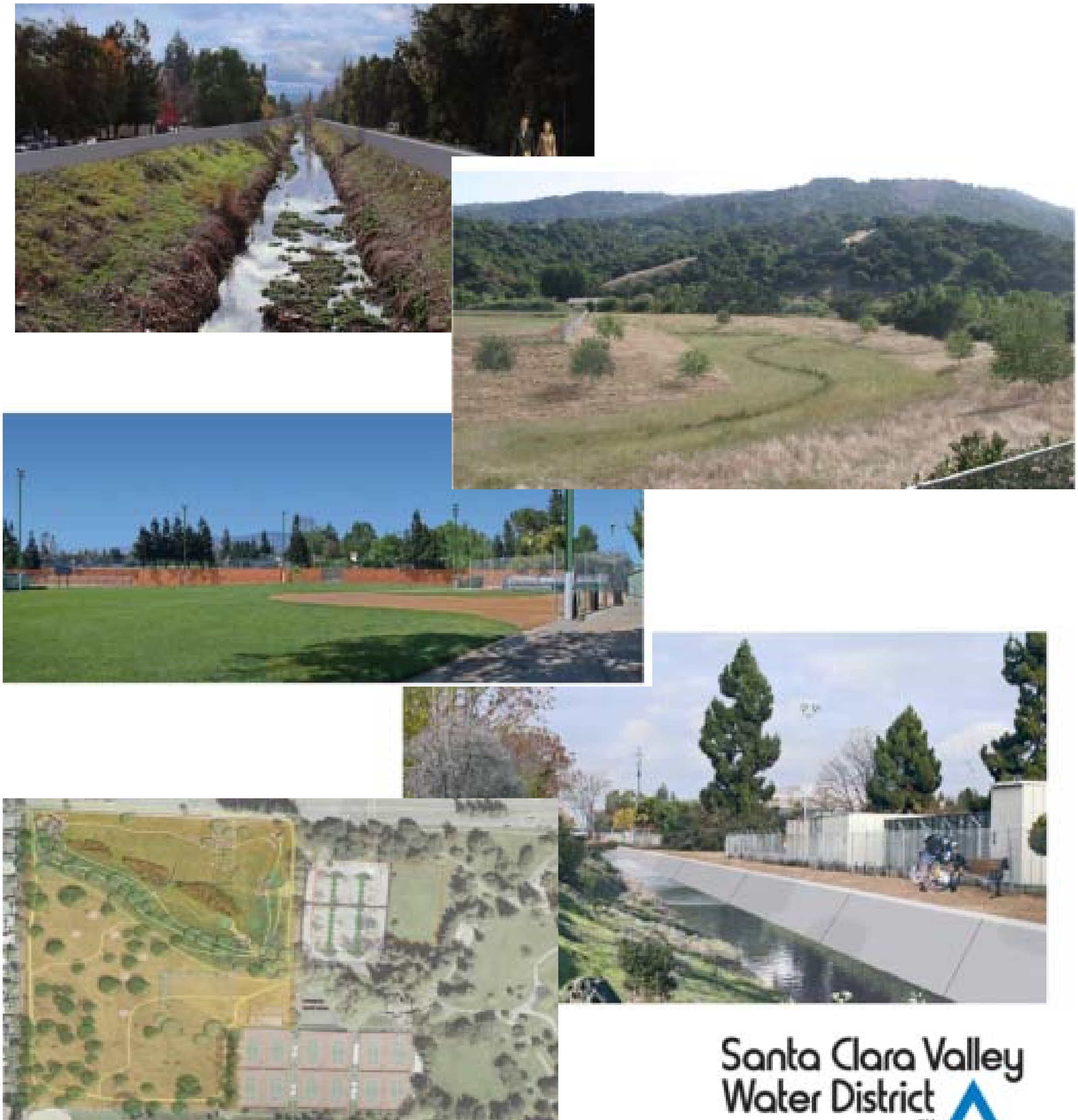
Permanente Creek Flood Protection Project Planning Study Report



Santa Clara Valley Water District

July 2008

Santa Clara Valley Water District

PERMANENTE CREEK FLOOD PROTECTION PROJECT

PLANNING STUDY REPORT

PROJECT NO. 10244001

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EXECUTIVE SUMMARY

Introduction

The Santa Clara Valley at one time supported extensive riparian vegetation and wildlife along the banks of the Lower Peninsula watersheds. The banks of the Permanente and Hale Creeks, prone to regular flooding, supported a diverse and biologically rich habitat. As the valley portions of the watershed were converted to farms and orchards, the creeks were significantly altered. The creek floodplains were converted to farms and then to urbanized use. Flooding became a major problem in the watershed.

The Permanente watershed has a history of recurring floods which have adversely impacted the safety and economic stability of the residents and businesses within the floodplain. Flooding in the watershed has been documented as far back as 1862. Other floods were recorded in 1911, 1940, 1950, 1952, 1955, 1958, 1963, 1968, 1983, 1995, and 1998.

This report presents the flood-related problems in the Permanente Creek watershed. This capital improvement project was initiated as part of the Clean Safe Creeks program, approved by the voters of Santa Clara County in 2000. Based on the District's Ends Policies, a variety of alternatives that would satisfy the project objectives were evaluated. The alternatives were assessed for feasibility and broad environmental impacts. To ensure all concerns were addressed, the recommended alternative was developed in coordination with the cities of Mountain View, Los Altos, and Cupertino, Santa Clara County, resource agencies, stakeholders, and the citizens residing in and owning properties adjacent to recommended project impact areas. The recommended project was selected because it best served the interests of the public and met the District Board of Director's Ends Policies.

This report is prepared in accordance with the District Act, which directs the preparation of plans for a project and reports to be filed with the Board. To comply with the California Environmental Quality Act, an Environmental Impact Report will be prepared to address the recommended project's environmental impacts.

Project Objectives

The project objectives were developed to meet the flood protection commitments made in the Clean, Safe Creeks (CSC) measure. These objectives included the following:

- Provide flood protection to 1,664 parcels downstream of El Camino Real from a 100-year flood;
- Prevent the flooding of Middlefield Road and Central Expressway;
- Develop an asset protection plan for the deteriorating concrete channels built previously;
- Develop guidelines for long term maintenance of the facility; and
- Minimize the cost for maintenance.

Project Alternatives

A thorough range of potential alternatives were reviewed. Twenty-six conceptual alternatives were identified. These included no-project, structural, flood detention, floodproofing, and restoration alternatives. The conceptual alternatives were analyzed for whether they met the project's objectives, were technically buildable, were affordable, and had available right-of-way. The alternatives were thus winnowed to twelve feasible alternatives, which included structural and flood detention alternatives. These feasible alternatives were rated using Natural Flood Protection objectives and compared with each other. The best rated alternative was selected as the staff-recommended alternative.

Public Outreach

Community feedback and support was actively sought during the project planning process of the project. The District created a Permanente Creek Task Force composed of local citizens and staff from the affected cities to assist the project team in planning decisions. The District also held several public meetings at various local venues to discuss the project planning process and gather public input. District staff made several presentations to the city councils of Mountain View, Los Altos, and Cupertino and the County Board of Supervisors to inform them of project progress and seek feedback. District staff has also met with resource agencies and various local stakeholder groups.

Staff-Recommended Alternative

After reviewing the feasible alternatives using Natural Flood Protection objectives, engagement with the community, and feedback received from citizens, the Permanente Task Force, City staff, and elected officials, District staff has identified Alternative Z as the staff-recommended alternative for the Board's consideration. This alternative best meets the project's objectives and the Board's Ends policies. This alternative is composed of the following project elements (see Figure P1 for map):

- Offstream flood detention facilities in:
    - Rancho San Antonio Park
    - Blach Jr. High School
    - Cuesta Park Annex
    - McKelvey Park
- Bypass channel along Hale Creek
- Bypass channel connecting Blach detention and Cuesta Annex detention
- Channel widening along reaches of Permanente Creek and Hale Creek
- Floodwalls north of Highway 101 on levee channels
- A new diversion structure at the Permanente Diversion

There will be an opportunity for restoration, habitat enhancement, and trail extension upstream of Highway 101 for the Board's consideration.

Estimated Project Cost, Financing, and Schedule

The estimated capital cost for the recommended alternative is $58 million in 2008 dollars. The overall (including current effort) current value maintenance cost for the 50-year project length is $22 million. The optional restoration project element would cost $3.5 million. Thus, the overall project cost in 2008 dollars would be $84 million.

Not all of the recommended alternative's elements are needed to meet the CSC measure's protection level. Two of the project elements needed for the overall watershed plan could be built at a later date. This would reduce the project's current capital cost to $40 million. The project's capital budget is approximately $38.6 million.

Project design would be conducted in phases, based on work complexity and outreach effort needed. The design would be conducted from 2009 through 2011. Construction activities for some project elements could commence in 2010, with the entire project completed by 2015.

Project Implementation

If the Board elects to accept the staff recommended alternative and authorize work to continue, the following milestones would be the next steps followed:

- Draft Environmental Impact Report (DEIR) in winter 2008;
- Final project planning report and EIR in spring 2009;
- Certification of EIR and approval of the project planning report in summer 2009;
- Construction commencement in 2010.

Figure P1. Staff Recommended Alternative

CHAPTER 1
BACKGROUND

The Permanente Creek Flood Protection Project's Planning Study Report (PSR) presents the existing flood protection problems in the Permanente Creek watershed. The PSR addresses the impacts of the potential flooding on the Cities of Los Altos and Mountain View. The PSR includes a discussion of the alternatives analyzed, and a recommended capital improvement project. An Environmental Impact Report (EIR) will be prepared separately and contain a discussion of the environmental impacts of, and mitigation for the recommended project.

Public hearings will be held on the PSR and the EIR. Comments will be solicited from the community and responsible agencies. The Santa Clara Valley Water District (District) Board of Directors (Board) will then decide what action, if any, to take.

1.1 Project Background

Recurrent flooding along Permanente and Hale Creeks presents a long term hazard to public health and safety, property values, and economic stability in the Cities of Los Altos and Mountain View. Hydraulic models of Permanente and Hale Creeks have shown that more than 3,000 parcels would likely be subject to flooding in a one-percent event (Figure 1.1 – Watershed Flood Map). Flood protection structures constructed in the 1960's have deteriorated and thousands of feet of concrete channels need to be repaired or replaced.

