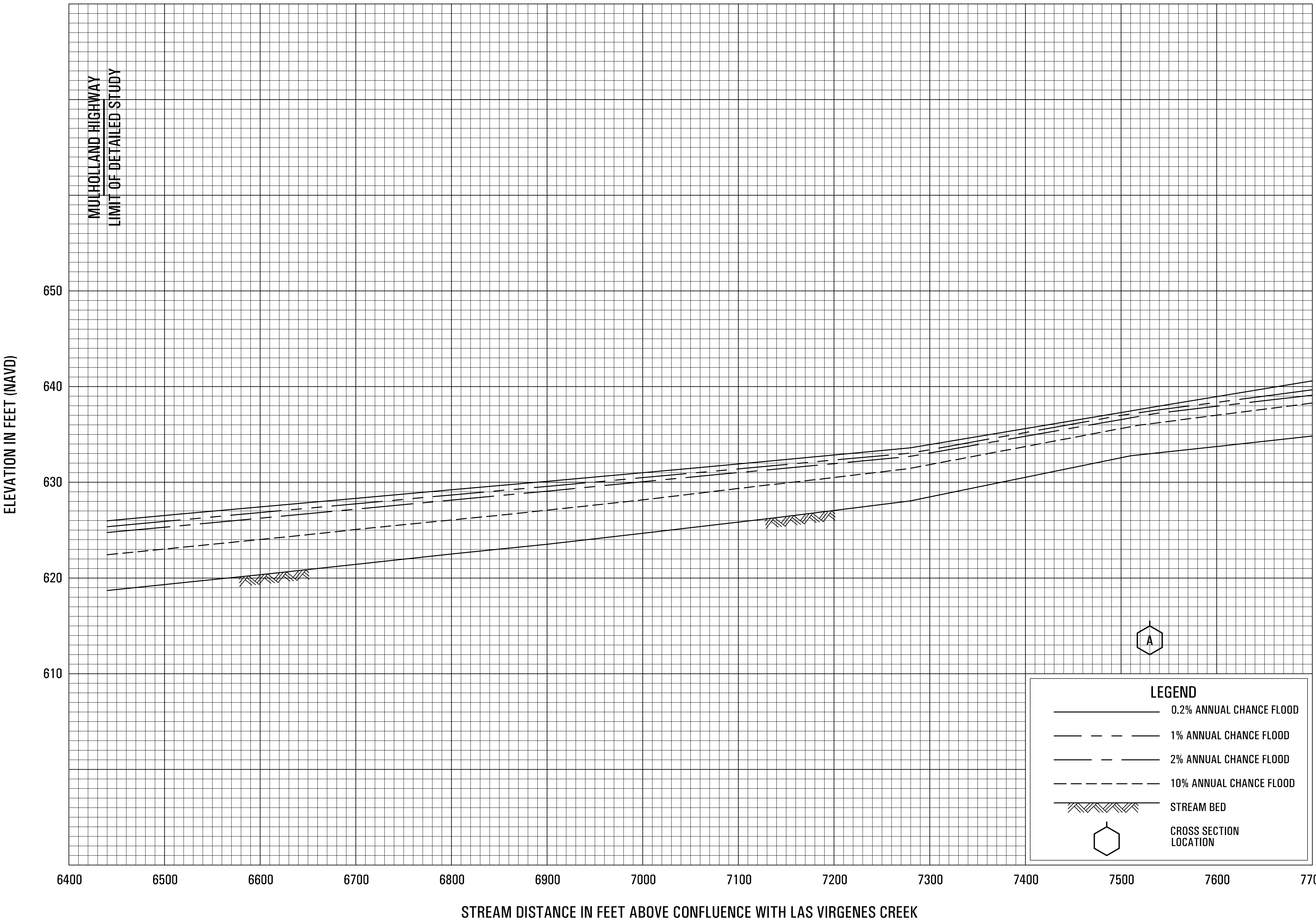
FLOOD PROFILES

SANTA MARIA CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



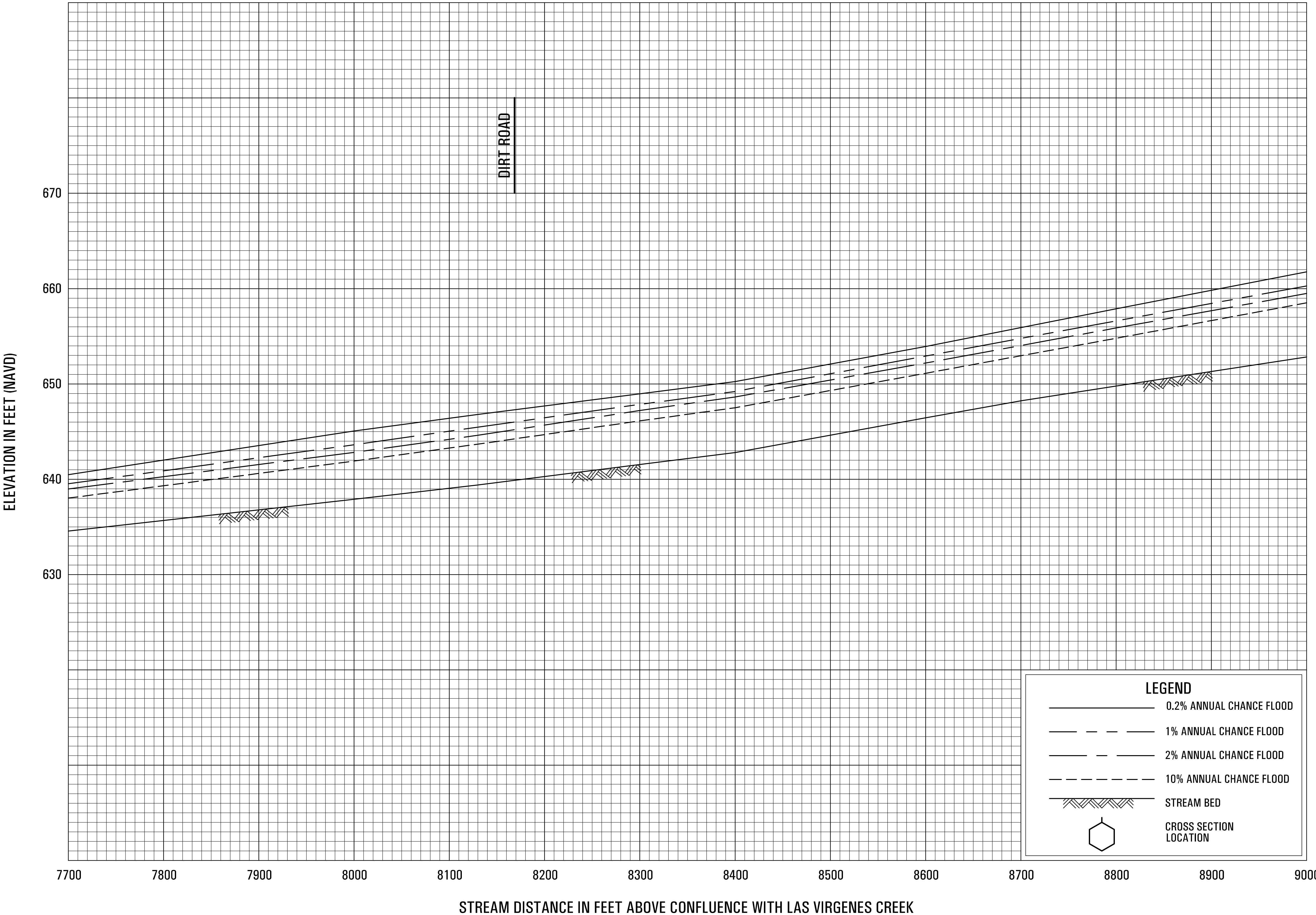
FLOOD PROFILES

STOKES CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



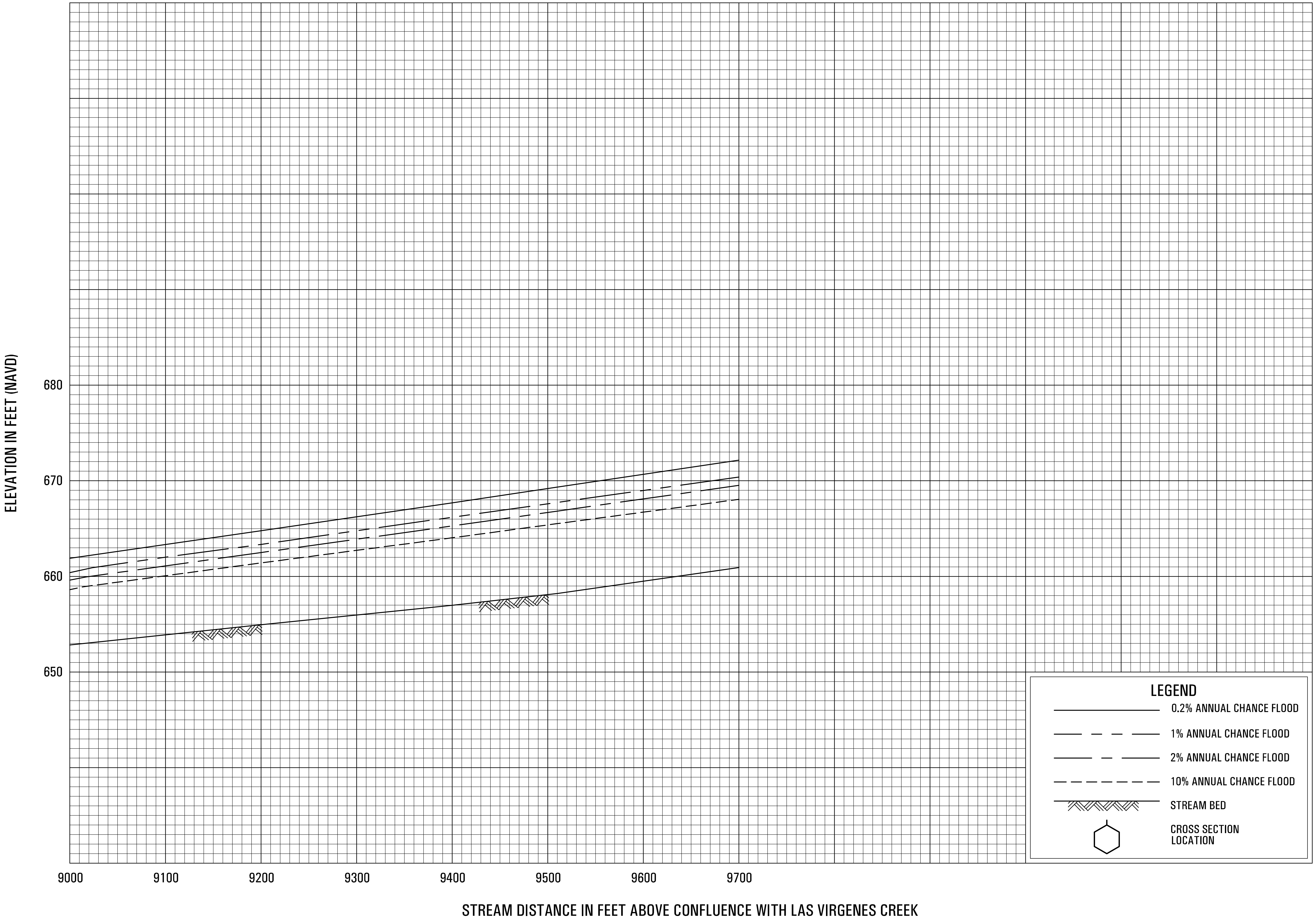
FLOOD PROFILES

STOKES CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



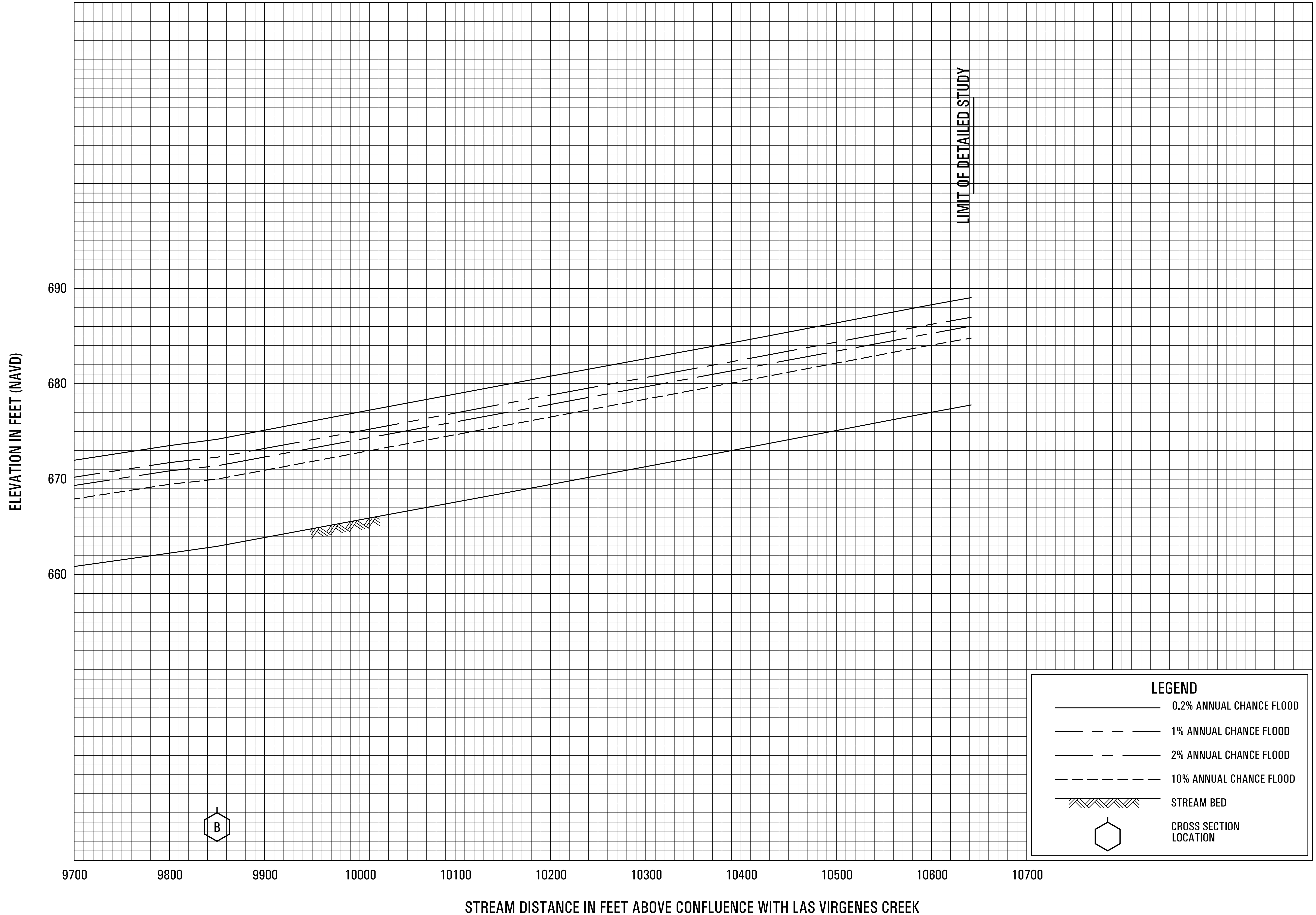
FLOOD PROFILES

STOKES CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



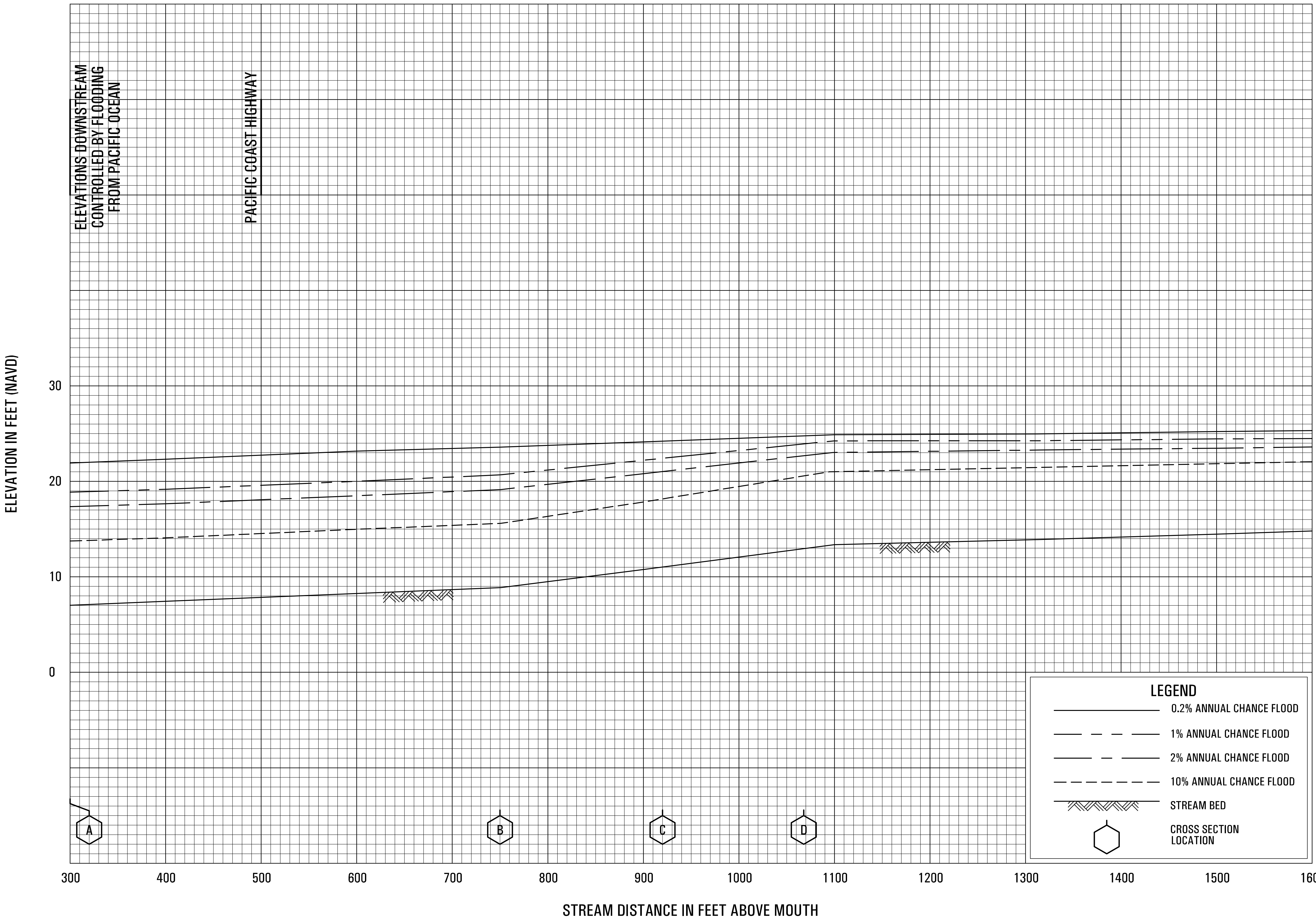
FLOOD PROFILES

STOKES CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



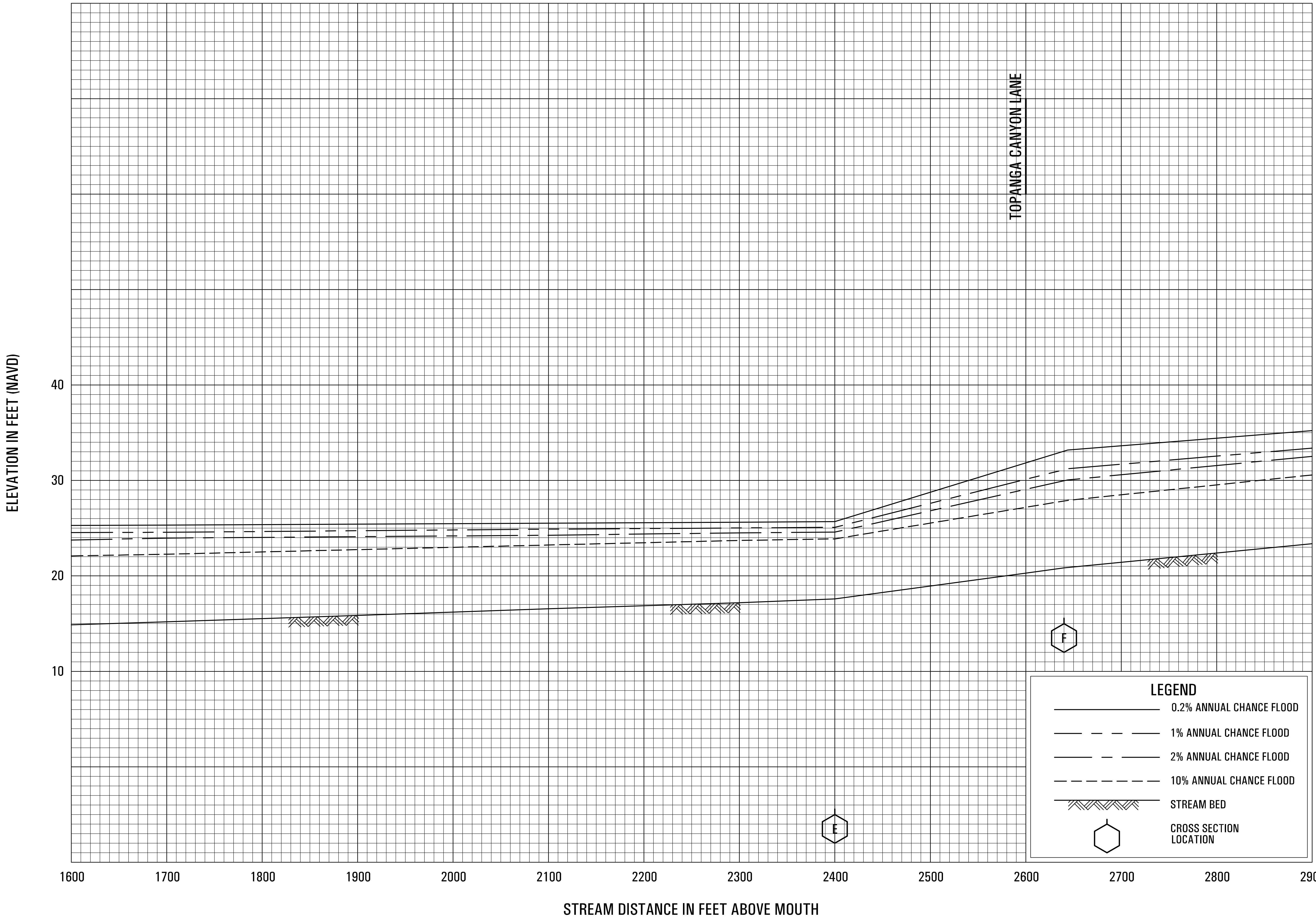
FLOOD PROFILES

TOPANGA CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



FLOOD PROFILES

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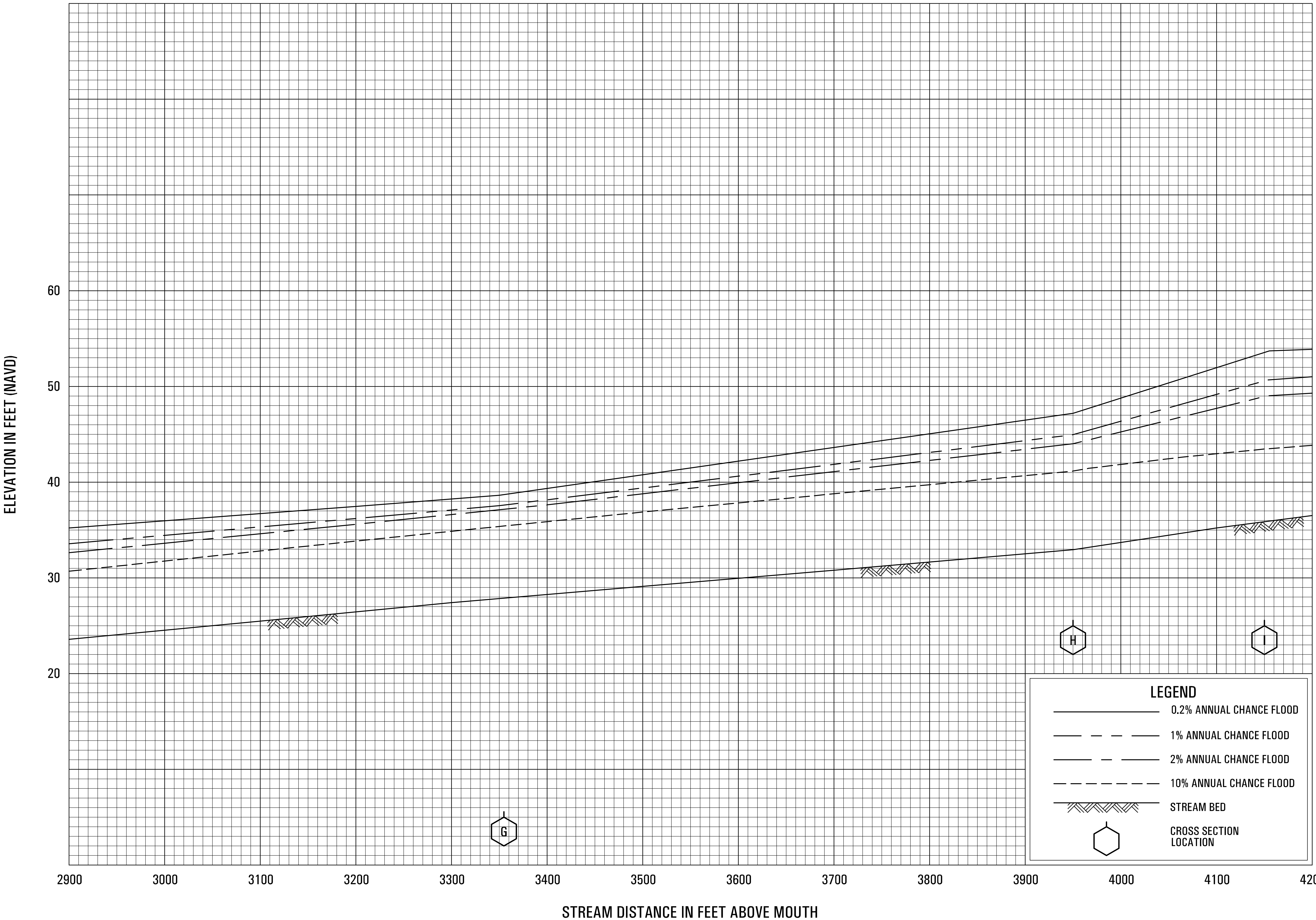
FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



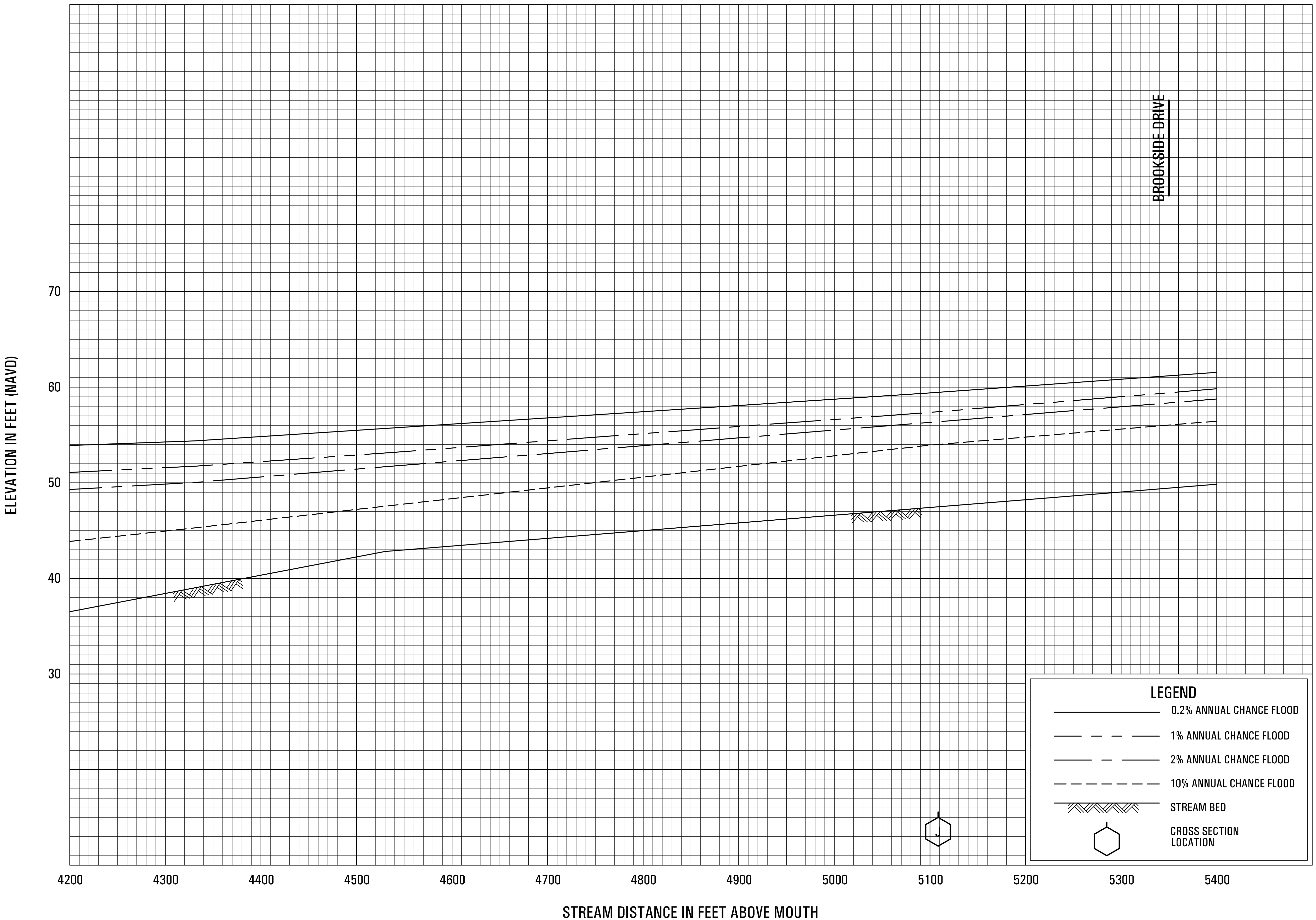
FLOOD PROFILES

TOPANGA CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



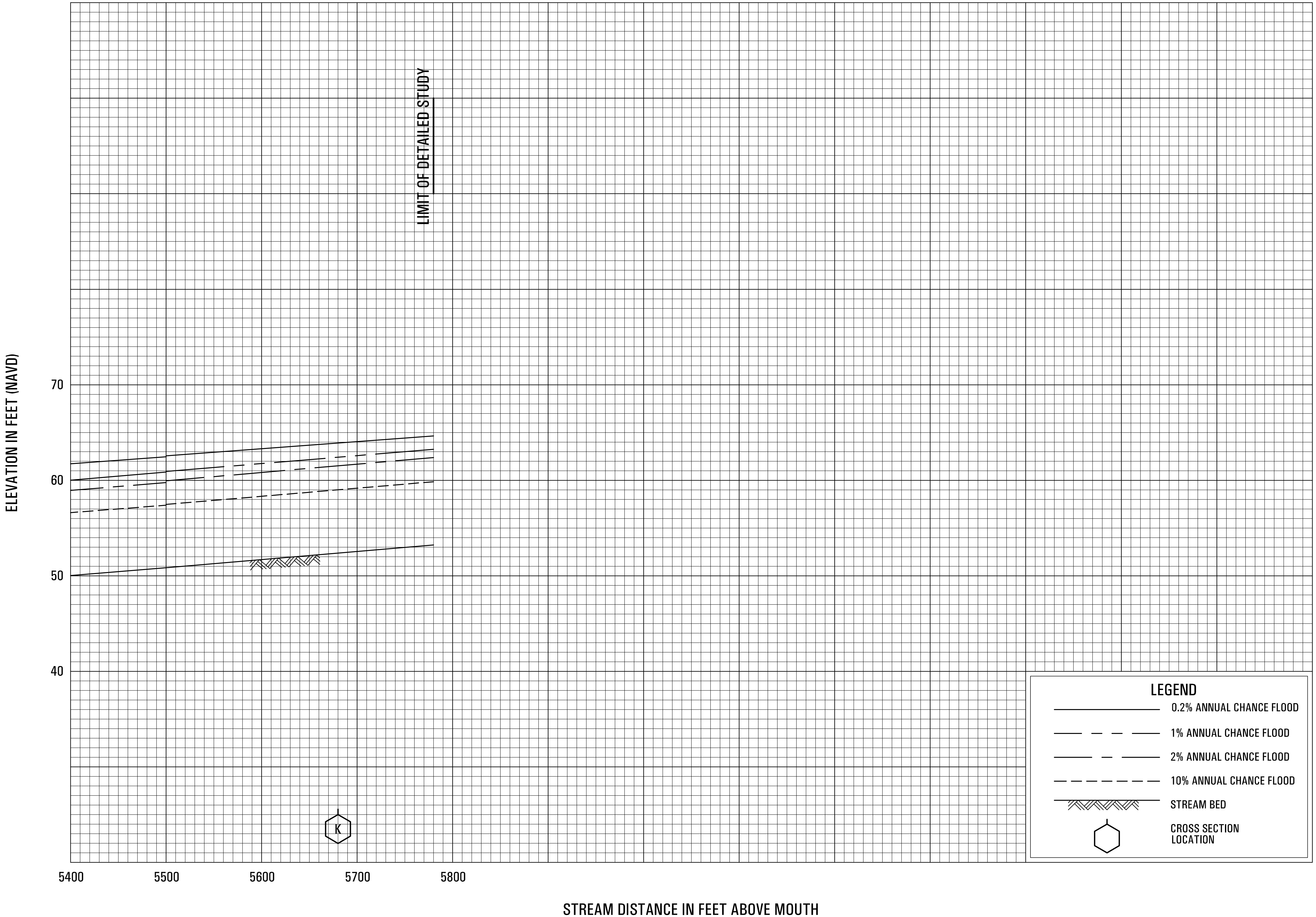
FLOOD PROFILES

TOPANGA CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



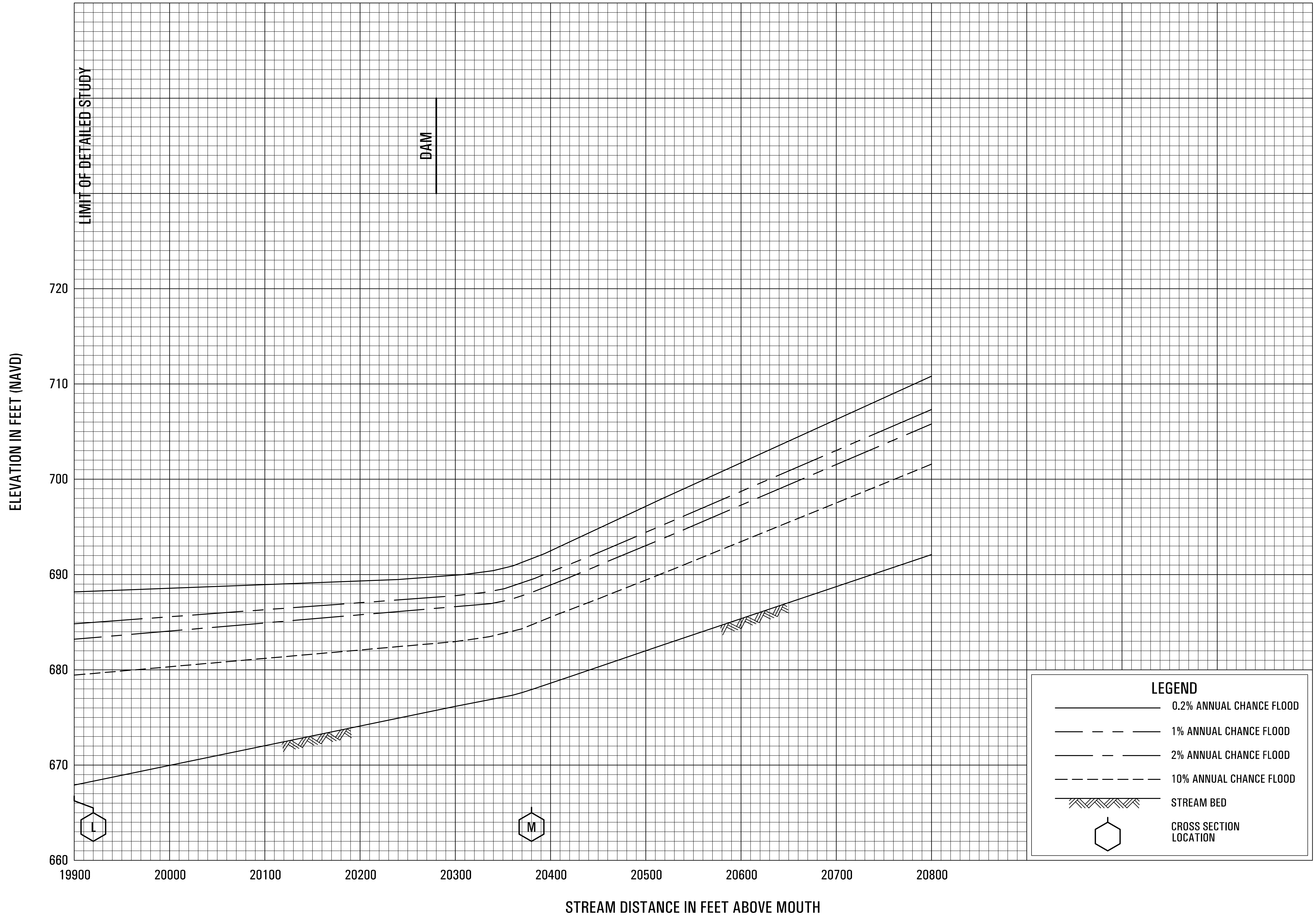
FLOOD PROFILES

TOPANGA CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



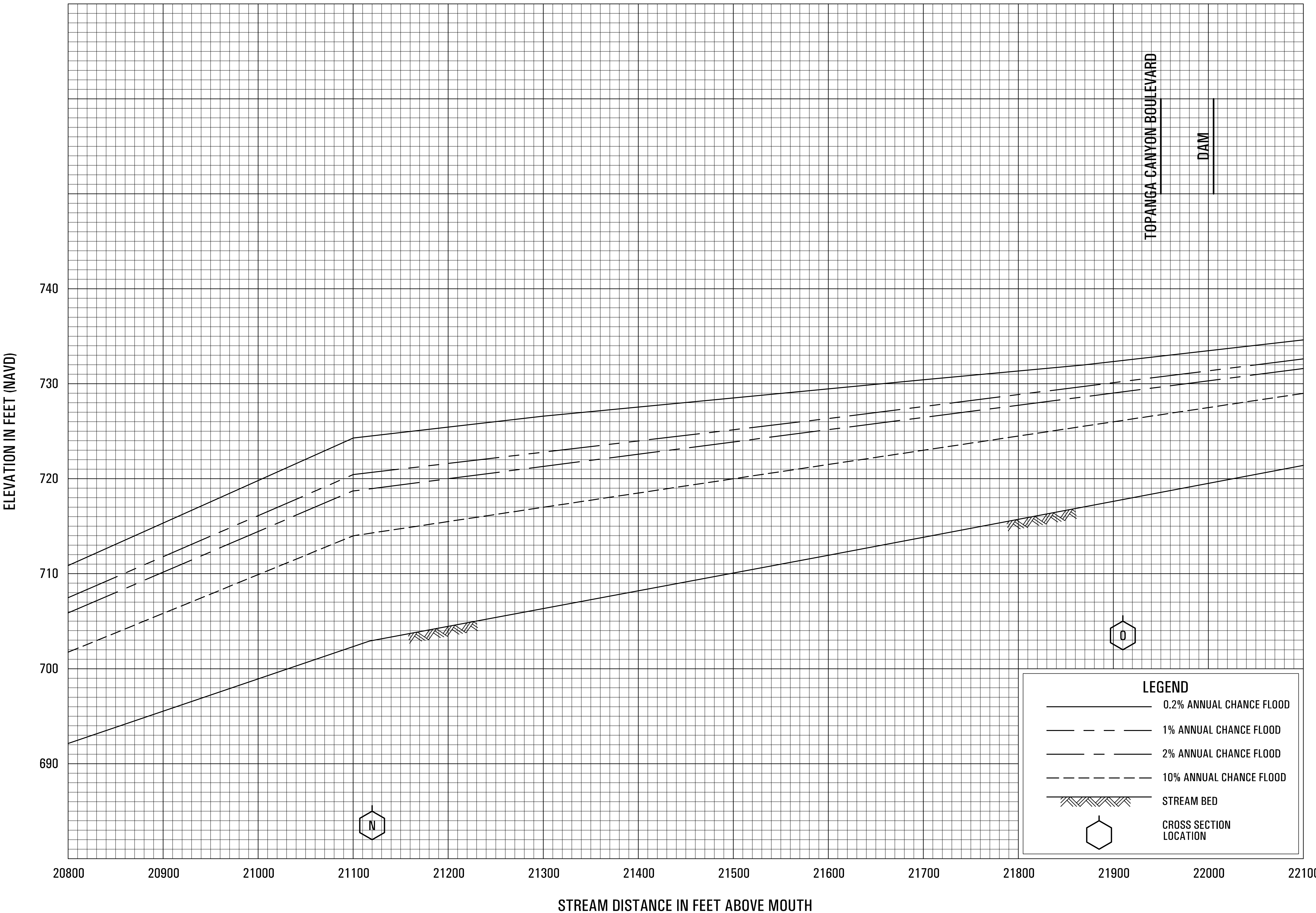
FLOOD PROFILES

TOPANGA CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



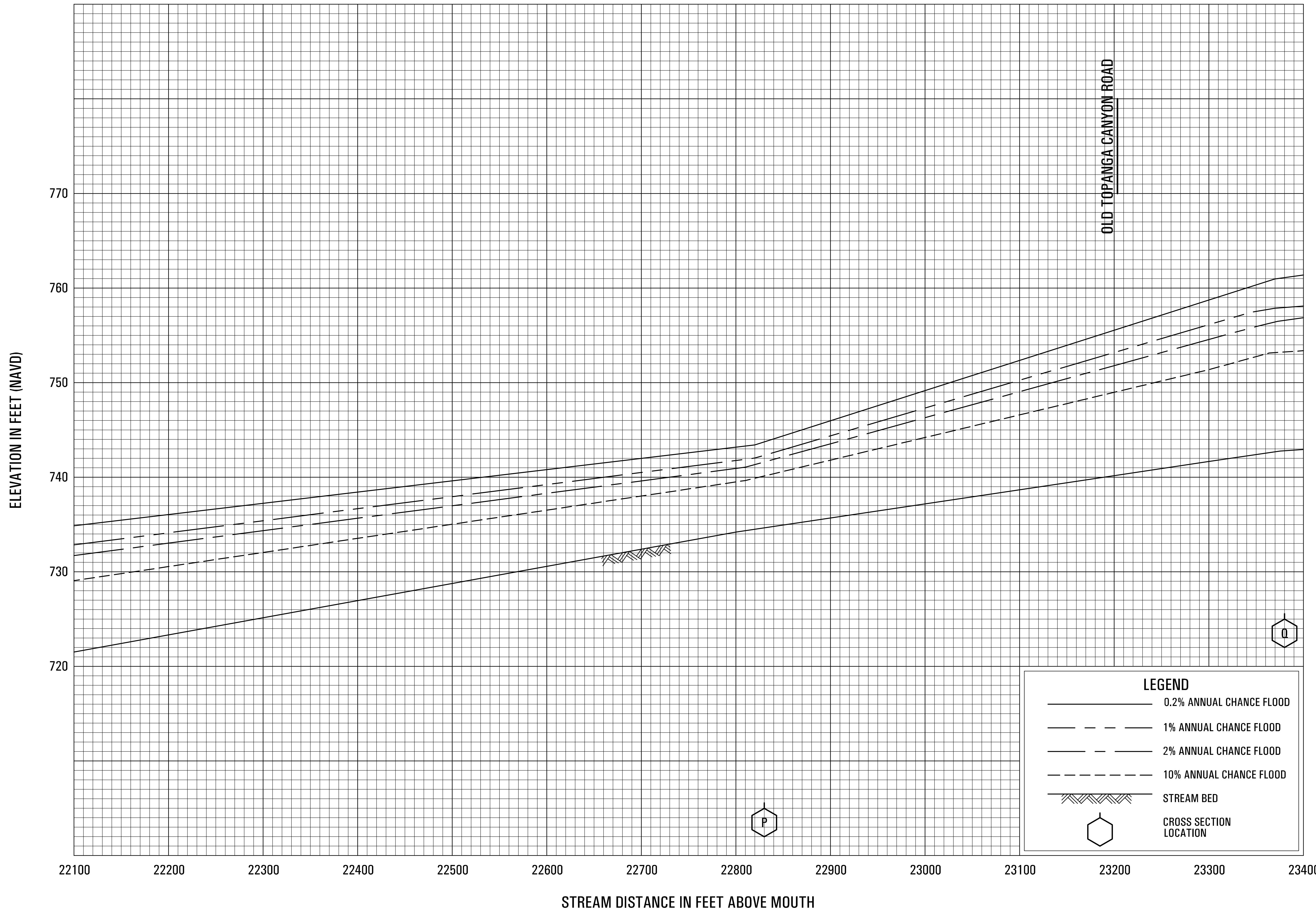
FLOOD PROFILES

TOPANGA CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



FLOOD PROFILES

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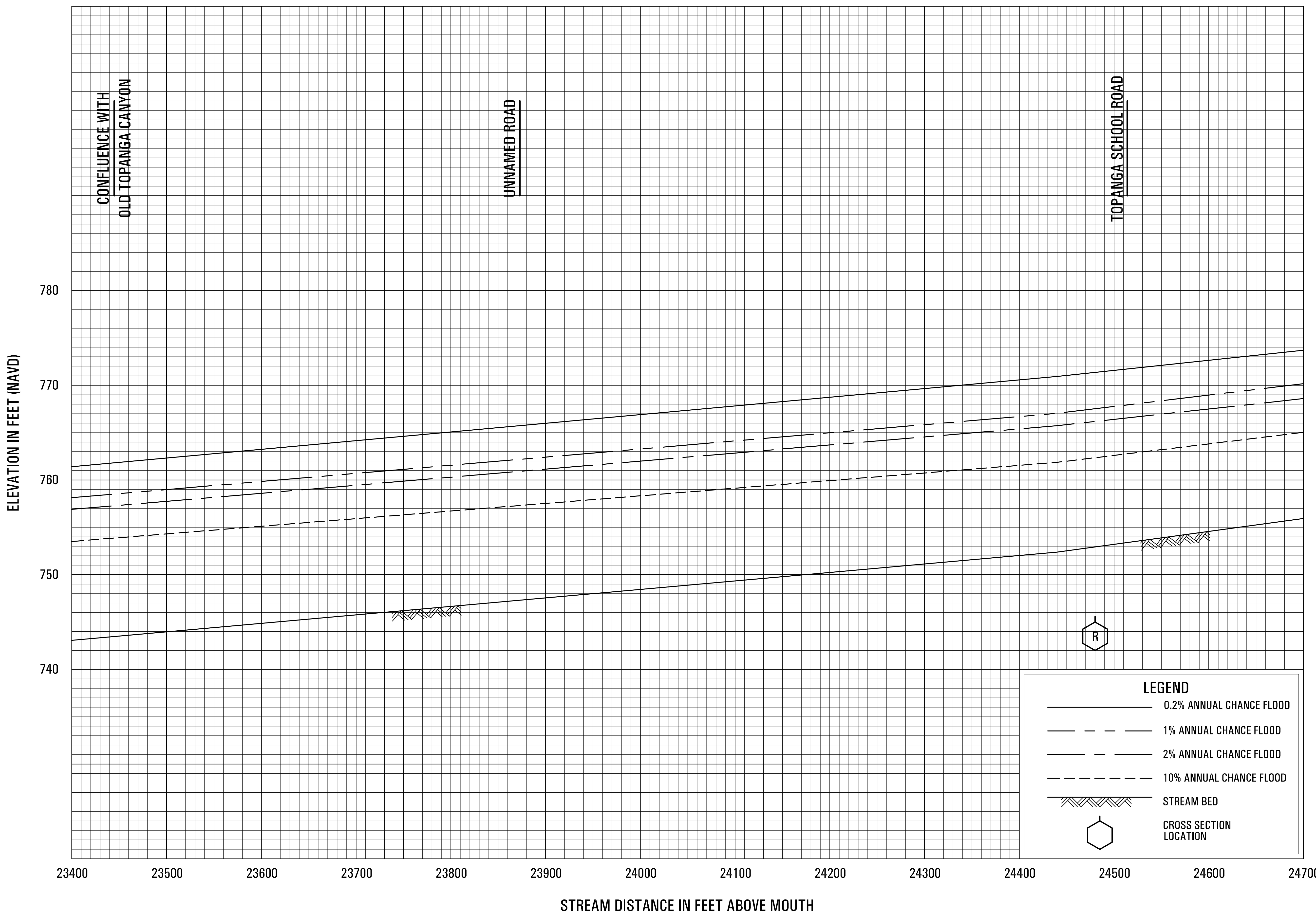
FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



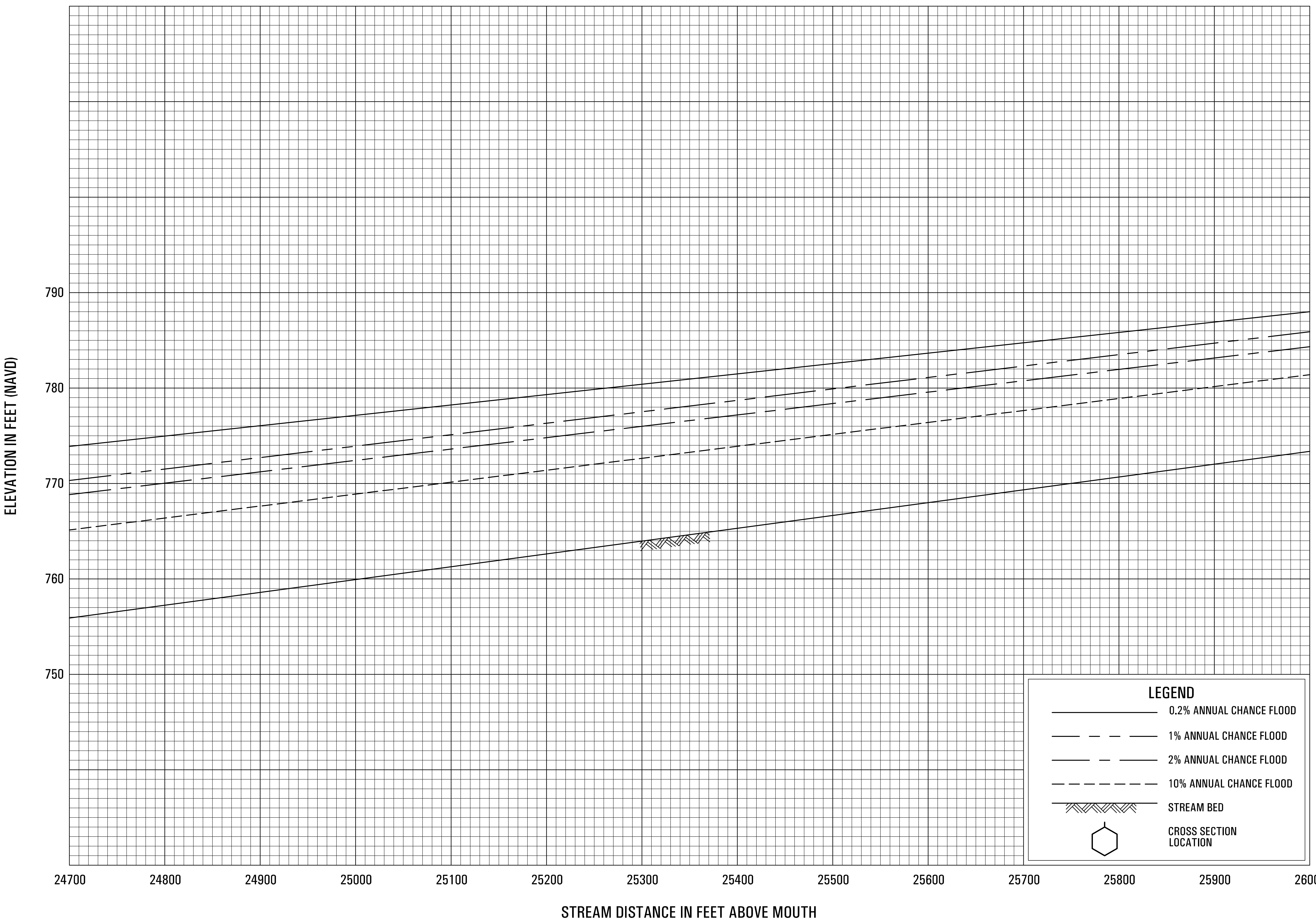
FLOOD PROFILES

TOPANGA CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



FLOOD PROFILES

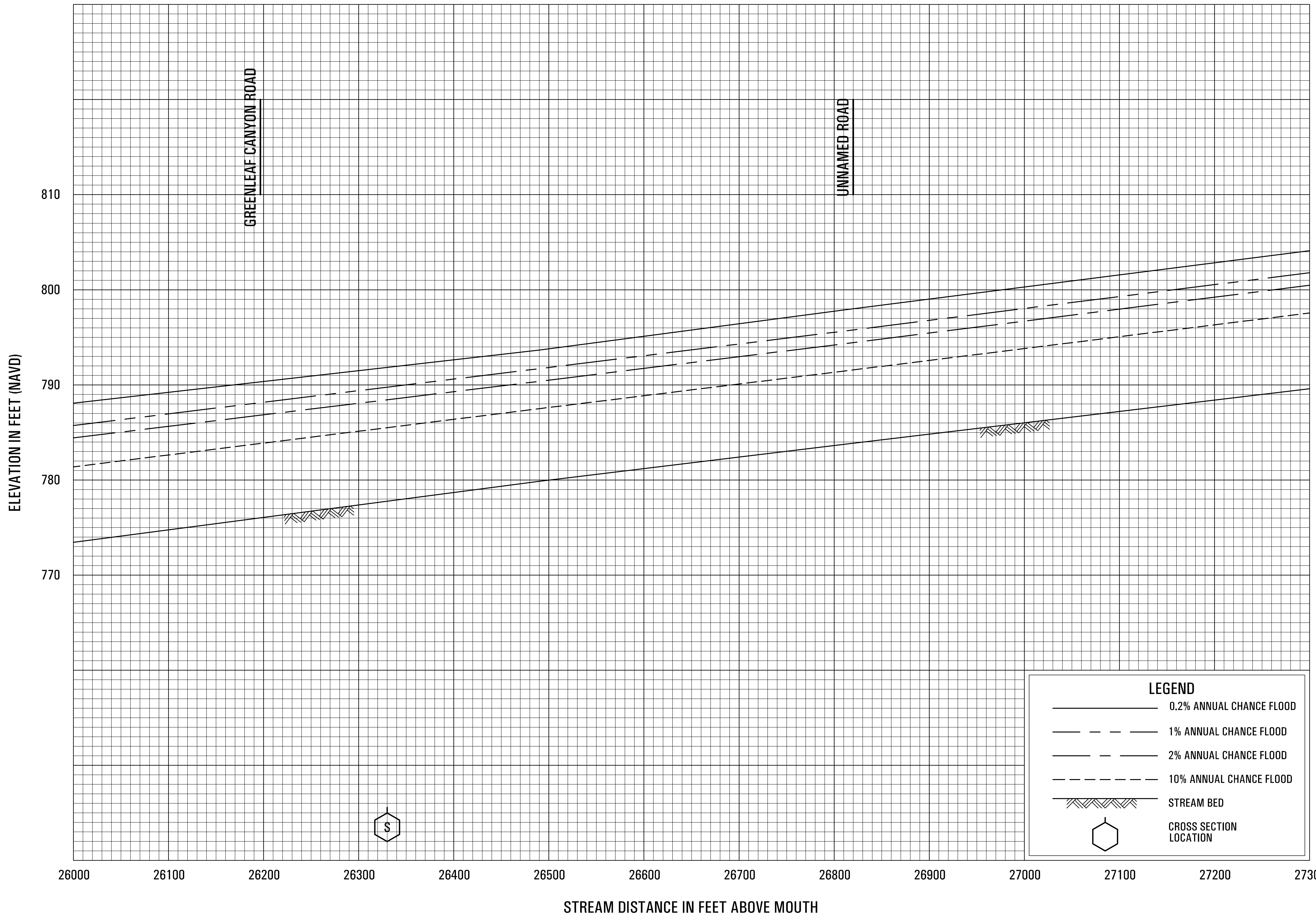
TOPANGA CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS

180P



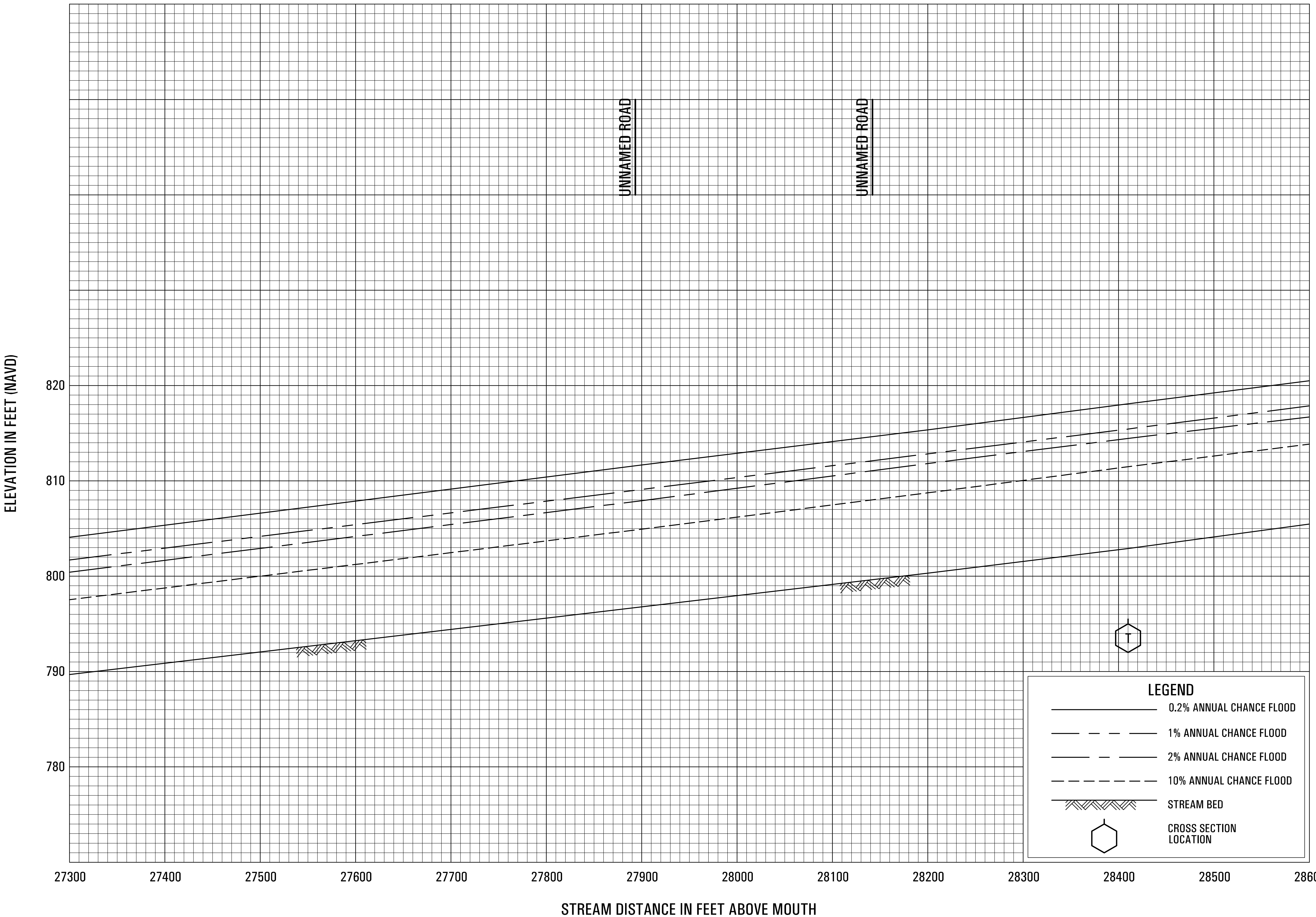
FLOOD PROFILES

TOPANGA CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



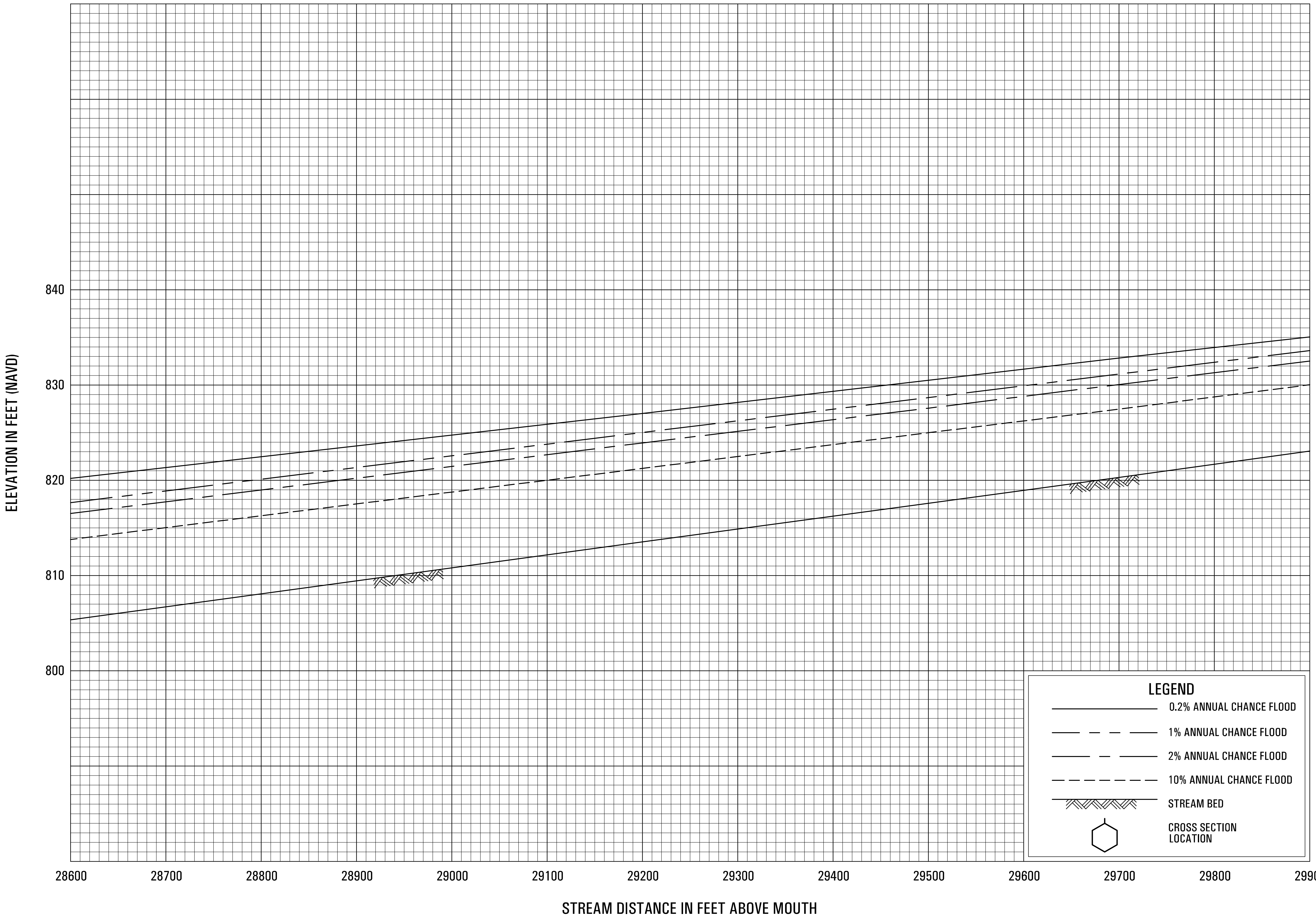
FLOOD PROFILES

TOPANGA CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



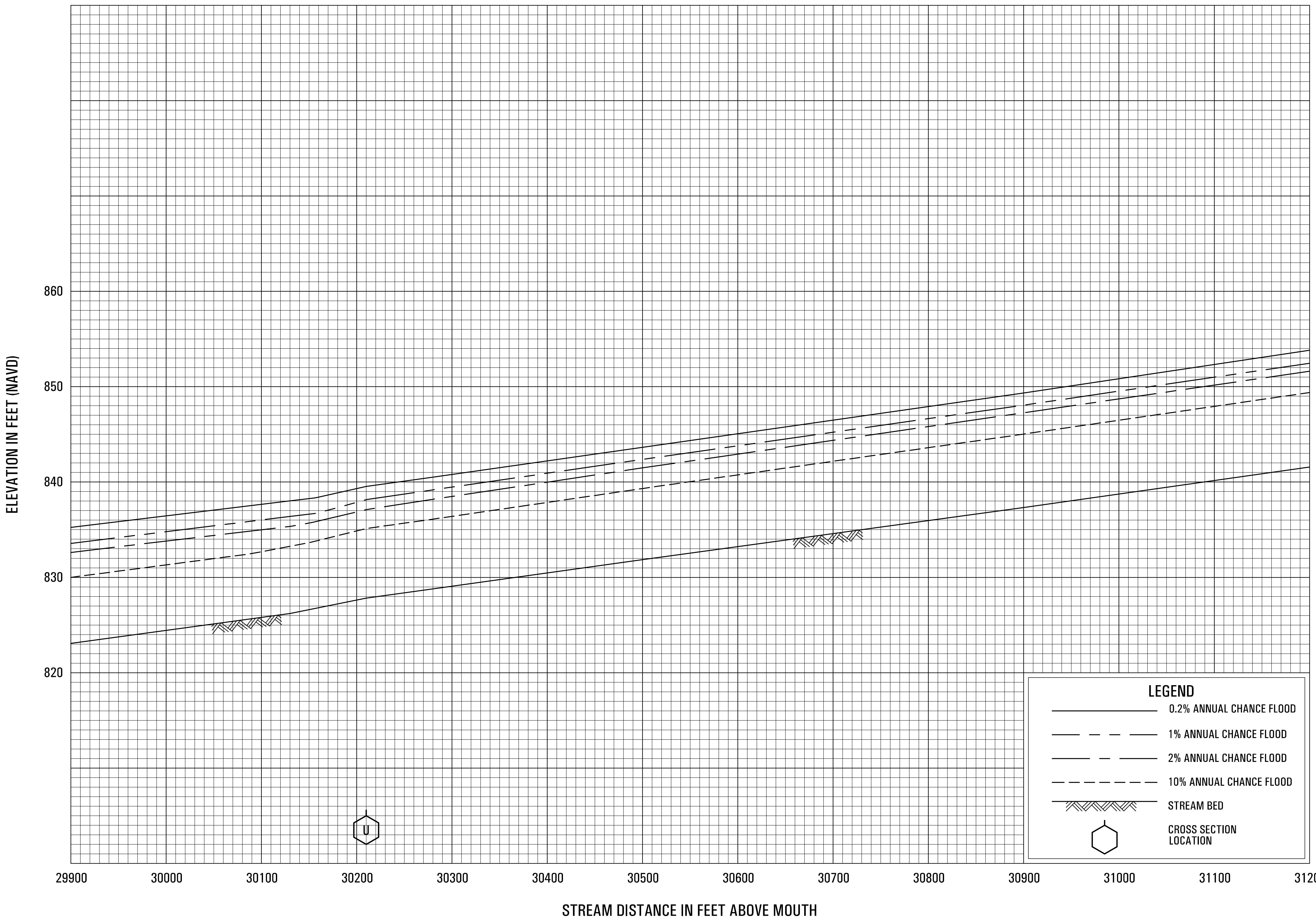
FLOOD PROFILES

TOPANGA CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



FLOOD PROFILES

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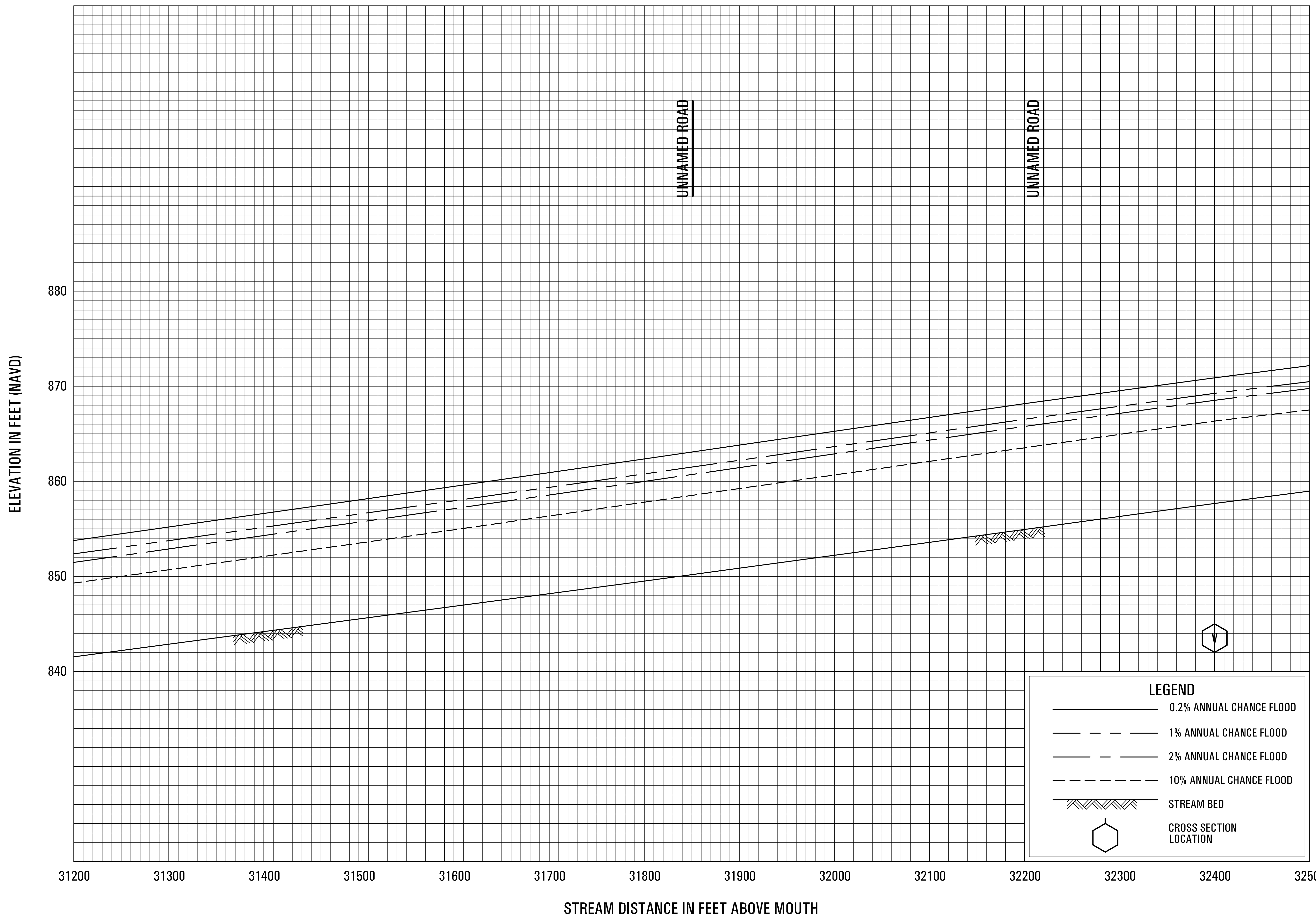
LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



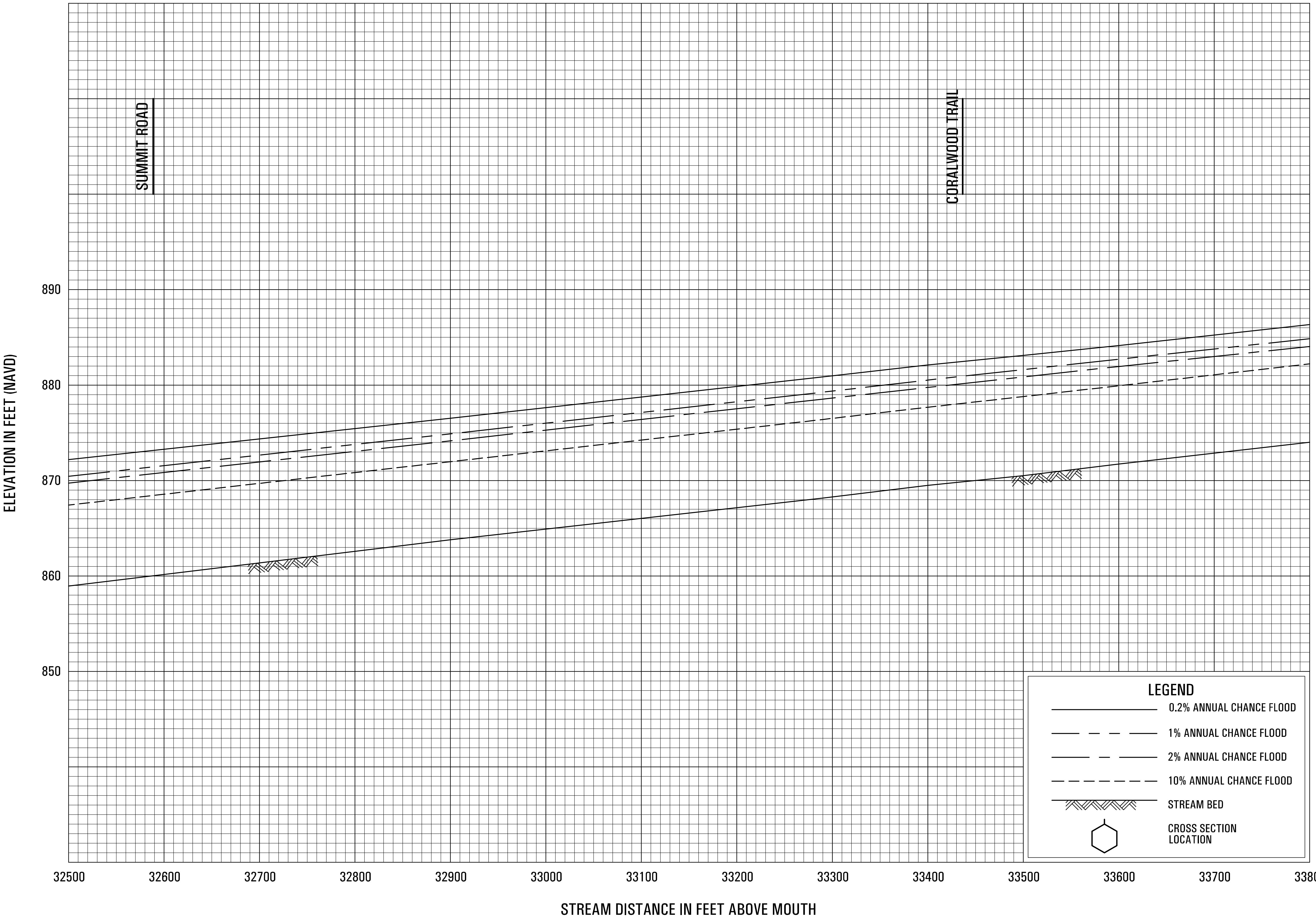
FLOOD PROFILES

TOPANGA CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



FLOOD PROFILES

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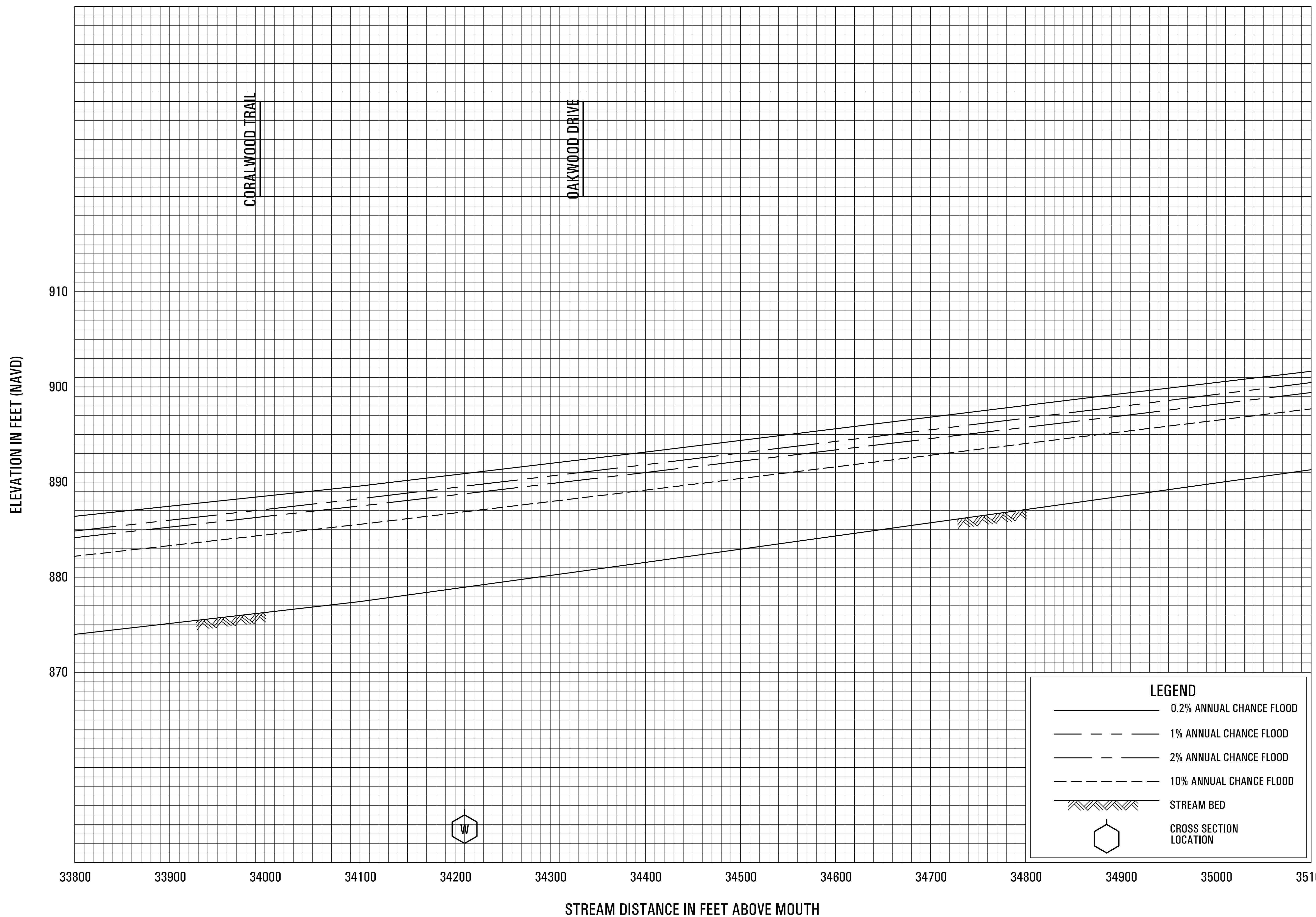
FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



FLOOD PROFILES

TOPANGA CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

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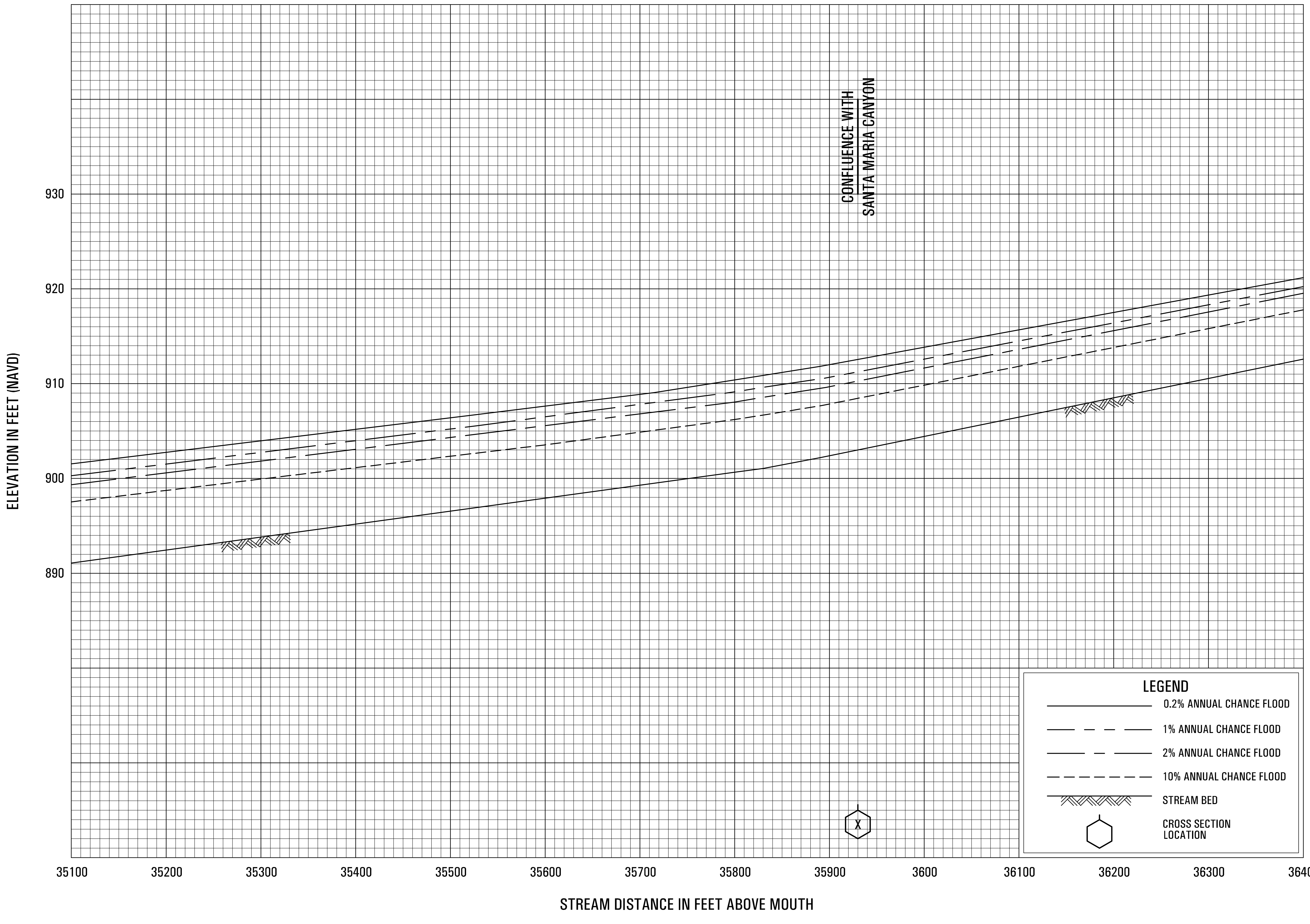

FLOOD PROFILES

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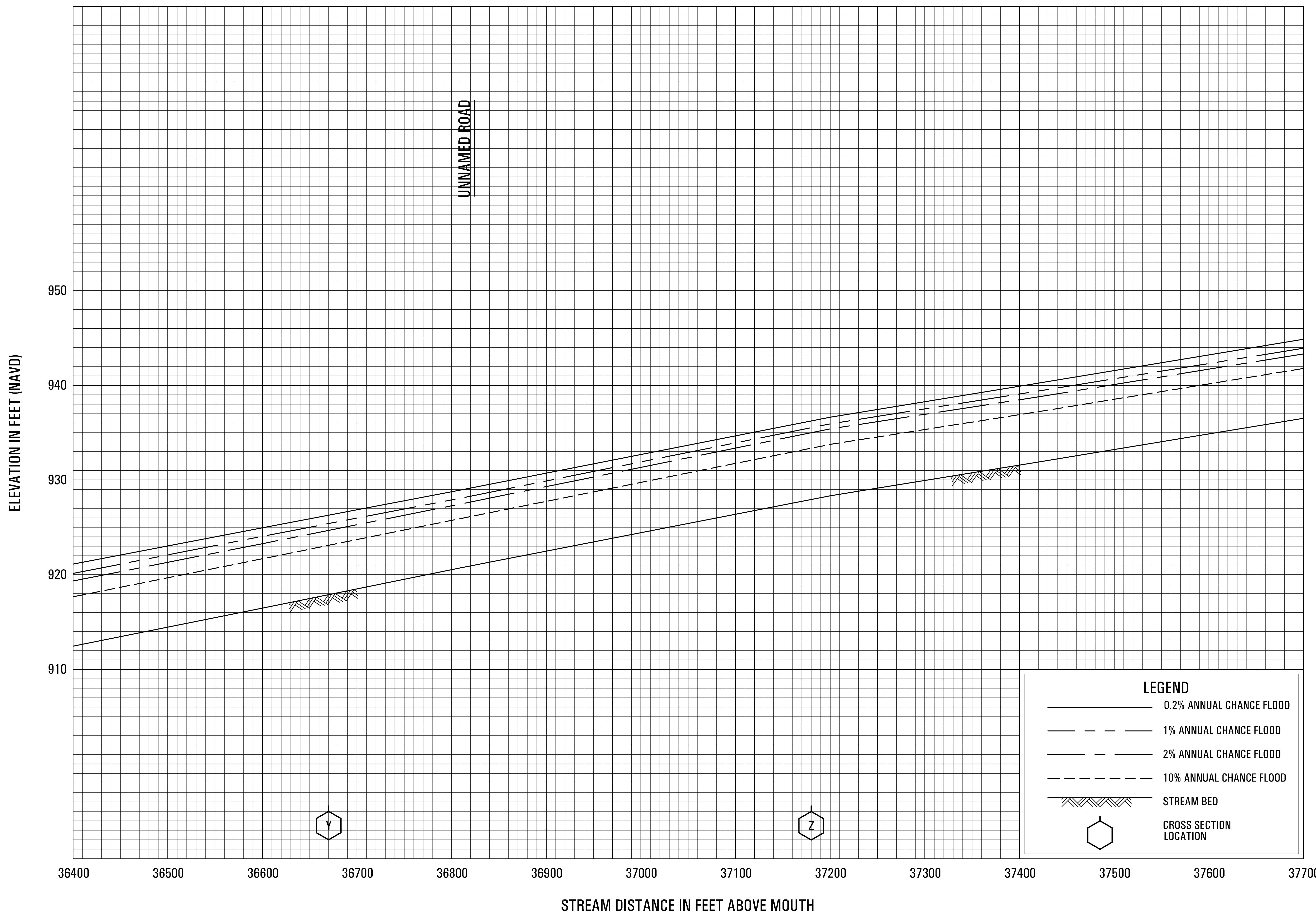

FLOOD PROFILES

TOPANGA CANYON

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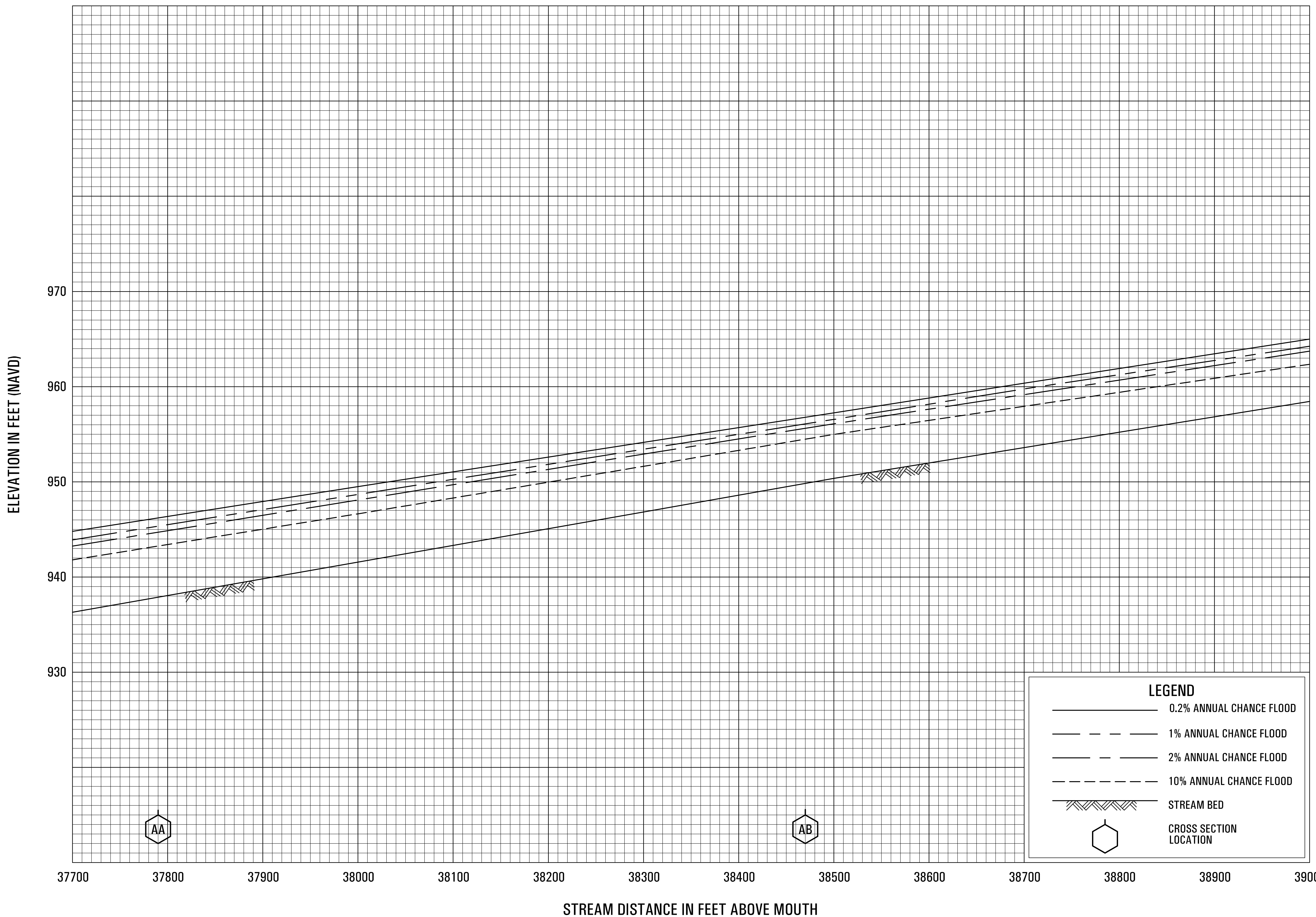
LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