As part of the Clean, Safe Creeks (CSC) and Natural Flood Protection Program (projects funded by the voter-approved Measure B in November 2000), the District initiated the Permanente Creek Flood Protection Project study to identify flood protection, maintenance, structural repair, and habitat restoration opportunities within the watershed.

1.2 Purpose of the Planning Study Report

This report has been prepared in accordance with the District Act. The report includes the following:

- Background information and project goals and objectives (Chapter 1)
- Watershed description (Chapter 2)
- Problem definition (Chapter 3)
- Formulation of project alternatives (Chapter 4)
- Project Planning Outreach (Chapter 5)
- Recommended project (Chapter 6)
- Description of maintenance program (Chapter 7)
- Project cost, funding, and schedule (Chapter 8)
- Conclusions and recommendations (Chapter 9)

In addition to this report, an EIR will be prepared to address the environmental impacts of the recommended project. The EIR will contain a detailed discussion of the impacts and proposed mitigation measures. The EIR will support decision making by the District and other responsible and cooperating agencies to ensure compliance with the California Environmental Quality Act

(CEQA). The District Board must consider these impacts before making its decision on the project to meet lead agency responsibilities.

1.3 Study Overview

The recommended project proposes improvements from north of Freeway 101 to south of Freeway 280. To assist in discussion of project elements, the watershed has been subdivided into the following reaches (Figure 1.2 – Project Reaches):

Permanente Creek:

- Reach P1: From San Francisco Bay to Boat Pond Bridge
- Reach P2: Boat Pond Bridge to Highway 101
- Reach P3: Highway 101 to Villa Street
- Reach P4: Villa Street to upstream of El Camino Real
- Reach P5: Upstream of El Camino Real to confluence with Hale Creek
- Reach P6: Hale Creek to Cuesta Drive
- Reach P7: Cuesta Drive to Permanente Diversion
- Reach P8: Diversion to Foothill Expressway

Hale Creek:

- Reach H1: Confluence with Permanente Creek to Rosita Avenue
- Reach H2: Rosita Avenue to Foothill Expressway

Permanente Diversion is referred to as reach PD. Also, the creeks upstream of Foothill Expressway are referred as upper watershed reaches.

A number of different alternatives would satisfy the objectives of the District and the affected communities. Each alternative was assessed for its ability to meet project objectives, affordability, and how well in met the Board's Ends Policy.

1.4 Goals and Objectives of the District

The District is the water resource management agency responsible for meeting the flood protection and wholesale water supply needs of Santa Clara County's 1.8 million residents. The mission of the District is a healthy, safe, and enhanced quality of living in Santa Clara County through watershed stewardship and comprehensive management of water resources in a practical, cost-effective, and environmentally-sensitive manner. The District's goals are expressed through the Ends Policies adopted by the Board. These policies are:

Water Supply:

- There is a reliable supply of healthy, clean drinking water.

- The water supply meets or exceeds all applicable water quality regulatory standards in a cost-effective manner.

- The water supply is reliable to meet future demands in Santa Clara County, consistent with the County's and cities' General Plans and other appropriate regional and statewide projections.
- Baseline water supplies for Santa Clara County are safeguarded and maintained.
- The integrity of the District's existing Water Utility infrastructure is maintained.
- Imported water supplies and quality are protected and maintained.
- Groundwater resources are sustained and protected for water supply reliability and to minimize land subsidence.
- The groundwater basins are aggressively protected from contamination and the threat of contamination.
- Water recycling is expanded within Santa Clara County in partnership with the community, consistent with the District's Integrated Water Resources Plan (IWRP), reflecting its comparative cost assessments and other Board policies.
- Water conservation is implemented to the maximum extent that is practical.

Flood Protection:

- There is reduced potential for flood damages.
- There is natural flood protection that balances environmental quality, community benefit and protection from creek flooding in a cost effective manner. In providing flood protection, balance the following multiple objectives:

    1. Homes, schools, businesses, and transportation networks are protected from flooding and erosion.
    2. Ecological functions and processes are supported.
    3. Physical stream functions and processes are integrated.
    4. Maintenance requirements.
    5. Projects are integrated within the watershed as a whole.
    6. The quality and availability of water is protected.
    7. Cooperation with local agencies achieves mutually beneficial goals.
    8. Community benefits beyond flood protection.
    9. Life-cycle costs are minimized.

Environmental Enhancement:

- There is an enhanced quality of life in Santa Clara County through the protection and enhancement of watersheds, streams, and the natural resources therein.
- Mitigations are implemented to protect watersheds, streams, and the natural resources therein.
- Potential Mitigation banking opportunities are identified and implemented as determined appropriate by the Board. In identifying and selecting mitigation banking opportunities, emphasis shall be placed on the environmental benefits.
- Environmental enhancements are implemented to improve watersheds, streams, and the natural resources therein.
- Potential environmental enhancement opportunities are identified to the Board.
- Environmental enhancement opportunities are implemented as determined appropriate by the Board.

1.5 Project Objectives

The project's objectives are:

- Develop a plan for the entire watershed that presents alternatives and a recommendation for providing flood protection for all flows up to the one-percent flood for Permanente Creek, Hale Creek, and the Permanente Diversion between Foothill Expressway and San Francisco Bay.
- Identify opportunities for environmental enhancement such as stream restoration, as well as trails, parks, and open space for the Board consideration.
- Provide flood protection to 1,664 parcels (1,378 homes, 160 businesses and 4 schools/institutions) downstream of El Camino Real from a 100-year flood (saving potential damages in excess of $47.9 million).
- Prevent flooding of Middlefield Road and Central Expressway.
- Develop assets protection plan for the deteriorating facilities of the existing flood control channel along Permanente Creek and Hale Creek.
- Development of guidelines for the long-term maintenance of the facility.
- Minimize the cost for maintenance.

1.6 Previous District Engineering Studies and Capital Projects

This section briefly describes previous District engineering studies, improvement projects, and major maintenance projects. Projects are described in chronological order.

Permanente Diversion Channel

In 1956, a "Preliminary Report on the Improvement of a Portion of Permanente Creek in Zone NW-1, Project 3" was prepared by Thelo A. Perrot Consulting Engineer for the Santa Clara County Flood Control and Water Conservation District. The report was prepared in response to the 1955 flooding, and proposed the construction of a diversion channel which would carry high flows from Permanente Creek to Stevens Creek.

The concrete trapezoidal Permanente Diversion channel was constructed circa 1960. An earthen trapezoidal channel was also constructed on Permanente Creek downstream of Portland Avenue. The work is detailed in the 1959 "Permanente Creek Cross Channel" plans.

Hale Creek Improvements

In 1956, a "Preliminary Engineering Report, Hale Creek Improvement Project No. 9, Zone NW-1" was prepared by Don Reinoehl Consulting Engineers for the Santa Clara County Flood Control and Water Conservation District. The study recommended numerous improvements to Hale Creek, including lining portions of the invert with concrete, building a debris basin upstream of Fremont Avenue, and replacing six bridges and culverts.

Based on this work, in the early 1960's a concrete-lined trapezoidal channel was constructed on Hale Creek beginning at the confluence with Permanente Creek and extending upstream to Rosita Avenue. This work is detailed in the "Hale Creek Improvement Zone N.W.-1 "Northwest"; Project No. 9, Unit 1" plans dated 1959 and 1960.

Permanente Creek – Bay to Highway 101

In the early 1960's, a trapezoidal channel was constructed on Permanente Creek from Mountain View Slough to Highway 101. Portions of the channel were lined with concrete, but the majority of the channel was unlined. The work is detailed in the 1960 "Permanente Creek Improvements" plans.

Permanente Creek Vertical – Walled Concrete Channel

In 1961, a soils report entitled "Proposed Improvements of Permanente Creek" was prepared by Cooper & Clark Consulting Engineers for the Santa Clara County Flood Control and Water Conservation District. The study consisted of the analysis of 9 soil borings from Highway 101 to Mountain View Avenue to determine if the soils were suitable for the construction of a concrete vertical walled channel.

In 1962 a vertical-walled concrete channel was constructed from El Camino Real to Hale Creek. The work is detailed in the 1962 "Permanente Creek – Hale Creek to El Camino Real" plans.

In 1967 a vertical-walled concrete channel was constructed on Permanente Creek from Highway 101 to Villa Street. The project is detailed in the 1965 plans, "Permanente Creek - Bayshore Highway to Villa St."

Permanente Creek – Villa St. Culvert and California/El Camino Culvert

In the early 1960's, two box culverts were constructed: the Villa St. culvert and the California/El Camino culvert. A concrete-line trapezoidal channel was constructed between the two culverts.

The work is detailed in the following plans: "Permanente Creek - El Camino Real to Latham St", 1962; "Permanente Creek - Villa St. to 485 ft. South of Villa St.", 1963; "Permanente Creek - 485 ft. South of Villa St. to California St.", 1964; and "Permanente Creek, California St. to Latham St., 1964.

Mountain View Slough Studies

In 1964, the Santa Clara County Flood Control and Water District prepared a "Report on a Study of Drainage of the Mountain View Bay Front Area and Permanente and Stevens Creeks Outfall Channels." The report proposed that a slotted weir be installed to reduce sedimentation in Mountain View slough. The report also studied methods of draining the lowland areas near the Bay in Mountain View; the study concluded that pumping is the most effective method of draining these areas.

In 1966 the "Mountain View Slough Slotted Weir Study" was prepared by Lynne Burst for the District. This study concluded that a slotted weir in Mountain View Slough, as proposed in the 1964 study, would not be effective in reducing sedimentation in the slough. The slotted weir was therefore not installed.

Mountain View Slough – East Levee Raising

In 1976 the Final Environmental Impact Report on the Proposed Mountain View Slough Levee Repair Project was prepared by the Santa Clara Valley Water District. The report studies the environmental impacts of raising the eastern levee of Mountain View Slough.