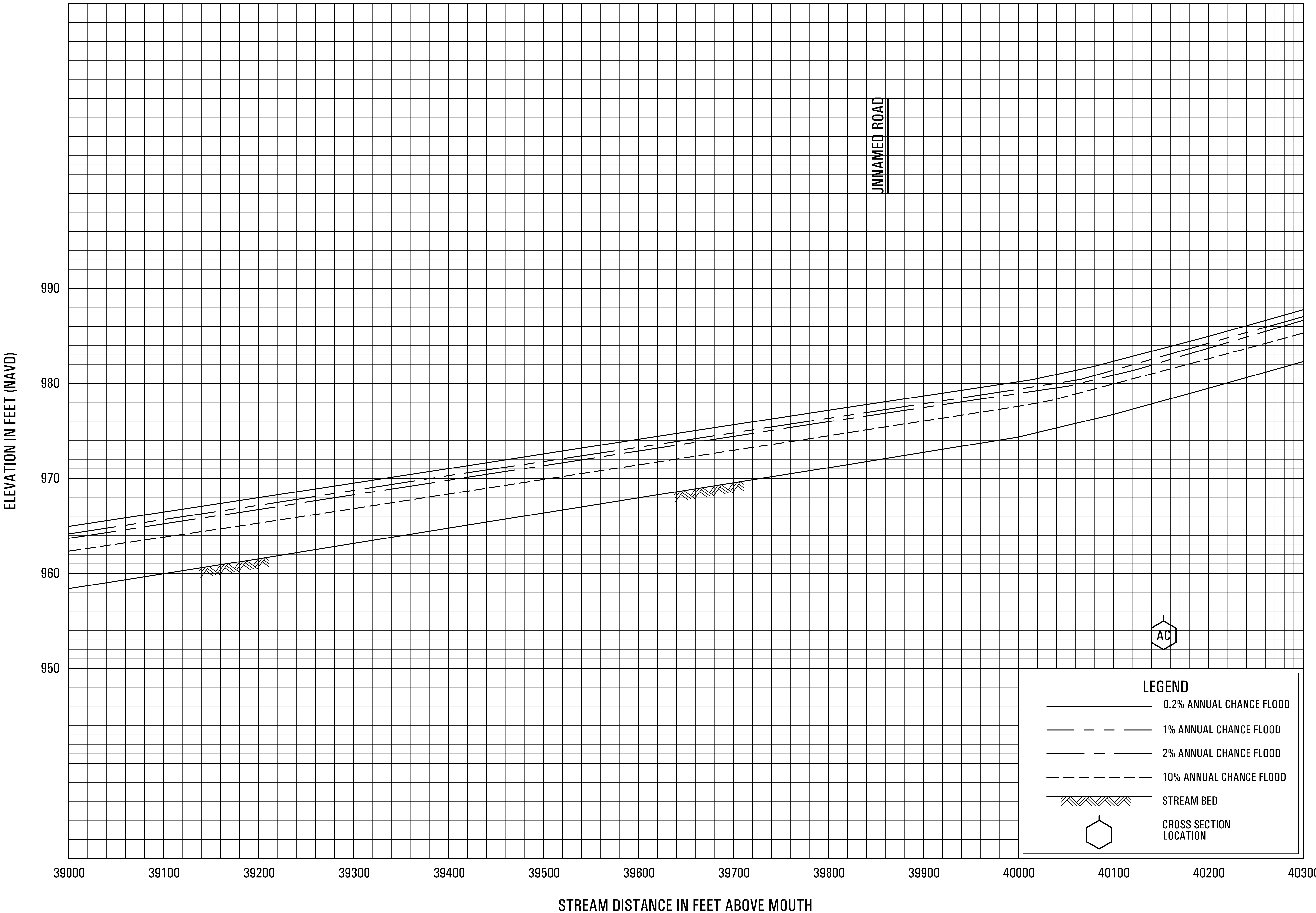
FLOOD PROFILES

TOPANGA CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



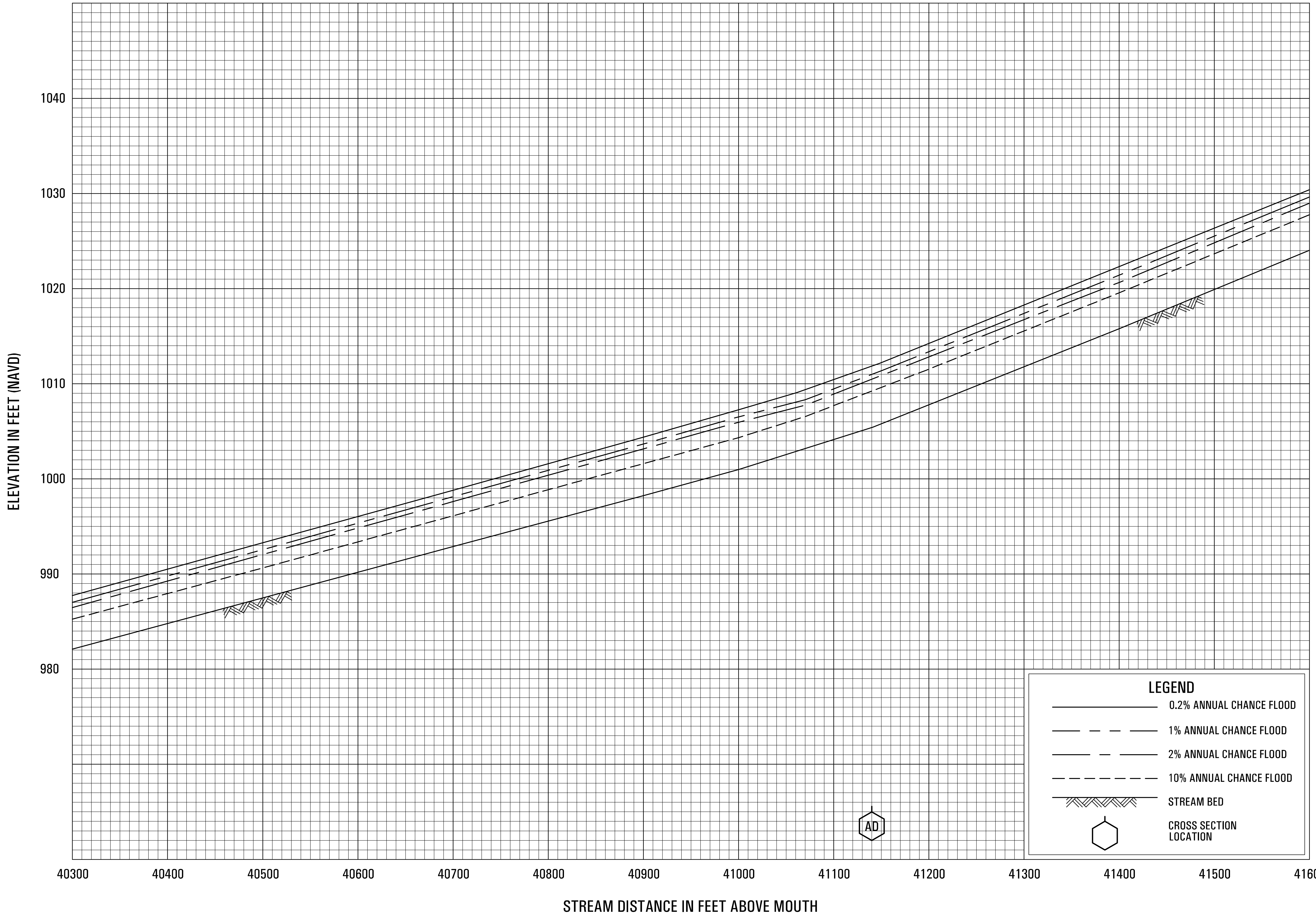
FLOOD PROFILES

TOPANGA CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



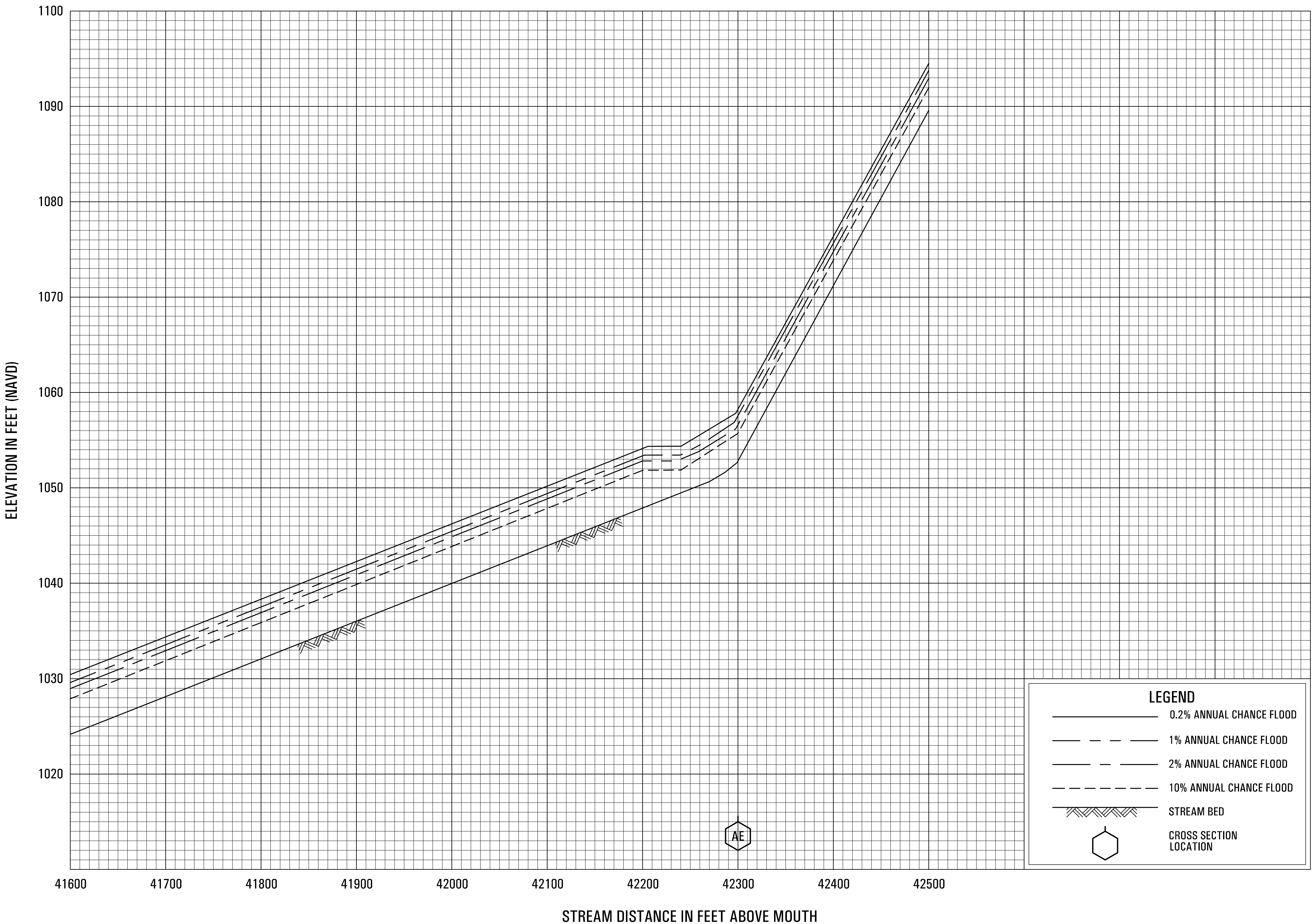
FLOOD PROFILES

TOPANGA CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



FLOOD PROFILES

TOPANGA CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

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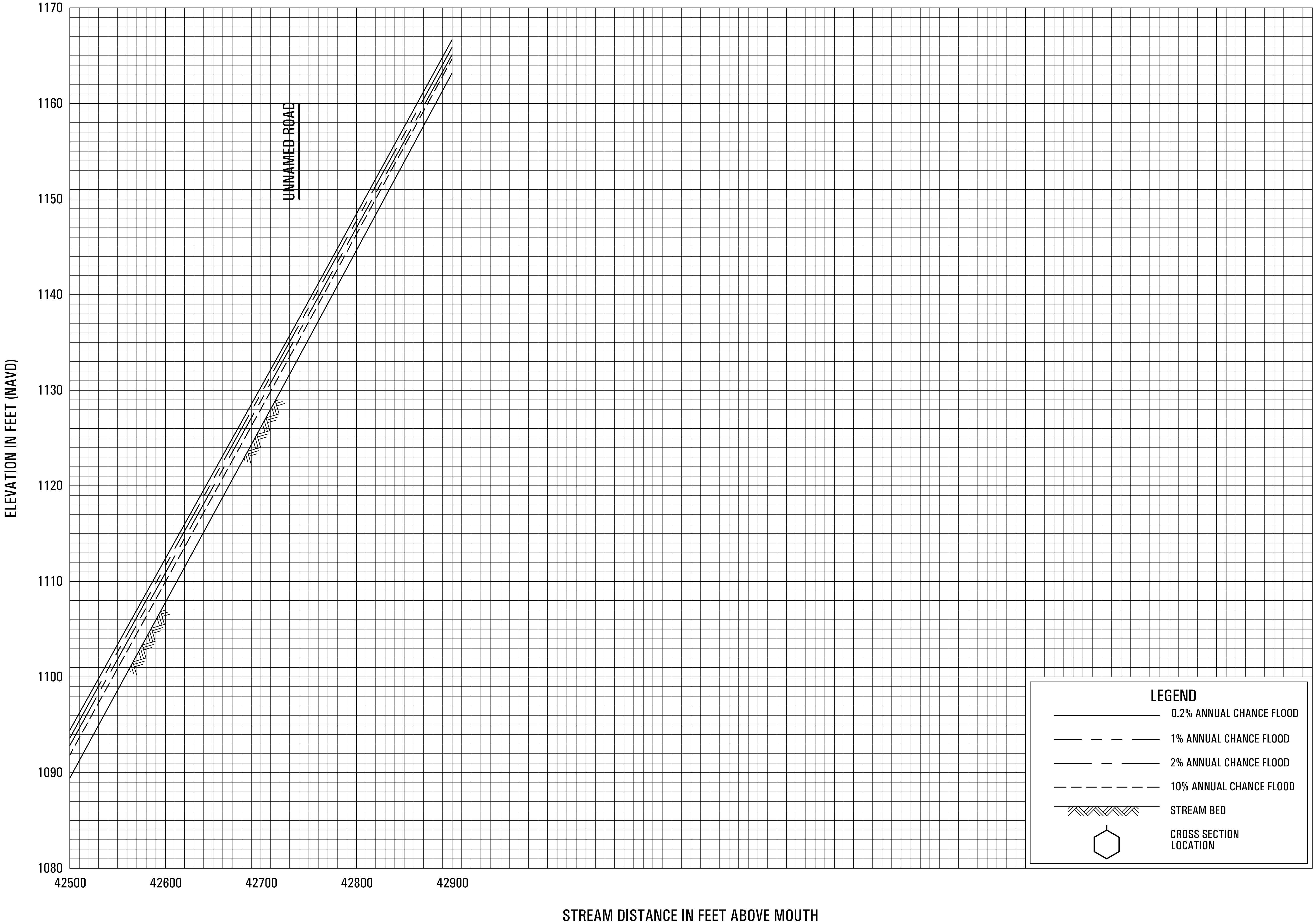

FLOOD PROFILES

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LOS ANGELES COUNTY, CA

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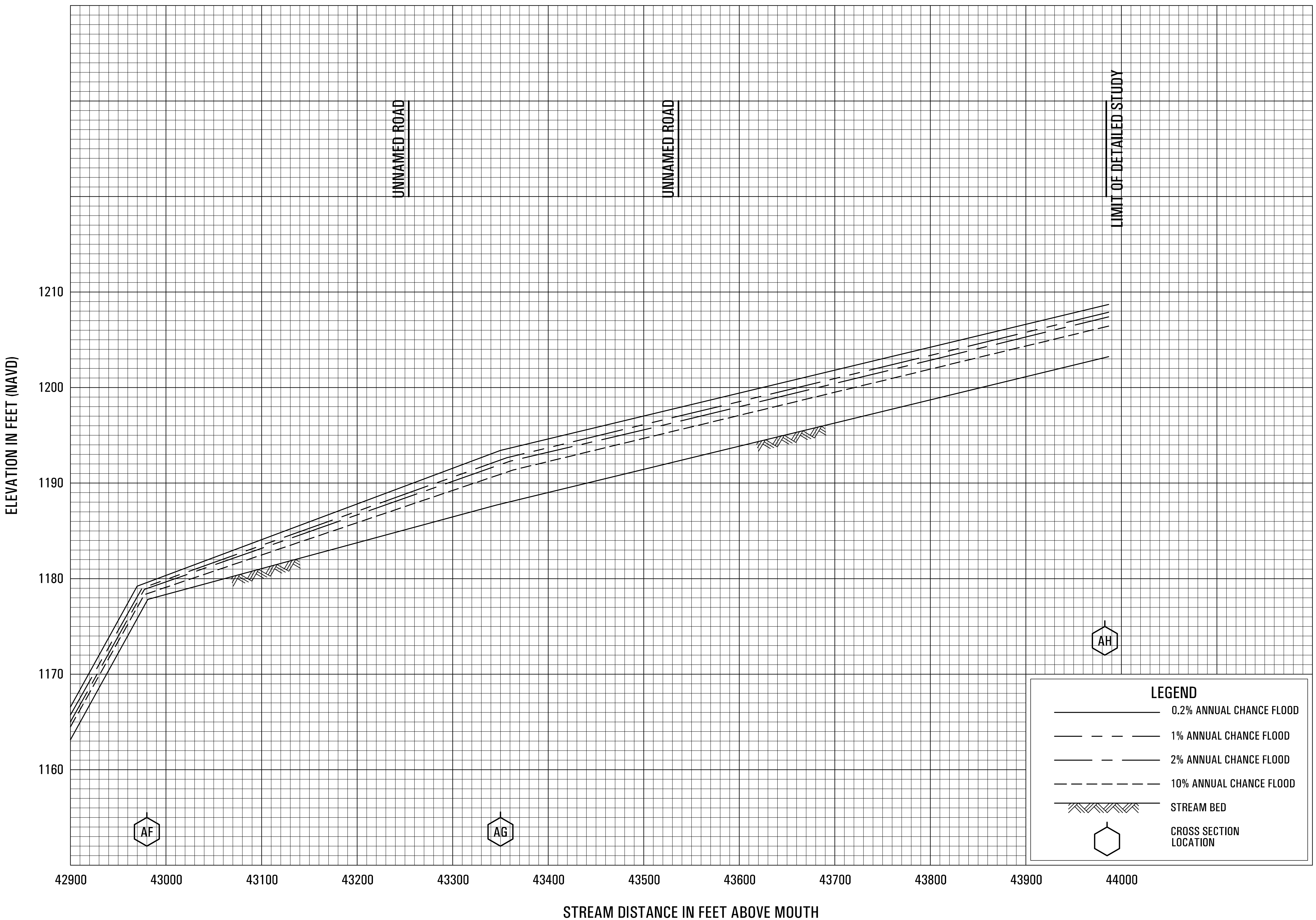

FLOOD PROFILES

TOPANGA CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

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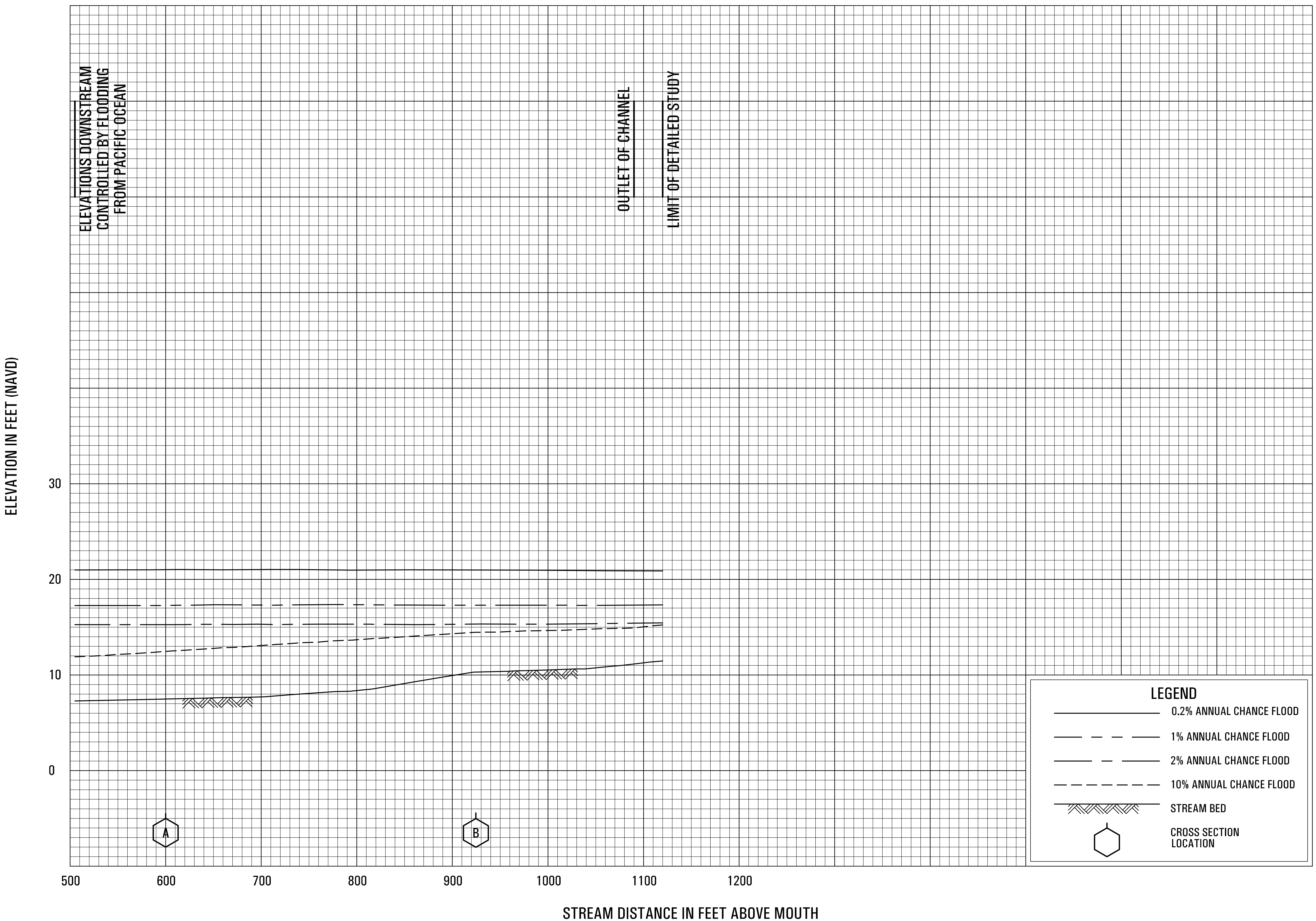


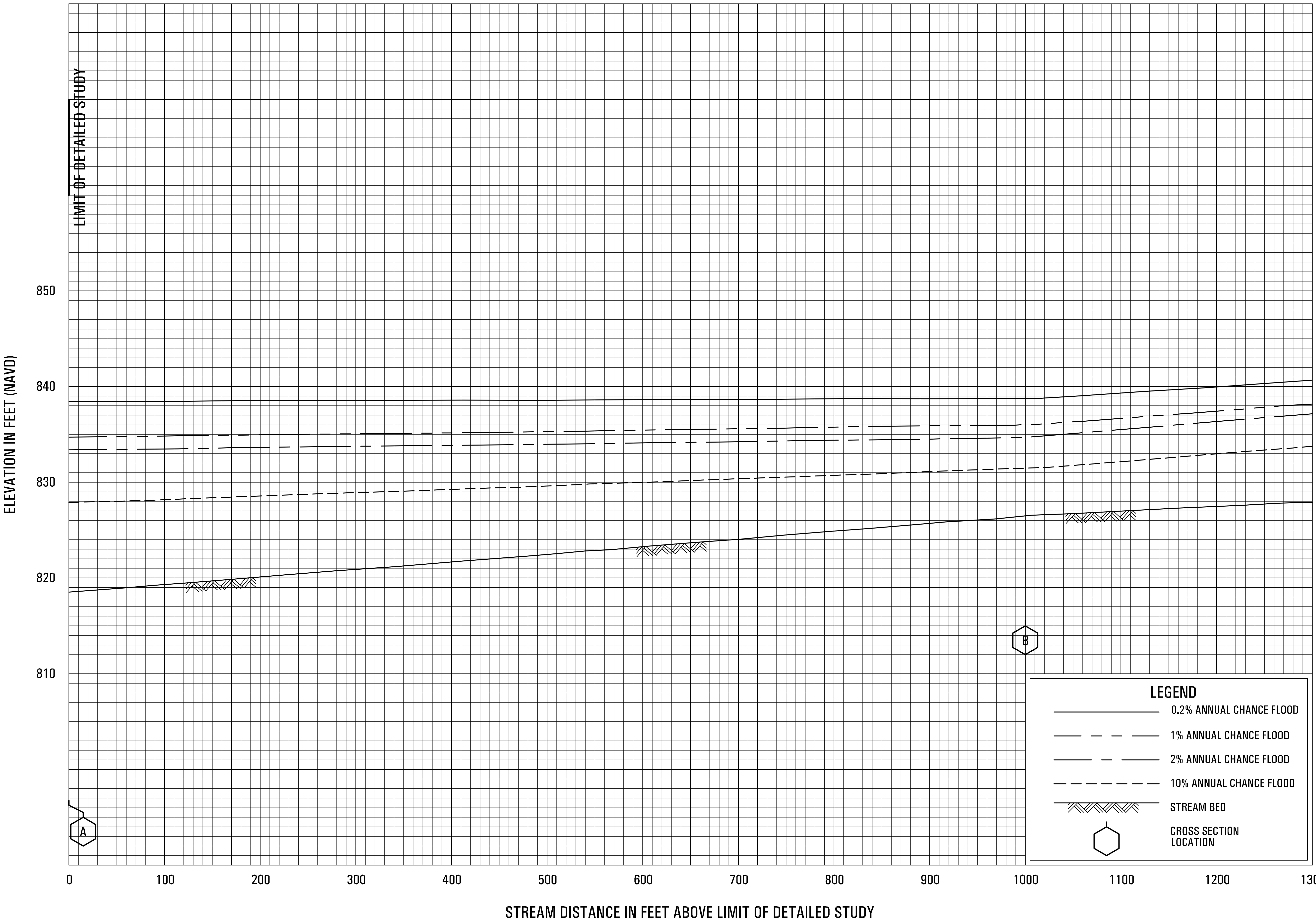
FLOOD PROFILES

TRANCAS CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



FLOOD PROFILES

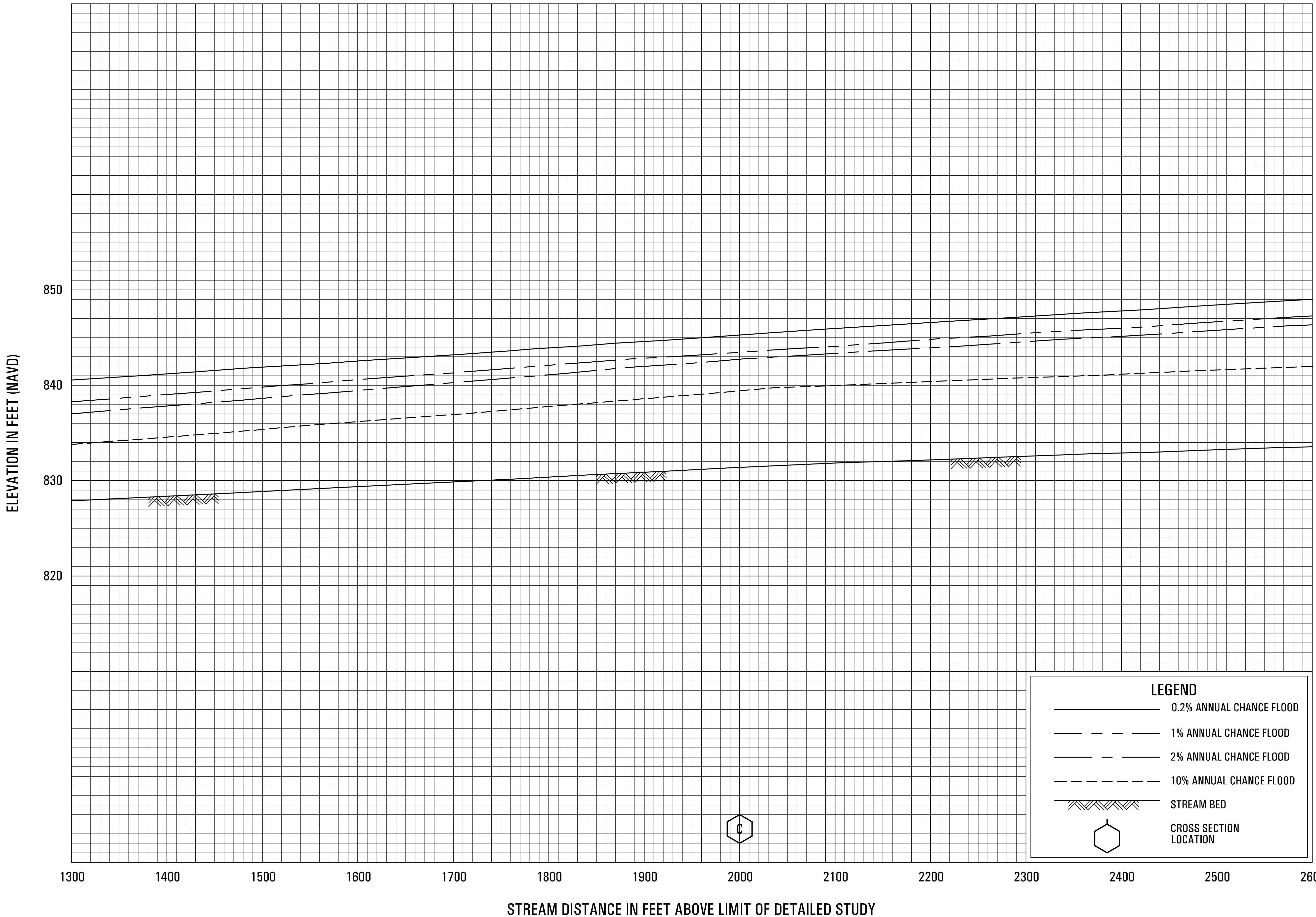
TRIUNFO CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS

197P



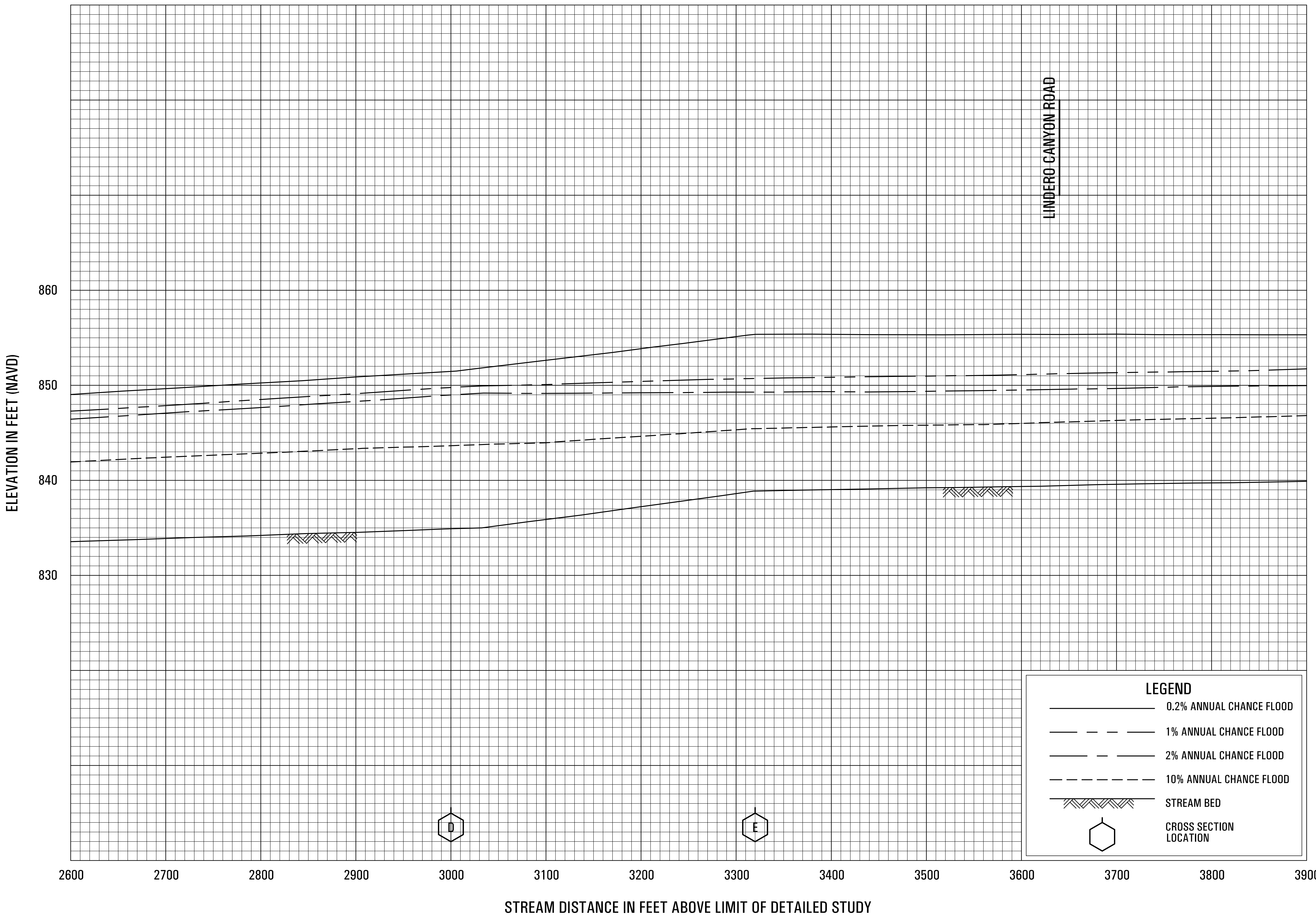
FLOOD PROFILES

TRIUNFO CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



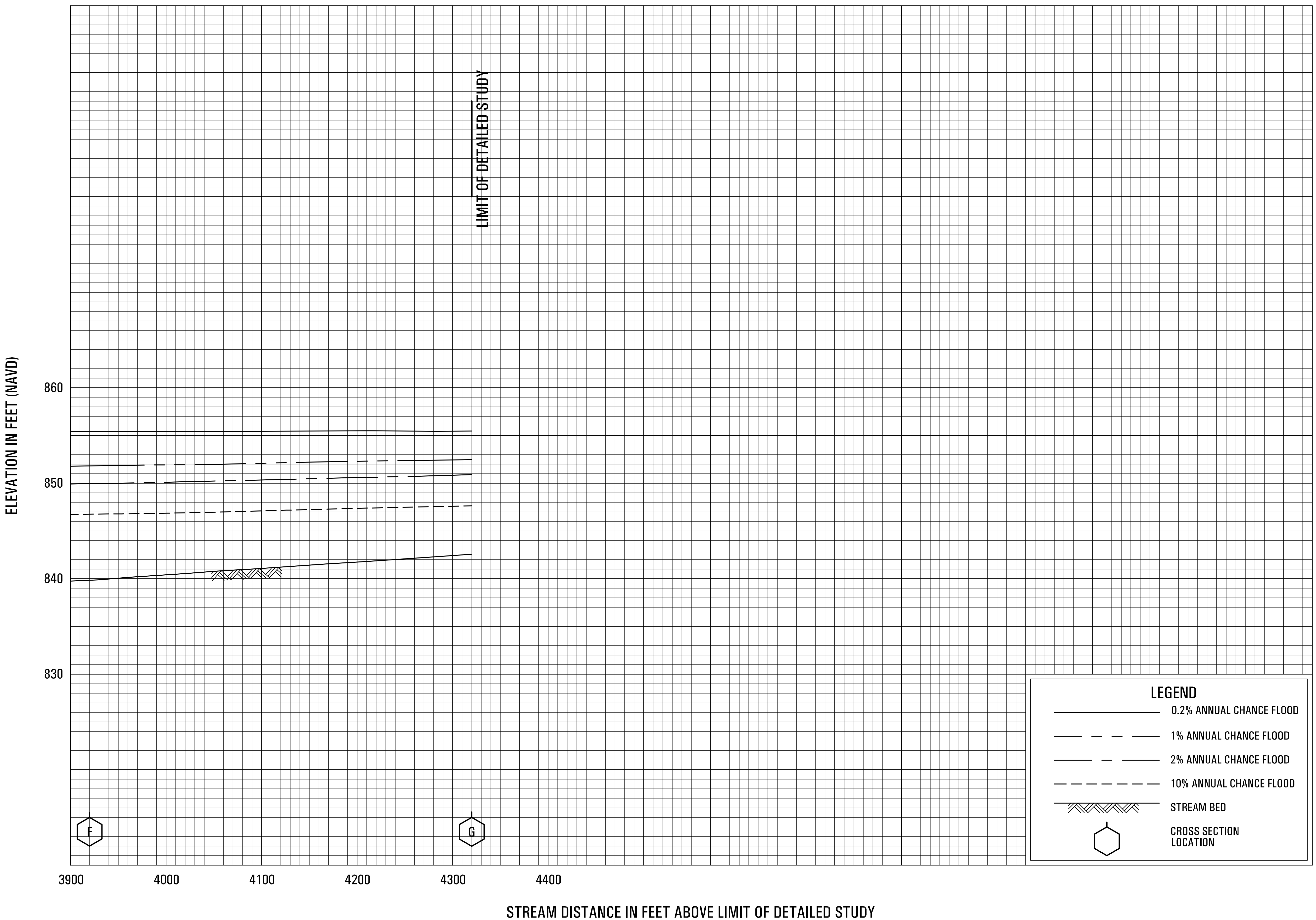
FLOOD PROFILES

TRIUNFO CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



FLOOD PROFILES

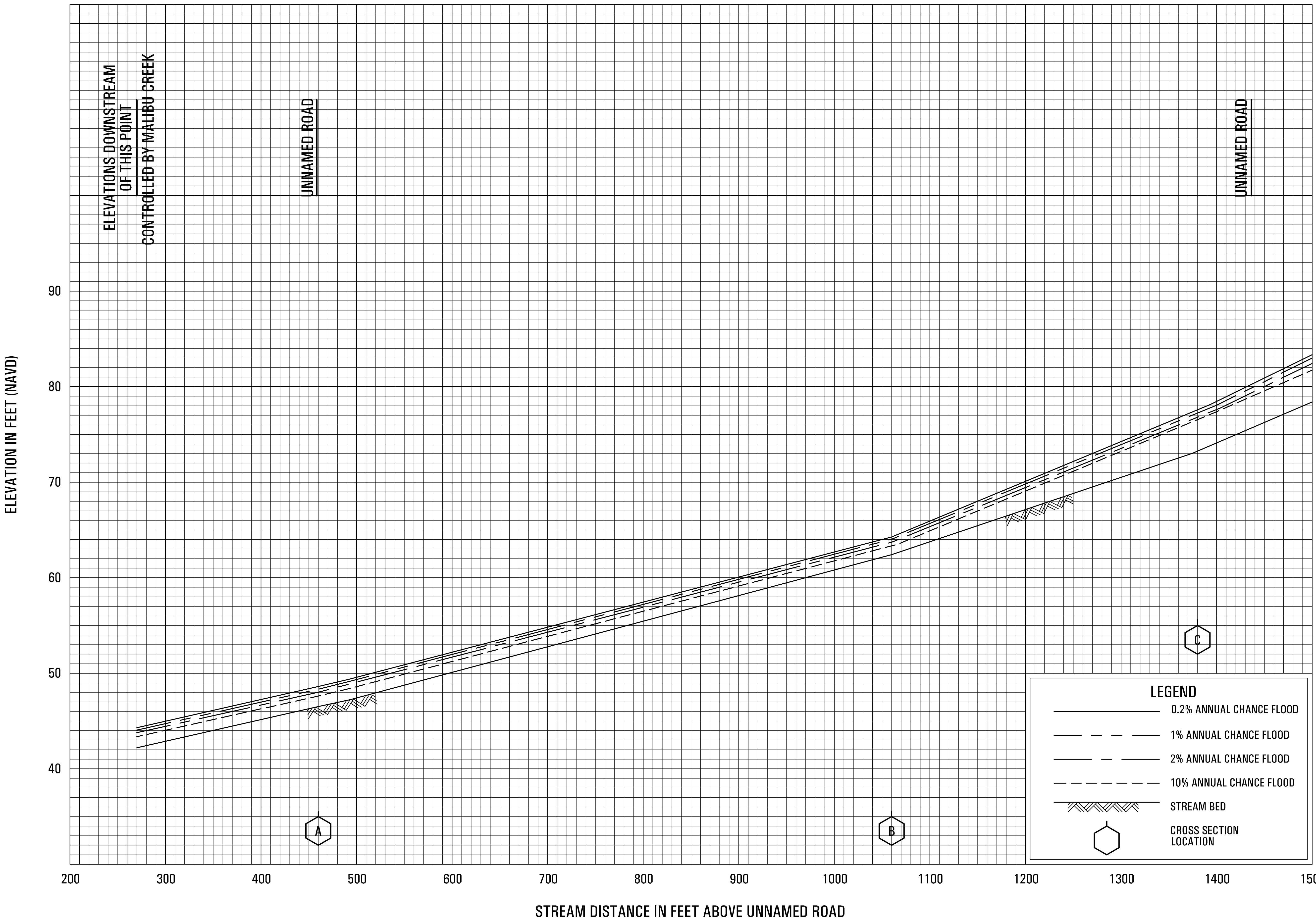
TRIUNFO CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS

200P



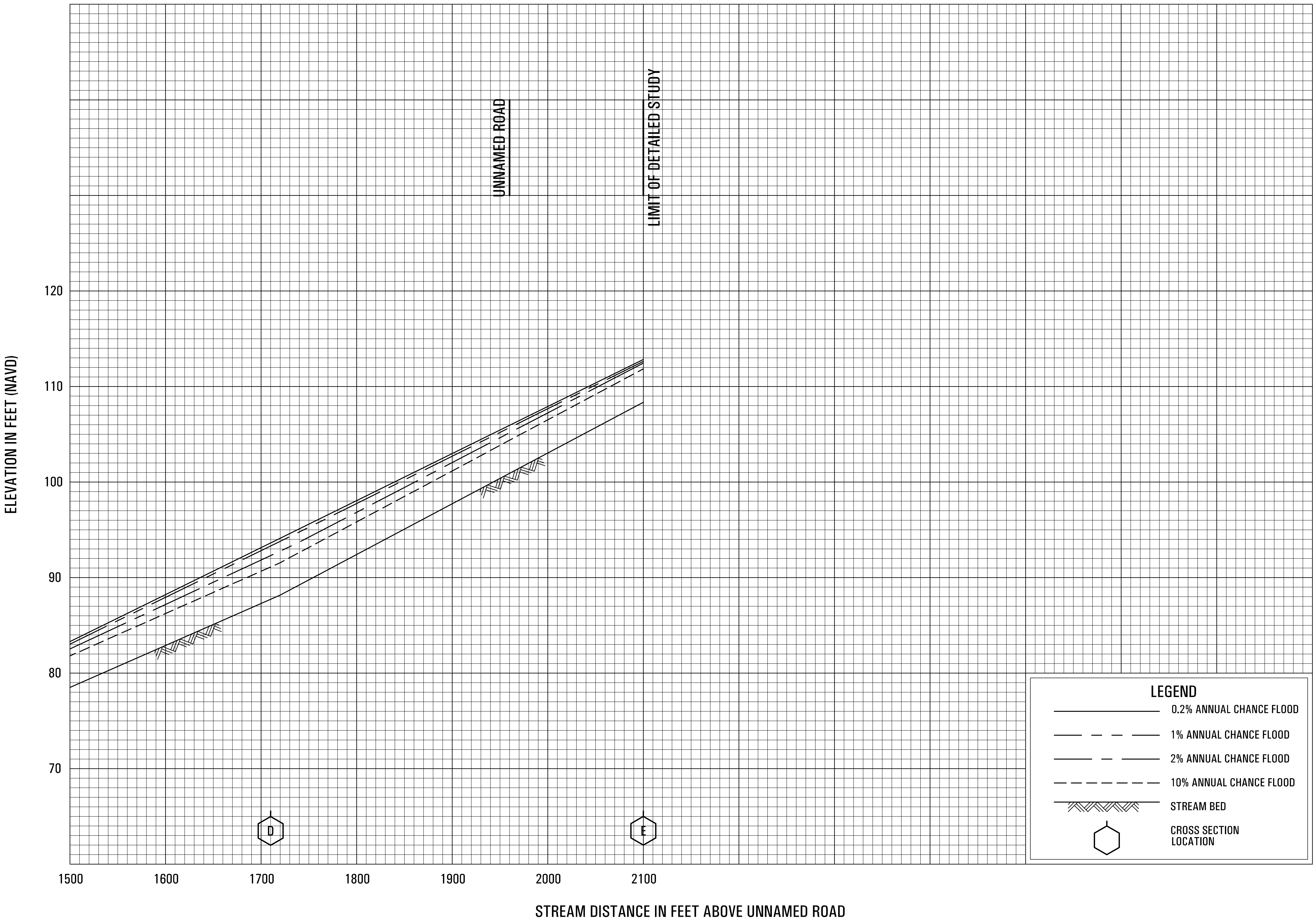
FLOOD PROFILES

UNNAMED CANYON (SERRA RETREAT AREA)

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



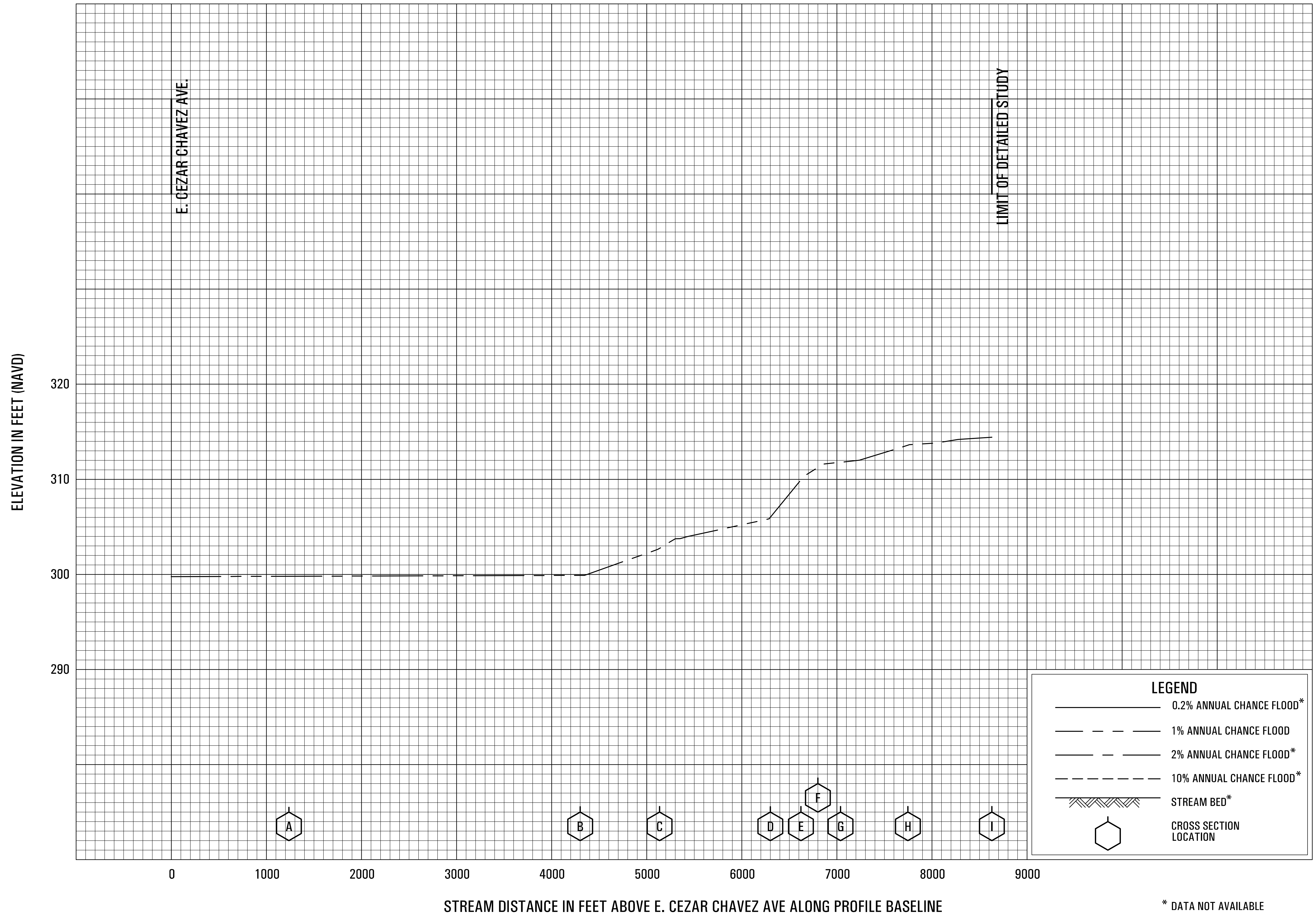
FLOOD PROFILES

UNNAMED CANYON (SERRA RETREAT AREA)

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



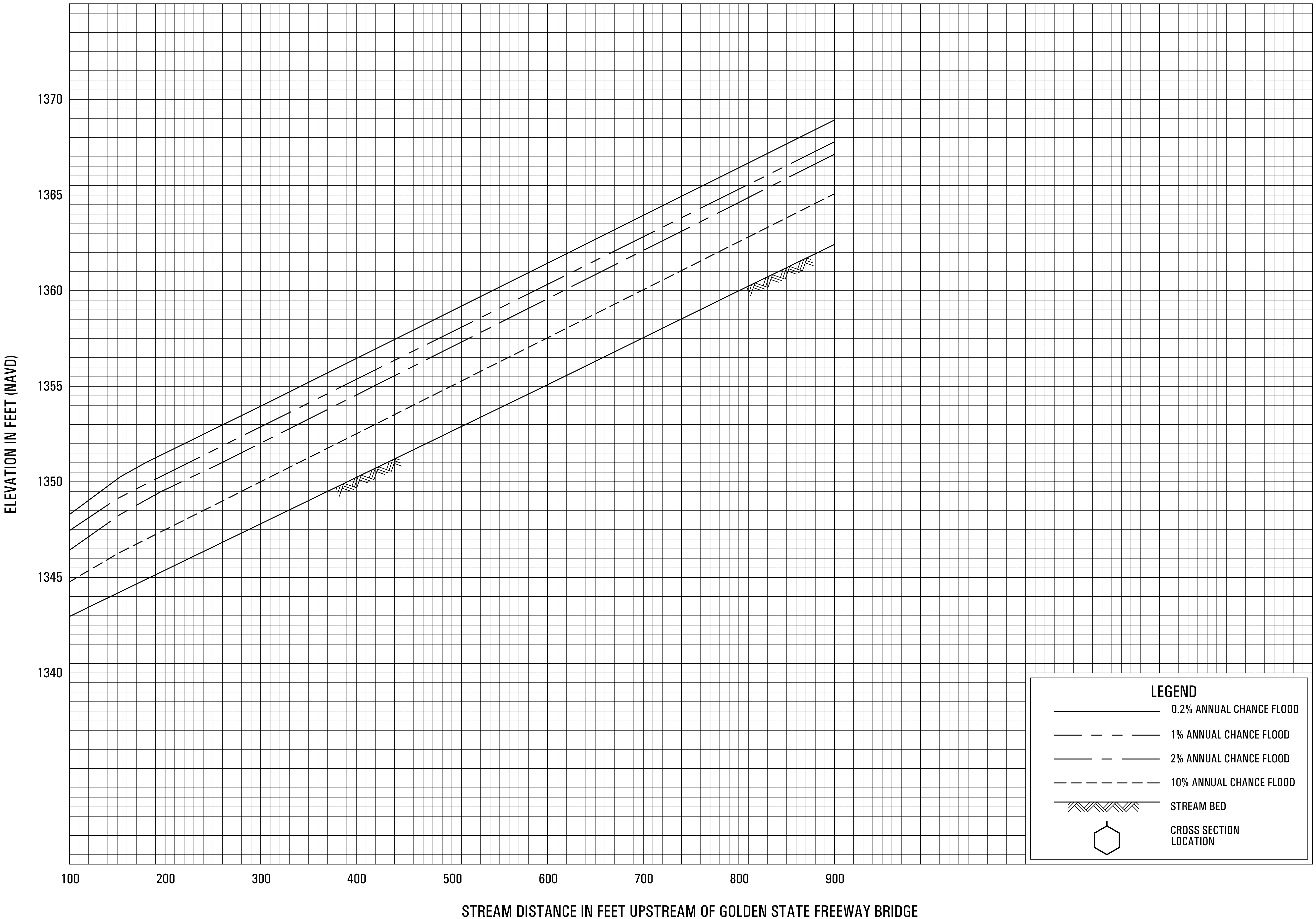
FLOOD PROFILES

UPPER LOS ANGELES RIVER LEFT OVERBANK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



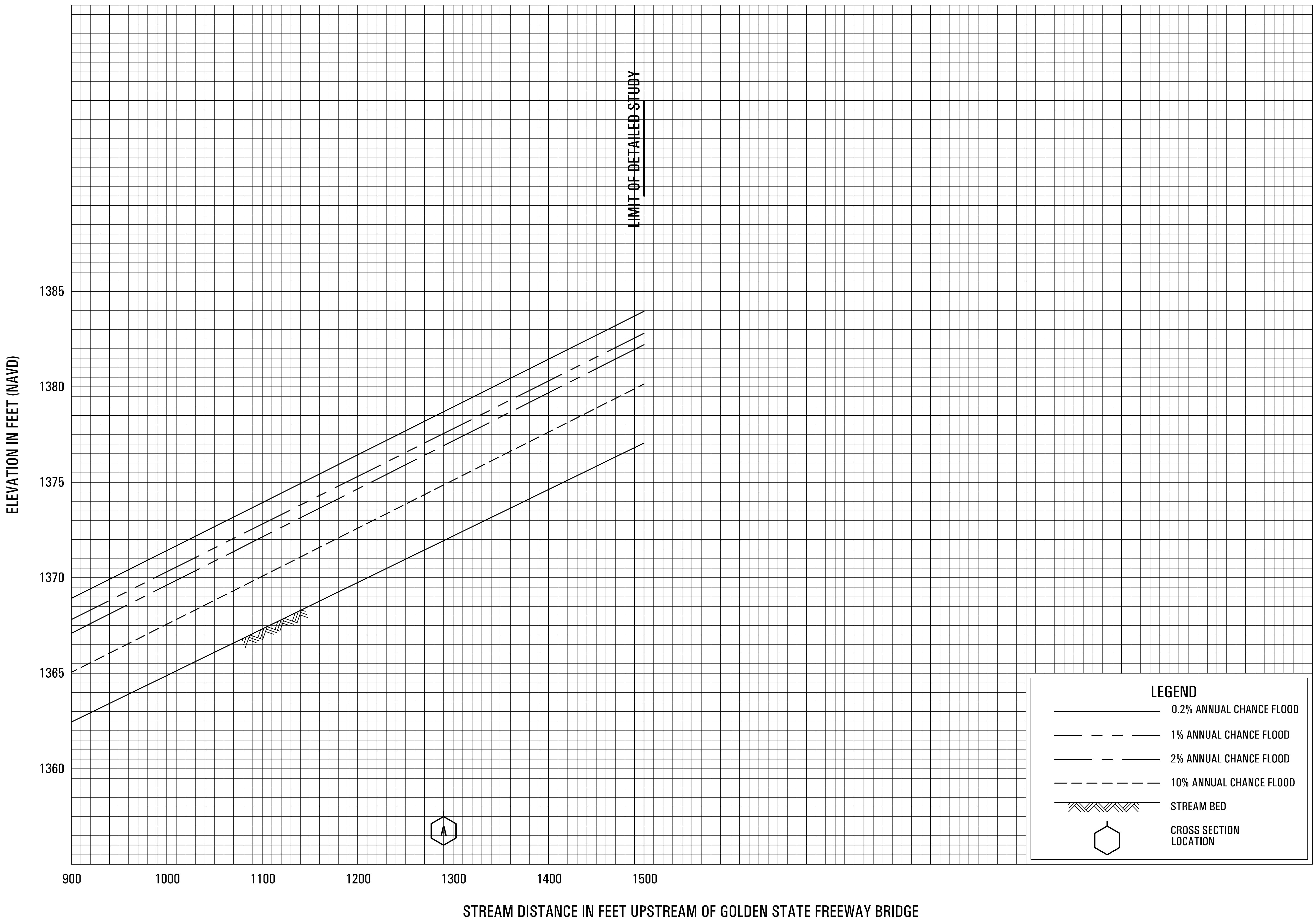
FLOOD PROFILES

WELDON CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



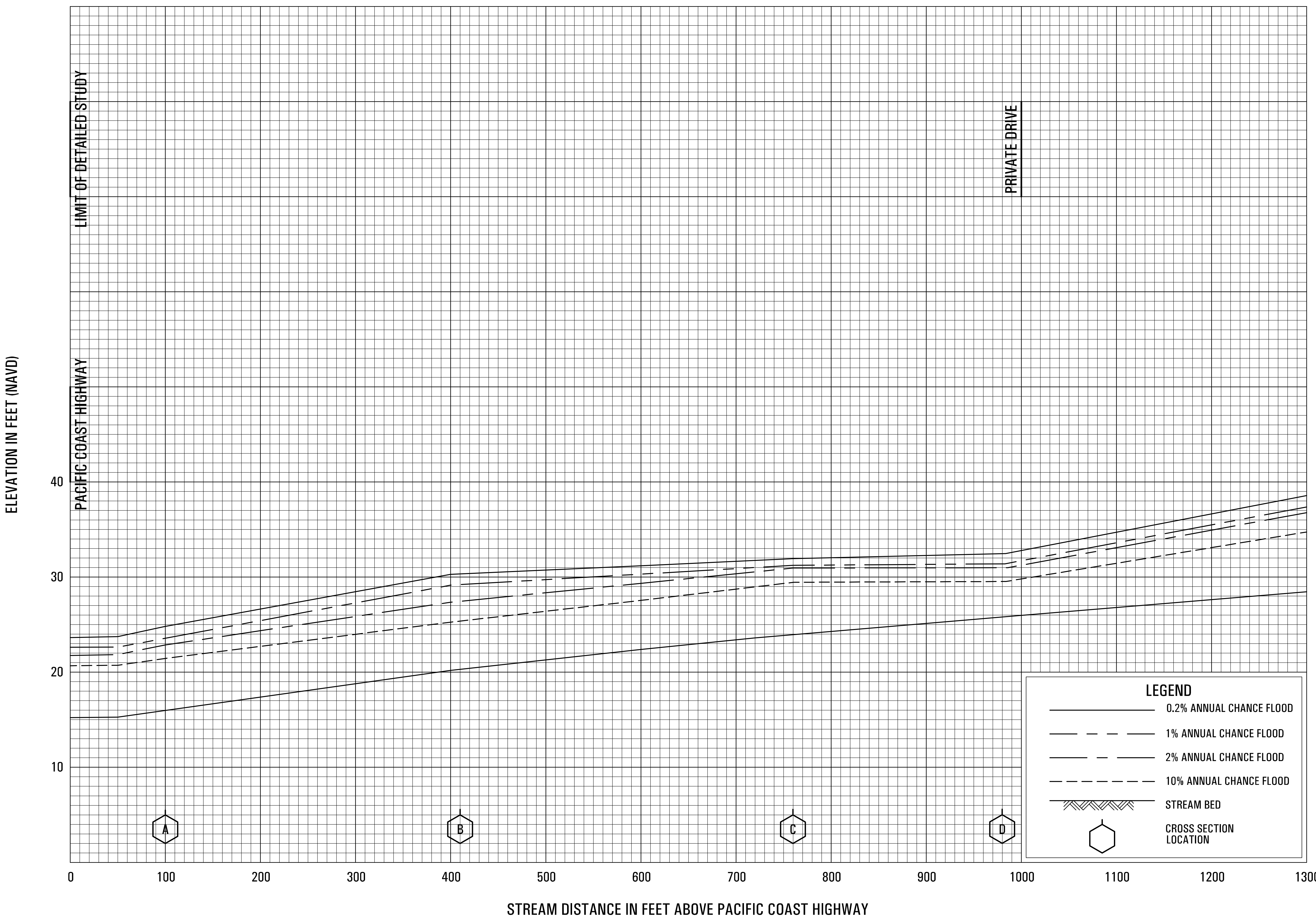
FLOOD PROFILES

WELDON CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



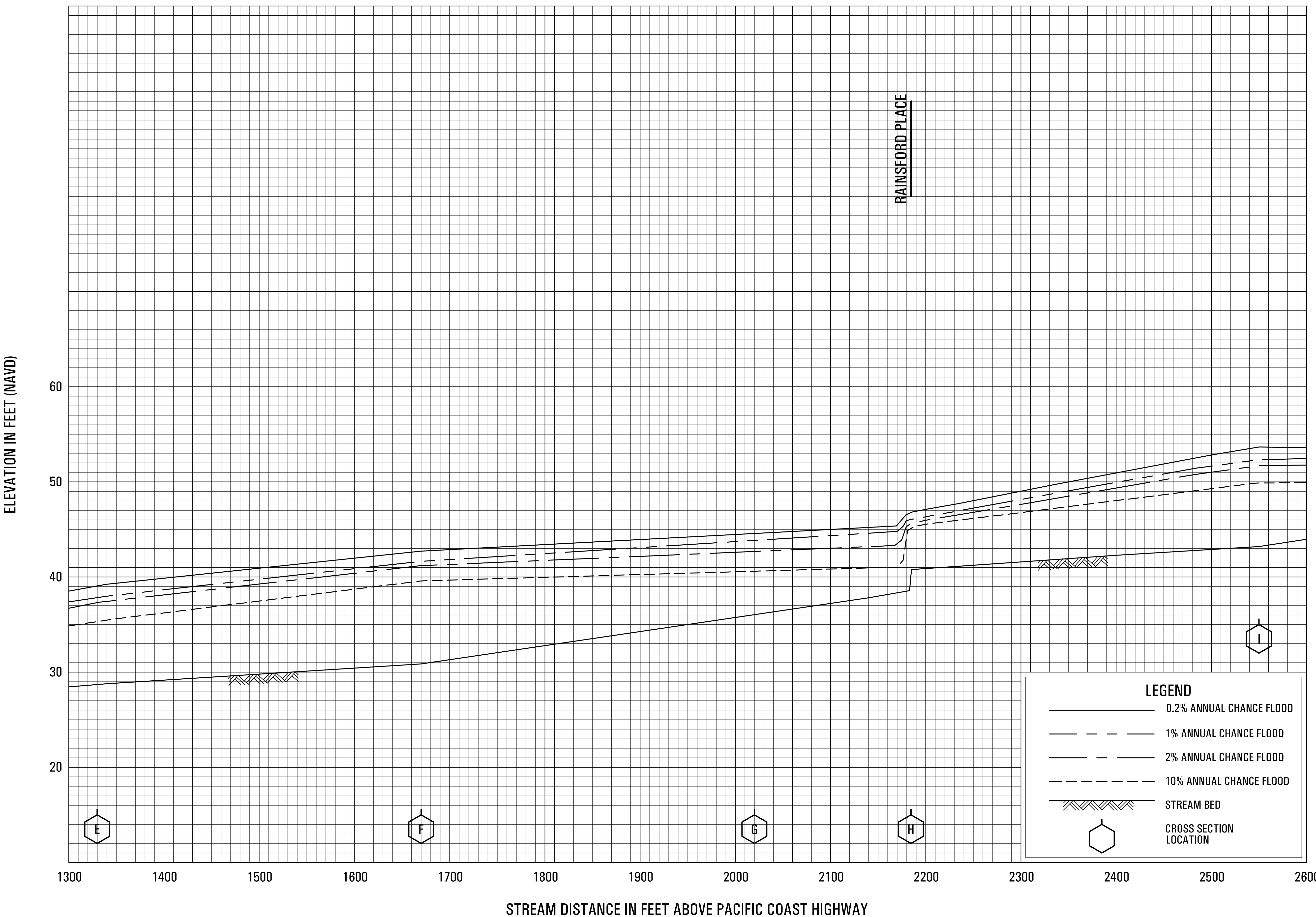
FLOOD PROFILES

ZUMA CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



FLOOD PROFILES

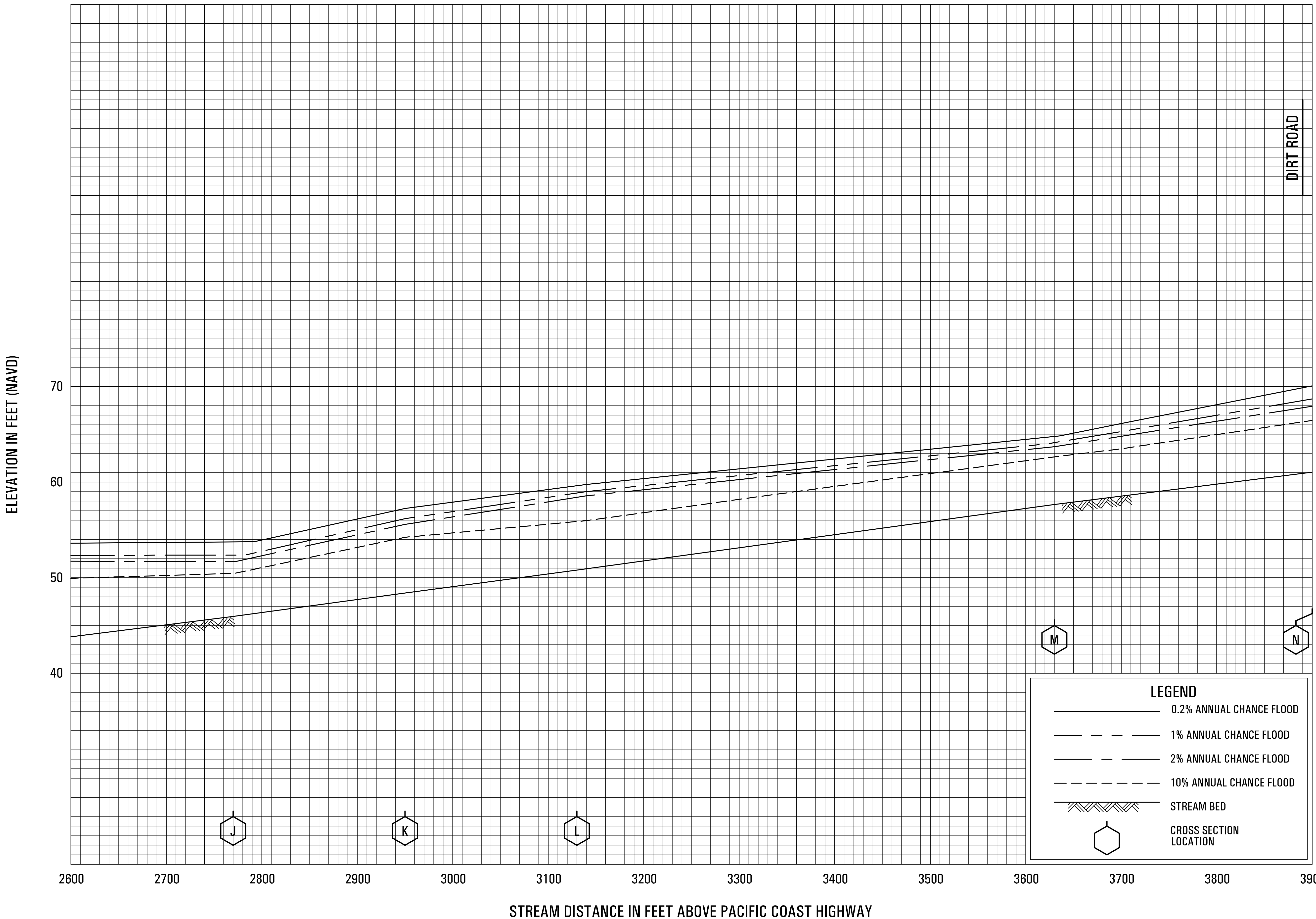
ZUMA CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS

207P



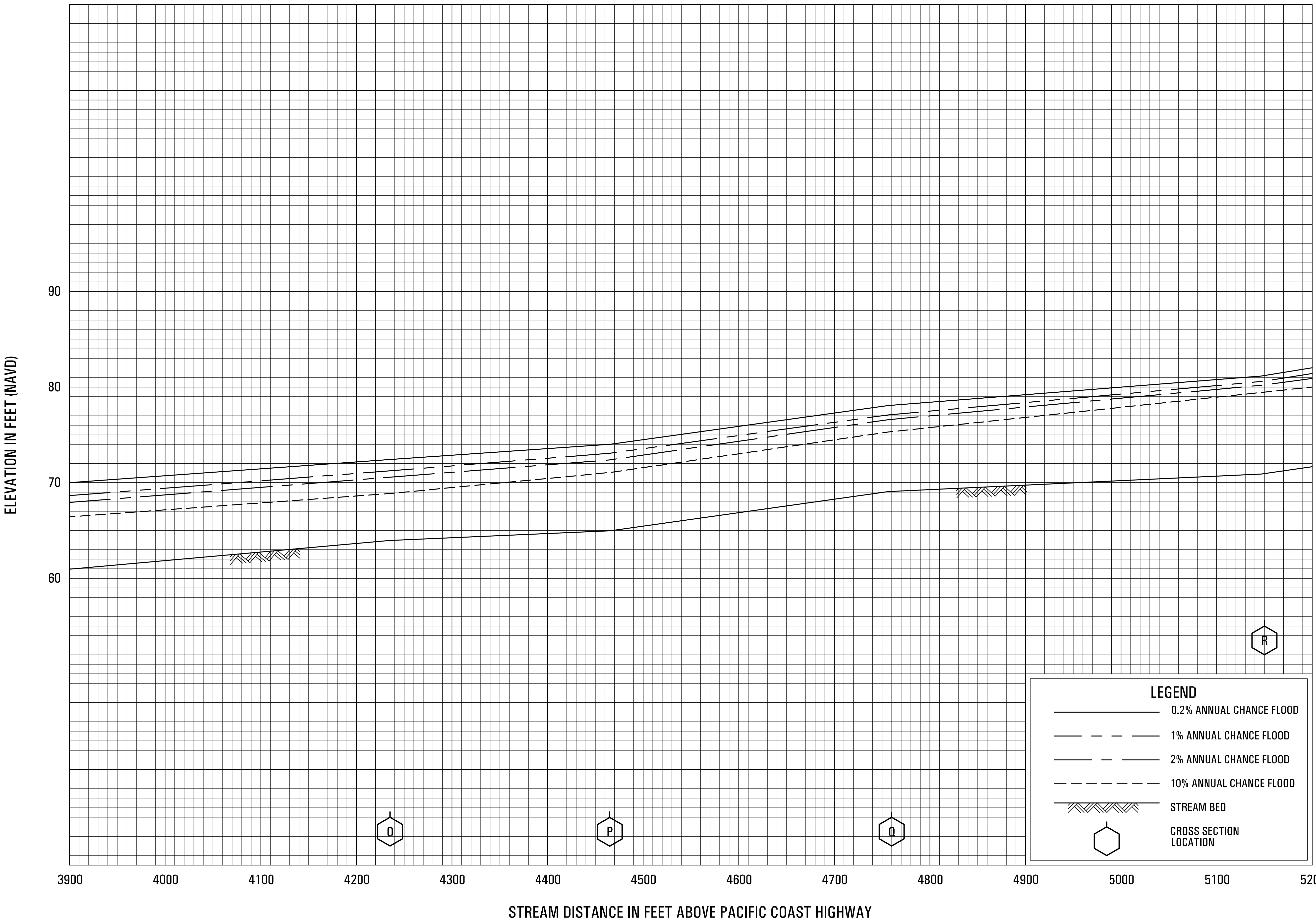
FLOOD PROFILES

ZUMA CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



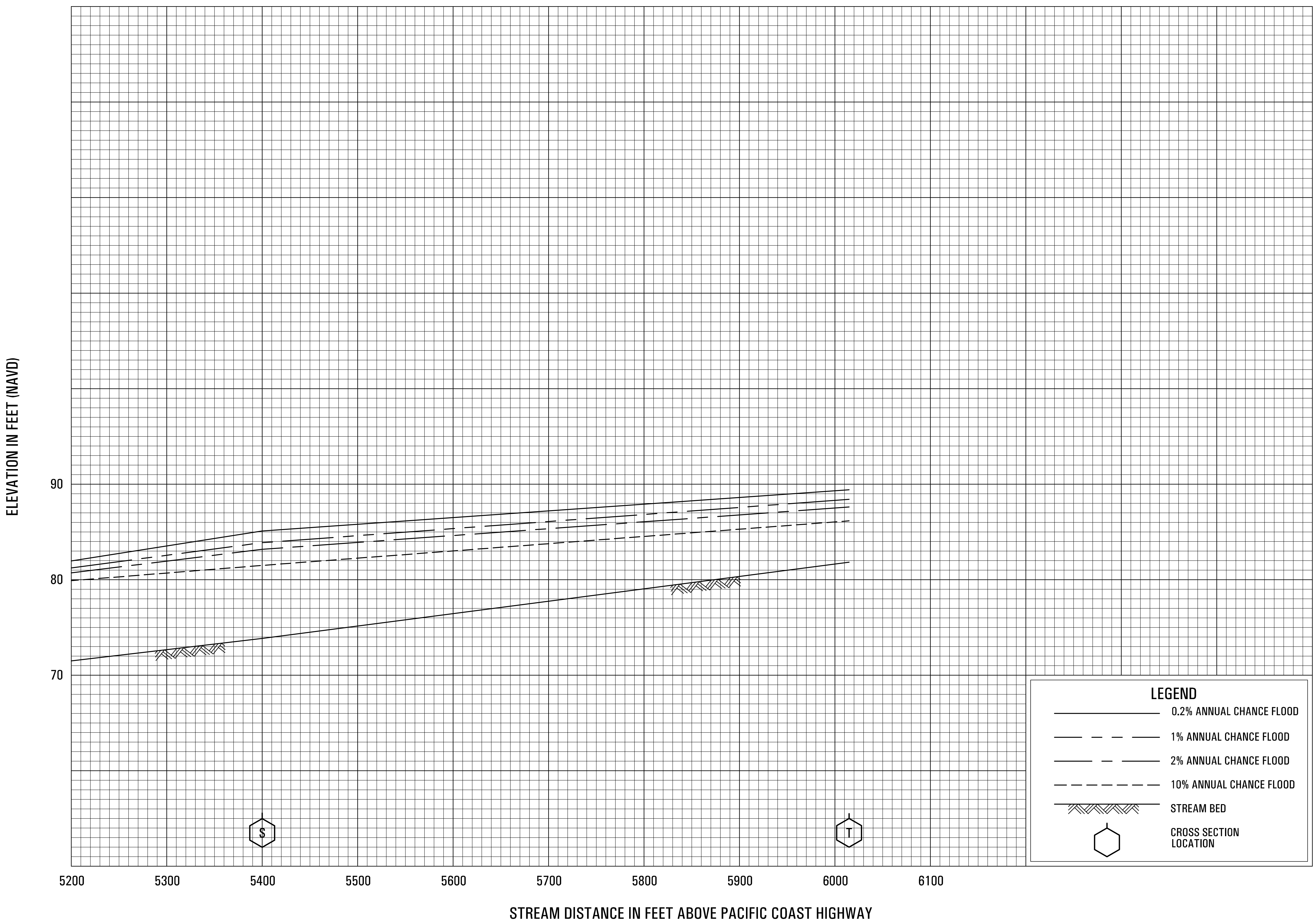
FLOOD PROFILES

ZUMA CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



FLOOD PROFILES

ZUMA CANYON

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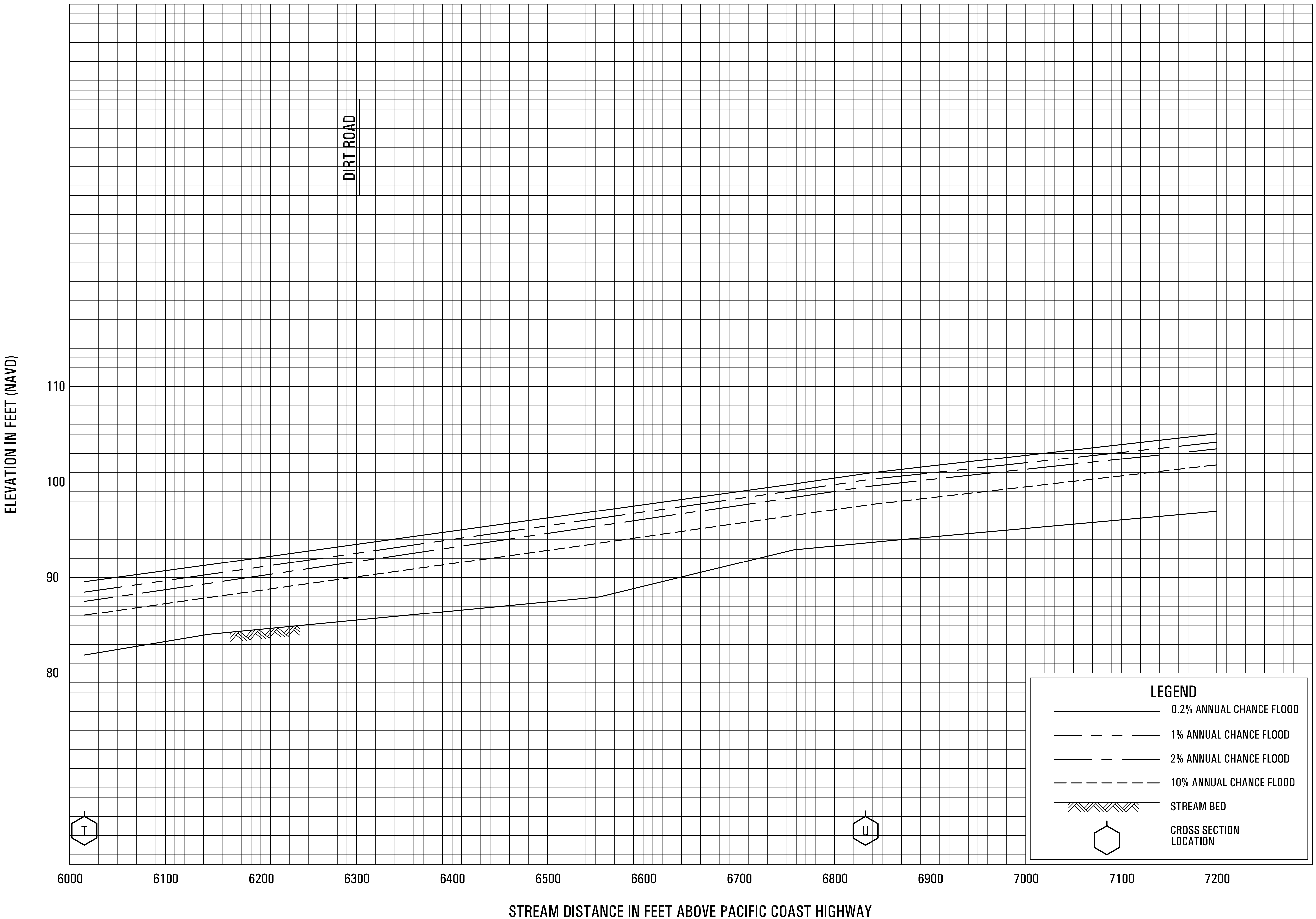
LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



FLOOD PROFILES

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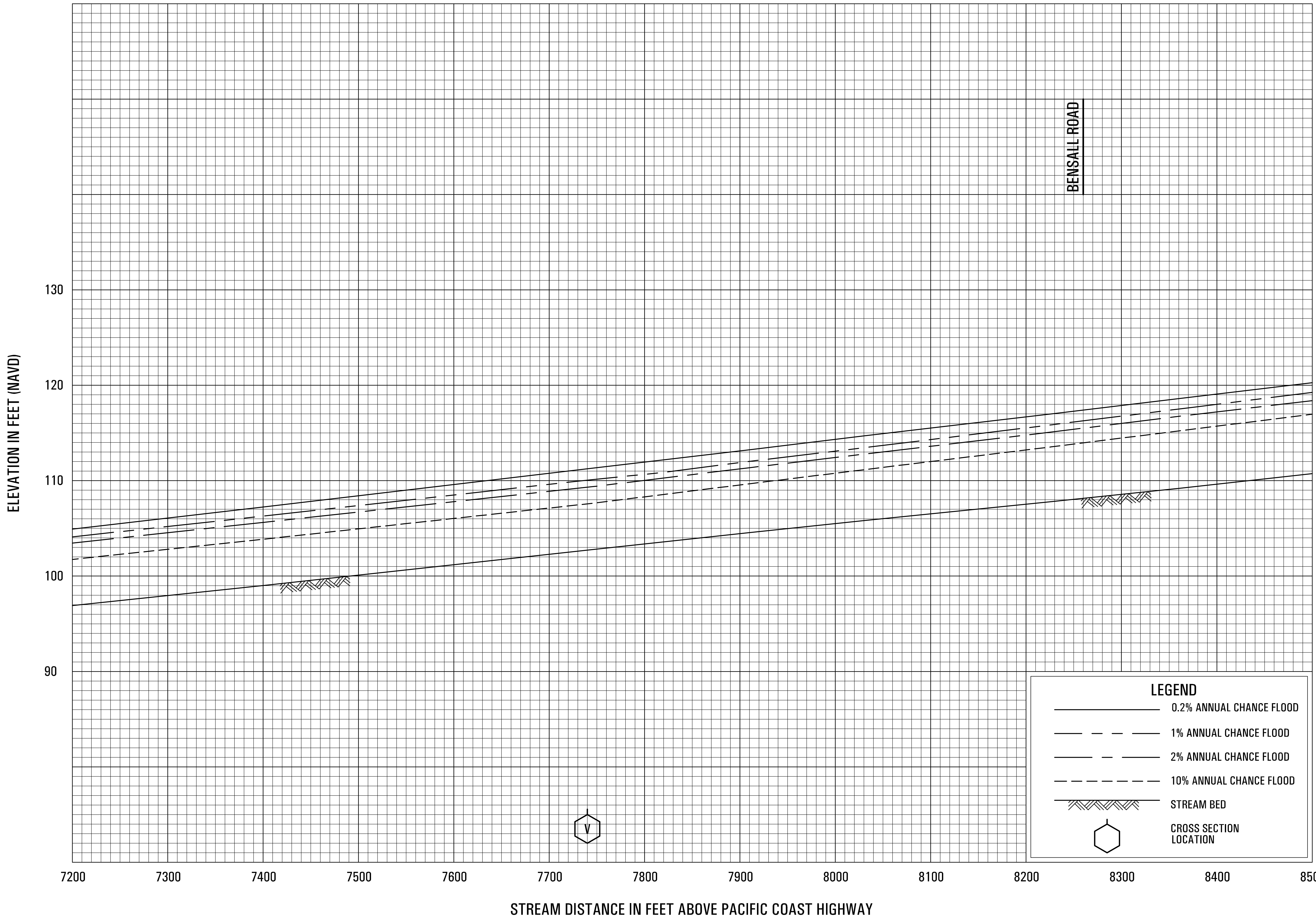

FLOOD PROFILES

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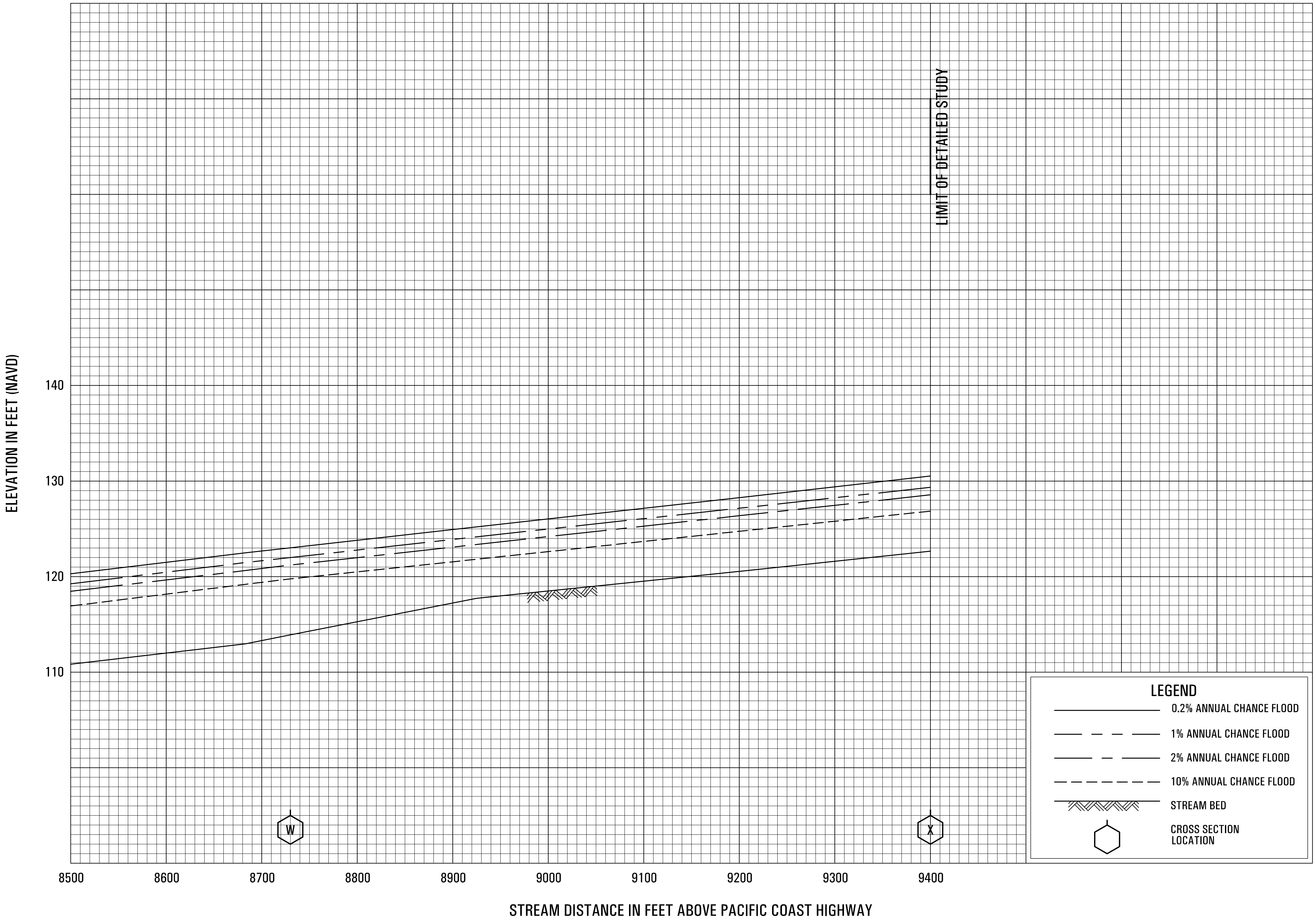
FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS



FLOOD PROFILES

ZUMA CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOS ANGELES COUNTY, CA

AND INCORPORATED AREAS

Appendix F

AVEK 2011 Annual Water Quality Report

ANTELOPE VALLEY – EAST KERN WATER AGENCY

2011 ANNUAL WATER QUALITY REPORT

LOS ANGELES COUNTY SYSTEM

A PUBLIC AGENCY

February 1, 2012

Dear General Manager:

This is the 2011 Annual Water Quality Report from the Antelope Valley-East Kern Water Agency (AVEK). Since the water you obtain from AVEK represents one of your sources of water, we have included the actual laboratory reports of analyses as well as a summary of results for your convenience.

In accordance with the Consumer Confidence Report (CCR) guidance manuals issued by the California Department of Public Health and the United States Environmental Protection Agency, we are herein providing you with the monitoring data and other information you will need to produce your CCR.

Please notice that *bromate* monitoring has been added to this year's report. Bromate is a disinfection byproduct formed when water containing bromide is disinfected with ozone. We implemented the use of ozone in our treatment process full-time in 2011 and state and federal regulations require us to monitor for bromate at the entry point to our distribution system monthly. Compliance is based upon a running annual average, computed quarterly, of these monthly samples. The MCL, based upon the running annual average, is 10 μg/L.

If you have any questions or need additional information, please call me at 661-943-3201. However, please do not designate AVEK or this office as your contact in your CCR. According to the CDPH and EPA guidelines, the designated contact person should be someone from your system. While we are always happy to clarify questions about AVEK water, we do not have the specific information necessary to answer questions about your water, blending practices or distribution systems.

Respectfully,

Justin Livesay
Laboratory Director

6500 WEST AVENUE N • PALMDALE, CALIFORNIA 93551
(661) 943-3201 • FAX (661) 943-3204

Antelope Valley-East Kern Water Agency

2011 Annual Water Quality Report

We are very pleased to provide you with this year's Annual Water Quality Report. We want to keep you informed about the excellent water we have delivered to you over the past year. Our goal is, and always has been, to provide to you a safe supply of drinking water.

Our water source is the State Water Project, California Aqueduct. The California Department of Public Health has assessed the vulnerability of this source as to possible contaminating activities. The assessment's description and discussion of vulnerability:

> "The California Aqueduct originates at the Sacramento-San Joaquin Delta at Clifton Court Forebay. Water in the Delta originates in the Sacramento River watershed, the San Joaquin watershed, and the watershed drainage from the Mokelumne River, Stanislaus River, Merced River and several smaller rivers that drain the eastern slopes of the Sierra Nevadas. Located in these drainage areas are a broad variety of potential sources of contamination including municipal, industrial and agricultural activities. Also influencing the quality of water pumped from the Delta is the impact of the estuarial nature of the Delta and the naturally occurring salt-water intrusion which is dependent to a large extent on the inflow from the contributing rivers.
>
> The possible contaminating activities present within the California Aqueduct watershed are described in the State Water Project Watershed Sanitary Survey conducted by the California Department of Water Resources and their consultants in 1986 and updated in 2001 and 2006.
>
> A copy of the complete assessment may be viewed at, Antelope Valley-East Kern Water Agency, 6500 West Avenue N, Palmdale, CA 93551."

If you have any questions about this report or the Antelope Valley-East Kern Water Agency, please contact Justin Livesay, Laboratory Director at 661-943-3201. We want our valued customers to be informed about our Water Agency. If you want to learn more, please attend any of our regularly scheduled Board meetings. They are held on the second and fourth Tuesday of every month, 6:30 PM, at the Antelope Valley-East Kern Water Agency Office, 6500 West Avenue N, Palmdale, CA, 93551.

Antelope Valley-East Kern Water Agency routinely monitors for contaminants in our drinking water according to Federal and State laws. The table in this report, "2011 Annual Water Quality Report", shows the results of our monitoring for the period of January 1st to December 31st, 2011.

All drinking water, including bottled drinking water, may be reasonably expected to contain at least small amounts of some contaminants. It is important to remember that the presence of these contaminants does not necessarily pose a health risk. More information about contaminants and potential health effects can be obtained by calling the Environmental Protection Agency's Safe Drinking Water Hotline at 1-800-426-4791.

We are proud to report that our drinking water is safe and meets or exceeds all State and Federal requirements. We have learned through our monitoring and testing that some contaminants have been detected. The EPA has determined that your water IS SAFE at these levels.

Total Coliform: Water systems are required to meet a strict standard for coliform bacteria. Coliform bacteria are usually harmless, but their presence in water can be an indication of disease-causing bacteria. When coliform bacteria are found, special follow-up tests are done to determine if harmful bacteria are present in the water supply. If the standard is exceeded, the water supplier must notify the public by newspaper, television or radio.

Some people may be more vulnerable to contaminants in drinking water than the general population. Immuno-compromised persons such as persons with cancer undergoing chemotherapy, persons who have undergone organ transplants, people with HIV/AIDS or other immune system disorders, some elderly, and infants can be particularly at risk from infections. These people should seek advice about drinking water from their health care providers. EPA/CDC guidelines on appropriate means to lessen the risk of infection by *Cryptosporidium* and other microbiological contaminants are available from the Safe Drinking Water Hotline (800-426-4791).

Antelope Valley-East Kern Water Agency

2011 Annual Water Quality Report - Los Angeles County System

The Antelope Valley-East Kern Water Agency provides treated surface water as a source of drinking water.
Treatment technique: Conventional
EPA Turbidity Performance Standards: Turbidity of the filtered water must:

1. Be less than or equal to 0.30 NTU in 95% of measurements in a month.
2. Not exceed 1 NTU at any time.

Lowest monthly percentage of samples that met Turbidity Performance Standard No. 1: **100%**
Highest single turbidity measurement during the year: **0.23 NTU**
Percentage of samples < 0.30 NTU: **100%**
The number of violations of any surface water treatment requirements: **NONE**
Turbidity (measured in NTU) is a measurement of the cloudiness of water and is a good indicator of water quality and filtration performance. Turbidity results which meet performance standards are considered to be in compliance with filtration requirements.

MICROBIOLOGICAL CONTAMINANTS

Type of Sample(s)	Parameter	Sampling Frequency	MCL	No. of Months in Violation	System Results	
					Range	Average
Distribution	Total Coliform Bacteria	104 - 154 / mo	5% positive	None	0.0 - 0.8%	0.07%
Distribution	Fecal Coliform/*E. coli*	104 - 154 / mo	1 pos. with 2 TC pos.	None	0%	0%

INORGANIC CONTAMINANTS

					RESULTS							
					Acton Plant Effluent (CWR)		Eastside Plant Effluent (CWR)		Quartz Hill Plant Effluent (CWR)		Raw Influent (Source)	
Parameter	Units	MCL	DLR	PHG or (MCLG)	Range	Average	Range	Average	Range	Average	Range	Average
Aluminum	mg/L	1	0.05	0.6	ND	ND	ND	ND	ND	ND		ND
Antimony	µg/L	6	6	20		ND		ND		ND		ND
Arsenic	µg/L	10	2	0.004		ND		ND		ND		ND
Barium	mg/L	1	0.1	2		ND		ND		ND		ND
Beryllium	µg/L	4	1	1		ND		ND		ND		ND
Cadmium	µg/L	5	1	0.04		ND		ND		ND		ND
Chromium (Total)	µg/L	50	10			ND		ND		ND		ND
Cyanide	µg/L	150	100	150		ND		ND		ND		ND
Fluoride	mg/L	2	0.1	1		ND		ND		ND		ND
Lead	µg/L		5	0.2		ND		ND		ND		ND
Mercury	µg/L	2	1	1.2		ND		ND		ND		ND
Nickel	µg/L	100	10	12		ND		ND		ND		ND
Nitrate (as NO3)	mg/L	45	2	45		ND		2.0		2.2	ND-3.6	2.2
Nitrite (as N)	mg/L	1	0.4	1		ND		ND		ND		ND
Nitrate+Nitrite (as N)	mg/L	10		10		ND		ND		1.0		1.0
Perchlorate	µg/L	6	4	6		ND		ND		ND		ND
Selenium	µg/L	50	5	30		ND		ND		ND		ND
Thallium	µg/L	2	1	0.1		ND		ND		ND		ND

RADIOLOGICAL CONTAMINANTS

					RESULTS
Parameter	Units	MCL	DLR	PHG	Raw Influent (Source)
Gross Beta	pCi/L	50	4		<4.0 ± 1.06
Tritium	pCi/L	20000	1000	400	<1000 ± 115
Strontium 90	pCi/L	8	2	0.35	<2.0 ± 0.192

VOLATILE ORGANIC CONTAMINANTS

					RESULTS
Parameter	Units	MCL	DLR	PHG	Raw Influent (Source)
1,1,1-Trichlorethane (1,1,1-TCA)	µg/L	200	0.5	100	ND
1,1,2,2-Tetrachloroethane	µg/L	1	0.5	0.1	ND
1,1,2-Trichloroethane (1,1,2-TCA)	µg/L	5	0.5	0.3	ND
1,1-Dichloroethane (1,1-DCA)	µg/L	5	0.5	3	ND
1,1-Dichloroethylene (1,1-DCE)	µg/L	6	0.5	10	ND
1,2,4-Trichlorobenzene	µg/L	5	0.5	5	ND
1,2-Dichlorobenzene (o-DCB)	µg/L	600	0.5	600	ND
1,2-Dichloroethane (1,2-DCA)	µg/L	0.5	0.5	0.4	ND
1,2-Dichloropropane	µg/L	5	0.5	0.5	ND
1,3-Dichloropropene (Total)	µg/L	0.5	0.5	0.2	ND
1,4-Dichlorobenzene (p-DCB)	µg/L	5	0.5	6	ND
Benzene	µg/L	1	0.5	0.15	ND
Carbon tetrachloride	µg/L	0.5	0.5	0.1	ND
cis-1,2-Dichloroethylene (c-1,2-DCE)	µg/L	6	0.5	100	ND
Dichloromethane (Methylene Chloride)	µg/L	5	0.5	4	ND
Ethylbenzene	µg/L	300	0.5	300	ND
Methyl-tert-butyl ether (MTBE)	µg/L	13	3	13	ND
Monochlorobenzene (Chlorobenzene)	µg/L	70	0.5	200	ND
Styrene	µg/L	100	0.5	0.5	ND
Tetrachloroethylene (PCE)	µg/L	5	0.5	0.06	ND
Toluene	µg/L	150	0.5	150	ND
trans-1,2-Dichloroethylene (t-1,2-DCE)	µg/L	10	0.5	60	ND
Trichloroethylene (TCE)	µg/L	5	0.5	1.7	ND
Trichlorofluromethane (Freon11)	µg/L	150	5	700	ND
Trichlorotrifluoroethane (Freon 113)	µg/L	1200	10	4000	ND
Vinyl Chloride (VC)	µg/L	0.5	0.5	0.05	ND
Xylenes (Total)	µg/L	1750	0.5	1800	<0.50

Antelope Valley-East Kern Water Agency
2011 Annual Water Quality Report - Los Angeles County System

GENERAL PHYSICAL AND SECONDARY STANDARDS

Parameter	Units	MCL	DLR	RESULTS: Acton Plant Effluent (CWR) Range	Acton Plant Effluent (CWR) Average	Eastside Plant Effluent (CWR) Range	Eastside Plant Effluent (CWR) Average	Quartz Hill Plant Effluent (CWR) Range	Quartz Hill Plant Effluent (CWR) Average	Raw Influent (Source) Range	Raw Influent (Source) Average
Aluminum	µg/L	200	50	ND	ND	ND	ND	ND	ND		ND
Calcium	mg/L	no standard			12		14		13		13
Chloride	mg/L	250			25		23		24		22
Color	Units	15		<1-<5	<5	<1-<5	<5	<1-<5	<5		
Copper	µg/L	1000	50		ND		ND		ND		ND
Foaming Agents (MBAS)	mg/L	0.5			<0.050		<0.050		<0.050		<0.050
Hardness (Total) as CaCO3	mg/L	no standard			55		62		60		60
Iron	µg/L	300	100		ND		ND		ND		ND
Magnesium	mg/L	no standard			6.1		6.8		6.5		6.5
Manganese	µg/L	50	20		ND		ND		ND		ND
Odor @ 60 C	Units	3	1	<1 - 1	<1	<1	<1	<1	<1		
pH	Units	no standard		6.1-8.9	6.5	5.8-7.9	6.6	6.1-7.6	6.5	6.7-8.4	7.6
Potassium	mg/L	no standard			<2.0		<2.0		<2.0		<2.0
Silver	µg/L	100	10		ND		ND		ND		ND
Sodium	mg/L	no standard			20		21		21		20
Specific Conductance	µmhos	900			250		240	157 - 439	277	141-430	261
Sulfate	mg/L	250	0.5		37		35		35		16
Thiobencarb (Bolero)	µg/L	1	1		ND		ND		ND		ND
Total Dissolved Solids	mg/L	500			150		140		140		130
Turbidity	Units	5		0.01-0.15	0.03	0.02-0.10	0.03	0.00-0.23	0.04		
Zinc	mg/L	5.0	0.050		0.180		0.520		0.550		ND
Total Alkalinity (as CaCO3)	mg/L	no standard			41		38		38	40-78	54
Bicarbonate Alkalinity(HCO3)	mg/L	no standard			50		47		46		
Carbonate Alkalinity	mg/L	no standard			<1.8		<1.8		<1.8		
Hydroxide Alkalinity	mg/L	no standard			<1.0		<1.0		<1.0		

DISINFECTION RESIDUAL, PRECURSORS, and BYPRODUCTS

Type of Sample(s)	Parameter	Units	MCL/MRDL	DLR	MRDLG	RESULTS: Range	RESULTS: Average
Distribution	Chlorine (as total Cl2)	mg/L	4.0**		4	0.04 - 1.70	0.85
Treated Water	Total Organic Carbon (TOC)	mg/L	Treatment Requirement	0.3		1.1 - 2.2	1.5
Source Water	Total Organic Carbon (TOC)	mg/L	Treatment Requirement	0.3		2.1 - 4.4	2.9
Distribution	Total Trihalomethanes	µg/L	80**	0.5		14 - 28	19 #
Distribution	Total Haloacetic Acids (5)	µg/L	60**	2		4.6 - 13	7.9 #
Treated Water	Bromate	µg/L	10*	5		ND-13.0	3.2

** Running Annual Average of distribution system samples. The MCLs are based upon Running Annual Averages.

This average is a system-wide value, please see the attached summaries for site specific averages.

* Compliance is based on the running annual average computed quarterly, of monthly samples, collected at the entrance to the distribution system.

DEFINITIONS and FOOTNOTES:

Plant Effluent, CWR, is finished, treated drinking water.

Raw Water is the Source Water, the California Aqueduct, prior to treatment.

Units: **mg/L** = milligrams per liter, parts per million (ppm)
- **µg/L** = micrograms per liter, parts per billion (ppb)
- **µmhos** = micromhos, a measure of specific conductance
- **MFL** = million fibers per liter
- **pCi/L** = pico Curies per liter
- **<** = less than
- **>** = greater than
- **ND** = none detected above the DLR
- **NTU** = nephelometric turbidity unit is a measure of the clarity of water. Turbidity in excess of 5 NTU is just noticeable to the average person.

MCL: Maximum Contaminant Level. The highest level of a contaminant that is allowed in drinking water. MCLs are set by the U.S. Environmental Protection Agency or the California Department of Public Health as close to the PHGs and MCLGs as is economically or technologically feasible.

MRDL: Maximum Residual Disinfectant Level. The level of a disinfectant added for water treatment that may not be exceeded at the consumer's tap.

DLR: Detection Limit for purposes of Reporting.

(DL): Detection limit determined by the Laboratory when no DLR has been established.

MCLG: The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs are set by the U.S. Environmental Protection Agency.

MRDLG: Maximum Residual Disinfectant Level Goal. The level of a disinfectant added for water treatment below which there is no known or expected risk to health. MRDLGs are set by the U.S. Environmental Protection Agency.

PHG: Public Health Goal: The level of a contaminant in drinking water below which there is no known or expected risk to health. PHGs are set by the California Office of Environmental Health Hazard Assessment.

Primary Drinking Water Standard: Primary MCLs, specific treatment techniques adopted in lieu of primary MCLs, and monitoring and reporting requirements for MCLs that are specified in regulations.

Secondary Standards: Aesthetic standards established by the California Department of Public Health.

AL: Action Level. There is no MCL, if this level is exceeded, action is required by the Califronia Department of Public Health.

This average is a system-wide value, please see the attached summary for site specific averages.

** Total Trihalomethanes and Haloacetic Acids(5) MCLs an annual running average of distribution system samples.

*** A corrosion inhibitor is added to the treated water before entry into the distribution system

All analyses performed by the ELAP certified laboratories: AVEK Water Agency, BSK Analytical Laboratories, or BSK subcontract lab.

ACTON, EASTSIDE & QUARTZ HILL WATER TREATMENT PLANTS

Distribution System & Disinfection Byproducts
Finished Drinking Water
Monitoring Results

State of California
Drinking Water Program

Department of Public Health

Quarterly TTHM Report for Disinfection Byproducts Compliance Based on Flow-Weighted Averages (in mg/L or ppb)

System Name: Antelope Valley-East Kern Water Agency System No.: 1910045 Year: 2011 Quarter: 4th

	Year:	2007				2008				2009				2010				2011			
	Quarter:	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
	Sample Date (month/date):	3/15	6/21	9/21	12/20	3/20	6/19	9/18	12/15	3/19	6/18	9/17	12/17	3/18	6/17	9/16	12/16	3/17	6/16	9/15	12/15
Facility 1	Site 1	42.6	58	80	79	64	69	53	45	77	99	66	33	33	32	40	62	39	38	32	27
	Site 2	32.0	47	60	50	53	50	36	70	36	69	27	19	13	21	16	14	20	12	15	13*
	Site 3	24.8	42	48	44	33	39	27	40	110	58	23	21	15	19	13	7.9	21	14	9.2	9.2
	Site 4	43.4	47	54	44	69	44	28	65	43	55	17	16	9.5	14	12	8.7	30	8.9	8.8	8.5
	Quarterly Average	35.7	48.5	60.5	54.3	54.8	50.5	36.0	55.0	66.5	70.3	33.3	22.3	17.6	21.5	20.3	23.2	27.5	18.2	16.3	14.4
Facility 2	Site 5	59.1	47	63	45	15	47	29	16	off	60	39	11	16	31	28	23	off	13	12	1.7
	Site 6	52.5	51	76	51	21	55	31	36	off	71	48	13	19	41	27	26	off	19	15	3.2
	Site 7	80.1	64	84	48	15	70	38	44	off	90	50	20	7.3	52	32	23	off	26	29	2.5
	Site 8	77.7	60	101	59	19	63	38	44	off	84	63	17	23	50	34	38	off	23	25	2.1
	Quarterly Average	67.4	55.5	81.0	50.8	17.5	58.8	34.0	35.0	off	76.3	50.0	15.3	16.3	43.5	30.3	27.5	off	20.3	20.3	2.4
Facility 3	Site 9	116.0	84	109	off	off	35	43	off	off	85	78	off	off	59	38	45	off	48	32	off
	Site 10	119.0	86	99	off	off	35	42	off	off	84	66	off	off	60	34	43	off	50	30	off
	Site 11	96.5	68	92	off	off	27	31	off	off	60	41	off	off	36	26	7.8	off	40	22	off
	Site 12	101.0	76	93	off	off	28	33	off	off	59	38	off	off	35	27	7.9	off	40	22	off
	Quarterly Average	108.1	78.5	98.3	off	off	31.3	37.3	off	off	72.0	55.8	off	off	47.5	31.3	25.9	off	44.5	26.5	off
System-Wide Quarterly Weighted Ave.		39.4	49.6	63.2	54.0	51.2	50.9	35.9	49.1	66.5	70.8	35.0	21.4	17.5	22.9	21.1	23.5	27.5	18.5	16.8	13.6
System-Wide Running Annual Ave.		29.4	34.2	45.0	51.6	54.5	54.8	48.0	46.8	50.6	55.6	55.4	48.4	36.2	24.2	20.7	21.3	23.8	22.7	21.6	19.1
Meets Standard ☑* (check box ☐)		Yes ☑ No ☐	Yes ☑ No ☐	Yes ☑ No ☐	Yes ☑ No ☐	Yes ☑ No ☐	Yes ☑ No ☐	Yes ☑ No ☐	Yes ☑ No ☐	Yes ☑ No ☐	Yes ☑ No ☐	Yes ☑ No ☐	Yes ☑ No ☐	Yes ☑ No ☐	Yes ☑ No ☐	Yes ☑ No ☐	Yes ☑ No ☐	Yes ☑ No ☐	Yes ☑ No ☐	Yes ☑ No ☐	Yes ☑ No ☐
Number of Samples Taken		12	12	12	8	8	12	12	8	4	12	12	8	8	12	12	12	4	12	12	8

Identify the treatment facility and associated sample locations in the table below. For systems using weighted averages to calculate system-wide quarterly averages (in accordance with an approved monitoring plan), the fraction of flow for each treatment facility should be reported in the box provided following each treatment facility name.

Facility 1:	Quartz Hill	0.93 (fraction of flow)	Facility 2:	Eastside	0.05 (fraction of flow)	Facility 3:	Acton	0.02 (fraction of flow)
Site	Location		Site	Location		Site	Location	
1	LVAV		5	E. 116th St.		9	Vincent 1	
2	Ave. M/ 5th St.		6	Ave. R/ 110th St. E.		10	Vincent 2	
3	QHWD		7	E. 177th St.		11	Acton TWR 1	
4	Ave. L-12/ 60th		8	E. 165th St.		12	Acton TWR 2	

Signature ________ Date 1/3/12

*If, during the first year of monitoring, any individual quarter's average will cause the running annual average of that system to exceed the standard, then the system is out of compliance at the end of that quarter.

Current Year Comments: The fraction of flow for each treatment facility is calculated quarterly based upon actual flow: 09/15/11 - 12/15/11: Quartz Hill 2566.9MG (0.932), Eastside 146.1MG (0.053). Acton 39.8MG (0.015). Acton WTP shut down beginning Nov. 17. Facility 1, Site 2 sample collected at 10th/N (next nearest sample point) rather than Ave. M/5th St. due to ongoing construction.

State of California
Drinking Water Program

Department of Public Health

Quarterly HAA5 Report for Disinfection Byproducts Compliance Based on Flow-Weighted Averages (in µg/L or ppb)

System Name: Antelope Valley-East Kern Water Agency System No.: 1910045 Year: 2011 Quarter: 4th

	Year:	2007				2008				2009				2010				2011			
	Quarter:	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
	Sample Date (month/date):	3/15	6/21	9/21	12/20	3/20	6/19	9/18	12/15	3/19	6/18	9/17	12/17	3/18	6/17	9/16	12/16	3/17	6/16	9/15	12/15
Facility 1	Site 1	35.0	16	18	15	16	12	11	6.9	9.2	20	26	11	10	13	16	16	22	7.9	15	8.1
	Site 2	26.7	12	14	7.4	16	7.2	5.8	12.0	8.0	16	9.1	6.0	9.3	7.2	6.8	6.2	8.3	3.7	9.0	4.7*
	Site 3	23.4	11	12	7.6	8	5.8	3.5	7.1	21	13	7.9	6.0	4.9	8.0	5.9	5.6	8.4	3.5	4.5	3.1
	Site 4	22.6	11	12	8.1	17	7.4	4.6	9.7	15	14	4.9	5.6	4.1	6.6	6.0	6.4	15	5.8	4.2	3.5
	Quarterly Average	26.9	12.5	14.0	9.5	14.2	8.1	6.2	8.9	13.3	15.8	12.0	7.2	7.1	8.7	8.7	8.6	13.4	5.2	8.2	4.9
Facility 2	Site 5	27.2	13	14	8.6	3.4	5.1	ND	1.9	off	13	13	4.4	5.4	15	12	8.2	off	3.0	3.8	ND
	Site 6	31.3	14	17	7.4	4.0	7.1	4.1	6.3	off	16	14	4.8	5.6	16	11	9.2	off	3.6	8.8	ND
	Site 7	32.5	1.2	19.0	7.8	2.7	11	4.8	7.3	off	24	14	6.3	1.7	19	15	6.9	off	5.5	12	ND
	Site 8	34.2	16	17	11	3.7	12	5.2	6.8	off	16	16	5.5	7.9	20	15	12	off	4.1	11	ND
	Quarterly Average	31.3	11.1	16.8	8.7	3.5	8.8	3.5	5.6	off	17.3	14.3	5.3	5.2	17.5	13.3	9.1	off	4.1	8.9	ND
Facility 3	Site 9	56.3	20	21	off	off	3.9	6.7	off	off	15	13	off	off	23	15	12	off	13	13	off
	Site 10	59.6	20	22	off	off	3.7	6.5	off	off	15	13	off	off	24	15	13	off	12	11	off
	Site 11	50.6	18	18	off	off	3.3	4.6	off	off	13	8.6	off	off	13	11	6.2	off	8.2	8.5	off
	Site 12	50.9	18	18	off	off	3.4	5.0	off	off	14	8.6	off	off	9.0	11	6.1	off	8.0	10	off
	Quarterly Average	54.4	19.0	19.8	off	off	3.6	5.7	off	off	14.3	10.8	off	off	17.3	13.0	9.3	off	10.3	10.6	off
	System-Wide Quarterly Weighted	27.7	12.4	14.4	9.4	13.2	8.1	5.9	7.9	13.3	15.9	12.2	7.0	7.0	9.3	9.1	8.6	13.4	5.2	8.3	4.6
	System-Wide Running Annual Ave.	21.3	19.4	18.1	16.0	12.3	11.3	9.2	8.8	8.8	10.8	12.3	12.1	10.5	8.9	8.1	8.5	10.1	9.1	8.9	7.9
	Meets Standard ☑ (check box) ☐	Yes ☑ No ☐	Yes ☑ No ☐	Yes ☑ No ☐	Yes ☑ No ☐	Yes ☑ No ☐	Yes ☑ No ☐	Yes ☑ No ☐	Yes ☑ No ☐	Yes ☑ No ☐	Yes ☑ No ☐	Yes ☑ No ☐	Yes ☑ No ☐	Yes ☑ No ☐	Yes ☑ No ☐	Yes ☑ No ☐	Yes ☑ No ☐	Yes ☑ No ☐	Yes ☑ No ☐	Yes ☑ No ☐	Yes ☑ No ☐
	Number of Samples Taken	12	12	12	8	8	12	11	8	4	12	12	8	8	12	12	12	4	12	12	8

Identify the treatment facility and associated sample locations in the table below. For systems using weighted averages to calculate system-wide quarterly averages (in accordance with an approved monitoring plan), the fraction of flow for each treatment facility should be reported in the box provided following each treatment facility name.

Facility 1: Quartz Hill	0.93 fraction of flow	Facility 2: Eastside	0.05 fraction of flow	Facility 3: Acton	0.02 fraction of flow
Site	Location	Site	Location	Site	Location
1	LVAV	5	E. 116th St.	9	Vincent 1
2	Ave. M/ 5th St.	6	Ave. R/ 110th St. E.	10	Vincent 2
3	QHWD	7	E. 177th St.	11	Acton TWS 1
4	Ave. L-12/ 60th	8	E. 165th St.	12	Acton TWS 2

Signature: [signature]   Date: 1/13/12

*If, during the first year of monitoring, any individual quarter's average will cause the running annual average of that system to exceed the standard, then the system is out of compliance at the end of that quarter.

Current Year Comments: The fraction of flow for each treatment facility is calculated quarterly based upon actual flow: 09/15/11 - 12/15/11: Quartz Hill 2566.9MG (0.932), Eastside 146.1MG (0.053). Acton 39.8MG (0.015). Acton WTP shut down beginning Nov. 17. Facility 1, Site 2 sample collected at 10th/N (next nearest sample point) rather than Ave. M/5th St. due to ongoing construction.

Quarterly Bromate Report for Disinfection Byproducts Compliance (in μg/L or ppb)

System Name: Antelope Valley-East Kern Water Agency System No.: 1910045 Year: 2011 Quarter: 4th

	2010				1st Qtr.				2nd Qtr.				3rd Qtr.				4th Qtr.			
Sample Date (month/date):	1st Q	2nd Q	3rd Q	4th Q	1/12	2/9	3/9	Quarterly Average	4/13	5/11	6/8	Quarterly Average	7/14	8/10	9/14	Quarterly Average	10/12	11/9	12/14	Quarterly Average
Site 1					3.9	3.1	3.2	3.4	2.4	ND	3.8	2.1	2.2	6.1	4.5	4.3	2.7	1.7	3.2	2.5
Site 2					OFF	OFF	OFF		OFF	ND	2.4	1.2	2.2	4.2	3.4	3.3	2.3	3.4	OFF	2.9
Site 3					OFF	OFF	OFF		OFF	1.1	2.2	1.6	1.9	5.2	13.0	6.7	3.5	4.6	OFF	4.1
System Quarterly Average								3.4				1.6				4.7				3.1
Running Annual Average								**3.4**				**2.5**				**3.3**				**3.2**
Meets Standard?* (check box)								Yes ☑ No ☐				Yes ☑ No ☐				Yes ☑ No ☐				Yes ☑ No ☐

Identify the sample locations in the table below.

Site	Sample Location
1	Quartz Hill Clear Well Reservoir
2	Eastside Clear Well Reservoir
3	Acton Clear Well Reservoir

Comments: Samples collected at the entry point to the distribution system for each treatment plant using ozone. "OFF" denotes treatment plant shutdown.

FIRST YEAR OF COMPLIANCE MONITORING

Signature [signature] Date 1/3/12

*If, during the first year of monitoring, any individual quarter's average will cause the running annual average of that system to exceed the standard, then the system is out of compliance at the end of that quarter.

State of California
Drinking Water Program

Department of Health Services

Quarterly Report for Disinfectant Residuals Compliance
For Systems Using Chlorine or Chloramines

System Name: Antelope Valley-East Kern Water Agency System No.: 1910045

Calendar Year: 2011 Quarter: 4th

1st Quarter			
	Month	Number of Samples Taken	Monthly Ave. Chlorine Level (mg/L)
Previous Year	April		0.82
	May		0.87
	June		0.85
	July		0.85
	August		0.91
	September		0.75
	October		0.80
	November		0.83
	December		0.83
Current Year	January	108	0.86
	February	108	0.85
	March	137	0.89
Running Annual Average (RAA):			0.84
Meets standard? (i.e. RAA < MRDL of 4.0 mg/L as Cl2)			YES

2nd Quarter			
	Month	Number of Samples Taken	Monthly Ave. Chlorine Level (mg/L)
Previous Year	July		0.85
	August		0.91
	September		0.75
	October		0.80
	November		0.83
	December		0.83
Current Year	January		0.86
	February		0.85
	March		0.89
	April	115	0.88
	May	153	0.90
	June	122	0.83
Running Annual Average (RAA):			0.85
Meets standard? (i.e. RAA < MRDL of 4.0 mg/L as Cl2)			YES

3rd Quarter			
	Month	Number of Samples Taken	Monthly Ave. Chlorine Level (mg/L)
Previous Yr	October		0.80
	November		0.83
	December		0.83
Current Year	January		0.86
	February		0.85
	March		0.89
	April		0.88
	May		0.90
	June		0.83
	July	124	0.83
	August	154	0.84
	September	124	0.84
Running Annual Average (RAA):			0.85
Meets standard? (i.e. RAA < MRDL of 4.0 mg/L as Cl2)			YES

4th Quarter			
	Month	Number of Samples Taken	Monthly Ave. Chlorine Level (mg/L)
Current Year	January		0.86
	February		0.85
	March		0.89
	April		0.88
	May		0.90
	June		0.83
	July		0.83
	August		0.84
	September		0.84
	October	123	0.81
	November	153	0.85
	December	104	0.81
Running Annual Average (RAA):			0.85
Meets standard? (i.e. RAA < MRDL of 4.0 mg/L as Cl2)			YES

Comments:

Signature: [signature] Date: 1/13/12

BSK Analytical Laboratories
Engineers & Laboratories

Certificate of Analysis

Justin Livesay
Antelope Valley East Kern Water Agency
6500 W. Avenue N
Palmdale, CA 93551

Report Issue Date: 03/28/2011 16:19
Received Date: 03/18/2011
Received Time: 08:30

Lab Sample ID: A1C1448-01
Sample Date: 03/17/2011 09:40
Sample Type: Grab
Sampled by: Eric Kane
Matrix: Water

Sample Description: LVAV (Cal Water)

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Trihalomethanes by GC-MS									
Bromodichloromethane	EPA 524.2	14	0.50	ug/L	1	A103209	03/24/11	03/25/11	
Bromoform	EPA 524.2	3.6	0.50	ug/L	1	A103209	03/24/11	03/25/11	
Chloroform	EPA 524.2	9.3	0.50	ug/L	1	A103209	03/24/11	03/25/11	
Dibromochloromethane	EPA 524.2	13	0.50	ug/L	1	A103209	03/24/11	03/25/11	
Surrogate: Bromofluorobenzene	EPA 524.2	99 %	*Acceptable range: 70-130 %*						
Trihalomethanes by GC-MS									
Total Trihalomethanes	EPA 524.2	39		ug/L					
Haloacetic Acids by GC-ECD									
Dibromoacetic Acid (DBAA) (2C)	EPA 552.2	5.2	1.0	ug/L	1	A103158	03/23/11	03/25/11	
Dichloroacetic Acid (DCAA) (2C)	EPA 552.2	8.3	1.0	ug/L	1	A103158	03/23/11	03/25/11	
Monobromoacetic Acid (MBAA)	EPA 552.2	1.1	1.0	ug/L	1	A103158	03/23/11	03/25/11	
Monochloroacetic Acid (MCAA)	EPA 552.2	3.4	2.0	ug/L	1	A103158	03/23/11	03/25/11	
Trichloroacetic Acid (TCAA)	EPA 552.2	3.8	1.0	ug/L	1	A103158	03/23/11	03/25/11	
Surrogate: 2,3-Dibromopropionic Acid	EPA 552.2	114 %	*Acceptable range: 70-130 %*						
Surrogate: 2,3-Dibromopropionic Acid (2C)	EPA 552.2	107 %	*Acceptable range: 70-130 %*						
Haloacetic Acids by GC-ECD									
Total Haloacetic Acids (HAA)	EPA 552.2	22		ug/L					

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Antelope Valley East Kern Water Agency
6500 W. Avenue N
Palmdale, CA 93551

Report Issue Date: 03/28/2011 16:19
Received Date: 03/18/2011
Received Time: 08:30

Lab Sample ID: A1C1448-02
Sample Date: 03/17/2011 08:40
Sample Type: Grab
Sampled by: Eric Kane
Matrix: Water

Sample Description: 5th/M

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Trihalomethanes by GC-MS									
Bromodichloromethane	EPA 524.2	**5.7**	0.50	ug/L	1	A103209	03/24/11	03/25/11	
Bromoform	EPA 524.2	**2.5**	0.50	ug/L	1	A103209	03/24/11	03/25/11	
Chloroform	EPA 524.2	**3.0**	0.50	ug/L	1	A103209	03/24/11	03/25/11	
Dibromochloromethane	EPA 524.2	**8.6**	0.50	ug/L	1	A103209	03/24/11	03/25/11	
Surrogate: Bromofluorobenzene	EPA 524.2	98 %		*Acceptable range: 70-130 %*					
Trihalomethanes by GC-MS									
Total Trihalomethanes	EPA 524.2	**20**		ug/L					
Haloacetic Acids by GC-ECD									
Dibromoacetic Acid (DBAA) (2C)	EPA 552.2	**3.7**	1.0	ug/L	1	A103158	03/23/11	03/25/11	
Dichloroacetic Acid (DCAA) (2C)	EPA 552.2	**3.3**	1.0	ug/L	1	A103158	03/23/11	03/25/11	
Monobromoacetic Acid (MBAA)	EPA 552.2	ND	1.0	ug/L	1	A103158	03/23/11	03/25/11	
Monochloroacetic Acid (MCAA)	EPA 552.2	ND	2.0	ug/L	1	A103158	03/23/11	03/25/11	
Trichloroacetic Acid (TCAA)	EPA 552.2	**1.3**	1.0	ug/L	1	A103158	03/23/11	03/25/11	
Surrogate: 2,3-Dibromopropionic Acid	EPA 552.2	115 %		*Acceptable range: 70-130 %*					
Surrogate: 2,3-Dibromopropionic Acid (2C)	EPA 552.2	111 %		*Acceptable range: 70-130 %*					
Haloacetic Acids by GC-ECD									
Total Haloacetic Acids (HAA)	EPA 552.2	**8.3**		ug/L					

1414 Stanislaus Street Fresno, CA 93706 (559) 497-2888 FAX (559) 485-6935 www.bsklabs.com

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Antelope Valley East Kern Water Agency
6500 W. Avenue N
Palmdale, CA 93551

Report Issue Date: 03/28/2011 16:19
Received Date: 03/18/2011
Received Time: 08:30

Lab Sample ID: A1C1448-03
Sample Date: 03/17/2011 09:05
Sample Type: Grab
Sampled by: Eric Kane
Matrix: Water

Sample Description: QHWD(50th/N)

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Trihalomethanes by GC-MS									
Bromodichloromethane	EPA 524.2	**6.2**	0.50	ug/L	1	A103209	03/24/11	03/25/11	
Bromoform	EPA 524.2	**2.8**	0.50	ug/L	1	A103209	03/24/11	03/25/11	
Chloroform	EPA 524.2	**3.3**	0.50	ug/L	1	A103209	03/24/11	03/25/11	
Dibromochloromethane	EPA 524.2	**8.5**	0.50	ug/L	1	A103209	03/24/11	03/25/11	
Surrogate: Bromofluorobenzene	EPA 524.2	100 %		*Acceptable range: 70-130 %*					
Trihalomethanes by GC-MS									
Total Trihalomethanes	EPA 524.2	**21**		ug/L					
Haloacetic Acids by GC-ECD									
Dibromoacetic Acid (DBAA) (2C)	EPA 552.2	**3.5**	1.0	ug/L	1	A103158	03/23/11	03/25/11	
Dichloroacetic Acid (DCAA) (2C)	EPA 552.2	**3.6**	1.0	ug/L	1	A103158	03/23/11	03/25/11	
Monobromoacetic Acid (MBAA)	EPA 552.2	ND	1.0	ug/L	1	A103158	03/23/11	03/25/11	
Monochloroacetic Acid (MCAA)	EPA 552.2	ND	2.0	ug/L	1	A103158	03/23/11	03/25/11	
Trichloroacetic Acid (TCAA)	EPA 552.2	**1.3**	1.0	ug/L	1	A103158	03/23/11	03/25/11	
Surrogate: 2,3-Dibromopropionic Acid	EPA 552.2	114 %		*Acceptable range: 70-130 %*					
Surrogate: 2,3-Dibromopropionic Acid (2C)	EPA 552.2	111 %		*Acceptable range: 70-130 %*					
Haloacetic Acids by GC-ECD									
Total Haloacetic Acids (HAA)	EPA 552.2	**8.4**		ug/L					

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Certificate of Analysis

Justin Livesay
Antelope Valley East Kern Water Agency
6500 W. Avenue N
Palmdale, CA 93551

Report Issue Date: 03/28/2011 16:19
Received Date: 03/18/2011
Received Time: 08:30

Lab Sample ID: A1C1448-04
Sample Date: 03/17/2011 09:15
Sample Type: Grab

Sampled by: Eric Kane
Matrix: Water

Sample Description: L-12/60th

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Trihalomethanes by GC-MS									
Bromodichloromethane	EPA 524.2	**9.7**	0.50	ug/L	1	A103209	03/24/11	03/25/11	
Bromoform	EPA 524.2	**3.0**	0.50	ug/L	1	A103209	03/24/11	03/25/11	
Chloroform	EPA 524.2	**5.9**	0.50	ug/L	1	A103209	03/24/11	03/25/11	
Dibromochloromethane	EPA 524.2	**11**	0.50	ug/L	1	A103209	03/24/11	03/25/11	
Surrogate: Bromofluorobenzene	EPA 524.2	95 %		*Acceptable range: 70-130 %*					
Trihalomethanes by GC-MS									
Total Trihalomethanes	EPA 524.2	**30**		ug/L					
Haloacetic Acids by GC-ECD									
Dibromoacetic Acid (DBAA) (2C)	EPA 552.2	**4.3**	1.0	ug/L	1	A103158	03/23/11	03/25/11	
Dichloroacetic Acid (DCAA) (2C)	EPA 552.2	**6.1**	1.0	ug/L	1	A103158	03/23/11	03/25/11	
Monobromoacetic Acid (MBAA)	EPA 552.2	ND	1.0	ug/L	1	A103158	03/23/11	03/25/11	
Monochloroacetic Acid (MCAA)	EPA 552.2	**2.8**	2.0	ug/L	1	A103158	03/23/11	03/25/11	
Trichloroacetic Acid (TCAA)	EPA 552.2	**1.9**	1.0	ug/L	1	A103158	03/23/11	03/25/11	
Surrogate: 2,3-Dibromopropionic Acid	EPA 552.2	110 %		*Acceptable range: 70-130 %*					
Surrogate: 2,3-Dibromopropionic Acid (2C)	EPA 552.2	109 %		*Acceptable range: 70-130 %*					
Haloacetic Acids by GC-ECD									
Total Haloacetic Acids (HAA)	EPA 552.2	**15**		ug/L					

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Report Issue Date: 06/30/2011 16:50
Received Date: 06/17/2011
Received Time: 08:00

Lab Sample ID: A1F1514-01
Sample Date: 06/16/2011 07:49
Sample Type: Grab

Sampled by: Erik Kane / Mark Allgood
Matrix: Water

Sample Description: VIN 1

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Trihalomethanes by GC-MS									
Bromodichloromethane	EPA 524.2	**14**	0.50	ug/L	1	A107313	06/20/11	06/21/11	
Bromoform	EPA 524.2	**8.0**	0.50	ug/L	1	A107313	06/20/11	06/21/11	
Chloroform	EPA 524.2	**4.6**	0.50	ug/L	1	A107313	06/20/11	06/21/11	
Dibromochloromethane	EPA 524.2	**22**	0.50	ug/L	1	A107313	06/20/11	06/21/11	
Surrogate: Bromofluorobenzene	EPA 524.2	101 %		*Acceptable range: 70-130 %*					
'Total Trihalomethanes, EPA 524.2		**48**	0.50	ug/L					
Haloacetic Acids by GC-ECD									
Dibromoacetic Acid (DBAA)	EPA 552.2	**7.3**	1.0	ug/L	1	A107406	06/22/11	06/24/11	
Dichloroacetic Acid (DCAA)	EPA 552.2	**2.9**	1.0	ug/L	1	A107406	06/22/11	06/24/11	
Monobromoacetic Acid (MBAA)	EPA 552.2	**1.0**	1.0	ug/L	1	A107406	06/22/11	06/24/11	
Monochloroacetic Acid (MCAA)	EPA 552.2	ND	2.0	ug/L	1	A107406	06/22/11	06/24/11	
Total Haloacetic Acids, EPA 552.2		**13**	1.0	ug/L					
Trichloroacetic Acid (TCAA)	EPA 552.2	**1.4**	1.0	ug/L	1	A107406	06/22/11	06/24/11	
Surrogate: 2,3-Dibromopropionic Acid	EPA 552.2	86 %		*Acceptable range: 70-130 %*					

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Report Issue Date: 06/30/2011 16:50
Received Date: 06/17/2011
Received Time: 08:00

Lab Sample ID: A1F1514-02
Sample Date: 06/16/2011 07:52
Sample Type: Grab
Sampled by: Erik Kane / Mark Allgood
Matrix: Water

Sample Description: VIN 2

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Trihalomethanes by GC-MS									
Bromodichloromethane	EPA 524.2	**14**	0.50	ug/L	1	A107313	06/20/11	06/21/11	
Bromoform	EPA 524.2	**9.0**	0.50	ug/L	1	A107313	06/20/11	06/21/11	
Chloroform	EPA 524.2	**4.8**	0.50	ug/L	1	A107313	06/20/11	06/21/11	
Dibromochloromethane	EPA 524.2	**22**	0.50	ug/L	1	A107313	06/20/11	06/21/11	
Surrogate: Bromofluorobenzene	EPA 524.2	105 %		*Acceptable range: 70-130 %*					
***Total Trihalomethanes, EPA 524.2**		**50**	0.50	ug/L					
Haloacetic Acids by GC-ECD									
Dibromoacetic Acid (DBAA)	EPA 552.2	**7.5**	1.0	ug/L	1	A107523	06/24/11	06/27/11	
Dichloroacetic Acid (DCAA)	EPA 552.2	**2.9**	1.0	ug/L	1	A107523	06/24/11	06/27/11	
Monobromoacetic Acid (MBAA)	EPA 552.2	ND	1.0	ug/L	1	A107523	06/24/11	06/27/11	
Monochloroacetic Acid (MCAA)	EPA 552.2	ND	2.0	ug/L	1	A107523	06/24/11	06/27/11	
Total Haloacetic Acids, EPA 552.2		**12**	1.0	ug/L					
Trichloroacetic Acid (TCAA)	EPA 552.2	**1.4**	1.0	ug/L	1	A107523	06/24/11	06/27/11	
Surrogate: 2,3-Dibromopropionic Acid	EPA 552.2	98 %		*Acceptable range: 70-130 %*					

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Report Issue Date: 06/30/2011 16:50
Received Date: 06/17/2011
Received Time: 08:00

Lab Sample ID: A1F1514-03
Sample Date: 06/16/2011 09:00
Sample Type: Grab

Sampled by: Erik Kane / Mark Allgood
Matrix: Water

Sample Description: TWR1

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Trihalomethanes by GC-MS									
Bromodichloromethane	EPA 524.2	**10**	0.50	ug/L	1	A107313	06/20/11	06/21/11	
Bromoform	EPA 524.2	**8.0**	0.50	ug/L	1	A107313	06/20/11	06/21/11	
Chloroform	EPA 524.2	**3.1**	0.50	ug/L	1	A107313	06/20/11	06/21/11	
Dibromochloromethane	EPA 524.2	**19**	0.50	ug/L	1	A107313	06/20/11	06/21/11	
Surrogate: Bromofluorobenzene	EPA 524.2	109 %		*Acceptable range: 70-130 %*					
***Total Trihalomethanes, EPA 524.2**		**40**	0.50	ug/L					
Haloacetic Acids by GC-ECD									
Dibromoacetic Acid (DBAA)	EPA 552.2	**6.4**	1.0	ug/L	1	A107523	06/24/11	06/27/11	
Dichloroacetic Acid (DCAA)	EPA 552.2	**1.8**	1.0	ug/L	1	A107523	06/24/11	06/27/11	
Monobromoacetic Acid (MBAA)	EPA 552.2	ND	1.0	ug/L	1	A107523	06/24/11	06/27/11	
Monochloroacetic Acid (MCAA)	EPA 552.2	ND	2.0	ug/L	1	A107523	06/24/11	06/27/11	
Total Haloacetic Acids, EPA 552.2		**8.2**	1.0	ug/L					
Trichloroacetic Acid (TCAA)	EPA 552.2	ND	1.0	ug/L	1	A107523	06/24/11	06/27/11	
Surrogate: 2,3-Dibromopropionic Acid	EPA 552.2	100 %		*Acceptable range: 70-130 %*					

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Report Issue Date: 06/30/2011 16:50
Received Date: 06/17/2011
Received Time: 08:00

Lab Sample ID: A1F1514-04
Sample Date: 06/16/2011 09:00
Sample Type: Grab
Sampled by: Erik Kane / Mark Allgood
Matrix: Water

Sample Description: TWR2

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Trihalomethanes by GC-MS									
Bromodichloromethane	EPA 524.2	**10**	0.50	ug/L	1	A107313	06/20/11	06/21/11	
Bromoform	EPA 524.2	**8.2**	0.50	ug/L	1	A107313	06/20/11	06/21/11	
Chloroform	EPA 524.2	**3.1**	0.50	ug/L	1	A107313	06/20/11	06/21/11	
Dibromochloromethane	EPA 524.2	**19**	0.50	ug/L	1	A107313	06/20/11	06/21/11	
Surrogate: Bromofluorobenzene	EPA 524.2	111 %		*Acceptable range: 70-130 %*					
***Total Trihalomethanes, EPA 524.2**		**40**	0.50	ug/L					
Haloacetic Acids by GC-ECD									
Dibromoacetic Acid (DBAA)	EPA 552.2	**6.3**	1.0	ug/L	1	A107523	06/24/11	06/28/11	
Dichloroacetic Acid (DCAA)	EPA 552.2	**1.8**	1.0	ug/L	1	A107523	06/24/11	06/28/11	
Monobromoacetic Acid (MBAA)	EPA 552.2	ND	1.0	ug/L	1	A107523	06/24/11	06/28/11	
Monochloroacetic Acid (MCAA)	EPA 552.2	ND	2.0	ug/L	1	A107523	06/24/11	06/28/11	
Total Haloacetic Acids, EPA 552.2		**8.0**	1.0	ug/L					
Trichloroacetic Acid (TCAA)	EPA 552.2	ND	1.0	ug/L	1	A107523	06/24/11	06/28/11	
Surrogate: 2,3-Dibromopropionic Acid	EPA 552.2	99 %		*Acceptable range: 70-130 %*					

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Received Date: 06/17/2011
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Lab Sample ID: A1F1514-05
Sample Date: 06/16/2011 07:00
Sample Type: Grab
Sampled by: Erik Kane / Mark Allgood
Matrix: Water

Sample Description: 116TH

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Trihalomethanes by GC-MS									
Bromodichloromethane	EPA 524.2	**2.7**	0.50	ug/L	1	A107313	06/20/11	06/21/11	
Bromoform	EPA 524.2	**3.3**	0.50	ug/L	1	A107313	06/20/11	06/21/11	
Chloroform	EPA 524.2	**0.86**	0.50	ug/L	1	A107313	06/20/11	06/21/11	
Dibromochloromethane	EPA 524.2	**6.0**	0.50	ug/L	1	A107313	06/20/11	06/21/11	
Surrogate: Bromofluorobenzene	EPA 524.2	108 %		*Acceptable range: 70-130 %*					
***Total Trihalomethanes, EPA 524.2**		**13**	0.50	ug/L					
Haloacetic Acids by GC-ECD									
Dibromoacetic Acid (DBAA)	EPA 552.2	**3.0**	1.0	ug/L	1	A107523	06/24/11	06/28/11	
Dichloroacetic Acid (DCAA)	EPA 552.2	ND	1.0	ug/L	1	A107523	06/24/11	06/28/11	
Monobromoacetic Acid (MBAA)	EPA 552.2	ND	1.0	ug/L	1	A107523	06/24/11	06/28/11	
Monochloroacetic Acid (MCAA)	EPA 552.2	ND	2.0	ug/L	1	A107523	06/24/11	06/28/11	
Total Haloacetic Acids, EPA 552.2		**3.0**	1.0	ug/L					
Trichloroacetic Acid (TCAA)	EPA 552.2	ND	1.0	ug/L	1	A107523	06/24/11	06/28/11	
Surrogate: 2,3-Dibromopropionic Acid	EPA 552.2	102 %		*Acceptable range: 70-130 %*					

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Report Issue Date: 06/30/2011 16:50
Received Date: 06/17/2011
Received Time: 08:00

Lab Sample ID: A1F1514-06
Sample Date: 06/16/2011 07:20
Sample Type: Grab

Sampled by: Erik Kane / Mark Allgood
Matrix: Water

Sample Description: 110th

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Trihalomethanes by GC-MS									
Bromodichloromethane	EPA 524.2	**4.0**	0.50	ug/L	1	A107313	06/20/11	06/21/11	
Bromoform	EPA 524.2	**4.9**	0.50	ug/L	1	A107313	06/20/11	06/21/11	
Chloroform	EPA 524.2	**1.4**	0.50	ug/L	1	A107313	06/20/11	06/21/11	
Dibromochloromethane	EPA 524.2	**8.8**	0.50	ug/L	1	A107313	06/20/11	06/21/11	
Surrogate: Bromofluorobenzene	EPA 524.2	110 %		*Acceptable range: 70-130 %*					
***Total Trihalomethanes, EPA 524.2**		**19**	0.50	ug/L					
Haloacetic Acids by GC-ECD									
Dibromoacetic Acid (DBAA)	EPA 552.2	**3.6**	1.0	ug/L	1	A107523	06/24/11	06/28/11	
Dichloroacetic Acid (DCAA)	EPA 552.2	ND	1.0	ug/L	1	A107523	06/24/11	06/28/11	
Monobromoacetic Acid (MBAA)	EPA 552.2	ND	1.0	ug/L	1	A107523	06/24/11	06/28/11	
Monochloroacetic Acid (MCAA)	EPA 552.2	ND	2.0	ug/L	1	A107523	06/24/11	06/28/11	
Total Haloacetic Acids, EPA 552.2		**3.6**	1.0	ug/L					
Trichloroacetic Acid (TCAA)	EPA 552.2	ND	1.0	ug/L	1	A107523	06/24/11	06/28/11	
Surrogate: 2,3-Dibromopropionic Acid	EPA 552.2	99 %		*Acceptable range: 70-130 %*					

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Report Issue Date: 06/30/2011 16:50
Received Date: 06/17/2011
Received Time: 08:00

Lab Sample ID: A1F1514-07
Sample Date: 06/16/2011 07:55
Sample Type: Grab
Sampled by: Erik Kane / Mark Allgood
Matrix: Water

Sample Description: 177th

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Trihalomethanes by GC-MS									
Bromodichloromethane	EPA 524.2	**5.9**	0.50	ug/L	1	A107313	06/20/11	06/21/11	
Bromoform	EPA 524.2	**5.9**	0.50	ug/L	1	A107313	06/20/11	06/21/11	
Chloroform	EPA 524.2	**1.8**	0.50	ug/L	1	A107313	06/20/11	06/21/11	
Dibromochloromethane	EPA 524.2	**12**	0.50	ug/L	1	A107313	06/20/11	06/21/11	
Surrogate: Bromofluorobenzene	EPA 524.2	107 %		*Acceptable range: 70-130 %*					
Total Trihalomethanes, EPA 524.2		**26**	0.50	ug/L					
Haloacetic Acids by GC-ECD									
Dibromoacetic Acid (DBAA)	EPA 552.2	**4.4**	1.0	ug/L	1	A107523	06/24/11	06/28/11	
Dichloroacetic Acid (DCAA)	EPA 552.2	**1.0**	1.0	ug/L	1	A107523	06/24/11	06/28/11	
Monobromoacetic Acid (MBAA)	EPA 552.2	ND	1.0	ug/L	1	A107523	06/24/11	06/28/11	
Monochloroacetic Acid (MCAA)	EPA 552.2	ND	2.0	ug/L	1	A107523	06/24/11	06/28/11	
Total Haloacetic Acids, EPA 552.2		**5.5**	1.0	ug/L					
Trichloroacetic Acid (TCAA)	EPA 552.2	ND	1.0	ug/L	1	A107523	06/24/11	06/28/11	
Surrogate: 2,3-Dibromopropionic Acid	EPA 552.2	96 %		*Acceptable range: 70-130 %*					

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Report Issue Date: 06/30/2011 16:50
Received Date: 06/17/2011
Received Time: 08:00

Lab Sample ID: A1F1514-08
Sample Date: 06/16/2011 07:40
Sample Type: Grab
Sampled by: Erik Kane / Mark Allgood
Matrix: Water

Sample Description: 165th

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Trihalomethanes by GC-MS									
Bromodichloromethane	EPA 524.2	**5.4**	0.50	ug/L	1	A107313	06/20/11	06/21/11	
Bromoform	EPA 524.2	**5.3**	0.50	ug/L	1	A107313	06/20/11	06/21/11	
Chloroform	EPA 524.2	**1.7**	0.50	ug/L	1	A107313	06/20/11	06/21/11	
Dibromochloromethane	EPA 524.2	**11**	0.50	ug/L	1	A107313	06/20/11	06/21/11	
Surrogate: Bromofluorobenzene	EPA 524.2	108 %		*Acceptable range: 70-130 %*					
'Total Trihalomethanes, EPA 524.2		**23**	0.50	ug/L					
Haloacetic Acids by GC-ECD									
Dibromoacetic Acid (DBAA)	EPA 552.2	**4.1**	1.0	ug/L	1	A107523	06/24/11	06/28/11	
Dichloroacetic Acid (DCAA)	EPA 552.2	ND	1.0	ug/L	1	A107523	06/24/11	06/28/11	
Monobromoacetic Acid (MBAA)	EPA 552.2	ND	1.0	ug/L	1	A107523	06/24/11	06/28/11	
Monochloroacetic Acid (MCAA)	EPA 552.2	ND	2.0	ug/L	1	A107523	06/24/11	06/28/11	
Total Haloacetic Acids, EPA 552.2		**4.1**	1.0	ug/L					
Trichloroacetic Acid (TCAA)	EPA 552.2	ND	1.0	ug/L	1	A107523	06/24/11	06/28/11	
Surrogate: 2,3-Dibromopropionic Acid	EPA 552.2	94 %		*Acceptable range: 70-130 %*					

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Report Issue Date: 06/28/2011 21:37
Received Date: 06/17/2011
Received Time: 08:00

Lab Sample ID: A1F1511-01
Sample Date: 06/16/2011 10:40
Sample Type: Grab
Sampled by: John Laux/Josh Ball
Matrix: Water

Sample Description: LVAV (Cal Water)

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Trihalomethanes by GC-MS									
Bromodichloromethane	EPA 524.2	**11**	0.50	ug/L	1	A107313	06/20/11	06/21/11	
Bromoform	EPA 524.2	**6.8**	0.50	ug/L	1	A107313	06/20/11	06/21/11	
Chloroform	EPA 524.2	**3.8**	0.50	ug/L	1	A107313	06/20/11	06/21/11	
Dibromochloromethane	EPA 524.2	**16**	0.50	ug/L	1	A107313	06/20/11	06/21/11	
Surrogate: Bromofluorobenzene	EPA 524.2	105 %		*Acceptable range: 70-130 %*					
***Total Trihalomethanes, EPA 524.2**		**38**	0.50	ug/L					
Haloacetic Acids by GC-ECD									
Dibromoacetic Acid (DBAA)	EPA 552.2	**5.5**	1.0	ug/L	1	A107405	06/22/11	06/24/11	
Dichloroacetic Acid (DCAA)	EPA 552.2	**2.4**	1.0	ug/L	1	A107405	06/22/11	06/24/11	
Monobromoacetic Acid (MBAA)	EPA 552.2	ND	1.0	ug/L	1	A107405	06/22/11	06/24/11	
Monochloroacetic Acid (MCAA)	EPA 552.2	ND	2.0	ug/L	1	A107405	06/22/11	06/24/11	
Total Haloacetic Acids, EPA 552.2		**7.9**	1.0	ug/L					
Trichloroacetic Acid (TCAA)	EPA 552.2	ND	1.0	ug/L	1	A107405	06/22/11	06/24/11	
Surrogate: 2,3-Dibromopropionic Acid	EPA 552.2	87 %		*Acceptable range: 70-130 %*					

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Report Issue Date: 06/28/2011 21:37
Received Date: 06/17/2011
Received Time: 08:00

Lab Sample ID: A1F1511-02
Sample Date: 06/16/2011 09:40
Sample Type: Grab

Sampled by: John Laux/Josh Ball
Matrix: Water

Sample Description: 5th/M

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Trihalomethanes by GC-MS									
Bromodichloromethane	EPA 524.2	**3.5**	0.50	ug/L	1	A107313	06/20/11	06/21/11	
Bromoform	EPA 524.2	**2.1**	0.50	ug/L	1	A107313	06/20/11	06/21/11	
Chloroform	EPA 524.2	**1.3**	0.50	ug/L	1	A107313	06/20/11	06/21/11	
Dibromochloromethane	EPA 524.2	**5.6**	0.50	ug/L	1	A107313	06/20/11	06/21/11	
Surrogate: Bromofluorobenzene	EPA 524.2	94 %		*Acceptable range: 70-130 %*					
Total Trihalomethanes, EPA 524.2		**12**	0.50	ug/L					
Haloacetic Acids by GC-ECD									
Dibromoacetic Acid (DBAA)	EPA 552.2	**2.6**	1.0	ug/L	1	A107405	06/22/11	06/24/11	
Dichloroacetic Acid (DCAA)	EPA 552.2	**1.1**	1.0	ug/L	1	A107405	06/22/11	06/24/11	
Monobromoacetic Acid (MBAA)	EPA 552.2	ND	1.0	ug/L	1	A107405	06/22/11	06/24/11	
Monochloroacetic Acid (MCAA)	EPA 552.2	ND	2.0	ug/L	1	A107405	06/22/11	06/24/11	
Total Haloacetic Acids, EPA 552.2		**3.7**	1.0	ug/L					
Trichloroacetic Acid (TCAA)	EPA 552.2	ND	1.0	ug/L	1	A107405	06/22/11	06/24/11	
Surrogate: 2,3-Dibromopropionic Acid	EPA 552.2	85 %		*Acceptable range: 70-130 %*					

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Report Issue Date: 06/28/2011 21:37
Received Date: 06/17/2011
Received Time: 08:00

Lab Sample ID: A1F1511-03
Sample Date: 06/16/2011 10:00
Sample Type: Grab

Sampled by: John Laux/Josh Ball
Matrix: Water

Sample Description: QHWD (50TH/N)

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Trihalomethanes by GC-MS									
Bromodichloromethane	EPA 524.2	**3.8**	0.50	ug/L	1	A107313	06/20/11	06/21/11	
Bromoform	EPA 524.2	**2.1**	0.50	ug/L	1	A107313	06/20/11	06/21/11	
Chloroform	EPA 524.2	**1.6**	0.50	ug/L	1	A107313	06/20/11	06/21/11	
Dibromochloromethane	EPA 524.2	**6.2**	0.50	ug/L	1	A107313	06/20/11	06/21/11	
Surrogate: Bromofluorobenzene	EPA 524.2	93 %		*Acceptable range: 70-130 %*					
***Total Trihalomethanes, EPA 524.2**		**14**	0.50	ug/L					
Haloacetic Acids by GC-ECD									
Dibromoacetic Acid (DBAA)	EPA 552.2	**2.3**	1.0	ug/L	1	A107405	06/22/11	06/24/11	
Dichloroacetic Acid (DCAA)	EPA 552.2	**1.2**	1.0	ug/L	1	A107405	06/22/11	06/24/11	
Monobromoacetic Acid (MBAA)	EPA 552.2	ND	1.0	ug/L	1	A107405	06/22/11	06/24/11	
Monochloroacetic Acid (MCAA)	EPA 552.2	ND	2.0	ug/L	1	A107405	06/22/11	06/24/11	
Total Haloacetic Acids, EPA 552.2		**3.5**	1.0	ug/L					
Trichloroacetic Acid (TCAA)	EPA 552.2	ND	1.0	ug/L	1	A107405	06/22/11	06/24/11	
Surrogate: 2,3-Dibromopropionic Acid	EPA 552.2	82 %		*Acceptable range: 70-130 %*					

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Report Issue Date: 06/28/2011 21:37
Received Date: 06/17/2011
Received Time: 08:00

Lab Sample ID: A1F1511-04
Sample Date: 06/16/2011 09:15
Sample Type: Grab
Sampled by: John Laux/Josh Ball
Matrix: Water

Sample Description: L-12/60TH

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Trihalomethanes by GC-MS									
Bromodichloromethane	EPA 524.2	**2.1**	0.50	ug/L	1	A107313	06/20/11	06/21/11	
Bromoform	EPA 524.2	**2.0**	0.50	ug/L	1	A107313	06/20/11	06/21/11	
Chloroform	EPA 524.2	**0.80**	0.50	ug/L	1	A107313	06/20/11	06/21/11	
Dibromochloromethane	EPA 524.2	**4.0**	0.50	ug/L	1	A107313	06/20/11	06/21/11	
Surrogate: Bromofluorobenzene	EPA 524.2	108 %		*Acceptable range: 70-130 %*					
***Total Trihalomethanes, EPA 524.2**		**8.9**	0.50	ug/L					
Haloacetic Acids by GC-ECD									
Dibromoacetic Acid (DBAA)	EPA 552.2	**4.4**	1.0	ug/L	1	A107406	06/22/11	06/24/11	
Dichloroacetic Acid (DCAA)	EPA 552.2	**1.4**	1.0	ug/L	1	A107406	06/22/11	06/24/11	
Monobromoacetic Acid (MBAA)	EPA 552.2	ND	1.0	ug/L	1	A107406	06/22/11	06/24/11	
Monochloroacetic Acid (MCAA)	EPA 552.2	ND	2.0	ug/L	1	A107406	06/22/11	06/24/11	
Total Haloacetic Acids, EPA 552.2		**5.8**	1.0	ug/L					
Trichloroacetic Acid (TCAA)	EPA 552.2	ND	1.0	ug/L	1	A107406	06/22/11	06/24/11	
Surrogate: 2,3-Dibromopropionic Acid	EPA 552.2	87 %		*Acceptable range: 70-130 %*					

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Report Issue Date: 09/30/2011 14:47
Received Date: 09/16/2011
Received Time: 10:20

Lab Sample ID: A1I1335-01
Sample Date: 09/15/2011 06:46
Sample Type: Grab
Sampled by: Terry Brown
Matrix: Water

Sample Description: VIN1

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Trihalomethanes by GC-MS									
Bromodichloromethane	EPA 524.2	**9.1**	0.50	ug/L	1	A111548	09/23/11	09/26/11	
Bromoform	EPA 524.2	**5.4**	0.50	ug/L	1	A111548	09/23/11	09/26/11	
Chloroform	EPA 524.2	**3.8**	0.50	ug/L	1	A111548	09/23/11	09/26/11	
Dibromochloromethane	EPA 524.2	**14**	0.50	ug/L	1	A111548	09/23/11	09/26/11	
Surrogate: Bromofluorobenzene	EPA 524.2	113 %		*Acceptable range: 70-130 %*					
***Total Trihalomethanes, EPA 524.2**		**32**	0.50	ug/L					
Haloacetic Acids by GC-ECD									
Dibromoacetic Acid (DBAA)	EPA 552.2	**6.7**	1.0	ug/L	1	A111516	09/23/11	09/25/11	
Dichloroacetic Acid (DCAA)	EPA 552.2	**2.8**	1.0	ug/L	1	A111516	09/23/11	09/25/11	
Monobromoacetic Acid (MBAA)	EPA 552.2	ND	1.0	ug/L	1	A111516	09/23/11	09/25/11	
Monochloroacetic Acid (MCAA)	EPA 552.2	**3.1**	2.0	ug/L	1	A111516	09/23/11	09/25/11	
Trichloroacetic Acid (TCAA)	EPA 552.2	ND	1.0	ug/L	1	A111516	09/23/11	09/25/11	
Surrogate: 2,3-Dibromopropionic Acid	EPA 552.2	99 %		*Acceptable range: 70-130 %*					
***Total Haloacetic Acids, EPA 552.2**		**13**	2.0	ug/L					

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Report Issue Date: 09/30/2011 14:47
Received Date: 09/16/2011
Received Time: 10:20

Lab Sample ID: A1I1335-02
Sample Date: 09/15/2011 06:45
Sample Type: Grab

Sampled by: Terry Brown
Matrix: Water

Sample Description: VIN2

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Trihalomethanes by GC-MS									
Bromodichloromethane	EPA 524.2	**8.8**	0.50	ug/L	1	A111548	09/23/11	09/26/11	
Bromoform	EPA 524.2	**4.7**	0.50	ug/L	1	A111548	09/23/11	09/26/11	
Chloroform	EPA 524.2	**3.5**	0.50	ug/L	1	A111548	09/23/11	09/26/11	
Dibromochloromethane	EPA 524.2	**13**	0.50	ug/L	1	A111548	09/23/11	09/26/11	
Surrogate: Bromofluorobenzene	EPA 524.2	99 %	*Acceptable range: 70-130 %*						
***Total Trihalomethanes, EPA 524.2**		**30**	0.50	ug/L					
Haloacetic Acids by GC-ECD									
Dibromoacetic Acid (DBAA)	EPA 552.2	**7.3**	1.0	ug/L	1	A111516	09/23/11	09/25/11	
Dichloroacetic Acid (DCAA)	EPA 552.2	**3.0**	1.0	ug/L	1	A111516	09/23/11	09/25/11	
Monobromoacetic Acid (MBAA)	EPA 552.2	**1.1**	1.0	ug/L	1	A111516	09/23/11	09/25/11	
Monochloroacetic Acid (MCAA)	EPA 552.2	ND	2.0	ug/L	1	A111516	09/23/11	09/25/11	
Trichloroacetic Acid (TCAA)	EPA 552.2	ND	1.0	ug/L	1	A111516	09/23/11	09/25/11	
Surrogate: 2,3-Dibromopropionic Acid	EPA 552.2	109 %	*Acceptable range: 70-130 %*						
***Total Haloacetic Acids, EPA 552.2**		**11**	2.0	ug/L					

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Report Issue Date: 09/30/2011 14:47
Received Date: 09/16/2011
Received Time: 10:20

Lab Sample ID: A1I1335-03
Sample Date: 09/15/2011 07:01
Sample Type: Grab
Sampled by: Terry Brown
Matrix: Water

Sample Description: TWR1

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Trihalomethanes by GC-MS									
Bromodichloromethane	EPA 524.2	**6.2**	0.50	ug/L	1	A111549	09/26/11	09/27/11	
Bromoform	EPA 524.2	**3.7**	0.50	ug/L	1	A111549	09/26/11	09/27/11	
Chloroform	EPA 524.2	**2.2**	0.50	ug/L	1	A111549	09/26/11	09/27/11	
Dibromochloromethane	EPA 524.2	**10**	0.50	ug/L	1	A111549	09/26/11	09/27/11	
Surrogate: Bromofluorobenzene	EPA 524.2	100 %	*Acceptable range: 70-130 %*						
***Total Trihalomethanes, EPA 524.2**		**22**	0.50	ug/L					
Haloacetic Acids by GC-ECD									
Dibromoacetic Acid (DBAA)	EPA 552.2	**6.6**	1.0	ug/L	1	A111516	09/23/11	09/25/11	
Dichloroacetic Acid (DCAA)	EPA 552.2	**1.9**	1.0	ug/L	1	A111516	09/23/11	09/25/11	
Monobromoacetic Acid (MBAA)	EPA 552.2	ND	1.0	ug/L	1	A111516	09/23/11	09/25/11	
Monochloroacetic Acid (MCAA)	EPA 552.2	ND	2.0	ug/L	1	A111516	09/23/11	09/25/11	
Trichloroacetic Acid (TCAA)	EPA 552.2	ND	1.0	ug/L	1	A111516	09/23/11	09/25/11	
Surrogate: 2,3-Dibromopropionic Acid	EPA 552.2	106 %	*Acceptable range: 70-130 %*						
***Total Haloacetic Acids, EPA 552.2**		**8.5**	2.0	ug/L					

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Report Issue Date: 09/30/2011 14:47
Received Date: 09/16/2011
Received Time: 10:20

Lab Sample ID: A1I1335-04
Sample Date: 09/15/2011 07:02
Sample Type: Grab

Sampled by: Terry Brown
Matrix: Water

Sample Description: TWR2

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Trihalomethanes by GC-MS									
Bromodichloromethane	EPA 524.2	**6.1**	0.50	ug/L	1	A111549	09/26/11	09/27/11	
Bromoform	EPA 524.2	**3.4**	0.50	ug/L	1	A111549	09/26/11	09/27/11	
Chloroform	EPA 524.2	**2.1**	0.50	ug/L	1	A111549	09/26/11	09/27/11	
Dibromochloromethane	EPA 524.2	**10**	0.50	ug/L	1	A111549	09/26/11	09/27/11	
Surrogate: Bromofluorobenzene	EPA 524.2	97 %		*Acceptable range: 70-130 %*					
***Total Trihalomethanes, EPA 524.2**		**22**	0.50	ug/L					
Haloacetic Acids by GC-ECD									
Dibromoacetic Acid (DBAA)	EPA 552.2	**6.2**	1.0	ug/L	1	A111516	09/23/11	09/25/11	
Dichloroacetic Acid (DCAA)	EPA 552.2	**1.9**	1.0	ug/L	1	A111516	09/23/11	09/25/11	
Monobromoacetic Acid (MBAA)	EPA 552.2	ND	1.0	ug/L	1	A111516	09/23/11	09/25/11	
Monochloroacetic Acid (MCAA)	EPA 552.2	**2.1**	2.0	ug/L	1	A111516	09/23/11	09/25/11	
Trichloroacetic Acid (TCAA)	EPA 552.2	ND	1.0	ug/L	1	A111516	09/23/11	09/25/11	
Surrogate: 2,3-Dibromopropionic Acid	EPA 552.2	103 %		*Acceptable range: 70-130 %*					
***Total Haloacetic Acids, EPA 552.2**		**10**	2.0	ug/L					

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Report Issue Date: 09/30/2011 14:49
Received Date: 09/16/2011
Received Time: 10:20

Lab Sample ID: A1I1322-01
Sample Date: 09/15/2011 07:58
Sample Type: Grab

Sampled by: Justin Livesay
Matrix: Water

Sample Description: 116th

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Trihalomethanes by GC-MS									
Bromodichloromethane	EPA 524.2	**2.7**	0.50	ug/L	1	A111548	09/23/11	09/26/11	
Bromoform	EPA 524.2	**2.8**	0.50	ug/L	1	A111548	09/23/11	09/26/11	
Chloroform	EPA 524.2	**1.1**	0.50	ug/L	1	A111548	09/23/11	09/26/11	
Dibromochloromethane	EPA 524.2	**5.8**	0.50	ug/L	1	A111548	09/23/11	09/26/11	
Surrogate: Bromofluorobenzene	EPA 524.2	110 %		*Acceptable range: 70-130 %*					
***Total Trihalomethanes, EPA 524.2**		**12**	0.50	ug/L					
Haloacetic Acids by GC-ECD									
Dibromoacetic Acid (DBAA)	EPA 552.2	**3.8**	1.0	ug/L	1	A111516	09/23/11	09/25/11	
Dichloroacetic Acid (DCAA)	EPA 552.2	ND	1.0	ug/L	1	A111516	09/23/11	09/25/11	
Monobromoacetic Acid (MBAA)	EPA 552.2	ND	1.0	ug/L	1	A111516	09/23/11	09/25/11	
Monochloroacetic Acid (MCAA)	EPA 552.2	ND	2.0	ug/L	1	A111516	09/23/11	09/25/11	
Trichloroacetic Acid (TCAA)	EPA 552.2	ND	1.0	ug/L	1	A111516	09/23/11	09/25/11	
Surrogate: 2,3-Dibromopropionic Acid	EPA 552.2	100 %		*Acceptable range: 70-130 %*					
***Total Haloacetic Acids, EPA 552.2**		**3.8**	2.0	ug/L					

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Report Issue Date: 09/30/2011 14:49
Received Date: 09/16/2011
Received Time: 10:20

Lab Sample ID: A1I1322-02
Sample Date: 09/15/2011 08:12
Sample Type: Grab
Sampled by: Justin Livesay
Matrix: Water

Sample Description: 110th

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Trihalomethanes by GC-MS									
Bromodichloromethane	EPA 524.2	**3.3**	0.50	ug/L	1	A111548	09/23/11	09/26/11	
Bromoform	EPA 524.2	**3.3**	0.50	ug/L	1	A111548	09/23/11	09/26/11	
Chloroform	EPA 524.2	**1.3**	0.50	ug/L	1	A111548	09/23/11	09/26/11	
Dibromochloromethane	EPA 524.2	**6.8**	0.50	ug/L	1	A111548	09/23/11	09/26/11	
Surrogate: Bromofluorobenzene	EPA 524.2	110 %		*Acceptable range: 70-130 %*					
*Total Trihalomethanes, EPA 524.2**		**15**	0.50	ug/L					
Haloacetic Acids by GC-ECD									
Dibromoacetic Acid (DBAA)	EPA 552.2	**5.5**	1.0	ug/L	1	A111516	09/23/11	09/25/11	
Dichloroacetic Acid (DCAA)	EPA 552.2	**1.1**	1.0	ug/L	1	A111516	09/23/11	09/25/11	
Monobromoacetic Acid (MBAA)	EPA 552.2	ND	1.0	ug/L	1	A111516	09/23/11	09/25/11	
Monochloroacetic Acid (MCAA)	EPA 552.2	**2.2**	2.0	ug/L	1	A111516	09/23/11	09/25/11	
Trichloroacetic Acid (TCAA)	EPA 552.2	ND	1.0	ug/L	1	A111516	09/23/11	09/25/11	
Surrogate: 2,3-Dibromopropionic Acid	EPA 552.2	110 %		*Acceptable range: 70-130 %*					
*Total Haloacetic Acids, EPA 552.2**		**8.8**	2.0	ug/L					

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Report Issue Date: 09/30/2011 14:49
Received Date: 09/16/2011
Received Time: 10:20

Lab Sample ID: A1I1322-03
Sample Date: 09/15/2011 08:39
Sample Type: Grab

Sampled by: Justin Livesay
Matrix: Water

Sample Description: 177th

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Trihalomethanes by GC-MS									
Bromodichloromethane	EPA 524.2	**8.3**	0.50	ug/L	1	A111548	09/23/11	09/26/11	
Bromoform	EPA 524.2	**5.0**	0.50	ug/L	1	A111548	09/23/11	09/26/11	
Chloroform	EPA 524.2	**3.3**	0.50	ug/L	1	A111548	09/23/11	09/26/11	
Dibromochloromethane	EPA 524.2	**12**	0.50	ug/L	1	A111548	09/23/11	09/26/11	
Surrogate: Bromofluorobenzene	EPA 524.2	99 %		*Acceptable range: 70-130 %*					
***Total Trihalomethanes, EPA 524.2**		**29**	0.50	ug/L					
Haloacetic Acids by GC-ECD									
Dibromoacetic Acid (DBAA)	EPA 552.2	**6.3**	1.0	ug/L	1	A111516	09/23/11	09/25/11	
Dichloroacetic Acid (DCAA)	EPA 552.2	**2.5**	1.0	ug/L	1	A111516	09/23/11	09/25/11	
Monobromoacetic Acid (MBAA)	EPA 552.2	ND	1.0	ug/L	1	A111516	09/23/11	09/25/11	
Monochloroacetic Acid (MCAA)	EPA 552.2	**3.3**	2.0	ug/L	1	A111516	09/23/11	09/25/11	
Trichloroacetic Acid (TCAA)	EPA 552.2	ND	1.0	ug/L	1	A111516	09/23/11	09/25/11	
Surrogate: 2,3-Dibromopropionic Acid	EPA 552.2	101 %		*Acceptable range: 70-130 %*					
***Total Haloacetic Acids, EPA 552.2**		**12**	2.0	ug/L					

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Report Issue Date: 09/30/2011 14:49
Received Date: 09/16/2011
Received Time: 10:20

Lab Sample ID: A1I1322-04
Sample Date: 09/15/2011 08:50
Sample Type: Grab

Sampled by: Justin Livesay
Matrix: Water

Sample Description: 165th

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Trihalomethanes by GC-MS									
Bromodichloromethane	EPA 524.2	**6.9**	0.50	ug/L	1	A111548	09/23/11	09/26/11	
Bromoform	EPA 524.2	**4.5**	0.50	ug/L	1	A111548	09/23/11	09/26/11	
Chloroform	EPA 524.2	**2.7**	0.50	ug/L	1	A111548	09/23/11	09/26/11	
Dibromochloromethane	EPA 524.2	**11**	0.50	ug/L	1	A111548	09/23/11	09/26/11	
Surrogate: Bromofluorobenzene	EPA 524.2	105 %		*Acceptable range: 70-130 %*					
***Total Trihalomethanes, EPA 524.2**		**25**	0.50	ug/L					
Haloacetic Acids by GC-ECD									
Dibromoacetic Acid (DBAA)	EPA 552.2	**6.4**	1.0	ug/L	1	A111516	09/23/11	09/25/11	
Dichloroacetic Acid (DCAA)	EPA 552.2	**2.0**	1.0	ug/L	1	A111516	09/23/11	09/25/11	
Monobromoacetic Acid (MBAA)	EPA 552.2	ND	1.0	ug/L	1	A111516	09/23/11	09/25/11	
Monochloroacetic Acid (MCAA)	EPA 552.2	**2.4**	2.0	ug/L	1	A111516	09/23/11	09/25/11	
Trichloroacetic Acid (TCAA)	EPA 552.2	ND	1.0	ug/L	1	A111516	09/23/11	09/25/11	
Surrogate: 2,3-Dibromopropionic Acid	EPA 552.2	104 %		*Acceptable range: 70-130 %*					
***Total Haloacetic Acids, EPA 552.2**		**11**	2.0	ug/L					

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Report Issue Date: 09/30/2011 14:49
Received Date: 09/16/2011
Received Time: 10:20

Lab Sample ID: A1I1322-05
Sample Date: 09/15/2011 12:00
Sample Type: Grab

Sampled by: Justin Livesay
Matrix: Water

Sample Description: LVAV

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Trihalomethanes by GC-MS									
Bromodichloromethane	EPA 524.2	**10**	0.50	ug/L	1	A111548	09/23/11	09/26/11	
Bromoform	EPA 524.2	**4.0**	0.50	ug/L	1	A111548	09/23/11	09/26/11	
Chloroform	EPA 524.2	**5.5**	0.50	ug/L	1	A111548	09/23/11	09/26/11	
Dibromochloromethane	EPA 524.2	**13**	0.50	ug/L	1	A111548	09/23/11	09/26/11	
Surrogate: Bromofluorobenzene	EPA 524.2	108 %		*Acceptable range: 70-130 %*					
***Total Trihalomethanes, EPA 524.2**		**32**	0.50	ug/L					
Haloacetic Acids by GC-ECD									
Dibromoacetic Acid (DBAA)	EPA 552.2	**5.9**	1.0	ug/L	1	A111516	09/23/11	09/25/11	
Dichloroacetic Acid (DCAA)	EPA 552.2	**3.9**	1.0	ug/L	1	A111516	09/23/11	09/25/11	
Monobromoacetic Acid (MBAA)	EPA 552.2	ND	1.0	ug/L	1	A111516	09/23/11	09/25/11	
Monochloroacetic Acid (MCAA)	EPA 552.2	**3.8**	2.0	ug/L	1	A111516	09/23/11	09/25/11	
Trichloroacetic Acid (TCAA)	EPA 552.2	**1.1**	1.0	ug/L	1	A111516	09/23/11	09/25/11	
Surrogate: 2,3-Dibromopropionic Acid	EPA 552.2	105 %		*Acceptable range: 70-130 %*					
***Total Haloacetic Acids, EPA 552.2**		**15**	2.0	ug/L					

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Report Issue Date: 09/30/2011 14:49
Received Date: 09/16/2011
Received Time: 10:20

Lab Sample ID: A1I1322-06
Sample Date: 09/15/2011 09:55
Sample Type: Grab

Sampled by: Justin Livesay
Matrix: Water

Sample Description: 5th/M

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Trihalomethanes by GC-MS									
Bromodichloromethane	EPA 524.2	**4.0**	0.50	ug/L	1	A111548	09/23/11	09/26/11	
Bromoform	EPA 524.2	**2.5**	0.50	ug/L	1	A111548	09/23/11	09/26/11	
Chloroform	EPA 524.2	**1.9**	0.50	ug/L	1	A111548	09/23/11	09/26/11	
Dibromochloromethane	EPA 524.2	**6.6**	0.50	ug/L	1	A111548	09/23/11	09/26/11	
Surrogate: Bromofluorobenzene	EPA 524.2	110 %		*Acceptable range: 70-130 %*					
***Total Trihalomethanes, EPA 524.2**		**15**	0.50	ug/L					
Haloacetic Acids by GC-ECD									
Dibromoacetic Acid (DBAA)	EPA 552.2	**5.3**	1.0	ug/L	1	A111516	09/23/11	09/25/11	
Dichloroacetic Acid (DCAA)	EPA 552.2	**1.6**	1.0	ug/L	1	A111516	09/23/11	09/25/11	
Monobromoacetic Acid (MBAA)	EPA 552.2	ND	1.0	ug/L	1	A111516	09/23/11	09/25/11	
Monochloroacetic Acid (MCAA)	EPA 552.2	**2.1**	2.0	ug/L	1	A111516	09/23/11	09/25/11	
Trichloroacetic Acid (TCAA)	EPA 552.2	ND	1.0	ug/L	1	A111516	09/23/11	09/25/11	
Surrogate: 2,3-Dibromopropionic Acid	EPA 552.2	102 %		*Acceptable range: 70-130 %*					
***Total Haloacetic Acids, EPA 552.2**		**9.0**	2.0	ug/L					

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Report Issue Date: 09/30/2011 14:49
Received Date: 09/16/2011
Received Time: 10:20

Lab Sample ID: A1I1322-07
Sample Date: 09/15/2011 09:25
Sample Type: Grab

Sampled by: Justin Livesay
Matrix: Water

Sample Description: QHWD (70TH/M-8)

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Trihalomethanes by GC-MS									
Bromodichloromethane	EPA 524.2	**2.3**	0.50	ug/L	1	A111548	09/23/11	09/26/11	
Bromoform	EPA 524.2	**1.7**	0.50	ug/L	1	A111548	09/23/11	09/26/11	
Chloroform	EPA 524.2	**1.1**	0.50	ug/L	1	A111548	09/23/11	09/26/11	
Dibromochloromethane	EPA 524.2	**4.1**	0.50	ug/L	1	A111548	09/23/11	09/26/11	
Surrogate: Bromofluorobenzene	EPA 524.2	102 %		*Acceptable range: 70-130 %*					
***Total Trihalomethanes, EPA 524.2**		**9.2**	0.50	ug/L					
Haloacetic Acids by GC-ECD									
Dibromoacetic Acid (DBAA)	EPA 552.2	**3.2**	1.0	ug/L	1	A111516	09/23/11	09/25/11	
Dichloroacetic Acid (DCAA)	EPA 552.2	**1.3**	1.0	ug/L	1	A111516	09/23/11	09/25/11	
Monobromoacetic Acid (MBAA)	EPA 552.2	ND	1.0	ug/L	1	A111516	09/23/11	09/25/11	
Monochloroacetic Acid (MCAA)	EPA 552.2	ND	2.0	ug/L	1	A111516	09/23/11	09/25/11	
Trichloroacetic Acid (TCAA)	EPA 552.2	ND	1.0	ug/L	1	A111516	09/23/11	09/25/11	
Surrogate: 2,3-Dibromopropionic Acid	EPA 552.2	106 %		*Acceptable range: 70-130 %*					
***Total Haloacetic Acids, EPA 552.2**		**4.5**	2.0	ug/L					

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Report Issue Date: 09/30/2011 14:49
Received Date: 09/16/2011
Received Time: 10:20

Lab Sample ID: A1I1322-08
Sample Date: 09/15/2011 09:00
Sample Type: Grab

Sampled by: Justin Livesay
Matrix: Water

Sample Description: L-12/60th

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Trihalomethanes by GC-MS									
Bromodichloromethane	EPA 524.2	**2.1**	0.50	ug/L	1	A111548	09/23/11	09/26/11	
Bromoform	EPA 524.2	**1.5**	0.50	ug/L	1	A111548	09/23/11	09/26/11	
Chloroform	EPA 524.2	**1.0**	0.50	ug/L	1	A111548	09/23/11	09/26/11	
Dibromochloromethane	EPA 524.2	**4.2**	0.50	ug/L	1	A111548	09/23/11	09/26/11	
Surrogate: Bromofluorobenzene	EPA 524.2	96 %		*Acceptable range: 70-130 %*					
***Total Trihalomethanes, EPA 524.2**		**8.8**	0.50	ug/L					
Haloacetic Acids by GC-ECD									
Dibromoacetic Acid (DBAA)	EPA 552.2	**3.1**	1.0	ug/L	1	A111516	09/23/11	09/25/11	
Dichloroacetic Acid (DCAA)	EPA 552.2	**1.1**	1.0	ug/L	1	A111516	09/23/11	09/25/11	
Monobromoacetic Acid (MBAA)	EPA 552.2	ND	1.0	ug/L	1	A111516	09/23/11	09/25/11	
Monochloroacetic Acid (MCAA)	EPA 552.2	ND	2.0	ug/L	1	A111516	09/23/11	09/25/11	
Trichloroacetic Acid (TCAA)	EPA 552.2	ND	1.0	ug/L	1	A111516	09/23/11	09/25/11	
Surrogate: 2,3-Dibromopropionic Acid	EPA 552.2	108 %		*Acceptable range: 70-130 %*					
***Total Haloacetic Acids, EPA 552.2**		**4.2**	2.0	ug/L					

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Report Issue Date: 12/29/2011 16:01
Received Date: 12/16/2011
Received Time: 10:23