In 1993 the eastern levee of the Mountain View Slough was raised. This work is detailed in the 1993 plans, "Permanente Creek, Mt. View Slough East Levee Raising and Maintenance Access Road". The West levee was not altered.

Permanente Creek and Permanente Diversion Planning Study and Improvements

The 1979 "Permanente Creek Planning Study, Final Engineer's Report" addressed flooding, erosion, and sedimentation problems on Permanente Creek from Portland Avenue to Hale Creek and along the Permanente Diversion Channel. The plan recommended modifications to the diversion channel and to the creek near Portland Avenue which would provide 25-year protection to that area. The plan also proposed flood-proofing El Camino Hospital to provide one-percent flood protection. Construction of reservoirs in the upper portion of the watershed was evaluated but could not be justified due to a low benefit/cost ratio.

In 1981 the following work was performed on Permanente Creek: the trapezoidal channel downstream of Portland Avenue was lined with concrete; and sacked concrete was installed in the channel upstream of Cuesta Drive and downstream of Marilyn Drive. In 1981 the following work was also performed on the Permanente Diversion Channel: a 183-centimeter (72-inch) pipe was installed under Blach Jr. High School to supplement the capacity of the existing double box culvert; floodwalls near Carmel Terrace were raised; and the Diversion Channel entrance to the box culvert under Highway 85 was modified. This work was detailed in the 1980 plans "Permanente Diversion and Permanente Creek."

In 1981, El Camino Hospital was flood-proofed to ensure that the hospital was protected against the one-percent flood. Flood-proofing measures included the installation of earth mounds, floodwalls, and ramps.

Permanente Diversion – Remedial Measures at Blach School

In 1984 a study entitled "Permanente Diversion Channel Remedial Flood Control Measures (at Altamead Drive and Blach School), Engineer's Report and Negative Declaration", was prepared to address flooding, sediment and maintenance problems on the Permanente Diversion near Altamead Drive. The study proposed removing the existing buried culverts and replacing them with a vertical-walled open channel in order to allow for easier sediment removal. The study was prepared in response to the 1983 flooding of Blach Jr. High School and surrounding areas.

In 1986 the double box culvert and the 183-centimeter (72-inch) pipe under Blach Jr. High School along the Permanente Diversion Channel were removed and replaced with a vertical-walled concrete channel. This work is detailed in the 1985 plans "Permanente Diversion Channel."

Study of Proposed Permanente Creek Flood Control Dam

In 1996, a report entitled "Preliminary Geologic Evaluation of Permanente Creek for the Proposed Siting of a Flood Control Dam" was prepared by the District to provide a preliminary reconnaissance evaluation of the geological conditions at a proposed dam site in the upper watershed of Permanente Creek. The study concluded that the proposed dam site may not be feasible due to geologic conditions. The study identified two alternative dam sites where geological conditions were more favorable; however, both of these locations would provide less flood storage.

To date, no flood control dam has been constructed in the watershed.

1.7 Previous Studies and Actions by Other Agencies

FEMA Floodplain Studies

In 1980, the Federal Emergency Management Agency (FEMA) published Flood Insurance Studies for the Cities of Mountain View and Los Altos. The purpose of these studies was to identify the existence and severity of flood hazards within these cities.

U.S.G.S. Sediment Studies

In 1989, the U.S. Geological Survey published the Water-Resources Investigations Report 89-4130, "Effects of Limestone Quarrying and Cement-Plant Operations on Runoff and Sediment Yields in the Upper Permanente Creek Basin, Santa Clara County, California. The report was prepared in cooperation with the District. The report quantified the impact of the upstream cement and aggregate quarry on creek sedimentation.

1.8 Cities and Major Property Owners Within the Watershed

City of Mountain View

The northern portion of the Permanente Creek watershed lies within the City of Mountain View. This section relates portions of the City's General Plan dealing with creek issues, as well as the City's Shoreline at Mountain View Park and a proposed pedestrian trail along Permanente Creek.

General Plan

Environmental Management Polices and Actions from the Mountain View General Plan which may be related to flood management within the Permanente Watershed include the following:

- "Protect residents and their property from flood hazards."
- "Preserve and enhance the biological resources in Mountain View."
- "Promote the visibility of and safe physical access to San Francisco Bay, the baylands, Stevens Creek, and other natural resources in the city."
- "Improve open space areas to provide a diversity of recreational and leisure opportunities for the community."

Shoreline at Mountain View

Shoreline at Mountain View is a regional park and nature preserve owned by the City of Mountain View which encompasses 2.52 square kilometers (622 acres). Shoreline at Mountain View is located at the extreme northern end of the City of Mountain View, and is bounded by Amphitheater Parkway to the south and salt ponds to the north. Permanente Creek runs south to north through the center of the park.

The park contains approximately .96 square kilometer (237 acres) of wetland habitat, 0.78 square kilometer (195 acres) of upland habitat, a 0.81 square kilometer (200 acre) golf course, and a sailing lake. The Mountain View Tidal Marsh is located on the east side of the main channel of Permanente Creek, just upstream of the salt ponds. The Mountain View Tidal Marsh is a part of Mountain View Slough, and is connected to the main channel of Permanente Creek.

Shoreline Lake is a small salt-water lake used primarily for windsurfing. The lake is maintained by pumping water into the lake from the Bay, and discharging the overflow into Permanente Creek at an outfall near Shoreline Boulevard.

Prior to the development of Shoreline at Mountain View, a sanitary landfill was created on site. The landfill served the dual purpose of raising money to fund the park, and raising the elevation of the site to reduce the risk of flooding. The large hill (Vista Slope) located on the eastern side of Permanente Creek immediately north of Amphitheater Parkway marks the remains of the inactive landfill. Shoreline Amphitheater, a large outdoor concert venue, is located adjacent to the Vista Slope and Shoreline at Mountain View.

Proposed Permanente Creek Pedestrian Trail

The "City of Mountain View Permanente Creek Development Guidelines" (1996) describes plans for a 1.6 kilometer pedestrian and bicycle trail along the east side of Permanente Creek between Highway 101 and Shoreline Boulevard. Portions of the proposed trail are located within lands held through fee title or easement by the District.

City of Los Altos

The central portion of the Permanente watershed lies within the City of Los Altos. This section relates portions of the City's General Plan dealing with creeks issues.

- "Reduce the potential for flooding along the creeks that traverse Los Altos."
- "… continue to discourage concrete lining of creek beds and encourage Santa Clara Valley Water District to use environmentally sensitive solutions to control local erosion problems.
- … encourage the Santa Clara Valley Water District to regularly maintain creek banks, to clear drainage channels of silt and debris, and to minimize disruption to riparian habitat in an environmentally sensitive manner."
- "Minimize the risk of hazards to Los Altos residents."
- "Preserve and protect natural areas – natural creek channels, topography, and vegetation – which are valuable natural resources."
- "Preserve the natural beauty and rural-suburban atmosphere and the high quality of residential neighborhoods in Los Altos."

County of Santa Clara

The southern (upstream) portion of the Permanente watershed lies within the County of Santa Clara (County). This section relates portions of the County's General Plan dealing with creek issues.

- "Restore wetlands, riparian areas, and other habitats that improve Bay water quality."
- "Improve current knowledge and awareness of habitats and natural areas."
- "Protect the biological integrity of critical habitat areas."
- "Encourage habitat restoration."
- "Develop parks and public open space lands."
- "Minimize the resident population within high hazard areas.
- "Reduce the magnitude of the hazard, if feasible."
- "Reduce non-point source pollution."
- "Prepare and implement comprehensive watershed management plans."

Rancho San Antonio County Park and Rancho San Antonio Open Space Preserve

Rancho San Antonio County Park is located in the foothills southwest of Highway 280 and immediately north of the Hanson Cement Plant and limestone quarry. The park is located within the Permanente watershed. Permanente Creek runs through the center of the park. The 0.7 square kilometer (165 acre) park is mostly undeveloped and contains several hiking, biking, and equestrian trails. Most of the park's development is located along the eastern side of the park; developments include parking lots, picnic areas, tennis, handball and basketball courts and playing fields. The park is owned by the County but operated by the Mid-Peninsula Regional Open Space District (MPROSD)

Rancho San Antonio Open Space Preserve, which is owned and operated by MPROSD, is located in the foothills southwest of Highway 280, immediately west of Rancho San Antonio County Park. The majority of the park's 8.6 square kilometers (2,135 acres) of open space lie within the Permanente Watershed, and most of South Branch Permanente Creek and North Branch Permanente Creek are located within the Preserve. Development within the park includes the Deer Hollow Farm, an interpretive farm which is open to the public, and 37 km (23 miles) of hiking and equestrian trails.

Hanson Cement Plant and Limestone Quarry

The Hanson (formerly Kaiser) Cement Plant and Limestone Quarry is located in the upper Permanente Creek Basin. The limestone mined from the quarry is used for the on site production of cement. The quarry and cement plant operations directly affect over 1.2 square kilometers (300 acres) of the upper Permanente Creek Basin. Minor quarry operations began in 1900; operations increased in 1939, when large amounts of cement were produced for Shasta Dam. Operations have continued at large scale up to the present time. Based on discussions with plant management, plant operations will continue into the foreseeable future.

Cargill Salt Ponds/ Federal Wetlands Restoration Area

Salt evaporation ponds formerly owned by Cargill Incorporated (formerly Leslie Salt Co.) and now owned by the United States covering a total area of over 3.2 square kilometers (800 acres), are located adjacent to both sides of Reach P1 of Permanente Creek (along Mountain View Slough). The salt ponds are bound to the north by San Francisco Bay, and to the south by Shoreline at Mountain View. These two ponds are the first two in the salt-making chain that ringed the South Bay; therefore, they are the least saline of the salt ponds.

Both the east and west creek levees were owned by Cargill. The District had an agreement with Cargill to maintain the east levee at an elevation of 9.5 feet above mean sea level; the District has no responsibility to maintain the west levee. The ponds have been purchased by the U.S. Fish and Wildlife Service for the South Bay Salt Pond Restoration Project, which is a long-term planning effort underway to determine the restoration plan for the ponds. The current preliminary plan is to restore the ponds back to their natural salt marsh habitat, although schedules and means have not yet been determined.