Lab Sample ID: A1L1253-01
Sample Date: 12/15/2011 08:02
Sample Type: Grab

Sampled by: Alan Morris
Matrix: Water

Sample Description: 116th

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Trihalomethanes by GC-MS									
Bromodichloromethane	EPA 524.2	ND	0.50	ug/L	1	A114821	12/20/11	12/20/11	
Bromoform	EPA 524.2	**0.94**	0.50	ug/L	1	A114821	12/20/11	12/20/11	
Chloroform	EPA 524.2	ND	0.50	ug/L	1	A114821	12/20/11	12/20/11	
Dibromochloromethane	EPA 524.2	**0.74**	0.50	ug/L	1	A114821	12/20/11	12/20/11	
Surrogate: Bromofluorobenzene	EPA 524.2	112 %		*Acceptable range: 70-130 %*					
***Total Trihalomethanes, EPA 524.2**		**1.7**	0.50	ug/L					
Haloacetic Acids by GC-ECD									
Dibromoacetic Acid (DBAA)	EPA 552.2	ND	1.0	ug/L	1	A114995	12/24/11	12/25/11	
Dichloroacetic Acid (DCAA)	EPA 552.2	ND	1.0	ug/L	1	A114995	12/24/11	12/25/11	
Monobromoacetic Acid (MBAA)	EPA 552.2	ND	1.0	ug/L	1	A114995	12/24/11	12/25/11	
Monochloroacetic Acid (MCAA)	EPA 552.2	ND	2.0	ug/L	1	A114995	12/24/11	12/25/11	
Trichloroacetic Acid (TCAA)	EPA 552.2	ND	1.0	ug/L	1	A114995	12/24/11	12/25/11	
Surrogate: 2,3-Dibromopropionic Acid	EPA 552.2	94 %		*Acceptable range: 70-130 %*					
*Total Haloacetic Acids, EPA 552.2		ND	2.0	ug/L					

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Report Issue Date: 12/29/2011 16:01
Received Date: 12/16/2011
Received Time: 10:23

Lab Sample ID: A1L1253-02
Sample Date: 12/15/2011 08:20
Sample Type: Grab

Sampled by: Alan Morris
Matrix: Water

Sample Description: 110th

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Trihalomethanes by GC-MS									
Bromodichloromethane	EPA 524.2	**0.69**	0.50	ug/L	1	A114822	12/20/11	12/21/11	
Bromoform	EPA 524.2	**1.3**	0.50	ug/L	1	A114822	12/20/11	12/21/11	
Chloroform	EPA 524.2	ND	0.50	ug/L	1	A114822	12/20/11	12/21/11	
Dibromochloromethane	EPA 524.2	**1.2**	0.50	ug/L	1	A114822	12/20/11	12/21/11	
Surrogate: Bromofluorobenzene	EPA 524.2	100 %		*Acceptable range: 70-130 %*					
***Total Trihalomethanes, EPA 524.2**		**3.2**	0.50	ug/L					
Haloacetic Acids by GC-ECD									
Dibromoacetic Acid (DBAA)	EPA 552.2	ND	1.0	ug/L	1	A115036	12/27/11	12/28/11	
Dichloroacetic Acid (DCAA)	EPA 552.2	ND	1.0	ug/L	1	A115036	12/27/11	12/28/11	
Monobromoacetic Acid (MBAA)	EPA 552.2	ND	1.0	ug/L	1	A115036	12/27/11	12/28/11	
Monochloroacetic Acid (MCAA)	EPA 552.2	ND	2.0	ug/L	1	A115036	12/27/11	12/28/11	
Trichloroacetic Acid (TCAA)	EPA 552.2	ND	1.0	ug/L	1	A115036	12/27/11	12/28/11	
Surrogate: 2,3-Dibromopropionic Acid	EPA 552.2	98 %		*Acceptable range: 70-130 %*					
*Total Haloacetic Acids, EPA 552.2		ND	2.0	ug/L					

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Report Issue Date: 12/29/2011 16:01
Received Date: 12/16/2011
Received Time: 10:23

Lab Sample ID: A1L1253-03
Sample Date: 12/15/2011 08:44
Sample Type: Grab
Sampled by: Alan Morris
Matrix: Water

Sample Description: 177th

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Trihalomethanes by GC-MS									
Bromodichloromethane	EPA 524.2	**0.81**	0.50	ug/L	1	A114822	12/20/11	12/21/11	
Bromoform	EPA 524.2	**0.69**	0.50	ug/L	1	A114822	12/20/11	12/21/11	
Chloroform	EPA 524.2	ND	0.50	ug/L	1	A114822	12/20/11	12/21/11	
Dibromochloromethane	EPA 524.2	**0.97**	0.50	ug/L	1	A114822	12/20/11	12/21/11	
Surrogate: Bromofluorobenzene	EPA 524.2	93 %		*Acceptable range: 70-130 %*					
***Total Trihalomethanes, EPA 524.2**		**2.5**	0.50	ug/L					
Haloacetic Acids by GC-ECD									
Dibromoacetic Acid (DBAA)	EPA 552.2	ND	1.0	ug/L	1	A114995	12/24/11	12/25/11	
Dichloroacetic Acid (DCAA)	EPA 552.2	ND	1.0	ug/L	1	A114995	12/24/11	12/25/11	
Monobromoacetic Acid (MBAA)	EPA 552.2	ND	1.0	ug/L	1	A114995	12/24/11	12/25/11	
Monochloroacetic Acid (MCAA)	EPA 552.2	ND	2.0	ug/L	1	A114995	12/24/11	12/25/11	
Trichloroacetic Acid (TCAA)	EPA 552.2	ND	1.0	ug/L	1	A114995	12/24/11	12/25/11	
Surrogate: 2,3-Dibromopropionic Acid	EPA 552.2	98 %		*Acceptable range: 70-130 %*					
*Total Haloacetic Acids, EPA 552.2		ND	2.0	ug/L					

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Report Issue Date: 12/29/2011 16:01
Received Date: 12/16/2011
Received Time: 10:23

Lab Sample ID: A1L1253-04
Sample Date: 12/15/2011 09:00
Sample Type: Grab

Sampled by: Alan Morris
Matrix: Water

Sample Description: 165th

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Trihalomethanes by GC-MS									
Bromodichloromethane	EPA 524.2	**0.60**	0.50	ug/L	1	A114822	12/20/11	12/21/11	
Bromoform	EPA 524.2	**0.72**	0.50	ug/L	1	A114822	12/20/11	12/21/11	
Chloroform	EPA 524.2	ND	0.50	ug/L	1	A114822	12/20/11	12/21/11	
Dibromochloromethane	EPA 524.2	**0.79**	0.50	ug/L	1	A114822	12/20/11	12/21/11	
Surrogate: Bromofluorobenzene	EPA 524.2	100 %		*Acceptable range: 70-130 %*					
***Total Trihalomethanes, EPA 524.2**		**2.1**	0.50	ug/L					
Haloacetic Acids by GC-ECD									
Dibromoacetic Acid (DBAA)	EPA 552.2	ND	1.0	ug/L	1	A114995	12/24/11	12/25/11	
Dichloroacetic Acid (DCAA)	EPA 552.2	ND	1.0	ug/L	1	A114995	12/24/11	12/25/11	
Monobromoacetic Acid (MBAA)	EPA 552.2	ND	1.0	ug/L	1	A114995	12/24/11	12/25/11	
Monochloroacetic Acid (MCAA)	EPA 552.2	ND	2.0	ug/L	1	A114995	12/24/11	12/25/11	
Trichloroacetic Acid (TCAA)	EPA 552.2	ND	1.0	ug/L	1	A114995	12/24/11	12/25/11	
Surrogate: 2,3-Dibromopropionic Acid	EPA 552.2	96 %		*Acceptable range: 70-130 %*					
*Total Haloacetic Acids, EPA 552.2		ND	2.0	ug/L					

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Report Issue Date: 12/29/2011 16:01
Received Date: 12/16/2011
Received Time: 10:23

Lab Sample ID: A1L1253-05
Sample Date: 12/15/2011 09:55
Sample Type: Grab
Sampled by: John Laux
Matrix: Water

Sample Description: LVAV

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Trihalomethanes by GC-MS									
Bromodichloromethane	EPA 524.2	**6.7**	0.50	ug/L	1	A114822	12/20/11	12/21/11	
Bromoform	EPA 524.2	**5.8**	0.50	ug/L	1	A114822	12/20/11	12/21/11	
Chloroform	EPA 524.2	**2.9**	0.50	ug/L	1	A114822	12/20/11	12/21/11	
Dibromochloromethane	EPA 524.2	**12**	0.50	ug/L	1	A114822	12/20/11	12/21/11	
Surrogate: Bromofluorobenzene	EPA 524.2	100 %		*Acceptable range: 70-130 %*					
'Total Trihalomethanes, EPA 524.2		**27**	0.50	ug/L					
Haloacetic Acids by GC-ECD									
Dibromoacetic Acid (DBAA)	EPA 552.2	**4.8**	1.0	ug/L	1	A114995	12/24/11	12/25/11	
Dichloroacetic Acid (DCAA)	EPA 552.2	**3.3**	1.0	ug/L	1	A114995	12/24/11	12/25/11	
Monobromoacetic Acid (MBAA)	EPA 552.2	ND	1.0	ug/L	1	A114995	12/24/11	12/25/11	
Monochloroacetic Acid (MCAA)	EPA 552.2	ND	2.0	ug/L	1	A114995	12/24/11	12/25/11	
Trichloroacetic Acid (TCAA)	EPA 552.2	ND	1.0	ug/L	1	A114995	12/24/11	12/25/11	
Surrogate: 2,3-Dibromopropionic Acid	EPA 552.2	77 %		*Acceptable range: 70-130 %*					
'Total Haloacetic Acids, EPA 552.2		**8.1**	2.0	ug/L					

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Report Issue Date: 12/29/2011 16:01
Received Date: 12/16/2011
Received Time: 10:23

Lab Sample ID: A1L1253-06
Sample Date: 12/15/2011 11:20
Sample Type: Grab

Sampled by: John Laux
Matrix: Water

Sample Description: 10th/N

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Trihalomethanes by GC-MS									
Bromodichloromethane	EPA 524.2	**1.9**	0.50	ug/L	1	A114822	12/20/11	12/21/11	
Bromoform	EPA 524.2	**5.1**	0.50	ug/L	1	A114822	12/20/11	12/21/11	
Chloroform	EPA 524.2	**0.66**	0.50	ug/L	1	A114822	12/20/11	12/21/11	
Dibromochloromethane	EPA 524.2	**5.8**	0.50	ug/L	1	A114822	12/20/11	12/21/11	
Surrogate: Bromofluorobenzene	EPA 524.2	100 %		*Acceptable range: 70-130 %*					
***Total Trihalomethanes, EPA 524.2**		**13**	0.50	ug/L					
Haloacetic Acids by GC-ECD									
Dibromoacetic Acid (DBAA)	EPA 552.2	**3.6**	1.0	ug/L	1	A114995	12/24/11	12/25/11	
Dichloroacetic Acid (DCAA)	EPA 552.2	**1.1**	1.0	ug/L	1	A114995	12/24/11	12/25/11	
Monobromoacetic Acid (MBAA)	EPA 552.2	ND	1.0	ug/L	1	A114995	12/24/11	12/25/11	
Monochloroacetic Acid (MCAA)	EPA 552.2	ND	2.0	ug/L	1	A114995	12/24/11	12/25/11	
Trichloroacetic Acid (TCAA)	EPA 552.2	ND	1.0	ug/L	1	A114995	12/24/11	12/25/11	
Surrogate: 2,3-Dibromopropionic Acid	EPA 552.2	74 %		*Acceptable range: 70-130 %*					
***Total Haloacetic Acids, EPA 552.2**		**4.7**	2.0	ug/L					

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Report Issue Date: 12/29/2011 16:01
Received Date: 12/16/2011
Received Time: 10:23

Lab Sample ID: A1L1253-07
Sample Date: 12/15/2011 10:30
Sample Type: Grab

Sampled by: John Laux
Matrix: Water

Sample Description: QHWD (50th/N)

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Trihalomethanes by GC-MS									
Bromodichloromethane	EPA 524.2	**1.4**	0.50	ug/L	1	A114822	12/20/11	12/21/11	
Bromoform	EPA 524.2	**3.8**	0.50	ug/L	1	A114822	12/20/11	12/21/11	
Chloroform	EPA 524.2	ND	0.50	ug/L	1	A114822	12/20/11	12/21/11	
Dibromochloromethane	EPA 524.2	**4.0**	0.50	ug/L	1	A114822	12/20/11	12/21/11	
Surrogate: Bromofluorobenzene	EPA 524.2	100 %		*Acceptable range: 70-130 %*					
***Total Trihalomethanes, EPA 524.2**		**9.2**	0.50	ug/L					
Haloacetic Acids by GC-ECD									
Dibromoacetic Acid (DBAA)	EPA 552.2	**3.1**	1.0	ug/L	1	A114995	12/24/11	12/25/11	
Dichloroacetic Acid (DCAA)	EPA 552.2	ND	1.0	ug/L	1	A114995	12/24/11	12/25/11	
Monobromoacetic Acid (MBAA)	EPA 552.2	ND	1.0	ug/L	1	A114995	12/24/11	12/25/11	
Monochloroacetic Acid (MCAA)	EPA 552.2	ND	2.0	ug/L	1	A114995	12/24/11	12/25/11	
Trichloroacetic Acid (TCAA)	EPA 552.2	ND	1.0	ug/L	1	A114995	12/24/11	12/25/11	
Surrogate: 2,3-Dibromopropionic Acid	EPA 552.2	76 %		*Acceptable range: 70-130 %*					
***Total Haloacetic Acids, EPA 552.2**		**3.1**	2.0	ug/L					

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Palmdale, CA 93551

Report Issue Date: 12/29/2011 16:01
Received Date: 12/16/2011
Received Time: 10:23

Lab Sample ID: A1L1253-08
Sample Date: 12/15/2011 09:30
Sample Type: Grab
Sampled by: John Laux
Matrix: Water

Sample Description: L-12/60th

Organics

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Trihalomethanes by GC-MS									
Bromodichloromethane	EPA 524.2	**1.2**	0.50	ug/L	1	A114822	12/20/11	12/21/11	
Bromoform	EPA 524.2	**3.7**	0.50	ug/L	1	A114822	12/20/11	12/21/11	
Chloroform	EPA 524.2	ND	0.50	ug/L	1	A114822	12/20/11	12/21/11	
Dibromochloromethane	EPA 524.2	**3.6**	0.50	ug/L	1	A114822	12/20/11	12/21/11	
Surrogate: Bromofluorobenzene	EPA 524.2	101 %		*Acceptable range: 70-130 %*					
***Total Trihalomethanes, EPA 524.2**		**8.5**	0.50	ug/L					
Haloacetic Acids by GC-ECD									
Dibromoacetic Acid (DBAA)	EPA 552.2	**3.5**	1.0	ug/L	1	A114995	12/24/11	12/25/11	
Dichloroacetic Acid (DCAA)	EPA 552.2	ND	1.0	ug/L	1	A114995	12/24/11	12/25/11	
Monobromoacetic Acid (MBAA)	EPA 552.2	ND	1.0	ug/L	1	A114995	12/24/11	12/25/11	
Monochloroacetic Acid (MCAA)	EPA 552.2	ND	2.0	ug/L	1	A114995	12/24/11	12/25/11	
Trichloroacetic Acid (TCAA)	EPA 552.2	ND	1.0	ug/L	1	A114995	12/24/11	12/25/11	
Surrogate: 2,3-Dibromopropionic Acid	EPA 552.2	82 %		*Acceptable range: 70-130 %*					
***Total Haloacetic Acids, EPA 552.2**		**3.5**	2.0	ug/L					

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Report Issue Date: 01/20/2011 13:02
Received Date: 01/14/2011
Received Time: 08:16

Lab Sample ID: A1A0929-02
Sample Date: 01/12/2011 08:17
Sample Type: Grab

Sampled by: Terry Brown/Justin Livesay
Matrix: Water

Sample Description: QHWTP CWR

General Chemistry

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Bromate	EPA 317.0	**0.0039**	0.0010	mg/L	1	A100708	01/18/11	01/18/11	
Bromide	EPA 300.1	**0.12**	0.0050	mg/L	1	A100761	01/19/11	01/19/11	

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Report Issue Date: 02/21/2011 22:41
Received Date: 02/11/2011
Received Time: 08:00

Lab Sample ID: A1B0918-01
Sample Date: 02/09/2011 12:26
Sample Type: Grab

Sampled by: Justin Livesay
Matrix: Water

Sample Description: QHWTP CWR

General Chemistry

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Bromate	EPA 317.0	**0.0031**	0.0010	mg/L	1	A101764	02/14/11	02/14/11	
Bromide	EPA 300.1	**0.054**	0.0050	mg/L	1	A101970	02/16/11	02/16/11	

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Report Issue Date: 03/21/2011 15:22
Received Date: 03/10/2011
Received Time: 10:00

Lab Sample ID: A1C0841-01
Sample Date: 03/09/2011 08:58
Sample Type: Grab

Sampled by: Kat White/Terry Brown
Matrix: Water

Sample Description: QHWTP CWR

General Chemistry

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Bromate	EPA 317.0	**0.0032**	0.0010	mg/L	1	A103072	03/18/11	03/18/11	
Bromide	EPA 300.1	**0.067**	0.0050	mg/L	1	A102811	03/11/11	03/11/11	

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Report Issue Date: 04/26/2011 8:51
Received Date: 04/14/2011
Received Time: 10:00

Lab Sample ID: A1D1095-01
Sample Date: 04/13/2011 07:49
Sample Type: Grab

Sampled by: Kat White
Matrix: Water

Sample Description: QHWTP CWR

General Chemistry

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Bromate	EPA 317.0	**0.0024**	0.0010	mg/L	1	A104355	04/18/11	04/18/11	
Bromide	EPA 300.1	**0.075**	0.010	mg/L	2	A104489	04/20/11	04/20/11	

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Report Issue Date: 05/24/2011 14:18
Received Date: 05/13/2011
Received Time: 08:15

Lab Sample ID: A1E1050-01
Sample Date: 05/12/2011 11:15
Sample Type: Grab
Sampled by: Eric Kane
Matrix: Water

Sample Description: AWTP CWR

General Chemistry

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Bromate	EPA 317.0	**0.0011**	0.0010	mg/L	1	A105885	05/17/11	05/17/11	
Bromide	EPA 300.1	**0.019**	0.0050	mg/L	1	A105820	05/17/11	05/17/11	

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Report Issue Date: 05/24/2011 14:07
Received Date: 05/12/2011
Received Time: 10:00

Lab Sample ID: A1E0923-03
Sample Date: 05/11/2011 06:31
Sample Type: Grab
Sample Control Qualifiers: SC02
Sampled by: Doug Paterson
Matrix: Water

Sample Description: EWTP CWR

General Chemistry

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Bromate	EPA 317.0	ND	0.0010	mg/L	1	A105885	05/17/11	05/17/11	
Bromide	EPA 300.1	**0.019**	0.0050	mg/L	1	A105820	05/17/11	05/17/11	

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Report Issue Date: 05/24/2011 14:07
Received Date: 05/12/2011
Received Time: 10:00

Lab Sample ID: A1E0923-01
Sample Date: 05/11/2011 07:26
Sampled by: Justin Livesay
Sample Type: Grab
Matrix: Water
Sample Control Qualifiers: SC02

Sample Description: QHWTP CWR

General Chemistry

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Bromate	EPA 317.0	ND	0.0010	mg/L	1	A105885	05/17/11	05/17/11	
Bromide	EPA 300.1	**0.022**	0.0050	mg/L	1	A105820	05/17/11	05/17/11	

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Report Issue Date: 06/28/2011 21:34
Received Date: 06/17/2011
Received Time: 08:00

Lab Sample ID: A1F1510-01
Sample Date: 06/09/2011 10:50
Sample Type: Grab

Sampled by: Eric Kane
Matrix: Water

Sample Description: AWTP CWR

General Chemistry

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Bromate	EPA 317.0	**0.0022**	0.0010	mg/L	1	A107298	06/17/11	06/17/11	

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Report Issue Date: 6/23/2011 16:22
Received Date: 06/09/2011
Received Time: 08:00

Lab Sample ID: A1F0823-03
Sample Date: 06/08/2011 07:20
Sample Type: Grab

Sampled by: Doug Paterson
Matrix: Water

Sample Description: EWTP CWR

General Chemistry

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Bromate	EPA 317.0	**0.0024**	0.0010	mg/L	1	A106996	06/10/11	06/10/11	

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Report Issue Date: 6/23/2011 16:22
Received Date: 06/09/2011
Received Time: 08:00

Lab Sample ID: A1F0823-01
Sample Date: 06/08/2011 09:05
Sample Type: Grab

Sampled by: Justin Livesay
Matrix: Water

Sample Description: QHWTP CWR

General Chemistry

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Bromate	EPA 317.0	**0.0038**	0.0010	mg/L	1	A106996	06/10/11	06/10/11	

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Report Issue Date: 07/25/2011 11:55
Received Date: 07/15/2011
Received Time: 13:28

Lab Sample ID: A1G1182-04
Sample Date: 07/14/2011 11:30
Sample Type: Grab
Sampled by: Eric Kane
Matrix: Water

Sample Description: AWTP CWR

General Chemistry

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Bromate	EPA 317.0	**0.0019**	0.0010	mg/L	1	A108587	07/21/11	07/21/11	

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Report Issue Date: 07/25/2011 11:55
Received Date: 07/15/2011
Received Time: 13:28

Lab Sample ID: A1G1182-03
Sample Date: 07/13/2011 06:14
Sample Type: Grab

Sampled by: Doug Paterson
Matrix: Water

Sample Description: EWTP CWR

General Chemistry

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Bromate	EPA 317.0	**0.0022**	0.0010	mg/L	1	A108587	07/21/11	07/21/11	

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Report Issue Date: 07/25/2011 11:55
Received Date: 07/15/2011
Received Time: 13:28

Lab Sample ID: A1G1182-01
Sample Date: 07/13/2011 12:51
Sample Type: Grab
Sampled by: S. Livesly
Matrix: Water

Sample Description: QHWTP CWR

General Chemistry

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Bromate	EPA 317.0	**0.0022**	0.0010	mg/L	1	A108587	07/21/11	07/21/11	

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Report Issue Date: 08/22/2011 13:16
Received Date: 08/12/2011
Received Time: 08:30

Lab Sample ID: A1H1232-04
Sample Date: 08/11/2011 10:00
Sample Type: Grab

Sampled by: Kat White
Matrix: Water

Sample Description: AWTP CWR

General Chemistry

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Bromate	EPA 317.0	**0.0052**	0.0010	mg/L	1	A109808	08/15/11	08/15/11	

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Report Issue Date: 08/22/2011 13:16
Received Date: 08/12/2011
Received Time: 08:30

Lab Sample ID: A1H1232-03
Sample Date: 08/10/2011 08:10
Sample Type: Grab
Sampled by: Kat White
Matrix: Water

Sample Description: EWTP CWR

General Chemistry

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Bromate	EPA 317.0	**0.0042**	0.0010	mg/L	1	A109808	08/15/11	08/15/11	

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Report Issue Date: 08/22/2011 13:16
Received Date: 08/12/2011
Received Time: 08:30

Lab Sample ID: A1H1232-01
Sample Date: 08/10/2011 10:10
Sample Type: Grab
Sampled by: Kat White
Matrix: Water

Sample Description: QHWTP CWR

General Chemistry

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Bromate	EPA 317.0	**0.0061**	0.0010	mg/L	1	A109808	08/15/11	08/15/11	

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Report Issue Date: 09/28/2011 13:02
Received Date: 09/15/2011
Received Time: 09:50

Lab Sample ID: A1I1115-04
Sample Date: 09/14/2011 08:25
Sample Type: Grab
Sampled by: E. Kane
Matrix: Water

Sample Description: AWTP CWR

General Chemistry

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Bromate	EPA 317.0	**0.013**	0.0010	mg/L	1	A111571	09/23/11	09/23/11	

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Report Issue Date: 09/28/2011 13:02
Received Date: 09/15/2011
Received Time: 09:50

Lab Sample ID: A1I1115-03
Sample Date: 09/14/2011 07:06
Sample Type: Grab

Sampled by: S. Horn
Matrix: Water

Sample Description: EWTP CWR

General Chemistry

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Bromate	EPA 317.0	**0.0034**	0.0010	mg/L	1	A111571	09/23/11	09/23/11	

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Report Issue Date: 09/28/2011 13:02
Received Date: 09/15/2011
Received Time: 09:50

Lab Sample ID: A1I1115-01
Sample Date: 09/14/2011 12:55
Sample Type: Grab

Sampled by: K. White
Matrix: Water

Sample Description: QHWTP CWR

General Chemistry

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Bromate	EPA 317.0	**0.0045**	0.0010	mg/L	1	A111571	09/23/11	09/23/11	

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Report Issue Date: 11/01/2011 17:01
Received Date: 10/14/2011
Received Time: 10:00

Lab Sample ID: A1J1198-04
Sample Date: 10/12/2011 09:24
Sample Type: Grab
Sampled by: Doug Paterson
Matrix: Water

Sample Description: AWTP CWR

General Chemistry

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Bromate	EPA 317.0	**0.0035**	0.0010	mg/L	1	A113042	10/31/11	10/31/11	

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Report Issue Date: 11/01/2011 17:01
Received Date: 10/14/2011
Received Time: 10:00

Lab Sample ID: A1J1198-03
Sample Date: 10/12/2011 06:36
Sample Type: Grab

Sampled by: Doug Paterson
Matrix: Water

Sample Description: EWTP CWR

General Chemistry

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Bromate	EPA 317.0	**0.0023**	0.0010	mg/L	1	A113042	10/31/11	10/31/11	

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Report Issue Date: 11/01/2011 17:01
Received Date: 10/14/2011
Received Time: 10:00

Lab Sample ID: A1J1198-01
Sample Date: 10/12/2011 09:28
Sample Type: Grab

Sampled by: Kat White
Matrix: Water

Sample Description: QHWTP CWR

General Chemistry

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Bromate	EPA 317.0	**0.0027**	0.0010	mg/L	1	A112742	10/21/11	10/21/11	

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Report Issue Date: 11/18/2011 12:23
Received Date: 11/10/2011
Received Time: 08:10

Lab Sample ID: A1K0834-04
Sample Date: 11/09/2011 08:50
Sample Type: Grab
Sampled by: Kat White
Matrix: Water

Sample Description: AWTP CWR

General Chemistry

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Bromate	EPA 317.0	**0.0046**	0.0010	mg/L	1	A113626	11/15/11	11/15/11	

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Report Issue Date: 11/18/2011 12:23
Received Date: 11/10/2011
Received Time: 08:10

Lab Sample ID: A1K0834-03
Sample Date: 11/09/2011 06:04
Sample Type: Grab
Sampled by: Doug Patterson
Matrix: Water

Sample Description: EWTP CWR

General Chemistry

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Bromate	EPA 317.0	**0.0034**	0.0010	mg/L	1	A113626	11/15/11	11/15/11	

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Report Issue Date: 11/18/2011 12:23
Received Date: 11/10/2011
Received Time: 08:10

Lab Sample ID: A1K0834-01
Sample Date: 11/09/2011 10:44
Sample Type: Grab
Sampled by: Kat White
Matrix: Water

Sample Description: QHWTP CWR

General Chemistry

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Bromate	EPA 317.0	**0.0017**	0.0010	mg/L	1	A113626	11/15/11	11/15/11	

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Report Issue Date: 12/29/2011 13:19
Received Date: 12/16/2011
Received Time: 10:23

Lab Sample ID: A1L1252-01
Sample Date: 12/14/2011 09:15
Sample Type: Grab

Sampled by: Kat White
Matrix: Water

Sample Description: QHWTP CWR

General Chemistry

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Bromate	EPA 317.0	**0.0032**	0.0010	mg/L	1	A114879	12/20/11	12/20/11	X01

ACTON WATER TREATMENT PLANT

Plant Effluent
Finished Drinking Water
Monitoring Results

BSK Analytical Laboratories

EDT

Date of Report: 11|05|25|1329
Laboratory Name: BSK Analytical Laboratories
Name of Sampler: Eric Kane

Sample ID No.: A1E1049-01
Signature Lab Director: [signature]

Date/Time Sample Collected: 11|05|12|1115
Date/Time Sample Received @ Lab : 11|05|13|0815
Date Analyses Completed: 11|05|24

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
System Number: 1910045
Name or Number of Sample Source: ACTON PLANT - TREATED EFFLUENT

User ID: 4TH
Station Number: 1910045-004
Date/Time of Sample: 11|05|12|1115
Laboratory Code: 5810
Date Analyses Completed: 11|05|24
Submitted by: BSK Analytical Laboratories
Phone #: 559-497-2888

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
1000	ug/L	Aluminum (Al) (ug/L)	01105	ND	50

A1E1049 FINAL 05252011 1329

BSK Analytical Laboratories

EDT

Date of Report: 11|06|28|2132
Laboratory Name: BSK Analytical Laboratories
Name of Sampler: Eric Kane

Sample ID No.: A1F1509-01
Signature Lab Director: [signature]

Date/Time Sample Collected: 11|06|09|1050
Date/Time Sample Received @ Lab : 11|06|17|0800
Date Analyses Completed: 11|06|27

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
System Number: 1910045
Name or Number of Sample Source: ACTON PLANT - TREATED EFFLUENT

User ID: 4TH
Date/Time of Sample: 11|06|09|1050
Submitted by: BSK Analytical Laboratories

Station Number: 1910045-004
Laboratory Code: 5810
Date Analyses Completed: 11|06|27
Phone #: 559-497-2888

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
1000	ug/L	Aluminum (Al) (ug/L)	01105	ND	50

BSK Analytical Laboratories

EDT

Date of Report: 11|07|26|1658

Laboratory Name: BSK Analytical Laboratories

Name of Sampler: S. Livesly

Sample ID No.: A1G1244-03

Signature Lab Director: [signature]

Date/Time Sample Collected: 11|07|14|1130

Date/Time Sample Received @ Lab : 11|07|15|1338

Date Analyses Completed: 11|07|24

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY

System Number: 1910045

Name or Number of Sample Source: ACTON PLANT - TREATED EFFLUENT

User ID: 4TH

Station Number: 1910045-004

Date/Time of Sample: 11|07|14|1130

Laboratory Code: 5810

Submitted by: BSK Analytical Laboratories

Date Analyses Completed: 11|07|24

Phone #: 559-497-2888

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
1000	ug/L	Aluminum (Al) (ug/L)	01105	ND	50

BSK Analytical Laboratories

EDT

Date of Report: 11|08|24|0818

Laboratory Name: BSK Analytical Laboratories

Name of Sampler: Kat White

Sample ID No.: A1H1233-03

Signature Lab Director: [signature]

Date/Time Sample Collected: 11|08|10|1000

Date/Time Sample Received @ Lab : 11|08|12|0820

Date Analyses Completed: 11|08|22

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY

System Number: 1910045

Name or Number of Sample Source: ACTON PLANT - TREATED EFFLUENT

User ID: 4TH

Station Number: 1910045-004

Date/Time of Sample: 11|08|10|1000

Laboratory Code: 5810

Submitted by: BSK Analytical Laboratories

Date Analyses Completed: 11|08|22

Phone #: 559-497-2888

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
1000	ug/L	Aluminum (Al) (ug/L)	01105	ND	50

A1H1233 FINAL 08242011 0818

BSK Analytical Laboratories

EDT

Date of Report: 11|09|28|1256
Laboratory Name: BSK Analytical Laboratories
Name of Sampler: E. Kane

Sample ID No.: A1I1114-04
Signature Lab Director: [signature]

Date/Time Sample Collected: 11|09|14|0840
Date/Time Sample Received @ Lab : 11|09|15|0950
Date Analyses Completed: 11|09|25

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
Name or Number of Sample Source: ACTON PLANT - TREATED EFFLUENT
System Number: 1910045

User ID: 4TH
Date/Time of Sample: 11|09|14|0840
Submitted by: BSK Analytical Laboratories

Station Number: 1910045-004
Laboratory Code: 5810
Date Analyses Completed: 11|09|25
Phone #: 559-497-2888

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
1000	ug/L	Aluminum (Al) (ug/L)	01105	ND	50

1414 Stanislaus Street Fresno, CA 93706 (559) 497-2888 FAX (559) 485-6935 www.bsklabs.com

BSK Analytical Laboratories

EDT

Date of Report: 11|10|26|1108
Laboratory Name: BSK Analytical Laboratories
Name of Sampler: Kat White

Sample ID No.: A1J1218-03
Signature Lab Director:

Date/Time Sample Collected: 11|10|13|0924
Date/Time Sample Received @ Lab : 11|10|14|1000
Date Analyses Completed: 11|10|18

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
Name or Number of Sample Source: ACTON PLANT - TREATED EFFLUENT
System Number: 1910045

User ID: 4TH
Date/Time of Sample: 11|10|13|0924
Submitted by: BSK Analytical Laboratories

Station Number: 1910045-004
Laboratory Code: 5810
Date Analyses Completed: 11|10|18
Phone #: 559-497-2888

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
1000	ug/L	Aluminum (Al) (ug/L)	01105	ND	50

BSK Analytical Laboratories

EDT

Date of Report: 11|11|18|1228
Laboratory Name: BSK Analytical Laboratories
Name of Sampler: Andrew Atrops

Sample ID No.: A1K0840-03
Signature Lab Director:

Date/Time Sample Collected: 11|11|09|0855
Date/Time Sample Received @ Lab : 11|11|10|0810
Date Analyses Completed: 11|11|14

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
System Number: 1910045
Name or Number of Sample Source: ACTON PLANT - TREATED EFFLUENT

User ID: 4TH
Date/Time of Sample: 11|11|09|0855
Submitted by: BSK Analytical Laboratories

Station Number: 1910045-004
Laboratory Code: 5810
Date Analyses Completed: 11|11|14
Phone #: 559-497-2888

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
1000	ug/L	Aluminum (Al) (ug/L)	01105	ND	50

BSK Analytical Laboratories

Amended

EDT

Date of Report: 11|12|30|1555
Laboratory Name: BSK Analytical Laboratories
Name of Sampler: Bill Hagen

Sample ID No.: A1K0266-01
Signature Lab Director:

Date/Time Sample Collected: 11|11|02|0745
Date/Time Sample Received @ Lab : 11|11|03|0800
Date Analyses Completed: 11|11|14

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
System Number: 1910045
Name or Number of Sample Source: ACTON PLANT - TREATED EFFLUENT

User ID: 4TH
Date/Time of Sample: 11|11|02|0745
Submitted by: BSK Analytical Laboratories

Station Number: 1910045-004
Laboratory Code: 5810
Date Analyses Completed: 11|11|14
Phone #: 559-497-2888

Chain of Custody Notes

Date: 12/14/11
Initials: RLR
Note: Sample A1K0266-05 has three additional Source Codes for state Write-On reporting:1910045-002, 1910045-003 and 1510053-001. The additional state forms will be accommodated by amended reports.

Report Amendments

Date: **12/28/11**
Initials: **RLR**
This amended report supersedes any previous reports issued by the laboratory. Amendments to this report are as follows: Chloride data now included on sample A1K0266-04.

Report Amendments

Date: **12/29/11**
Initials: **RLR**
This amended report supersedes any previous reports issued by the laboratory. Amendments to this report are as follows: includes state form reports for 1910045-003, 005 and 1510053-001.

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Hardness, (Total) as CaCO3	00900	55	
	mg/L	Calcium (Ca) (mg/L)	00916	12	
	mg/L	Magnesium (Mg) (mg/L)	00927	6.1	
	mg/L	Sodium (Na) (mg/L)	00929	20	
	mg/L	Potassium (K) (mg/L)	00937	< 2.0	

Total Cations Meq/L Value: 1.97

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Alkalinity, (Total) (as CaCO3 equivalents)	00410	41	
	mg/L	Hydroxide (OH) (mg/L)	71830	< 1.0	
	mg/L	Carbonate (CO3) (mg/L)	00445	< 1.8	
	mg/L	Bicarbonate (HCO3) (mg/L)	00440	50	
600	mg/L	Sulfate (SO4) (mg/L)	00945	37	0.5
600	mg/L	Chloride (Cl) (mg/L)	00940	25	
45	mg/L	Nitrate (as NO3) (mg/L)	71850	ND	2.0

BSK Analytical Laboratories

Amended

EDT

Date of Report: 11|12|30|1555
Laboratory Name: BSK Analytical Laboratories
Name of Sampler: Bill Hagen

Sample ID No.: A1K0266-01
Signature Lab Director: [signature]

Date/Time Sample Collected: 11|11|02|0745
Date/Time Sample Received @ Lab : 11|11|03|0800
Date Analyses Completed: 11|11|14

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
System Number: 1910045
Name or Number of Sample Source: ACTON PLANT - TREATED EFFLUENT

User ID: 4TH
Date/Time of Sample: 11|11|02|0745
Submitted by: BSK Analytical Laboratories

Station Number: 1910045-004
Laboratory Code: 5810
Date Analyses Completed: 11|11|14
Phone #: 559-497-2888

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
2	mg/L	Fluoride (F) (Natural-Source)	00951	ND	0.1

Total Anions Meq/L Value: 2.29

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
15	Units	Color, Apparent (Unfiltered)	00081	< 1.0	
5	NTU	Lab Turbidity (NTU)	82079	< 0.10	
0.5	mg/L	MBAS (mg/L)	38260	< 0.050	
3	TON	Odor Threshold at 60 C (TON)	00086	1.0	1.0
	Std Units	pH (Laboratory) (Std.Units)	00403	7.6	
2200	umho/cm	Specific Conductance (E.C.) (umhos/cm)	00095	250	
1500	mg/L	Total Filterable Residue@180C(TDS)(mg/L)	70300	150	
1000	ug/L	Aluminum (Al) (ug/L)	01105	ND	50
6	ug/L	Antimony (ug/L)	01097	ND	6.0
10	ug/L	Arsenic (As) (ug/L)	01002	ND	2.0
1000	ug/L	Barium (Ba) (ug/L)	01007	ND	100
4	ug/L	Beryllium (ug/L)	01012	ND	1.0
5	ug/L	Cadmium (Cd) (ug/L)	01027	ND	1.0
50	ug/L	Chromium (Total Cr) (ug/L)	01034	ND	10
1000	ug/L	Copper (Cu) (ug/L)	01042	ND	50
300	ug/L	Iron (Fe) (ug/L)	01045	ND	100
	ug/L	Lead (Pb) (ug/L)	01051	ND	5.0
50	ug/L	Manganese (Mn) (ug/L)	01055	ND	20
2	ug/L	Mercury (Hg) (ug/L)	71900	ND	1.0
100	ug/L	Nickel (ug/L)	01067	ND	10
50	ug/L	Selenium (Se) (ug/L)	01147	ND	5.0
100	ug/L	Silver (Ag) (ug/L)	01077	ND	10
2	ug/L	Thallium (ug/L)	01059	ND	1.0
5000	ug/L	Zinc (Zn) (ug/L)	01092	180	50

ADDITIONAL ANALYSES

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	NA	Agressiveness Index	82383	11	
150	ug/L	Cyanide (ug/L)	01291	ND	100
	NA	Langelier Index at 60 C	71813	- 1.2	
1000	ug/L	Nitrite as Nitrogen(N) (ug/L)	00620	ND	400

BSK Analytical Laboratories

Amended

EDT

Date of Report: 11|12|30|1555
Laboratory Name: BSK Analytical Laboratories
Name of Sampler: Bill Hagen

Sample ID No.: A1K0266-01
Signature Lab Director: [signature]

Date/Time Sample Collected: 11|11|02|0745
Date/Time Sample Received @ Lab : 11|11|03|0800
Date Analyses Completed: 11|11|14

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
System Number: 1910045
Name or Number of Sample Source: ACTON PLANT - TREATED EFFLUENT

User ID: 4TH
Date/Time of Sample: 11|11|02|0745
Submitted by: BSK Analytical Laboratories

Station Number: 1910045-004
Laboratory Code: 5810
Date Analyses Completed: 11|11|14
Phone #: 559-497-2888

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
		ADDITIONAL ANALYSES			
6	ug/L	Perchlorate (ug/L)	A-031	ND	4.0

TEST METHOD	CHEMICAL	ENTRY #	ANALYSES RESULTS	MCL µG/L	DLR µG/L
	REGULATED ORGANIC CHEMICALS				
EPA 525.2	Alachlor (ALANEX)	77825	ND	2	1.0
EPA 525.2	Atrazine (AATREX)	39033	ND	1	0.5
EPA 525.2	Benzo (a) Pyrene	34247	ND	0.2	0.1
EPA 525.2	Di(2-ethylhexyl) Adipate	A-026	ND	400	5.0
EPA 525.2	Diethylhexylphthalate (DEHP)	39100	ND	4	3.0
EPA 525.2	Molinate (ORDRAM)	82199	ND	20	2.0
EPA 525.2	Simazine (PRINCEP)	39055	ND	4	1.0
EPA 525.2	Thiobencarb (BOLERO)	A-001	ND	70	1.0
	UNREGULATED ORGANIC CHEMICALS				
EPA 525.2	Bromacil (HYVAR)	82198	ND		10
EPA 525.2	Butachlor	77860	ND		0.38
EPA 525.2	Diazinon	39570	< 0.25		
EPA 525.2	Dimethoate (CYGON)	38458	< 10		
EPA 525.2	Metolachlor	39356	< 0.50		
EPA 525.2	Metribuzin	81408	< 0.50		
EPA 525.2	Propachlor	38533	ND		0.5

Antelope Valley-East Kern Water Agency

LA System No. 1910045

TOC Removal Running Annual Average

Sample Date	Plant	Alkalinity mgCaCO3/L	Raw TOC mg/L	Treated TOC mg/L	Actual % TOC reduction	Required % TOC reduction	"TOC Removal Ratio" actual % /required %
1/12/2011	QHWTP	53.9	3.10	1.55	50.0	35	1.4
"	EWTP	plant off					
"	AWTP	plant off					
2/9/2011	QHWTP	52.6	4.41	2.16	51.0	45	1.1
"	EWTP	plant off					
"	AWTP	plant off					
3/9/2011	QHWTP	50.3	4.01	1.92	52.1	45	1.2
"	EWTP	plant off					
"	AWTP	plant off					
4/13/2011	QHWTP	51.7	3.82	1.83	52.1	35	1.5
"	EWTP	plant off					
"	AWTP	plant off					
5/11/2011	QHWTP	40.8	3.23	1.55	52.0	35	1.5
"	EWTP	41.9	3.58	1.54	57.0	35	1.6
5/12/2011	AWTP	40.6	3.47	1.55	55.3	35	1.6
6/8/2011	QHWTP	54.6	2.87	1.57	45.3	35	1.3
"	EWTP	53.4	3.08	1.71	44.5	35	1.3
6/9/2011	AWTP	56.0	3.04	1.61	47.0	35	1.3
7/13/2011	QHWTP	39.8	2.64	1.26	52.3	35	1.5
"	EWTP	41.0	2.78	1.40	49.6	35	1.4
7/14/2011	AWTP	41.2	2.82	1.28	54.6	35	1.6
8/10/2011	QHWTP	53.6	2.66	1.43	46.2	35	1.3
"	EWTP	54.4	2.87	1.55	46.0	35	1.3
8/11/2011	AWTP	53.5	2.77	1.50	45.8	35	1.3
9/14/2011	QHWTP	57.6	2.41	1.35	44.0	35	1.3
"	EWTP	58.5	2.61	1.55	40.6	35	1.2
"	AWTP	57.6	2.56	1.49	41.8	35	1.2
10/12/2011	QHWTP	65.6	2.17	1.24	42.9	25	1.7
"	EWTP	67.2	2.37	1.42	40.1	25	1.6
10/13/2011	AWTP	66.0	2.40	1.41	41.3	25	1.7
11/9/2011	QHWTP	53.4	2.09	1.09	47.8	35	1.4
"	EWTP	54.1	2.18	1.22	44.0	35	1.3
"	AWTP	54.5	2.19	1.19	45.7	35	1.3
12/14/2011	QHWTP	78.2	2.39	1.44	39.7	25	1.6
"	EWTP	plant off					
"	AWTP	plant off					
	Minimum	39.8	2.1	1.1	39.7		
	Maximum	78.2	4.4	2.2	57.0		
	RAA	53.5	2.9	1.5	47.3		

Running Annual Average (RAA) **1.4**

Title 22 California Code of Regulations, Chapter 15.5, Article 5:

Required percent TOC reduction**

Table 64536.2-A Source Water Alkalinity

Raw TOC	0-60	<60 - 120	>120
>2.0 - 4.0	35.0 %	25.0 %	15.0 %
>4.0 - 8.0	45.0 %	35.0 %	25.0 %
>8.0	50.0 %	40.0 %	30.0 %

**If one or more of the section 64636.4(b) 1-6 conditions are met, the system may assign a monthly value of 1 for the TOC removal ratio in lieu of the calculated va

List condition when used:

1. The system's source water TOC level, prior to any treatment is less than or equal to 2.0 mg/L
2. The system's treated water TOC level is less than or equal to 2.0 mg/L
3. The system's source water SUVA, prior to any treatment, is less than or equal to 2.0 L/mg-m
4. The system's finished water SUVA is less than or equal to 2.0 L/mg-m
5. A system practicing softening removes at least 10 mg/L of magnesium hardness (as CaCO3)
6. A system practicing enhanced softening lowers alkalinity below 60 mg/L (as CaCO3)

GENERAL MINERAL & PHYSICAL & INORGANIC ANALYSIS (9/99)

Date of Report: 11/05/18 Sample ID No.055

Laboratory Signature Lab

Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY Director:

Name of Sampler:ERIK KANE Employed By: AVEK WATER AGENCY

Date/Time Sample Collected:11/05/12/1110 Date/Time Sample Received @ Lab:11/05/12/1143 Date Analyses Completed:11/05/13

System Name:ANTELOPE VALLEY-EAST KERN WATER AGENCY System Number: 1910045

Name or Number of Sample Source:ACTON PLANT - TREATED EFFLUENT FORCE

User ID: 4TH Station Number: 1910045-004

Date/Time of Sample: |11|05|12|1110| (YY MM DD TTTT) Laboratory Code: 6080

Date Analysis completed: |11|05|13| (YY MM DD)

Submitted by:__________ Phone #:__________

PAGE 1 OF 1 ADDITIONAL ANALYSES

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Organic Carbon (TOC) (mg/L)	00680	1.55	0.30

\+ Indicates Secondary Drinking Water Standards

EDT

GENERAL MINERAL & PHYSICAL & INORGANIC ANALYSIS (9/99)

Date of Report: 11/06/17 | Sample ID No.060
Laboratory Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY | Signature Lab Director: [signature]
Name of Sampler: ERIK KANE | Employed By: AVEK WATER AGENCY
Date/Time Sample Collected: 11/06/09/1055 | Date/Time Sample Received @ Lab: 11/06/09/1135 | Date Analyses Completed: 11/06/15

==

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY | System Number: 1910045
Name or Number of Sample Source: ACTON PLANT - TREATED EFFLUENT FORCE

****

* User ID: 4TH | Station Number: 1910045-004 *
* Date/Time of Sample: |11|06|09|1055| | Laboratory Code: 6080 *
* YY MM DD TTTT | YY MM DD *
* Date Analysis completed: |11|06|15| *
* Submitted by: ______________________ Phone #: ______________ *

****

PAGE 1 OF 1

ADDITIONAL ANALYSES

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Organic Carbon (TOC) (mg/L)	00680	1.61	0.30

+ Indicates Secondary Drinking Water Standards

GENERAL MINERAL & PHYSICAL & INORGANIC ANALYSIS (9/99)

Date of Report: 11/07/26
Sample ID No.078
Laboratory Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
Signature Lab Director:
Name of Sampler:ERIK KANE
Employed By: AVEK WATER AGENCY
Date/Time Sample Collected:11/07/14/1145
Date/Time Sample Received @ Lab:11/07/14/1215
Date Analyses Completed:11/07/25

==

System Name:ANTELOPE VALLEY-EAST KERN WATER AGENCY
System Number: 1910045
Name or Number of Sample Source:ACTON PLANT - TREATED EFFLUENT FORCE

****

* User ID: 4TH Station Number: 1910045-004 *
* Date/Time of Sample: |11|07|14|1145| Laboratory Code: 6080 *
* YY MM DD TTTT YY MM DD *
* Date Analysis completed: |11|07|25| *
* Submitted by:____________________ Phone #:________________ *

****

PAGE 1 OF 1

ADDITIONAL ANALYSES

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Organic Carbon (TOC) (mg/L)	00680	1.28	0.30

+ Indicates Secondary Drinking Water Standards

EDT

GENERAL MINERAL & PHYSICAL & INORGANIC ANALYSIS (9/99)

Date of Report: 11/08/18 Sample ID No.096

Laboratory Signature Lab

Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY Director:

Name of Sampler:ERIK KANE Employed By: AVEK WATER AGENCY

Date/Time Sample Collected:11/08/11/1013 Date/Time Sample Received @ Lab:11/08/11/1053 Date Analyses Completed:11/08/17

==

System Name:ANTELOPE VALLEY-EAST KERN WATER AGENCY System Number: 1910045

Name or Number of Sample Source:ACTON PLANT - TREATED EFFLUENT FORCE

****

* User ID: 4TH Station Number: 1910045-004 *

* Date/Time of Sample: |11|08|11|1013| Laboratory Code: 6080 *

* YY MM DD TTTT YY MM DD *

* Date Analysis completed: |11|08|17| *

* Submitted by:______________________________ Phone #:_____________________ *

****

PAGE 1 OF 1 ADDITIONAL ANALYSES

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Organic Carbon (TOC) (mg/L)	00680	1.50	0.30

\+ Indicates Secondary Drinking Water Standards

EDT

GENERAL MINERAL & PHYSICAL & INORGANIC ANALYSIS (9/99)

Date of Report: 11/09/29 Sample ID No.114

Laboratory Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY Signature Lab Director:

Name of Sampler:ERIC KANE Employed By: AVEK WATER AGENCY

Date/Time Sample Collected:11/09/14/0840 Date/Time Sample Received @ Lab:11/09/14/0938 Date Analyses Completed:11/09/23

==

System Name:ANTELOPE VALLEY-EAST KERN WATER AGENCY System Number: 1910045

Name or Number of Sample Source:ACTON PLANT - TREATED EFFLUENT

****

* User ID: 4TH Station Number: 1910045-004 *
* Date/Time of Sample: |11|09|14|0840| Laboratory Code: 6080 *
* YY MM DD TTTT YY MM DD *
* Date Analysis completed: |11|09|23| *
* Submitted by:________________ Phone #:____________ *

****

PAGE 1 OF 1 ADDITIONAL ANALYSES

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Organic Carbon (TOC) (mg/L)	00680	1.49	0.30

+ Indicates Secondary Drinking Water Standards

EDT

GENERAL MINERAL & PHYSICAL & INORGANIC ANALYSIS (9/99)

Date of Report: 11/10/24 Sample ID No.133

Laboratory Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY

Signature Lab Director:

Name of Sampler:Andrew Atrops Employed By: AVEK Water Agency

Date/Time Sample Collected:11/10/13/0916

Date/Time Sample Received @ Lab:11/10/13/1013

Date Analyses Completed:11/10/20

==

System Name:ANTELOPE VALLEY-EAST KERN WATER AGENCY

System Number: 1910045

Name or Number of Sample Source:ACTON PLANT - TREATED EFFLUENT

****

* User ID: 4TH Station Number: 1910045-004 *

* Date/Time of Sample: |11|10|13|0916| Laboratory Code: 6080 *

* YY MM DD TTTT YY MM DD *

* Date Analysis completed: |11|10|20| *

* Submitted by:________________________ Phone #:__________________ *

****

PAGE 1 OF 1 ADDITIONAL ANALYSES

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Organic Carbon (TOC) (mg/L)	00680	1.41	0.30

+ Indicates Secondary Drinking Water Standards

EDT

GENERAL MINERAL & PHYSICAL & INORGANIC ANALYSIS (9/99)

Date of Report: 11/12/02 Sample ID No.152

Laboratory Signature Lab
Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY Director:

Name of Sampler:ANDREW ATROPS Employed By: AVEK WATER AGENCY

Date/Time Sample Collected:11/11/09/0845 Date/Time Sample Received @ Lab:11/11/09/0949 Date Analyses Completed:11/12/01

===

System Name:ANTELOPE VALLEY-EAST KERN WATER AGENCY System Number: 1910045

Name or Number of Sample Source:ACTON PLANT - TREATED EFFLUENT

****

* User ID: 4TH Station Number: 1910045-004 *

* Date/Time of Sample: |11|11|09|0845| Laboratory Code: 6080 *

* YY MM DD TTTT YY MM DD *

* Date Analysis completed: |11|12|01| *

* Submitted by:________________ Phone #:____________ *

****

PAGE 1 OF 1 ADDITIONAL ANALYSES

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Organic Carbon (TOC) (mg/L)	00680	1.19	0.30

+ Indicates Secondary Drinking Water Standards

ACTON WATER TREATMENT PLANT

Plant Influent
Untreated Source Water
Monitoring Results

BSK Analytical Laboratories

Amended

EDT

Date of Report: 11|03|11|1329
Laboratory Name: BSK Analytical Laboratories
Name of Sampler: Kat White

Sample ID No.: A1C0821-01
Signature Lab Director: [signature]

Date/Time Sample Collected: 11|03|09|1400
Date/Time Sample Received @ Lab : 11|03|10|1000
Date Analyses Completed: 11|03|10

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
Name or Number of Sample Source: ACTON PLANT - INFLUENT
System Number: 1910045

User ID: 4TH
Date/Time of Sample: 11|03|09|1400
Submitted by: BSK Analytical Laboratories

Station Number: 1910045-003
Laboratory Code: 5810
Date Analyses Completed: 11|03|10
Phone #: 559-497-2888

Report Amendments

Date: 3/11/11

Initials: PJE

This amended report supersedes any previous reports issued by the laboratory. Amendments to this report are as follows: Report amended to send state data to the following PS codes: 1910045-002, 1910045-005, 1910045-003, and 1510053-001.

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
45	mg/L	Nitrate (as NO3) (mg/L)	71850	3.2	2.0

Total Anions Meq/L Value:	0.05

A1C0821 FINAL 03112011 1329

BSK Analytical Laboratories

Amended

EDT

Date of Report: 11|06|28|1115
Laboratory Name: BSK Analytical Laboratories
Name of Sampler: Justin Livesay

Sample ID No.: A1F0795-04
Signature Lab Director: [signature]

Date/Time Sample Collected: 11|06|08|1407
Date/Time Sample Received @ Lab : 11|06|09|0800
Date Analyses Completed: 11|06|10

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
Name or Number of Sample Source: ACTON PLANT - INFLUENT
System Number: 1910045

User ID: 4TH
Date/Time of Sample: 11|06|08|1407
Submitted by: BSK Analytical Laboratories

Station Number: 1910045-003
Laboratory Code: 5810
Date Analyses Completed: 11|06|10
Phone #: 559-497-2888

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
45	mg/L	Nitrate (as NO3) (mg/L)	71850	2.0	2.0

Total Anions Meq/L Value: 0.03

A1F0795 FINAL 06282011 1115

BSK Analytical Laboratories

Amended

EDT

Date of Report: 11|09|30|1013
Laboratory Name: BSK Analytical Laboratories
Name of Sampler: Justin Livesay

Sample ID No.: A1I1271-01
Signature Lab Director:

Date/Time Sample Collected: 11|09|15|1431
Date/Time Sample Received @ Lab : 11|09|16|1020
Date Analyses Completed: 11|09|16

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
Name or Number of Sample Source: ACTON PLANT - INFLUENT
System Number: 1910045

User ID: 4TH
Date/Time of Sample: 11|09|15|1431
Submitted by: BSK Analytical Laboratories

Station Number: 1910045-003
Laboratory Code: 5810
Date Analyses Completed: 11|09|16
Phone #: 559-497-2888

Chain of Custody Notes

Date: 9/29/11
Initials: RLR
Note: Data is reported to four ps codes EDT: 1910045-002, 1910045-005, 1910045-003 and 1510053-001. Subsequent amended write on report hardcopies reflect the report being generated multiple times to accommodate this request.

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
45	mg/L	Nitrate (as NO3) (mg/L)	71850	ND	2.0

Total Anions Meq/L Value:	0.00

A1I1271 FINAL 09302011 1013

BSK Analytical Laboratories

Amended

EDT

Date of Report: 12|01|10|0959
Laboratory Name: BSK Analytical Laboratories
Name of Sampler: k. White

Sample ID No.: A1L1169-03
Signature Lab Director: [signature]

Date/Time Sample Collected: 11|12|15|1216
Date/Time Sample Received @ Lab : 11|12|16|1023
Date Analyses Completed: 11|12|16

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
Name or Number of Sample Source: ACTON PLANT - INFLUENT
System Number: 1910045

User ID: 4TH
Date/Time of Sample: 11|12|15|1216
Submitted by: BSK Analytical Laboratories

Station Number: 1910045-003
Laboratory Code: 5810
Date Analyses Completed: 11|12|16
Phone #: 559-497-2888

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
45	mg/L	Nitrate (as NO3) (mg/L)	71850	3.6	2.0

Total Anions Meq/L Value:	0.06

A1L1169 FINAL 01102012 0959

BSK Analytical Laboratories

Amended

EDT

Date of Report: 11|12|30|1547
Laboratory Name: BSK Analytical Laboratories
Name of Sampler: Client

Sample ID No.: A1K0266-05
Signature Lab Director: [signature]

Date/Time Sample Collected: 11|11|02|1307
Date/Time Sample Received @ Lab : 11|11|03|0800
Date Analyses Completed: 11|11|14

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
System Number: 1910045
Name or Number of Sample Source: ACTON PLANT - INFLUENT

User ID: 4TH
Date/Time of Sample: 11|11|02|1307
Submitted by: BSK Analytical Laboratories

Station Number: 1910045-003
Laboratory Code: 5810
Date Analyses Completed: 11|11|14
Phone #: 559-497-2888

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Hardness, (Total) as CaCO3	00900	60	
	mg/L	Calcium (Ca) (mg/L)	00916	13	
	mg/L	Magnesium (Mg) (mg/L)	00927	6.5	
	mg/L	Sodium (Na) (mg/L)	00929	20	
	mg/L	Potassium (K) (mg/L)	00937	< 2.0	
		Total Cations Meq/L Value: 2.05			
	mg/L	Alkalinity, (Total) (as CaCO3 equivalents)	00410	58	
	mg/L	Hydroxide (OH) (mg/L)	71830	< 1.0	
	mg/L	Carbonate (CO3) (mg/L)	00445	< 1.8	
	mg/L	Bicarbonate (HCO3) (mg/L)	00440	71	
600	mg/L	Sulfate (SO4) (mg/L)	00945	16	0.5
600	mg/L	Chloride (Cl) (mg/L)	00940	22	
45	mg/L	Nitrate (as NO3) (mg/L)	71850	2.2	2.0
2	mg/L	Fluoride (F) (Natural-Source)	00951	ND	0.1
		Total Anions Meq/L Value: 2.15			
15	Units	Color, Apparent (Unfiltered)	00081	10	
5	NTU	Lab Turbidity (NTU)	82079	0.47	
0.5	mg/L	MBAS (mg/L)	38260	< 0.050	
3	TON	Odor Threshold at 60 C (TON)	00086	1.0	1.0
	Std Units	pH (Laboratory) (Std.Units)	00403	8.2	
2200	umho/cm	Specific Conductance (E.C.) (umhos/cm)	00095	220	
1500	mg/L	Total Filterable Residue@180C(TDS)(mg/L)	70300	130	
1000	ug/L	Aluminum (Al) (ug/L)	01105	ND	50
6	ug/L	Antimony (ug/L)	01097	ND	6.0
10	ug/L	Arsenic (As) (ug/L)	01002	ND	2.0
1000	ug/L	Barium (Ba) (ug/L)	01007	ND	100
4	ug/L	Beryllium (ug/L)	01012	ND	1.0
5	ug/L	Cadmium (Cd) (ug/L)	01027	ND	1.0
50	ug/L	Chromium (Total Cr) (ug/L)	01034	ND	10
1000	ug/L	Copper (Cu) (ug/L)	01042	ND	50

BSK Analytical Laboratories

Amended

EDT

Date of Report: 11|12|30|1547 **Sample ID No.:** A1K0266-05
Laboratory Name: BSK Analytical Laboratories **Signature Lab Director:**
Name of Sampler: Client

Date/Time Sample Collected: 11|11|02|1307 **Date/Time Sample Received @ Lab :** 11|11|03|0800 **Date Analyses Completed:** 11|11|14

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY **System Number:** 1910045
Name or Number of Sample Source: ACTON PLANT - INFLUENT

User ID: 4TH **Station Number:** 1910045-003
Date/Time of Sample: 11|11|02|1307 **Laboratory Code:** 5810
Date Analyses Completed: 11|11|14
Submitted by: BSK Analytical Laboratories **Phone #:** 559-497-2888

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
300	ug/L	Iron (Fe) (ug/L)	01045	ND	100
	ug/L	Lead (Pb) (ug/L)	01051	ND	5.0
50	ug/L	Manganese (Mn) (ug/L)	01055	ND	20
2	ug/L	Mercury (Hg) (ug/L)	71900	ND	1.0
100	ug/L	Nickel (ug/L)	01067	ND	10
50	ug/L	Selenium (Se) (ug/L)	01147	ND	5.0
100	ug/L	Silver (Ag) (ug/L)	01077	ND	10
2	ug/L	Thallium (ug/L)	01059	ND	1.0
5000	ug/L	Zinc (Zn) (ug/L)	01092	ND	50
		ADDITIONAL ANALYSES			
	NA	Agressiveness Index	82383	11	
150	ug/L	Cyanide (ug/L)	01291	ND	100
	NA	Langelier Index at 60 C	71813	- 0.42	
1000	ug/L	Nitrite as Nitrogen(N) (ug/L)	00620	ND	400
6	ug/L	Perchlorate (ug/L)	A-031	ND	4.0

TEST METHOD	CHEMICAL	ENTRY #	ANALYSES RESULTS	MCL µG/L	DLR µG/L
	REGULATED ORGANIC CHEMICALS				
EPA 524.2	Bromodichloromethane	32101	ND		1.0
EPA 524.2	Bromoform	32104	ND		1.0
EPA 524.2	Chloroform (Trichloromethane)	32106	ND		1.0
EPA 524.2	Dibromochloromethane	32105	ND		1.0
EPA 524.2a	Total Trihalomethanes (TTHMs)	82080	< 0.50	80	
	REGULATED ORGANIC CHEMICALS				
EPA 524.2	1,1,1-Trichloroethane (1,1,1-TCA)	34506	ND	200	0.5
EPA 524.2	1,1,2,2-Tetrachloroethane	34516	ND	1	0.5
EPA 524.2	1,1,2-Trichloroethane (1,1,2-TCA)	34511	ND	5	0.5
EPA 524.2	1,1-Dichloroethane (1,1-DCA)	34496	ND	5	0.5
EPA 524.2	1,1-Dichloroethylene (1,1-DCE)	34501	ND	6	0.5
EPA 524.2	1,2,4-Trichlorobenzene	34551	ND	5	0.5
EPA 524.2	1,2-Dichlorobenzene (o-DCB)	34536	ND	600	0.5

A1K0266 FINAL 12302011 1547

BSK Analytical Laboratories

Amended

EDT

Date of Report: 11|12|30|1547 **Sample ID No.:** A1K0266-05
Laboratory Name: BSK Analytical Laboratories **Signature Lab Director:**
Name of Sampler: Client

Date/Time Sample Collected: 11|11|02|1307 **Date/Time Sample Received @ Lab :** 11|11|03|0800 **Date Analyses Completed:** 11|11|14

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY **System Number:** 1910045
Name or Number of Sample Source: ACTON PLANT - INFLUENT

User ID: 4TH **Station Number:** 1910045-003
Date/Time of Sample: 11|11|02|1307 **Laboratory Code:** 5810
Submitted by: BSK Analytical Laboratories **Date Analyses Completed:** 11|11|14
Phone #: 559-497-2888

TEST METHOD	CHEMICAL	ENTRY #	ANALYSES RESULTS	MCL µG/L	DLR µG/L
	REGULATED ORGANIC CHEMICALS				
EPA 524.2	1,2-Dichloroethane (1,2-DCA)	34531	ND	0.5	0.5
EPA 524.2	1,2-Dichloropropane	34541	ND	5	0.5
EPA 524.2	1,4-Dichlorobenzene (p-DCB)	34571	ND	5	0.5
EPA 524.2	Benzene	34030	ND	1	0.5
EPA 524.2	Carbon Tetrachloride	32102	ND	0.5	0.5
EPA 524.2	cis-1,2-Dichloroethylene (c-1,2-DCE)	77093	ND	6	0.5
EPA 524.2	cis-1,3-Dichloropropene (D-D)	34704	ND	0.5	0.5
EPA 524.2	Dichloromethane (Methylene Chloride)	34423	ND	5	0.5
EPA 524.2	Ethyl Benzene	34371	ND	300	0.5
EPA 524.2	m,p-Xylene	A-014	ND		0.5
EPA 524.2	Methyl tert-Butyl Ether(MTBE)	46491	ND	5	3.0
EPA 524.2	Monochlorobenzene (Chlorobenzene)	34301	ND	70	0.5
EPA 524.2	o-Xylene	77135	ND		0.5
EPA 524.2	Styrene	77128	ND	100	0.5
EPA 524.2	Tetrachloroethylene (PCE)	34475	ND	5	0.5
EPA 524.2	Toluene	34010	ND	150	0.5
EPA 524.2	trans-1,2-Dichloroethylene (t-1,2-DCE)	34546	ND	10	0.5
EPA 524.2	trans-1,3-Dichloropropene	34699	ND	0.5	0.5
EPA 524.2	Trichloroethylene (TCE)	39180	ND	5	0.5
EPA 524.2	Trichlorofluoromethane (FREON 11)	34488	ND	150	5.0
EPA 524.2	Trichlorotrifluoroethane (FREON 113)	81611	ND	1200	10
EPA 524.2	Vinyl Chloride (VC)	39175	ND	0.5	0.5
EPA 524.2a	Total 1,3-Dichloropropene	34561	ND	0.5	0.5
EPA 524.2a	Total Xylenes (m,p, & o)	81551	< 0.50	1750	
EPA 525.2	Alachlor (ALANEX)	77825	ND	2	1.0
EPA 525.2	Atrazine (AATREX)	39033	ND	1	0.5
EPA 525.2	Benzo (a) Pyrene	34247	ND	0.2	0.1
EPA 525.2	Di(2-ethylhexyl) Adipate	A-026	ND	400	5.0
EPA 525.2	Diethylhexylphthalate (DEHP)	39100	ND	4	3.0
EPA 525.2	Molinate (ORDRAM)	82199	ND	20	2.0
EPA 525.2	Simazine (PRINCEP)	39055	ND	4	1.0
EPA 525.2	Thiobencarb (BOLERO)	A-001	ND	70	1.0
	UNREGULATED ORGANIC CHEMICALS				

BSK Analytical Laboratories

Amended

EDT

Date of Report: 11|12|30|1547
Laboratory Name: BSK Analytical Laboratories
Name of Sampler: Client

Sample ID No.: A1K0266-05
Signature Lab Director:

Date/Time Sample Collected: 11|11|02|1307
Date/Time Sample Received @ Lab : 11|11|03|0800
Date Analyses Completed: 11|11|14

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
System Number: 1910045
Name or Number of Sample Source: ACTON PLANT - INFLUENT

User ID: 4TH
Station Number: 1910045-003
Date/Time of Sample: 11|11|02|1307
Laboratory Code: 5810
Date Analyses Completed: 11|11|14
Submitted by: BSK Analytical Laboratories
Phone #: 559-497-2888

TEST METHOD	CHEMICAL	ENTRY #	ANALYSES RESULTS	MCL µG/L	DLR µG/L
	UNREGULATED ORGANIC CHEMICALS				
EPA 524.2	1,1,1,2-Tetrachloroethane	77562	ND		0.5
EPA 524.2	1,1-Dichloropropene	77168	ND		0.5
EPA 524.2	1,2,3-Trichlorobenzene	77613	ND		0.5
EPA 524.2	1,2,4-Trimethylbenzene	77222	< 0.50		
EPA 524.2	1,3,5-Trimethylbenzene	77226	ND		0.5
EPA 524.2	1,3-Dichlorobenzene (m-DCB)	34566	ND		0.5
EPA 524.2	1,3-Dichloropropane	77173	ND		0.5
EPA 524.2	2,2-Dichloropropane	77170	ND		0.5
EPA 524.2	2-Chlorotoluene	A-008	ND		0.5
EPA 524.2	4-Chlorotoluene	A-009	ND		0.5
EPA 524.2	Acetone	81552	< 10		
EPA 524.2	Bromobenzene	81555	ND		0.5
EPA 524.2	Bromochloromethane	A-012	ND		0.5
EPA 524.2	Bromomethane (Methyl Bromide)	34413	ND		0.5
EPA 524.2	Chloroethane	34311	ND		0.5
EPA 524.2	Chloromethane (Methyl Chloride)	34418	ND		0.5
EPA 524.2	Dibromomethane	77596	ND		0.5
EPA 524.2	Dichlorodifluoromethane (Freon 12)	34668	ND		0.5
EPA 524.2	Diisopropyl Ether (DIPE)	A-036	ND		3.0
EPA 524.2	Ethyl tert-Butyl Ether (ETBE)	A-033	ND		3.0
EPA 524.2	Hexachlorobutadiene	34391	ND		0.5
EPA 524.2	Isopropylbenzene (Cumene)	77223	ND		0.5
EPA 524.2	Mesitylene (1,3,5-Trimethylbenzene)	77226	ND		0.5
EPA 524.2	Methyl Ethyl Ketone (MEK, Butanone)	81595	ND		5.0
EPA 524.2	Methyl Isobutyl Ketone (MIBK)	81596	ND		5.0
EPA 524.2	Naphthalene	34696	ND		0.5
EPA 524.2	n-Butylbenzene	A-010	ND		0.5
EPA 524.2	n-Propylbenzene	77224	ND		0.5
EPA 524.2	p-Isopropyltoluene	A-011	< 0.50		
EPA 524.2	sec-Butylbenzene	77350	ND		0.5
EPA 524.2	tert-Amyl Methyl Ether (TAME)	A-034	ND		3.0
EPA 524.2	tert-Butyl Alcohol (TBA)	77035	ND		2.0
EPA 524.2	tert-Butylbenzene	77353	ND		0.5
EPA 525.2	Bromacil (HYVAR)	82198	ND		10

BSK Analytical Laboratories

Amended

EDT

Date of Report: 11|12|30|1547
Laboratory Name: BSK Analytical Laboratories
Name of Sampler: Client

Sample ID No.: A1K0266-05
Signature Lab Director:

Date/Time Sample Collected: 11|11|02|1307
Date/Time Sample Received @ Lab : 11|11|03|0800
Date Analyses Completed: 11|11|14

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
Name or Number of Sample Source: ACTON PLANT - INFLUENT
System Number: 1910045

User ID: 4TH
Date/Time of Sample: 11|11|02|1307
Submitted by: BSK Analytical Laboratories

Station Number: 1910045-003
Laboratory Code: 5810
Date Analyses Completed: 11|11|14
Phone #: 559-497-2888

TEST METHOD	CHEMICAL	ENTRY #	ANALYSES RESULTS	MCL µG/L	DLR µG/L
	UNREGULATED ORGANIC CHEMICALS				
EPA 525.2	Butachlor	77860	ND		0.38
EPA 525.2	Diazinon	39570	< 0.25		
EPA 525.2	Dimethoate (CYGON)	38458	< 10		
EPA 525.2	Metolachlor	39356	< 0.50		
EPA 525.2	Metribuzin	81408	< 0.50		
EPA 525.2	Propachlor	38533	ND		0.5

RADIOACTIVITY ANALYSIS (9/99)

Date of Report: 11/12/05
Sample ID No 3057601001/K0266
Laboratory
Signature Lab
Name: PACE ANALYTICAL SERVICES, INC-GREENSBURG Director:
Name of Sampler:client
Employed By: client
Date/Time Sample Collected:11/11/02/1307
Date/Time Sample Received @ Lab:11/11/14/0950
Date Analyses Completed:11/12/02

System Name:ANTELOPE VALLEY-EAST KERN WATER AGENCY
System Number: 1910045
Name or Number of Sample Source:ACTON PLANT - INFLUENT

User ID: 4TH
Station Number: 1910045-003
Date/Time of Sample: |11|11|02|1307| (YY MM DD TTTT)
Laboratory Code: 0010
Date Analysis completed: |11|12|02| (YY MM DD)
Submitted by: ____________
Phone #: ____________

MCL	REPORT UNITS	CHEMICAL	STORET CODE	ANALYSES RESULTS	DLR
	pCi/L	TITLE 22 CALIFORNIA CODE OF REGULATIONS			
	pCi/L	SECTION 64442 (22 CCR 64442)			
15	pCi/L	Gross Alpha	01501		3.0
	pCi/L	Gross Alpha Counting Error	01502		
	pCi/L	Gross Alpha MDA95 *	A-072		
20	pCi/L	Uranium	28012		1.0
	pCi/L	Uranium Counting Error	A-028		
	pCi/L	Uranium MDA95	A-073		
	pCi/L	Radium 226	09501		1.0
	pCi/L	Radium 226 Counting Error	09502		
	pCi/L	Radium 226 MDA95	A-074		
	pCi/L	Radium 228	11501		1.0
	pCi/L	Radium 228 Counting Error	11502		
	pCi/L	Radium 228 MDA95	A-075		
5	pCi/L	Ra 226 + Ra 228, Combined	11503		
	pCi/L	Ra 226 + Ra 228 Counting Error, Combined	11504		
	pCi/L	Ra 226 + Ra 229 MDA95, Combined	A-076		
	pCi/L	RADIUM, TOTAL, (FOR NTNC ONLY, BY 903.0)			
	pCi/L	Radium, Total	A-080		
	pCi/L	Radium, Total, Counting Error	A-081		
	pCi/L	Radium, Total, MDA95	A-082		
	pCi/L	TITLE 22 CALIFORNIA CODE OF REGULATIONS			
	pCi/L	SECTION 64443 (22 CCR 64443)			
50	pCi/L	Gross Beta	03501	< 4.0	4.0
	pCi/L	Gross Beta Counting Error	03502	1.06	

	pCi/L Gross Beta MDA95	A-077		
4	pCi/L Gross Beta, Calculated Dose Equivalent *	A-071		
8	pCi/L Strontium 90	13501	< 2.0	2.0
	pCi/L Strontium 90 Counting Error	13502	0.192	
	pCi/L Strontium 90 MDA95	A-078		
20000	pCi/L Tritium	07000	< 1000	1000
	pCi/L Tritium Counting Error	07001	115	
	pCi/L Tritium MDA95	A-079		
	pCi/L RADON			
	pCi/L Radon 222	82303		100.0
	pCi/L Radon 222 Counting Error	82302		
	pCi/L			
	pCi/L *MDA95 is Minimum Detectable Activity at			
	pCi/L the 95% confidence level, per			
	pCi/L 22 CCR 64442 and 64443.			
	pCi/L			
	pCi/L **Gross Beta, Calculated Total Body or			
	pCi/L Organ Dose Equivalent, Per 22 CCR 64443			
	pCi/L			

Antelope Valley-East Kern Water Agency

LA System No. 1910045

TOC Removal Running Annual Average

Sample Date	Plant	Alkalinity mgCaCO3/L	Raw TOC mg/L	Treated TOC mg/L	Actual % TOC reduction	Required % TOC reduction	"TOC Removal Ratio" actual % /required %
1/12/2011	QHWTP	53.9	3.10	1.55	50.0	35	1.4
"	EWTP	plant off					
"	AWTP	plant off					
2/9/2011	QHWTP	52.6	4.41	2.16	51.0	45	1.1
"	EWTP	plant off					
"	AWTP	plant off					
3/9/2011	QHWTP	50.3	4.01	1.92	52.1	45	1.2
"	EWTP	plant off					
"	AWTP	plant off					
4/13/2011	QHWTP	51.7	3.82	1.83	52.1	35	1.5
"	EWTP	plant off					
"	AWTP	plant off					
5/11/2011	QHWTP	40.8	3.23	1.55	52.0	35	1.5
"	EWTP	41.9	3.58	1.54	57.0	35	1.6
5/12/2011	AWTP	40.6	3.47	1.55	55.3	35	1.6
6/8/2011	QHWTP	54.6	2.87	1.57	45.3	35	1.3
"	EWTP	53.4	3.08	1.71	44.5	35	1.3
6/9/2011	AWTP	56.0	3.04	1.61	47.0	35	1.3
7/13/2011	QHWTP	39.8	2.64	1.26	52.3	35	1.5
"	EWTP	41.0	2.78	1.40	49.6	35	1.4
7/14/2011	AWTP	41.2	2.82	1.28	54.6	35	1.6
8/10/2011	QHWTP	53.6	2.66	1.43	46.2	35	1.3
"	EWTP	54.4	2.87	1.55	46.0	35	1.3
8/11/2011	AWTP	53.5	2.77	1.50	45.8	35	1.3
9/14/2011	QHWTP	57.6	2.41	1.35	44.0	35	1.3
"	EWTP	58.5	2.61	1.55	40.6	35	1.2
"	AWTP	57.6	2.56	1.49	41.8	35	1.2
10/12/2011	QHWTP	65.6	2.17	1.24	42.9	25	1.7
"	EWTP	67.2	2.37	1.42	40.1	25	1.6
10/13/2011	AWTP	66.0	2.40	1.41	41.3	25	1.7
11/9/2011	QHWTP	53.4	2.09	1.09	47.8	35	1.4
"	EWTP	54.1	2.18	1.22	44.0	35	1.3
"	AWTP	54.5	2.19	1.19	45.7	35	1.3
12/14/2011	QHWTP	78.2	2.39	1.44	39.7	25	1.6
"	EWTP	plant off					
"	AWTP	plant off					
	Minimum	39.8	2.1	1.1	39.7		
	Maximum	78.2	4.4	2.2	57.0		
	RAA	53.5	2.9	1.5	47.3		

Running Annual Average (RAA) **1.4**

Title 22 California Code of Regulations, Chapter 15.5, Article 5:

Required percent TOC reduction**

Table 64536.2-A Source Water Alkalinity

Raw TOC	0-60	<60 - 120	>120
>2.0 - 4.0	35.0 %	25.0 %	15.0 %
>4.0 - 8.0	45.0 %	35.0 %	25.0 %
>8.0	50.0 %	40.0 %	30.0 %

**If one or more of the section 64636.4(b) 1-6 conditions are met, the system may assign a monthly value of 1 for the TOC removal ratio in lieu of the calculated va

List condition when used:

1. The system's source water TOC level, prior to any treatment is less than or equal to 2.0 mg/L
2. The system's treated water TOC level is less than or equal to 2.0 mg/L
3. The system's source water SUVA, prior to any treatment, is less than or equal to 2.0 L/mg-m
4. The system's finished water SUVA is less than or equal to 2.0 L/mg-m
5. A system practicing softening removes at least 10 mg/L of magnesium hardness (as CaCO3)
6. A system practicing enhanced softening lowers alkalinity below 60 mg/L (as CaCO3)

GENERAL MINERAL & PHYSICAL & INORGANIC ANALYSIS (9/99)

Date of Report: 11/05/18 | Sample ID No.056

Laboratory Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY | Signature Lab Director:

Name of Sampler: ERIK KANE | Employed By: AVEK WATER AGENCY

Date/Time Sample Collected: 11/05/12/1115 | Date/Time Sample Received @ Lab: 11/05/12/1143 | Date Analyses Completed: 11/05/18

==

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY | System Number: 1910045

Name or Number of Sample Source: ACTON PLANT - INFLUENT

****

* User ID: 4TH | Station Number: 1910045-003 *

* Date/Time of Sample: |11|05|12|1115| (YY MM DD TTTT) | Laboratory Code: 6080 *

* Date Analysis completed: |11|05|18| (YY MM DD) *

* Submitted by:______________________ Phone #:______________ *

****

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Hardness (as CaCO3) (mg/L)	00900		
	mg/L	Calcium (Ca) (mg/L)	00916		
	mg/L	Magnesium (Mg) (mg/L)	00927		
	mg/L	Sodium (NA) (mg/L)	00929		
	mg/L	Potassium (K) (mg/L)	00937		
Total Cations		Meq/L Value:			
	mg/L	Total Alkalinity (AS CaCO3) (mg/L)	00410	40.6	
	mg/L	Hydroxide (OH) (mg/L)	71830		
	mg/L	Carbonate (CO3) (mg/L)	00445		
	mg/L	Bicarbonate (HCO3) (mg/L)	00440		
*	mg/L+	Sulfate (SO4) (mg/L)	00945		.5
*	mg/L+	Chloride (Cl) (mg/L)	00940		
45	mg/L	Nitrate (as NO3) (mg/L)	71850		2.0
2 .	mg/L	Fluoride (F) (Natural-Source)	00951		.1
Total Anions		Meq/L Value:			
	Std.Units+	PH (Laboratory) (Std.Units)	00403		
***	umho/cm+	Specific Conductance (E.C.) (umhos/cm)	00095		
****	mg/L+	Total Filterable Residue@180C(TDS)(mg/L)	70300		
15	Units	Apparent Color (Unfiltered) (Units)	00081		
3	TON	Odor Threshold at 60 C (TON)	00086		1.
5	NTU	Lab Turbidity (NTU)	82079		
0.5	mg/L+	MBAS (mg/L)	38260		

* 250-500-600 ** 0.6-1.7 *** 900-1600-2200 **** 500-1000-1500

ADDITIONAL ANALYSES 056

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Organic Carbon (TOC) (mg/L)	00680	3.47	0.30

+ Indicates Secondary Drinking Water Standards

EDT

GENERAL MINERAL & PHYSICAL & INORGANIC ANALYSIS (9/99)

Date of Report: 11/06/17 Sample ID No.061

Laboratory Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY

Signature Lab Director:

Name of Sampler:ERIK KANE Employed By: AVEK WATER AGENCY

Date/Time Sample Collected:11/06/09/1040 Date/Time Sample Received @ Lab:11/06/09/1135 Date Analyses Completed:11/06/15

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System Name:ANTELOPE VALLEY-EAST KERN WATER AGENCY System Number: 1910045

Name or Number of Sample Source:ACTON PLANT - INFLUENT

****

* User ID: 4TH Station Number: 1910045-003 *

* Date/Time of Sample: |11|06|09|1040| Laboratory Code: 6080 *

* YY MM DD TTTT YY MM DD *

* Date Analysis completed: |11|06|15| *

* Submitted by:______________________ Phone #:______________ *

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MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Hardness (as CaCO3) (mg/L)	00900		
	mg/L	Calcium (Ca) (mg/L)	00916		
	mg/L	Magnesium (Mg) (mg/L)	00927		
	mg/L	Sodium (NA) (mg/L)	00929		
	mg/L	Potassium (K) (mg/L)	00937		
Total Cations		Meq/L Value:			
	mg/L	Total Alkalinity (AS CaCO3) (mg/L)	00410	56.0	
	mg/L	Hydroxide (OH) (mg/L)	71830		
	mg/L	Carbonate (CO3) (mg/L)	00445		
	mg/L	Bicarbonate (HCO3) (mg/L)	00440		
*	mg/L+	Sulfate (SO4) (mg/L)	00945		.5
*	mg/L+	Chloride (Cl) (mg/L)	00940		
45	mg/L	Nitrate (as NO3) (mg/L)	71850		2.0
2 .	mg/L	Fluoride (F) (Natural-Source)	00951		.1
Total Anions		Meq/L Value:			
	Std.Units+	PH (Laboratory) (Std.Units)	00403		
***	umho/cm+	Specific Conductance (E.C.) (umhos/cm)	00095		
****	mg/L+	Total Filterable Residue@180C(TDS)(mg/L)	70300		
15	Units	Apparent Color (Unfiltered) (Units)	00081		
3	TON	Odor Threshold at 60 C (TON)	00086		1.
5	NTU	Lab Turbidity (NTU)	82079		
0.5	mg/L+	MBAS (mg/L)	38260		

* 250-500-600 ** 0.6-1.7 *** 900-1600-2200 **** 500-1000-1500

ADDITIONAL ANALYSES 061

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Organic Carbon (TOC) (mg/L)	00680	3.04	0.30

+ Indicates Secondary Drinking Water Standards

GENERAL MINERAL & PHYSICAL & INORGANIC ANALYSIS (9/99)

Date of Report: 11/07/26 Sample ID No.079

Laboratory Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY Signature Lab Director: ________

Name of Sampler: ERIK KANE Employed By: AVEK WATER AGENCY

Date/Time Sample Collected: 11/07/14/1140 Date/Time Sample Received @ Lab: 11/07/14/1215 Date Analyses Completed: 11/07/25

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY System Number: 1910045

Name or Number of Sample Source: ACTON PLANT - INFLUENT

* User ID: 4TH Station Number: 1910045-003
* Date/Time of Sample: |11|07|14|1140| (YY MM DD TTTT) Laboratory Code: 6080
* Date Analysis completed: |11|07|25| (YY MM DD)
* Submitted by: ________ Phone #: ________

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Hardness (as CaCO3) (mg/L)	00900		
	mg/L	Calcium (Ca) (mg/L)	00916		
	mg/L	Magnesium (Mg) (mg/L)	00927		
	mg/L	Sodium (NA) (mg/L)	00929		
	mg/L	Potassium (K) (mg/L)	00937		
Total Cations		Meq/L Value:			
	mg/L	Total Alkalinity (AS CaCO3) (mg/L)	00410	41.2	
	mg/L	Hydroxide (OH) (mg/L)	71830		
	mg/L	Carbonate (CO3) (mg/L)	00445		
	mg/L	Bicarbonate (HCO3) (mg/L)	00440		
*	mg/L+	Sulfate (SO4) (mg/L)	00945		.5
*	mg/L+	Chloride (Cl) (mg/L)	00940		
45	mg/L	Nitrate (as NO3) (mg/L)	71850		2.0
2 .	mg/L	Fluoride (F) (Natural-Source)	00951		.1
Total Anions		Meq/L Value:			
	Std.Units+	PH (Laboratory) (Std.Units)	00403		
***	umho/cm+	Specific Conductance (E.C.) (umhos/cm)	00095		
****	mg/L+	Total Filterable Residue@180C(TDS)(mg/L)	70300		
15	Units	Apparent Color (Unfiltered) (Units)	00081		
3	TON	Odor Threshold at 60 C (TON)	00086		1.
5	NTU	Lab Turbidity (NTU)	82079		
0.5	mg/L+	MBAS (mg/L)	38260		

* 250-500-600 ** 0.6-1.7 *** 900-1600-2200 **** 500-1000-1500

ADDITIONAL ANALYSES 079

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Organic Carbon (TOC) (mg/L)	00680	2.82	0.30

+ Indicates Secondary Drinking Water Standards

GENERAL MINERAL & PHYSICAL & INORGANIC ANALYSIS (9/99)

Date of Report: 11/08/18 — Sample ID No.097

Laboratory Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY — Signature Lab Director: [signature]

Name of Sampler: ERIK KANE — Employed By: AVEK WATER AGENCY

Date/Time Sample Collected: 11/08/11/1005 — Date/Time Sample Received @ Lab: 11/08/11/1053 — Date Analyses Completed: 11/08/17

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY — System Number: 1910045

Name or Number of Sample Source: ACTON PLANT - INFLUENT

- User ID: 4TH — Station Number: 1910045-003
- Date/Time of Sample: |11|08|11|1005| (YY MM DD TTTT) — Laboratory Code: 6080
- Date Analysis completed: |11|08|17| (YY MM DD)
- Submitted by: ______ Phone #: ______

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Hardness (as CaCO3) (mg/L)	00900		
	mg/L	Calcium (Ca) (mg/L)	00916		
	mg/L	Magnesium (Mg) (mg/L)	00927		
	mg/L	Sodium (NA) (mg/L)	00929		
	mg/L	Potassium (K) (mg/L)	00937		
Total Cations		Meq/L Value:			
	mg/L	Total Alkalinity (AS CaCO3) (mg/L)	00410	53.5	
	mg/L	Hydroxide (OH) (mg/L)	71830		
	mg/L	Carbonate (CO3) (mg/L)	00445		
	mg/L	Bicarbonate (HCO3) (mg/L)	00440		
*	mg/L+	Sulfate (SO4) (mg/L)	00945		.5
*	mg/L+	Chloride (Cl) (mg/L)	00940		
45	mg/L	Nitrate (as NO3) (mg/L)	71850		2.0
2 .	mg/L	Fluoride (F) (Natural-Source)	00951		.1
Total Anions		Meq/L Value:			
	Std.Units+	PH (Laboratory) (Std.Units)	00403		
***	umho/cm+	Specific Conductance (E.C.) (umhos/cm)	00095		
****	mg/L+	Total Filterable Residue@180C(TDS)(mg/L)	70300		
15	Units	Apparent Color (Unfiltered) (Units)	00081		
3	TON	Odor Threshold at 60 C (TON)	00086		1.
5	NTU	Lab Turbidity (NTU)	82079		
0.5	mg/L+	MBAS (mg/L)	38260		

* 250-500-600 ** 0.6-1.7 *** 900-1600-2200 **** 500-1000-1500

ADDITIONAL ANALYSES 097

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Organic Carbon (TOC) (mg/L)	00680	2.77	0.30

+ Indicates Secondary Drinking Water Standards

GENERAL MINERAL & PHYSICAL & INORGANIC ANALYSIS (9/99)

Date of Report: 11/09/29 | Sample ID No.115

Laboratory Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY | Signature Lab Director:

Name of Sampler: ERIC KANE | Employed By: AVEK WATER AGENCY

Date/Time Sample Collected: 11/09/14/0835 | Date/Time Sample Received @ Lab: 11/09/14/0938 | Date Analyses Completed: 11/09/23

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY | System Number: 1910045

Name or Number of Sample Source: ACTON PLANT - INFLUENT

* User ID: 4TH | Station Number: 1910045-003
* Date/Time of Sample: |11|09|14|0835| (YY MM DD TTTT) | Laboratory Code: 6080
* Date Analysis completed: |11|09|23| (YY MM DD)
* Submitted by: ______ | Phone #: ______

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Hardness (as CaCO3) (mg/L)	00900		
	mg/L	Calcium (Ca) (mg/L)	00916		
	mg/L	Magnesium (Mg) (mg/L)	00927		
	mg/L	Sodium (NA) (mg/L)	00929		
	mg/L	Potassium (K) (mg/L)	00937		
Total Cations		Meq/L Value:			
	mg/L	Total Alkalinity (AS CaCO3) (mg/L)	00410	57.6	
	mg/L	Hydroxide (OH) (mg/L)	71830		
	mg/L	Carbonate (CO3) (mg/L)	00445		
	mg/L	Bicarbonate (HCO3) (mg/L)	00440		
*	mg/L+	Sulfate (SO4) (mg/L)	00945		.5
*	mg/L+	Chloride (Cl) (mg/L)	00940		
45	mg/L	Nitrate (as NO3) (mg/L)	71850		2.0
2 .	mg/L	Fluoride (F) (Natural-Source)	00951		.1
Total Anions		Meq/L Value:			
	Std.Units+	PH (Laboratory) (Std.Units)	00403		
***	umho/cm+	Specific Conductance (E.C.) (umhos/cm)	00095		
****	mg/L+	Total Filterable Residue@180C(TDS)(mg/L)	70300		
15	Units	Apparent Color (Unfiltered) (Units)	00081	<	
3	TON	Odor Threshold at 60 C (TON)	00086	<	1.
5	NTU	Lab Turbidity (NTU)	82079		
0.5	mg/L+	MBAS (mg/L)	38260		

* 250-500-600 ** 0.6-1.7 *** 900-1600-2200 **** 500-1000-1500

ADDITIONAL ANALYSES 115

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Organic Carbon (TOC) (mg/L)	00680	2.56	0.30

+ Indicates Secondary Drinking Water Standards

GENERAL MINERAL & PHYSICAL & INORGANIC ANALYSIS (9/99)

Date of Report: 11/10/24 Sample ID No.134

Laboratory Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY Signature Lab Director:

Name of Sampler:Andrew Atrops Employed By: AVEK Water Agency

Date/Time Sample Collected:11/10/13/0921 Date/Time Sample Received @ Lab:11/10/13/1013 Date Analyses Completed:11/10/20

System Name:ANTELOPE VALLEY-EAST KERN WATER AGENCY System Number: 1910045

Name or Number of Sample Source:ACTON PLANT - INFLUENT

User ID: 4TH Station Number: 1910045-003

Date/Time of Sample: |11|10|13|0921| Laboratory Code: 6080

YY MM DD TTTT

YY MM DD

Date Analysis completed: |11|10|20|

Submitted by:__________ Phone #:__________

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Hardness (as CaCO3) (mg/L)	00900		
	mg/L	Calcium (Ca) (mg/L)	00916		
	mg/L	Magnesium (Mg) (mg/L)	00927		
	mg/L	Sodium (NA) (mg/L)	00929		
	mg/L	Potassium (K) (mg/L)	00937		
Total Cations		Meq/L Value:			
	mg/L	Total Alkalinity (AS CaCO3) (mg/L)	00410	66.0	
	mg/L	Hydroxide (OH) (mg/L)	71830		
	mg/L	Carbonate (CO3) (mg/L)	00445		
	mg/L	Bicarbonate (HCO3) (mg/L)	00440		
*	mg/L+	Sulfate (SO4) (mg/L)	00945		.5
*	mg/L+	Chloride (Cl) (mg/L)	00940		
45	mg/L	Nitrate (as NO3) (mg/L)	71850		2.0
2 .	mg/L	Fluoride (F) (Natural-Source)	00951		.1
Total Anions		Meq/L Value:			
	Std.Units+	PH (Laboratory) (Std.Units)	00403		
***	umho/cm+	Specific Conductance (E.C.) (umhos/cm)	00095		
****	mg/L+	Total Filterable Residue@180C(TDS)(mg/L)	70300		
15	Units	Apparent Color (Unfiltered) (Units)	00081		
3	TON	Odor Threshold at 60 C (TON)	00086		1.
5	NTU	Lab Turbidity (NTU)	82079		
0.5	mg/L+	MBAS (mg/L)	38260		

* 250-500-600 ** 0.6-1.7 *** 900-1600-2200 **** 500-1000-1500

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Organic Carbon (TOC) (mg/L)	00680	2.40	0.30

+ Indicates Secondary Drinking Water Standards

GENERAL MINERAL & PHYSICAL & INORGANIC ANALYSIS (9/99)

Date of Report: 11/12/02 Sample ID No.153
Laboratory Signature Lab
Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY Director:
Name of Sampler:ANDREW ATROPS Employed By: AVEK WATER AGENCY
Date/Time Sample Collected:11/11/09/0847 Date/Time Sample Received @ Lab:11/11/09/0949 Date Analyses Completed:11/12/01

System Name:ANTELOPE VALLEY-EAST KERN WATER AGENCY System Number: 1910045
Name or Number of Sample Source:ACTON PLANT - INFLUENT

* User ID: 4TH Station Number: 1910045-003 *
* Date/Time of Sample: |11|11|09|0847| Laboratory Code: 6080 *
* YY MM DD TTTT YY MM DD *
* Date Analysis completed: |11|12|01| *
* Submitted by:________________ Phone #:________________ *

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Hardness (as CaCO3) (mg/L)	00900		
	mg/L	Calcium (Ca) (mg/L)	00916		
	mg/L	Magnesium (Mg) (mg/L)	00927		
	mg/L	Sodium (NA) (mg/L)	00929		
	mg/L	Potassium (K) (mg/L)	00937		
Total Cations		Meq/L Value:			
	mg/L	Total Alkalinity (AS CaCO3) (mg/L)	00410	54.5	
	mg/L	Hydroxide (OH) (mg/L)	71830		
	mg/L	Carbonate (CO3) (mg/L)	00445		
	mg/L	Bicarbonate (HCO3) (mg/L)	00440		
*	mg/L+	Sulfate (SO4) (mg/L)	00945		.5
*	mg/L+	Chloride (Cl) (mg/L)	00940		
45	mg/L	Nitrate (as NO3) (mg/L)	71850		2.0
2 .	mg/L	Fluoride (F) (Natural-Source)	00951		.1
Total Anions		Meq/L Value:			
	Std.Units+	PH (Laboratory) (Std.Units)	00403		
***	umho/cm+	Specific Conductance (E.C.) (umhos/cm)	00095		
****	mg/L+	Total Filterable Residue@180C(TDS)(mg/L)	70300		
15	Units	Apparent Color (Unfiltered) (Units)	00081		
3	TON	Odor Threshold at 60 C (TON)	00086		1.
5	NTU	Lab Turbidity (NTU)	82079		
0.5	mg/L+	MBAS (mg/L)	38260		

* 250-500-600 ** 0.6-1.7 *** 900-1600-2200 **** 500-1000-1500

ADDITIONAL ANALYSES 153

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Organic Carbon (TOC) (mg/L)	00680	2.19	0.30

+ Indicates Secondary Drinking Water Standards

EASTSIDE WATER TREATMENT PLANT

Plant Effluent
Finished Drinking Water
Monitoring Results

BSK Analytical Laboratories

EDT

Date of Report: 11|05|23|1126
Laboratory Name: BSK Analytical Laboratories
Name of Sampler: Doug Paterson

Sample ID No.: A1E0914-01
Signature Lab Director: [signature]

Date/Time Sample Collected: 11|05|11|0630
Date/Time Sample Received @ Lab : 11|05|12|1000
Date Analyses Completed: 11|05|22

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
System Number: 1910045
Name or Number of Sample Source: EASTSIDE PLANT - TREATED EFFLUENT

User ID: 4TH
Date/Time of Sample: 11|05|11|0630
Submitted by: BSK Analytical Laboratories

Station Number: 1910045-006
Laboratory Code: 5810
Date Analyses Completed: 11|05|22
Phone #: 559-497-2888

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
1000	ug/L	Aluminum (Al) (ug/L)	01105	ND	50

A1E0914 FINAL 05232011 1126

BSK Analytical Laboratories

EDT

Date of Report: 11|06|23|1703
Laboratory Name: BSK Analytical Laboratories
Name of Sampler: Doug Paterson

Sample ID No.: A1F0795-01
Signature Lab Director: [signature]

Date/Time Sample Collected: 11|06|08|0720
Date/Time Sample Received @ Lab : 11|06|09|0800
Date Analyses Completed: 11|06|19

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
System Number: 1910045
Name or Number of Sample Source: EASTSIDE PLANT - TREATED EFFLUENT

User ID: 4TH
Station Number: 1910045-006
Date/Time of Sample: 11|06|08|0720
Laboratory Code: 5810
Date Analyses Completed: 11|06|19
Submitted by: BSK Analytical Laboratories
Phone #: 559-497-2888

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
1000	ug/L	Aluminum (Al) (ug/L)	01105	ND	50

BSK Analytical Laboratories

EDT

Date of Report: 11|07|26|1658
Laboratory Name: BSK Analytical Laboratories
Name of Sampler: Doug Paterson

Sample ID No.: A1G1244-01
Signature Lab Director: [signature]

Date/Time Sample Collected: 11|07|13|0631
Date/Time Sample Received @ Lab : 11|07|15|1338
Date Analyses Completed: 11|07|24

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
System Number: 1910045
Name or Number of Sample Source: EASTSIDE PLANT - TREATED EFFLUENT

User ID: 4TH
Station Number: 1910045-006
Date/Time of Sample: 11|07|13|0631
Laboratory Code: 5810
Submitted by: BSK Analytical Laboratories
Date Analyses Completed: 11|07|24
Phone #: 559-497-2888

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
1000	ug/L	Aluminum (Al) (ug/L)	01105	ND	50

BSK Analytical Laboratories

EDT

Date of Report: 11|08|24|0818
Laboratory Name: BSK Analytical Laboratories
Name of Sampler: Kat White

Sample ID No.: A1H1233-01
Signature Lab Director: [signature]

Date/Time Sample Collected: 11|08|10|0810
Date/Time Sample Received @ Lab : 11|08|12|0820
Date Analyses Completed: 11|08|22

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
System Number: 1910045
Name or Number of Sample Source: EASTSIDE PLANT - TREATED EFFLUENT

User ID: 4TH
Date/Time of Sample: 11|08|10|0810
Submitted by: BSK Analytical Laboratories

Station Number: 1910045-006
Laboratory Code: 5810
Date Analyses Completed: 11|08|22
Phone #: 559-497-2888

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
1000	ug/L	Aluminum (Al) (ug/L)	01105	ND	50

A1H1233 FINAL 08242011 0818

BSK Analytical Laboratories

EDT

Date of Report: 11|09|28|1256
Laboratory Name: BSK Analytical Laboratories
Name of Sampler: S. Horn

Sample ID No.: A1I1114-01
Signature Lab Director:

Date/Time Sample Collected: 11|09|14|0705
Date/Time Sample Received @ Lab : 11|09|15|0950
Date Analyses Completed: 11|09|25

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
System Number: 1910045
Name or Number of Sample Source: EASTSIDE PLANT - TREATED EFFLUENT

User ID: 4TH
Date/Time of Sample: 11|09|14|0705
Submitted by: BSK Analytical Laboratories

Station Number: 1910045-006
Laboratory Code: 5810
Date Analyses Completed: 11|09|25
Phone #: 559-497-2888

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
1000	ug/L	Aluminum (Al) (ug/L)	01105	ND	50

BSK Analytical Laboratories

EDT

Date of Report: 11|10|26|1108
Laboratory Name: BSK Analytical Laboratories
Name of Sampler: Doug Patterson

Sample ID No.: A1J1218-01
Signature Lab Director:

Date/Time Sample Collected: 11|10|12|0636
Date/Time Sample Received @ Lab : 11|10|14|1000
Date Analyses Completed: 11|10|18

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
Name or Number of Sample Source: EASTSIDE PLANT - TREATED EFFLUENT
System Number: 1910045

User ID: 4TH
Date/Time of Sample: 11|10|12|0636
Submitted by: BSK Analytical Laboratories

Station Number: 1910045-006
Laboratory Code: 5810
Date Analyses Completed: 11|10|18
Phone #: 559-497-2888

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
1000	ug/L	Aluminum (Al) (ug/L)	01105	ND	50

A1J1218 FINAL 10262011 1108

BSK Analytical Laboratories

EDT

Date of Report: 11|11|18|1228
Laboratory Name: BSK Analytical Laboratories
Name of Sampler: Doug Patterson

Sample ID No.: A1K0840-01
Signature Lab Director: [signature]

Date/Time Sample Collected: 11|11|09|0605
Date/Time Sample Received @ Lab : 11|11|10|0810
Date Analyses Completed: 11|11|14

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
Name or Number of Sample Source: EASTSIDE PLANT - TREATED EFFLUENT
System Number: 1910045

User ID: 4TH
Date/Time of Sample: 11|11|09|0605
Submitted by: BSK Analytical Laboratories

Station Number: 1910045-006
Laboratory Code: 5810
Date Analyses Completed: 11|11|14
Phone #: 559-497-2888

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
1000	ug/L	Aluminum (Al) (ug/L)	01105	ND	50

BSK Analytical Laboratories

Amended

EDT

Date of Report: 11|12|30|1555
Laboratory Name: BSK Analytical Laboratories
Name of Sampler: Doug Patterson
Sample ID No.: A1K0266-02
Signature Lab Director: R [signature]

Date/Time Sample Collected: 11|11|02|0719
Date/Time Sample Received @ Lab : 11|11|03|0800
Date Analyses Completed: 11|11|14

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
System Number: 1910045
Name or Number of Sample Source: EASTSIDE PLANT - TREATED EFFLUENT

User ID: 4TH
Station Number: 1910045-006
Date/Time of Sample: 11|11|02|0719
Laboratory Code: 5810
Date Analyses Completed: 11|11|14
Submitted by: BSK Analytical Laboratories
Phone #: 559-497-2888

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Hardness, (Total) as CaCO3	00900	62	
	mg/L	Calcium (Ca) (mg/L)	00916	14	
	mg/L	Magnesium (Mg) (mg/L)	00927	6.8	
	mg/L	Sodium (Na) (mg/L)	00929	21	
	mg/L	Potassium (K) (mg/L)	00937	< 2.0	
Total Cations Meq/L Value: 2.17					
	mg/L	Alkalinity, (Total) (as CaCO3 equivalents)	00410	38	
	mg/L	Hydroxide (OH) (mg/L)	71830	< 1.0	
	mg/L	Carbonate (CO3) (mg/L)	00445	< 1.8	
	mg/L	Bicarbonate (HCO3) (mg/L)	00440	47	
600	mg/L	Sulfate (SO4) (mg/L)	00945	35	0.5
600	mg/L	Chloride (Cl) (mg/L)	00940	23	
45	mg/L	Nitrate (as NO3) (mg/L)	71850	2.0	2.0
2	mg/L	Fluoride (F) (Natural-Source)	00951	ND	0.1
Total Anions Meq/L Value: 2.18					
15	Units	Color, Apparent (Unfiltered)	00081	< 1.0	
5	NTU	Lab Turbidity (NTU)	82079	< 0.10	
0.5	mg/L	MBAS (mg/L)	38260	< 0.050	
3	TON	Odor Threshold at 60 C (TON)	00086	1.0	1.0
	Std Units	pH (Laboratory) (Std.Units)	00403	7.5	
2200	umho/cm	Specific Conductance (E.C.) (umhos/cm)	00095	240	
1500	mg/L	Total Filterable Residue@180C(TDS)(mg/L)	70300	140	
1000	ug/L	Aluminum (Al) (ug/L)	01105	ND	50
6	ug/L	Antimony (ug/L)	01097	ND	6.0
10	ug/L	Arsenic (As) (ug/L)	01002	ND	2.0
1000	ug/L	Barium (Ba) (ug/L)	01007	ND	100
4	ug/L	Beryllium (ug/L)	01012	ND	1.0
5	ug/L	Cadmium (Cd) (ug/L)	01027	ND	1.0
50	ug/L	Chromium (Total Cr) (ug/L)	01034	ND	10
1000	ug/L	Copper (Cu) (ug/L)	01042	ND	50

BSK Analytical Laboratories

Amended

EDT

Date of Report: 11|12|30|1555 **Sample ID No.:** A1K0266-02
Laboratory Name: BSK Analytical Laboratories **Signature Lab Director:**
Name of Sampler: Doug Patterson

Date/Time Sample Collected: 11|11|02|0719 **Date/Time Sample Received @ Lab :** 11|11|03|0800 **Date Analyses Completed:** 11|11|14

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY **System Number:** 1910045
Name or Number of Sample Source: EASTSIDE PLANT - TREATED EFFLUENT

User ID: 4TH **Station Number:** 1910045-006
Date/Time of Sample: 11|11|02|0719 **Laboratory Code:** 5810
Date Analyses Completed: 11|11|14
Submitted by: BSK Analytical Laboratories **Phone #:** 559-497-2888

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
300	ug/L	Iron (Fe) (ug/L)	01045	ND	100
	ug/L	Lead (Pb) (ug/L)	01051	ND	5.0
50	ug/L	Manganese (Mn) (ug/L)	01055	ND	20
2	ug/L	Mercury (Hg) (ug/L)	71900	ND	1.0
100	ug/L	Nickel (ug/L)	01067	ND	10
50	ug/L	Selenium (Se) (ug/L)	01147	ND	5.0
100	ug/L	Silver (Ag) (ug/L)	01077	ND	10
2	ug/L	Thallium (ug/L)	01059	ND	1.0
5000	ug/L	Zinc (Zn) (ug/L)	01092	520	50
		ADDITIONAL ANALYSES			
	NA	Agressiveness Index	82383	11	
150	ug/L	Cyanide (ug/L)	01291	ND	100
	NA	Langelier Index at 60 C	71813	- 1.3	
1000	ug/L	Nitrite as Nitrogen(N) (ug/L)	00620	ND	400
6	ug/L	Perchlorate (ug/L)	A-031	ND	4.0

TEST METHOD	CHEMICAL	ENTRY #	ANALYSES RESULTS	MCL µG/L	DLR µG/L
	REGULATED ORGANIC CHEMICALS				
EPA 525.2	Alachlor (ALANEX)	77825	ND	2	1.0
EPA 525.2	Atrazine (AATREX)	39033	ND	1	0.5
EPA 525.2	Benzo (a) Pyrene	34247	ND	0.2	0.1
EPA 525.2	Di(2-ethylhexyl) Adipate	A-026	ND	400	5.0
EPA 525.2	Diethylhexylphthalate (DEHP)	39100	ND	4	3.0
EPA 525.2	Molinate (ORDRAM)	82199	ND	20	2.0
EPA 525.2	Simazine (PRINCEP)	39055	ND	4	1.0
EPA 525.2	Thiobencarb (BOLERO)	A-001	ND	70	1.0
	UNREGULATED ORGANIC CHEMICALS				
EPA 525.2	Bromacil (HYVAR)	82198	ND		10
EPA 525.2	Butachlor	77860	ND		0.38
EPA 525.2	Diazinon	39570	< 0.25		
EPA 525.2	Dimethoate (CYGON)	38458	< 10		

BSK Analytical Laboratories

Amended

EDT

Date of Report: 11|12|30|1555
Laboratory Name: BSK Analytical Laboratories
Name of Sampler: Doug Patterson

Sample ID No.: A1K0266-02
Signature Lab Director: [signature]

Date/Time Sample Collected: 11|11|02|0719
Date/Time Sample Received @ Lab : 11|11|03|0800
Date Analyses Completed: 11|11|14

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
System Number: 1910045
Name or Number of Sample Source: EASTSIDE PLANT - TREATED EFFLUENT

User ID: 4TH
Date/Time of Sample: 11|11|02|0719
Submitted by: BSK Analytical Laboratories

Station Number: 1910045-006
Laboratory Code: 5810
Date Analyses Completed: 11|11|14
Phone #: 559-497-2888

TEST METHOD	CHEMICAL	ENTRY #	ANALYSES RESULTS	MCL μG/L	DLR μG/L
	UNREGULATED ORGANIC CHEMICALS				
EPA 525.2	Metolachlor	39356	< 0.50		
EPA 525.2	Metribuzin	81408	< 0.50		
EPA 525.2	Propachlor	38533	ND		0.5

Antelope Valley-East Kern Water Agency
LA System No. 1910045
TOC Removal Running Annual Average

Sample Date	Plant	Alkalinity mgCaCO3/L	Raw TOC mg/L	Treated TOC mg/L	Actual % TOC reduction	Required % TOC reduction	"TOC Removal Ratio" actual % /required %
1/12/2011	QHWTP	53.9	3.10	1.55	50.0	35	1.4
"	EWTP	plant off					
"	AWTP	plant off					
2/9/2011	QHWTP	52.6	4.41	2.16	51.0	45	1.1
"	EWTP	plant off					
"	AWTP	plant off					
3/9/2011	QHWTP	50.3	4.01	1.92	52.1	45	1.2
"	EWTP	plant off					
"	AWTP	plant off					
4/13/2011	QHWTP	51.7	3.82	1.83	52.1	35	1.5
"	EWTP	plant off					
"	AWTP	plant off					
5/11/2011	QHWTP	40.8	3.23	1.55	52.0	35	1.5
"	EWTP	41.9	3.58	1.54	57.0	35	1.6
5/12/2011	AWTP	40.6	3.47	1.55	55.3	35	1.6
6/8/2011	QHWTP	54.6	2.87	1.57	45.3	35	1.3
"	EWTP	53.4	3.08	1.71	44.5	35	1.3
6/9/2011	AWTP	56.0	3.04	1.61	47.0	35	1.3
7/13/2011	QHWTP	39.8	2.64	1.26	52.3	35	1.5
"	EWTP	41.0	2.78	1.40	49.6	35	1.4
7/14/2011	AWTP	41.2	2.82	1.28	54.6	35	1.6
8/10/2011	QHWTP	53.6	2.66	1.43	46.2	35	1.3
"	EWTP	54.4	2.87	1.55	46.0	35	1.3
8/11/2011	AWTP	53.5	2.77	1.50	45.8	35	1.3
9/14/2011	QHWTP	57.6	2.41	1.35	44.0	35	1.3
"	EWTP	58.5	2.61	1.55	40.6	35	1.2
"	AWTP	57.6	2.56	1.49	41.8	35	1.2
10/12/2011	QHWTP	65.6	2.17	1.24	42.9	25	1.7
"	EWTP	67.2	2.37	1.42	40.1	25	1.6
10/13/2011	AWTP	66.0	2.40	1.41	41.3	25	1.7
11/9/2011	QHWTP	53.4	2.09	1.09	47.8	35	1.4
"	EWTP	54.1	2.18	1.22	44.0	35	1.3
"	AWTP	54.5	2.19	1.19	45.7	35	1.3
12/14/2011	QHWTP	78.2	2.39	1.44	39.7	25	1.6
"	EWTP	plant off					
"	AWTP	plant off					
	Minimum	39.8	2.1	1.1	39.7		
	Maximum	78.2	4.4	2.2	57.0		
	RAA	53.5	2.9	1.5	47.3		

Running Annual Average (RAA) **1.4**

Title 22 California Code of Regulations, Chapter 15.5, Article 5:
Required percent TOC reduction**

Table 64536.2-A — Source Water Alkalinity

Raw TOC	0-60	<60 - 120	>120
>2.0 - 4.0	35.0 %	25.0 %	15.0 %
>4.0 - 8.0	45.0 %	35.0 %	25.0 %
>8.0	50.0 %	40.0 %	30.0 %

**If one or more of the section 64636.4(b) 1-6 conditions are met, the system may assign a monthly value of 1 for the TOC removal ratio in lieu of the calculated va
List condition when used:

1. The system's source water TOC level, prior to any treatment is less than or equal to 2.0 mg/L
2. The system's treated water TOC level is less than or equal to 2.0 mg/L
3. The system's source water SUVA, prior to any treatment, is less than or equal to 2.0 L/mg-m
4. The system's finished water SUVA is less than or equal to 2.0 L/mg-m
5. A system practicing softening removes at least 10 mg/L of magnesium hardness (as CaCO3)
6. A system practicing enhanced softening lowers alkalinity below 60 mg/L (as CaCO3)

EDT

GENERAL MINERAL & PHYSICAL & INORGANIC ANALYSIS (9/99)

Date of Report: 11/05/18 Sample ID No.031

Laboratory Signature Lab

Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY Director:

Name of Sampler: DOUG PATTERSON Employed By: AVEK WATER AGENCY

Date/Time Sample Collected: 11/05/11/0640 Date/Time Sample Received @ Lab: 11/05/11/0857 Date Analyses Completed: 11/05/13

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY System Number: 1910045

Name or Number of Sample Source: EASTSIDE PLANT - TREATED EFFLUENT FORCE

User ID: 4TH Station Number: 1910045-006

Date/Time of Sample: |11|05|11|0640| Laboratory Code: 6080

YY MM DD TTTT

Date Analysis completed: |11|05|13|

YY MM DD

Submitted by:____________________ Phone #:________________

PAGE 1 OF 1 ADDITIONAL ANALYSES

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Organic Carbon (TOC) (mg/L)	00680	1.54	0.30

+ Indicates Secondary Drinking Water Standards

EDT

GENERAL MINERAL & PHYSICAL & INORGANIC ANALYSIS (9/99)

Date of Report: 11/06/17 Sample ID No.064

Laboratory Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY

Signature Lab Director:

Name of Sampler:STEVE HORN Employed By: AVEK WATER AGENCY

Date/Time Sample Collected:11/06/08/0727

Date/Time Sample Received @ Lab:11/06/08/1005

Date Analyses Completed:11/06/15

===

System Name:ANTELOPE VALLEY-EAST KERN WATER AGENCY

System Number: 1910045

Name or Number of Sample Source:EASTSIDE PLANT - TREATED EFFLUENT FORCE

****

* User ID: 4TH Station Number: 1910045-006 *

* Date/Time of Sample: |11|06|08|0727| Laboratory Code: 6080 *

* YY MM DD TTTT YY MM DD *

* Date Analysis completed: |11|06|15| *

* Submitted by:____________________ Phone #:______________ *

****

PAGE 1 OF 1

ADDITIONAL ANALYSES

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Organic Carbon (TOC) (mg/L)	00680	1.71	0.30

\+ Indicates Secondary Drinking Water Standards

GENERAL MINERAL & PHYSICAL & INORGANIC ANALYSIS (9/99)

Date of Report: 11/07/26 Sample ID No.082

Laboratory Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY Signature Lab Director: [signature]

Name of Sampler:DOUG PATERSON Employed By: AVEK WATER AGENCY

Date/Time Sample Collected:11/07/13/0625 Date/Time Sample Received @ Lab:11/07/13/0815 Date Analyses Completed:11/07/25

==

System Name:ANTELOPE VALLEY-EAST KERN WATER AGENCY System Number: 1910045

Name or Number of Sample Source:EASTSIDE PLANT - TREATED EFFLUENT FORCE

****

* User ID: 4TH Station Number: 1910045-006 *

* Date/Time of Sample: |11|07|13|0625| Laboratory Code: 6080 *

* YY MM DD TTTT YY MM DD *

* Date Analysis completed: |11|07|25| *

* Submitted by:______________________ Phone #:______________ *

****

PAGE 1 OF 1 ADDITIONAL ANALYSES

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Organic Carbon (TOC) (mg/L)	00680	1.40	0.30

\+ Indicates Secondary Drinking Water Standards

EDT

GENERAL MINERAL & PHYSICAL & INORGANIC ANALYSIS (9/99)

Date of Report: 11/08/18 Sample ID No.100

Laboratory Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY

Signature Lab Director:

Name of Sampler:STEVE HORN Employed By: AVEK WATER AGENCY

Date/Time Sample Collected:11/08/10/0820

Date/Time Sample Received @ Lab:11/08/10/1009

Date Analyses Completed:11/08/17

System Name:ANTELOPE VALLEY-EAST KERN WATER AGENCY

System Number: 1910045

Name or Number of Sample Source:EASTSIDE PLANT - TREATED EFFLUENT FORCE

User ID: 4TH

Station Number: 1910045-006

Date/Time of Sample: |11|08|10|0820| (YY MM DD TTTT)

Laboratory Code: 6080

Date Analysis completed: |11|08|17| (YY MM DD)

Submitted by:____________________ Phone #:____________________

PAGE 1 OF 1

ADDITIONAL ANALYSES

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Organic Carbon (TOC) (mg/L)	00680	1.55	0.30

+ Indicates Secondary Drinking Water Standards

GENERAL MINERAL & PHYSICAL & INORGANIC ANALYSIS (9/99)

Date of Report: 11/09/29
Sample ID No.118
Laboratory Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
Signature Lab Director:
Name of Sampler:STEVE HORN
Employed By: AVEK WATER AGENCY
Date/Time Sample Collected:11/09/14/0720
Date/Time Sample Received @ Lab:11/09/14/1115
Date Analyses Completed:11/09/23

System Name:ANTELOPE VALLEY-EAST KERN WATER AGENCY
System Number: 1910045
Name or Number of Sample Source:EASTSIDE PLANT - TREATED EFFLUENT

User ID: 4TH
Station Number: 1910045-006
Date/Time of Sample: |11|09|14|0720| (YY MM DD TTTT)
Laboratory Code: 6080
Date Analysis completed: |11|09|23| (YY MM DD)
Submitted by:
Phone #:

ADDITIONAL ANALYSES

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Organic Carbon (TOC) (mg/L)	00680	1.55	0.30

+ Indicates Secondary Drinking Water Standards

GENERAL MINERAL & PHYSICAL & INORGANIC ANALYSIS (9/99)

Date of Report: 11/10/24 Sample ID No.137

Laboratory Signature Lab

Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY Director:

Name of Sampler:Steve Horn Employed By: AVEK Water Agency

Date/Time Sample Collected:11/10/12/0630 Date/Time Sample Received @ Lab:11/10/12/0930 Date Analyses Completed:11/10/20

==

System Name:ANTELOPE VALLEY-EAST KERN WATER AGENCY System Number: 1910045

Name or Number of Sample Source:EASTSIDE PLANT - TREATED EFFLUENT

****

* User ID: 4TH Station Number: 1910045-006 *

* Date/Time of Sample: |11|10|12|0630| Laboratory Code: 6080 *

* YY MM DD TTTT YY MM DD *

* Date Analysis completed: |11|10|20| *

* Submitted by:____________________ Phone #:________________ *

****

PAGE 1 OF 1 ADDITIONAL ANALYSES

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Organic Carbon (TOC) (mg/L)	00680	1.42	0.30

+ Indicates Secondary Drinking Water Standards

GENERAL MINERAL & PHYSICAL & INORGANIC ANALYSIS (9/99)

Date of Report: 11/12/02
Sample ID No.156
Laboratory Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
Signature Lab Director:
Name of Sampler: DOUG PATERSON
Employed By: AVEK WATER AGENCY
Date/Time Sample Collected: 11/11/09/0617
Date/Time Sample Received @ Lab: 11/11/09/0826
Date Analyses Completed: 11/12/01

==

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
System Number: 1910045
Name or Number of Sample Source: EASTSIDE PLANT - TREATED EFFLUENT

****

* User ID: 4TH Station Number: 1910045-006 *
* Date/Time of Sample: |11|11|09|0617| Laboratory Code: 6080 *
* YY MM DD TTTT YY MM DD *
* Date Analysis completed: |11|12|01| *
* Submitted by:________________ Phone #:________________ *

****

PAGE 1 OF 1

ADDITIONAL ANALYSES

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Organic Carbon (TOC) (mg/L)	00680	1.22	0.30

+ Indicates Secondary Drinking Water Standards

EASTSIDE WATER TREATMENT PLANT

Plant Influent
Untreated Source Water
Monitoring Results

BSK Analytical Laboratories

Amended

EDT

Date of Report: 11|03|11|1327
Laboratory Name: BSK Analytical Laboratories
Name of Sampler: Kat White

Sample ID No.: A1C0821-01
Signature Lab Director: [signature]

Date/Time Sample Collected: 11|03|09|1400
Date/Time Sample Received @ Lab : 11|03|10|1000
Date Analyses Completed: 11|03|10

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
System Number: 1910045
Name or Number of Sample Source: EASTSIDE PLANT - INFLUENT

User ID: 4TH
Station Number: 1910045-005
Date/Time of Sample: 11|03|09|1400
Laboratory Code: 5810
Submitted by: BSK Analytical Laboratories
Date Analyses Completed: 11|03|10
Phone #: 559-497-2888

Report Amendments

Date: 3/11/11

Initials: PJE

This amended report supersedes any previous reports issued by the laboratory. Amendments to this report are as follows: Report amended to send state data to the following PS codes: 1910045-002, 1910045-005, 1910045-003, and 1510053-001.

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
45	mg/L	Nitrate (as NO3) (mg/L)	71850	3.2	2.0

Total Anions Meq/L Value: 0.05

A1C0821 RECREATE 03112011 1328

BSK Analytical Laboratories

Amended

EDT

Date of Report: 11|06|28|1111
Laboratory Name: BSK Analytical Laboratories
Name of Sampler: Justin Livesay

Sample ID No.: A1F0795-04
Signature Lab Director: [signature]

Date/Time Sample Collected: 11|06|08|1407
Date/Time Sample Received @ Lab : 11|06|09|0800
Date Analyses Completed: 11|06|10

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
Name or Number of Sample Source: EASTSIDE PLANT - INFLUENT
System Number: 1910045

User ID: 4TH
Date/Time of Sample: 11|06|08|1407
Submitted by: BSK Analytical Laboratories

Station Number: 1910045-005
Laboratory Code: 5810
Date Analyses Completed: 11|06|10
Phone #: 559-497-2888

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
45	mg/L	Nitrate (as NO3) (mg/L)	71850	2.0	2.0

Total Anions Meq/L Value: 0.03

A1F0795 FINAL 06282011 1111

BSK Analytical Laboratories

Amended

EDT

Date of Report: 11|09|30|1011
Laboratory Name: BSK Analytical Laboratories
Name of Sampler: Justin Livesay

Sample ID No.: A1|1271-01
Signature Lab Director:

Date/Time Sample Collected: 11|09|15|1431
Date/Time Sample Received @ Lab : 11|09|16|1020
Date Analyses Completed: 11|09|16

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
Name or Number of Sample Source: EASTSIDE PLANT - INFLUENT
System Number: 1910045

User ID: 4TH
Date/Time of Sample: 11|09|15|1431
Submitted by: BSK Analytical Laboratories

Station Number: 1910045-005
Laboratory Code: 5810
Date Analyses Completed: 11|09|16
Phone #: 559-497-2888

Chain of Custody Notes

Date: 9/29/11
Initials: RLR
Note: Data is reported to four ps codes EDT: 1910045-002, 1910045-005, 1910045-003 and 1510053-001. Subsequent amended write on report hardcopies reflect the report being generated multiple times to accommodate this request.

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
45	mg/L	Nitrate (as NO3) (mg/L)	71850	ND	2.0

Total Anions Meq/L Value:	0.00

1414 Stanislaus Street Fresno, CA 93706 (559) 497-2888 FAX (559) 485-6935 www.bsklabs.com

BSK Analytical Laboratories

Amended

EDT

Date of Report: 12|01|10|0957
Laboratory Name: BSK Analytical Laboratories
Name of Sampler: k. White

Sample ID No.: A1L1169-03
Signature Lab Director: R [signature]

Date/Time Sample Collected: 11|12|15|1216
Date/Time Sample Received @ Lab : 11|12|16|1023
Date Analyses Completed: 11|12|16

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
Name or Number of Sample Source: EASTSIDE PLANT - INFLUENT
System Number: 1910045

User ID: 4TH
Date/Time of Sample: 11|12|15|1216
Submitted by: BSK Analytical Laboratories

Station Number: 1910045-005
Laboratory Code: 5810
Date Analyses Completed: 11|12|16
Phone #: 559-497-2888

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
45	mg/L	Nitrate (as NO3) (mg/L)	71850	3.6	2.0

Total Anions Meq/L Value:	0.06

BSK Analytical Laboratories

Amended

EDT

Date of Report: 11|12|30|1531
Laboratory Name: BSK Analytical Laboratories
Name of Sampler: Client

Sample ID No.: A1K0266-05
Signature Lab Director:

Date/Time Sample Collected: 11|11|02|1307
Date/Time Sample Received @ Lab : 11|11|03|0800
Date Analyses Completed: 11|11|14

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
System Number: 1910045
Name or Number of Sample Source: EASTSIDE PLANT - INFLUENT

User ID: 4TH
Date/Time of Sample: 11|11|02|1307
Submitted by: BSK Analytical Laboratories

Station Number: 1910045-005
Laboratory Code: 5810
Date Analyses Completed: 11|11|14
Phone #: 559-497-2888

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Hardness, (Total) as CaCO3	00900	60	
	mg/L	Calcium (Ca) (mg/L)	00916	13	
	mg/L	Magnesium (Mg) (mg/L)	00927	6.5	
	mg/L	Sodium (Na) (mg/L)	00929	20	
	mg/L	Potassium (K) (mg/L)	00937	< 2.0	
		Total Cations Meq/L Value: 2.05			
	mg/L	Alkalinity, (Total) (as CaCO3 equivalents)	00410	58	
	mg/L	Hydroxide (OH) (mg/L)	71830	< 1.0	
	mg/L	Carbonate (CO3) (mg/L)	00445	< 1.8	
	mg/L	Bicarbonate (HCO3) (mg/L)	00440	71	
600	mg/L	Sulfate (SO4) (mg/L)	00945	16	0.5
600	mg/L	Chloride (Cl) (mg/L)	00940	22	
45	mg/L	Nitrate (as NO3) (mg/L)	71850	2.2	2.0
2	mg/L	Fluoride (F) (Natural-Source)	00951	ND	0.1
		Total Anions Meq/L Value: 2.15			
15	Units	Color, Apparent (Unfiltered)	00081	10	
5	NTU	Lab Turbidity (NTU)	82079	0.47	
0.5	mg/L	MBAS (mg/L)	38260	< 0.050	
3	TON	Odor Threshold at 60 C (TON)	00086	1.0	1.0
	Std Units	pH (Laboratory) (Std.Units)	00403	8.2	
2200	umho/cm	Specific Conductance (E.C.) (umhos/cm)	00095	220	
1500	mg/L	Total Filterable Residue@180C(TDS)(mg/L)	70300	130	
1000	ug/L	Aluminum (Al) (ug/L)	01105	ND	50
6	ug/L	Antimony (ug/L)	01097	ND	6.0
10	ug/L	Arsenic (As) (ug/L)	01002	ND	2.0
1000	ug/L	Barium (Ba) (ug/L)	01007	ND	100
4	ug/L	Beryllium (ug/L)	01012	ND	1.0
5	ug/L	Cadmium (Cd) (ug/L)	01027	ND	1.0
50	ug/L	Chromium (Total Cr) (ug/L)	01034	ND	10
1000	ug/L	Copper (Cu) (ug/L)	01042	ND	50

A1K0266 FINAL 12302011 1532

BSK Analytical Laboratories

Amended

EDT

Date of Report: 11|12|30|1531 **Sample ID No.:** A1K0266-05

Laboratory Name: BSK Analytical Laboratories **Signature Lab Director:**

Name of Sampler: Client

Date/Time Sample Collected: 11|11|02|1307 **Date/Time Sample Received @ Lab :** 11|11|03|0800 **Date Analyses Completed:** 11|11|14

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY **System Number:** 1910045

Name or Number of Sample Source: EASTSIDE PLANT - INFLUENT

User ID: 4TH **Station Number:** 1910045-005

Date/Time of Sample: 11|11|02|1307 **Laboratory Code:** 5810

Date Analyses Completed: 11|11|14

Submitted by: BSK Analytical Laboratories **Phone #:** 559-497-2888

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
300	ug/L	Iron (Fe) (ug/L)	01045	ND	100
	ug/L	Lead (Pb) (ug/L)	01051	ND	5.0
50	ug/L	Manganese (Mn) (ug/L)	01055	ND	20
2	ug/L	Mercury (Hg) (ug/L)	71900	ND	1.0
100	ug/L	Nickel (ug/L)	01067	ND	10
50	ug/L	Selenium (Se) (ug/L)	01147	ND	5.0
100	ug/L	Silver (Ag) (ug/L)	01077	ND	10
2	ug/L	Thallium (ug/L)	01059	ND	1.0
5000	ug/L	Zinc (Zn) (ug/L)	01092	ND	50

ADDITIONAL ANALYSES

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	NA	Agressiveness Index	82383	11	
150	ug/L	Cyanide (ug/L)	01291	ND	100
	NA	Langelier Index at 60 C	71813	- 0.42	
1000	ug/L	Nitrite as Nitrogen(N) (ug/L)	00620	ND	400
6	ug/L	Perchlorate (ug/L)	A-031	ND	4.0

TEST METHOD	CHEMICAL	ENTRY #	ANALYSES RESULTS	MCL µG/L	DLR µG/L
REGULATED ORGANIC CHEMICALS					
EPA 524.2	Bromodichloromethane	32101	ND		1.0
EPA 524.2	Bromoform	32104	ND		1.0
EPA 524.2	Chloroform (Trichloromethane)	32106	ND		1.0
EPA 524.2	Dibromochloromethane	32105	ND		1.0
EPA 524.2a	Total Trihalomethanes (TTHMs)	82080	< 0.50	80	
REGULATED ORGANIC CHEMICALS					
EPA 524.2	1,1,1-Trichloroethane (1,1,1-TCA)	34506	ND	200	0.5
EPA 524.2	1,1,2,2-Tetrachloroethane	34516	ND	1	0.5
EPA 524.2	1,1,2-Trichloroethane (1,1,2-TCA)	34511	ND	5	0.5
EPA 524.2	1,1-Dichloroethane (1,1-DCA)	34496	ND	5	0.5
EPA 524.2	1,1-Dichloroethylene (1,1-DCE)	34501	ND	6	0.5
EPA 524.2	1,2,4-Trichlorobenzene	34551	ND	5	0.5
EPA 524.2	1,2-Dichlorobenzene (o-DCB)	34536	ND	600	0.5

BSK Analytical Laboratories

Amended

EDT

Date of Report: 11|12|30|1531
Laboratory Name: BSK Analytical Laboratories
Name of Sampler: Client

Sample ID No.: A1K0266-05
Signature Lab Director:

Date/Time Sample Collected: 11|11|02|1307
Date/Time Sample Received @ Lab : 11|11|03|0800
Date Analyses Completed: 11|11|14

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
System Number: 1910045
Name or Number of Sample Source: EASTSIDE PLANT - INFLUENT

User ID: 4TH
Date/Time of Sample: 11|11|02|1307
Submitted by: BSK Analytical Laboratories

Station Number: 1910045-005
Laboratory Code: 5810
Date Analyses Completed: 11|11|14
Phone #: 559-497-2888

TEST METHOD	CHEMICAL	ENTRY #	ANALYSES RESULTS	MCL µG/L	DLR µG/L
	REGULATED ORGANIC CHEMICALS				
EPA 524.2	1,2-Dichloroethane (1,2-DCA)	34531	ND	0.5	0.5
EPA 524.2	1,2-Dichloropropane	34541	ND	5	0.5
EPA 524.2	1,4-Dichlorobenzene (p-DCB)	34571	ND	5	0.5
EPA 524.2	Benzene	34030	ND	1	0.5
EPA 524.2	Carbon Tetrachloride	32102	ND	0.5	0.5
EPA 524.2	cis-1,2-Dichloroethylene (c-1,2-DCE)	77093	ND	6	0.5
EPA 524.2	cis-1,3-Dichloropropene (D-D)	34704	ND	0.5	0.5
EPA 524.2	Dichloromethane (Methylene Chloride)	34423	ND	5	0.5
EPA 524.2	Ethyl Benzene	34371	ND	300	0.5
EPA 524.2	m,p-Xylene	A-014	ND		0.5
EPA 524.2	Methyl tert-Butyl Ether(MTBE)	46491	ND	5	3.0
EPA 524.2	Monochlorobenzene (Chlorobenzene)	34301	ND	70	0.5
EPA 524.2	o-Xylene	77135	ND		0.5
EPA 524.2	Styrene	77128	ND	100	0.5
EPA 524.2	Tetrachloroethylene (PCE)	34475	ND	5	0.5
EPA 524.2	Toluene	34010	ND	150	0.5
EPA 524.2	trans-1,2-Dichloroethylene (t-1,2-DCE)	34546	ND	10	0.5
EPA 524.2	trans-1,3-Dichloropropene	34699	ND	0.5	0.5
EPA 524.2	Trichloroethylene (TCE)	39180	ND	5	0.5
EPA 524.2	Trichlorofluoromethane (FREON 11)	34488	ND	150	5.0
EPA 524.2	Trichlorotrifluoroethane (FREON 113)	81611	ND	1200	10
EPA 524.2	Vinyl Chloride (VC)	39175	ND	0.5	0.5
EPA 524.2a	Total 1,3-Dichloropropene	34561	ND	0.5	0.5
EPA 524.2a	Total Xylenes (m,p, & o)	81551	< 0.50	1750	
EPA 525.2	Alachlor (ALANEX)	77825	ND	2	1.0
EPA 525.2	Atrazine (AATREX)	39033	ND	1	0.5
EPA 525.2	Benzo (a) Pyrene	34247	ND	0.2	0.1
EPA 525.2	Di(2-ethylhexyl) Adipate	A-026	ND	400	5.0
EPA 525.2	Diethylhexylphthalate (DEHP)	39100	ND	4	3.0
EPA 525.2	Molinate (ORDRAM)	82199	ND	20	2.0
EPA 525.2	Simazine (PRINCEP)	39055	ND	4	1.0
EPA 525.2	Thiobencarb (BOLERO)	A-001	ND	70	1.0
	UNREGULATED ORGANIC CHEMICALS				

BSK Analytical Laboratories

Amended

EDT

Date of Report: 11|12|30|1531
Sample ID No.: A1K0266-05
Laboratory Name: BSK Analytical Laboratories
Signature Lab Director:
Name of Sampler: Client

Date/Time Sample Collected: 11|11|02|1307
Date/Time Sample Received @ Lab : 11|11|03|0800
Date Analyses Completed: 11|11|14

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
System Number: 1910045
Name or Number of Sample Source: EASTSIDE PLANT - INFLUENT

User ID: 4TH
Station Number: 1910045-005
Date/Time of Sample: 11|11|02|1307
Laboratory Code: 5810
Date Analyses Completed: 11|11|14
Submitted by: BSK Analytical Laboratories
Phone #: 559-497-2888

TEST METHOD	CHEMICAL	ENTRY #	ANALYSES RESULTS	MCL µG/L	DLR µG/L
	UNREGULATED ORGANIC CHEMICALS				
EPA 524.2	1,1,1,2-Tetrachloroethane	77562	ND		0.5
EPA 524.2	1,1-Dichloropropene	77168	ND		0.5
EPA 524.2	1,2,3-Trichlorobenzene	77613	ND		0.5
EPA 524.2	1,2,4-Trimethylbenzene	77222	< 0.50		
EPA 524.2	1,3,5-Trimethylbenzene	77226	ND		0.5
EPA 524.2	1,3-Dichlorobenzene (m-DCB)	34566	ND		0.5
EPA 524.2	1,3-Dichloropropane	77173	ND		0.5
EPA 524.2	2,2-Dichloropropane	77170	ND		0.5
EPA 524.2	2-Chlorotoluene	A-008	ND		0.5
EPA 524.2	4-Chlorotoluene	A-009	ND		0.5
EPA 524.2	Acetone	81552	< 10		
EPA 524.2	Bromobenzene	81555	ND		0.5
EPA 524.2	Bromochloromethane	A-012	ND		0.5
EPA 524.2	Bromomethane (Methyl Bromide)	34413	ND		0.5
EPA 524.2	Chloroethane	34311	ND		0.5
EPA 524.2	Chloromethane (Methyl Chloride)	34418	ND		0.5
EPA 524.2	Dibromomethane	77596	ND		0.5
EPA 524.2	Dichlorodifluoromethane (Freon 12)	34668	ND		0.5
EPA 524.2	Diisopropyl Ether (DIPE)	A-036	ND		3.0
EPA 524.2	Ethyl tert-Butyl Ether (ETBE)	A-033	ND		3.0
EPA 524.2	Hexachlorobutadiene	34391	ND		0.5
EPA 524.2	Isopropylbenzene (Cumene)	77223	ND		0.5
EPA 524.2	Mesitylene (1,3,5-Trimethylbenzene)	77226	ND		0.5
EPA 524.2	Methyl Ethyl Ketone (MEK, Butanone)	81595	ND		5.0
EPA 524.2	Methyl Isobutyl Ketone (MIBK)	81596	ND		5.0
EPA 524.2	Naphthalene	34696	ND		0.5
EPA 524.2	n-Butylbenzene	A-010	ND		0.5
EPA 524.2	n-Propylbenzene	77224	ND		0.5
EPA 524.2	p-Isopropyltoluene	A-011	< 0.50		
EPA 524.2	sec-Butylbenzene	77350	ND		0.5
EPA 524.2	tert-Amyl Methyl Ether (TAME)	A-034	ND		3.0
EPA 524.2	tert-Butyl Alcohol (TBA)	77035	ND		2.0
EPA 524.2	tert-Butylbenzene	77353	ND		0.5
EPA 525.2	Bromacil (HYVAR)	82198	ND		10

BSK Analytical Laboratories

Amended

EDT

Date of Report: 11|12|30|1531
Laboratory Name: BSK Analytical Laboratories
Name of Sampler: Client

Sample ID No.: A1K0266-05
Signature Lab Director: [signature]

Date/Time Sample Collected: 11|11|02|1307
Date/Time Sample Received @ Lab : 11|11|03|0800
Date Analyses Completed: 11|11|14

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
System Number: 1910045
Name or Number of Sample Source: EASTSIDE PLANT - INFLUENT

User ID: 4TH
Date/Time of Sample: 11|11|02|1307
Submitted by: BSK Analytical Laboratories

Station Number: 1910045-005
Laboratory Code: 5810
Date Analyses Completed: 11|11|14
Phone #: 559-497-2888

TEST METHOD	CHEMICAL	ENTRY #	ANALYSES RESULTS	MCL µG/L	DLR µG/L
	UNREGULATED ORGANIC CHEMICALS				
EPA 525.2	Butachlor	77860	ND		0.38
EPA 525.2	Diazinon	39570	< 0.25		
EPA 525.2	Dimethoate (CYGON)	38458	< 10		
EPA 525.2	Metolachlor	39356	< 0.50		
EPA 525.2	Metribuzin	81408	< 0.50		
EPA 525.2	Propachlor	38533	ND		0.5

RADIOACTIVITY ANALYSIS (9/99)

Date of Report: 11/12/05 Sample ID No 3057601001/K0286
Laboratory Signature Lab
Name: PACE ANALYTICAL SERVICES, INC-GREENSBURG Director:
Name of Sampler:client Employed By: client
Date/Time Sample Collected:11/11/02/1307 Date/Time Sample Received @ Lab:11/11/14/0950 Date Analyses Completed:11/12/02

==

System Name:ANTELOPE VALLEY-EAST KERN WATER AGENCY System Number: 1910045
Name or Number of Sample Source:EASTSIDE PLANT - INFLUENT

****

* User ID: 4TH Station Number: 1910045-005 *
* Date/Time of Sample: |11|11|02|1307| Laboratory Code: 0010 *
* YY MM DD TTTT YY MM DD *
* Date Analysis completed: |11|12|02| *
* Submitted by:______________ Phone #:____________ *

****

MCL	REPORT UNITS	CHEMICAL	STORET CODE	ANALYSES RESULTS	DLR
	pCi/L	TITLE 22 CALIFORNIA CODE OF REGULATIONS			
	pCi/L	SECTION 64442 (22 CCR 64442)			
15	pCi/L	Gross Alpha	01501		3.0
	pCi/L	Gross Alpha Counting Error	01502		
	pCi/L	Gross Alpha MDA95 *	A-072		
20	pCi/L	Uranium	28012		1.0
	pCi/L	Uranium Counting Error	A-028		
	pCi/L	Uranium MDA95	A-073		
	pCi/L	Radium 226	09501		1.0
	pCi/L	Radium 226 Counting Error	09502		
	pCi/L	Radium 226 MDA95	A-074		
	pCi/L	Radium 228	11501		1.0
	pCi/L	Radium 228 Counting Error	11502		
	pCi/L	Radium 228 MDA95	A-075		
5	pCi/L	Ra 226 + Ra 228, Combined	11503		
	pCi/L	Ra 226 + Ra 228 Counting Error, Combined	11504		
	pCi/L	Ra 226 + Ra 229 MDA95, Combined	A-076		
	pCi/L	RADIUM, TOTAL, (FOR NTNC ONLY, BY 903.0)			
	pCi/L	Radium, Total	A-080		
	pCi/L	Radium, Total, Counting Error	A-081		
	pCi/L	Radium, Total, MDA95	A-082		
	pCi/L	TITLE 22 CALIFORNIA CODE OF REGULATIONS			
	pCi/L	SECTION 64443 (22 CCR 64443)			
50	pCi/L	Gross Beta	03501	< 4.0	4.0
	pCi/L	Gross Beta Counting Error	03502	1.06	

	pCi/L	Gross Beta MDA95	A-077			
4	pCi/L	Gross Beta, Calculated Dose Equivalent *	A-071			
8	pCi/L	Strontium 90	13501	<	2.0	2.0
	pCi/L	Strontium 90 Counting Error	13502		0.192	
	pCi/L	Strontium 90 MDA95	A-078			
20000	pCi/L	Tritium	07000	<	1000	1000
	pCi/L	Tritium Counting Error	07001		115	
	pCi/L	Tritium MDA95	A-079			
	pCi/L	RADON				
	pCi/L	Radon 222	82303			100.0
	pCi/L	Radon 222 Counting Error	82302			
	pCi/L					
	pCi/L	*MDA95 is Minimum Detectable Activity at				
	pCi/L	the 95% confidence level, per				
	pCi/L	22 CCR 64442 and 64443.				
	pCi/L					
	pCi/L	**Gross Beta, Calculated Total Body or				
	pCi/L	Organ Dose Equivalent, Per 22 CCR 64443				
	pCi/L					

Antelope Valley-East Kern Water Agency

LA System No. 1910045

TOC Removal Running Annual Average

Sample Date	Plant	Alkalinity mgCaCO3/L	Raw TOC mg/L	Treated TOC mg/L	Actual % TOC reduction	Required % TOC reduction	"TOC Removal Ratio" actual % /required %
1/12/2011	QHWTP	53.9	3.10	1.55	50.0	35	1.4
"	EWTP	plant off					
"	AWTP	plant off					
2/9/2011	QHWTP	52.6	4.41	2.16	51.0	45	1.1
"	EWTP	plant off					
"	AWTP	plant off					
3/9/2011	QHWTP	50.3	4.01	1.92	52.1	45	1.2
"	EWTP	plant off					
"	AWTP	plant off					
4/13/2011	QHWTP	51.7	3.82	1.83	52.1	35	1.5
"	EWTP	plant off					
"	AWTP	plant off					
5/11/2011	QHWTP	40.8	3.23	1.55	52.0	35	1.5
"	EWTP	41.9	3.58	1.54	57.0	35	1.6
5/12/2011	AWTP	40.6	3.47	1.55	55.3	35	1.6
6/8/2011	QHWTP	54.6	2.87	1.57	45.3	35	1.3
"	EWTP	53.4	3.08	1.71	44.5	35	1.3
6/9/2011	AWTP	56.0	3.04	1.61	47.0	35	1.3
7/13/2011	QHWTP	39.8	2.64	1.26	52.3	35	1.5
"	EWTP	41.0	2.78	1.40	49.6	35	1.4
7/14/2011	AWTP	41.2	2.82	1.28	54.6	35	1.6
8/10/2011	QHWTP	53.6	2.66	1.43	46.2	35	1.3
"	EWTP	54.4	2.87	1.55	46.0	35	1.3
8/11/2011	AWTP	53.5	2.77	1.50	45.8	35	1.3
9/14/2011	QHWTP	57.6	2.41	1.35	44.0	35	1.3
"	EWTP	58.5	2.61	1.55	40.6	35	1.2
"	AWTP	57.6	2.56	1.49	41.8	35	1.2
10/12/2011	QHWTP	65.6	2.17	1.24	42.9	25	1.7
"	EWTP	67.2	2.37	1.42	40.1	25	1.6
10/13/2011	AWTP	66.0	2.40	1.41	41.3	25	1.7
11/9/2011	QHWTP	53.4	2.09	1.09	47.8	35	1.4
"	EWTP	54.1	2.18	1.22	44.0	35	1.3
"	AWTP	54.5	2.19	1.19	45.7	35	1.3
12/14/2011	QHWTP	78.2	2.39	1.44	39.7	25	1.6
"	EWTP	plant off					
"	AWTP	plant off					
	Minimum	39.8	2.1	1.1	39.7		
	Maximum	78.2	4.4	2.2	57.0		
	RAA	53.5	2.9	1.5	47.3		

Running Annual Average (RAA) **1.4**

Title 22 California Code of Regulations, Chapter 15.5, Article 5:

Required percent TOC reduction**

Table 64536.2-A — Source Water Alkalinity

Raw TOC	0-60	<60 - 120	>120
>2.0 - 4.0	35.0 %	25.0 %	15.0 %
>4.0 - 8.0	45.0 %	35.0 %	25.0 %
>8.0	50.0 %	40.0 %	30.0 %

**If one or more of the section 64536.4(b) 1-6 conditions are met, the system may assign a monthly value of 1 for the TOC removal ratio in lieu of the calculated va

List condition when used:

1. The system's source water TOC level, prior to any treatment is less than or equal to 2.0 mg/L
2. The system's treated water TOC level is less than or equal to 2.0 mg/L
3. The system's source water SUVA, prior to any treatment, is less than or equal to 2.0 L/mg-m
4. The system's finished water SUVA is less than or equal to 2.0 L/mg-m
5. A system practicing softening removes at least 10 mg/L of magnesium hardness (as CaCO3)
6. A system practicing enhanced softening lowers alkalinity below 60 mg/L (as CaCO3)

GENERAL MINERAL & PHYSICAL & INORGANIC ANALYSIS (9/99)

Date of Report: 11/05/18 Sample ID No.032

Laboratory Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY Signature Lab Director:

Name of Sampler:DOUG PATTERSON Employed By: AVEK WATER AGENCY

Date/Time Sample Collected:11/05/11/0645 Date/Time Sample Received @ Lab:11/05/11/0857 Date Analyses Completed:11/05/18

System Name:ANTELOPE VALLEY-EAST KERN WATER AGENCY System Number: 1910045

Name or Number of Sample Source:EASTSIDE PLANT - INFLUENT

User ID: 4TH Station Number: 1910045-005

Date/Time of Sample: |11|05|11|0645| (YY MM DD TTTT) Laboratory Code: 6080

Date Analysis completed: |11|05|18| (YY MM DD)

Submitted by: ______________ Phone #: ______________

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Hardness (as CaCO3) (mg/L)	00900		
	mg/L	Calcium (Ca) (mg/L)	00916		
	mg/L	Magnesium (Mg) (mg/L)	00927		
	mg/L	Sodium (NA) (mg/L)	00929		
	mg/L	Potassium (K) (mg/L)	00937		
Total Cations		Meq/L Value:			
	mg/L	Total Alkalinity (AS CaCO3) (mg/L)	00410	41.9	
	mg/L	Hydroxide (OH) (mg/L)	71830		
	mg/L	Carbonate (CO3) (mg/L)	00445		
	mg/L	Bicarbonate (HCO3) (mg/L)	00440		
*	mg/L+	Sulfate (SO4) (mg/L)	00945		.5
*	mg/L+	Chloride (Cl) (mg/L)	00940		
45	mg/L	Nitrate (as NO3) (mg/L)	71850		2.0
2 .	mg/L	Fluoride (F) (Natural-Source)	00951		.1
Total Anions		Meq/L Value:			
	Std.Units+	PH (Laboratory) (Std.Units)	00403		
***	umho/cm+	Specific Conductance (E.C.) (umhos/cm)	00095		
****	mg/L+	Total Filterable Residue@180C(TDS)(mg/L)	70300		
15	Units	Apparent Color (Unfiltered) (Units)	00081		
3	TON	Odor Threshold at 60 C (TON)	00086		1.
5	NTU	Lab Turbidity (NTU)	82079		
0.5	mg/L+	MBAS (mg/L)	38260		

* 250-500-600 ** 0.6-1.7 *** 900-1600-2200 **** 500-1000-1500

ADDITIONAL ANALYSES 032

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Organic Carbon (TOC) (mg/L)	00680	3.58	0.30

+ Indicates Secondary Drinking Water Standards

GENERAL MINERAL & PHYSICAL & INORGANIC ANALYSIS (9/99)

Date of Report: 11/06/17 Sample ID No.065

Laboratory Signature Lab

Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY Director:

Name of Sampler: STEVE HORN Employed By: AVEK WATER AGENCY

Date/Time Sample Collected: 11/06/08/0720 Date/Time Sample Received @ Lab: 11/06/08/1005 Date Analyses Completed: 11/06/15

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY System Number: 1910045

Name or Number of Sample Source: EASTSIDE PLANT - INFLUENT

* User ID: 4TH Station Number: 1910045-005 *
* Date/Time of Sample: |11|06|08|0720| (YY MM DD TTTT) Laboratory Code: 6080 *
* Date Analysis completed: |11|06|15| (YY MM DD) *
* Submitted by: ______ Phone #: ______ *

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Hardness (as CaCO3) (mg/L)	00900		
	mg/L	Calcium (Ca) (mg/L)	00916		
	mg/L	Magnesium (Mg) (mg/L)	00927		
	mg/L	Sodium (NA) (mg/L)	00929		
	mg/L	Potassium (K) (mg/L)	00937		
Total Cations		Meq/L Value:			
	mg/L	Total Alkalinity (AS CaCO3) (mg/L)	00410	53.4	
	mg/L	Hydroxide (OH) (mg/L)	71830		
	mg/L	Carbonate (CO3) (mg/L)	00445		
	mg/L	Bicarbonate (HCO3) (mg/L)	00440		
*	mg/L+	Sulfate (SO4) (mg/L)	00945		.5
*	mg/L+	Chloride (Cl) (mg/L)	00940		
45	mg/L	Nitrate (as NO3) (mg/L)	71850		2.0
2 .	mg/L	Fluoride (F) (Natural-Source)	00951		.1
Total Anions		Meq/L Value:			
	Std.Units+	PH (Laboratory) (Std.Units)	00403		
***	umho/cm+	Specific Conductance (E.C.) (umhos/cm)	00095		
****	mg/L+	Total Filterable Residue@180C(TDS)(mg/L)	70300		
15	Units	Apparent Color (Unfiltered) (Units)	00081		
3	TON	Odor Threshold at 60 C (TON)	00086		1.
5	NTU	Lab Turbidity (NTU)	82079		
0.5	mg/L+	MBAS (mg/L)	38260		

* 250-500-600 ** 0.6-1.7 *** 900-1600-2200 **** 500-1000-1500

ADDITIONAL ANALYSES 065

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Organic Carbon (TOC) (mg/L)	00680	3.08	0.30

+ Indicates Secondary Drinking Water Standards

GENERAL MINERAL & PHYSICAL & INORGANIC ANALYSIS (9/99)

Date of Report: 11/07/26 Sample ID No.083

Laboratory Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY

Signature Lab Director: ____________

Name of Sampler: DOUG PATERSON Employed By: AVEK WATER AGENCY

Date/Time Sample Collected: 11/07/13/0630 Date/Time Sample Received @ Lab: 11/07/13/0815 Date Analyses Completed: 11/07/25

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY System Number: 1910045

Name or Number of Sample Source: EASTSIDE PLANT - INFLUENT

User ID: 4TH Station Number: 1910045-005

Date/Time of Sample: |11|07|13|0630| (YY MM DD TTTT) Laboratory Code: 6080

Date Analysis completed: |11|07|25| (YY MM DD)

Submitted by: ____________ Phone #: ____________

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Hardness (as CaCO3) (mg/L)	00900		
	mg/L	Calcium (Ca) (mg/L)	00916		
	mg/L	Magnesium (Mg) (mg/L)	00927		
	mg/L	Sodium (NA) (mg/L)	00929		
	mg/L	Potassium (K) (mg/L)	00937		
Total Cations		Meq/L Value:			
	mg/L	Total Alkalinity (AS CaCO3) (mg/L)	00410	41.0	
	mg/L	Hydroxide (OH) (mg/L)	71830		
	mg/L	Carbonate (CO3) (mg/L)	00445		
	mg/L	Bicarbonate (HCO3) (mg/L)	00440		
*	mg/L+	Sulfate (SO4) (mg/L)	00945		.5
*	mg/L+	Chloride (Cl) (mg/L)	00940		
45	mg/L	Nitrate (as NO3) (mg/L)	71850		2.0
2 .	mg/L	Fluoride (F) (Natural-Source)	00951		.1
Total Anions		Meq/L Value:			
	Std.Units+	PH (Laboratory) (Std.Units)	00403		
***	umho/cm+	Specific Conductance (E.C.) (umhos/cm)	00095		
****	mg/L+	Total Filterable Residue@180C(TDS)(mg/L)	70300		
15	Units	Apparent Color (Unfiltered) (Units)	00081		
3	TON	Odor Threshold at 60 C (TON)	00086		1.
5	NTU	Lab Turbidity (NTU)	82079		
0.5	mg/L+	MBAS (mg/L)	38260		

* 250-500-600 ** 0.6-1.7 *** 900-1600-2200 **** 500-1000-1500

ADDITIONAL ANALYSES 083

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Organic Carbon (TOC) (mg/L)	00680	2.78	0.30

+ Indicates Secondary Drinking Water Standards

GENERAL MINERAL & PHYSICAL & INORGANIC ANALYSIS (9/99)

Date of Report: 11/08/18 Sample ID No.101

Laboratory Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY

Signature Lab Director:

Name of Sampler: STEVE HORN Employed By: AVEK WATER AGENCY

Date/Time Sample Collected: 11/08/10/0820 Date/Time Sample Received @ Lab: 11/08/10/1009 Date Analyses Completed: 11/08/17

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System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY System Number: 1910045

Name or Number of Sample Source: EASTSIDE PLANT - INFLUENT

****

* User ID: 4TH Station Number: 1910045-005 *

* Date/Time of Sample: |11|08|10|0820| Laboratory Code: 6080 *

* YY MM DD TTTT YY MM DD *

* Date Analysis completed: |11|08|17| *

* Submitted by:______________________ Phone #:______________ *

****

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Hardness (as CaCO3) (mg/L)	00900		
	mg/L	Calcium (Ca) (mg/L)	00916		
	mg/L	Magnesium (Mg) (mg/L)	00927		
	mg/L	Sodium (NA) (mg/L)	00929		
	mg/L	Potassium (K) (mg/L)	00937		

Total Cations Meq/L Value:

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Alkalinity (AS CaCO3) (mg/L)	00410	54.4	
	mg/L	Hydroxide (OH) (mg/L)	71830		
	mg/L	Carbonate (CO3) (mg/L)	00445		
	mg/L	Bicarbonate (HCO3) (mg/L)	00440		
*	mg/L+	Sulfate (SO4) (mg/L)	00945		.5
*	mg/L+	Chloride (Cl) (mg/L)	00940		
45	mg/L	Nitrate (as NO3) (mg/L)	71850		2.0
2 .	mg/L	Fluoride (F) (Natural-Source)	00951		.1

Total Anions Meq/L Value:

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	Std.Units+	PH (Laboratory) (Std.Units)	00403		
***	umho/cm+	Specific Conductance (E.C.) (umhos/cm)	00095		
****	mg/L+	Total Filterable Residue@180C(TDS)(mg/L)	70300		
15	Units	Apparent Color (Unfiltered) (Units)	00081		
3	TON	Odor Threshold at 60 C (TON)	00086		1.
5	NTU	Lab Turbidity (NTU)	82079		
0.5	mg/L+	MBAS (mg/L)	38260		

* 250-500-600 ** 0.6-1.7 *** 900-1600-2200 **** 500-1000-1500

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Organic Carbon (TOC) (mg/L)	00680	2.87	0.30

+ Indicates Secondary Drinking Water Standards

EDT

GENERAL MINERAL & PHYSICAL & INORGANIC ANALYSIS (9/99)

Date of Report: 11/09/29 Sample ID No.119

Laboratory Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY

Signature Lab Director:

Name of Sampler: STEVE HORN Employed By: AVEK WATER AGENCY

Date/Time Sample Collected: 11/09/14/0705

Date/Time Sample Received @ Lab: 11/09/14/1115

Date Analyses Completed: 11/09/23

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System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY

System Number: 1910045

Name or Number of Sample Source: EASTSIDE PLANT - INFLUENT

****

* User ID: 4TH Station Number: 1910045-005 *
* Date/Time of Sample: |11|09|14|0705| Laboratory Code: 6080 *
* YY MM DD TTTT YY MM DD *
* Date Analysis completed: |11|09|23| *
* Submitted by:______________ Phone #:______________ *

****

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Hardness (as CaCO3) (mg/L)	00900		
	mg/L	Calcium (Ca) (mg/L)	00916		
	mg/L	Magnesium (Mg) (mg/L)	00927		
	mg/L	Sodium (NA) (mg/L)	00929		
	mg/L	Potassium (K) (mg/L)	00937		
Total Cations		Meq/L Value:			
	mg/L	Total Alkalinity (AS CaCO3) (mg/L)	00410	58.5	
	mg/L	Hydroxide (OH) (mg/L)	71830		
	mg/L	Carbonate (CO3) (mg/L)	00445		
	mg/L	Bicarbonate (HCO3) (mg/L)	00440		
*	mg/L+	Sulfate (SO4) (mg/L)	00945		.5
*	mg/L+	Chloride (Cl) (mg/L)	00940		
45	mg/L	Nitrate (as NO3) (mg/L)	71850		2.0
2 .	mg/L	Fluoride (F) (Natural-Source)	00951		.1
Total Anions		Meq/L Value:			
	Std.Units+	PH (Laboratory) (Std.Units)	00403		
***	umho/cm+	Specific Conductance (E.C.) (umhos/cm)	00095		
****	mg/L+	Total Filterable Residue@180C(TDS)(mg/L)	70300		
15	Units	Apparent Color (Unfiltered) (Units)	00081	<	
3	TON	Odor Threshold at 60 C (TON)	00086	<	1.
5	NTU	Lab Turbidity (NTU)	82079		
0.5	mg/L+	MBAS (mg/L)	38260		

* 250-500-600 ** 0.6-1.7 *** 900-1600-2200 **** 500-1000-1500

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Organic Carbon (TOC) (mg/L)	00680	2.61	0.30

+ Indicates Secondary Drinking Water Standards

EDT

GENERAL MINERAL & PHYSICAL & INORGANIC ANALYSIS (9/99)

Date of Report: 11/10/24 Sample ID No.138

Laboratory Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY Signature Lab Director:

Name of Sampler: Steve Horn Employed By: AVEK Water Agency

Date/Time Sample Collected: 11/10/12/0620 Date/Time Sample Received @ Lab: 11/10/12/0930 Date Analyses Completed: 11/10/20

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY System Number: 1910045

Name or Number of Sample Source: EASTSIDE PLANT - INFLUENT

User ID: 4TH Station Number: 1910045-005

Date/Time of Sample: |11|10|12|0620| (YY MM DD TTTT) Laboratory Code: 6080

Date Analysis completed: |11|10|20| (YY MM DD)

Submitted by: ______________ Phone #: ______________

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Hardness (as CaCO3) (mg/L)	00900		
	mg/L	Calcium (Ca) (mg/L)	00916		
	mg/L	Magnesium (Mg) (mg/L)	00927		
	mg/L	Sodium (NA) (mg/L)	00929		
	mg/L	Potassium (K) (mg/L)	00937		
Total Cations		Meq/L Value:			
	mg/L	Total Alkalinity (AS CaCO3) (mg/L)	00410	67.2	
	mg/L	Hydroxide (OH) (mg/L)	71830		
	mg/L	Carbonate (CO3) (mg/L)	00445		
	mg/L	Bicarbonate (HCO3) (mg/L)	00440		
*	mg/L+	Sulfate (SO4) (mg/L)	00945		.5
*	mg/L+	Chloride (Cl) (mg/L)	00940		
45	mg/L	Nitrate (as NO3) (mg/L)	71850		2.0
2 .	mg/L	Fluoride (F) (Natural-Source)	00951		.1
Total Anions		Meq/L Value:			
	Std.Units+	PH (Laboratory) (Std.Units)	00403		
***	umho/cm+	Specific Conductance (E.C.) (umhos/cm)	00095		
****	mg/L+	Total Filterable Residue@180C(TDS)(mg/L)	70300		
15	Units	Apparent Color (Unfiltered) (Units)	00081		
3	TON	Odor Threshold at 60 C (TON)	00086		1.
5	NTU	Lab Turbidity (NTU)	82079		
0.5	mg/L+	MBAS (mg/L)	38260		

* 250-500-600 ** 0.6-1.7 *** 900-1600-2200 **** 500-1000-1500

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Organic Carbon (TOC) (mg/L)	00680	2.37	0.30

+ Indicates Secondary Drinking Water Standards

GENERAL MINERAL & PHYSICAL & INORGANIC ANALYSIS (9/99)

Date of Report: 11/12/02 Sample ID No.157

Laboratory Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY Signature Lab Director:

Name of Sampler:DOUG PATERSON Employed By: AVEK WATER AGENCY

Date/Time Sample Collected:11/11/09/0609 Date/Time Sample Received @ Lab:11/11/09/0826 Date Analyses Completed:11/12/01

System Name:ANTELOPE VALLEY-EAST KERN WATER AGENCY System Number: 1910045

Name or Number of Sample Source:EASTSIDE PLANT - INFLUENT

User ID: 4TH Station Number: 1910045-005

Date/Time of Sample: |11|11|09|0609| (YY MM DD TTTT) Laboratory Code: 6080

Date Analysis completed: |11|12|01| (YY MM DD)

Submitted by:__________ Phone #:__________

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Hardness (as CaCO3) (mg/L)	00900		
	mg/L	Calcium (Ca) (mg/L)	00916		
	mg/L	Magnesium (Mg) (mg/L)	00927		
	mg/L	Sodium (NA) (mg/L)	00929		
	mg/L	Potassium (K) (mg/L)	00937		
Total Cations		Meq/L Value:			
	mg/L	Total Alkalinity (AS CaCO3) (mg/L)	00410	54.1	
	mg/L	Hydroxide (OH) (mg/L)	71830		
	mg/L	Carbonate (CO3) (mg/L)	00445		
	mg/L	Bicarbonate (HCO3) (mg/L)	00440		
*	mg/L+	Sulfate (SO4) (mg/L)	00945		.5
*	mg/L+	Chloride (Cl) (mg/L)	00940		
45	mg/L	Nitrate (as NO3) (mg/L)	71850		2.0
2 .	mg/L	Fluoride (F) (Natural-Source)	00951		.1
Total Anions		Meq/L Value:			
	Std.Units+	PH (Laboratory) (Std.Units)	00403		
***	umho/cm+	Specific Conductance (E.C.) (umhos/cm)	00095		
****	mg/L+	Total Filterable Residue@180C(TDS)(mg/L)	70300		
15	Units	Apparent Color (Unfiltered) (Units)	00081		
3	TON	Odor Threshold at 60 C (TON)	00086		1.
5	NTU	Lab Turbidity (NTU)	82079		
0.5	mg/L+	MBAS (mg/L)	38260		

* 250-500-600 ** 0.6-1.7 *** 900-1600-2200 **** 500-1000-1500

ADDITIONAL ANALYSES 157

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Organic Carbon (TOC) (mg/L)	00680	2.18	0.30

+ Indicates Secondary Drinking Water Standards

QUARTZ HILL
WATER TREATMENT PLANT

Plant Effluent
Finished Drinking Water
Monitoring Results

BSK Analytical Laboratories

EDT

Date of Report: 11|01|26|0926
Laboratory Name: BSK Analytical Laboratories
Name of Sampler: Kat White

Sample ID No.: A1A0928-01
Signature Lab Director: [signature]

Date/Time Sample Collected: 11|01|12|0814
Date/Time Sample Received @ Lab : 11|01|14|0816
Date Analyses Completed: 11|01|25

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
System Number: 1910045
Name or Number of Sample Source: QUARTZ HILL WTP - CLEAR WELL - TREATED

User ID: 4TH
Station Number: 1910045-001
Date/Time of Sample: 11|01|12|0814
Laboratory Code: 5810
Submitted by: BSK Analytical Laboratories
Date Analyses Completed: 11|01|25
Phone #: 559-497-2888

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
1000	ug/L	Aluminum (Al) (ug/L)	01105	ND	50

BSK Analytical Laboratories

EDT

Date of Report: 11|02|22|1205
Laboratory Name: BSK Analytical Laboratories
Name of Sampler: Kat White

Sample ID No.: A1B0919-01
Signature Lab Director: [signature]

Date/Time Sample Collected: 11|02|09|1050
Date/Time Sample Received @ Lab : 11|02|11|0800
Date Analyses Completed: 11|02|17

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
System Number: 1910045
Name or Number of Sample Source: QUARTZ HILL WTP - CLEAR WELL - TREATED

User ID: 4TH
Station Number: 1910045-001
Date/Time of Sample: 11|02|09|1050
Laboratory Code: 5810
Submitted by: BSK Analytical Laboratories
Date Analyses Completed: 11|02|17
Phone #: 559-497-2888

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
1000	ug/L	Aluminum (Al) (ug/L)	01105	ND	50

A1B0919 FINAL 02222011 1205

BSK Analytical Laboratories

EDT

Date of Report: 11|03|28|1107
Laboratory Name: BSK Analytical Laboratories
Name of Sampler: Kat White/Ray Rodriguez

Sample ID No.: A1C1476-02
Signature Lab Director: [signature]

Date/Time Sample Collected: 11|03|09|0845
Date/Time Sample Received @ Lab : 11|03|18|0830
Date Analyses Completed: 11|03|27

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
Name or Number of Sample Source: QUARTZ HILL WTP - CLEAR WELL - TREATED
System Number: 1910045

User ID: 4TH
Date/Time of Sample: 11|03|09|0845
Submitted by: BSK Analytical Laboratories

Station Number: 1910045-001
Laboratory Code: 5810
Date Analyses Completed: 11|03|27
Phone #: 559-497-2888

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
1000	ug/L	Aluminum (Al) (ug/L)	01105	ND	50

BSK Analytical Laboratories

EDT

Date of Report: 11|04|25|1108
Laboratory Name: BSK Analytical Laboratories
Name of Sampler: Kat White

Sample ID No.: A1D1094-01
Signature Lab Director: [signature]

Date/Time Sample Collected: 11|04|13|0740
Date/Time Sample Received @ Lab : 11|04|14|1000
Date Analyses Completed: 11|04|23

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
System Number: 1910045
Name or Number of Sample Source: QUARTZ HILL WTP - CLEAR WELL - TREATED

User ID: 4TH
Date/Time of Sample: 11|04|13|0740
Submitted by: BSK Analytical Laboratories

Station Number: 1910045-001
Laboratory Code: 5810
Date Analyses Completed: 11|04|23
Phone #: 559-497-2888

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
1000	ug/L	Aluminum (Al) (ug/L)	01105	ND	50

BSK Analytical Laboratories

EDT

Date of Report: 11|05|23|1126
Laboratory Name: BSK Analytical Laboratories
Name of Sampler: Kat White

Sample ID No.: A1E0914-02
Signature Lab Director: [signature]

Date/Time Sample Collected: 11|05|11|0926
Date/Time Sample Received @ Lab : 11|05|12|1000
Date Analyses Completed: 11|05|22

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
System Number: 1910045
Name or Number of Sample Source: QUARTZ HILL WTP - CLEAR WELL - TREATED

User ID: 4TH
Date/Time of Sample: 11|05|11|0926
Submitted by: BSK Analytical Laboratories

Station Number: 1910045-001
Laboratory Code: 5810
Date Analyses Completed: 11|05|22
Phone #: 559-497-2888

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
1000	ug/L	Aluminum (Al) (ug/L)	01105	ND	50

BSK Analytical Laboratories

EDT

Date of Report: 11|06|23|1703
Laboratory Name: BSK Analytical Laboratories
Name of Sampler: Justin Livesay

Sample ID No.: A1F0795-02
Signature Lab Director: [signature]

Date/Time Sample Collected: 11|06|08|0908
Date/Time Sample Received @ Lab : 11|06|09|0800
Date Analyses Completed: 11|06|19

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
System Number: 1910045
Name or Number of Sample Source: QUARTZ HILL WTP - CLEAR WELL - TREATED

User ID: 4TH
Station Number: 1910045-001
Date/Time of Sample: 11|06|08|0908
Laboratory Code: 5810
Date Analyses Completed: 11|06|19
Submitted by: BSK Analytical Laboratories
Phone #: 559-497-2888

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
1000	ug/L	Aluminum (Al) (ug/L)	01105	ND	50

BSK Analytical Laboratories

EDT

Date of Report: 11|07|26|1658

Laboratory Name: BSK Analytical Laboratories

Name of Sampler: Eric Kane

Sample ID No.: A1G1244-02

Signature Lab Director: [signature]

Date/Time Sample Collected: 11|07|13|1249

Date/Time Sample Received @ Lab : 11|07|15|1338

Date Analyses Completed: 11|07|24

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY

System Number: 1910045

Name or Number of Sample Source: QUARTZ HILL WTP - CLEAR WELL - TREATED

User ID: 4TH

Station Number: 1910045-001

Date/Time of Sample: 11|07|13|1249

Laboratory Code: 5810

Submitted by: BSK Analytical Laboratories

Date Analyses Completed: 11|07|24

Phone #: 559-497-2888

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
1000	ug/L	Aluminum (Al) (ug/L)	01105	ND	50

A1G1244 FINAL 07262011 1658

BSK Analytical Laboratories

EDT

Date of Report: 11|08|24|0818
Laboratory Name: BSK Analytical Laboratories
Name of Sampler: Kat White

Sample ID No.: A1H1233-02
Signature Lab Director: [signature]

Date/Time Sample Collected: 11|08|10|1039
Date/Time Sample Received @ Lab : 11|08|12|0820
Date Analyses Completed: 11|08|22

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
System Number: 1910045
Name or Number of Sample Source: QUARTZ HILL WTP - CLEAR WELL - TREATED

User ID: 4TH
Date/Time of Sample: 11|08|10|1039
Submitted by: BSK Analytical Laboratories

Station Number: 1910045-001
Laboratory Code: 5810
Date Analyses Completed: 11|08|22
Phone #: 559-497-2888

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
1000	ug/L	Aluminum (Al) (ug/L)	01105	ND	50

BSK Analytical Laboratories

EDT

Date of Report: 11|09|28|1256
Laboratory Name: BSK Analytical Laboratories
Name of Sampler: K. White

Sample ID No.: A1I1114-02
Signature Lab Director:

Date/Time Sample Collected: 11|09|14|1252
Date/Time Sample Received @ Lab : 11|09|15|0950
Date Analyses Completed: 11|09|25

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
System Number: 1910045
Name or Number of Sample Source: QUARTZ HILL WTP - CLEAR WELL - TREATED

User ID: 4TH
Date/Time of Sample: 11|09|14|1252
Submitted by: BSK Analytical Laboratories

Station Number: 1910045-001
Laboratory Code: 5810
Date Analyses Completed: 11|09|25
Phone #: 559-497-2888

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
1000	ug/L	Aluminum (Al) (ug/L)	01105	ND	50

A1I1114 FINAL 09282011 1256

BSK Analytical Laboratories

EDT

Date of Report: 11|10|26|1108
Laboratory Name: BSK Analytical Laboratories
Name of Sampler: Kat White

Sample ID No.: A1J1218-02
Signature Lab Director:

Date/Time Sample Collected: 11|10|12|0928
Date/Time Sample Received @ Lab : 11|10|14|1000
Date Analyses Completed: 11|10|18

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
System Number: 1910045
Name or Number of Sample Source: QUARTZ HILL WTP - CLEAR WELL - TREATED

User ID: 4TH
Station Number: 1910045-001
Date/Time of Sample: 11|10|12|0928
Laboratory Code: 5810
Date Analyses Completed: 11|10|18
Submitted by: BSK Analytical Laboratories
Phone #: 559-497-2888

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
1000	ug/L	Aluminum (Al) (ug/L)	01105	ND	50

BSK Analytical Laboratories

EDT

Date of Report: 11|11|18|1228
Laboratory Name: BSK Analytical Laboratories
Name of Sampler: Kat White

Sample ID No.: A1K0840-02
Signature Lab Director: [signature]

Date/Time Sample Collected: 11|11|09|1040
Date/Time Sample Received @ Lab : 11|11|10|0810
Date Analyses Completed: 11|11|14

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
System Number: 1910045
Name or Number of Sample Source: QUARTZ HILL WTP - CLEAR WELL - TREATED

User ID: 4TH
Date/Time of Sample: 11|11|09|1040
Submitted by: BSK Analytical Laboratories

Station Number: 1910045-001
Laboratory Code: 5810
Date Analyses Completed: 11|11|14
Phone #: 559-497-2888

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
1000	ug/L	Aluminum (Al) (ug/L)	01105	ND	50

BSK Analytical Laboratories

EDT

Date of Report: 12|01|03|1521
Laboratory Name: BSK Analytical Laboratories
Name of Sampler: k. White

Sample ID No.: A1L1169-01
Signature Lab Director:

Date/Time Sample Collected: 11|12|14|0835
Date/Time Sample Received @ Lab : 11|12|16|1023
Date Analyses Completed: 11|12|21

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
System Number: 1910045
Name or Number of Sample Source: QUARTZ HILL WTP - CLEAR WELL - TREATED

User ID: 4TH
Station Number: 1910045-001
Date/Time of Sample: 11|12|14|0835
Laboratory Code: 5810
Date Analyses Completed: 11|12|21
Submitted by: BSK Analytical Laboratories
Phone #: 559-497-2888

Chain of Custody Notes

Date: 1/3/12
Initials: RLR
Note: Raw sample data to be uploaded EDT to 4 different ps codes: 1910045-002, 1910045-005, 1910045-003 and 1510053-001. Multiple uploads will be accommodated by three amended reports.