1.9 The Recommended Capital Improvement Project

After evaluating a thorough range of alternatives, including several alternatives that met the project objectives and the District Board's Ends Policies and the No Project alternative, this report recommends a capital improvement project to be constructed. The recommended project would improve flood protection for the citizens of Mountain View and Los Altos, would improve flood protection for local streets and utilities, would address the long term deterioration of the previously built concrete channels, and would provide opportunities for environmental enhancements and trail construction. The recommended project would provide Natural Flood Protection by doing the best possible job of balancing the various flood protection objectives.

A summary of the recommended alternative's project elements, costs, and benefits is provided below. The project would be funded by Clean, Safe Creeks funds, with construction scheduled for 2010 to 2016. The project elements would be designed and built in phases, with emphasis placed on whichever elements are capable of being designed more rapidly in order to provide the fastest flood protection.

The recommended project would include the following elements:

- Offstream flood detention facilities in:
    - Rancho San Antonio Park
    - Blach Jr. High School
    - Cuesta Park Annex
    - McKelvey Park
- Bypass channel for Reach H2 of Hale Creek.
- Bypass channel for Reach P7 of Permanente Creek.
- Channel widening for Reaches P5 of Permanente Creek and H1 of Hale Creek.
- Floodwalls north of Highway 101 to downstream of Amphitheater Parkway.
- New low-flow diversion structure at the Permanente Diversion.
- Opportunity for riparian restoration and public trail extension in Reach P3 between Highway 101 and Middlefield Road.

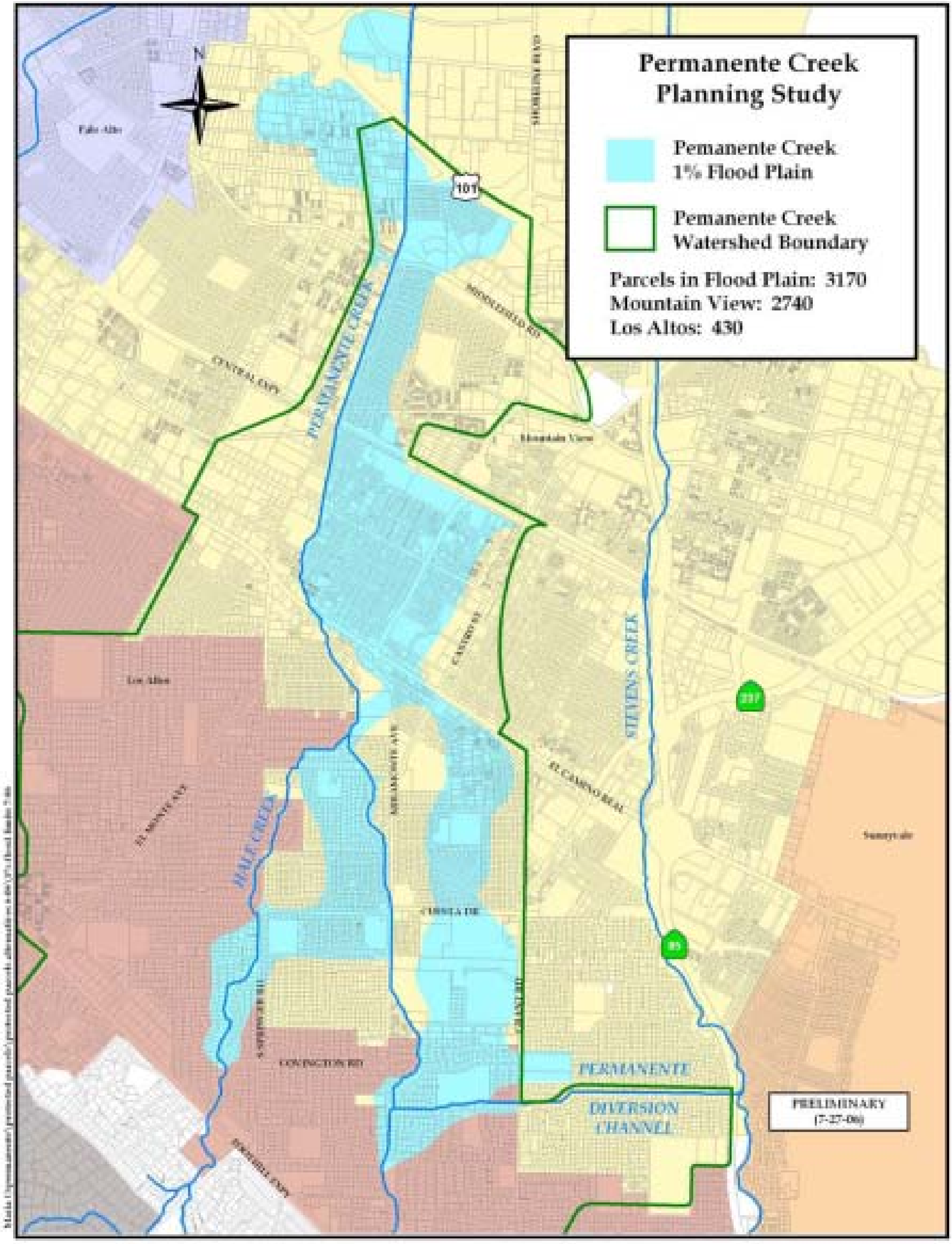

Figure 1.1. Permanente Watershed & Floodplain

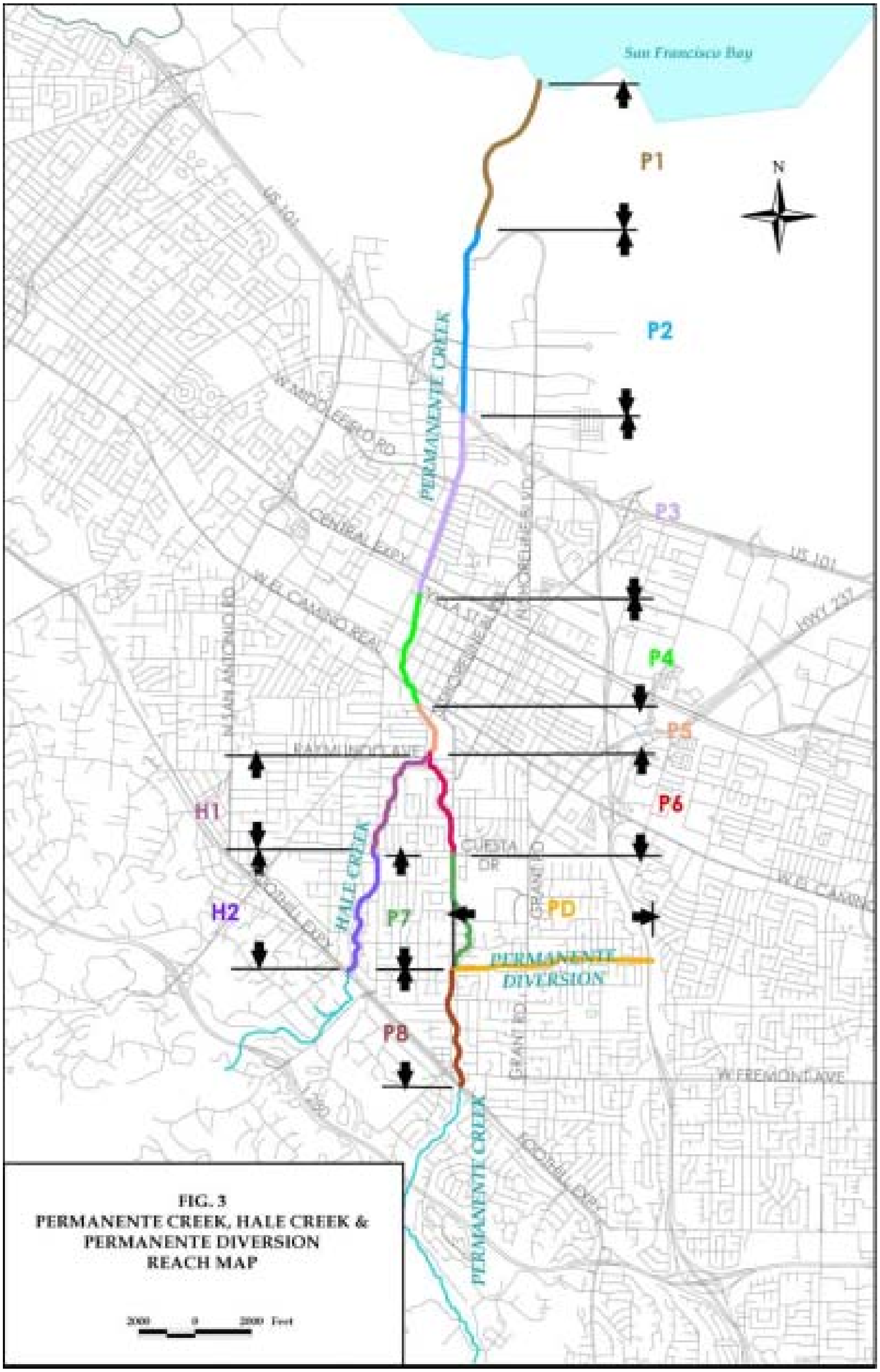

Figure 1.2. Reach Map

CHAPTER 2
WATERSHED DESCRIPTION

This chapter provides a description of the Permanente Creek watershed. Information on the basin hydrology, geology, and setting is provided in the following sections.

2.1 Watershed Description

The Permanente watershed lies within the Northwest portion of Santa Clara County and is in the District's Lower Peninsula Flood Control Zone. The lower portions of the watershed lie within the cities of Mountain View and Los Altos, while the upper watershed is located in an unincorporated area of Santa Clara County (see Figure 1.1 – Watershed Map). Water flows from the Santa Cruz Mountains in the South to the floor of the Santa Clara Valley and the San Francisco Bay in the North.

Permanente Creek forms in the upper watershed area at the confluence of North Branch (Ohlone Creek) and South Branch Permanente Creeks. The major tributary to Permanente Creek is Hale Creek, which connect to Permanente Creek just south of El Camino Real. Tributaries to Hale Creek include Magdalena Creek, Loyola Creek and Summerhill Channel. The majority of the flows from the upper Permanente watershed area are diverted to Stevens Creek through the Permanente Diversion Channel.