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
1000	ug/L	Aluminum (Al) (ug/L)	01105	ND	50

A1L1169 FINAL 01032012 1521

BSK Analytical Laboratories

Amended

EDT

Date of Report: 11|12|30|1555
Laboratory Name: BSK Analytical Laboratories
Name of Sampler: Client
Sample ID No.: A1K0266-03
Signature Lab Director:

Date/Time Sample Collected: 11|11|02|1300
Date/Time Sample Received @ Lab : 11|11|03|0800
Date Analyses Completed: 11|11|14

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
System Number: 1910045
Name or Number of Sample Source: QUARTZ HILL WTP - CLEAR WELL - TREATED

User ID: 4TH
Station Number: 1910045-001
Laboratory Code: 5810
Date/Time of Sample: 11|11|02|1300
Date Analyses Completed: 11|11|14
Submitted by: BSK Analytical Laboratories
Phone #: 559-497-2888

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Hardness, (Total) as CaCO3	00900	60	
	mg/L	Calcium (Ca) (mg/L)	00916	13	
	mg/L	Magnesium (Mg) (mg/L)	00927	6.5	
	mg/L	Sodium (Na) (mg/L)	00929	21	
	mg/L	Potassium (K) (mg/L)	00937	< 2.0	
Total Cations Meq/L Value: 2.10					
	mg/L	Alkalinity, (Total) (as CaCO3 equivalents)	00410	38	
	mg/L	Hydroxide (OH) (mg/L)	71830	< 1.0	
	mg/L	Carbonate (CO3) (mg/L)	00445	< 1.8	
	mg/L	Bicarbonate (HCO3) (mg/L)	00440	46	
600	mg/L	Sulfate (SO4) (mg/L)	00945	35	0.5
600	mg/L	Chloride (Cl) (mg/L)	00940	24	
45	mg/L	Nitrate (as NO3) (mg/L)	71850	2.2	2.0
2	mg/L	Fluoride (F) (Natural-Source)	00951	ND	0.1
Total Anions Meq/L Value: 2.19					
15	Units	Color, Apparent (Unfiltered)	00081	< 1.0	
5	NTU	Lab Turbidity (NTU)	82079	< 0.10	
0.5	mg/L	MBAS (mg/L)	38260	< 0.050	
3	TON	Odor Threshold at 60 C (TON)	00086	1.0	1.0
	Std Units	pH (Laboratory) (Std.Units)	00403	7.6	
2200	umho/cm	Specific Conductance (E.C.) (umhos/cm)	00095	230	
1500	mg/L	Total Filterable Residue@180C(TDS)(mg/L)	70300	140	
1000	ug/L	Aluminum (Al) (ug/L)	01105	ND	50
6	ug/L	Antimony (ug/L)	01097	ND	6.0
10	ug/L	Arsenic (As) (ug/L)	01002	ND	2.0
1000	ug/L	Barium (Ba) (ug/L)	01007	ND	100
4	ug/L	Beryllium (ug/L)	01012	ND	1.0
5	ug/L	Cadmium (Cd) (ug/L)	01027	ND	1.0
50	ug/L	Chromium (Total Cr) (ug/L)	01034	ND	10
1000	ug/L	Copper (Cu) (ug/L)	01042	ND	50

BSK Analytical Laboratories

Amended

EDT

Date of Report: 11|12|30|1555 **Sample ID No.:** A1K0266-03
Laboratory Name: BSK Analytical Laboratories **Signature Lab Director:**
Name of Sampler: Client

Date/Time Sample Collected: 11|11|02|1300 **Date/Time Sample Received @ Lab :** 11|11|03|0800 **Date Analyses Completed:** 11|11|14

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY **System Number:** 1910045
Name or Number of Sample Source: QUARTZ HILL WTP - CLEAR WELL - TREATED

User ID: 4TH **Station Number:** 1910045-001
Date/Time of Sample: 11|11|02|1300 **Laboratory Code:** 5810
Date Analyses Completed: 11|11|14
Submitted by: BSK Analytical Laboratories **Phone #:** 559-497-2888

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
300	ug/L	Iron (Fe) (ug/L)	01045	ND	100
	ug/L	Lead (Pb) (ug/L)	01051	ND	5.0
50	ug/L	Manganese (Mn) (ug/L)	01055	ND	20
2	ug/L	Mercury (Hg) (ug/L)	71900	ND	1.0
100	ug/L	Nickel (ug/L)	01067	ND	10
50	ug/L	Selenium (Se) (ug/L)	01147	ND	5.0
100	ug/L	Silver (Ag) (ug/L)	01077	ND	10
2	ug/L	Thallium (ug/L)	01059	ND	1.0
5000	ug/L	Zinc (Zn) (ug/L)	01092	550	50
		ADDITIONAL ANALYSES			
	NA	Agressiveness Index	82383	11	
150	ug/L	Cyanide (ug/L)	01291	ND	100
	NA	Langelier Index at 60 C	71813	- 1.2	
1000	ug/L	Nitrite as Nitrogen(N) (ug/L)	00620	ND	400
6	ug/L	Perchlorate (ug/L)	A-031	ND	4.0

TEST METHOD	CHEMICAL	ENTRY #	ANALYSES RESULTS	MCL µG/L	DLR µG/L
	REGULATED ORGANIC CHEMICALS				
EPA 525.2	Alachlor (ALANEX)	77825	ND	2	1.0
EPA 525.2	Atrazine (AATREX)	39033	ND	1	0.5
EPA 525.2	Benzo (a) Pyrene	34247	ND	0.2	0.1
EPA 525.2	Di(2-ethylhexyl) Adipate	A-026	ND	400	5.0
EPA 525.2	Diethylhexylphthalate (DEHP)	39100	ND	4	3.0
EPA 525.2	Molinate (ORDRAM)	82199	ND	20	2.0
EPA 525.2	Simazine (PRINCEP)	39055	ND	4	1.0
EPA 525.2	Thiobencarb (BOLERO)	A-001	ND	70	1.0
	UNREGULATED ORGANIC CHEMICALS				
EPA 525.2	Bromacil (HYVAR)	82198	ND		10
EPA 525.2	Butachlor	77860	ND		0.38
EPA 525.2	Diazinon	39570	< 0.25		
EPA 525.2	Dimethoate (CYGON)	38458	< 10		

BSK Analytical Laboratories

Amended

EDT

Date of Report: 11|12|30|1555
Laboratory Name: BSK Analytical Laboratories
Name of Sampler: Client

Sample ID No.: A1K0266-03
Signature Lab Director:

Date/Time Sample Collected: 11|11|02|1300
Date/Time Sample Received @ Lab : 11|11|03|0800
Date Analyses Completed: 11|11|14

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
System Number: 1910045
Name or Number of Sample Source: QUARTZ HILL WTP - CLEAR WELL - TREATED

User ID: 4TH
Date/Time of Sample: 11|11|02|1300
Submitted by: BSK Analytical Laboratories

Station Number: 1910045-001
Laboratory Code: 5810
Date Analyses Completed: 11|11|14
Phone #: 559-497-2888

TEST METHOD	CHEMICAL	ENTRY #	ANALYSES RESULTS	MCL µG/L	DLR µG/L
	UNREGULATED ORGANIC CHEMICALS				
EPA 525.2	Metolachlor	39356	< 0.50		
EPA 525.2	Metribuzin	81408	< 0.50		
EPA 525.2	Propachlor	38533	ND		0.5

Antelope Valley-East Kern Water Agency
LA System No. 1910045
TOC Removal Running Annual Average

Sample Date	Plant	Alkalinity mgCaCO3/L	Raw TOC mg/L	Treated TOC mg/L	Actual % TOC reduction	Required % TOC reduction	"TOC Removal Ratio" actual % /required %
1/12/2011	QHWTP	53.9	3.10	1.55	50.0	35	1.4
"	EWTP	plant off					
"	AWTP	plant off					
2/9/2011	QHWTP	52.6	4.41	2.16	51.0	45	1.1
"	EWTP	plant off					
"	AWTP	plant off					
3/9/2011	QHWTP	50.3	4.01	1.92	52.1	45	1.2
"	EWTP	plant off					
"	AWTP	plant off					
4/13/2011	QHWTP	51.7	3.82	1.83	52.1	35	1.5
"	EWTP	plant off					
"	AWTP	plant off					
5/11/2011	QHWTP	40.8	3.23	1.55	52.0	35	1.5
"	EWTP	41.9	3.58	1.54	57.0	35	1.6
5/12/2011	AWTP	40.6	3.47	1.55	55.3	35	1.6
6/8/2011	QHWTP	54.6	2.87	1.57	45.3	35	1.3
"	EWTP	53.4	3.08	1.71	44.5	35	1.3
6/9/2011	AWTP	56.0	3.04	1.61	47.0	35	1.3
7/13/2011	QHWTP	39.8	2.64	1.26	52.3	35	1.5
"	EWTP	41.0	2.78	1.40	49.6	35	1.4
7/14/2011	AWTP	41.2	2.82	1.28	54.6	35	1.6
8/10/2011	QHWTP	53.6	2.66	1.43	46.2	35	1.3
"	EWTP	54.4	2.87	1.55	46.0	35	1.3
8/11/2011	AWTP	53.5	2.77	1.50	45.8	35	1.3
9/14/2011	QHWTP	57.6	2.41	1.35	44.0	35	1.3
"	EWTP	58.5	2.61	1.55	40.6	35	1.2
"	AWTP	57.6	2.56	1.49	41.8	35	1.2
10/12/2011	QHWTP	65.6	2.17	1.24	42.9	25	1.7
"	EWTP	67.2	2.37	1.42	40.1	25	1.6
10/13/2011	AWTP	66.0	2.40	1.41	41.3	25	1.7
11/9/2011	QHWTP	53.4	2.09	1.09	47.8	35	1.4
"	EWTP	54.1	2.18	1.22	44.0	35	1.3
"	AWTP	54.5	2.19	1.19	45.7	35	1.3
12/14/2011	QHWTP	78.2	2.39	1.44	39.7	25	1.6
"	EWTP	plant off					
"	AWTP	plant off					
	Minimum	39.8	2.1	1.1	39.7		
	Maximum	78.2	4.4	2.2	57.0		
	RAA	53.5	2.9	1.5	47.3		

Running Annual Average (RAA) **1.4**

Title 22 California Code of Regulations, Chapter 15.5, Article 5:
Required percent TOC reduction**

Table 64536.2-A — Source Water Alkalinity

Raw TOC	0-60	<60 - 120	>120
>2.0 - 4.0	35.0 %	25.0 %	15.0 %
>4.0 - 8.0	45.0 %	35.0 %	25.0 %
>8.0	50.0 %	40.0 %	30.0 %

**If one or more of the section 64636.4(b) 1-6 conditions are met, the system may assign a monthly value of 1 for the TOC removal ratio in lieu of the calculated va

List condition when used: ______

1. The system's source water TOC level, prior to any treatment is less than or equal to 2.0 mg/L
2. The system's treated water TOC level is less than or equal to 2.0 mg/L
3. The system's source water SUVA, prior to any treatment, is less than or equal to 2.0 L/mg-m
4. The system's finished water SUVA is less than or equal to 2.0 L/mg-m
5. A system practicing softening removes at least 10 mg/L of magnesium hardness (as CaCO3)
6. A system practicing enhanced softening lowers alkalinity below 60 mg/L (as CaCO3)

GENERAL MINERAL & PHYSICAL & INORGANIC ANALYSIS (9/99)

Date of Report: 11/01/24
Sample ID No.001
Laboratory Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
Signature Lab Director:
Name of Sampler: JUSTIN LIVESAY
Employed By: AVEK WATER AGENCY
Date/Time Sample Collected: 11/01/12/0815
Date/Time Sample Received @ Lab: 11/01/12/0821
Date Analyses Completed: 11/01/21

==

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
System Number: 1910045
Name or Number of Sample Source: QUARTZ HILL WTP - CLEAR WELL - TREATED

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* User ID: 4TH Station Number: 1910045-001 *
* Date/Time of Sample: |11|01|12|0815| Laboratory Code: 6080 *
* YY MM DD TTTT YY MM DD *
* Date Analysis completed: |11|01|21| *
* Submitted by: ____________ Phone #: ____________ *

****

ADDITIONAL ANALYSES

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Organic Carbon (TOC) (mg/L)	00680	1.55	0.30

\+ Indicates Secondary Drinking Water Standards

EDT

GENERAL MINERAL & PHYSICAL & INORGANIC ANALYSIS (9/99)

Date of Report: 11/02/22 Sample ID No.010

Laboratory Signature Lab

Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY Director:

Name of Sampler:KAT WHITE Employed By: AVEK WATER AGENCY

Date/Time Sample Collected:11/02/09/1052

Date/Time Sample Received @ Lab:11/02/09/1055

Date Analyses Completed:11/02/14

System Name:ANTELOPE VALLEY-EAST KERN WATER AGENCY

System Number: 1910045

Name or Number of Sample Source:QUARTZ HILL WTP - CLEAR WELL - TREATED

User ID: 4TH Station Number: 1910045-001

Date/Time of Sample: |11|02|09|1052| (YY MM DD TTTT) Laboratory Code: 6080

Date Analysis completed: |11|02|14| (YY MM DD)

Submitted by:__________ Phone #:__________

PAGE 1 OF 1 ADDITIONAL ANALYSES

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Organic Carbon (TOC) (mg/L)	00680	2.16	0.30

+ Indicates Secondary Drinking Water Standards

EDT

GENERAL MINERAL & PHYSICAL & INORGANIC ANALYSIS (9/99)

Date of Report: 11/03/18 Sample ID No.020

Laboratory Signature Lab

Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY Director:

Name of Sampler:KAT WHITE Employed By: AVEK WATER AGENCY

Date/Time Sample Collected:11/03/09/0845 Date/Time Sample Received @ Lab:11/03/09/0900 Date Analyses Completed:11/03/17

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System Name:ANTELOPE VALLEY-EAST KERN WATER AGENCY System Number: 1910045

Name or Number of Sample Source:QUARTZ HILL WTP - CLEAR WELL - TREATED

****

* User ID: 4TH Station Number: 1910045-001 *

* Date/Time of Sample: |11|03|09|0845| Laboratory Code: 6080 *

* YY MM DD TTTT YY MM DD *

* Date Analysis completed: |11|03|17| *

* Submitted by:________________ Phone #:________________ *

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PAGE 1 OF 1 ADDITIONAL ANALYSES

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Organic Carbon (TOC) (mg/L)	00680	1.92	0.30

+ Indicates Secondary Drinking Water Standards

GENERAL MINERAL & PHYSICAL & INORGANIC ANALYSIS (9/99)

Date of Report: 11/04/21 Sample ID No.035
Laboratory Signature Lab
Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY Director:
Name of Sampler:KAT WHITE Employed By: AVEK WATER AGENCY
Date/Time Sample Collected:11/04/13/0745 Date/Time Sample Received @ Lab:11/04/13/0749 Date Analyses Completed:11/04/20

System Name:ANTELOPE VALLEY-EAST KERN WATER AGENCY System Number: 1910045
Name or Number of Sample Source:QUARTZ HILL WTP - CLEAR WELL - TREATED

User ID: 4TH Station Number: 1910045-001
Date/Time of Sample: |11|04|13|0745| (YY MM DD TTTT) Laboratory Code: 6080
Date Analysis completed: |11|04|20| (YY MM DD)
Submitted by:__________ Phone #:__________

PAGE 1 OF 1 ADDITIONAL ANALYSES

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Organic Carbon (TOC) (mg/L)	00680	1.83	0.30

+ Indicates Secondary Drinking Water Standards

GENERAL MINERAL & PHYSICAL & INORGANIC ANALYSIS (9/99)

Date of Report: 11/05/18 Sample ID No.045

Laboratory Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
Signature Lab Director:

Name of Sampler:KAT WHITE Employed By: AVEK WATER AGENCY

Date/Time Sample Collected:11/05/11/0936 Date/Time Sample Received @ Lab:11/05/11/1000 Date Analyses Completed:11/05/13

==

System Name:ANTELOPE VALLEY-EAST KERN WATER AGENCY System Number: 1910045

Name or Number of Sample Source:QUARTZ HILL WTP - CLEAR WELL - TREATED

****

* User ID: 4TH Station Number: 1910045-001 *

* Date/Time of Sample: |11|05|11|0936| Laboratory Code: 6080 *

* YY MM DD TTTT YY MM DD *

* Date Analysis completed: |11|05|13| *

* Submitted by:____________________ Phone #:______________ *

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PAGE 1 OF 1 ADDITIONAL ANALYSES

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Organic Carbon (TOC) (mg/L)	00680	1.55	0.30

\+ Indicates Secondary Drinking Water Standards

EDT

GENERAL MINERAL & PHYSICAL & INORGANIC ANALYSIS (9/99)

Date of Report: 11/06/17 Sample ID No.068

Laboratory Signature Lab

Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY Director:

Name of Sampler:JUSTIN LIVESAY Employed By: AVEK WATER AGENCY

Date/Time Sample Collected:11/06/08/0900 Date/Time Sample Received @ Lab:11/06/08/0900 Date Analyses Completed:11/06/15

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System Name:ANTELOPE VALLEY-EAST KERN WATER AGENCY System Number: 1910045

Name or Number of Sample Source:QUARTZ HILL WTP - CLEAR WELL - TREATED

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* User ID: 4TH Station Number: 1910045-001 *

* Date/Time of Sample: |11|06|08|0900| Laboratory Code: 6080 *

* YY MM DD TTTT YY MM DD *

* Date Analysis completed: |11|06|15| *

* Submitted by:______________________ Phone #:______________ *

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PAGE 1 OF 1 ADDITIONAL ANALYSES

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Organic Carbon (TOC) (mg/L)	00680	1.57	0.30

+ Indicates Secondary Drinking Water Standards

GENERAL MINERAL & PHYSICAL & INORGANIC ANALYSIS (9/99)

Date of Report: 11/07/26 Sample ID No.086

Laboratory Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY

Signature Lab Director:

Name of Sampler:JUSTIN LIVESAY Employed By: AVEK WATER AGENCY

Date/Time Sample Collected:11/07/13/1255 Date/Time Sample Received @ Lab:11/07/13/1255 Date Analyses Completed:11/07/25

==

System Name:ANTELOPE VALLEY-EAST KERN WATER AGENCY System Number: 1910045

Name or Number of Sample Source:QUARTZ HILL WTP - CLEAR WELL - TREATED

****

* User ID: 4TH Station Number: 1910045-001 *

* Date/Time of Sample: |11|07|13|1255| Laboratory Code: 6080 *

* YY MM DD TTTT YY MM DD *

* Date Analysis completed: |11|07|25| *

* Submitted by:________________________ Phone #:__________________ *

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PAGE 1 OF 1 ADDITIONAL ANALYSES

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Organic Carbon (TOC) (mg/L)	00680	1.26	0.30

+ Indicates Secondary Drinking Water Standards

EDT

GENERAL MINERAL & PHYSICAL & INORGANIC ANALYSIS (9/99)

Date of Report: 11/08/18 Sample ID No.104

Laboratory Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY

Signature Lab Director:

Name of Sampler: KAT WHITE Employed By: AVEK WATER AGENCY

Date/Time Sample Collected: 11/08/10/0843

Date/Time Sample Received @ Lab: 11/08/10/0843

Date Analyses Completed: 11/08/17

==

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY

System Number: 1910045

Name or Number of Sample Source: QUARTZ HILL WTP - CLEAR WELL - TREATED

****

* User ID: 4TH Station Number: 1910045-001 *

* Date/Time of Sample: |11|08|10|0843| Laboratory Code: 6080 *

* YY MM DD TTTT YY MM DD *

* Date Analysis completed: |11|08|17| *

* Submitted by:______________________ Phone #:________________ *

****

PAGE 1 OF 1 ADDITIONAL ANALYSES

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Organic Carbon (TOC) (mg/L)	00680	1.43	0.30

\+ Indicates Secondary Drinking Water Standards

EDT

GENERAL MINERAL & PHYSICAL & INORGANIC ANALYSIS (9/99)

Date of Report: 11/09/29 | Sample ID No.122
Laboratory Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY | Signature Lab Director:
Name of Sampler:KAT WHITE | Employed By: AVEK WATER AGENCY
Date/Time Sample Collected:11/09/14/1301 | Date/Time Sample Received @ Lab:11/09/14/1308 | Date Analyses Completed:11/09/23

System Name:ANTELOPE VALLEY-EAST KERN WATER AGENCY | System Number: 1910045
Name or Number of Sample Source:QUARTZ HILL WTP - CLEAR WELL - TREATED

* User ID: 4TH | Station Number: 1910045-001
* Date/Time of Sample: |11|09|14|1301| (YY MM DD TTTT) | Laboratory Code: 6080
* Date Analysis completed: |11|09|23| (YY MM DD)
* Submitted by:________________ | Phone #:________________

PAGE 1 OF 1

ADDITIONAL ANALYSES

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Organic Carbon (TOC) (mg/L)	00680	1.35	0.30

+ Indicates Secondary Drinking Water Standards

GENERAL MINERAL & PHYSICAL & INORGANIC ANALYSIS (9/99)

Date of Report: 11/10/24 Sample ID No.141

Laboratory Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY

Signature Lab Director:

Name of Sampler:Kat White

Employed By: AVEK Water Agency

Date/Time Sample Collected:11/10/12/0806

Date/Time Sample Received @ Lab:11/10/12/0830

Date Analyses Completed:11/10/20

==

System Name:ANTELOPE VALLEY-EAST KERN WATER AGENCY

System Number: 1910045

Name or Number of Sample Source:QUARTZ HILL WTP - CLEAR WELL - TREATED

****

* User ID: 4TH Station Number: 1910045-001 *

* Date/Time of Sample: |11|10|12|0806| Laboratory Code: 6080 *

* YY MM DD TTTT YY MM DD *

* Date Analysis completed: |11|10|20| *

* Submitted by:____________________ Phone #:______________ *

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PAGE 1 OF 1

ADDITIONAL ANALYSES

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Organic Carbon (TOC) (mg/L)	00680	1.24	0.30

+ Indicates Secondary Drinking Water Standards

GENERAL MINERAL & PHYSICAL & INORGANIC ANALYSIS (9/99)

Date of Report: 11/12/02
Sample ID No.160

Laboratory
Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
Signature Lab Director:

Name of Sampler:KAT WHITE
Employed By: AVEK WATER AGENCY

Date/Time Sample Collected:11/11/09/1041
Date/Time Sample Received @ Lab:11/11/09/1047
Date Analyses Completed:11/12/01

==

System Name:ANTELOPE VALLEY-EAST KERN WATER AGENCY
System Number: 1910045

Name or Number of Sample Source:QUARTZ HILL WTP - CLEAR WELL - TREATED

****

* User ID: 4TH   Station Number: 1910045-001 *

* Date/Time of Sample: |11|11|09|1041| Laboratory Code: 6080 *

* YY MM DD TTTT   YY MM DD *

*   Date Analysis completed: |11|12|01| *

* Submitted by:________________   Phone #:____________ *

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ADDITIONAL ANALYSES

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Organic Carbon (TOC) (mg/L)	00680	1.09	0.30

\+ Indicates Secondary Drinking Water Standards

GENERAL MINERAL & PHYSICAL & INORGANIC ANALYSIS (9/99)

Date of Report: 12/01/17 Sample ID No.179

Laboratory Signature Lab

Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY Director:

Name of Sampler:KAT WHITE Employed By: AVEK WATER AGENCY

Date/Time Sample Collected:11/12/14/0845 Date/Time Sample Received @ Lab:11/12/14/0855 Date Analyses Completed:12/01/16

===

System Name:ANTELOPE VALLEY-EAST KERN WATER AGENCY System Number: 1910045

Name or Number of Sample Source:QUARTZ HILL WTP - CLEAR WELL - TREATED

****

* User ID: 4TH Station Number: 1910045-001 *

* Date/Time of Sample: |11|12|14|0845| Laboratory Code: 6080 *

* YY MM DD TTTT YY MM DD *

* Date Analysis completed: |12|01|16| *

* Submitted by:______________________ Phone #:________________ *

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PAGE 1 OF 1 ADDITIONAL ANALYSES

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Organic Carbon (TOC) (mg/L)	00680	1.44	0.30

+ Indicates Secondary Drinking Water Standards

QUARTZ HILL
WATER TREATMENT PLANT

Plant Influent
Untreated Source Water
Monitoring Results

BSK Analytical Laboratories

EDT

Date of Report: 11|03|11|1324
Laboratory Name: BSK Analytical Laboratories
Name of Sampler: Kat White

Sample ID No.: A1C0821-01
Signature Lab Director: [signature]

Date/Time Sample Collected: 11|03|09|1400
Date/Time Sample Received @ Lab : 11|03|10|1000
Date Analyses Completed: 11|03|10

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
Name or Number of Sample Source: QUARTZ HILL WTP - RAW
System Number: 1910045

User ID: 4TH
Date/Time of Sample: 11|03|09|1400
Submitted by: BSK Analytical Laboratories

Station Number: 1910045-002
Laboratory Code: 5810
Date Analyses Completed: 11|03|10
Phone #: 559-497-2888

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
45	mg/L	Nitrate (as NO3) (mg/L)	71850	3.2	2.0

Total Anions Meq/L Value: 0.05

BSK Analytical Laboratories

EDT

Date of Report: 11|06|23|1703
Laboratory Name: BSK Analytical Laboratories
Name of Sampler: Justin Livesay

Sample ID No.: A1F0795-04
Signature Lab Director: [signature]

Date/Time Sample Collected: 11|06|08|1407
Date/Time Sample Received @ Lab : 11|06|09|0800
Date Analyses Completed: 11|06|10

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
System Number: 1910045
Name or Number of Sample Source: QUARTZ HILL WTP - RAW

User ID: 4TH
Date/Time of Sample: 11|06|08|1407
Submitted by: BSK Analytical Laboratories

Station Number: 1910045-002
Laboratory Code: 5810
Date Analyses Completed: 11|06|10
Phone #: 559-497-2888

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
45	mg/L	Nitrate (as NO3) (mg/L)	71850	2.0	2.0

Total Anions Meq/L Value:	0.03

A1F0795 FINAL 06232011 1703

BSK Analytical Laboratories

EDT

Date of Report: 11|09|30|0938
Laboratory Name: BSK Analytical Laboratories
Name of Sampler: Justin Livesay

Sample ID No.: A1I1271-01
Signature Lab Director:

Date/Time Sample Collected: 11|09|15|1431
Date/Time Sample Received @ Lab : 11|09|16|1020
Date Analyses Completed: 11|09|16

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
Name or Number of Sample Source: QUARTZ HILL WTP - RAW
System Number: 1910045

User ID: 4TH
Date/Time of Sample: 11|09|15|1431
Submitted by: BSK Analytical Laboratories

Station Number: 1910045-002
Laboratory Code: 5810
Date Analyses Completed: 11|09|16
Phone #: 559-497-2888

Chain of Custody Notes

Date: 9/29/11
Initials: RLR
Note: Data is reported to four ps codes EDT: 1910045-002, 1910045-005, 1910045-003 and 1510053-001. Subsequent amended write on report hardcopies reflect the report being generated multiple times to accommodate this request.

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
45	mg/L	Nitrate (as NO3) (mg/L)	71850	ND	2.0

Total Anions Meq/L Value:	0.00

BSK Analytical Laboratories

EDT

Date of Report: 12|01|03|1521
Laboratory Name: BSK Analytical Laboratories
Name of Sampler: k. White

Sample ID No.: A1L1169-03
Signature Lab Director: [signature]

Date/Time Sample Collected: 11|12|15|1216
Date/Time Sample Received @ Lab : 11|12|16|1023
Date Analyses Completed: 11|12|16

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
System Number: 1910045
Name or Number of Sample Source: QUARTZ HILL WTP - RAW

User ID: 4TH
Date/Time of Sample: 11|12|15|1216
Submitted by: BSK Analytical Laboratories

Station Number: 1910045-002
Laboratory Code: 5810
Date Analyses Completed: 11|12|16
Phone #: 559-497-2888

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
45	mg/L	Nitrate (as NO3) (mg/L)	71850	3.6	2.0

Total Anions Meq/L Value:	0.06

BSK Analytical Laboratories

EDT

Date of Report: 11|12|14|1535
Laboratory Name: BSK Analytical Laboratories
Name of Sampler: Client

Sample ID No.: A1K0266-05
Signature Lab Director: [signature]

Date/Time Sample Collected: 11|11|02|1307
Date/Time Sample Received @ Lab : 11|11|03|0800
Date Analyses Completed: 11|11|14

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
System Number: 1910045
Name or Number of Sample Source: QUARTZ HILL WTP - RAW

User ID: 4TH
Station Number: 1910045-002
Date/Time of Sample: 11|11|02|1307
Laboratory Code: 5810
Date Analyses Completed: 11|11|14
Submitted by: BSK Analytical Laboratories
Phone #: 559-497-2888

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Hardness, (Total) as CaCO3	00900	60	
	mg/L	Calcium (Ca) (mg/L)	00916	13	
	mg/L	Magnesium (Mg) (mg/L)	00927	6.5	
	mg/L	Sodium (Na) (mg/L)	00929	20	
	mg/L	Potassium (K) (mg/L)	00937	< 2.0	
Total Cations Meq/L Value:		2.05			
	mg/L	Alkalinity, (Total) (as CaCO3 equivalents)	00410	58	
	mg/L	Hydroxide (OH) (mg/L)	71830	< 1.0	
	mg/L	Carbonate (CO3) (mg/L)	00445	< 1.8	
	mg/L	Bicarbonate (HCO3) (mg/L)	00440	71	
600	mg/L	Sulfate (SO4) (mg/L)	00945	16	0.5
600	mg/L	Chloride (Cl) (mg/L)	00940	22	
45	mg/L	Nitrate (as NO3) (mg/L)	71850	2.2	2.0
2	mg/L	Fluoride (F) (Natural-Source)	00951	ND	0.1
Total Anions Meq/L Value:		2.15			
15	Units	Color, Apparent (Unfiltered)	00081	10	
5	NTU	Lab Turbidity (NTU)	82079	0.47	
0.5	mg/L	MBAS (mg/L)	38260	< 0.050	
3	TON	Odor Threshold at 60 C (TON)	00086	1.0	1.0
	Std Units	pH (Laboratory) (Std.Units)	00403	8.2	
2200	umho/cm	Specific Conductance (E.C.) (umhos/cm)	00095	220	
1500	mg/L	Total Filterable Residue@180C(TDS)(mg/L)	70300	130	
1000	ug/L	Aluminum (Al) (ug/L)	01105	ND	50
6	ug/L	Antimony (ug/L)	01097	ND	6.0
10	ug/L	Arsenic (As) (ug/L)	01002	ND	2.0
1000	ug/L	Barium (Ba) (ug/L)	01007	ND	100
4	ug/L	Beryllium (ug/L)	01012	ND	1.0
5	ug/L	Cadmium (Cd) (ug/L)	01027	ND	1.0
50	ug/L	Chromium (Total Cr) (ug/L)	01034	ND	10
1000	ug/L	Copper (Cu) (ug/L)	01042	ND	50
300	ug/L	Iron (Fe) (ug/L)	01045	ND	100
	ug/L	Lead (Pb) (ug/L)	01051	ND	5.0

A1K0266 FINAL 12142011 1536

BSK Analytical Laboratories

EDT

Date of Report: 11|12|14|1535
Laboratory Name: BSK Analytical Laboratories
Name of Sampler: Client

Sample ID No.: A1K0266-05
Signature Lab Director:

Date/Time Sample Collected: 11|11|02|1307
Date/Time Sample Received @ Lab : 11|11|03|0800
Date Analyses Completed: 11|11|14

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
Name or Number of Sample Source: QUARTZ HILL WTP - RAW
System Number: 1910045

User ID: 4TH
Date/Time of Sample: 11|11|02|1307
Submitted by: BSK Analytical Laboratories

Station Number: 1910045-002
Laboratory Code: 5810
Date Analyses Completed: 11|11|14
Phone #: 559-497-2888

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
50	ug/L	Manganese (Mn) (ug/L)	01055	ND	20
2	ug/L	Mercury (Hg) (ug/L)	71900	ND	1.0
100	ug/L	Nickel (ug/L)	01067	ND	10
50	ug/L	Selenium (Se) (ug/L)	01147	ND	5.0
100	ug/L	Silver (Ag) (ug/L)	01077	ND	10
2	ug/L	Thallium (ug/L)	01059	ND	1.0
5000	ug/L	Zinc (Zn) (ug/L)	01092	ND	50

ADDITIONAL ANALYSES

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	NA	Agressiveness Index	82383	11	
150	ug/L	Cyanide (ug/L)	01291	ND	100
	NA	Langelier Index at 60 C	71813	- 0.42	
1000	ug/L	Nitrite as Nitrogen(N) (ug/L)	00620	ND	400
6	ug/L	Perchlorate (ug/L)	A-031	ND	4.0

TEST METHOD	CHEMICAL	ENTRY #	ANALYSES RESULTS	MCL µG/L	DLR µG/L
	REGULATED ORGANIC CHEMICALS				
EPA 524.2	Bromodichloromethane	32101	ND		1.0
EPA 524.2	Bromoform	32104	ND		1.0
EPA 524.2	Chloroform (Trichloromethane)	32106	ND		1.0
EPA 524.2	Dibromochloromethane	32105	ND		1.0
EPA 524.2a	Total Trihalomethanes (TTHMs)	82080	< 0.50	80	
	REGULATED ORGANIC CHEMICALS				
EPA 524.2	1,1,1-Trichloroethane (1,1,1-TCA)	34506	ND	200	0.5
EPA 524.2	1,1,2,2-Tetrachloroethane	34516	ND	1	0.5
EPA 524.2	1,1,2-Trichloroethane (1,1,2-TCA)	34511	ND	5	0.5
EPA 524.2	1,1-Dichloroethane (1,1-DCA)	34496	ND	5	0.5
EPA 524.2	1,1-Dichloroethylene (1,1-DCE)	34501	ND	6	0.5
EPA 524.2	1,2,4-Trichlorobenzene	34551	ND	5	0.5
EPA 524.2	1,2-Dichlorobenzene (o-DCB)	34536	ND	600	0.5
EPA 524.2	1,2-Dichloroethane (1,2-DCA)	34531	ND	0.5	0.5
EPA 524.2	1,2-Dichloropropane	34541	ND	5	0.5
EPA 524.2	1,4-Dichlorobenzene (p-DCB)	34571	ND	5	0.5
EPA 524.2	Benzene	34030	ND	1	0.5

BSK Analytical Laboratories

EDT

Date of Report: 11|12|14|1535
Laboratory Name: BSK Analytical Laboratories
Name of Sampler: Client

Sample ID No.: A1K0266-05
Signature Lab Director: [signature]

Date/Time Sample Collected: 11|11|02|1307
Date/Time Sample Received @ Lab : 11|11|03|0800
Date Analyses Completed: 11|11|14

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
System Number: 1910045
Name or Number of Sample Source: QUARTZ HILL WTP - RAW

User ID: 4TH
Station Number: 1910045-002
Date/Time of Sample: 11|11|02|1307
Laboratory Code: 5810
Submitted by: BSK Analytical Laboratories
Date Analyses Completed: 11|11|14
Phone #: 559-497-2888

TEST METHOD	CHEMICAL	ENTRY #	ANALYSES RESULTS	MCL µG/L	DLR µG/L
	REGULATED ORGANIC CHEMICALS				
EPA 524.2	Carbon Tetrachloride	32102	ND	0.5	0.5
EPA 524.2	cis-1,2-Dichloroethylene (c-1,2-DCE)	77093	ND	6	0.5
EPA 524.2	cis-1,3-Dichloropropene (D-D)	34704	ND	0.5	0.5
EPA 524.2	Dichloromethane (Methylene Chloride)	34423	ND	5	0.5
EPA 524.2	Ethyl Benzene	34371	ND	300	0.5
EPA 524.2	m,p-Xylene	A-014	ND		0.5
EPA 524.2	Methyl tert-Butyl Ether(MTBE)	46491	ND	5	3.0
EPA 524.2	Monochlorobenzene (Chlorobenzene)	34301	ND	70	0.5
EPA 524.2	o-Xylene	77135	ND		0.5
EPA 524.2	Styrene	77128	ND	100	0.5
EPA 524.2	Tetrachloroethylene (PCE)	34475	ND	5	0.5
EPA 524.2	Toluene	34010	ND	150	0.5
EPA 524.2	trans-1,2-Dichloroethylene (t-1,2-DCE)	34546	ND	10	0.5
EPA 524.2	trans-1,3-Dichloropropene	34699	ND	0.5	0.5
EPA 524.2	Trichloroethylene (TCE)	39180	ND	5	0.5
EPA 524.2	Trichlorofluoromethane (FREON 11)	34488	ND	150	5.0
EPA 524.2	Trichlorotrifluoroethane (FREON 113)	81611	ND	1200	10
EPA 524.2	Vinyl Chloride (VC)	39175	ND	0.5	0.5
EPA 524.2a	Total 1,3-Dichloropropene	34561	ND	0.5	0.5
EPA 524.2a	Total Xylenes (m,p, & o)	81551	< 0.50	1750	
EPA 525.2	Alachlor (ALANEX)	77825	ND	2	1.0
EPA 525.2	Atrazine (AATREX)	39033	ND	1	0.5
EPA 525.2	Benzo (a) Pyrene	34247	ND	0.2	0.1
EPA 525.2	Di(2-ethylhexyl) Adipate	A-026	ND	400	5.0
EPA 525.2	Diethylhexylphthalate (DEHP)	39100	ND	4	3.0
EPA 525.2	Molinate (ORDRAM)	82199	ND	20	2.0
EPA 525.2	Simazine (PRINCEP)	39055	ND	4	1.0
EPA 525.2	Thiobencarb (BOLERO)	A-001	ND	70	1.0
	UNREGULATED ORGANIC CHEMICALS				
EPA 524.2	1,1,1,2-Tetrachloroethane	77562	ND		0.5
EPA 524.2	1,1-Dichloropropene	77168	ND		0.5
EPA 524.2	1,2,3-Trichlorobenzene	77613	ND		0.5
EPA 524.2	1,2,4-Trimethylbenzene	77222	< 0.50		
EPA 524.2	1,3,5-Trimethylbenzene	77226	ND		0.5
EPA 524.2	1,3-Dichlorobenzene (m-DCB)	34566	ND		0.5

BSK Analytical Laboratories

EDT

Date of Report: 11|12|14|1535
Laboratory Name: BSK Analytical Laboratories
Name of Sampler: Client

Sample ID No.: A1K0266-05
Signature Lab Director:

Date/Time Sample Collected: 11|11|02|1307
Date/Time Sample Received @ Lab : 11|11|03|0800
Date Analyses Completed: 11|11|14

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
System Number: 1910045
Name or Number of Sample Source: QUARTZ HILL WTP - RAW

User ID: 4TH
Station Number: 1910045-002
Date/Time of Sample: 11|11|02|1307
Laboratory Code: 5810
Date Analyses Completed: 11|11|14
Submitted by: BSK Analytical Laboratories
Phone #: 559-497-2888

TEST METHOD	CHEMICAL	ENTRY #	ANALYSES RESULTS	MCL µG/L	DLR µG/L
	UNREGULATED ORGANIC CHEMICALS				
EPA 524.2	1,3-Dichloropropane	77173	ND		0.5
EPA 524.2	2,2-Dichloropropane	77170	ND		0.5
EPA 524.2	2-Chlorotoluene	A-008	ND		0.5
EPA 524.2	4-Chlorotoluene	A-009	ND		0.5
EPA 524.2	Acetone	81552	< 10		
EPA 524.2	Bromobenzene	81555	ND		0.5
EPA 524.2	Bromochloromethane	A-012	ND		0.5
EPA 524.2	Bromomethane (Methyl Bromide)	34413	ND		0.5
EPA 524.2	Chloroethane	34311	ND		0.5
EPA 524.2	Chloromethane (Methyl Chloride)	34418	ND		0.5
EPA 524.2	Dibromomethane	77596	ND		0.5
EPA 524.2	Dichlorodifluoromethane (Freon 12)	34668	ND		0.5
EPA 524.2	Diisopropyl Ether (DIPE)	A-036	ND		3.0
EPA 524.2	Ethyl tert-Butyl Ether (ETBE)	A-033	ND		3.0
EPA 524.2	Hexachlorobutadiene	34391	ND		0.5
EPA 524.2	Isopropylbenzene (Cumene)	77223	ND		0.5
EPA 524.2	Mesitylene (1,3,5-Trimethylbenzene)	77226	ND		0.5
EPA 524.2	Methyl Ethyl Ketone (MEK, Butanone)	81595	ND		5.0
EPA 524.2	Methyl Isobutyl Ketone (MIBK)	81596	ND		5.0
EPA 524.2	Naphthalene	34696	ND		0.5
EPA 524.2	n-Butylbenzene	A-010	ND		0.5
EPA 524.2	n-Propylbenzene	77224	ND		0.5
EPA 524.2	p-Isopropyltoluene	A-011	< 0.50		
EPA 524.2	sec-Butylbenzene	77350	ND		0.5
EPA 524.2	tert-Amyl Methyl Ether (TAME)	A-034	ND		3.0
EPA 524.2	tert-Butyl Alcohol (TBA)	77035	ND		2.0
EPA 524.2	tert-Butylbenzene	77353	ND		0.5
EPA 525.2	Bromacil (HYVAR)	82198	ND		10
EPA 525.2	Butachlor	77860	ND		0.38
EPA 525.2	Diazinon	39570	< 0.25		
EPA 525.2	Dimethoate (CYGON)	38458	< 10		
EPA 525.2	Metolachlor	39356	< 0.50		
EPA 525.2	Metribuzin	81408	< 0.50		
EPA 525.2	Propachlor	38533	ND		0.5

A1K0266 FINAL 12142011 1536

RADIOACTIVITY ANALYSIS (9/99)

Date of Report: 11/12/05 Sample ID No.B057601001/K0266
Laboratory Signature Lab
Name: PACE ANALYTICAL SERVICES, INC-GREENSBURG Director:
Name of Sampler:client Employed By: client
Date/Time Sample Collected:11/11/02/1307 Date/Time Sample Received @ Lab:11/11/14/0950 Date Analyses Completed:11/12/02

System Name:ANTELOPE VALLEY-EAST KERN WATER AGENCY System Number: 1910045
Name or Number of Sample Source:QUARTZ HILL WTP - RAW

User ID: 4TH Station Number: 1910045-002
Date/Time of Sample: |11|11|02|1307| (YY MM DD TTTT) Laboratory Code: 0010
Date Analysis completed: |11|12|02| (YY MM DD)
Submitted by:__________ Phone #:__________

MCL	REPORT UNITS	CHEMICAL	STORET CODE	ANALYSES RESULTS	DLR
	pCi/L	TITLE 22 CALIFORNIA CODE OF REGULATIONS			
	pCi/L	SECTION 64442 (22 CCR 64442)			
15	pCi/L	Gross Alpha	01501		3.0
	pCi/L	Gross Alpha Counting Error	01502		
	pCi/L	Gross Alpha MDA95 *	A-072		
20	pCi/L	Uranium	28012		1.0
	pCi/L	Uranium Counting Error	A-028		
	pCi/L	Uranium MDA95	A-073		
	pCi/L	Radium 226	09501		1.0
	pCi/L	Radium 226 Counting Error	09502		
	pCi/L	Radium 226 MDA95	A-074		
	pCi/L	Radium 228	11501		1.0
	pCi/L	Radium 228 Counting Error	11502		
	pCi/L	Radium 228 MDA95	A-075		
5	pCi/L	Ra 226 + Ra 228, Combined	11503		
	pCi/L	Ra 226 + Ra 228 Counting Error, Combined	11504		
	pCi/L	Ra 226 + Ra 229 MDA95, Combined	A-076		
	pCi/L	RADIUM, TOTAL, (FOR NTNC ONLY, BY 903.0)			
	pCi/L	Radium, Total	A-080		
	pCi/L	Radium, Total, Counting Error	A-081		
	pCi/L	Radium, Total, MDA95	A-082		
	pCi/L	TITLE 22 CALIFORNIA CODE OF REGULATIONS			
	pCi/L	SECTION 64443 (22 CCR 64443)			
50	pCi/L	Gross Beta	03501	< 4.0	4.0
	pCi/L	Gross Beta Counting Error	03502	1.06	

	pCi/L	Gross Beta MDA95	A-077		
4	pCi/L	Gross Beta, Calculated Dose Equivalent *	A-071		
8	pCi/L	Strontium 90	13501	< 2.0	2.0
	pCi/L	Strontium 90 Counting Error	13502	0.192	
	pCi/L	Strontium 90 MDA95	A-078		
20000	pCi/L	Tritium	07000	< 1000	1000
	pCi/L	Tritium Counting Error	07001	115	
	pCi/L	Tritium MDA95	A-079		
	pCi/L	RADON			
	pCi/L	Radon 222	82303		100.0
	pCi/L	Radon 222 Counting Error	82302		
	pCi/L				
	pCi/L	*MDA95 is Minimum Detectable Activity at			
	pCi/L	the 95% confidence level, per			
	pCi/L	22 CCR 64442 and 64443.			
	pCi/L				
	pCi/L	**Gross Beta, Calculated Total Body or			
	pCi/L	Organ Dose Equivalent, Per 22 CCR 64443			
	pCi/L				

Antelope Valley-East Kern Water Agency
LA System No. 1910045
TOC Removal Running Annual Average

Sample Date	Plant	Alkalinity mgCaCO3/L	Raw TOC mg/L	Treated TOC mg/L	Actual % TOC reduction	Required % TOC reduction	"TOC Removal Ratio" actual % /required %
1/12/2011	QHWTP	53.9	3.10	1.55	50.0	35	1.4
"	EWTP	plant off					
"	AWTP	plant off					
2/9/2011	QHWTP	52.6	4.41	2.16	51.0	45	1.1
"	EWTP	plant off					
"	AWTP	plant off					
3/9/2011	QHWTP	50.3	4.01	1.92	52.1	45	1.2
"	EWTP	plant off					
"	AWTP	plant off					
4/13/2011	QHWTP	51.7	3.82	1.83	52.1	35	1.5
"	EWTP	plant off					
"	AWTP	plant off					
5/11/2011	QHWTP	40.8	3.23	1.55	52.0	35	1.5
"	EWTP	41.9	3.58	1.54	57.0	35	1.6
5/12/2011	AWTP	40.6	3.47	1.55	55.3	35	1.6
6/8/2011	QHWTP	54.6	2.87	1.57	45.3	35	1.3
"	EWTP	53.4	3.08	1.71	44.5	35	1.3
6/9/2011	AWTP	56.0	3.04	1.61	47.0	35	1.3
7/13/2011	QHWTP	39.8	2.64	1.26	52.3	35	1.5
"	EWTP	41.0	2.78	1.40	49.6	35	1.4
7/14/2011	AWTP	41.2	2.82	1.28	54.6	35	1.6
8/10/2011	QHWTP	53.6	2.66	1.43	46.2	35	1.3
"	EWTP	54.4	2.87	1.55	46.0	35	1.3
8/11/2011	AWTP	53.5	2.77	1.50	45.8	35	1.3
9/14/2011	QHWTP	57.6	2.41	1.35	44.0	35	1.3
"	EWTP	58.5	2.61	1.55	40.6	35	1.2
"	AWTP	57.6	2.56	1.49	41.8	35	1.2
10/12/2011	QHWTP	65.6	2.17	1.24	42.9	25	1.7
"	EWTP	67.2	2.37	1.42	40.1	25	1.6
10/13/2011	AWTP	66.0	2.40	1.41	41.3	25	1.7
11/9/2011	QHWTP	53.4	2.09	1.09	47.8	35	1.4
"	EWTP	54.1	2.18	1.22	44.0	35	1.3
"	AWTP	54.5	2.19	1.19	45.7	35	1.3
12/14/2011	QHWTP	78.2	2.39	1.44	39.7	25	1.6
"	EWTP	plant off					
"	AWTP	plant off					
	Minimum	39.8	2.1	1.1	39.7		
	Maximum	78.2	4.4	2.2	57.0		
	RAA	53.5	2.9	1.5	47.3		

Running Annual Average (RAA) **1.4**

Title 22 California Code of Regulations, Chapter 15.5, Article 5:
Required percent TOC reduction**

Table 64536.2-A — Source Water Alkalinity

Raw TOC	0-60	<60 - 120	>120
>2.0 - 4.0	35.0 %	25.0 %	15.0 %
>4.0 - 8.0	45.0 %	35.0 %	25.0 %
>8.0	50.0 %	40.0 %	30.0 %

**If one or more of the section 64636.4(b) 1-6 conditions are met, the system may assign a monthly value of 1 for the TOC removal ratio in lieu of the calculated va
List condition when used:

1. The system's source water TOC level, prior to any treatment is less than or equal to 2.0 mg/L
2. The system's treated water TOC level is less than or equal to 2.0 mg/L
3. The system's source water SUVA, prior to any treatment, is less than or equal to 2.0 L/mg-m
4. The system's finished water SUVA is less than or equal to 2.0 L/mg-m
5. A system practicing softening removes at least 10 mg/L of magnesium hardness (as CaCO3)
6. A system practicing enhanced softening lowers alkalinity below 60 mg/L (as CaCO3)

GENERAL MINERAL & PHYSICAL & INORGANIC ANALYSIS (9/99)

Date of Report: 11/01/24 — Sample ID No.004

Laboratory Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY — Signature Lab Director:

Name of Sampler: JUSTIN LIVESAY — Employed By: AVEK WATER AGENCY

Date/Time Sample Collected: 11/01/12/0820 — Date/Time Sample Received @ Lab: 11/01/12/0821 — Date Analyses Completed: 11/01/21

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY — System Number: 1910045

Name or Number of Sample Source: QUARTZ HILL WTP - RAW

User ID: 4TH — Station Number: 1910045-002

Date/Time of Sample: |11|01|12|0820| (YY MM DD TTTT) — Laboratory Code: 6080

Date Analysis completed: |11|01|21| (YY MM DD)

Submitted by: ______ Phone #: ______

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Hardness (as CaCO3) (mg/L)	00900		
	mg/L	Calcium (Ca) (mg/L)	00916		
	mg/L	Magnesium (Mg) (mg/L)	00927		
	mg/L	Sodium (NA) (mg/L)	00929		
	mg/L	Potassium (K) (mg/L)	00937		
Total Cations		Meq/L Value:			
	mg/L	Total Alkalinity (AS CaCO3) (mg/L)	00410	53.9	
	mg/L	Hydroxide (OH) (mg/L)	71830		
	mg/L	Carbonate (CO3) (mg/L)	00445		
	mg/L	Bicarbonate (HCO3) (mg/L)	00440		
*	mg/L+	Sulfate (SO4) (mg/L)	00945		.5
*	mg/L+	Chloride (Cl) (mg/L)	00940		
45	mg/L	Nitrate (as NO3) (mg/L)	71850		2.0
2 .	mg/L	Fluoride (F) (Natural-Source)	00951		.1
Total Anions		Meq/L Value:			
	Std.Units+	PH (Laboratory) (Std.Units)	00403		
***	umho/cm+	Specific Conductance (E.C.) (umhos/cm)	00095		
****	mg/L+	Total Filterable Residue@180C(TDS)(mg/L)	70300		
15	Units	Apparent Color (Unfiltered) (Units)	00081		
3	TON	Odor Threshold at 60 C (TON)	00086		1.
5	NTU	Lab Turbidity (NTU)	82079		
0.5	mg/L+	MBAS (mg/L)	38260		

* 250-500-600 ** 0.6-1.7 *** 900-1600-2200 **** 500-1000-1500

ADDITIONAL ANALYSES 004

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Organic Carbon (TOC) (mg/L)	00680	3.10	0.30

+ Indicates Secondary Drinking Water Standards

EDT

GENERAL MINERAL & PHYSICAL & INORGANIC ANALYSIS (9/99)

Date of Report: 11/02/22
Sample ID No.011
Laboratory Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
Signature Lab Director:
Name of Sampler: KAT WHITE
Employed By: AVEK WATER AGENCY
Date/Time Sample Collected: 11/02/09/1054
Date/Time Sample Received @ Lab: 11/02/09/1055
Date Analyses Completed: 11/02/14

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
System Number: 1910045
Name or Number of Sample Source: QUARTZ HILL WTP - RAW

User ID: 4TH
Station Number: 1910045-002
Date/Time of Sample: |11|02|09|1054| (YY MM DD TTTT)
Laboratory Code: 6080
Date Analysis completed: |11|02|14| (YY MM DD)
Submitted by: ______________________
Phone #: ______________________

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Hardness (as CaCO3) (mg/L)	00900		
	mg/L	Calcium (Ca) (mg/L)	00916		
	mg/L	Magnesium (Mg) (mg/L)	00927		
	mg/L	Sodium (NA) (mg/L)	00929		
	mg/L	Potassium (K) (mg/L)	00937		
Total Cations		Meq/L Value:			
	mg/L	Total Alkalinity (AS CaCO3) (mg/L)	00410	52.6	
	mg/L	Hydroxide (OH) (mg/L)	71830		
	mg/L	Carbonate (CO3) (mg/L)	00445		
	mg/L	Bicarbonate (HCO3) (mg/L)	00440		
*	mg/L+	Sulfate (SO4) (mg/L)	00945		.5
*	mg/L+	Chloride (Cl) (mg/L)	00940		
45	mg/L	Nitrate (as NO3) (mg/L)	71850		2.0
2 .	mg/L	Fluoride (F) (Natural-Source)	00951		.1
Total Anions		Meq/L Value:			
	Std.Units+	PH (Laboratory) (Std.Units)	00403		
***	umho/cm+	Specific Conductance (E.C.) (umhos/cm)	00095		
****	mg/L+	Total Filterable Residue@180C(TDS)(mg/L)	70300		
15	Units	Apparent Color (Unfiltered) (Units)	00081		
3	TON	Odor Threshold at 60 C (TON)	00086		1.
5	NTU	Lab Turbidity (NTU)	82079		
0.5	mg/L+	MBAS (mg/L)	38260		

* 250-500-600 ** 0.6-1.7 *** 900-1600-2200 **** 500-1000-1500

ADDITIONAL ANALYSES 011

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Organic Carbon (TOC) (mg/L)	00680	4.41	0.30

+ Indicates Secondary Drinking Water Standards

GENERAL MINERAL & PHYSICAL & INORGANIC ANALYSIS (9/99)

Date of Report: 11/03/18 Sample ID No.021

Laboratory Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY

Signature Lab Director: [signature]

Name of Sampler: KAT WHITE Employed By: AVEK WATER AGENCY

Date/Time Sample Collected: 11/03/09/0843 Date/Time Sample Received @ Lab: 11/03/09/0900 Date Analyses Completed: 11/03/17

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY System Number: 1910045

Name or Number of Sample Source: QUARTZ HILL WTP - RAW

User ID: 4TH Station Number: 1910045-002

Date/Time of Sample: |11|03|09|0843| (YY MM DD TTTT) Laboratory Code: 6080

Date Analysis completed: |11|03|17| (YY MM DD)

Submitted by: ______ Phone #: ______

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Hardness (as CaCO3) (mg/L)	00900		
	mg/L	Calcium (Ca) (mg/L)	00916		
	mg/L	Magnesium (Mg) (mg/L)	00927		
	mg/L	Sodium (NA) (mg/L)	00929		
	mg/L	Potassium (K) (mg/L)	00937		
Total Cations		Meq/L Value:			
	mg/L	Total Alkalinity (AS CaCO3) (mg/L)	00410	50.3	
	mg/L	Hydroxide (OH) (mg/L)	71830		
	mg/L	Carbonate (CO3) (mg/L)	00445		
	mg/L	Bicarbonate (HCO3) (mg/L)	00440		
*	mg/L+	Sulfate (SO4) (mg/L)	00945		.5
*	mg/L+	Chloride (Cl) (mg/L)	00940		
45	mg/L	Nitrate (as NO3) (mg/L)	71850		2.0
2 .	mg/L	Fluoride (F) (Natural-Source)	00951		.1
Total Anions		Meq/L Value:			
	Std.Units+	PH (Laboratory) (Std.Units)	00403		
***	umho/cm+	Specific Conductance (E.C.) (umhos/cm)	00095		
****	mg/L+	Total Filterable Residue@180C(TDS)(mg/L)	70300		
15	Units	Apparent Color (Unfiltered) (Units)	00081		
3	TON	Odor Threshold at 60 C (TON)	00086		1.
5	NTU	Lab Turbidity (NTU)	82079		
0.5	mg/L+	MBAS (mg/L)	38260		

* 250-500-600 ** 0.6-1.7 *** 900-1600-2200 **** 500-1000-1500

ADDITIONAL ANALYSES 021

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Organic Carbon (TOC) (mg/L)	00680	4.01	0.30

+ Indicates Secondary Drinking Water Standards

GENERAL MINERAL & PHYSICAL & INORGANIC ANALYSIS (9/99)

Date of Report: 11/04/21
Sample ID No.036
Laboratory
Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
Signature Lab Director:
Name of Sampler:KAT WHITE
Employed By: AVEK WATER AGENCY
Date/Time Sample Collected:11/04/13/0742
Date/Time Sample Received @ Lab:11/04/13/0749
Date Analyses Completed:11/04/20

System Name:ANTELOPE VALLEY-EAST KERN WATER AGENCY
System Number: 1910045
Name or Number of Sample Source:QUARTZ HILL WTP - RAW

User ID: 4TH
Station Number: 1910045-002
Date/Time of Sample: |11|04|13|0742| (YY MM DD TTTT)
Laboratory Code: 6080
Date Analysis completed: |11|04|20| (YY MM DD)
Submitted by: ____________
Phone #: ____________

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Hardness (as CaCO3) (mg/L)	00900		
	mg/L	Calcium (Ca) (mg/L)	00916		
	mg/L	Magnesium (Mg) (mg/L)	00927		
	mg/L	Sodium (NA) (mg/L)	00929		
	mg/L	Potassium (K) (mg/L)	00937		
Total Cations		Meq/L Value:			
	mg/L	Total Alkalinity (AS CaCO3) (mg/L)	00410	51.7	
	mg/L	Hydroxide (OH) (mg/L)	71830		
	mg/L	Carbonate (CO3) (mg/L)	00445		
	mg/L	Bicarbonate (HCO3) (mg/L)	00440		
*	mg/L+	Sulfate (SO4) (mg/L)	00945		.5
*	mg/L+	Chloride (Cl) (mg/L)	00940		
45	mg/L	Nitrate (as NO3) (mg/L)	71850		2.0
2 .	mg/L	Fluoride (F) (Natural-Source)	00951		.1
Total Anions		Meq/L Value:			
	Std.Units+	PH (Laboratory) (Std.Units)	00403		
***	umho/cm+	Specific Conductance (E.C.) (umhos/cm)	00095		
****	mg/L+	Total Filterable Residue@180C(TDS)(mg/L)	70300		
15	Units	Apparent Color (Unfiltered) (Units)	00081		
3	TON	Odor Threshold at 60 C (TON)	00086		1.
5	NTU	Lab Turbidity (NTU)	82079		
0.5	mg/L+	MBAS (mg/L)	38260		

* 250-500-600 ** 0.6-1.7 *** 900-1600-2200 **** 500-1000-1500

ADDITIONAL ANALYSES 036

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Organic Carbon (TOC) (mg/L)	00680	3.82	0.30

+ Indicates Secondary Drinking Water Standards

GENERAL MINERAL & PHYSICAL & INORGANIC ANALYSIS (9/99)

Date of Report: 11/05/18 Sample ID No.046

Laboratory Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY

Signature Lab Director:

Name of Sampler:KAT WHITE Employed By: AVEK WATER AGENCY

Date/Time Sample Collected:11/05/11/0926 Date/Time Sample Received @ Lab:11/05/11/1000 Date Analyses Completed:11/05/18

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System Name:ANTELOPE VALLEY-EAST KERN WATER AGENCY System Number: 1910045

Name or Number of Sample Source:QUARTZ HILL WTP - RAW

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* User ID: 4TH Station Number: 1910045-002 *

* Date/Time of Sample: |11|05|11|0926| Laboratory Code: 6080 *

* YY MM DD TTTT YY MM DD *

* Date Analysis completed: |11|05|18| *

* Submitted by:____________________ Phone #:____________________ *

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MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Hardness (as CaCO3) (mg/L)	00900		
	mg/L	Calcium (Ca) (mg/L)	00916		
	mg/L	Magnesium (Mg) (mg/L)	00927		
	mg/L	Sodium (NA) (mg/L)	00929		
	mg/L	Potassium (K) (mg/L)	00937		
Total Cations		Meq/L Value:			
	mg/L	Total Alkalinity (AS CaCO3) (mg/L)	00410	40.8	
	mg/L	Hydroxide (OH) (mg/L)	71830		
	mg/L	Carbonate (CO3) (mg/L)	00445		
	mg/L	Bicarbonate (HCO3) (mg/L)	00440		
*	mg/L+	Sulfate (SO4) (mg/L)	00945		.5
*	mg/L+	Chloride (Cl) (mg/L)	00940		
45	mg/L	Nitrate (as NO3) (mg/L)	71850		2.0
2 .	mg/L	Fluoride (F) (Natural-Source)	00951		.1
Total Anions		Meq/L Value:			
	Std.Units+	PH (Laboratory) (Std.Units)	00403		
***	umho/cm+	Specific Conductance (E.C.) (umhos/cm)	00095		
****	mg/L+	Total Filterable Residue@180C(TDS)(mg/L)	70300		
15	Units	Apparent Color (Unfiltered) (Units)	00081		
3	TON	Odor Threshold at 60 C (TON)	00086		1.
5	NTU	Lab Turbidity (NTU)	82079		
0.5	mg/L+	MBAS (mg/L)	38260		

* 250-500-600 ** 0.6-1.7 *** 900-1600-2200 **** 500-1000-1500

 ADDITIONAL ANALYSES 046

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Organic Carbon (TOC) (mg/L)	00680	3.23	0.30

+ Indicates Secondary Drinking Water Standards

GENERAL MINERAL & PHYSICAL & INORGANIC ANALYSIS (9/99)

Date of Report: 11/06/17 Sample ID No.069

Laboratory Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY

Signature Lab Director: [signature]

Name of Sampler: JUSTIN LIVESAY Employed By: AVEK WATER AGENCY

Date/Time Sample Collected: 11/06/08/0900 Date/Time Sample Received @ Lab: 11/06/08/0900 Date Analyses Completed: 11/06/15

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System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY System Number: 1910045

Name or Number of Sample Source: QUARTZ HILL WTP - RAW

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* User ID: 4TH Station Number: 1910045-002 *
* Date/Time of Sample: |11|06|08|0900| Laboratory Code: 6080 *
* YY MM DD TTTT YY MM DD *
* Date Analysis completed: |11|06|15| *
* Submitted by:________________ Phone #:________________ *

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MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Hardness (as CaCO3) (mg/L)	00900		
	mg/L	Calcium (Ca) (mg/L)	00916		
	mg/L	Magnesium (Mg) (mg/L)	00927		
	mg/L	Sodium (NA) (mg/L)	00929		
	mg/L	Potassium (K) (mg/L)	00937		
Total Cations		Meq/L Value:			
	mg/L	Total Alkalinity (AS CaCO3) (mg/L)	00410	54.6	
	mg/L	Hydroxide (OH) (mg/L)	71830		
	mg/L	Carbonate (CO3) (mg/L)	00445		
	mg/L	Bicarbonate (HCO3) (mg/L)	00440		
*	mg/L+	Sulfate (SO4) (mg/L)	00945		.5
*	mg/L+	Chloride (Cl) (mg/L)	00940		
45	mg/L	Nitrate (as NO3) (mg/L)	71850		2.0
2 .	mg/L	Fluoride (F) (Natural-Source)	00951		.1
Total Anions		Meq/L Value:			
	Std.Units+	PH (Laboratory) (Std.Units)	00403		
***	umho/cm+	Specific Conductance (E.C.) (umhos/cm)	00095		
****	mg/L+	Total Filterable Residue@180C(TDS)(mg/L)	70300		
15	Units	Apparent Color (Unfiltered) (Units)	00081		
3	TON	Odor Threshold at 60 C (TON)	00086		1.
5	NTU	Lab Turbidity (NTU)	82079		
0.5	mg/L+	MBAS (mg/L)	38260		

* 250-500-600 ** 0.6-1.7 *** 900-1600-2200 **** 500-1000-1500

ADDITIONAL ANALYSES 069

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Organic Carbon (TOC) (mg/L)	00680	2.87	0.30

+ Indicates Secondary Drinking Water Standards

EDT

GENERAL MINERAL & PHYSICAL & INORGANIC ANALYSIS (9/99)

Date of Report: 11/07/26 Sample ID No.087

Laboratory Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY

Signature Lab Director:

Name of Sampler:JUSTIN LIVESAY Employed By: AVEK WATER AGENCY

Date/Time Sample Collected:11/07/13/1255 Date/Time Sample Received @ Lab:11/07/13/1255 Date Analyses Completed:11/07/25

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System Name:ANTELOPE VALLEY-EAST KERN WATER AGENCY System Number: 1910045

Name or Number of Sample Source:QUARTZ HILL WTP - RAW

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* User ID: 4TH Station Number: 1910045-002 *

* Date/Time of Sample: |11|07|13|1255| Laboratory Code: 6080 *

* YY MM DD TTTT YY MM DD *

* Date Analysis completed: |11|07|25| *

* Submitted by:________________________ Phone #:________________ *

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MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Hardness (as CaCO3) (mg/L)	00900		
	mg/L	Calcium (Ca) (mg/L)	00916		
	mg/L	Magnesium (Mg) (mg/L)	00927		
	mg/L	Sodium (NA) (mg/L)	00929		
	mg/L	Potassium (K) (mg/L)	00937		
Total Cations		Meq/L Value:			
	mg/L	Total Alkalinity (AS CaCO3) (mg/L)	00410	39.8	
	mg/L	Hydroxide (OH) (mg/L)	71830		
	mg/L	Carbonate (CO3) (mg/L)	00445		
	mg/L	Bicarbonate (HCO3) (mg/L)	00440		
*	mg/L+	Sulfate (SO4) (mg/L)	00945		.5
*	mg/L+	Chloride (Cl) (mg/L)	00940		
45	mg/L	Nitrate (as NO3) (mg/L)	71850		2.0
2 .	mg/L	Fluoride (F) (Natural-Source)	00951		.1
Total Anions		Meq/L Value:			
	Std.Units+	PH (Laboratory) (Std.Units)	00403		
***	umho/cm+	Specific Conductance (E.C.) (umhos/cm)	00095		
****	mg/L+	Total Filterable Residue@180C(TDS)(mg/L)	70300		
15	Units	Apparent Color (Unfiltered) (Units)	00081		
3	TON	Odor Threshold at 60 C (TON)	00086		1.
5	NTU	Lab Turbidity (NTU)	82079		
0.5	mg/L+	MBAS (mg/L)	38260		

* 250-500-600 ** 0.6-1.7 *** 900-1600-2200 **** 500-1000-1500

ADDITIONAL ANALYSES 087

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Organic Carbon (TOC) (mg/L)	00680	2.64	0.30

+ Indicates Secondary Drinking Water Standards

EDT

GENERAL MINERAL & PHYSICAL & INORGANIC ANALYSIS (9/99)

Date of Report: 11/08/18 | Sample ID No.105
Laboratory Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY | Signature Lab Director: [signature]
Name of Sampler: KAT WHITE | Employed By: AVEK WATER AGENCY
Date/Time Sample Collected: 11/08/10/0839 | Date/Time Sample Received @ Lab: 11/08/10/0843 | Date Analyses Completed: 11/08/17

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY | System Number: 1910045
Name or Number of Sample Source: QUARTZ HILL WTP - RAW

User ID: 4TH | Station Number: 1910045-002
Date/Time of Sample: |11|08|10|0839| (YY MM DD TTTT) | Laboratory Code: 6080
Date Analysis completed: |11|08|17| (YY MM DD)
Submitted by: ____________ | Phone #: ____________

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Hardness (as CaCO3) (mg/L)	00900		
	mg/L	Calcium (Ca) (mg/L)	00916		
	mg/L	Magnesium (Mg) (mg/L)	00927		
	mg/L	Sodium (NA) (mg/L)	00929		
	mg/L	Potassium (K) (mg/L)	00937		
Total Cations		Meq/L Value:			
	mg/L	Total Alkalinity (AS CaCO3) (mg/L)	00410	53.6	
	mg/L	Hydroxide (OH) (mg/L)	71830		
	mg/L	Carbonate (CO3) (mg/L)	00445		
	mg/L	Bicarbonate (HCO3) (mg/L)	00440		
*	mg/L+	Sulfate (SO4) (mg/L)	00945		.5
*	mg/L+	Chloride (Cl) (mg/L)	00940		
45	mg/L	Nitrate (as NO3) (mg/L)	71850		2.0
2 .	mg/L	Fluoride (F) (Natural-Source)	00951		.1
Total Anions		Meq/L Value:			
	Std.Units+	PH (Laboratory) (Std.Units)	00403		
***	umho/cm+	Specific Conductance (E.C.) (umhos/cm)	00095		
****	mg/L+	Total Filterable Residue@180C(TDS)(mg/L)	70300		
15	Units	Apparent Color (Unfiltered) (Units)	00081		
3	TON	Odor Threshold at 60 C (TON)	00086		1.
5	NTU	Lab Turbidity (NTU)	82079		
0.5	mg/L+	MBAS (mg/L)	38260		

* 250-500-600 ** 0.6-1.7 *** 900-1600-2200 **** 500-1000-1500

ADDITIONAL ANALYSES 105

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Organic Carbon (TOC) (mg/L)	00680	2.66	0.30

+ Indicates Secondary Drinking Water Standards

EDT

GENERAL MINERAL & PHYSICAL & INORGANIC ANALYSIS (9/99)

Date of Report: 11/09/29
Sample ID No.123

Laboratory Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
Signature Lab Director:

Name of Sampler: KAT WHITE
Employed By: AVEK WATER AGENCY

Date/Time Sample Collected: 11/09/14/1305
Date/Time Sample Received @ Lab: 11/09/14/1308
Date Analyses Completed: 11/09/23

==

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
System Number: 1910045

Name or Number of Sample Source: QUARTZ HILL WTP - RAW

****

* User ID: 4TH
Station Number: 1910045-002 *

* Date/Time of Sample: |11|09|14|1305|
YY MM DD TTTT
Laboratory Code: 6080 *

* Date Analysis completed: |11|09|23| *
YY MM DD *

* Submitted by: __________ Phone #: __________ *

****

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Hardness (as CaCO3) (mg/L)	00900		
	mg/L	Calcium (Ca) (mg/L)	00916		
	mg/L	Magnesium (Mg) (mg/L)	00927		
	mg/L	Sodium (NA) (mg/L)	00929		
	mg/L	Potassium (K) (mg/L)	00937		
Total Cations		Meq/L Value:			
	mg/L	Total Alkalinity (AS CaCO3) (mg/L)	00410	57.6	
	mg/L	Hydroxide (OH) (mg/L)	71830		
	mg/L	Carbonate (CO3) (mg/L)	00445		
	mg/L	Bicarbonate (HCO3) (mg/L)	00440		
*	mg/L+	Sulfate (SO4) (mg/L)	00945		.5
*	mg/L+	Chloride (Cl) (mg/L)	00940		
45	mg/L	Nitrate (as NO3) (mg/L)	71850		2.0
2 .	mg/L	Fluoride (F) (Natural-Source)	00951		.1
Total Anions		Meq/L Value:			
	Std.Units+	PH (Laboratory) (Std.Units)	00403		
***	umho/cm+	Specific Conductance (E.C.) (umhos/cm)	00095		
****	mg/L+	Total Filterable Residue@180C(TDS)(mg/L)	70300		
15	Units	Apparent Color (Unfiltered) (Units)	00081	<	
3	TON	Odor Threshold at 60 C (TON)	00086	<	1.
5	NTU	Lab Turbidity (NTU)	82079		
0.5	mg/L+	MBAS (mg/L)	38260		

* 250-500-600 ** 0.6-1.7 *** 900-1600-2200 **** 500-1000-1500

ADDITIONAL ANALYSES 123

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Organic Carbon (TOC) (mg/L)	00680	2.41	0.30

+ Indicates Secondary Drinking Water Standards

GENERAL MINERAL & PHYSICAL & INORGANIC ANALYSIS (9/99)

Date of Report: 11/10/24
Sample ID No.142
Laboratory
Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY
Signature Lab Director: ____________
Name of Sampler:Chris Brundage
Employed By: AVEK Water Agency
Date/Time Sample Collected:11/10/12/0825
Date/Time Sample Received @ Lab:11/10/12/0830
Date Analyses Completed:11/10/20

==

System Name:ANTELOPE VALLEY-EAST KERN WATER AGENCY
System Number: 1910045
Name or Number of Sample Source:QUARTZ HILL WTP - RAW

****

* User ID: 4TH   Station Number: 1910045-002 *
* Date/Time of Sample: |11|10|12|0825| Laboratory Code: 6080 *
*   YY MM DD TTTT   YY MM DD *
*   Date Analysis completed: |11|10|20| *
* Submitted by:____________   Phone #:____________ *

****

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Hardness (as CaCO3) (mg/L)	00900		
	mg/L	Calcium (Ca) (mg/L)	00916		
	mg/L	Magnesium (Mg) (mg/L)	00927		
	mg/L	Sodium (NA) (mg/L)	00929		
	mg/L	Potassium (K) (mg/L)	00937		
Total Cations		Meq/L Value:			
	mg/L	Total Alkalinity (AS CaCO3) (mg/L)	00410	65.6	
	mg/L	Hydroxide (OH) (mg/L)	71830		
	mg/L	Carbonate (CO3) (mg/L)	00445		
	mg/L	Bicarbonate (HCO3) (mg/L)	00440		
*	mg/L+	Sulfate (SO4) (mg/L)	00945		.5
*	mg/L+	Chloride (Cl) (mg/L)	00940		
45	mg/L	Nitrate (as NO3) (mg/L)	71850		2.0
2 .	mg/L	Fluoride (F) (Natural-Source)	00951		.1
Total Anions		Meq/L Value:			
	Std.Units+	PH (Laboratory) (Std.Units)	00403		
***	umho/cm+	Specific Conductance (E.C.) (umhos/cm)	00095		
****	mg/L+	Total Filterable Residue@180C(TDS)(mg/L)	70300		
15	Units	Apparent Color (Unfiltered) (Units)	00081		
3	TON	Odor Threshold at 60 C (TON)	00086		1.
5	NTU	Lab Turbidity (NTU)	82079		
0.5	mg/L+	MBAS (mg/L)	38260		

* 250-500-600   ** 0.6-1.7   *** 900-1600-2200   **** 500-1000-1500

ADDITIONAL ANALYSES 142

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Organic Carbon (TOC) (mg/L)	00680	2.17	0.30
		+ Indicates Secondary Drinking Water Standards			

GENERAL MINERAL & PHYSICAL & INORGANIC ANALYSIS (9/99)

Date of Report: 11/12/02 | Sample ID No.161
Laboratory | Signature Lab
Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY | Director:
Name of Sampler: KAT WHITE | Employed By: AVEK WATER AGENCY

Date/Time Sample Collected: 11/11/09/1042 | Date/Time Sample Received @ Lab: 11/11/09/1047 | Date Analyses Completed: 11/12/01

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY | System Number: 1910045
Name or Number of Sample Source: QUARTZ HILL WTP - RAW

* User ID: 4TH | Station Number: 1910045-002
* Date/Time of Sample: |11|11|09|1042| (YY MM DD TTTT) | Laboratory Code: 6080
* Date Analysis completed: |11|12|01| (YY MM DD)
* Submitted by: ______________ | Phone #: ______________

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Hardness (as CaCO3) (mg/L)	00900		
	mg/L	Calcium (Ca) (mg/L)	00916		
	mg/L	Magnesium (Mg) (mg/L)	00927		
	mg/L	Sodium (NA) (mg/L)	00929		
	mg/L	Potassium (K) (mg/L)	00937		
Total Cations		Meq/L Value:			
	mg/L	Total Alkalinity (AS CaCO3) (mg/L)	00410	53.4	
	mg/L	Hydroxide (OH) (mg/L)	71830		
	mg/L	Carbonate (CO3) (mg/L)	00445		
	mg/L	Bicarbonate (HCO3) (mg/L)	00440		
*	mg/L+	Sulfate (SO4) (mg/L)	00945		.5
*	mg/L+	Chloride (Cl) (mg/L)	00940		
45	mg/L	Nitrate (as NO3) (mg/L)	71850		2.0
2 .	mg/L	Fluoride (F) (Natural-Source)	00951		.1
Total Anions		Meq/L Value:			
	Std.Units+	PH (Laboratory) (Std.Units)	00403		
***	umho/cm+	Specific Conductance (E.C.) (umhos/cm)	00095		
****	mg/L+	Total Filterable Residue@180C(TDS)(mg/L)	70300		
15	Units	Apparent Color (Unfiltered) (Units)	00081		
3	TON	Odor Threshold at 60 C (TON)	00086		1.
5	NTU	Lab Turbidity (NTU)	82079		
0.5	mg/L+	MBAS (mg/L)	38260		

* 250-500-600 ** 0.6-1.7 *** 900-1600-2200 **** 500-1000-1500

ADDITIONAL ANALYSES 161

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Organic Carbon (TOC) (mg/L)	00680	2.09	0.30

+ Indicates Secondary Drinking Water Standards

GENERAL MINERAL & PHYSICAL & INORGANIC ANALYSIS (9/99)

Date of Report: 12/01/17 Sample ID No.180

Laboratory Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY

Signature Lab Director:

Name of Sampler: KAT WHITE

Employed By: AVEK WATER AGENCY

Date/Time Sample Collected: 11/12/14/0836

Date/Time Sample Received @ Lab: 11/12/14/0855

Date Analyses Completed: 12/01/16

==

System Name: ANTELOPE VALLEY-EAST KERN WATER AGENCY

System Number: 1910045

Name or Number of Sample Source: QUARTZ HILL WTP - RAW

****

* User ID: 4TH Station Number: 1910045-002 *
* Date/Time of Sample: |11|12|14|0836| Laboratory Code: 6080 *
* YY MM DD TTTT YY MM DD *
* Date Analysis completed: |12|01|16| *
* Submitted by: ______________ Phone #: ______________ *

****

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Hardness (as CaCO3) (mg/L)	00900		
	mg/L	Calcium (Ca) (mg/L)	00916		
	mg/L	Magnesium (Mg) (mg/L)	00927		
	mg/L	Sodium (NA) (mg/L)	00929		
	mg/L	Potassium (K) (mg/L)	00937		
Total Cations		Meq/L Value:			
	mg/L	Total Alkalinity (AS CaCO3) (mg/L)	00410	78.2	
	mg/L	Hydroxide (OH) (mg/L)	71830		
	mg/L	Carbonate (CO3) (mg/L)	00445		
	mg/L	Bicarbonate (HCO3) (mg/L)	00440		
*	mg/L+	Sulfate (SO4) (mg/L)	00945		.5
*	mg/L+	Chloride (Cl) (mg/L)	00940		
45	mg/L	Nitrate (as NO3) (mg/L)	71850		2.0
2 .	mg/L	Fluoride (F) (Natural-Source)	00951		.1
Total Anions		Meq/L Value:			
	Std.Units+	PH (Laboratory) (Std.Units)	00403		
***	umho/cm+	Specific Conductance (E.C.) (umhos/cm)	00095		
****	mg/L+	Total Filterable Residue@180C(TDS)(mg/L)	70300		
15	Units	Apparent Color (Unfiltered) (Units)	00081		
3	TON	Odor Threshold at 60 C (TON)	00086		1.
5	NTU	Lab Turbidity (NTU)	82079		
0.5	mg/L+	MBAS (mg/L)	38260		

* 250-500-600 ** 0.6-1.7 *** 900-1600-2200 **** 500-1000-1500

ADDITIONAL ANALYSES 180

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Organic Carbon (TOC) (mg/L)	00680	2.39	0.30

+ Indicates Secondary Drinking Water Standards

Appendix G

Table 1.1 from Tech Memo No. 1 Development, Evaluation, and Selection of Treatment Alternatives for the Eastside Water Treatment Plant

Table 1.1 Characteristics of the Two Source Waters for the New EWTP - SPW Aqueduct and LRW (2000 to 2006)
Eastside Water Treatment Plant
Palmdale Water District

		SPW Aqueduct					Littlerock Reservoir				
Parameter	Units	No. of Samples	Minimum	Maximum	Median	Average	No. of Samples	Minimum	Maximum	Median	Average
Sulfate	mg/L	9	37	63	40	44	5	11	24	17	17
Chloride	mg/L	9	54	145	100	92	5	–	10	–	–
Iron	mg/L	9	0.01	0.53	0.27	0.26	4	0.01	0.45	0.16	0.19
Manganese	mg/L	8	0.002	0.02	0.01	0.01	3	0.03	0.21	0.12	0.12
Total Hardness	mg/L as $CaCO_3$	9	99	198	110	119	5	75	147	130	114
Total Alkalinity	mg/L as $CaCO_3$	186	44	106	77	74	90	71	237	96	106
pH	-	183	7.3	8.8	8.3	8.2	93	7.0	8.8	7.5	7.4
Turbidity	NTU	172	0.2	71	2.3	3.5	86	0.2	41	2.3	3.5
Temperature	°C	175	8.9	27.2	18.3	17.8	90	6.7	22.2	11.1	11.7
Bromide	mg/L	53	0.05	0.43	0.18	0.19	8	–	<0.01	–	–
Total Organic Carbon (TOC)[1]	mg/L	77	1.3	8.1	3.0	3.3	28	1.7	9.1	5.0	4.7
Color (True)	Color Unit	175	1	80	20	25	90	10	50	30	33
Odor	Threshold Odor Number	-	–	<1[1]	–	–	5	11	24	17	17

Notes
1. Data provided courtesy of AVEK. Data is for the time between January 1999 and June 2006.

Appendix H

Analysis of the Energy Intensity of Water Supplies for West

Analysis of the Energy Intensity of Water Supplies for West Basin Municipal Water District

March, 2007

Robert C. Wilkinson, Ph.D.

Note to Readers

This report for West Basin Municipal Water District is an update and revision of an analysis and report by Robert Wilkinson, Fawzi Karajeh, and Julie Mottin (Hannah) conducted in April 2005. The earlier report, *Water Sources "Powering" Southern California: Imported Water, Recycled Water, Ground Water, and Desalinated Water*, was undertaken with support from the California Department of Water Resources, and it examined the energy intensity of water supply sources for both West Basin and Central Basin Municipal Water Districts. This analysis focuses exclusively on West Basin, and it includes new data for ocean desalination based on new engineering developments that have occurred over the past year and a half.

Principal Investigator: Robert C. Wilkinson, Ph.D.

Dr. Wilkinson is Director of the Water Policy Program at the Donald Bren School of Environmental Science and Management, and Lecturer in the Environmental Studies Program, at the University of California, Santa Barbara. His teaching, research, and consulting focuses on water policy, climate change, and environmental policy issues. Dr. Wilkinson advises private sector entities and government agencies in the U.S. and internationally. He currently served on the public advisory committee for California's 2005 State Water Plan, and he represented the University of California on the Governor's Task Force on Desalination.
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West Basin Municipal Water District

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Overview

Southern California relies on imported and local water supplies for both potable and non-potable uses. Imported water travels great distances and over significant elevation gains through both the California State Water Project (SWP) and Colorado River Aqueduct (CRA) before arriving in Southern California, consuming a large amount of energy in the process. Local sources of water often require less energy to provide a sustainable supply of water. Three water source alternatives which are found or produced locally and could reduce the amount of imported water are desalinated ocean water, groundwater, and recycled water. Groundwater and recycled water are significantly less energy intensive than imports, while ocean desalination is getting close to the energy intensity of imports.

Energy requirements vary considerably between these four water sources. All water sources require pumping, treatment, and distribution. Differences in energy requirements arise from the varying processes needed to produce water to meet appropriate standards. This study examines the energy needed to complete each process for the waters supplied by West Basin Municipal Water District (West Basin).

Specific elements of energy inputs examined in this study for each water source are as follows:

- Energy required to **import water** includes three processes: pumping California SWP and CRA supplies to water providers; treating water to applicable standards; and distributing it to customers.
- **Desalination of ocean water** includes three basic processes: 1) pumping water from the ocean or intermediate source (e.g. a powerplant) to the desalination plant; 2) pre-treating and then desalting water including discharge of concentrate; and 3) distributing water from the desalination plant to customers.
- **Groundwater** usage requires energy for three processes: pumping groundwater from local aquifers to treatment facilities; treating water to applicable standards; and distributing water from the treatment plant to customers. Additional injection energy is sometimes needed for groundwater replenishment.
- Energy required to **recycle water** includes three processes: pumping water from secondary treatment plants to tertiary treatment plants; tertiary treatment of the water, and distributing water from the treatment plant to customers.

The energy intensity results of this study are summarized in the table on the following page. They indicate that recycled water is among the least energy-intensive supply options available, followed by groundwater that is naturally recharged and recharged with recycled water. Imported water and ocean desalination are the most energy intensive water supply options in California. East Branch State Water Project water is close in energy intensity to desalination figures based on current technology, and at some points along the system, SWP supplies exceed estimated ocean desalination energy intensity. The following table identifies energy inputs to each of the water supplies including estimated energy requirements for desalination. Details describing the West Basin system operations are included in the water source sections. Note that the Title 22 recycled water energy figure reflects only the *marginal* energy required to treat secondary effluent wastewater which has been processed to meet legal discharge requirements, along with the energy to convey it to user

Energy Intensity of Water Supplies for West Basin Municipal Water District

	af/yr	Percentage of Total Source Type	kWh/af Conveyance Pumping	kWh/af MWD Treatment	kWh/af Recycled Treatment	kWh/af Groundwater Pumping	kWh/af Groundwater Treatment	kWh/af Desalination	kWh/af WBMWD Distribution	Total kWh/af	Total kWh/year
Imported Deliveries											
State Water Project (SWP) [1]	57,559	43%	3,000	44	NA	NA	NA	NA	0	3,044	175,209,596
Colorado River Aqueduct (CRA) [1] (other that replenishment water)	76,300	57%	2,000	44	NA	NA	NA	NA	0	2,044	155,957,200
Groundwater[2]											
natural recharge	19,720	40%	NA	NA	NA	350	0	NA	0	350	6,902,030
replenished with (injected) SWP water [1]	9,367	19%	3,000	44	NA	350	0	NA	0	3,394	31,791,598
replenished with (injected) CRA water [1]	11,831	24%	2,000	44	NA	350	0	NA	0	2,394	28,323,432
replenished with (injected) recycled water	8,381	17%	205	0	790	350	0	NA	220	1,565	13,116,278
Recycled Water											
West Basin Treatment, Title 22	21,506	60%	205	NA	0	NA	NA	NA	285	490	10,537,940
West Basin Treatment, RO	14,337	40%	205	NA	790	NA	NA	NA	285	1,280	18,351,360
Ocean Desalination	20,000	100%	200	NA	NA	NA	NA	3,027	460	3,687	82,588,800

Notes:

NA Not applicable

[1] Imported water based on percentage of CRA and SWP water MWD received, averaged over an 11-year period. Note that the figures for imports do not include an accounting for system losses due to evaporation and other factors. These losses clearly exist, and an estimate of 5% or more may be reasonable. The figures for imports above should therefore be understood to be conservative (that is, the actual energy intensity is in fact higher for imported supplies than indicated by the figures).

[2] Groundwater values include entire basin, West Basin service area covers approximately 86% of the basin. Groundwater values are specific to aquifer characteristics, including depth, within the basin.

Energy Intensity of Water

Water treatment and delivery systems in California, including extraction of "raw water" supplies from natural sources, conveyance, treatment and distribution, end-use, and wastewater collection and treatment, account for one of the largest energy uses in the state.[1] The California Energy Commission estimated in its 2005 Integrated Energy Policy Report that approximately 19% of California's electricity is used for water related purposes including delivery, end-uses, and wastewater treatment.[2] The total energy embodied in a unit of water (that is, the amount of energy required to transport, treat, and process a given amount of water) varies with location, source, and use within the state. In many areas, the energy intensity may increase in the future due to limits on water resource extraction, and regulatory requirements for water quality, and other factors.[3] Technology improvements may offset this trend to some extent.

> ***Energy intensity*** is the total amount of energy, calculated on a whole-system basis, required for the use of a given amount of water in a specific location.

The Water-Energy Nexus

Water and energy systems are interconnected in several important ways in California. Water systems both provide energy – through hydropower – and consume large amounts of energy, mainly through pumping. Critical elements of California's water infrastructure are highly energy-intensive. Moving large quantities of water long distances and over significant elevation gains, treating and distributing it within the state's communities and rural areas, using it for various purposes, and treating the resulting wastewater, accounts for one of the largest uses of electrical energy in the state.[4]

Improving the efficiency with which water is used provides an important opportunity to increase related energy efficiency. ("*Efficiency*" as used here describes the useful work or service provided by a given amount of water.) Significant potential economic as well as environmental benefits can be cost-effectively achieved in the energy sector through efficiency improvements in the state's water systems and through shifting to less energy intensive local sources. The California Public Utilities Commission is currently planning to include water efficiency improvements as a means of achieving energy efficiency benefits for the state.[5]

Overview of Energy Inputs to Water Systems

There are four principle energy elements in water systems:

1. primary water extraction and supply delivery (imported and local)
2. treatment and distribution within service areas
3. on-site water pumping, treatment, and thermal inputs (heating and cooling)

4. wastewater collection, treatment, and discharge

Pumping water in each of these four stages is energy-intensive. Other important components of embedded energy in water include groundwater pumping, treatment and pressurization of water supply systems, treatment and thermal energy (heating and cooling) applications at the point of end-use, and wastewater pumping and treatment.[6]

1. Primary water extraction and supply delivery

Moving water from near sea-level in the Sacramento-San Joaquin Delta to the San Joaquin-Tulare Lake Basin, the Central Coast, and Southern California, and from the Colorado River to metropolitan Southern California, is highly energy intensive. Approximately 3,236 kWh is required to pump one acre-foot of SWP water to the end of the East Branch in Southern California, and 2,580 kWh for the West Branch. About 2,000 kWh is required to pump one acre foot of water through the CRA to southern California.[7] Groundwater pumping also requires significant amounts of energy depending on the depth of the source. (Data on groundwater is incomplete and difficult to obtain because California does not systematically manage groundwater resources.)

2. Treatment and distribution within service areas

Within local service areas, water is treated, pumped, and pressurized for distribution. Local conditions and sources determine both the treatment requirements and the energy required for pumping and pressurization.

3. On-site water pumping, treatment, and thermal inputs

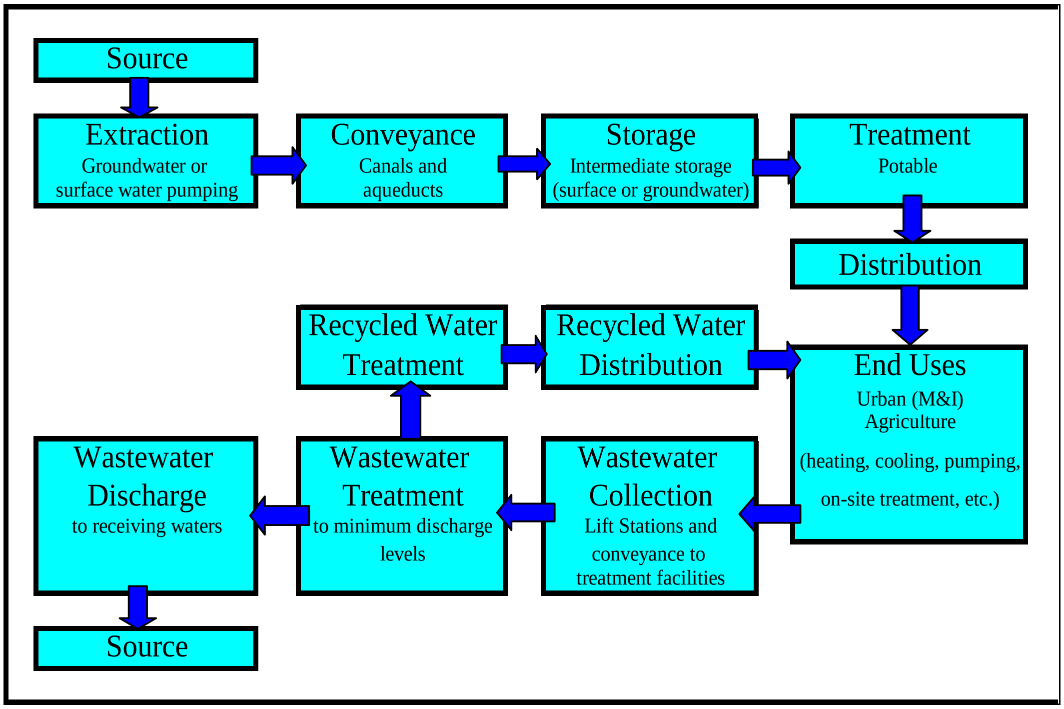
Individual water users use energy to further treat water supplies (e.g. softeners, filters, etc.), circulate and pressurize water supplies (e.g. building circulation pumps), and heat and cool water for various purposes.

4. Wastewater collection, treatment, and discharge

Finally, wastewater is collected and treated by a wastewater authority (unless a septic system or other alternative is being used). Wastewater is often pumped to treatment facilities where gravity flow is not possible, and standard treatment processes require energy for pumping, aeration, and other processes. (In cases where water is reclaimed and re-used, the calculation of total energy intensity is adjusted to account for wastewater as a *source* of water supply. The energy intensity generally includes the additional energy for treatment processes beyond the level required for wastewater discharge, plus distribution.)

The simplified flow chart below illustrates the steps in the water system process. A spreadsheet computer model is available to allow cumulative calculations of the energy inputs embedded at each stage of the process. This methodology is consistent with that applied by the California Energy Commission in its analysis of the energy intensity of water.

Simplified Flow Diagram of Energy Inputs to Water Systems



Source: Robert Wilkinson, UCSB[8]

Calculating Energy Intensity

Total energy intensity, or the amount of energy required to facilitate the use of a given amount of water in a specific location, may be calculated by accounting for the summing the energy requirements for the following factors:

- imported supplies
- local supplies
- regional distribution
- treatment
- local distribution
- on-site thermal (heating or cooling)
- on-site pumping
- wastewater collection
- wastewater treatment

Water pumping, and specifically the long-distance transport of water in conveyance systems, is a major element of California's total demand for electricity as noted above. Water use (based on embedded energy) is the next largest consumer of electricity in a typical Southern California home after refrigerators and air conditioners. Electricity required to support water service in the typical home in Southern California is estimated at between 14% to 19% of total residential energy demand. [9] If air conditioning is not a factor the figure is even higher. Nearly three quarters of this energy demand is for pumping imported water.

Interbasin Transfers

Some of California's water systems are uniquely energy-intensive, relative to national averages, due to the pumping requirements of major conveyance systems which move large volumes of water long distances and over thousands of feet in elevation lift. Some of the interbasin transfer systems (systems that move water from one watershed to another) are net energy producers, such as the San Francisco and Los Angeles aqueducts. Others, such as the SWP and the CRA require large amounts of electrical energy to convey water. On *average*, approximately 3,000 kWh is necessary to pump one AF of SWP water to southern California,[10] and 2,000 kWh is required to pump one AF of water through the CRA to southern California.[11]

Total energy savings for reducing the full embedded energy of *marginal* (e.g. imported) supplies of water used indoors in Southern California is estimated at about 3,500 kWh/af.[12] Conveyance over long distances and over mountain ranges accounts for this high marginal energy intensity. In addition to avoiding the energy and other costs of pumping additional water supplies, there are environmental benefits through reduced extractions from stressed ecosystems such as the delta.

Imported Water:
The State Water Project and the Colorado River Aqueduct

Water diversion, conveyance, and storage systems developed in California in the 20th century are remarkable engineering accomplishments. These water works move millions of AF of water around the state annually. The state's 1,200-plus reservoirs have a total storage capacity of more than 42.7 million acre feet (maf).[13] West Basin receives imported water from Northern California through the State Water Project and Colorado River water via the Colorado River Aqueduct. The Metropolitan Water District of Southern California delivers both of these imported water supplies to the West Basin.

California's Major Interbasin Water Projects

The State Water Project

The State Water Project (SWP) is a state-owned system. It was built and is managed by the California Department of Water Resources (DWR). The SWP provides supplemental water for agricultural and urban uses.[14] SWP facilities include 28 dams and reservoirs, 22 pumping and generating plants, and nearly 660 miles of aqueducts.[15] Lake Oroville on the Feather River, the project's largest storage facility, has a total capacity of about 3.5 maf.[16] Oroville Dam is the tallest and one of the largest earth-fill dams in the United States.[17]

Water is pumped out of the delta for the SWP at two locations. In the northern Delta, Barker Slough Pumping Plant diverts water for delivery to Napa and Solano counties through the North Bay

Aqueduct.[18] Further south at the Clifton Court Forebay, water is pumped into Bethany Reservoir by the Banks Pumping Plant. From Bethany Reservoir, the majority of the water is conveyed south in the 444-mile-long Governor Edmund G. Brown California Aqueduct to agricultural users in the San Joaquin Valley and to urban users in Southern California. The South Bay Pumping Plant also lifts water from the Bethany Reservoir into the South Bay Aqueduct. [19]

The State Water Project is the largest consumer of electrical energy in the state, requiring an average of 5,000 GWh per year.[20] The energy required to operate the SWP is provided by a combination of DWR's own hydroelectric and other generation plants and power purchased from other utilities. The project's eight hydroelectric power plants, including three pumping-generating plants, and a coal-fired plant produce enough electricity in a normal year to supply about two-thirds of the project's necessary power.

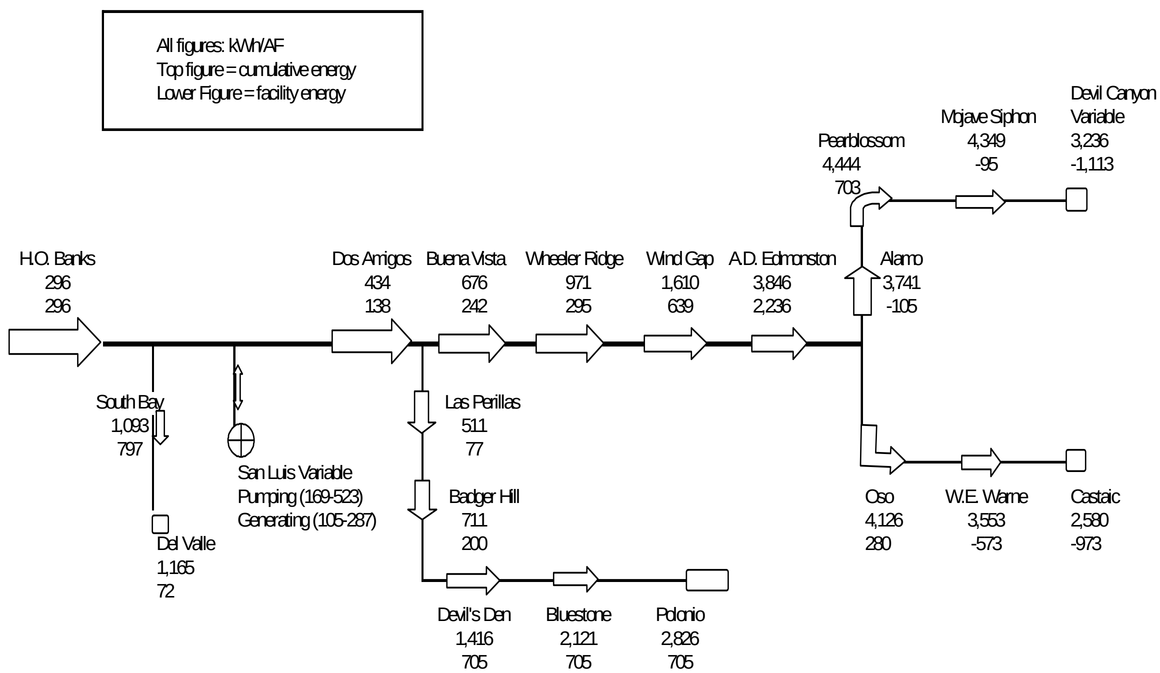
Energy requirements would be considerably higher if the SWP was delivering full contract volumes of water. The project delivered an average of approximately 2.0 mafy, or half its contracted volumes, throughout the 1980s and 1990s.[21] Since 2000 the volumes of imported water have generally increased.

The following map indicates the location of the pumping and power generation facilities on the SWP.

Names and Locations of Primary State Water Delivery Facilities

The following schematic shows each individual pumping unit on the State Water Project, along with data for both the individual and cumulative energy required to deliver an AF of water to that point in the system. Note that the figures include energy recovery in the system, but they do not account for losses due to evaporation and other factors. These losses may be in the range of 5% or more. While more study of this issue is in order, it is important to observe that the energy intensity numbers are conservative (e.g. low) in that they assume that all of the water originally pumped from the delta reaches the ends of the system without loss.

State Water Project
Kilowatt-Hours per Acre Foot Pumped
(Includes Transmission Losses)



Source: Wilkinson, based on data from: California Department of Water Resources, State Water Project Analysis Office, Division of Operations and Maintenance, *Bulletin 132-97*, 4/25/97.

The Colorado River Aqueduct

Significant volumes of water are imported to the Los Angeles Basin and San Diego in Southern California from the Colorado River via the Colorado River Aqueduct (CRA). The aqueduct was built by the Metropolitan Water District of Southern California (MWD). Though MWD's allotment of the Colorado River water is 550,000 afy, it has historically extracted as much as 1.3 mafy through a combination of waste reduction arrangements with Imperial Irrigation District (IID) (adding about 106,000 afy) and by using "surplus" water.[22] The Colorado River water supplies require about 2,000 kWh/af for conveyance to the Los Angeles basin.

The Colorado River Aqueduct extends 242 miles from Lake Havasu on the Colorado River to its terminal reservoir, Lake Mathews, near Riverside. The CRA was completed in 1941 and expanded in 1961 to a capacity of more than 1 MAF per year. Five pumping plants lift the water 1,616 feet, over several mountain ranges, to southern California. To pump an average of 1.2 maf of water per year into the Los Angeles basin requires approximately 2,400 GWh of energy for the CRA's five pumping plants.[23] On average, the energy required to import Colorado River water is about 2,000 kWh/AF. The aqueduct was designed to carry a flow of 1,605 cfs (with the capacity for an additional 15%).

The sequence for CRA pumping is as follows: The Whitsett Pumping Plant elevates water from Lake Havasu 291 feet out of the Colorado River basin. At "mile 2," Gene pumping plant elevates water 303 feet to Iron Mountain pumping plant at mile 69, which then boosts the water another 144 feet. The last two pumping plants provide the highest lifts - Eagle Mountain, at mile 110, lifts the water 438 feet, and Hinds Pumping Plant, located at mile 126, lifts the water 441 feet.[24]

MWD has recently improved the system's energy efficiency. The average energy requirement for the CRA was reduced from approximately 2,100 kWh /af to about 2,000 kWh /af "through the increase in unit efficiencies provided through an energy efficiency program." The energy required to pump each acre foot of water through the CRA is essentially constant, regardless of the total annual volume of water pumped. This is due to the 8-pump design at each pumping plant. The average pumping energy efficiency does not vary with the number of pumps operated, and MWD states that the same 2,000 kWh/af estimate is appropriate for both the "Maximum Delivery Case" and the "Minimum Delivery Case."[25]

It appears that there are limited opportunities to shift pumping off of peak times on the CRA. Due to the relatively steep grade of the CRA, limited active water storage, and transit times between plants, the system does not generally lend itself to shifting pumping loads from on-peak to off-peak. Under the Minimum Delivery Case, the reduced annual water deliveries would not necessarily bring a reduction in annual peak load, since an 8-pump flow may still need to be maintained in certain months.

Electricity to run the CRA pumps is provided by power from hydroelectric projects on the Colorado River as well as off-peak power purchased from a number of utilities. The Metropolitan Water District has contractual hydroelectric rights on the Colorado River to "more than 20 percent of the firm energy and contingent capacity of the Hoover power plant and 50 percent of the energy and capacity of the Parker power plant."[26] Energy purchased from utilities makes up approximately 25 percent of the remaining energy needed to power the Colorado River Aqueduct.[27]

Minimizing the Need for Inter-Basin Transfers

For over 100 years, California has sought to transfer water from one watershed for use in another. The practice has caused a number of problems. As of 2001, California law requires that the state examine ways to "*minimize the need to import water from other hydrologic regions*" and report on these approaches in the official State Water Plan.[28] A new focus and priority has been placed on developing *local* water supply sources, including efficiency, reuse, recharge, and desalination. The law directs the Department of Water Resources as follows:[29]

> The department, as a part of the preparation of the department's Bulletin 160-03, shall include in the California Water Plan a report on the development of regional and local water projects within each hydrologic region of the state, as described in the department's Bulletin 160-98, to improve water supplies to meet municipal, agricultural, and environmental water needs and *minimize the need to import water from other hydrologic regions*.

(Note that Bulletin 160-03 became Bulletin 160-05 due to a slip in the completion schedule.)

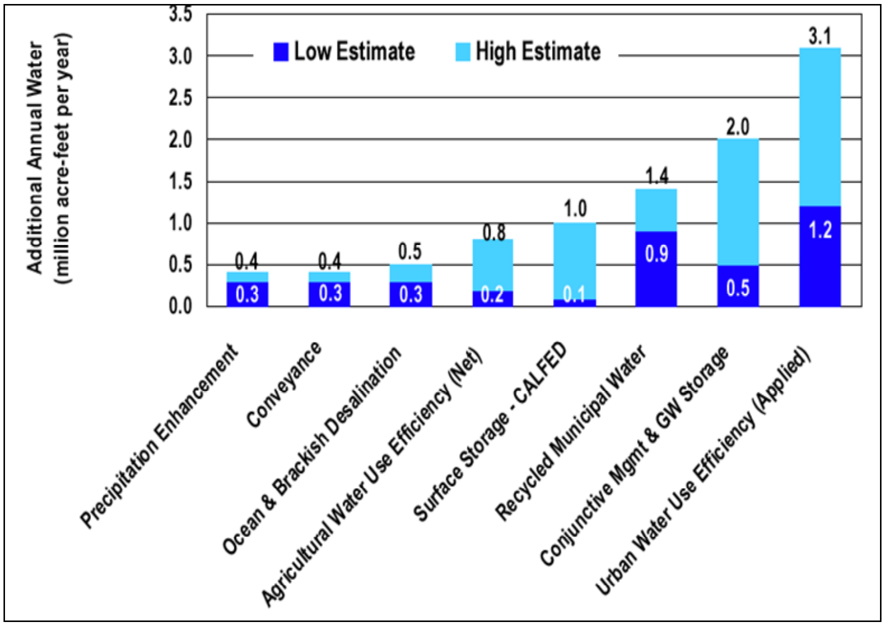
The legislation set forth the range of local supply options to be considered:

> The report shall include, but is not limited to, regional and local water projects that use technologies for desalting brackish groundwater and ocean water, reclaiming water for use within the community generating the water to be reclaimed, the construction of improved potable water treatment facilities so that water from sources determined to be unsuitable can be used, and the construction of dual water systems and brine lines, particularly in connection with new developments and when replacing water piping in developed or redeveloped areas.

This law calls for a thorough consideration in the state's official water planning process of work that is already going on in various areas of the state. The significance of the legislation is that for the first time, local supply development is designated as a priority in order to minimize inter-basin transfers.

The Department of Water Resources State Water Plan (Bulletin 160-05) reflects this new direction for the state in its projection of water supply options for the next quarter century. The following graph clearly indicates the importance of local water supplies from various sources in the future.

California State Water Plan 2005
Water Management and Supply Options for the Next 25 Years



Source: *California Water Plan Update 2005*.[30]

Energy Requirements for Treatment of State Water Project and the Colorado River Aqueduct Supplies

Imported SWP and CRA supplies require an estimated 44 kWh/af for treatment before it enters the local distribution systems. Water pressure from MWD's system is sufficient to move supplies through the West Basin distribution system without requiring additional pressure.

Groundwater and Recycled Water at West Basin MWD

Nearly half of the water used in the service area of the Metropolitan Water District of Southern California (from Ventura to Mexico) is secured from *local* sources, and the percentage of total supplies provided by local sources is growing steadily.[31] This figure is up from approximately one-third of the supply provided by local resources in the mid-1990s.[32] MWD has encouraged local supply development through support for recycling, groundwater recovery, conservation, groundwater storage, and most recently, ocean desalination.

Groundwater and recycled water are important and growing supply sources for West Basin. Water flows through natural hydrologic cycles continuously. The water we use today has made the journey many times. In water recycling programs, water is treated and re-used for various purposes including recharging groundwater aquifers. The treatment processes essentially short-circuit the longer-term process of natural evaporation and precipitation. In cities around the world water is used and then returned to natural water systems where it flows along to more users down stream. It is often used again and again before it flows to the ocean or to a terminal salt sink.

Groundwater at West Basin MWD

Groundwater reservoirs in West Basin are replenished with four water sources; natural recharge, SWP supplies, CRA supplies, and recycled water supplies. The largest portion (approximately 40%) of groundwater supplies is derived from natural recharge. The energy associated with recovering this naturally recharged supply is estimated at 350 kWh/af for groundwater pumping.

Imported water, from both the SWP and CRA, is injected into the groundwater supply in West Basin. The imported water remains at sufficient pressure for injection, so no additional energy is required. The energy requirements for importing water are significant, however, primarily due to the energy associated with importing the water from northern California and the Colorado River. The imported water also passes through MWD's treatment plant, incurring additional energy requirements. The total energy intensity for West Basin's imported water used for recharge of groundwater storage from the SWP is 3,394 kWh/af and from the CRA is 2,394 kWh/af.

Recycled water is also used to recharge groundwater in the basin. West Basin replenishes groundwater by injecting RO treated recycled water from the West Basin Water Recycling Facility (WBWRF). The total energy use is 1,565 kWh/af. Details for the recycled water energy are described in the next section.

Recycled Water at West Basin MWD

Many cities in California are using advanced processes and filtering technology to treat wastewater so it can be re-used for irrigation, industry, and other purposes. In response to increasing demands for water, limitations on imported water supplies, and the threat of drought, West Basin has developed state-of-the-art regional water recycling programs. Water is increasingly being used more than once within systems at both the end-use level and at the municipal level. This is because scarce water resources (and wastewater discharges) are increasing in cost and because cost-effective technologies and techniques for re-using water have been developed that meet health and safety requirements. At the end-use, water is recycled within processes such as cooling towers and industrial processes prior to entering the wastewater system. Once-through systems are increasingly being replaced by re-use technologies. At the municipal level, water re-use has become a significant source of supplies for both landscape irrigation and for commercial and industrial processes. MWD of Southern California is supporting 33 recycling programs in which treated wastewater is used for non-potable purposes.[33]

West Basin provides customers with recycled water used for municipal, commercial and industrial applications. Approximately 27,000 AF of recycled water is annually distributed to more than 210 sites in the South Bay. These sites use recycled water for a wide range of non-potable applications. Based in El Segundo, California, the WBWRF is among the largest projects of its kind in the nation, producing five qualities of recycled water with the capacity at full build-out to recycle 100,000 AF per year of wastewater from the Los Angeles Hyperion Treatment Plant.

In 1998, West Basin began to construct the nation's only regional high-purity water treatment facility, the Carson Regional Water Recycling Facility (CRWRF). A pipeline stretching through five South Bay communities connects the CRWRP to West Basin's El Segundo facility. At the CRWRF, West Basin ultra-purifies the recycled water it gets from the El Segundo facility. From the CRWRF, West Basin uses service lines to transport two types of purified water to the BP Refinery in Carson. The West Basin expansion also includes a new disposal pipeline to carry brine reject water from the CRWRF to a Los Angeles County Sanitation District's outfall.

In order to provide perspective on the energy requirements for the WBWRF, two water qualities and associated energy intensity are presented. "Title 22" water, produced by a gravity filter treatment system, requires conveyance pumping energy from Hyperion to WBWRF at 205 kWh/af. The water flows through the filters via gravity, thus no additional energy is required for treatment. The final energy requirement is 285 kWh/af for distribution with a total energy requirement of 490 kWh/af. This is the lowest grade of recycled water that WBWRF produces. Contrasting the Title 22 water, WBWRF produces RO water with a total energy requirement of 1,280 kWh/af. This includes 205 kWh/af for conveyance from Hyperion, 790 kWh/af for treatment with RO, and 285 kWh/af for distribution.

More than 210 South Bay sites use 9 billion gallons of West Basin's recycled water for applications including irrigation, industrial processes, indirect potable uses, and seawater barrier injection. West Basin has been successful in changing the perception of recycled water from merely a conservation tool with minimal applications to a cost-effective business tool that can reduce costs and improve reliability.

Local oil refineries are major customers for West Basin's recycled water. The Chevron Refinery in El Segundo, the Exxon-Mobile refinery in Torrance, and the BP refinery in Carson use recycled water for cooling towers and in the boiler feed systems.

Ocean Water Desalination Development

Desalination technologies are in use around the world. A number of approaches work well and produce high quality water. Many workable and proven technology options are available to remove salt from water. During World War Two, desalination technology was developed as a water source for military operations.[34] Grand plans for nuclear-driven desalination systems in California were drawn up after the war, but they were never implemented due to cost and feasibility problems.

Desalination techniques range from distillation to "reverse osmosis" (RO) technologies. Current applications around the world are dominated by the "multistage flash distillation" process (at about 44% of the world's applications), and RO, (at about 42%).[35] Other desalting technologies include electrodialysis (6%), vapor compression (4%), multi-effect distillation (4%), and membrane softening (2%) to remove salts.[36] All of the ocean desalination projects currently in place or proposed for municipal water supply in California employ RO technology.

Reverse Osmosis Membranes

A recent inventory of desalination facilities world-wide indicated that as of the beginning of 1998, a total of 12,451 desalting units with a total capacity of 6.72 afy[37] had been installed or contracted worldwide.[38] (Note that *capacity* does not indicate actual operation.) Non-seawater desalination plants have a capacity 7,620 af/d[39], whereas the seawater desalination plant capacity reached 10,781af/d.[40]

Desalination systems are being used in over 100 countries, but 10 countries are responsible for 75 percent of the capacity.[41] Almost half of the desalting capacity is used to desalt seawater in the Middle East and North Africa. Saudi Arabia ranks first in total capacity (about 24 percent of the world's capacity) followed by the United Arab Emirates and Kuwait, with most of the capacity being made up of seawater desalting units that use the distillation process.[42]

The salinity of ocean water varies, with the average generally exceeding 30 grams per liter (g/l).[43] The Pacific Ocean is 34-38 g/l, the Atlantic Ocean averages about 35 g/l, and the Persian Gulf is 45 g/l. Brackish water drops to 0.5 to 3.0 g/l.[44] Potable water salt levels should be below 0.5 g/l.

Reducing salt levels from over 30 g/l to 0.5 g/l and lower (drinking water standards) using existing technologies requires considerable amounts of energy, either for thermal processes or for the pressure to drive water through extremely fine filters such as RO, or for some combination of thermal and pressure processes. Recent improvements in energy efficiency have reduced the amount of thermal and pumping energy required for the various processes, but high energy intensity is still an issue. The energy required is in part a function of the degree of salinity and the temperature of the water.

West Basin is in the process of developing plans to construct an ocean desalinating plant. Estimated energy requirements have been calculated by Gerry Filteau of Separation Processes, Inc for each step in the process.[45] The values presented for desalination are based on his work. Since the proposed plant will tap the source water at the power plant, there is no ocean intake pumping required. The source water is estimated to require 200 kWh/af this energy will bring ocean water from the power plant to the desalination system, approximately one quarter of a mile in distance. Pre-treatment of the source water is estimated at 341 kWh/af. This figure includes microfiltration and transfer to the RO units via a 5-10 micron cartridge filter. The RO process requires 2,686 kWh/af if operated at the most energy-efficient level. A slightly less efficient but more cost-effective level of operation would require 2,900 kWh/af, or 214 kWh/af additional energy input according to Filteau. Finally, an estimated 460 kWh/af is required to deliver the product water to the distribution system, including elevation gain, conveyance over distance, and pressurization to 90 psi. No additional energy is required to discharge the brine, as it flows back to the ocean outfall line by gravity.

The energy intensity figures presented here for desalination are lower than previous estimates. This is mainly due to improved membrane technologies, efficiency improvements for high pressure pumps, and pressure recovery systems. It should be noted that the figures provided here are based on engineering estimates, not on actual plant operations.

The total energy required to desalinate the ocean water, including each of the steps above, is estimated to be 3,687 kWh/af. If the energy intensity is increased slightly to improve cost-effectiveness, the total figure increases to 3,901 kWh/af.

Summary

This study examined the energy intensity of imported and local water supplies (ocean water, groundwater, and recycled water) for both potable and non-potable uses for West Basin. All water sources require pumping, treatment, and distribution. Differences in energy requirements arise from varying pumping, treatment, and distribution processes needed to produce water to meet appropriate standards for different uses.

The key findings of this study are: 1) the marginal energy required to treat and deliver recycled water is among the *least* energy intensive supply options available, 2) naturally recharged groundwater is low in energy intensity, though replenishment with imported water is not, and 3) current ocean desalination technology is getting close to the level of energy intensity of imported supplies.

Further refinement of the data in this study, such as applying an agency's own energy values, may provide a more accurate basis for decision-making tailored to a unique water system. The information presented, however, provides a reasonable basis for water managers to explore energy (and cost) benefits of increased use of local water sources, and it indicates that desalination of ocean water is getting close to the energy intensity of existing supplies.

Sources

[1] Water systems account for roughly 7% of California's electricity use: See Wilkinson, Robert C., 2000. Methodology For Analysis of The Energy Intensity of California's Water Systems, and an Assessment of Multiple Potential Benefits Through Integrated Water-Energy Efficiency Measures, Exploratory Research Project, Ernest Orlando Lawrence Berkeley Laboratory, California Institute for Energy Efficiency.

[2] California Energy Commission, 2005. *Integrated Energy Policy Report*, November 2005, CEC-100-2005-007-CMF.

[3] Franklin Burton, in a recent study for the Electric Power Research Institute (EPRI), includes the following elements in water systems: "Water systems involve the transportation of water from its source(s) of treatment plants, storage facilities, and the customer. Currently, most of the electricity used is for pumping; comparatively little is used in treatment. For most surface sources, treatment is required consisting usually of chemical addition, coagulation and settling, followed by filtration and disinfection. In the case of groundwater (well) systems, the treatment may consist only of disinfection with chlorine. In the future, however, implementation of new drinking water regulations will increase the use of higher energy consuming processes, such as ozone and membrane filtration." Burton, Franklin L., 1996, *Water and Wastewater Industries: Characteristics and Energy Management Opportunities*. (Burton Engineering) Los Altos, CA, Report CR-106941, Electric Power Research Institute Report, p.3-1.

[4] Wilkinson, Robert C., 2000. *Methodology For Analysis of The Energy Intensity of California's Water Systems, and an Assessment of Multiple Potential Benefits Through Integrated Water-Energy Efficiency Measures*, Exploratory Research Project, Ernest Orlando Lawrence Berkeley Laboratory, California Institute for Energy Efficiency.

[5] California Public Utilities Commission, Order Instituting Rulemaking Regarding to Examine the Commission's post-2005 Energy Efficiency Policies, Programs, Evaluation, Measurement and Verification, and Related Issues, Rulemaking 06-04-010 (Filed April 13, 2006)

[6] An AF of water is the volume of water that would cover one acre to a depth of one foot. An AF equals 325,851 gallons, or 43,560 cubic feet, or 1233.65 cubic meters.

[7] Metropolitan Water District of Southern California, *Integrated Resource Plan for Metropolitan's Colorado River Aqueduct Power Operations*, 1996, p.5.

[8] This schematic, based on the original analysis by Wilkinson (2000) has been refined and improved with input from Gary Wolff, Gary Klein, William Kost, and others. It is the basic approach reflected in the CEC IEPR and other analyses.

[9]QEI, Inc., 1992, *Electricity Efficiency Through Water Efficiency*, Report for the Southern California Edison Company, p. 24.

[10] Figures cited are *net* energy requirements (gross energy for pumping minus energy recovered through generation).

[11] Metropolitan Water District of Southern California, *Integrated Resource Plan for Metropolitan's Colorado River Aqueduct Power Operations*, 1996, p.5.

[12] Wilkinson, Robert C., 2000. *Methodology For Analysis of The Energy Intensity of California's Water Systems, and an Assessment of Multiple Potential Benefits Through Integrated Water-Energy Efficiency Measures*, Exploratory Research Project, Ernest Orlando Lawrence Berkeley Laboratory, California Institute for Energy Efficiency.

[13] California Department of Finance. California Statistical Abstract. Tables G-2, "Gross Capacities of Reservoirs by Hydrographic Region," and G-3 "Major Dams and Reservoirs of California." January 2001. (http://www.dof.ca.gov/html/fs_data/stat-abs/toc.htm)

[14] "The SWP, managed by the Department of Water Resources, is the largest state-built, multi-purpose water project in the country. Approximately 19 million of California's 32 million residents receive at least part of their water from the SWP. SWP water irrigates approximately 600,000 acres of farmland. The SWP was designed and built to deliver water, control floods, generate power, provide recreational opportunities, and enhance habitats for fish and wildlife." California Department of Water Resources, *Management of the California State Water Project*. Bulletin 132-96. p.xix.

[15] California Department of Water Resources, 1996, *Management of the California State Water Project*. Bulletin 132-96.p.xix.

[16] Three small reservoirs upstream of Lake Oroville — Lake Davis, Frenchman Lake, and Antelope Lake — are also SWP facilities. California Department of Water Resources, 1996, *Management of the California State Water Project*. Bulletin 132-96.

[17] California Department of Water Resources, 1996, *Management of the California State Water Project*. Bulletin 132-96. Power is generated at the Oroville Dam as water is released down the Feather River, which flows into the Sacramento River, through the Sacramento-San Joaquin Delta, and to the ocean through the San Francisco Bay.

[18] The North Bay Aqueduct was completed in 1988. (California Department of Water Resources, 1996, *Management of the California State Water Project*. Bulletin 132-96.)

[19] The South Bay Aqueduct provided initial deliveries for Alameda and Santa Clara counties in 1962 and has been fully operational since 1965. (California Department of Water Resources, 1996, *Management of the California State Water Project*. Bulletin 132-96.)

[20] Carrie Anderson, 1999, "Energy Use in the Supply, Use and Disposal of Water in California", Process Energy Group, Energy Efficiency Division, California Energy Commission, p.1.

[21] Average deliveries for 1980-89 were just under 2.0 mafy, deliveries for 1990-99 were just over 2.0 mafy. There is disagreement regarding the ability of the SWP to deliver the roughly 4.2 mafy that has been contracted for.

[22] According to MWD, "Metropolitan's annual dependable supply from the Colorado River is approximately 656,000 AF -- about 550,000 AF of entitlement and at least 106,000 AF obtained through a conservation program Metropolitan funds in the Imperial Irrigation District in the southeast corner of the state. However, Metropolitan has been allowed to take up to 1.3 maf of river water a year by diverting either surplus water or the unused portions of other agencies' apportionments." Metropolitan Water District of Southern California, 1999, "Fact Sheet" at: http://www.mwd.dst.ca.us/docs/fctsheet.htm.

[23] Metropolitan Water District of Southern California, 1999, http://www.mwd.dst.ca.us/pr/powres/summ.htm.

[24] The five pumping plants each have nine pumps. The plants are designed for a maximum flow of 225 cubic feet per second (cfs). The CRA is designed to operate at full capacity with eight pumps in operation at each plant (1800 cfs). The ninth pump operates as a spare to facilitating maintenance, emergency operations, and repairs. Metropolitan Water District of Southern California, 1999, Colorado River Aqueduct: http://aqueduct.mwd.dst.ca.us/areas/desert.htm, 08/01/99.

[25] Metropolitan Water District of Southern California, 1996, "Integrated Resource Plan for Metropolitan's Colorado River Aqueduct Power Operations", 1996, p.5.

[26] Metropolitan Water District of Southern California, 1999, "Summary of Metropolitan's Power Operation". February, 1999, p.1, http://aqueduct.mwd.dst.ca.us/areas/desert.htm.

[27] Metropolitan Water District of Southern California, 1999, http://www.mwd.dst.ca.us/pr/powres/summ.htm. MWD provides further important system information as follows: Metropolitan owns and operates 305 miles of 230 kV transmission lines from the Mead Substation in southern Nevada. The transmission system is used to deliver power from Hoover and Parker to the CRA pumps. Additionally, Mead is the primary interconnection point for Metropolitan's economy energy purchases. Metropolitan's transmission system is interconnected with several utilities at multiple

interconnection points. Metropolitan's CRA lies within Edison's control area. Resources for the load are contractually integrated with Edison's system pursuant to a Service and Interchange Agreement (Agreement), which terminates in 2017. Hoover and Parker resources provide spinning reserves and ramping capability, as well as peaking capacity and energy to Edison, thereby displacing higher cost alternative resources. Edison, in turn, provides Metropolitan with exchange energy, replacement capacity, supplemental power, dynamic control and use of Edison's transmission system.

[28] SB 672, Machado, 2001. California Water Plan: Urban Water Management Plans. (The law amended Section 10620 of, and adds Section 10013 to, the Water Code) September 2001.

[29] SEC. 2. Section 10013 to the Water Code, 10013. (a) SB 672, Machado. California Water Plan: Urban Water Management Plans. September 2001, (Emphasis added.)

[30] California Department of Water Resources, 2005. California Water Plan Update 2005. Bulletin 160-05, California Department of Water Resources, Sacramento, CA.

[31] Metropolitan Water District of Southern California, 2000. *The Regional Urban Water Management Plan for the Metropolitan Water District of Southern California*, p.A.2-3.

[32] "About 1.36 maf per year (34 percent) of the region's average supply is developed locally using groundwater basins and surface reservoirs and diversions to capture natural runoff." Metropolitan Water District of Southern California, 1996, "Integrated Resource Plan for Metropolitan's Colorado River Aqueduct Power Operations", 1996, Vol.1, p.1-2.

[33] MWD estimates that reclaimed water will ultimately produce 190,000 AF of water annually. Metropolitan Water District of Southern California, 1999, "Fact Sheet" at: http://www.mwd.dst.ca.us/docs/fctsheet.htm.

[34] Buros notes that "American government, through creation and funding of the Office of Saline Water (OSW) in the early 1960s and its successor organizations like the Office of Water Research and echnology (OWRT), made one of the most concentrated efforts to develop the desalting industry. The American government actively funded research and development for over 30 years, spending about $300 million in the process. This money helped to provide much of the basic investigation of the different technologies for desalting sea and brackish waters." Buros, O.K., 2000. *The ABCs of Desalting, International Desalination Association*, Topfield, Massachusetts, p.5. This very useful summary is available at http://www.ida.bm/PDFS/Publications/ABCs.pdf

[35] Buros, O.K., 2000. *The ABCs of Desalting, International Desalination Association*, Topfield, Massachusetts, p.5. This very useful summary is available at http://www.ida.bm/PDFS/Publications/ABCs.pdf See also; Buros et al.1980. *The USAID Desalination Manual.* Produced by CH2M HILL International for the U.S. Agency for International Development.

[36] Wangnick,Klaus.1998 *IDA Worldwide Desalting Plants Inventory Report No.15.*Produced by Wangnick Consulting for International Desalination Association; and Buros, O.K., 2000. *The ABCs of Desalting, International Desalination Association*, Topfield, Massachusetts, p.5.

[37] Desalination systems with a unit size of 100 m3/d or more. Figures in original cited as 6,000 mgd.

[38] Wangnick Consulting GMBH (http://www.wangnick.com) maintains a permanent desalting plants inventory and publishes the results biennially in co-operation with the International Desalination Association, as the IDA Worldwide Desalting Plants Inventory Report. Thus far, fifteen reports have been published, with the latest report having data through the end of 1997; and see Wangnick,Klaus.*1998 IDA Worldwide Desalting Plants Inventory Report No.15.*Produced by Wangnick Consulting for International Desalination Association. The data cited are as of December 31, 1997.

[39] Cited in original as 9,400,000 m3/d.

[40] Wangnick,Klaus.*1998 IDA Worldwide Desalting Plants Inventory Report No.15.*Produced by Wangnick Consulting for International Desalination Association. (Cited in original in m3d (13,300,000 m3/d).

[41] Wangnick,Klaus.1998 *IDA Worldwide Desalting Plants Inventory Report No.15.*Produced by Wangnick Consulting for International Desalination Association; and Buros, O.K., 2000. *The ABCs of Desalting, International Desalination Association*, Topfield, Massachusetts. The United States ranks second in over-all capacity (16 %) with most of the capacity in the RO process used to treat brackish water. The largest plant, at Yuma, Arizona, is not in use.

[42] Wangnick,Klaus.1998. *IDA Worldwide Desalting Plants Inventory Report No.15.* Produced by Wangnick Consulting for International Desalination Association; and Buros, O.K., 2000. *The ABCs of Desalting, International Desalination Association*, Topfield, Massachusetts.

[43] Salinity levels referenced in metric units.

[44] OTV. 1999. "Desalinating seawater." Memotechnique, Planete Technical Section, No. 31 (February), p.1; and Gleick, Peter H. 2000. *The World's Water: 2000-2001*, Island Press, Covelo, p.94.

[45] Gerry Filteau, Separation Processes, Inc., 2386 Faraday Ave., Suite 100, Calsbad, CA 92008, www.spi-engineering.com

Appendix I

Technical Support Document

Technical Support Document: -
Social Cost of Carbon for Regulatory Impact Analysis -
Under Executive Order 12866 -

Interagency Working Group on Social Cost of Carbon, United States Government

With participation by

Council of Economic Advisers
Council on Environmental Quality
Department of Agriculture
Department of Commerce
Department of Energy
Department of Transportation
Environmental Protection Agency
National Economic Council
Office of Energy and Climate Change
Office of Management and Budget
Office of Science and Technology Policy
Department of the Treasury

February 2010

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February 2010

Executive Summary

Under Executive Order 12866, agencies are required, to the extent permitted by law, "to assess both the costs and the benefits of the intended regulation and, recognizing that some costs and benefits are difficult to quantify, propose or adopt a regulation only upon a reasoned determination that the benefits of the intended regulation justify its costs." The purpose of the "social cost of carbon" (SCC) estimates presented here is to allow agencies to incorporate the social benefits of reducing carbon dioxide (CO_2) emissions into cost-benefit analyses of regulatory actions that have small, or "marginal," impacts on cumulative global emissions. The estimates are presented with an acknowledgement of the many uncertainties involved and with a clear understanding that they should be updated over time to reflect increasing knowledge of the science and economics of climate impacts.

The SCC is an estimate of the monetized damages associated with an incremental increase in carbon emissions in a given year. It is intended to include (but is not limited to) changes in net agricultural productivity, human health, property damages from increased flood risk, and the value of ecosystem services due to climate change.

This document presents a summary of the interagency process that developed these SCC estimates. Technical experts from numerous agencies met on a regular basis to consider public comments, explore the technical literature in relevant fields, and discuss key model inputs and assumptions. The main objective of this process was to develop a range of SCC values using a defensible set of input assumptions grounded in the existing scientific and economic literatures. In this way, key uncertainties and model differences transparently and consistently inform the range of SCC estimates used in the rulemaking process.

The interagency group selected four SCC values for use in regulatory analyses. Three values are based on the average SCC from three integrated assessment models, at discount rates of 2.5, 3, and 5 percent. The fourth value, which represents the 95th percentile SCC estimate across all three models at a 3 percent discount rate, is included to represent higher-than-expected impacts from temperature change further out in the tails of the SCC distribution.

Social Cost of CO_2, 2010 – 2050 (in 2007 dollars)

Discount Rate Year	5% Avg	3% Avg	2.5% Avg	3% 95th
2010	4.7	21.4	35.1	64.9
2015	5.7	23.8	38.4	72.8
2020	6.8	26.3	41.7	80.7
2025	8.2	29.6	45.9	90.4
2030	9.7	32.8	50.0	100.0
2035	11.2	36.0	54.2	109.7
2040	12.7	39.2	58.4	119.3
2045	14.2	42.1	61.7	127.8
2050	15.7	44.9	65.0	136.2

I. Monetizing Carbon Dioxide Emissions

The "social cost of carbon" (SCC) is an estimate of the monetized damages associated with an incremental increase in carbon emissions in a given year. It is intended to include (but is not limited to) changes in net agricultural productivity, human health, property damages from increased flood risk, and the value of ecosystem services. We report estimates of the social cost of carbon in dollars per metric ton of carbon dioxide throughout this document.[1]

When attempting to assess the incremental economic impacts of carbon dioxide emissions, the analyst faces a number of serious challenges. A recent report from the National Academies of Science (NRC 2009) points out that any assessment will suffer from uncertainty, speculation, and lack of information about (1) future emissions of greenhouse gases, (2) the effects of past and future emissions on the climate system, (3) the impact of changes in climate on the physical and biological environment, and (4) the translation of these environmental impacts into economic damages. As a result, any effort to quantify and monetize the harms associated with climate change will raise serious questions of science, economics, and ethics and should be viewed as provisional.

Despite the serious limits of both quantification and monetization, SCC estimates can be useful in estimating the social benefits of reducing carbon dioxide emissions. Under Executive Order 12866, agencies are required, to the extent permitted by law, "to assess both the costs and the benefits of the intended regulation and, recognizing that some costs and benefits are difficult to quantify, propose or adopt a regulation only upon a reasoned determination that the benefits of the intended regulation justify its costs." The purpose of the SCC estimates presented here is to make it possible for agencies to incorporate the social benefits from reducing carbon dioxide emissions into cost-benefit analyses of regulatory actions that have small, or "marginal," impacts on cumulative global emissions. Most federal regulatory actions can be expected to have marginal impacts on global emissions.

For such policies, the benefits from reduced (or costs from increased) emissions in any future year can be estimated by multiplying the change in emissions in that year by the SCC value appropriate for that year. The net present value of the benefits can then be calculated by multiplying each of these future benefits by an appropriate discount factor and summing across all affected years. This approach assumes that the marginal damages from increased emissions are constant for small departures from the baseline emissions path, an approximation that is reasonable for policies that have effects on emissions that are small relative to cumulative global carbon dioxide emissions. For policies that have a large (non-marginal) impact on global cumulative emissions, there is a separate question of whether the SCC is an appropriate tool for calculating the benefits of reduced emissions; we do not attempt to answer that question here.

An interagency group convened on a regular basis to consider public comments, explore the technical literature in relevant fields, and discuss key inputs and assumptions in order to generate SCC estimates. Agencies that actively participated in the interagency process include the Environmental Protection

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[1] In this document, we present all values of the SCC as the cost per metric ton of CO_2 emissions. Alternatively, one could report the SCC as the cost per metric ton of carbon emissions. The multiplier for translating between mass of CO_2 and the mass of carbon is 3.67 (the molecular weight of CO_2 divided by the molecular weight of carbon = 44/12 = 3.67).

Agency, and the Departments of Agriculture, Commerce, Energy, Transportation, and Treasury. This process was convened by the Council of Economic Advisers and the Office of Management and Budget, with active participation and regular input from the Council on Environmental Quality, National Economic Council, Office of Energy and Climate Change, and Office of Science and Technology Policy. The main objective of this process was to develop a range of SCC values using a defensible set of input assumptions that are grounded in the existing literature. In this way, key uncertainties and model differences can more transparently and consistently inform the range of SCC estimates used in the rulemaking process.

The interagency group selected four SCC estimates for use in regulatory analyses. For 2010, these estimates are $5, $21, $35, and $65 (in 2007 dollars). The first three estimates are based on the average SCC across models and socio-economic and emissions scenarios at the 5, 3, and 2.5 percent discount rates, respectively. The fourth value is included to represent the higher-than-expected impacts from temperature change further out in the tails of the SCC distribution. For this purpose, we use the SCC value for the 95^{th} percentile at a 3 percent discount rate. The central value is the average SCC across models at the 3 percent discount rate. For purposes of capturing the uncertainties involved in regulatory impact analysis, we emphasize the importance and value of considering the full range. These SCC estimates also grow over time. For instance, the central value increases to $24 per ton of CO_2 in 2015 and $26 per ton of CO_2 in 2020. See Appendix A for the full range of annual SCC estimates from 2010 to 2050.

It is important to emphasize that the interagency process is committed to updating these estimates as the science and economic understanding of climate change and its impacts on society improves over time. Specifically, we have set a preliminary goal of revisiting the SCC values within two years or at such time as substantially updated models become available, and to continue to support research in this area. In the meantime, we will continue to explore the issues raised in this document and consider public comments as part of the ongoing interagency process.

II. Social Cost of Carbon Values Used in Past Regulatory Analyses

To date, economic analyses for Federal regulations have used a wide range of values to estimate the benefits associated with reducing carbon dioxide emissions. In the final model year 2011 CAFE rule, the Department of Transportation (DOT) used both a "domestic" SCC value of $2 per ton of CO_2 and a "global" SCC value of $33 per ton of CO_2 for 2007 emission reductions (in 2007 dollars), increasing both values at 2.4 percent per year. It also included a sensitivity analysis at $80 per ton of CO_2. A domestic SCC value is meant to reflect the value of damages in the United States resulting from a unit change in carbon dioxide emissions, while a global SCC value is meant to reflect the value of damages worldwide.

A 2008 regulation proposed by DOT assumed a domestic SCC value of $7 per ton CO_2 (in 2006 dollars) for 2011 emission reductions (with a range of $0-$14 for sensitivity analysis), also increasing at 2.4 percent per year. A regulation finalized by DOE in October of 2008 used a domestic SCC range of $0 to $20 per ton CO_2 for 2007 emission reductions (in 2007 dollars). In addition, EPA's 2008 Advance Notice of Proposed Rulemaking for Greenhouse Gases identified what it described as "very preliminary" SCC estimates subject to revision. EPA's global mean values were $68 and $40 per ton CO_2 for discount rates of approximately 2 percent and 3 percent, respectively (in 2006 dollars for 2007 emissions).

In 2009, an interagency process was initiated to offer a preliminary assessment of how best to quantify the benefits from reducing carbon dioxide emissions. To ensure consistency in how benefits are evaluated across agencies, the Administration sought to develop a transparent and defensible method, specifically designed for the rulemaking process, to quantify avoided climate change damages from reduced CO_2 emissions. The interagency group did not undertake any original analysis. Instead, it combined SCC estimates from the existing literature to use as interim values until a more comprehensive analysis could be conducted.

The outcome of the preliminary assessment by the interagency group was a set of five interim values: global SCC estimates for 2007 (in 2006 dollars) of $55, $33, $19, $10, and $5 per ton of CO_2. The $33 and $5 values represented model-weighted means of the published estimates produced from the most recently available versions of three integrated assessment models—DICE, PAGE, and FUND—at approximately 3 and 5 percent discount rates. The $55 and $10 values were derived by adjusting the published estimates for uncertainty in the discount rate (using factors developed by Newell and Pizer (2003)) at 3 and 5 percent discount rates, respectively. The $19 value was chosen as a central value between the $5 and $33 per ton estimates. All of these values were assumed to increase at 3 percent annually to represent growth in incremental damages over time as the magnitude of climate change increases.

These interim values represent the first sustained interagency effort within the U.S. government to develop an SCC for use in regulatory analysis. The results of this preliminary effort were presented in several proposed and final rules and were offered for public comment in connection with proposed rules, including the joint EPA-DOT fuel economy and CO_2 tailpipe emission proposed rules.

III. Approach and Key Assumptions

Since the release of the interim values, interagency group has reconvened on a regular basis to generate improved SCC estimates. Specifically, the group has considered public comments and further explored the technical literature in relevant fields. This section details the several choices and assumptions that underlie the resulting estimates of the SCC.

It is important to recognize that a number of key uncertainties remain, and that current SCC estimates should be treated as provisional and revisable since they will evolve with improved scientific and economic understanding. The interagency group also recognizes that the existing models are imperfect and incomplete. The National Academy of Science (2009) points out that there is tension between the goal of producing quantified estimates of the economic damages from an incremental ton of carbon and the limits of existing efforts to model these effects. Throughout this document, we highlight a number of concerns and problems that should be addressed by the research community, including research programs housed in many of the agencies participating in the interagency process to estimate the SCC.

The U.S. Government will periodically review and reconsider estimates of the SCC used for cost-benefit analyses to reflect increasing knowledge of the science and economics of climate impacts, as well as improvements in modeling. In this context, statements recognizing the limitations of the analysis and calling for further research take on exceptional significance. The interagency group offers the new SCC values with all due humility about the uncertainties embedded in them and with a sincere promise to continue work to improve them.

A. Integrated Assessment Models

We rely on three integrated assessment models (IAMs) commonly used to estimate the SCC: the FUND, DICE, and PAGE models.[2] These models are frequently cited in the peer-reviewed literature and used in the IPCC assessment. Each model is given equal weight in the SCC values developed through this process, bearing in mind their different limitations (discussed below).

These models are useful because they combine climate processes, economic growth, and feedbacks between the climate and the global economy into a single modeling framework. At the same time, they gain this advantage at the expense of a more detailed representation of the underlying climatic and economic systems. DICE, PAGE, and FUND all take stylized, reduced-form approaches (see NRC 2009 for a more detailed discussion; see Nordhaus 2008 on the possible advantages of this approach). Other IAMs may better reflect the complexity of the science in their modeling frameworks but do not link physical impacts to economic damages. There is currently a limited amount of research linking climate impacts to economic damages, which makes this exercise even more difficult. Underlying the three IAMs selected for this exercise are a number of simplifying assumptions and judgments reflecting the various modelers' best attempts to synthesize the available scientific and economic research characterizing these relationships.

The three IAMs translate emissions into changes in atmospheric greenhouse concentrations, atmospheric concentrations into changes in temperature, and changes in temperature into economic damages. The emissions projections used in the models are based on specified socio-economic (GDP and population) pathways. These emissions are translated into concentrations using the carbon cycle built into each model, and concentrations are translated into warming based on each model's simplified representation of the climate and a key parameter, climate sensitivity. Each model uses a different approach to translate warming into damages. Finally, transforming the stream of economic damages over time into a single value requires judgments about how to discount them.

Each model takes a slightly different approach to model how changes in emissions result in changes in economic damages. In PAGE, for example, the consumption-equivalent damages in each period are calculated as a fraction of GDP, depending on the temperature in that period relative to the pre-industrial average temperature in each region. In FUND, damages in each period also depend on the rate of temperature change from the prior period. In DICE, temperature affects both consumption and investment. We describe each model in greater detail here. In a later section, we discuss key gaps in how the models account for various scientific and economic processes (e.g. the probability of catastrophe, and the ability to adapt to climate change and the physical changes it causes).

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[2] The DICE (Dynamic Integrated Climate and Economy) model by William Nordhaus evolved from a series of energy models and was first presented in 1990 (Nordhaus and Boyer 2000, Nordhaus 2008). The PAGE (Policy Analysis of the Greenhouse Effect) model was developed by Chris Hope in 1991 for use by European decision-makers in assessing the marginal impact of carbon emissions (Hope 2006, Hope 2008). The FUND (Climate Framework for Uncertainty, Negotiation, and Distribution) model, developed by Richard Tol in the early 1990s, originally to study international capital transfers in climate policy. is now widely used to study climate impacts (e.g., Tol 2002a, Tol 2002b, Anthoff et al. 2009, Tol 2009).

The parameters and assumptions embedded in the three models vary widely. A key objective of the interagency process was to enable a consistent exploration of the three models while respecting the different approaches to quantifying damages taken by the key modelers in the field. An extensive review of the literature was conducted to select three sets of input parameters for these models: climate sensitivity, socio-economic and emissions trajectories, and discount rates. A probability distribution for climate sensitivity was specified as an input into all three models. In addition, the interagency group used a range of scenarios for the socio-economic parameters and a range of values for the discount rate. All other model features were left unchanged, relying on the model developers' best estimates and judgments. In DICE, these parameters are handled deterministically and represented by fixed constants; in PAGE, most parameters are represented by probability distributions. FUND was also run in a mode in which parameters were treated probabilistically.

The sensitivity of the results to other aspects of the models (e.g. the carbon cycle or damage function) is also important to explore in the context of future revisions to the SCC but has not been incorporated into these estimates. Areas for future research are highlighted at the end of this document.

The DICE Model

The DICE model is an optimal growth model based on a global production function with an extra stock variable (atmospheric carbon dioxide concentrations). Emission reductions are treated as analogous to investment in "natural capital." By investing in natural capital today through reductions in emissions—implying reduced consumption—harmful effects of climate change can be avoided and future consumption thereby increased.

For purposes of estimating the SCC, carbon dioxide emissions are a function of global GDP and the carbon intensity of economic output, with the latter declining over time due to technological progress. The DICE damage function links global average temperature to the overall impact on the world economy. It varies quadratically with temperature change to capture the more rapid increase in damages expected to occur under more extreme climate change, and is calibrated to include the effects of warming on the production of market and nonmarket goods and services. It incorporates impacts on agriculture, coastal areas (due to sea level rise), "other vulnerable market sectors" (based primarily on changes in energy use), human health (based on climate-related diseases, such as malaria and dengue fever, and pollution), non-market amenities (based on outdoor recreation), and human settlements and ecosystems. The DICE damage function also includes the expected value of damages associated with low probability, high impact "catastrophic" climate change. This last component is calibrated based on a survey of experts (Nordhaus 1994). The expected value of these impacts is then added to the other market and non-market impacts mentioned above.

No structural components of the DICE model represent adaptation explicitly, though it is included implicitly through the choice of studies used to calibrate the aggregate damage function. For example, its agricultural impact estimates assume that farmers can adjust land use decisions in response to changing climate conditions, and its health impact estimates assume improvements in healthcare over time. In addition, the small impacts on forestry, water systems, construction, fisheries, and outdoor recreation imply optimistic and costless adaptation in these sectors (Nordhaus and Boyer, 2000; Warren et al., 2006). Costs of resettlement due to sea level rise are incorporated into damage estimates, but their magnitude is not clearly reported. Mastrandrea's (2009) review concludes that "in general, DICE assumes very effective adaptation, and largely ignores adaptation costs."

Note that the damage function in DICE has a somewhat different meaning from the damage functions in FUND and PAGE. Because GDP is endogenous in DICE and because damages in a given year reduce investment in that year, damages propagate forward in time and reduce GDP in future years. In contrast, GDP is exogenous in FUND and PAGE, so damages in any given year do not propagate forward.[3]

The PAGE Model

PAGE2002 (version 1.4epm) treats GDP growth as exogenous. It divides impacts into economic, non-economic, and catastrophic categories and calculates these impacts separately for eight geographic regions. Damages in each region are expressed as a fraction of output, where the fraction lost depends on the temperature change in each region. Damages are expressed as power functions of temperature change. The exponents of the damage function are the same in all regions but are treated as uncertain, with values ranging from 1 to 3 (instead of being fixed at 2 as in DICE).

PAGE2002 includes the consequences of catastrophic events in a separate damage sub-function. Unlike DICE, PAGE2002 models these events probabilistically. The probability of a "discontinuity" (i.e., a catastrophic event) is assumed to increase with temperature above a specified threshold. The threshold temperature, the rate at which the probability of experiencing a discontinuity increases above the threshold, and the magnitude of the resulting catastrophe are all modeled probabilistically.

Adaptation is explicitly included in PAGE. Impacts are assumed to occur for temperature increases above some tolerable level (2°C for developed countries and 0°C for developing countries for economic impacts, and 0°C for all regions for non-economic impacts), but adaptation is assumed to reduce these impacts. Default values in PAGE2002 assume that the developed countries can ultimately eliminate up to 90 percent of all economic impacts beyond the tolerable 2°C increase and that developing countries can eventually eliminate 50 percent of their economic impacts. All regions are assumed to be able to mitigate 25 percent of the non-economic impacts through adaptation (Hope 2006).

The FUND Model

Like PAGE, the FUND model treats GDP growth as exogenous. It includes separately calibrated damage functions for eight market and nonmarket sectors: agriculture, forestry, water, energy (based on heating and cooling demand), sea level rise (based on the value of land lost and the cost of protection),

[3] Using the default assumptions in DICE 2007, this effect generates an approximately 25 percent increase in the SCC relative to damages calculated by fixing GDP. In DICE2007, the time path of GDP is endogenous. Specifically, the path of GDP depends on the rate of saving and level of abatement in each period chosen by the optimizing representative agent in the model. We made two modifications to DICE to make it consistent with EMF GDP trajectories (see next section): we assumed a fixed rate of savings of 20%, and we re-calibrated the exogenous path of total factor productivity so that DICE would produce GDP projections in the absence of warming that exactly matched the EMF scenarios.

ecosystems, human health (diarrhea, vector-borne diseases, and cardiovascular and respiratory mortality), and extreme weather. Each impact sector has a different functional form, and is calculated separately for sixteen geographic regions. In some impact sectors, the fraction of output lost or gained due to climate change depends not only on the absolute temperature change but also on the rate of temperature change and level of regional income.[4] In the forestry and agricultural sectors, economic damages also depend on CO_2 concentrations.

Tol (2009) discusses impacts not included in FUND, noting that many are likely to have a relatively small effect on damage estimates (both positive and negative). However, he characterizes several omitted impacts as "big unknowns": for instance, extreme climate scenarios, biodiversity loss, and effects on economic development and political violence. With regard to potentially catastrophic events, he notes, "Exactly what would cause these sorts of changes or what effects they would have are not well-understood, although the chance of any one of them happening seems low. But they do have the potential to happen relatively quickly, and if they did, the costs could be substantial. Only a few studies of climate change have examined these issues."

Adaptation is included both implicitly and explicitly in FUND. Explicit adaptation is seen in the agriculture and sea level rise sectors. Implicit adaptation is included in sectors such as energy and human health, where wealthier populations are assumed to be less vulnerable to climate impacts. For example, the damages to agriculture are the sum of three effects: (1) those due to the rate of temperature change (damages are always positive); (2) those due to the level of temperature change (damages can be positive or negative depending on region and temperature); and (3) those from CO_2 fertilization (damages are generally negative but diminishing to zero).

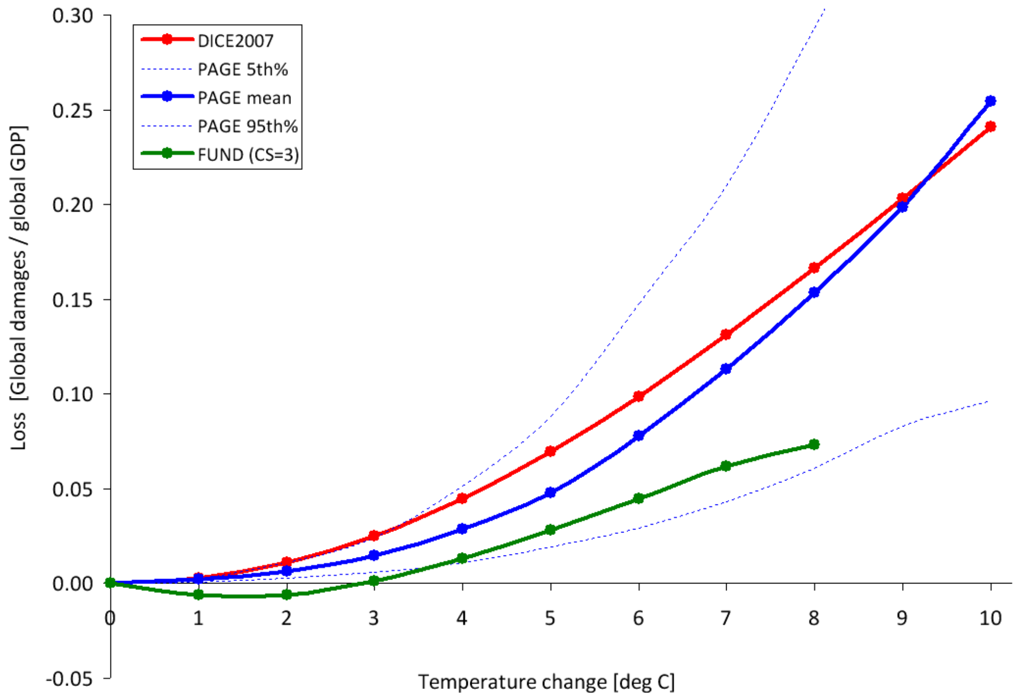
Adaptation is incorporated into FUND by allowing damages to be smaller if climate change happens more slowly. The combined effect of CO_2 fertilization in the agricultural sector, positive impacts to some regions from higher temperatures, and sufficiently slow increases in temperature across these sectors can result in negative economic damages from climate change.

Damage Functions

To generate revised SCC values, we rely on the IAM modelers' current best judgments of how to represent the effects of climate change (represented by the increase in global-average surface temperature) on the consumption-equivalent value of both market and non-market goods (represented as a fraction of global GDP). We recognize that these representations are incomplete and highly uncertain. But given the paucity of data linking the physical impacts to economic damages, we were not able to identify a better way to translate changes in climate into net economic damages, short of launching our own research program.

[4] In the deterministic version of FUND, the majority of damages are attributable to increased air conditioning demand, while reduced cold stress in Europe, North America, and Central and East Asia results in health benefits in those regions at low to moderate levels of warming (Warren et al., 2006).

Figure 1A: Annual Consumption Loss as a Fraction of Global GDP in 2100 Due to an Increase in Annual - Global Temperature in the DICE, FUND, and PAGE models[5]



The damage functions for the three IAMs are presented in Figures 1A and 1B, using the modeler's default scenarios and mean input assumptions. There are significant differences between the three models both at lower (figure 1B) and higher (figure 1A) increases in global-average temperature.

The lack of agreement among the models at lower temperature increases is underscored by the fact that the damages from FUND are well below the 5th percentile estimated by PAGE, while the damages estimated by DICE are roughly equal to the 95th percentile estimated by PAGE. This is significant because at higher discount rates we expect that a greater proportion of the SCC value is due to damages in years with lower temperature increases. For example, when the discount rate is 2.5 percent, about 45 percent of the 2010 SCC value in DICE is due to damages that occur in years when the temperature is less than or equal to 3 °C. This increases to approximately 55 percent and 80 percent at discount rates of 3 and 5 percent, respectively.

These differences underscore the need for a thorough review of damage functions—in particular, how the models incorporate adaptation, technological change, and catastrophic damages. Gaps in the literature make modifying these aspects of the models challenging, which highlights the need for additional research. As knowledge improves, the Federal government is committed to exploring how these (and other) models can be modified to incorporate more accurate estimates of damages.

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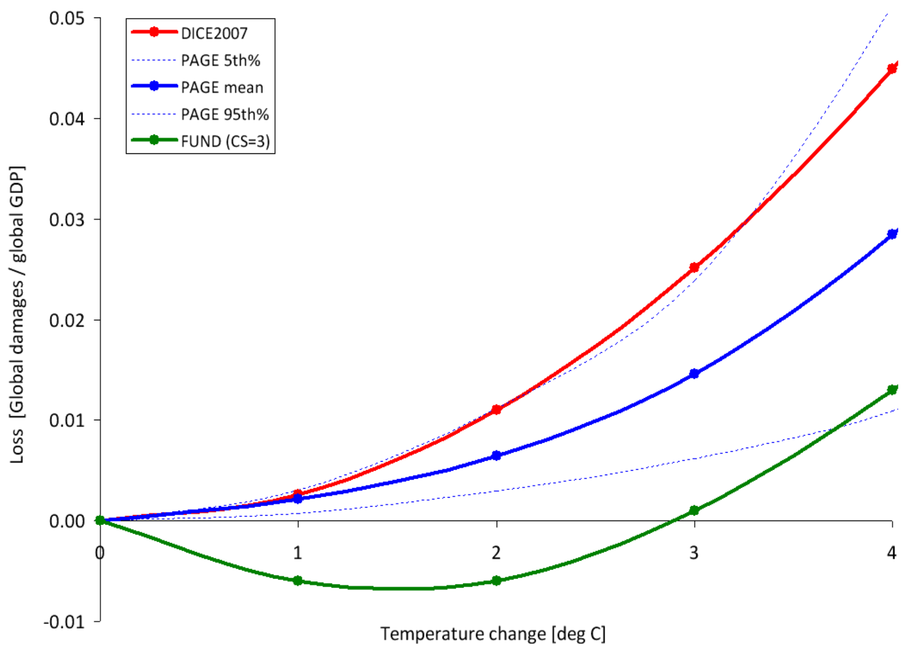
[5] The x-axis represents increases in annual, rather than equilibrium, temperature, while the y-axis represents the annual stream of benefits as a share of global GDP. Each specific combination of climate sensitivity, socio-economic, and emissions parameters will produce a different realization of damages for each IAM. The damage functions represented in Figures 1A and 1B are the outcome of default assumptions. For instance, under alternate assumptions, the damages from FUND may cross from negative to positive at less than or greater than 3 °C.

Figure 1B: Annual Consumption Loss for Lower Temperature Changes in DICE, FUND, and PAGE -



B. Global versus Domestic Measures of SCC

Because of the distinctive nature of the climate change problem, we center our current attention on a global measure of SCC. This approach is the same as that taken for the interim values, but it otherwise represents a departure from past practices, which tended to put greater emphasis on a domestic measure of SCC (limited to impacts of climate change experienced within U.S. borders). As a matter of law, consideration of both global and domestic values is generally permissible; the relevant statutory provisions are usually ambiguous and allow selection of either measure.[6]

Global SCC

Under current OMB guidance contained in Circular A-4, analysis of economically significant proposed and final regulations from the domestic perspective is required, while analysis from the international perspective is optional. However, the climate change problem is highly unusual in at least two respects. First, it involves a global externality: emissions of most greenhouse gases contribute to damages around the world even when they are emitted in the United States. Consequently, to address the global nature of the problem, the SCC must incorporate the full (global) damages caused by GHG emissions. Second, climate change presents a problem that the United States alone cannot solve. Even if the United States were to reduce its greenhouse gas emissions to zero, that step would be far from enough to avoid substantial climate change. Other countries would also need to take action to reduce emissions if

[6] It is true that federal statutes are presumed not to have extraterritorial effect, in part to ensure that the laws of the United States respect the interests of foreign sovereigns. But use of a global measure for the SCC does not give extraterritorial effect to federal law and hence does not intrude on such interests.

significant changes in the global climate are to be avoided. Emphasizing the need for a global solution to a global problem, the United States has been actively involved in seeking international agreements to reduce emissions and in encouraging other nations, including emerging major economies, to take significant steps to reduce emissions. When these considerations are taken as a whole, the interagency group concluded that a global measure of the benefits from reducing U.S. emissions is preferable.

When quantifying the damages associated with a change in emissions, a number of analysts (e.g., Anthoff, et al. 2009a) employ "equity weighting" to aggregate changes in consumption across regions. This weighting takes into account the relative reductions in wealth in different regions of the world. A per-capita loss of $500 in GDP, for instance, is weighted more heavily in a country with a per-capita GDP of $2,000 than in one with a per-capita GDP of $40,000. The main argument for this approach is that a loss of $500 in a poor country causes a greater reduction in utility or welfare than does the same loss in a wealthy nation. Notwithstanding the theoretical claims on behalf of equity weighting, the interagency group concluded that this approach would not be appropriate for estimating a SCC value used in domestic regulatory analysis.[7] For this reason, the group concluded that using the global (rather than domestic) value, without equity weighting, is the appropriate approach.

Domestic SCC

As an empirical matter, the development of a domestic SCC is greatly complicated by the relatively few region- or country-specific estimates of the SCC in the literature. One potential source of estimates comes from the FUND model. The resulting estimates suggest that the ratio of domestic to global benefits of emission reductions varies with key parameter assumptions. For example, with a 2.5 or 3 percent discount rate, the U.S. benefit is about 7-10 percent of the global benefit, on average, across the scenarios analyzed. Alternatively, if the fraction of GDP lost due to climate change is assumed to be similar across countries, the domestic benefit would be proportional to the U.S. share of global GDP, which is currently about 23 percent.[8]

On the basis of this evidence, the interagency workgroup determined that a range of values from 7 to 23 percent should be used to adjust the global SCC to calculate domestic effects. Reported domestic values should use this range. It is recognized that these values are approximate, provisional, and highly speculative. There is no a priori reason why domestic benefits should be a constant fraction of net global damages over time. Further, FUND does not account for how damages in other regions could affect the United States (e.g., global migration, economic and political destabilization). If more accurate methods for calculating the domestic SCC become available, the Federal government will examine these to determine whether to update its approach.

[7] It is plausible that a loss of $X inflicts more serious harm on a poor nation than on a wealthy one, but development of the appropriate "equity weight" is challenging. Emissions reductions also impose costs, and hence a full account would have to consider that a given cost of emissions reductions imposes a greater utility or welfare loss on a poor nation than on a wealthy one. Even if equity weighting—for both the costs and benefits of emissions reductions—is appropriate when considering the utility or welfare effects of international action, the interagency group concluded that it should not be used in developing an SCC for use in regulatory policy at this time.

[8] Based on 2008 GDP (in current US dollars) from the *World Bank Development Indicators Report*.

C. Valuing Non-CO_2 Emissions

While CO_2 is the most prevalent greenhouse gas emitted into the atmosphere, the U.S. included five other greenhouse gases in its recent endangerment finding: methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride. The climate impact of these gases is commonly discussed in terms of their 100-year global warming potential (GWP). GWP measures the ability of different gases to trap heat in the atmosphere (i.e., radiative forcing per unit of mass) over a particular timeframe relative to CO_2. However, because these gases differ in both radiative forcing and atmospheric lifetimes, their relative damages are not constant over time. For example, because methane has a short lifetime, its impacts occur primarily in the near term and thus are not discounted as heavily as those caused by longer-lived gases. Impacts other than temperature change also vary across gases in ways that are not captured by GWP. For instance, CO_2 emissions, unlike methane and other greenhouse gases, contribute to ocean acidification. Likewise, damages from methane emissions are not offset by the positive effect of CO_2 fertilization. Thus, transforming gases into CO_2-equivalents using GWP, and then multiplying the carbon-equivalents by the SCC, would not result in accurate estimates of the social costs of non-CO_2 gases.

In light of these limitations, and the significant contributions of non-CO_2 emissions to climate change, further research is required to link non-CO_2 emissions to economic impacts. Such work would feed into efforts to develop a monetized value of reductions in non-CO_2 greenhouse gas emissions. As part of ongoing work to further improve the SCC estimates, the interagency group hopes to develop methods to value these other greenhouse gases. The goal is to develop these estimates by the time we issue revised SCC estimates for carbon dioxide emissions.

D. Equilibrium Climate Sensitivity

Equilibrium climate sensitivity (ECS) is a key input parameter for the DICE, PAGE, and FUND models.[9] It is defined as the long-term increase in the annual global-average surface temperature from a doubling of atmospheric CO_2 concentration relative to pre-industrial levels (or stabilization at a concentration of approximately 550 parts per million (ppm)). Uncertainties in this important parameter have received substantial attention in the peer-reviewed literature.

The most authoritative statement about equilibrium climate sensitivity appears in the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC):

> *Basing our assessment on a combination of several independent lines of evidence…including observed climate change and the strength of known feedbacks simulated in [global climate models], we conclude that the global mean equilibrium warming for doubling CO_2, or 'equilibrium climate*

[9] The equilibrium climate sensitivity includes the response of the climate system to increased greenhouse gas concentrations over the short to medium term (up to 100-200 years), but it does not include long-term feedback effects due to possible large-scale changes in ice sheets or the biosphere, which occur on a time scale of many hundreds to thousands of years (e.g. Hansen et al. 2007).

sensitivity', is likely to lie in the range 2 °C to 4.5 °C, with a most likely value of about 3 °C. Equilibrium climate sensitivity is very likely larger than 1.5 °C. [10]

For fundamental physical reasons as well as data limitations, values substantially higher than 4.5 °C still cannot be excluded, but agreement with observations and proxy data is generally worse for those high values than for values in the 2 °C to 4.5 °C range. (Meehl et al., 2007, p 799)

After consulting with several lead authors of this chapter of the IPCC report, the interagency workgroup selected four candidate probability distributions and calibrated them to be consistent with the above statement: Roe and Baker (2007), log-normal, gamma, and Weibull. Table 1 included below gives summary statistics for the four calibrated distributions.

Table 1: Summary Statistics for Four Calibrated Climate Sensitivity Distributions

	Roe & Baker	Log-normal	Gamma	Weibull
Pr(ECS < 1.5°C)	0.013	0.050	0.070	0.102
Pr(2°C < ECS < 4.5°C)	0.667	0.667	0.667	0.667
5th percentile	1.72	1.49	1.37	1.13
10th percentile	1.91	1.74	1.65	1.48
Mode	2.34	2.52	2.65	2.90
Median (50th percentile)	3.00	3.00	3.00	3.00
Mean	3.50	3.28	3.19	3.07
90th percentile	5.86	5.14	4.93	4.69
95th percentile	7.14	5.97	5.59	5.17

Each distribution was calibrated by applying three constraints from the IPCC:

(1) a median equal to 3°C, to reflect the judgment of "a most likely value of about 3 °C";[11]
(2) two-thirds probability that the equilibrium climate sensitivity lies between 2 and 4.5 °C; and
(3) zero probability that it is less than 0°C or greater than 10°C (see Hegerl et al. 2006, p. 721).

We selected the calibrated Roe and Baker distribution from the four candidates for two reasons. First, the Roe and Baker distribution is the only one of the four that is based on a theoretical understanding of the response of the climate system to increased greenhouse gas concentrations (Roe and Baker 2007,

[10] This is in accord with the judgment that it "is likely to lie in the range 2 °C to 4.5 °C" and the IPCC definition of "likely" as greater than 66 percent probability (Le Treut et al.2007). "Very likely" indicates a greater than 90 percent probability.

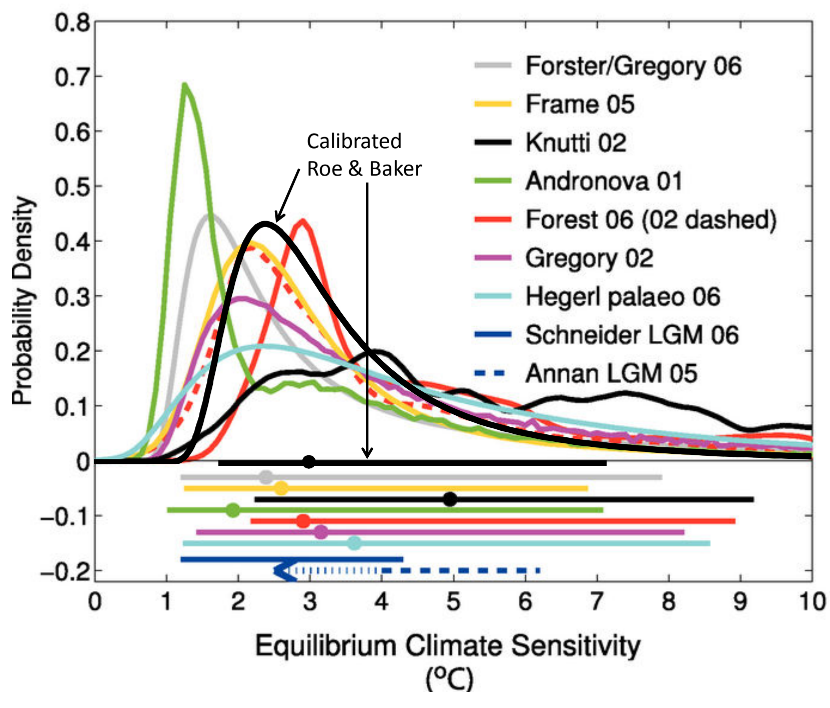
[11] Strictly speaking, "most likely" refers to the mode of a distribution rather than the median, but common usage would allow the mode, median, or mean to serve as candidates for the central or "most likely" value and the IPCC report is not specific on this point. For the distributions we considered, the median was between the mode and the mean. For the Roe and Baker distribution, setting the median equal to 3°C, rather than the mode or mean, gave a 95th percentile that is more consistent with IPCC judgments and the literature. For example, setting the mean and mode equal to 3°C produced 95th percentiles of 5.6 and 8.6 °C, respectively, which are in the lower and upper end of the range in the literature. Finally, the median is closer to 3°C than is the mode for the truncated distributions selected by the IPCC (Hegerl, et al., 2006); the average median is 3.1 °C and the average mode is 2.3 °C, which is most consistent with a Roe and Baker distribution with the median set equal to 3 °C.

Roe 2008). In contrast, the other three distributions are mathematical functions that are arbitrarily chosen based on simplicity, convenience, and general shape. The Roe and Baker distribution results from three assumptions about climate response: (1) absent feedback effects, the equilibrium climate sensitivity is equal to 1.2 °C; (2) feedback factors are proportional to the change in surface temperature; and (3) uncertainties in feedback factors are normally distributed. There is widespread agreement on the first point and the second and third points are common assumptions.

Second, the calibrated Roe and Baker distribution better reflects the IPCC judgment that "values substantially higher than 4.5°C still cannot be excluded." Although the IPCC made no quantitative judgment, the 95th percentile of the calibrated Roe & Baker distribution (7.1 °C) is much closer to the mean and the median (7.2 °C) of the 95th percentiles of 21 previous studies summarized by Newbold and Daigneault (2009). It is also closer to the mean (7.5 °C) and median (7.9 °C) of the nine truncated distributions examined by the IPCC (Hegerl, et al., 2006) than are the 95th percentiles of the three other calibrated distributions (5.2-6.0 °C).

Finally, we note the IPCC judgment that the equilibrium climate sensitivity "is very likely larger than 1.5°C." Although the calibrated Roe & Baker distribution, for which the probability of equilibrium climate sensitivity being greater than 1.5°C is almost 99 percent, is not inconsistent with the IPCC definition of "very likely" as "greater than 90 percent probability," it reflects a greater degree of certainty about very low values of ECS than was expressed by the IPCC.

Figure 2: Estimates of the Probability Density Function for Equilibrium Climate Sensitivity (°C)



To show how the calibrated Roe and Baker distribution compares to different estimates of the probability distribution function of equilibrium climate sensitivity in the empirical literature, Figure 2 (below) overlays it on Figure 9.20 from the IPCC Fourth Assessment Report. These functions are scaled to integrate to unity between 0 °C and 10 °C. The horizontal bars show the respective 5 percent to 95 percent ranges; dots indicate the median estimate.[12]

E. Socio-Economic and Emissions Trajectories

Another key issue considered by the interagency group is how to select the set of socio-economic and emissions parameters for use in PAGE, DICE, and FUND. Socio-economic pathways are closely tied to climate damages because, all else equal, more and wealthier people tend to emit more greenhouse gases and also have a higher (absolute) willingness to pay to avoid climate disruptions. For this reason, we consider how to model several input parameters in tandem: GDP, population, CO_2 emissions, and non-CO_2 radiative forcing. A wide variety of scenarios have been developed and used for climate change policy simulations (e.g., SRES 2000, CCSP 2007, EMF 2009). In determining which scenarios are appropriate for inclusion, we aimed to select scenarios that span most of the plausible ranges of outcomes for these variables.

To accomplish this task in a transparent way, we decided to rely on the recent Stanford Energy Modeling Forum exercise, EMF-22. EMF-22 uses ten well-recognized models to evaluate substantial, coordinated global action to meet specific stabilization targets. A key advantage of relying on these data is that GDP, population, and emission trajectories are internally consistent for each model and scenario evaluated. The EMF-22 modeling effort also is preferable to the IPCC SRES due to their age (SRES were developed in 1997) and the fact that 3 of 4 of the SRES scenarios are now extreme outliers in one or more variables. Although the EMF-22 scenarios have not undergone the same level of scrutiny as the SRES scenarios, they are recent, peer-reviewed, published, and publicly available.

To estimate the SCC for use in evaluating domestic policies that will have a small effect on global cumulative emissions, we use socio-economic and emission trajectories that span a range of plausible scenarios. Five trajectories were selected from EMF-22 (see Table 2 below). Four of these represent potential business-as-usual (BAU) growth in population, wealth, and emissions and are associated with CO_2 (only) concentrations ranging from 612 to 889 ppm in 2100. One represents an emissions pathway that achieves stabilization at 550 ppm CO_2e (i.e., CO_2-only concentrations of 425 – 484 ppm or a radiative forcing of 3.7 W/m^2) in 2100, a lower-than-BAU trajectory.[13] Out of the 10 models included in the EMF-22 exercise, we selected the trajectories used by MiniCAM, MESSAGE, IMAGE, and the optimistic scenario from MERGE. For the BAU pathways, we used the GDP, population, and emission trajectories from each of these four models. For the 550 ppm CO_2e scenario, we averaged the GDP, population, and emission trajectories implied by these same four models.

[12] The estimates based on instrumental data are from Andronova and Schlesinger (2001), Forest et al. (2002; dashed line, anthropogenic forcings only), Forest et al. (2006; solid line, anthropogenic and natural forcings), Gregory et al. (2002a), Knutti et al. (2002), Frame et al. (2005), and Forster and Gregory (2006). Hegerl et al. (2006) are based on multiple palaeoclimatic reconstructions of north hemisphere mean temperatures over the last 700 years. Also shown are the 5-95 percent approximate ranges for two estimates from the last glacial maximum (dashed, Annan et al. 2005; solid, Schneider von Deimling et al. 2006), which are based on models with different structural properties.

[13] Such an emissions path would be consistent with widespread action by countries to mitigate GHG emissions, though it could also result from technological advances. It was chosen because it represents the most stringent case analyzed by the EMF-22 where all the models converge: a 550 ppm, not to exceed, full participation scenario.

Table 2: Socioeconomic and Emissions Projections from Select EMF-22 Reference Scenarios -

Reference Fossil and Industrial CO_2 Emissions ($GtCO_2$/yr) -

EMF – 22 Based Scenarios	2000	2010	2020	2030	2050	2100
IMAGE	26.6	31.9	36.9	40.0	45.3	60.1
MERGE Optimistic	24.6	31.5	37.6	45.1	66.5	117.9
MESSAGE	26.8	29.2	37.6	42.1	43.5	42.7
MiniCAM	26.5	31.8	38.0	45.1	57.8	80.5
550 ppm average	26.2	31.1	33.2	32.4	20.0	12.8

Reference GDP (using market exchange rates in trillion 2005$)[14]

EMF – 22 Based Scenarios	2000	2010	2020	2030	2050	2100
IMAGE	38.6	53.0	73.5	97.2	156.3	396.6
MERGE Optimistic	36.3	45.9	59.7	76.8	122.7	268.0
MESSAGE	38.1	52.3	69.4	91.4	153.7	334.9
MiniCAM	36.1	47.4	60.8	78.9	125.7	369.5
550 ppm average	37.1	49.6	65.6	85.5	137.4	337.9

Global Population (billions)

EMF – 22 Based Scenarios	2000	2010	2020	2030	2050	2100
IMAGE	6.1	6.9	7.6	8.2	9.0	9.1
MERGE Optimistic	6.0	6.8	7.5	8.2	9.0	9.7
MESSAGE	6.1	6.9	7.7	8.4	9.4	10.4
MiniCAM	6.0	6.8	7.5	8.1	8.8	8.7
550 ppm average	6.1	6.8	7.6	8.2	8.7	9.1

We explore how sensitive the SCC is to various assumptions about how the future will evolve without prejudging what is likely to occur. The interagency group considered formally assigning probability weights to different states of the world, but this proved challenging to do in an analytically rigorous way given the dearth of information on the likelihood of a full range of future socio-economic pathways.

There are a number of caveats. First, EMF BAU scenarios represent the modelers' judgment of the most likely pathway absent mitigation policies to reduce greenhouse gas emissions, rather than the wider range of possible outcomes. Nevertheless, these views of the most likely outcome span a wide range,

[14] While the EMF-22 models used market exchange rates (MER) to calculate global GDP, it is also possible to use purchasing power parity (PPP). PPP takes into account the different price levels across countries, so it more accurately describes relative standards of living across countries. MERs tend to make low-income countries appear poorer than they actually are. Because many models assume convergence in per capita income over time, use of MER-adjusted GDP gives rise to projections of higher economic growth in low income countries. There is an ongoing debate about how much this will affect estimated climate impacts. Critics of the use of MER argue that it leads to overstated economic growth and hence a significant upward bias in projections of greenhouse gas emissions, and unrealistically high future temperatures (e.g., Castles and Henderson 2003). Others argue that convergence of the emissions-intensity gap across countries at least partially offset the overstated income gap so that differences in exchange rates have less of an effect on emissions (Holtsmark and Alfsen, 2005; Tol, 2006). Nordhaus (2007b) argues that the ideal approach is to use superlative PPP accounts (i.e., using cross-sectional PPP measures for relative incomes and outputs and national accounts price and quantity indexes for time-series extrapolations). However, he notes that it important to keep this debate in perspective; it is by no means clear that exchange-rate-conversion issues are as important as uncertainties about population, technological change, or the many geophysical uncertainties.

from the more optimistic (e.g. abundant low-cost, low-carbon energy) to more pessimistic (e.g. constraints on the availability of nuclear and renewables).[15] Second, the socio-economic trajectories associated with a 550 ppm CO_2e concentration scenario are not derived from an assessment of what policy is optimal from a benefit-cost standpoint. Rather, it is indicative of one possible future outcome. The emission trajectories underlying some BAU scenarios (e.g. MESSAGE's 612 ppm) also are consistent with some modest policy action to address climate change.[16] We chose not to include socio-economic trajectories that achieve even lower GHG concentrations at this time, given the difficulty many models had in converging to meet these targets.

For comparison purposes, the Energy Information Agency in its 2009 Annual Energy Outlook projected that global carbon dioxide emissions will grow to 30.8, 35.6, and 40.4 gigatons in 2010, 2020, and 2030, respectively, while world GDP is projected to be $51.8, $71.0 and $93.9 trillion (in 2005 dollars using market exchange rates) in 2010, 2020, and 2030, respectively. These projections are consistent with one or more EMF-22 scenarios. Likewise, the United Nations' 2008 Population Prospect projects population will grow from 6.1 billion people in 2000 to 9.1 billion people in 2050, which is close to the population trajectories for the IMAGE, MiniCAM, and MERGE models.

In addition to fossil and industrial CO_2 emissions, each EMF scenario provides projections of methane, nitrous oxide, fluorinated greenhouse gases, and net land use CO_2 emissions out to 2100. These assumptions also are used in the three models while retaining the default radiative forcings due to other factors (e.g. aerosols and other gases). See the Appendix for greater detail.

F. Discount Rate

The choice of a discount rate, especially over long periods of time, raises highly contested and exceedingly difficult questions of science, economics, philosophy, and law. Although it is well understood that the discount rate has a large influence on the current value of future damages, there is no consensus about what rates to use in this context. Because carbon dioxide emissions are long-lived, subsequent damages occur over many years. In calculating the SCC, we first estimate the future damages to agriculture, human health, and other market and non-market sectors from an additional unit of carbon dioxide emitted in a particular year in terms of reduced consumption (or consumption equivalents) due to the impacts of elevated temperatures, as represented in each of the three IAMs. Then we discount the stream of future damages to its present value in the year when the additional unit of emissions was released using the selected discount rate, which is intended to reflect society's marginal rate of substitution between consumption in different time periods.

For rules with both intra- and intergenerational effects, agencies traditionally employ constant discount rates of both 3 percent and 7 percent in accordance with OMB Circular A-4. As Circular A-4 acknowledges, however, the choice of discount rate for intergenerational problems raises distinctive

[15] For instance, in the MESSAGE model's reference case total primary energy production from nuclear, biomass, and non-biomass renewables is projected to increase from about 15 percent of total primary energy in 2000 to 54 percent in 2100. In comparison, the MiniCAM reference case shows 10 percent in 2000 and 21 percent in 2100.

[16] For example, MiniCAM projects if all non-US OECD countries reduce CO_2 emissions to 83 percent below 2005 levels by 2050 (per the G-8 agreement) but all other countries continue along a BAU path CO_2 concentrations in 2100 would drop from 794 ppmv in its reference case to 762 ppmv.

problems and presents considerable challenges. After reviewing those challenges, Circular A-4 states, "If your rule will have important intergenerational benefits or costs you might consider a further sensitivity analysis using a lower but positive discount rate in addition to calculating net benefits using discount rates of 3 and 7 percent." For the specific purpose of developing the SCC, we adapt and revise that approach here.

Arrow et al. (1996) outlined two main approaches to determine the discount rate for climate change analysis, which they labeled "descriptive" and "prescriptive." The descriptive approach reflects a positive (non-normative) perspective based on observations of people's actual choices—e.g., savings versus consumption decisions over time, and allocations of savings among more and less risky investments. Advocates of this approach generally call for inferring the discount rate from market rates of return "because of a lack of justification for choosing a social welfare function that is any different than what decision makers [individuals] actually use" (Arrow et al. 1996).