Hale Creek has a watershed area of approximately 10.4 square kilometers (4 square miles); while the Permanente Creek watershed area is approximately 45.3 square kilometers (17.5 square miles) at its outflow to San Francisco Bay.

The Permanente Creek watershed has a semi-arid Mediterranean climate characterized by mild, wet winters, and warm, dry summers. The distribution of rainfall is strongly affected by topography. Rainfall levels are highest in the upper watershed area in the Santa Cruz Mountains and lowest by San Francisco Bay. Average annual rainfall ranges up to 91 centimeters (36 inches) per year in the highest sections of the hills, while the average annual rainfall near the Bay is only 33 centimeters (13 inches). Over 80 percent of the seasonal precipitation occurs between November and March. The steep topography of the upper watershed results in short duration, high intensity runoff during major storms. Runoff in the lower, urbanized section of the creeks is conveyed to the creeks by the municipal storm drain system, which tends to increase the magnitude of the more frequent events, while partially reducing the magnitude of very large events.

2.2 Creek Descriptions

This section presents brief descriptions of the reaches of Permanente Creek, Hale Creek, the Permanente Diversion, and Stevens Creek in the study area. Permanente Creek is described between San Francisco Bay and Foothill Expressway, Hale Creek is described from its confluence with Permanente to Foothill Expressway, and the Permanente Diversion Channel is described in its entirety.

2.2.1 Permanente Creek

2.2.1.1 Reach P1: San Francisco Bay to Boat Pond Bridge

This reach is an earth levee channel with tidal marsh vegetation. For the most part, the reach is a wide channel with a low flow (tidal) channel meandering through it. Salt ponds are located on both sides of the creek. It is difficult to gain access along this reach since there are no access points into the channel, and the maintenance pedestrian road further upstream on the west bank stops at the upstream end of the salt ponds.

Figure 2.1. Typical Photo of Reach P1

2.2.1.2 Reach P2: Boat Pond Bridge to Highway 101

This reach contains an earthen levee channel with tidal and brackish marsh vegetation in the lower banks and scattered ornamental and upland trees on the upper banks. From the salt ponds to Amphitheatre Parkway, the reach has a wide invert with a meandering low flow channel. From Amphitheatre Parkway to Highway 101, the channel is trapezoidal earth with levees. There are no access points into the channel but there are maintenance roads on both banks along most of the reach.

Figure 2.2. Typical Photo of Downstream Portions of Reach P2

Figure 2.3. Typical Photo of Upstream Portions of Reach P2

2.2.1.3 Reach P3: Highway 101 to Villa Street

On the downstream side of Highway 101, for 58m the reach is a concrete trapezoidal channel. From Highway 101 upstream to Villa Street, the channel is rectangular concrete (U-Frame). The channel dimensions (w x h) from Highway 101 to Central Expressway are 3.66m x 2.74m (12 ft x 9 ft). The channel dimensions from Central Expressway to Villa Street are 3.048m x 3.048-3.5m (10 ft x 10-11.5 ft). There are maintenance ramps leading into the creek on the downstream sides of the Rock Street, San Luis Avenue, Hackett Avenue, and Villa Street culverts. There is a 0.56m (1.8 ft) drop structure about 10 meters downstream of the Hetch-Hetchy Bridge.

Figure 2.4. Typical Photo of Reach P3

2.2.1.4 Reach P4: Villa Street to El Camino Real

The reach consists of two underground culverts separated by a 54m long concrete trapezoidal section. The Villa Street culvert is about 270 meters long and extends from the downstream end of Villa Street to about 55 meters downstream of California Street. The El Camino/California culvert is about 795 meters long and extends from the downstream end of California Street to about 60 meters upstream of El Camino Real. There is a maintenance ramp on the downstream side of Villa Street. There are two drop structures along this reach. One is located at the downstream end of the El Camino/California culvert; the other is located within the same culvert underneath Latham Street.

Figure 2.5. Typical Photo of Reach P4 Between the Culverts

2.2.1.5 Reach P5: El Camino Real to Confluence with Hale Creek

The majority of the channel is a concrete U-Frame with w x h dimensions of 3.66m x 2.13-3.048m (12 ft x 7-10 ft). At the Hale Creek confluence, the channel changes to a concrete trapezoid. There is a maintenance ramp at the downstream end of the Mountain View Bridge. There are two sloped drops along this reach, one just upstream of the El Camino Real culvert and another just upstream of the Park Avenue bridge.

Figure 2.6. Typical Photo of Reach P5

2.2.1.6 Reach P6: Confluence with Hale Creek to Miramonte/Cuesta Culvert

This reach is a natural earth channel and typically quite small, with some sections of sacked concrete (SCSP), shotcrete, and stacked concrete walls. The vegetation varies from mature trees and grass to no vegetation at all (bare earth). It is difficult to access this reach, but there are access gates (no ramps) at Barbara Avenue, Marilyn Drive, and the Hale Creek Confluence.

Figure 2.7. Typical Photo Along Reach P6

2.2.1.7 Reach P7: Miramonte/Cuesta Culvert to Permanente Diversion

This reach consists of a natural, trapezoidal-shaped channel with some steep banks. The vegetation consists mainly of mature trees with little or no undergrowth. There are no maintenance ramps to gain access to the creek along this reach. There is a gate at the Covington Bridge for access to the old stream gage at that location. There is one main vertical drop just downstream of Abandoned Bridge #31.

Figure 2.8. Typical Photo Along Reach P7

2.2.1.8 Reach P8: Permanente Diversion to Foothill Expressway

This reach consists of a concrete trapezoidal section about 340 meters long upstream to Portland Avenue, followed by a large natural channel from Portland Avenue to Foothill Expressway. There are two maintenance ramps downstream of Portland Avenue. There are also two drop structures downstream of the Portland Avenue bridge, one of which is part of the Permanente Creek stream gage.

Figure 2.9. Typical Photo for Reach P8 Downstream of Portland Avenue

Figure 2.10. Typical Photo for Reach P8 Upstream of Portland Avenue

2.2.2 HALE CREEK

2.2.2.1 Reach H1: Confluence with Permanente Creek to Rose/Rosita Culvert

In this reach, the channel consists of a concrete channel which varies from straight to mildly sinuous sections. All sections are either U-frame or trapezoidal. All bridge crossings are freespans, with some private crossings composed of steel and wooden sections.

Figure 2.11. Typical photo of Reach H1

2.2.2.2 Reach H2: Rose/Rosita Culvert to Foothill Expressway

The channel alignment varies from straight to mildly sinuous. The channel is natural with a simple trapezoidal configuration. Both banks are well-vegetated, with mature riparian trees and varying levels of undergrowth. Channel bottom sediments consist of sand and gravel.

Figure 2.12. Typical Photo of Reach H2

2.2.3. Permanente Diversion

2.2.3.1 Reach PD: Confluence with Steven Creek to Permanente Creek

The channel is mostly a concrete trapezoid with minimal to no sediment. There is a portion of the channel along Blach Junior High School (upstream of Grant Road) that is a larger concrete U-frame with heavy amounts of gravel and sand deposition.

Figure 2.13. Typical Photo of Reach PD (trapezoidal section)

Figure 2.14. Typical Photo of Reach PD (U-Frame section)

2.3 Watershed Hydrology

Appendix I contains the hydrology report, which was prepared by District Hydrology Unit staff. The report provides detailed information on the hydrology methodology and design flow calculations. Table 2.1 shows the design flow values for the watershed:

Table 2.1 – Watershed Design Flow Values

Location	Drainage Area (km^2)	Design 1% Flow (cms)	Design 10% Flow (cms)
South-branch Permanente	4.0	48	27
North-branch Permanente Creek (Ohlone)	3.5	25	11
Permanente upstream of Hwy 280	7.5	71	40
Permanente upstream of Diversion	8.4	76	42
Permanente Diversion	-	40	31
Permanente upstream of Hale Creek	-	40	14
Hale Creek upstream of Permanente	4.4	31	19
Permanente downstream of Hale Creek	14.0	65	27
Permanente @ SPRR	15.8	71	31
Permanente @ Hwy 101	16.5	74	34
Stevens Creek downstream of Diversion	24.9	218	127
Stevens Creek @ El Camino Real	26.5	221	130
Stevens Creek @ Hwy 101	29.8	229	139

2.4 Watershed Physiography and Geology

The Permanente Creek watershed is one of several relatively moderate-sized drainages on the eastern slopes of the Santa Cruz Mountains and floor area of Santa Clara Valley in the northwestern portion of the county. It lies between the Stevens Creek drainage on the south and east and Adobe Creek drainage on the west. The headwaters originate near Black Mountain, approximately 850 meters (2,800 feet) above sea level, along Monte Bello Ridge. The main drainage flows southeasterly through the mountains and shifts to the north at the foothills. At an elevation of approximately 90 meters (300 feet), it emerges from the foothills into Santa Clara Valley, passing across the valley floor. Stream flows are ephemeral. Permanente Creek continues to flow north across the valley floor to San Francisco Bay. It is joined by Hale Creek, its principle tributary from the west, just south of El Camino Real. The headwaters of Hale Creek are in the foothills area within the Town of Los Altos Hills. Within the valley floor area both streams pass through the cities of Los Altos and Mountain View.

The natural drainage system has been altered for many reasons, including alterations to accommodate greater flood protection. These include (1) a cutting of a high water diversion channel within the valley floor eastward to Stevens Creek from a point above the confluence of

Hale Creek and (2) the diverting of the mouth of the stream into San Francisco Bay from Charleston Slough eastward to Mountain View Slough. Stevens Creek, which originally entered the Bay at Mountain View Slough, was diverted eastward to form its new mouth at Whisman Slough.

Monte Bello Ridge, and most of the mountainous portion of the drainage, is underlain by the Franciscan Group of formations, a regional unit that forms much of the core of the Coast Ranges of California. The Franciscan Group consists of highly deformed, contorted, faulted, sheared and weathered sections of shale, sandstone, chert, limestone, and greenstone (metavolcanic rock). These were deposits as ancient sea floor sediments in a subduction zone where continental and oceanic plates were colliding on the crust of the earth. The colliding action, like sediments carried on converging conveyor belts, accounts for the intense deformation of the units. These were pervasively intruded by serpentine which is generally intensely sheared. The lower portion of the mountainous area is underlain by a narrow strip of northwesterly bedded tertiary shale of the Monterey Formation. These were deposited in inland seaways which invaded portions of the continent's edge during the Tertiary period (2 million to 65 million years ago). The foothills are underlain by gently and broadly folded claystone, sandstone, and conglomerate of the Santa Clara Formation. These are lightly consolidated to compacted and were deposited as alluvial outwash from the uplifting coast ranges during the Plio-Pleistocene epoch (10,000 years to 2 million years ago).

The older formations in the mountainous areas are cut by numerous ancient faults which are inactive. The closest active fault is the San Andreas fault which passes west of the watershed through the northwesterly trending Stevens Creek Canyon, just over the ridgeline of Monte Bello Ridge. The possibly active, northwesterly trending Monte Vista fault passes through the foothills of the watershed, forming a fault contact between the Franciscan Group on the southwest and the Monterey Formation on the northeast. This fault may be the northwesterly extension of the possibly active Shannon fault.

The valley floor area is underlain by young, unconsolidated alluvial fill washed down from the Santa Cruz Mountains. The upper elevated edge of the valley floor is underlain by alluvial fans, which splayed out from the mouths of streams emerging from the foothills and which have laterally coalesced with adjacent fans and contain relatively coarse sediments. Descending down the fan to its distal portion and onto the flat baylands, the surficial sediments become finer. They were deposited as basin, shallow marine and tidal deposits. The aggregation of unconsolidated sedimentary section beneath the valley floor, and including the subsurface portion of the Santa Clara formation beneath the young alluvial deposits, constitute the Santa Clara Valley groundwater basin. The maximum depth of the basin is in excess of 457 meters (1,500 feet). Groundwater in the basin may be unconfined (water table) or confined (under pressure). The pressure zone includes the deep aquifers within the basin areal interior.

The mineral quality of waters draining the mountainous and foothills area is expected to be a calcium bicarbonate to a calcium-magnesium bicarbonate type, ranging in total dissolved solids from about 150 to 350 milligrams per liter. Water of this concentration is suitable for most beneficial uses. The higher range of total dissolved solids concentration occurs at low flows when such flows are sustained by groundwater discharges from the bedrock and Santa Clara Formation. As the flows enter the valley, a certain amount infiltrates into the valley fill as natural ground water recharge. Beneficial recharge occurs in the elevated edges of the valley where the groundwater is unconfined and beyond the subsurface edges of the confined area. This area is known as the forebay of the basin. Along Permanente and Hale Creeks, the forebay extends from the foothills line to their confluence. Descending down the fan toward the baylands, the stream gradient flattens and the depth to groundwater beneath the stream is very shallow. Due to land subsidence, which created a local inland hydraulic gradient from the Bay, tidal water flows farther upstream across the subsided zone. This intrusion has caused the shallow aquifers beneath the bayfront area to become contaminated by salt.

Land use within the drainage varies. Large areas of the mountainous watershed are part of a limestone quarrying and Portland cement manufacturing operation. A portion below the cement operation is used for aluminum and chemical plant operation. Ranching is limited. Parts of the foothill areas are open lands with scattered oak trees and grassy slopes and a limited amount of dry farming and other parts contain residential development. The watershed within the valley floor is covered by urban development except for a portion of the baylands which is covered by salt evaporation ponds adjacent to the Bay and by a municipal landfill in the baylands that has been landscaped for recreational use. Urban development consists of residential use in elevated portions of the valley floor, commercial and residential use toward the toe of the fan, and industrial use at the upper edges of the baylands.

2.5 Historical Stream Channel

Permanente Creek has been significantly changed by human activity. Some of these alterations in creek geomorphology are very old. The oldest maps available show quite a different watershed than the one existing today. For example, the 1862 Railroad map (see Figure 2.15) and the 1872 City of San Jose map (see Figure 2.16) show that Permanente Creek used to naturally be a tributary to Stevens Creek (called "Cupertino Creek" in the former map and "Stephens Creek" in the latter map. As with most of the west-side creeks, Permanente/Stevens did not have a channelized path to the Bay but would simply drain to the marshes and disappear into various small sloughs.

By the time the 1876 Thomas Thompson & West Historical Atlas of Santa Clara County was published, the situation had been radically altered. Both Stevens Creek and Permanente Creek had already been separated, straightened, and channelized to the Bay. An obviously straightened man-made channel had already been constructed downstream of the Southern Pacific Railroad tracks to carry flows from Permanente Creek into Charleston Slough.

The 1899 (reprinted in 1923) USGS. Topographic Palo Alto Quadrangle shows that the alignment of Permanente and Hale Creeks upstream of Fremont Avenue is very similar to the present day alignment. Between Fremont Avenue and El Camino Real, Permanente Creek followed the present day alignment with the exception of an area near Cuesta Drive where the original channel has natural meanders while the present day channel was straightened to align with Miramonte Drive. The 1948 USGS Topographic Palo Alto Quadrangle shows that Permanente Creek was re-aligned downstream of the railroad tracks so that the creek closely follows its present-day alignment and discharges into Mountain View Slough. This map also shows Hale Creek terminating upstream of Springer Road. Thus, by the early 1940's, the creeks were generally in their current alignment.