One theoretical foundation for the cost-benefit analyses in which the social cost of carbon will be used—the Kaldor-Hicks potential-compensation test—also suggests that market rates should be used to discount future benefits and costs, because it is the market interest rate that would govern the returns potentially set aside today to compensate future individuals for climate damages that they bear (e.g., Just et al. 2004). As some have noted, the word "potentially" is an important qualification; there is no assurance that such returns will actually be set aside to provide compensation, and the very idea of compensation is difficult to define in the intergenerational context. On the other hand, societies provide compensation to future generations through investments in human capital and the resulting increase in knowledge, as well as infrastructure and other physical capital.

The prescriptive approach specifies a social welfare function that formalizes the normative judgments that the decision-maker wants explicitly to incorporate into the policy evaluation—e.g., how inter-personal comparisons of utility should be made, and how the welfare of future generations should be weighed against that of the present generation. Ramsey (1928), for example, has argued that it is "ethically indefensible" to apply a positive pure rate of time preference to discount values across generations, and many agree with this view.

Other concerns also motivate making adjustments to descriptive discount rates. In particular, it has been noted that the preferences of future generations with regard to consumption versus environmental amenities may not be the same as those today, making the current market rate on consumption an inappropriate metric by which to discount future climate-related damages. Others argue that the discount rate should be below market rates to correct for market distortions and uncertainties or inefficiencies in intergenerational transfers of wealth, which in the Kaldor-Hicks logic are presumed to compensate future generations for damage (a potentially controversial assumption, as noted above) (Arrow et al. 1996, Weitzman 1999).

Further, a legitimate concern about both descriptive and prescriptive approaches is that they tend to obscure important heterogeneity in the population. The utility function that underlies the prescriptive approach assumes a representative agent with perfect foresight and no credit constraints. This is an artificial rendering of the real world that misses many of the frictions that characterize individuals' lives and indeed the available descriptive evidence supports this. For instance, many individuals smooth consumption by borrowing with credit cards that have relatively high rates. Some are unable to access traditional credit markets and rely on payday lending operations or other high cost forms of smoothing consumption. Whether one puts greater weight on the prescriptive or descriptive approach, the high interest rates that credit-constrained individuals accept suggest that some account should be given to the discount rates revealed by their behavior.

We draw on both approaches but rely primarily on the descriptive approach to inform the choice of discount rate. With recognition of its limitations, we find this approach to be the most defensible and transparent given its consistency with the standard contemporary theoretical foundations of benefit-cost analysis and with the approach required by OMB's existing guidance. The logic of this framework also suggests that market rates should be used for discounting future consumption-equivalent damages. Regardless of the theoretical approach used to derive the appropriate discount rate(s), we note the inherent conceptual and practical difficulties of adequately capturing consumption trade-offs over many decades or even centuries. While relying primarily on the descriptive approach in selecting specific discount rates, the interagency group has been keenly aware of the deeply normative dimensions of both the debate over discounting in the intergenerational context and the consequences of selecting one discount rate over another.

Historically Observed Interest Rates

In a market with no distortions, the return to savings would equal the private return on investment, and the market rate of interest would be the appropriate choice for the social discount rate. In the real world risk, taxes, and other market imperfections drive a wedge between the risk-free rate of return on capital and the consumption rate of interest. Thus, the literature recognizes two conceptual discount concepts—the consumption rate of interest and the opportunity cost of capital.

According to OMB's Circular A-4, it is appropriate to use the rate of return on capital when a regulation is expected to displace or alter the use of capital in the private sector. In this case, OMB recommends Agencies use a discount rate of 7 percent. When regulation is expected to primarily affect private consumption—for instance, via higher prices for goods and services—a lower discount rate of 3 percent is appropriate to reflect how private individuals trade-off current and future consumption.

The interagency group examined the economics literature and concluded that the consumption rate of interest is the correct concept to use in evaluating the benefits and costs of a marginal change in carbon emissions (see Lind 1990, Arrow et al 1996, and Arrow 2000). The consumption rate of interest also is appropriate when the impacts of a regulation are measured in consumption (-equivalent) units, as is done in the three integrated assessment models used for estimating the SCC.

Individuals use a variety of savings instruments that vary with risk level, time horizon, and tax characteristics. The standard analytic framework used to develop intuition about the discount rate typically assumes a representative agent with perfect foresight and no credit constraints. The risk-free rate is appropriate for discounting certain future benefits or costs, but the benefits calculated by IAMs are uncertain. To use the risk-free rate to discount uncertain benefits, these benefits first must be transformed into "certainty equivalents," that is the maximum certain amount that we would exchange for the uncertain amount. However, the calculation of the certainty-equivalent requires first estimating the correlation between the benefits of the policy and baseline consumption.

If the IAM projections of future impacts represent expected values (not certainty-equivalent values), then the appropriate discount rate generally does not equal the risk-free rate. If the benefits of the policy tend to be high in those states of the world in which consumption is low, then the certainty-equivalent benefits will be higher than the expected benefits (and vice versa). Since many (though not necessarily all) of the important impacts of climate change will flow through market sectors such as agriculture and energy, and since willingness to pay for environmental protections typically increases with income, we might expect a positive (though not necessarily perfect) correlation between the net benefits from climate policies and market returns. This line of reasoning suggests that the proper discount rate would exceed the riskless rate. Alternatively, a negative correlation between the returns to climate policies and market returns would imply that a discount rate below the riskless rate is appropriate.

This discussion suggests that both the post-tax riskless and risky rates can be used to capture individuals' consumption-equivalent interest rate. As a measure of the post-tax riskless rate, we calculate the average real return from Treasury notes over the longest time period available (those from Newell and Pizer 2003) and adjust for Federal taxes (the average marginal rate from tax years 2003 through 2006 is around 27 percent).[17] This calculation produces a real interest rate of about 2.7 percent, which is roughly consistent with Circular A-4's recommendation to use 3 percent to represent the consumption rate of interest.[18] A measure of the post-tax risky rate for investments whose returns are positively correlated with overall equity market returns can be obtained by adjusting pre-tax rates of household returns to risky investments (approximately 7 percent) for taxes yields a real rate of roughly 5 percent.[19]

The Ramsey Equation

Ramsey discounting also provides a useful framework to inform the choice of a discount rate. Under this approach, the analyst applies either positive or normative judgments in selecting values for the key parameters of the Ramsey equation: η (coefficient of relative risk aversion or elasticity of the marginal utility of consumption) and ρ (pure rate of time preference).[20] These are then combined with g (growth

[17] The literature argues for a risk-free rate on government bonds as an appropriate measure of the consumption rate of interest. Arrow (2000) suggests that it is roughly 3-4 percent. OMB cites evidence of a 3.1 percent pre-tax rate for 10-year Treasury notes in the A-4 guidance. Newell and Pizer (2003) find real interest rates between 3.5 and 4 percent for 30-year Treasury securities.

[18] The positive approach reflects how individuals make allocation choices across time, but it is important to keep in mind that we wish to reflect preferences for society as a whole, which generally has a longer planning horizon.

[19] Cambell et al (2001) estimates that the annual real return from stocks for 1900-1995 was about 7 percent. The annual real rate of return for the S&P 500 from 1950 – 2008 was about 6.8 percent. In the absence of a better way to population-weight the tax rates, we use the middle of the 20 – 40 percent range to derive a post-tax interest rate (Kotlikoff and Rapson 2006).

[20] The parameter ρ measures the *pure rate of time preference*: people's behavior reveals a preference for an increase in utility today versus the future. Consequently, it is standard to place a lower weight on utility in the future. The parameter η captures *diminishing marginal utility*: consumption in the future is likely to be higher than consumption today, so diminishing marginal utility of consumption implies that the same monetary damage will

rate of per-capita consumption) to equal the interest rate at which future monetized damages are discounted: $\rho + \eta \cdot g$.[21] In the simplest version of the Ramsey model, with an optimizing representative agent with perfect foresight, what we are calling the "Ramsey discount rate," $\rho + \eta \cdot g$, will be equal to the rate of return to capital, i.e., the market interest rate.

A review of the literature provides some guidance on reasonable parameter values for the Ramsey discounting equation, based on both prescriptive and descriptive approaches.

- η. Most papers in the climate change literature adopt values for η in the range of 0.5 to 3 (Weitzman cites plausible values as those ranging from 1 to 4), although not all authors articulate whether their choice is based on prescriptive or descriptive reasoning.[22] Dasgupta (2008) argues that η should be greater than 1 and may be as high as 3, since η equal to 1 suggests savings rates that do not conform to observed behavior.

- ρ. With respect to the pure rate of time preference, most papers in the climate change literature adopt values for ρ in the range of 0 to 3 percent per year. The very low rates tend to follow from moral judgments involving intergenerational neutrality. Some have argued that to use any value other than $\rho = 0$ would unjustly discriminate against future generations (e.g., Arrow et al. 1996, Stern et al. 2006). However, even in an inter-generational setting, it may make sense to use a small positive pure rate of time preference because of the small probability of unforeseen cataclysmic events (Stern et al. 2006).

- g. A commonly accepted approximation is around 2 percent per year. For the socio-economic scenarios used for this exercise, the EMF models assume that g is about 1.5-2 percent to 2100.

Some economists and non-economists have argued for constant discount rates below 2 percent based on the prescriptive approach. When grounded in the Ramsey framework, proponents of this approach have argued that a ρ of zero avoids giving preferential treatment to one generation over another. The choice of η has also been posed as an ethical choice linked to the value of an additional dollar in poorer

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cause a smaller reduction of utility for wealthier individuals, either in the future or in current generations. If $\eta = 0$, then a one dollar increase in income is equally valuable regardless of level of income; if $\eta = 1$, then a one percent increase in income is equally valuable no matter the level of income; and if $\eta > 1$, then a one percent increase in income is less valuable to wealthier individuals.

[21] In this case, g could be taken from the selected EMF socioeconomic scenarios or alternative assumptions about the rate of consumption growth.

[22] Empirical estimates of η span a wide range of values. A benchmark value of 2 is near the middle of the range of values estimated or used by Szpiro (1986), Hall and Jones (2007), Arrow (2007), Dasgupta (2006, 2008), Weitzman (2007, 2009), and Nordhaus (2008). However, Chetty (2006) developed a method of estimating η using data on labor supply behavior. He shows that existing evidence of the effects of wage changes on labor supply imposes a tight upper bound on the curvature of utility over wealth (CRRA < 2) with the mean implied value of 0.71 and concludes that the standard expected utility model cannot generate high levels of risk aversion without contradicting established facts about labor supply. Recent work has jointly estimated the components of the Ramsey equation. Evans and Sezer (2005) estimate $\eta = 1.49$ for 22 OECD countries. They also estimate $\rho = 1.08$ percent per year using data on mortality rates. Anthoff, et al. (2009b) estimate $\eta = 1.18$, and $\rho = 1.4$ percent. When they multiply the bivariate probability distributions from their work and Evans and Sezer (2005) together, they find $\eta = 1.47$, and $\rho = 1.07$.

countries compared to wealthier ones. Stern et al. (2006) applies this perspective through his choice of ρ = 0.1 percent per year, η = 1 and g = 1.3 percent per year, which yields an annual discount rate of 1.4 percent. In the context of permanent income savings behavior, however, Stern's assumptions suggest that individuals would save 93 percent of their income.[23]

Recently, Stern (2008) revisited the values used in Stern et al. (2006), stating that there is a case to be made for raising η due to the amount of weight lower values place on damages far in the future (over 90 percent of expected damages occur after 2200 with η = 1). Using Stern's assumption that ρ = 0.1 percent, combined with a η of 1.5 to 2 and his original growth rate, yields a discount rate greater 2 percent.

We conclude that arguments made under the prescriptive approach can be used to justify discount rates between roughly 1.4 and 3.1 percent. In light of concerns about the most appropriate value for η, we find it difficult to justify rates at the lower end of this range under the Ramsey framework.

Accounting for Uncertainty in the Discount Rate

While the consumption rate of interest is an important driver of the benefits estimate, it is uncertain over time. Ideally, we would formally model this uncertainty, just as we do for climate sensitivity. Weitzman (1998, 2001) showed theoretically and Newell and Pizer (2003) and Groom et al. (2006) confirm empirically that discount rate uncertainty can have a large effect on net present values. A main result from these studies is that if there is a persistent element to the uncertainty in the discount rate (e.g., the rate follows a random walk), then it will result in an effective (or certainty-equivalent) discount rate that declines over time. Consequently, lower discount rates tend to dominate over the very long term (see Weitzman 1998, 1999, 2001; Newell and Pizer 2003; Groom et al. 2006; Gollier 2008; Summers and Zeckhauser 2008; and Gollier and Weitzman 2009).

The proper way to model discount rate uncertainty remains an active area of research. Newell and Pizer (2003) employ a model of how long-term interest rates change over time to forecast future discount rates. Their model incorporates some of the basic features of how interest rates move over time, and its parameters are estimated based on historical observations of long-term rates. Subsequent work on this topic, most notably Groom et al. (2006), uses more general models of interest rate dynamics to allow for better forecasts. Specifically, the volatility of interest rates depends on whether rates are currently low or high and variation in the level of persistence over time.

While Newell and Pizer (2003) and Groom et al (2006) attempt formally to model uncertainty in the discount rate, others argue for a declining scale of discount rates applied over time (e.g., Weitzman 2001, and the UK's "Green Book" for regulatory analysis). This approach uses a higher discount rate

[23] Stern (2008) argues that building in a positive rate of exogenous technical change over time reduces the implied savings rate and that η at or above 2 are inconsistent with observed behavior with regard to equity. (At the same time, adding exogenous technical change—all else equal—would increase g as well.)

initially, but applies a graduated scale of lower discount rates further out in time.[24] A key question that has emerged with regard to both of these approaches is the trade-off between potential time inconsistency and giving greater weight to far future outcomes (see the EPA Science Advisory Board's recent comments on this topic as part of its review of their *Guidelines for Economic Analysis*).[25]

The Discount Rates Selected for Estimating SCC

In light of disagreement in the literature on the appropriate market interest rate to use in this context and uncertainty about how interest rates may change over time, we use three discount rates to span a plausible range of certainty-equivalent constant discount rates: 2.5, 3, and 5 percent per year. Based on the review in the previous sections, the interagency workgroup determined that these three rates reflect reasonable judgments under both descriptive and prescriptive approaches.

The central value, 3 percent, is consistent with estimates provided in the economics literature and OMB's Circular A-4 guidance for the consumption rate of interest. As previously mentioned, the consumption rate of interest is the correct discounting concept to use when future damages from elevated temperatures are estimated in consumption-equivalent units. Further, 3 percent roughly corresponds to the after-tax riskless interest rate. The upper value of 5 percent is included to represent the possibility that climate damages are positively correlated with market returns. Additionally, this discount rate may be justified by the high interest rates that many consumers use to smooth consumption across periods.

The low value, 2.5 percent, is included to incorporate the concern that interest rates are highly uncertain over time. It represents the average certainty-equivalent rate using the mean-reverting and random walk approaches from Newell and Pizer (2003) starting at a discount rate of 3 percent. Using this approach, the certainty equivalent is about 2.2 percent using the random walk model and 2.8 percent using the mean reverting approach.[26] Without giving preference to a particular model, the average of the two rates is 2.5 percent. Further, a rate below the riskless rate would be justified if climate investments are negatively correlated with the overall market rate of return. Use of this lower value also responds to certain judgments using the prescriptive or normative approach and to ethical objections that have been raised about rates of 3 percent or higher.

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[24] For instance, the UK applies a discount rate of 3.5 percent to the first 30 years; 3 percent for years 31 - 75; 2.5 percent for years 76 - 125; 2 percent for years 126 - 200; 1.5 percent for years 201 - 300; and 1 percent after 300 years. As a sensitivity, it recommends a discount rate of 3 percent for the first 30 years, also decreasing over time.

[25] Uncertainty in future damages is distinct from uncertainty in the discount rate. Weitzman (2008) argues that Stern's choice of a low discount rate was "right for the wrong reasons." He demonstrates how the damages from a low probability, catastrophic event far in the future dominate the effect of the discount rate in a present value calculation and result in an infinite willingness-to-pay for mitigation today. Newbold and Daigneault, (2009) and Nordhaus (2009) find that Weitzman's result is sensitive to the functional forms chosen for climate sensitivity, utility, and consumption. Summers and Zeckhauser (2008) argue that uncertainty in future damages can also work in the other direction by increasing the benefits of waiting to learn the appropriate level of mitigation required.

[26] Calculations done by Pizer et al. using the original simulation program from Newell and Pizer (2003).

IV. Revised SCC Estimates

Our general approach to estimating SCC values is to run the three integrated assessment models (FUND, DICE, and PAGE) using the following inputs agreed upon by the interagency group:

- A Roe and Baker distribution for the climate sensitivity parameter bounded between 0 and 10 with a median of 3 °C and a cumulative probability between 2 and 4.5 °C of two-thirds.
- Five sets of GDP, population and carbon emissions trajectories based on EMF-22.
- Constant annual discount rates of 2.5, 3, and 5 percent.

Because the climate sensitivity parameter is modeled probabilistically, and because PAGE and FUND incorporate uncertainty in other model parameters, the final output from each model run is a distribution over the SCC in year *t*.

For each of the IAMS, the basic computational steps for calculating the SCC in a particular year *t* are:

1. Input the path of emissions, GDP, and population from the selected EMF-22 scenarios, and the extrapolations based on these scenarios for post-2100 years.

2. Calculate the temperature effects and (consumption-equivalent) damages in each year resulting from the baseline path of emissions.

    a. In PAGE, the consumption-equivalent damages in each period are calculated as a fraction of the EMF GDP forecast, depending on the temperature in that period relative to the pre-industrial average temperature in each region.
    b. In FUND, damages in each period depend on both the level and the rate of temperature change in that period.
    c. In DICE, temperature affects both consumption and investment, so we first adjust the EMF GDP paths as follows: Using the Cobb-Douglas production function with the DICE2007 parameters, we extract the path of exogenous technical change implied by the EMF GDP and population paths, then we recalculate the baseline GDP path taking into account climate damages resulting from the baseline emissions path.

3. Add an additional unit of carbon emissions in year *t.* (The exact unit varies by model.)

4. Recalculate the temperature effects and damages expected in all years beyond *t* resulting from this adjusted path of emissions, as in step 2.

5. Subtract the damages computed in step 2 from those in step 4 in each year. (DICE is run in 10 year time steps, FUND in annual time steps, while the time steps in PAGE vary.)

6. Discount the resulting path of marginal damages back to the year of emissions using the agreed upon fixed discount rates.

7. Calculate the SCC as the net present value of the discounted path of damages computed in step 6, divided by the unit of carbon emissions used to shock the models in step 3.

8. Multiply by 12/44 to convert from dollars per ton of carbon to dollars per ton of CO_2 (2007 dollars) in DICE and FUND. (All calculations are done in tons of CO_2 in PAGE).

The steps above were repeated in each model for multiple future years to cover the time horizons anticipated for upcoming rulemaking analysis. To maintain consistency across the three IAMs, climate damages are calculated as lost consumption in each future year.

It is important to note that each of the three models has a different default end year. The default time horizon is 2200 for PAGE, 2595 for DICE, and 3000 for the latest version of FUND. This is an issue for the multi-model approach because differences in SCC estimates may arise simply due to the model time horizon. Many consider 2200 too short a time horizon because it could miss a significant fraction of damages under certain assumptions about the growth of marginal damages and discounting, so each model is run here through 2300. This step required a small adjustment in the PAGE model only. This step also required assumptions about GDP, population, and greenhouse gas emission trajectories after 2100, the last year for which these data are available from the EMF-22 models. (A more detailed discussion of these assumptions is included in the Appendix.)

This exercise produces 45 separate distributions of the SCC for a given year, the product of 3 models, 3 discount rates, and 5 socioeconomic scenarios. This is clearly too many separate distributions for consideration in a regulatory impact analysis.

To produce a range of plausible estimates that still reflects the uncertainty in the estimation exercise, the distributions from each of the models and scenarios are equally weighed and combined to produce three separate probability distributions for SCC in a given year, one for each assumed discount rate. These distributions are then used to define a range of point estimates for the global SCC. In this way, no integrated assessment model or socioeconomic scenario is given greater weight than another. Because the literature shows that the SCC is quite sensitive to assumptions about the discount rate, and because no consensus exists on the appropriate rate to use in an intergenerational context, we present SCCs based on the average values across models and socioeconomic scenarios for each discount rate.

The interagency group selected four SCC values for use in regulatory analyses. Three values are based on the average SCC across models and socio-economic and emissions scenarios at the 2.5, 3, and 5 percent discount rates. The fourth value is included to represent the higher-than-expected economic impacts from climate change further out in the tails of the SCC distribution. For this purpose, we use the SCC value for the 95th percentile at a 3 percent discount rate. (The full set of distributions by model and scenario combination is included in the Appendix.) As noted above, the 3 percent discount rate is the central value, and so the central value that emerges is the average SCC across models at the 3 percent discount rate. For purposes of capturing the uncertainties involved in regulatory impact analysis, we emphasize the importance and value of considering the full range.

As previously discussed, low probability, high impact events are incorporated into the SCC values through explicit consideration of their effects in two of the three models as well as the use of a probability density function for equilibrium climate sensitivity. Treating climate sensitivity probabilistically results in more high temperature outcomes, which in turn lead to higher projections of damages. Although FUND does not include catastrophic damages (in contrast to the other two models), its probabilistic treatment of the equilibrium climate sensitivity parameter will directly affect the non-catastrophic damages that are a function of the rate of temperature change.

In Table 3, we begin by presenting SCC estimates for 2010 by model, scenario, and discount rate to illustrate the variability in the SCC across each of these input parameters. As expected, higher discount rates consistently result in lower SCC values, while lower discount rates result in higher SCC values for each socioeconomic trajectory. It is also evident that there are differences in the SCC estimated across the three main models. For these estimates, FUND produces the lowest estimates, while PAGE generally produces the highest estimates.

Table 3: Disaggregated Social Cost of CO_2 Values by Model, Socio-Economic Trajectory, and Discount Rate for 2010 (in 2007 dollars)

	Discount rate:	**5%**	**3%**	**2.5%**	**3%**
Model	*Scenario*	Avg	Avg	Avg	95th
DICE	IMAGE	10.8	35.8	54.2	70.8
	MERGE	7.5	22.0	31.6	42.1
	Message	9.8	29.8	43.5	58.6
	MiniCAM	8.6	28.8	44.4	57.9
	550 Average	8.2	24.9	37.4	50.8
PAGE	IMAGE	8.3	39.5	65.5	142.4
	MERGE	5.2	22.3	34.6	82.4
	Message	7.2	30.3	49.2	115.6
	MiniCAM	6.4	31.8	54.7	115.4
	550 Average	5.5	25.4	42.9	104.7
FUND	IMAGE	-1.3	8.2	19.3	39.7
	MERGE	-0.3	8.0	14.8	41.3
	Message	-1.9	3.6	8.8	32.1
	MiniCAM	-0.6	10.2	22.2	42.6
	550 Average	-2.7	-0.2	3.0	19.4

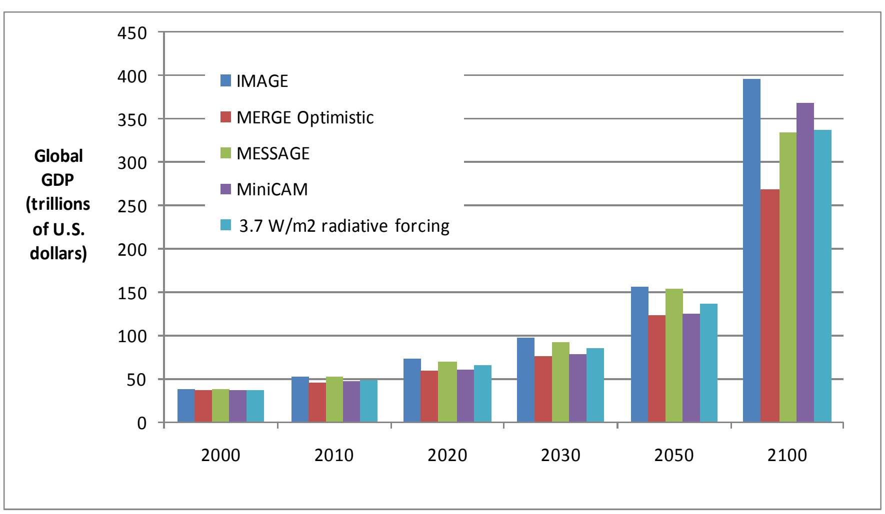
These results are not surprising when compared to the estimates in the literature for the latest versions of each model. For example, adjusting the values from the literature that were used to develop interim

SCC values to 2007 dollars for the year 2010 (assuming, as we did for the interim process, that SCC grows at 3 percent per year), FUND yields SCC estimates at or near zero for a 5 percent discount rate and around $9 per ton for a 3 percent discount rate. There are far fewer estimates using the latest versions of DICE and PAGE in the literature: Using similar adjustments to generate 2010 estimates, we calculate a SCC from DICE (based on Nordhaus 2008) of around $9 per ton for a 5 percent discount rate, and a SCC from PAGE (based on Hope 2006, 2008) close to $8 per ton for a 4 percent discount rate. Note that these comparisons are only approximate since the literature generally relies on Ramsey discounting, while we have assumed constant discount rates.[27]

The SCC estimates from FUND are sensitive to differences in emissions paths but relatively insensitive to differences in GDP paths across scenarios, while the reverse is true for DICE and PAGE. This likely occurs because of several structural differences among the models. Specifically in DICE and PAGE, the fraction of economic output lost due to climate damages increases with the level of temperature alone, whereas in FUND the fractional loss also increases with the rate of temperature change. Furthermore, in FUND increases in income over time decrease vulnerability to climate change (a form of adaptation), whereas this does not occur in DICE and PAGE. These structural differences among the models make FUND more sensitive to the path of emissions and less sensitive to GDP compared to DICE and PAGE.

Figure 3 shows that IMAGE has the highest GDP in 2100 while MERGE Optimistic has the lowest. The ordering of global GDP levels in 2100 directly corresponds to the rank ordering of SCC for PAGE and DICE. For FUND, the correspondence is less clear, a result that is to be expected given its less direct relationship between its damage function and GDP.

Figure 3: Level of Global GDP across EMF Scenarios



[27] Nordhaus (2008) runs DICE2007 with ρ = 1.5 and η = 2. The default approach in PAGE2002 (version 1.4epm) treats ρ and η as random parameters, specified using a triangular distribution such that the min, mode, and max = 0.1, 1, and 2 for ρ, and 0.5, 1, and 2 for η, respectively. The FUND default value for η is 1, and Tol generates SCC estimates for values of ρ = 0, 1, and 3 in many recent papers (e.g. Anthoff et al. 2009). The path of per-capita consumption growth, g, varies over time but is treated deterministically in two of the three models. In DICE, g is endogenous. Under Ramsey discounting, as economic growth slows in the future, the large damages from climate change that occur far out in the future are discounted at a lower rate than impacts that occur in the nearer term.

Table 4 shows the four selected SCC values in five year increments from 2010 to 2050. Values for 2010, 2020, 2040, and 2050 are calculated by first combining all outputs (10,000 estimates per model run) from all scenarios and models for a given discount rate. Values for the years in between are calculated using a simple linear interpolation.

Table 4: Social Cost of CO_2, 2010 – 2050 (in 2007 dollars)

Discount Rate Year	5% Avg	3% Avg	2.5% Avg	3% 95th
2010	4.7	21.4	35.1	64.9
2015	5.7	23.8	38.4	72.8
2020	6.8	26.3	41.7	80.7
2025	8.2	29.6	45.9	90.4
2030	9.7	32.8	50.0	100.0
2035	11.2	36.0	54.2	109.7
2040	12.7	39.2	58.4	119.3
2045	14.2	42.1	61.7	127.8
2050	15.7	44.9	65.0	136.2

The SCC increases over time because future emissions are expected to produce larger incremental damages as physical and economic systems become more stressed in response to greater climatic change. Note that this approach allows us to estimate the growth rate of the SCC directly using DICE, PAGE, and FUND rather than assuming a constant annual growth rate as was done for the interim estimates (using 3 percent). This helps to ensure that the estimates are internally consistent with other modeling assumptions. Table 5 illustrates how the growth rate for these four SCC estimates varies over time. The full set of annual SCC estimates between 2010 and 2050 is reported in the Appendix.

Table 5: Changes in the Average Annual Growth Rates of SCC Estimates between 2010 and 2050

Average Annual Growth Rate (%)	**5%** Avg	**3%** Avg	**2.5%** Avg	**3.0%** 95th
2010-2020	3.6%	2.1%	1.7%	2.2%
2020-2030	3.7%	2.2%	1.8%	2.2%
2030-2040	2.7%	1.8%	1.6%	1.8%
2040-2050	2.1%	1.4%	1.1%	1.3%

While the SCC estimate grows over time, the future monetized value of emissions reductions in each year (the SCC in year *t* multiplied by the change in emissions in year *t*) must be discounted to the present to determine its total net present value for use in regulatory analysis. Damages from future emissions should be discounted at the same rate as that used to calculate the SCC estimates themselves to ensure internal consistency—i.e., future damages from climate change, whether they result from emissions today or emissions in a later year, should be discounted using the same rate. For example, climate damages in the year 2020 that are calculated using a SCC based on a 5 percent discount rate also should be discounted back to the analysis year using a 5 percent discount rate.[28]

V. Limitations of the Analysis

As noted, any estimate of the SCC must be taken as provisional and subject to further refinement (and possibly significant change) in accordance with evolving scientific, economic, and ethical understandings. During the course of our modeling, it became apparent that there are several areas in particular need of additional exploration and research. These caveats, and additional observations in the following section, are necessary to consider when interpreting and applying the SCC estimates.

Incomplete treatment of non-catastrophic damages. The impacts of climate change are expected to be widespread, diverse, and heterogeneous. In addition, the exact magnitude of these impacts is uncertain because of the inherent complexity of climate processes, the economic behavior of current and future populations, and our inability to accurately forecast technological change and adaptation. Current IAMs do not assign value to all of the important physical, ecological, and economic impacts of climate change recognized in the climate change literature (some of which are discussed above) because of lack of precise information on the nature of damages and because the science incorporated into these models understandably lags behind the most recent research. Our ability to quantify and monetize impacts will undoubtedly improve with time. But it is also likely that even in future applications, a number of potentially significant damage categories will remain non-monetized. (Ocean acidification is one example of a potentially large damage from CO_2 emissions not quantified by any of the three models. Species and wildlife loss is another example that is exceedingly difficult to monetize.)

Incomplete treatment of potential catastrophic damages. There has been considerable recent discussion of the risk of catastrophic impacts and how best to account for extreme scenarios, such as the collapse of the Atlantic Meridional Overturning Circulation or the West Antarctic Ice Sheet, or large releases of methane from melting permafrost and warming oceans. Weitzman (2009) suggests that catastrophic damages are extremely large—so large, in fact, that the damages from a low probability, catastrophic event far in the future dominate the effect of the discount rate in a present value calculation and result in an infinite willingness-to-pay for mitigation today. However, Nordhaus (2009) concluded that the conditions under which Weitzman's results hold “are limited and do not apply to a wide range of potential uncertain scenarios."

Using a simplified IAM, Newbold and Daigneault (2009) confirmed the potential for large catastrophe risk premiums but also showed that the aggregate benefit estimates can be highly sensitive to the shapes of both the climate sensitivity distribution and the damage function at high temperature changes. Pindyck (2009) also used a simplified IAM to examine high-impact low-probability risks, using a right-skewed gamma distribution for climate sensitivity as well as an uncertain damage coefficient, but in most cases found only a modest risk premium. Given this difference in opinion, further research in this area is needed before its practical significance can be fully understood and a reasonable approach developed to account for such risks in regulatory analysis. (The next section discusses the scientific evidence on catastrophic impacts in greater detail.)

[28] However, it is possible that other benefits or costs of proposed regulations unrelated to CO_2 emissions will be discounted at rates that differ from those used to develop the SCC estimates.

Uncertainty in extrapolation of damages to high temperatures: The damage functions in these IAMs are typically calibrated by estimating damages at moderate temperature increases (e.g., DICE was calibrated at 2.5 °C) and extrapolated to far higher temperatures by assuming that damages increase as some power of the temperature change. Hence, estimated damages are far more uncertain under more extreme climate change scenarios.

Incomplete treatment of adaptation and technological change: Each of the three integrated assessment models used here assumes a certain degree of low- or no-cost adaptation. For instance, Tol assumes a great deal of adaptation in FUND, including widespread reliance on air conditioning ; so much so, that the largest single benefit category in FUND is the reduced electricity costs from not having to run air conditioning as intensively (NRC 2009).

Climate change also will increase returns on investment to develop technologies that allow individuals to cope with adverse climate conditions, and IAMs to do not adequately account for this directed technological change.[29] For example, scientists may develop crops that are better able to withstand higher and more variable temperatures. Although DICE and FUND have both calibrated their agricultural sectors under the assumption that farmers will change land use practices in response to climate change (Mastrandrea, 2009), they do not take into account technological changes that lower the cost of this adaptation over time. On the other hand, the calibrations do not account for increases in climate variability, pests, or diseases, which could make adaptation more difficult than assumed by the IAMs for a given temperature change. Hence, models do not adequately account for potential adaptation or technical change that might alter the emissions pathway and resulting damages. In this respect, it is difficult to determine whether the incomplete treatment of adaptation and technological change in these IAMs under or overstate the likely damages.

Risk aversion: A key question unanswered during this interagency process is what to assume about relative risk aversion with regard to high-impact outcomes. These calculations do not take into account the possibility that individuals may have a higher willingness to pay to reduce the likelihood of low-probability, high-impact damages than they do to reduce the likelihood of higher-probability but lower-impact damages with the same expected cost. (The inclusion of the 95th percentile estimate in the final set of SCC values was largely motivated by this concern.) If individuals do show such a higher willingness to pay, a further question is whether that fact should be taken into account for regulatory policy. Even if individuals are not risk-averse for such scenarios, it is possible that regulatory policy should include a degree of risk-aversion.

Assuming a risk-neutral representative agent is consistent with OMB's Circular A-4, which advises that the estimates of benefits and costs used in regulatory analysis are usually based on the average or the expected value and that "emphasis on these expected values is appropriate as long as society is 'risk neutral' with respect to the regulatory alternatives. While this may not always be the case, [analysts] should in general assume 'risk neutrality' in [their] analysis."

Nordhaus (2008) points to the need to explore the relationship between risk and income in the context of climate change across models and to explore the role of uncertainty regarding various parameters in

[29] However these research dollars will be diverted from whatever their next best use would have been in the absence of climate change (so productivity/GDP would have been still higher).

the results. Using FUND, Anthoff et al (2009) explored the sensitivity of the SCC to Ramsey equation parameter assumptions based on observed behavior. They conclude that "the assumed rate of risk aversion is at least as important as the assumed rate of time preference in determining the social cost of carbon." Since Circular A-4 allows for a different assumption on risk preference in regulatory analysis if it is adequately justified, we plan to continue investigating this issue.

V. A Further Discussion of Catastrophic Impacts and Damage Functions

As noted above, the damage functions underlying the three IAMs used to estimate the SCC may not capture the economic effects of all possible adverse consequences of climate change and may therefore lead to underestimates of the SCC (Mastrandrea 2009). In particular, the models' functional forms may not adequately capture: (1) potentially discontinuous "tipping point" behavior in Earth systems, (2) inter-sectoral and inter-regional interactions, including global security impacts of high-end warming, and (3) limited near-term substitutability between damage to natural systems and increased consumption.

It is the hope of the interagency group that over time researchers and modelers will work to fill these gaps and that the SCC estimates used for regulatory analysis by the Federal government will continue to evolve with improvements in modeling. In the meantime, we discuss some of the available evidence.

Extrapolation of climate damages to high levels of warming

The damage functions in the models are calibrated at moderate levels of warming and should therefore be viewed cautiously when extrapolated to the high temperatures found in the upper end of the distribution. Recent science suggests that there are a number of potential climatic "tipping points" at which the Earth system may exhibit discontinuous behavior with potentially severe social and economic consequences (e.g., Lenton et al, 2008, Kriegler et al., 2009). These tipping points include the disruption of the Indian Summer Monsoon, dieback of the Amazon Rainforest and boreal forests, collapse of the Greenland Ice Sheet and the West Antarctic Ice Sheet, reorganization of the Atlantic Meridional Overturning Circulation, strengthening of El Niño-Southern Oscillation, and the release of methane from melting permafrost. Many of these tipping points are estimated to have thresholds between about 3 °C and 5 °C (Lenton et al., 2008). Probabilities of several of these tipping points were assessed through expert elicitation in 2005–2006 by Kriegler et al. (2009); results from this study are highlighted in Table 6. Ranges of probability are averaged across core experts on each topic.

As previously mentioned, FUND does not include potentially catastrophic effects. DICE assumes a small probability of catastrophic damages that increases with increased warming, but the damages from these risks are incorporated as expected values (i.e., ignoring potential risk aversion). PAGE models catastrophic impacts in a probabilistic framework (see Figure 1), so the high-end output from PAGE potentially offers the best insight into the SCC if the world were to experience catastrophic climate change. For instance, at the 95th percentile and a 3 percent discount rate, the SCC estimated by PAGE across the five socio-economic and emission trajectories of \$113 per ton of CO_2 is almost double the value estimated by DICE, \$58 per ton in 2010. We cannot evaluate how well the three models account for catastrophic or non-catastrophic impacts, but this estimate highlights the sensitivity of SCC values in the tails of the distribution to the assumptions made about catastrophic impacts.

Table 6: Probabilities of Various Tipping Points from Expert Elicitation -

Possible Tipping Points	Duration before effect is fully realized (in years)	Additional Warming by 2100		
		0.5-1.5 C	1.5-3.0 C	3-5 C
Reorganization of Atlantic Meridional Overturning Circulation	about 100	0-18%	6-39%	18-67%
Greenland Ice Sheet collapse	at least 300	8-39%	33-73%	67-96%
West Antarctic Ice Sheet collapse	at least 300	5-41%	10-63%	33-88%
Dieback of Amazon rainforest	about 50	2-46%	14-84%	41-94%
Strengthening of El Niño-Southern Oscillation	about 100	1-13%	6-32%	19-49%
Dieback of boreal forests	about 50	13-43%	20-81%	34-91%
Shift in Indian Summer Monsoon	about 1	Not formally assessed		
Release of methane from melting permafrost	Less than 100	Not formally assessed.		

PAGE treats the possibility of a catastrophic event probabilistically, while DICE treats it deterministically (that is, by adding the expected value of the damage from a catastrophe to the aggregate damage function). In part, this results in different probabilities being assigned to a catastrophic event across the two models. For instance, PAGE places a probability near zero on a catastrophe at 2.5 °C warming, while DICE assumes a 4 percent probability of a catastrophe at 2.5 °C. By comparison, Kriegler et al. (2009) estimate a probability of at least 16-36 percent of crossing at least one of their primary climatic tipping points in a scenario with temperatures about 2-4 °C warmer than pre-Industrial levels in 2100.

It is important to note that crossing a climatic tipping point will not necessarily lead to an economic catastrophe in the sense used in the IAMs. A tipping point is a critical threshold across which some aspect of the Earth system starts to shifts into a qualitatively different state (for instance, one with dramatically reduced ice sheet volumes and higher sea levels). In the IAMs, a catastrophe is a low-probability environmental change with high economic impact.

Failure to incorporate inter-sectoral and inter-regional interactions

The damage functions do not fully incorporate either inter-sectoral or inter-regional interactions. For instance, while damages to the agricultural sector are incorporated, the effects of changes in food supply on human health are not fully captured and depend on the modeler's choice of studies used to calibrate the IAM. Likewise, the effects of climate damages in one region of the world on another region are not included in some of the models (FUND includes the effects of migration from sea level rise). These inter-regional interactions, though difficult to quantify, are the basis for climate-induced national and economic security concerns (e.g., Campbell et al., 2007; U.S. Department of Defense 2010) and are particularly worrisome at higher levels of warming. High-end warming scenarios, for instance, project water scarcity affecting 4.3-6.9 billion people by 2050, food scarcity affecting about 120 million additional people by 2080, and the creation of millions of climate refugees (Easterling et al., 2007; Campbell et al., 2007).

Imperfect substitutability of environmental amenities

Data from the geological record of past climate changes suggests that 6 °C of warming may have severe consequences for natural systems. For instance, during the Paleocene-Eocene Thermal Maximum about 55.5 million years ago, when the Earth experienced a geologically rapid release of carbon associated with an approximately 5 °C increase in global mean temperatures, the effects included shifts of about 400-900 miles in the range of plants (Wing et al., 2005), and dwarfing of both land mammals (Gingerich, 2006) and soil fauna (Smith et al., 2009).

The three IAMs used here assume that it is possible to compensate for the economic consequences of damages to natural systems through increased consumption of non-climate goods, a common assumption in many economic models. In the context of climate change, however, it is possible that the damages to natural systems could become so great that no increase in consumption of non-climate goods would provide complete compensation (Levy et al., 2005). For instance, as water supplies become scarcer or ecosystems become more fragile and less bio-diverse, the services they provide may become increasingly more costly to replace. Uncalibrated attempts to incorporate the imperfect substitutability of such amenities into IAMs (Sterner and Persson, 2008) indicate that the optimal degree of emissions abatement can be considerably greater than is commonly recognized.

VI. Conclusion

The interagency group selected four SCC estimates for use in regulatory analyses. For 2010, these estimates are $5, $21, $35, and $65 (in 2007 dollars). The first three estimates are based on the average SCC across models and socio-economic and emissions scenarios at the 5, 3, and 2.5 percent discount rates, respectively. The fourth value is included to represent the higher-than-expected impacts from temperature change further out in the tails of the SCC distribution. For this purpose, we use the SCC value for the 95^{th} percentile at a 3 percent discount rate. The central value is the average SCC across models at the 3 percent discount rate. For purposes of capturing the uncertainties involved in regulatory impact analysis, we emphasize the importance and value of considering the full range. These SCC estimates also grow over time. For instance, the central value increases to $24 per ton of CO_2 in 2015 and $26 per ton of CO_2 in 2020.

We noted a number of limitations to this analysis, including the incomplete way in which the integrated assessment models capture catastrophic and non-catastrophic impacts, their incomplete treatment of adaptation and technological change, uncertainty in the extrapolation of damages to high temperatures, and assumptions regarding risk aversion. The limited amount of research linking climate impacts to economic damages makes this modeling exercise even more difficult. It is the hope of the interagency group that over time researchers and modelers will work to fill these gaps and that the SCC estimates used for regulatory analysis by the Federal government will continue to evolve with improvements in modeling.

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Appendix

Table A1: Annual SCC Values: 2010–2050 (in 2007 dollars)

Discount Rate Year	5% Avg	3% Avg	2.5% Avg	3% 95th
2010	4.7	21.4	35.1	64.9
2011	4.9	21.9	35.7	66.5
2012	5.1	22.4	36.4	68.1
2013	5.3	22.8	37.0	69.6
2014	5.5	23.3	37.7	71.2
2015	5.7	23.8	38.4	72.8
2016	5.9	24.3	39.0	74.4
2017	6.1	24.8	39.7	76.0
2018	6.3	25.3	40.4	77.5
2019	6.5	25.8	41.0	79.1
2020	6.8	26.3	41.7	80.7
2021	7.1	27.0	42.5	82.6
2022	7.4	27.6	43.4	84.6
2023	7.7	28.3	44.2	86.5
2024	7.9	28.9	45.0	88.4
2025	8.2	29.6	45.9	90.4
2026	8.5	30.2	46.7	92.3
2027	8.8	30.9	47.5	94.2
2028	9.1	31.5	48.4	96.2
2029	9.4	32.1	49.2	98.1
2030	9.7	32.8	50.0	100.0
2031	10.0	33.4	50.9	102.0
2032	10.3	34.1	51.7	103.9
2033	10.6	34.7	52.5	105.8
2034	10.9	35.4	53.4	107.8
2035	11.2	36.0	54.2	109.7
2036	11.5	36.7	55.0	111.6
2037	11.8	37.3	55.9	113.6
2038	12.1	37.9	56.7	115.5
2039	12.4	38.6	57.5	117.4
2040	12.7	39.2	58.4	119.3
2041	13.0	39.8	59.0	121.0
2042	13.3	40.4	59.7	122.7
2043	13.6	40.9	60.4	124.4
2044	13.9	41.5	61.0	126.1
2045	14.2	42.1	61.7	127.8
2046	14.5	42.6	62.4	129.4
2047	14.8	43.2	63.0	131.1
2048	15.1	43.8	63.7	132.8
2049	15.4	44.4	64.4	134.5
2050	15.7	44.9	65.0	136.2

This Appendix also provides additional technical information about the non-CO_2 emission projections used in the modeling and the method for extrapolating emissions forecasts through 2300, and shows the full distribution of 2010 SCC estimates by model and scenario combination.

1. Other (non-CO_2) gases

In addition to fossil and industrial CO_2 emissions, each EMF scenario provides projections of methane (CH_4), nitrous oxide (N_2O), fluorinated gases, and net land use CO_2 emissions to 2100. These assumptions are used in all three IAMs while retaining each model's default radiative forcings (RF) due to other factors (e.g., aerosols and other gases). Specifically, to obtain the RF associated with the non-CO_2 EMF emissions only, we calculated the RF associated with the EMF atmospheric CO_2 concentrations and subtracted them from the EMF total RF.[30] This approach respects the EMF scenarios as much as possible and at the same time takes account of those components not included in the EMF projections. Since each model treats non-CO_2 gases differently (e.g., DICE lumps all other gases into one composite exogenous input), this approach was applied slightly differently in each of the models.

<u>FUND</u>: Rather than relying on RF for these gases, the actual emissions from each scenario were used in FUND. The model default trajectories for CH_4, N_20, SF_6, and the CO_2 emissions from land were replaced with the EMF values.

<u>PAGE</u>: PAGE models CO_2, CH_4, sulfur hexafluoride (SF_6), and aerosols and contains an "excess forcing" vector that includes the RF for everything else. To include the EMF values, we removed the default CH_4 and SF_6 factors[31], decomposed the excess forcing vector, and constructed a new excess forcing vector that includes the EMF RF for CH_4, N_20, and fluorinated gases, as well as the model default values for aerosols and other factors. Net land use CO_2 emissions were added to the fossil and industrial CO_2 emissions pathway.

<u>DICE</u>: DICE presents the greatest challenge because all forcing due to factors other than industrial CO_2 emissions is embedded in an exogenous non-CO_2 RF vector. To decompose this exogenous forcing path into EMF non-CO_2 gases and other gases, we relied on the references in DICE2007 to the Intergovernmental Panel on Climate Change's (IPCC) Fourth Assessment Report (AR4) and the discussion of aerosol forecasts in the IPCC's Third Assessment Report (TAR) and in AR4, as explained below. In DICE2007, Nordhaus assumes that exogenous forcing from all non-CO_2 sources is -0.06 W/m^2 in 2005, as reported in AR4, and increases linearly to 0.3 W/m^2 in 2105, based on GISS projections, and then stays constant after that time.

[30] Note EMF did not provide CO_2 concentrations for the IMAGE reference scenario. Thus, for this scenario, we fed the fossil, industrial and land CO_2 emissions into MAGICC (considered a "neutral arbiter" model, which is tuned to emulate the major global climate models) and the resulting CO_2 concentrations were used. Note also that MERGE assumes a neutral biosphere so net land CO_2 emissions are set to zero for all years for the MERGE Optimistic reference scenario, and for the MERGE component of the average 550 scenario (i.e., we add up the land use emissions from the other three models and divide by 4).

[31] Both the model default CH_4 emissions and the initial atmospheric CH_4 is set to zero to avoid double counting the effect of past CH_4 emissions.

According to AR4, the RF in 2005 from CH_4, N_20, and halocarbons (approximately similar to the F-gases in the EMF-22 scenarios) was 0.48 + 0.16 + 0.34 = 0.98 W/m^2 and RF from total aerosols was -1.2 W/m^2. Thus, the -.06 W/m^2 non-CO_2 forcing in DICE can be decomposed into: 0.98 W/m^2 due to the EMF non-CO_2 gases, -1.2 W/m^2 due to aerosols, and the remainder, 0.16 W/m^2, due to other residual forcing.

For subsequent years, we calculated the DICE default RF from aerosols and other non-CO_2 gases based on the following two assumptions:

(1) RF from aerosols declines linearly from 2005 to 2100 at the rate projected by the TAR and then stays constant thereafter, and
(2) With respect to RF from non-CO_2 gases not included in the EMF-22 scenarios, the share of non-aerosol RF matches the share implicit in the AR4 summary statistics cited above and remains constant over time.

Assumption (1) means that the RF from aerosols in 2100 equals 66 percent of that in 2000, which is the fraction of the TAR projection of total RF from aerosols (including sulfates, black carbon, and organic carbon) in 2100 vs. 2000 under the A1B SRES emissions scenario. Since the SRES marker scenarios were not updated for the AR4, the TAR provides the most recent IPCC projection of aerosol forcing. We rely on the A1B projection from the TAR because it provides one of the lower aerosol forecasts among the SRES marker scenarios and is more consistent with the AR4 discussion of the post-SRES literature on aerosols:

Aerosols have a net cooling effect and the representation of aerosol and aerosol precursor emissions, including sulphur dioxide, black carbon and organic carbon, has improved in the post-SRES scenarios. Generally, these emissions are projected to be lower than reported in SRES. {WGIII 3.2, TS.3, SPM}.[32]

Assuming a simple linear decline in aerosols from 2000 to 2100 also is more consistent with the recent literature on these emissions. For example, Figure A1 shows that the sulfur dioxide emissions peak over the short-term of some SRES scenarios above the upper bound estimates of the more recent scenarios.[33] Recent scenarios project sulfur emissions to peak earlier and at lower levels compared to the SRES in part because of new information about present and planned sulfur legislation in some developing countries, such as India and China.[34] The lower bound projections of the recent literature have also shifted downward slightly compared to the SRES scenario (IPCC 2007).

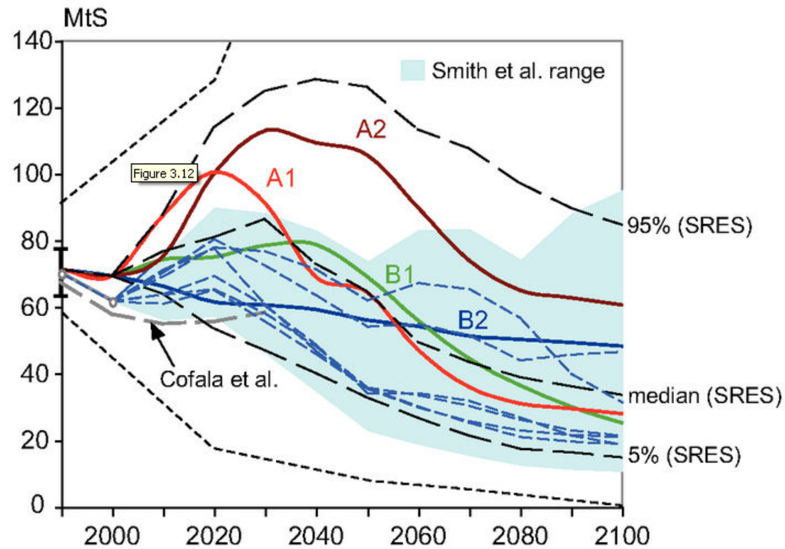
[32] AR4 Synthesis Report, p. 44, http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr.pdf

[33] See Smith, S.J., R. Andres, E. Conception, and J. Lurz, 2004: Historical sulfur dioxide emissions, 1850-2000: methods and results. Joint Global Research Institute, College Park, 14 pp.

[34] See Carmichael, G., D. Streets, G. Calori, M. Amann, M. Jacobson, J. Hansen, and H. Ueda, 2002: Changing trends in sulphur emissions in Asia: implications for acid deposition, air pollution, and climate. Environmental Science and Technology, 36(22):4707- 4713; Streets, D., K. Jiang, X. Hu, J. Sinton, X.-Q. Zhang, D. Xu, M. Jacobson, and J. Hansen, 2001: Recent reductions in China's greenhouse gas emissions. Science, 294(5548): 1835-1837.

With these assumptions, the DICE aerosol forcing changes from -1.2 in 2005 to -0.792 in 2105 W/m^2; forcing due to other non-CO_2 gases not included in the EMF scenarios declines from 0.160 to 0.153 W/m^2.

Figure A1: Sulphur Dioxide Emission Scenarios -



Notes: Thick colored lines depict the four SRES marker scenarios and black dashed lines show the median, 5th and 95th percentile of the frequency distribution for the full ensemble of 40 SRES scenarios. The blue area (and the thin dashed lines in blue) illustrates individual scenarios and the range of Smith et al. (2004). Dotted lines indicate the minimum and maximum of SO_2 emissions scenarios developed pre-SRES.
Source: IPCC (2007), AR4 WGIII 3.2, http://www.ipcc.ch/publications_and_data/ar4/wg3/en/ch3-ens3-2-2-4.html.

Although other approaches to decomposing the DICE exogenous forcing vector are possible, initial sensitivity analysis suggests that the differences among reasonable alternative approaches are likely to be minor. For example, adjusting the TAR aerosol projection above to assume that aerosols will be maintained at 2000 levels through 2100 reduces average SCC values (for 2010) by approximately 3 percent (or less than $2); assuming all aerosols are phased out by 2100 increases average 2010 SCC values by 6-7 percent (or $0.50-$3)–depending on the discount rate. These differences increase slightly for SCC values in later years but are still well within 10 percent of each other as far out as 2050.

Finally, as in PAGE, the EMF net land use CO_2 emissions are added to the fossil and industrial CO_2 emissions pathway.

2. - Extrapolating Emissions Projections to 2300

To run each model through 2300 requires assumptions about GDP, population, greenhouse gas emissions, and radiative forcing trajectories after 2100, the last year for which these projections are available from the EMF-22 models. These inputs were extrapolated from 2100 to 2300 as follows:

1. Population growth rate declines linearly, reaching zero in the year 2200.
2. GDP/ per capita growth rate declines linearly, reaching zero in the year 2300.
3. The decline in the fossil and industrial carbon intensity (CO_2/GDP) growth rate over 2090-2100 is maintained from 2100 through 2300.
4. Net land use CO_2 emissions decline linearly, reaching zero in the year 2200.
5. Non-CO_2 radiative forcing remains constant after 2100.

Long run stabilization of GDP per capita was viewed as a more realistic simplifying assumption than a linear or exponential extrapolation of the pre-2100 economic growth rate of each EMF scenario. This is based on the idea that increasing scarcity of natural resources and the degradation of environmental sinks available for assimilating pollution from economic production activities may eventually overtake the rate of technological progress. Thus, the overall rate of economic growth may slow over the very long run. The interagency group also considered allowing an exponential decline in the growth rate of GDP per capita. However, since this would require an additional assumption about how close to zero the growth rate would get by 2300, the group opted for the simpler and more transparent linear extrapolation to zero by 2300.

The population growth rate is also assumed to decline linearly, reaching zero by 2200. This assumption is reasonably consistent with the United Nations long run population forecast, which estimates global population to be fairly stable after 2150 in the medium scenario (UN 2004).[35] The resulting range of EMF population trajectories (Figure A2) also encompass the UN medium scenario forecasts through 2300 – global population of 8.5 billion by 2200, and 9 billion by 2300.

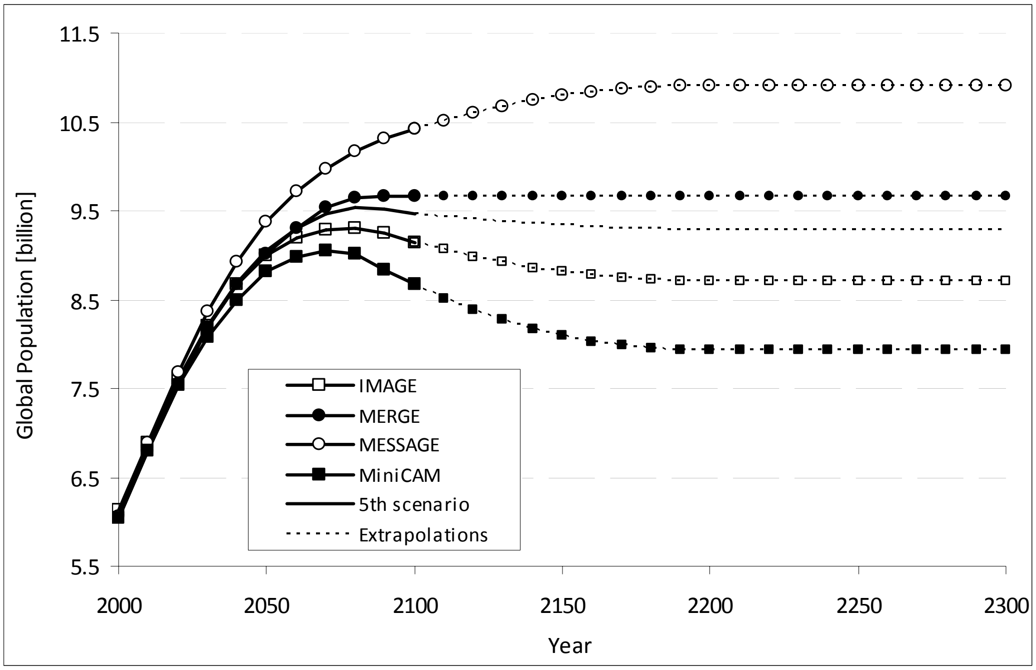
Maintaining the decline in the 2090-2100 carbon intensity growth rate (i.e., CO_2 per dollar of GDP) through 2300 assumes that technological improvements and innovations in the areas of energy efficiency and other carbon reducing technologies (possibly including currently unavailable methods) will continue to proceed at roughly the same pace that is projected to occur towards the end of the forecast period for each EMF scenario. This assumption implies that total cumulative emissions in 2300 will be between 5,000 and 12,000 GtC, which is within the range of the total potential global carbon stock estimated in the literature.

Net land use CO_2 emissions are expected to stabilize in the long run, so in the absence of any post 2100 projections, the group assumed a linear decline to zero by 2200. Given no a priori reasons for assuming a long run increase or decline in non-CO_2 radiative forcing, it is assumed to remain at the 2100 levels for each EMF scenario through 2300.

Figures A2-A7 show the paths of global population, GDP, fossil and industrial CO_2 emissions, net land CO_2 emissions, non-CO_2 radiative forcing, and CO_2 intensity (fossil and industrial CO_2 emissions/GDP) resulting from these assumptions.

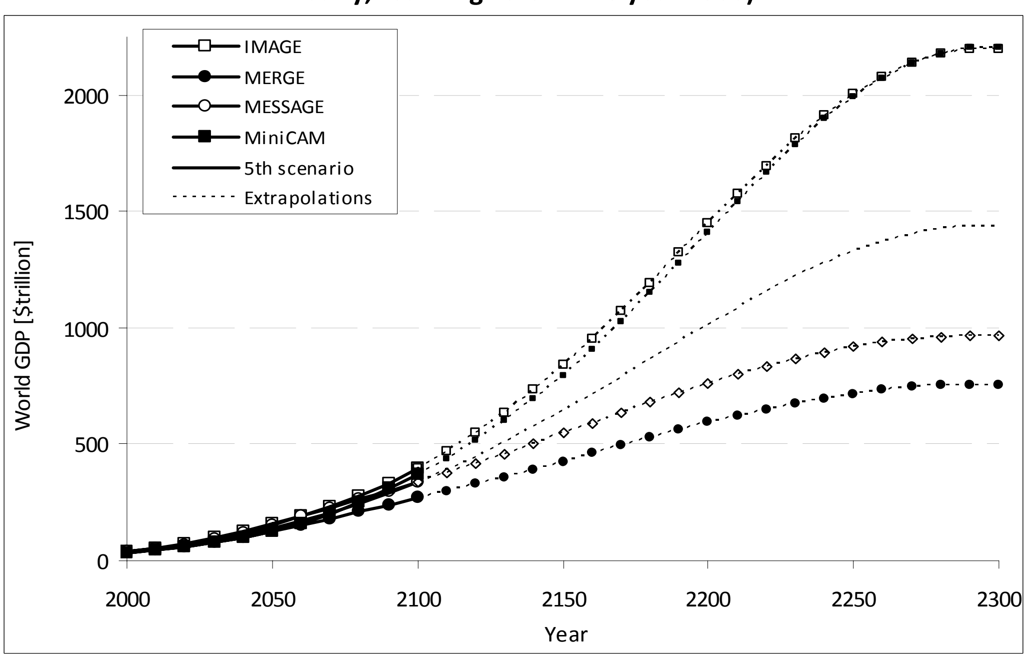
[35] United Nations. 2004. *World Population to 2300*.
http://www.un.org/esa/population/publications/longrange2/worldpop2300final.pdf

Figure A2. Global Population, 2000-2300 (Post-2100 extrapolations assume the population growth rate changes linearly to reach a zero growth rate by 2200.)



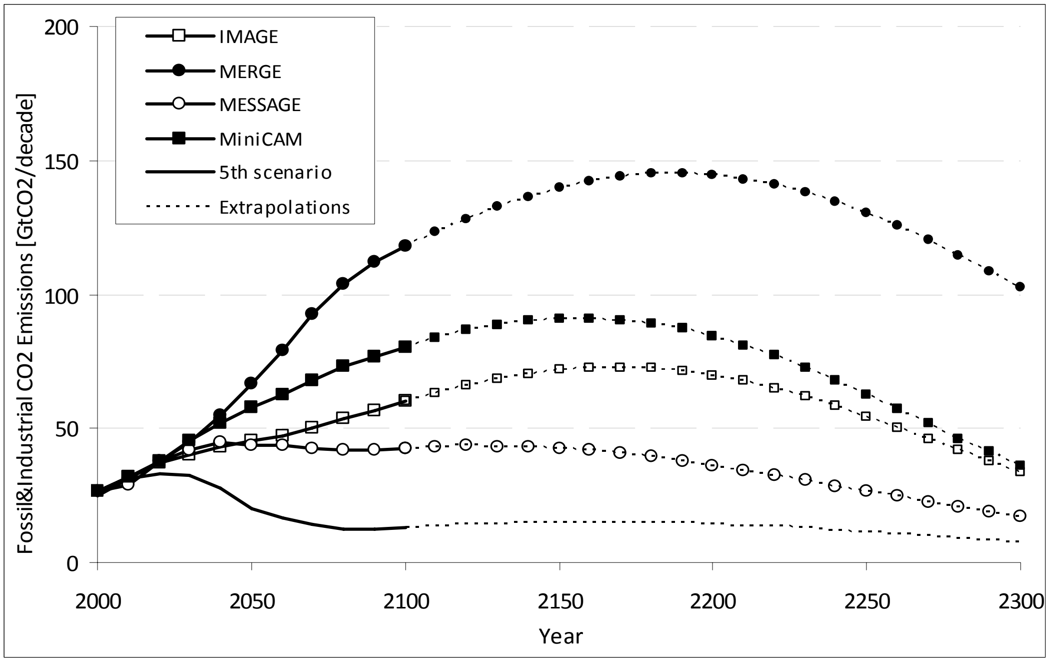
Note: In the fifth scenario, 2000-2100 population is equal to the average of the population under the 550 ppm CO_2e, full-participation, not-to-exceed scenarios considered by each of the four models.

Figure A3. World GDP, 2000-2300 (Post-2100 extrapolations assume GDP per capita growth declines linearly, reaching zero in the year 2300)



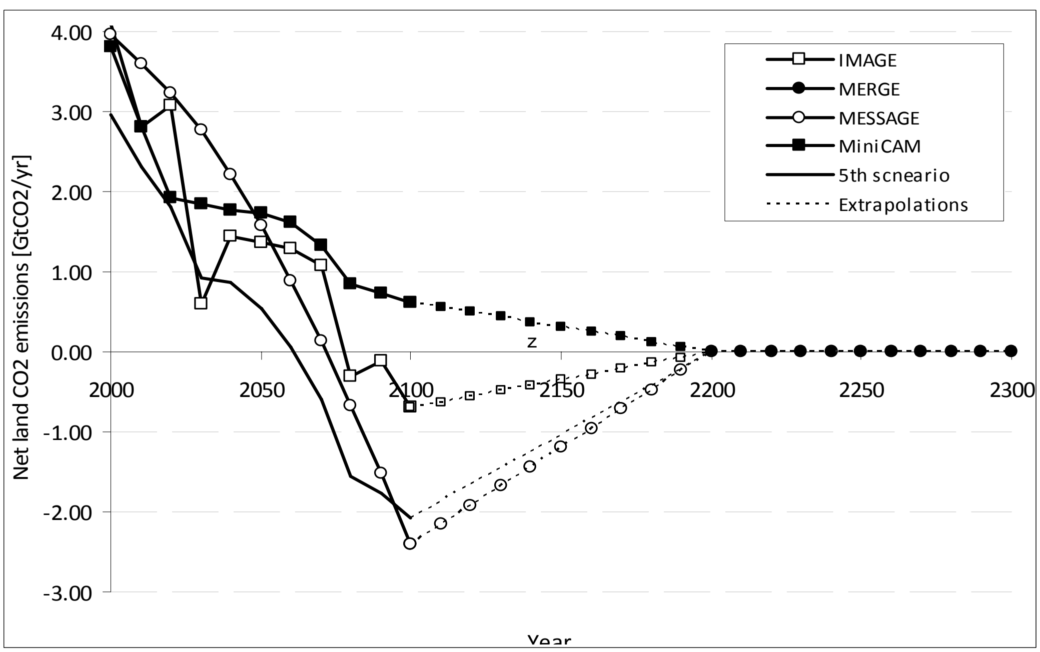
Note: In the fifth scenario, 2000-2100 GDP is equal to the average of the GDP under the 550 ppm CO_2e, full-participation, not-to-exceed scenarios considered by each of the four models.

Figure A4. Global Fossil and Industrial CO_2 Emissions, 2000-2300 (Post-2100 extrapolations assume growth rate of CO_2 intensity (CO_2/GDP) over 2090-2100 is maintained through 2300.)



Note: In the fifth scenario, 2000-2100 emissions are equal to the average of the emissions under the 550 ppm CO2e, full-participation, not-to-exceed scenarios considered by each of the four models.

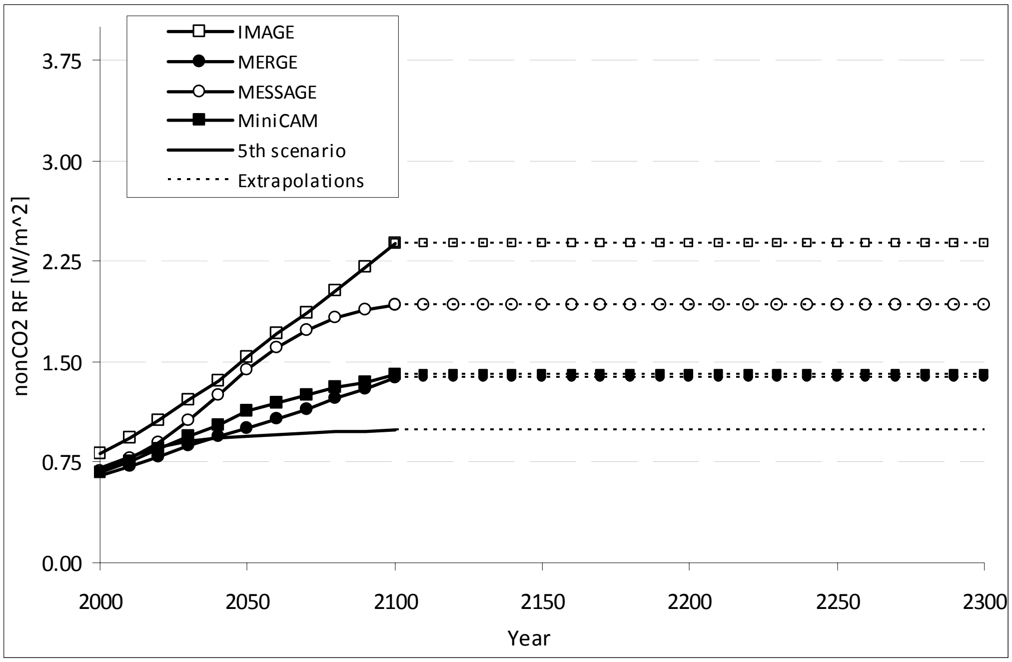
Figure A5. Global Net Land Use CO_2 Emissions, 2000-2300 (Post-2100 extrapolations assume emissions decline linearly, reaching zero in the year 2200)[36]



Note: In the fifth scenario, 2000-2100 emissions are equal to the average of the emissions under the 550 ppm CO2e, full-participation, not-to-exceed scenarios considered by each of the four models.

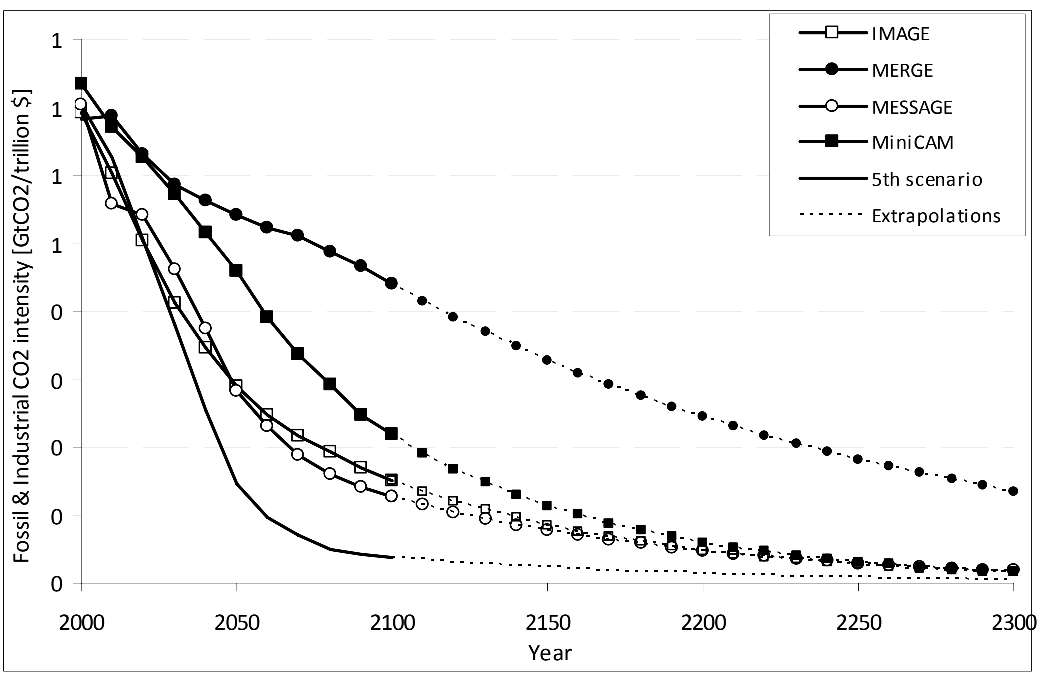
[36] MERGE assumes a neutral biosphere so net land CO_2 emissions are set to zero for all years for the MERGE Optimistic reference scenario, and for the MERGE component of the average 550 scenario (i.e., we add up the land use emissions from the other three models and divide by 4).

Figure A6. Global Non-CO_2 Radiative Forcing, 2000-2300 (Post-2100 extrapolations assume constant non-CO_2 radiative forcing after 2100.)



Note: In the fifth scenario, 2000-2100 emissions are equal to the average of the emissions under the 550 ppm CO2e, full-participation, not-to-exceed scenarios considered by each of the four models.

Figure A7. Global CO_2 Intensity (fossil & industrial CO_2 emissions/GDP), 2000-2300 (Post-2100 extrapolations assume decline in CO_2/GDP growth rate over 2090-2100 is maintained through 2300.)



Note: In the fifth scenario, 2000-2100 emissions are equal to the average of the emissions under the 550 ppm CO_2e, full-participation, not-to-exceed scenarios considered by each of the four models.

Table A2. 2010 Global SCC Estimates at 2.5 Percent Discount Rate (2007$/ton CO_2)

Percentile	1st	5th	10th	25th	50th	Avg	75th	90th	95th	99th
Scenario					PAGE					
IMAGE	3.3	5.9	8.1	13.9	28.8	65.5	68.2	147.9	239.6	563.8
MERGE optimistic	1.9	3.2	4.3	7.2	14.6	34.6	36.2	79.8	124.8	288.3
Message	2.4	4.3	5.8	9.8	20.3	49.2	50.7	114.9	181.7	428.4
MiniCAM base	2.7	4.6	6.4	11.2	22.8	54.7	55.7	120.5	195.3	482.3
5th scenario	2.0	3.5	4.7	8.1	16.3	42.9	41.5	103.9	176.3	371.9
Scenario					DICE					
IMAGE	16.4	21.4	25	33.3	46.8	54.2	69.7	96.3	111.1	130.0
MERGE optimistic	9.7	12.6	14.9	19.7	27.9	31.6	40.7	54.5	63.5	73.3
Message	13.5	17.2	20.1	27	38.5	43.5	55.1	75.8	87.9	103.0
MiniCAM base	13.1	16.7	19.8	26.7	38.6	44.4	56.8	79.5	92.8	109.3
5th scenario	10.8	14	16.7	22.2	32	37.4	47.7	67.8	80.2	96.8
Scenario					FUND					
IMAGE	-33.1	-18.9	-13.3	-5.5	4.1	19.3	18.7	43.5	67.1	150.7
MERGE optimistic	-33.1	-14.8	-10	-3	5.9	14.8	20.4	43.9	65.4	132.9
Message	-32.5	-19.8	-14.6	-7.2	1.5	8.8	13.8	33.7	52.3	119.2
MiniCAM base	-31.0	-15.9	-10.7	-3.4	6	22.2	21	46.4	70.4	152.9
5th scenario	-32.2	-21.6	-16.7	-9.7	-2.3	3	6.7	20.5	34.2	96.8

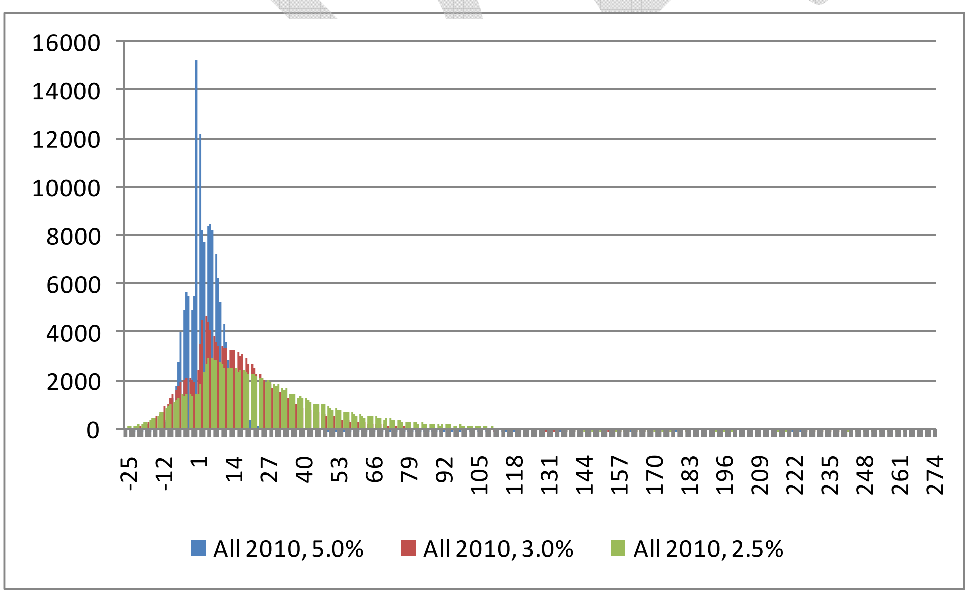
Table A3. 2010 Global SCC Estimates at 3 Percent Discount Rate (2007$/ton CO_2)

Percentile	1st	5th	10th	25th	50th	Avg	75th	90th	95th	99th
Scenario					PAGE					
IMAGE	2.0	3.5	4.8	8.1	16.5	39.5	41.6	90.3	142.4	327.4
MERGE optimistic	1.2	2.1	2.8	4.6	9.3	22.3	22.8	51.3	82.4	190.0
Message	1.6	2.7	3.6	6.2	12.5	30.3	31	71.4	115.6	263.0
MiniCAM base	1.7	2.8	3.8	6.5	13.2	31.8	32.4	72.6	115.4	287.0
5th scenario	1.3	2.3	3.1	5	9.6	25.4	23.6	62.1	104.7	222.5
Scenario					DICE					
IMAGE	11.0	14.5	17.2	22.8	31.6	35.8	45.4	61.9	70.8	82.1
MERGE optimistic	7.1	9.2	10.8	14.3	19.9	22	27.9	36.9	42.1	48.8
Message	9.7	12.5	14.7	19	26.6	29.8	37.8	51.1	58.6	67.4
MiniCAM base	8.8	11.5	13.6	18	25.2	28.8	36.9	50.4	57.9	67.8
5th scenario	7.9	10.1	11.8	15.6	21.6	24.9	31.8	43.7	50.8	60.6
Scenario					FUND					
IMAGE	-25.2	-15.3	-11.2	-5.6	0.9	8.2	10.4	25.4	39.7	90.3
MERGE optimistic	-24.0	-12.4	-8.7	-3.6	2.6	8	12.2	27	41.3	85.3
Message	-25.3	-16.2	-12.2	-6.8	-0.5	3.6	7.7	20.1	32.1	72.5
MiniCAM base	-23.1	-12.9	-9.3	-4	2.4	10.2	12.2	27.7	42.6	93.0
5th scenario	-24.1	-16.6	-13.2	-8.3	-3	-0.2	2.9	11.2	19.4	53.6

Table A4. 2010 Global SCC Estimates at 5 Percent Discount Rate (2007$/ton CO_2)

Percentile	1st	5th	10th	25th	50th	Avg	75th	90th	95th	99th
Scenario					PAGE					
IMAGE	0.5	0.8	1.1	1.8	3.5	8.3	8.5	19.5	31.4	67.2
MERGE optimistic	0.3	0.5	0.7	1.2	2.3	5.2	5.4	12.3	19.5	42.4
Message	0.4	0.7	0.9	1.6	3	7.2	7.2	17	28.2	60.8
MiniCAM base	0.3	0.6	0.8	1.4	2.7	6.4	6.6	15.9	24.9	52.6
5th scenario	0.3	0.6	0.8	1.3	2.3	5.5	5	12.9	22	48.7
Scenario					DICE					
IMAGE	4.2	5.4	6.2	7.6	10	10.8	13.4	16.8	18.7	21.1
MERGE optimistic	2.9	3.7	4.2	5.3	7	7.5	9.3	11.7	12.9	14.4
Message	3.9	4.9	5.5	7	9.2	9.8	12.2	15.4	17.1	18.8
MiniCAM base	3.4	4.2	4.7	6	7.9	8.6	10.7	13.5	15.1	16.9
5th scenario	3.2	4	4.6	5.7	7.6	8.2	10.2	12.8	14.3	16.0
Scenario					FUND					
IMAGE	-11.7	-8.4	-6.9	-4.6	-2.2	-1.3	0.7	4.1	7.4	17.4
MERGE optimistic	-10.6	-7.1	-5.6	-3.6	-1.3	-0.3	1.6	5.4	9.1	19.0
Message	-12.2	-8.9	-7.3	-4.9	-2.5	-1.9	0.3	3.5	6.5	15.6
MiniCAM base	-10.4	-7.2	-5.8	-3.8	-1.5	-0.6	1.3	4.8	8.2	18.0
5th scenario	-10.9	-8.3	-7	-5	-2.9	-2.7	-0.8	1.4	3.2	9.2

Figure A8. Histogram of Global SCC Estimates in 2010 (2007$/ton CO_2), by discount rate



* The distribution of SCC values ranges from -$5,192 to $66,116 but the X-axis has been truncated at approximately the 1st and 99th percentiles to better show the data.

Table A5. Additional Summary Statistics of 2010 Global SCC Estimates -

Discount rate:	5%				3%				2.5%			
Scenario	Mean	Variance	Skewness	Kurtosis	Mean	Variance	Skewness	Kurtosis	Mean	Variance	Skewness	Kurtosis
DICE	9.0	13.1	0.8	0.2	28.3	209.8	1.1	0.9	42.2	534.9	1.2	1.1
PAGE	6.5	136.0	6.3	72.4	29.8	3,383.7	8.6	151.0	49.3	9,546.0	8.7	143.8
FUND	-1.3	70.1	28.2	1,479.0	6.0	16,382.5	128.0	18,976.5	13.6	150,732.6	149.0	23,558.3

Appendix J

Long Range Finance Plan 2010 Update

Long Range Finance Plan 2010 Update

October 4, 2010

LRFP Aug 18, 2010

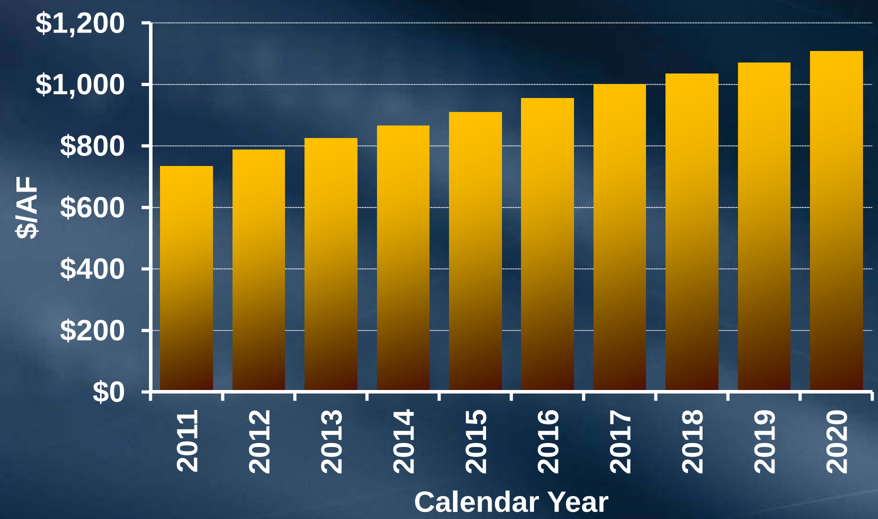
Average Annual Rate Increases About 5% Over Ten Years

Avg Rate Increase	20%	7.5%	7.5%	5%	5%	5%	5%	5%	4%	4%	4%
PAYGO, $M	37	95	125	125	125	125	125	125	125	125	125
Rev. Bond Cvg	1.6	1.9	2.0	2.0	2.2	2.1	2.0	2.0	2.0	2.1	2.1
Fixed Chg Cvg	1.1	1.3	1.4	1.4	1.4	1.3	1.3	1.2	1.2	1.3	1.3

CFO Group October 4, 2010 2

LRFP Aug 18, 2010

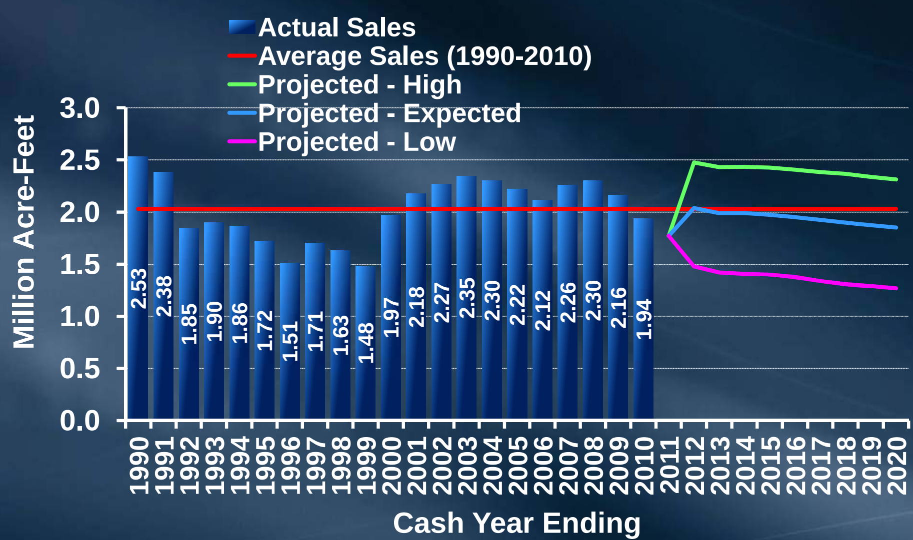
Average Rate



10-Year Rate Forecast

- Align to the IRP
  - Core Resources Strategy plus Water Use Efficiency
    - 20% by 2020 Retail and Regional efficiency
  - Lower water sales over 10-year period
  - Changed water supply, power costs
  - Departmental O&M, SWP capital and OMP&R, and CIP unchanged
  - No enhanced regional programs included
  - Updated 2010/11

Water Sales and Wheeling

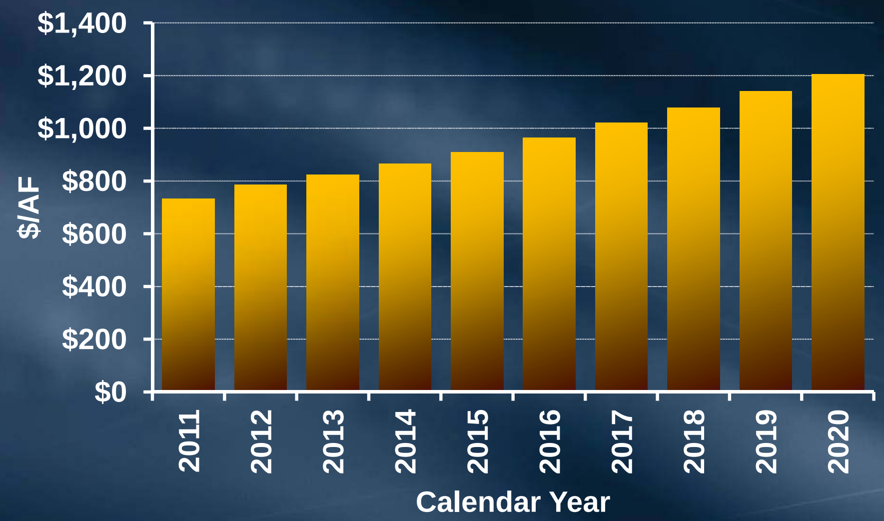


Average Annual Rate Increases About 6% Over Ten Years

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Avg Rate Increase	20%	7.5%	7.5%	5%	5%	5%	6%	6%	6%	6%	6%
PAYGO, $M	37	45	125	125	125	125	125	125	125	125	125
Rev. Bond Cvg	1.6	1.5	2.2	2.1	2.1	2.0	2.0	2.0	2.0	2.0	2.1
Fixed Chg Cvg	1.1	1.0	1.5	1.4	1.4	1.3	1.2	1.2	1.2	1.2	1.3

2010/11 Budget for PAYGO is $95M

Average Rate



Long-Term Estimated Rate Increases
(Based On Existing COS Method)

Rates and Charges Effective January 1 ($/AF)											
	2010*	2011	2012	2013	2014	2015	2016	2017	2017	2019	2020
Untreated Full Service											
Tier 1	$484	$527	$560	$580	$605	$633	$674	$715	$758	$808	$857
Tier 2	$594	$652	$686	$716	$748	$782	$827	$872	$917	$963	$1,009
Untreated Repl.	$366	$409	$442	$462	$487	$515	$556	$597	$640	$690	$739
Untreated Ag.*	$416	$482	$537								
Treated Full Service											
Tier 1	$701	$744	$794	$833	$877	$920	$970	$1,023	$1,079	$1,146	$1,214
Tier 2	$811	$869	$920	$969	$1,020	$1,069	$1,123	$1,180	$1,238	$1,301	$1,366
Treated Repl.	$558	$601	$651	$690	$734	$777	$827	$880	$936	$1,003	$1,071
Treated Ag.**	$615	$687	$765								
Untreated Whlg	$314	$372	$396	$416	$437	$460	$494	$527	$560	$594	$627

* Most rates effective September 1, 2009.
** The Interim Agricultural Water Program will be discontinued after 2012.

Long-Term Estimated Rate Increases
(Based On Existing COS Method)

Rates ($/AF) and Charges Effective January 1											
	2010*	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Tier 1 Supply Rate**	$170	$155	$164	$164	$168	$173	$180	$188	$198	$214	$230
Tier 2 Supply Rate	$280	$280	$290	$300	$311	$322	$333	$345	$357	$369	$382
System Access Rate	$154	$204	$217	$234	$250	$270	$294	$318	$339	$357	$380
Water Stewardship Rate	$41	$41	$43	$46	$51	$54	$55	$58	$58	$58	$58
System Power Rate	$119	$127	$136	$136	$136	$136	$145	$151	$163	$179	$189
Treatment Surcharge	$217	$217	$234	$253	$272	$287	$296	$308	$321	$338	$357
RTS Charge ($M)	$114	$125	$146	$160	$168	$180	$195	$213	$231	$240	$256
Capacity Charge ($/cfs)	$7,200	$7,200	$7,400	$7,400	$7,400	$7,500	$7,800	$8,100	$8,500	$8,900	$9,300

* Most rates effective September 1, 2009.
** Includes Delta Supply Surcharge

Discussion