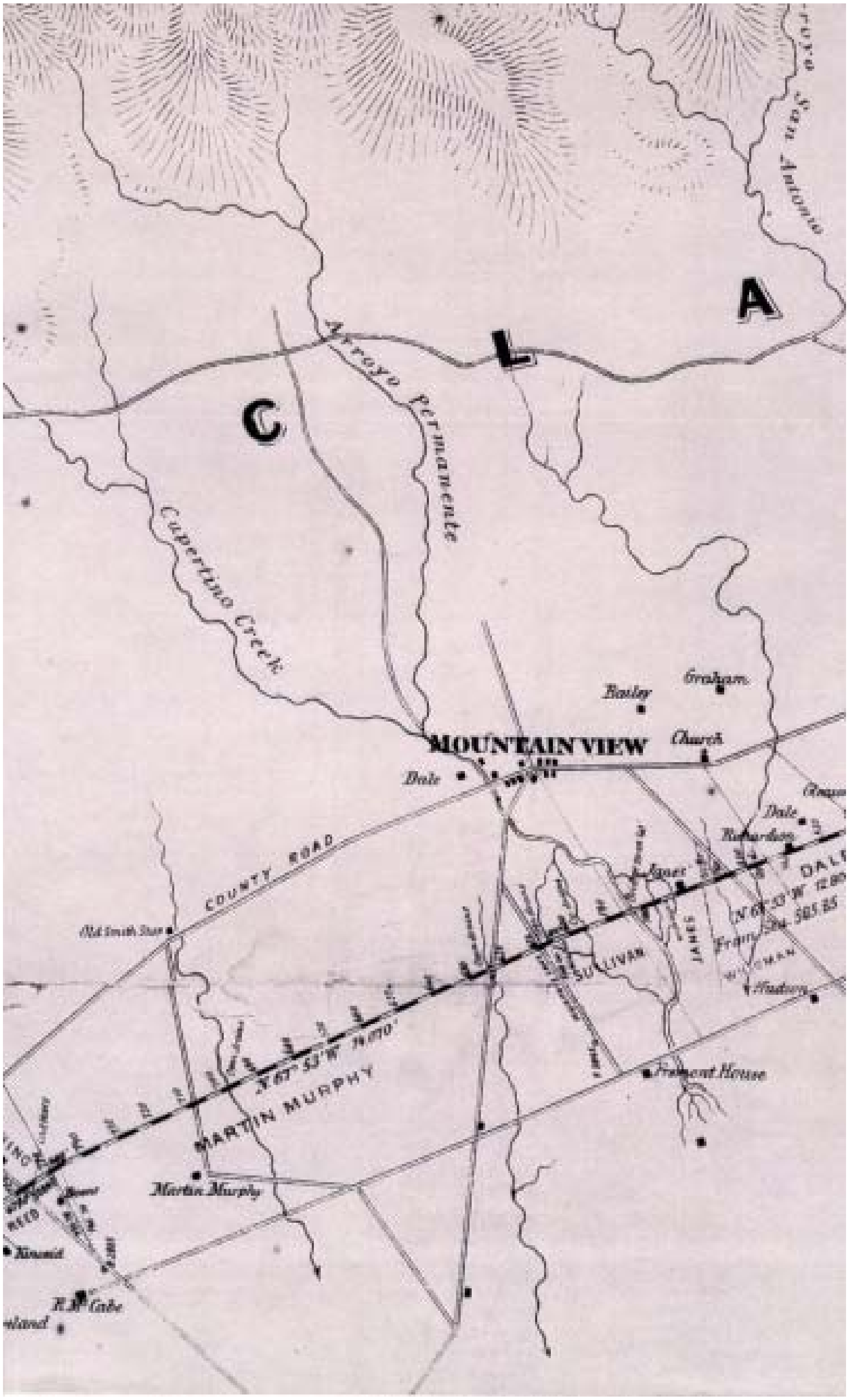

Figure 2.15. San Francisco San Jose Railroad, Allardt, 1862

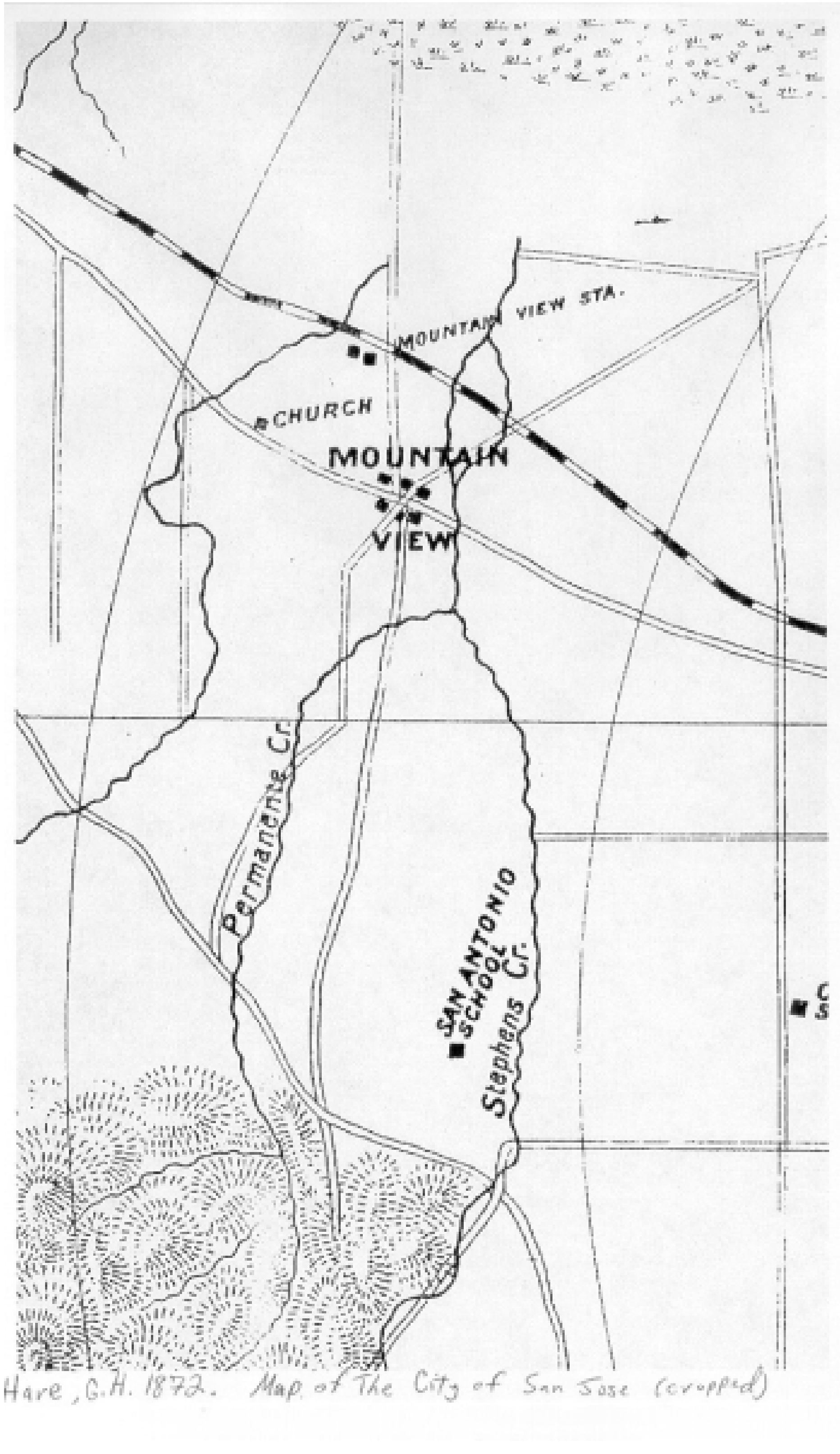

Figure 2.16 – City of San Jose, Hare, G.H. 1872

2.6 Land Subsidence

Over-drafting of the groundwater basin has caused land subsidence over the confined interior portion of the basin. Over-drafting refers to the process of extracting more water out of underground aquifers through pumping than is being replaced through percolation. The compressible layers of soil come under increased pressure as water pressure drops, causing the soil layers to reduce in width, which causes the general ground surface to drop. Land subsidence is a broad, gradual sagging of the surface that is usually hardly perceptible, except when it involves large hydraulic features such as creeks and pipelines. Subsidence in Santa Clara Valley began in the 1920's and generally ceased in 1969 when over-drafting was eliminated through the importation of water from the State Water Project.

Subsidence has led to collapse of well casings, and has had a significant impact on systems that rely on hydraulic gravity flow, such as sewer lines, storm drains, and creeks. Subsidence has caused bayfront lands in Santa Clara County to sink below sea level, enabling salt water to intrude upstream and dramatically affecting the riparian habitat. In addition, subsidence has increased the potential for tidal flooding.

Along Permanente Creek the greatest amount of subsidence was about 1.8 meters (6 feet), and was centered approximately where Highway 101 crosses the creek (see 2.17 – Subsidence). The bayfront was depressed below sea level by a few feet. In order to protect the baylands from encroaching bay water over the subsided areas, a bayfront levee system had to be constructed. Stream channels flowing to the Bay had to have their levees raised in order to pass the flows through the subsided areas. Drainage waters accumulating behind the levees had to be pumped over the levees into the channels. The subtle alterations of the topography caused by land subsidence would also have the consequences of a net reduction of the natural flood flow carrying capacity of the stream channels in the downstream reaches.

2.7 Summary of Environmental Setting

2.7.1 Land Use

Existing residential, commercial, and industrial development reaches of Hale and Permanente Creeks may restrict or preclude the development of flood management improvements (e.g., channel widening, detention basins) in the urbanized portions of the project area. Where undeveloped, no specific land use constraint is identified apart from the costs of acquisition, which may pose an economic constraint due to the local price of land.

The project area includes a diverse array of land uses, mostly residential, commercial, and industrial, with other uses (public, open space, recreational, and agricultural) occurring in some areas. Former agricultural uses, such as orchards, greenhouses, and packing plants were historically prevalent in much of the area.

Restoration of riparian habitat in the urbanized areas of the watershed may reduce flood conveyance capacity and increase the frequency of flooding of adjacent properties, which is a constraint for any restoration component of the project.

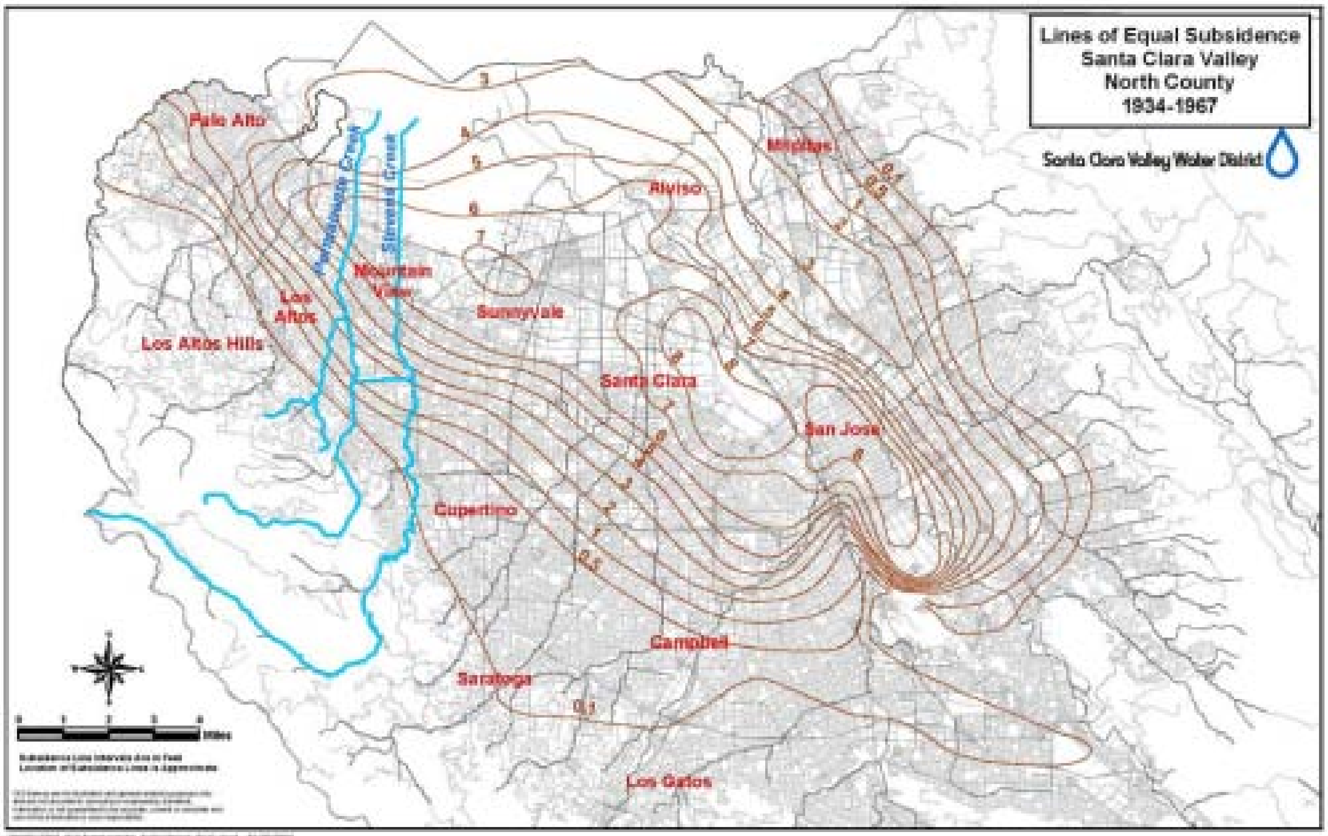

Figure 2.17. Subsidence in Santa Clara County

2.7.2 Biological Resources

A number of special-status plant and animal species have been recorded, or have the potential to occur in the project area. These species include California red-legged frog, California tiger salamander, California clapper rail, salt marsh harvest mouse, western burrowing owl, and western leatherwood. Additionally, species covered under the Migratory Bird Treaty Act likely use habitats within the project area for roosting, nesting, and foraging. Occurrences of these species within the project area may restrict or preclude the development of flood management improvements within specific locations.

Approximately 28 acres of jurisdictional wetlands and other waters of the U.S. (Section 404 of the Clean Water Act) have been identified within the project area (south of Foothill Expressway). Construction of flood management improvement facilities in these areas may result in the loss of wetlands and other waters of the U.S.

2.7.3 Cultural Resources

Records searches conducted for the project area and other data collection efforts identified three known cultural resource sites in the upper portion of the project area (south of Highway 280). Additional unrecorded sites may also be present in this location as it is believed that Native Americans inhabited the area prior to Spanish colonization. Construction activities may result in the disturbance and/or degradation of subsurface archaeological resources. Infrastructure (e.g., bridges, conveyance channels) and buildings found within the project area may be subject to NRHP or CRHR, depending upon age and context, for listing as historic structures.

2.7.4 Water Quality

A level 1 hazardous materials investigation was conducted in April 2002 (see Level 1 Hazardous Materials Investigation by Dames and Moore (D&M) Consulting Engineers 2002). This investigation provided the following information.

For the portion of the watershed north of Middlefield Road, groundwater and surface water has been widely affected by regional volatile organic compound plumes likely associated with historic industrial uses. Soils and groundwater have also been affected by lawn care chemicals, polynuclear aromatic hydrocarbons and metals associated with the former Palo Alto sewage treatment plant, and gasoline and hydrocarbon spills and runoff mainly associated with former gas stations, dry cleaning, and painting businesses in the areas well as the Jones Hall US Army Reserve Center. Soil impacts from pesticides are mostly concentrated in the portion of the watershed between Middlefield Road and Foothill Expressway, where the main agricultural concerns were historically located. The investigation identified potential impacts associated with possible historic spills at former greenhouse and packing plant locations. D&M’s report identified nine sites located adjacent to Permanente Creek as sites of potential concern. There were no sites identified along Hale Creek.

A level 1 hazardous materials investigation will be conducted for all of the affected areas in the proposed project. It will include physical investigations and site-specific historical research at McKelvey Park, Cuesta Park, Blach School, and the portion of Rancho San Antonio affected by the project. A level 2 investigation will be conducted for the sites affected by the project prior to project construction if the level 1 investigation warrants that effort.

2.7.5 Public Utilities

The project has attempted to minimize interference and impacts on local public utilities.

CHAPTER 3
PROBLEM DEFINITION

This chapter describes the currently identified problems in the watershed area.

3.1 Creek Flooding

3.1.1 Historic and Recent Flooding

The Permanente watershed has a history of recurring floods which have adversely impacted the safety and economic stability of the residents and businesses within the floodplain. Flooding within the Permanente watershed has been documented as far back as 1868. Flooding which has occurred on Permanente Creek, Hale Creek, and Permanente Diversion is described below. Figure 3.1 shows a map of the most recent flooding areas.

Permanente Watershed – 1862. A flood of great magnitude occurred in 1862. Records of the flood are poor; however, it is reported that the flood of 1862 was larger in magnitude than the flood of December 1955.

Permanente Watershed – January 1911. A large flood occurred in the watershed in January, 1911. Mr. R.E. Nordyke, a resident of the Hale Creek area, reported that "water flowed down Springer Road like a river". The January 20, 1911 *Mountain View Register-Leader* reported that "Saturday, January 14, 1911 goes down into history as a record breaking day for rainfall in Mountain View. The actual rainfall for that date was 4.60 inches, the greatest recorded in the history of Mountain View." (FEMA, 1980). Flood records are once again poor; however, it is reported that the flood of 1911 was larger in magnitude than the flood of December 1955.

Permanente Creek – February 1940. Several homes and some agricultural land in the vicinity of El Camino Real and Mountain View Avenue suffered light damage. Highways were also damaged and motorists were inconvenienced by the flooding.

Permanente Creek – November 1950. November flooding along Permanente Creek caused significant damage to agricultural and commercial properties. The following report ran in the November 20, 1950 *Mountain View Register-Leader*: "Swollen by the heaviest rains in 32 years, Permanente Creek burst its banks . . . and sent torrents of muddy water rushing into Mountain View streets, causing thousands of dollars of damage to merchandise in El Camino stores. . . Countless other thousands of dollars of damage was done to orchard land along Miramonte Road by the swirling waters as tons of precious top soil were swept away in the flood" (FEMA, 1980).

Permanente Creek – January 1952. Flooding along Permanente Creek caused significant damage to properties in Los Altos and Mountain View. The January 14, 1952 *Mountain View Register-Leader* reported that "Mountain View's new sewage plant was nearly under water, the El Camino Real underpass to Highway School was cut off to traffic, six homes on Springer Road were isolated, an office on El Camino and a house on Grant Road were inundated, . . . and navy pump crews prevented lapping waters from flowing into buildings at Moffet Homes" (FEMA, 1980). Flooding also occurred near San Ramon Avenue, San Luis Avenue, Middlefield Road., and at the intersection of El Camino Real and El Monte Avenue.

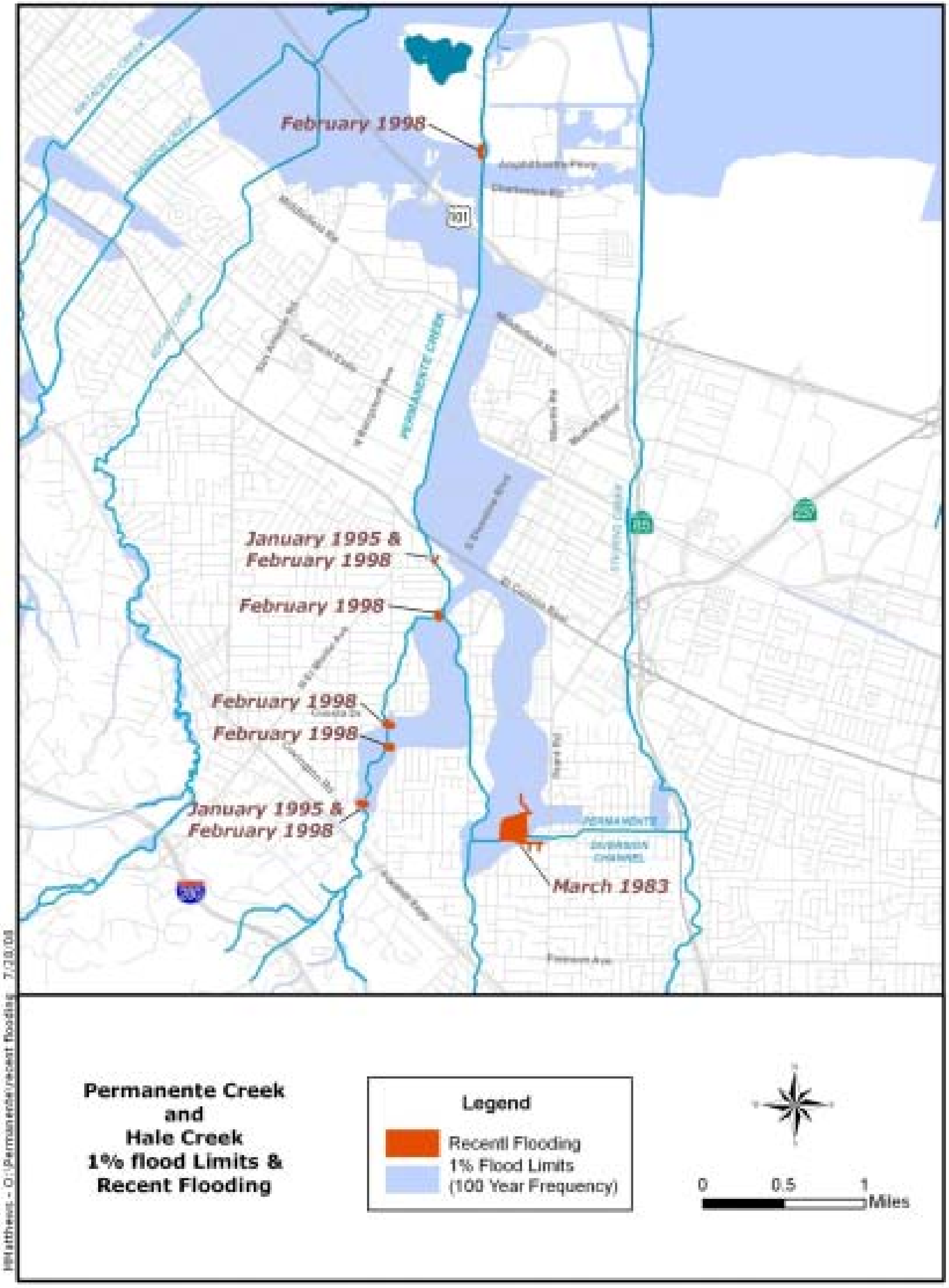

Figure 3.1. Recent Flooding

Permanente Creek and Hale Creek- December 1955. One of the greatest storms in modern times in Santa Clara County occurred in December 1955, the so-called "Christmas Storm." Most of the flooding occurred in the lower reaches of Permanente Creek where approximately 770 acres were inundated with floodwaters. Flooding near El Camino Real and Highway 101 was reported. During the flood, downed trees and debris blocked culverts and caused the creek to overtop its banks. Residential homes, agriculture, and commercial business in Mountain View and Los Altos sustained losses. Salt ponds at Mountain View Slough suffered extensive losses due to the flow of fresh water into the ponds. Several bridges and culverts in Mountain View were extensively damaged and eroded. Approximately 100 people residing in lowland areas were evacuated from their homes for a period of two weeks as a result of the flooding. The *Mountain View Register-Leader* reported that Police, Fire, and City crews were called on " to battle swollen Permanente Creek and flooded streets fed by rains which poured into the area without letting up" (FEMA, 1980). At Hale Creek, water overtopped the creek's banks near Marilyn Dr., Rosita Ave., Covington Drive, and Mountain View Avenue. Flooding in this area was reported to be up to 1 foot deep. Significant flooding is also reported to have occurred in the upstream portion of the watershed, in the vicinity of Magdalena Avenue and Hillview Road. Damages in the Permanente watershed totaled at $142,500 in 1955 dollars.

Permanente Creek – April 1958. In 1958, flooding occurred along both the upper and lower reaches of Permanente Creek. Flooding in the upper reaches was confined to areas near the creek. Water overtopped the banks at several locations and flooded streets, sidewalks, and yards in Los Altos and Mountain View (U.S. Army Corp of Engineers; June, 1959). In the lower reaches of the creek, flooding was more severe. Flooding is reported to have occurred near Middlefield Road, Barbara Road, El Camino Real (to a depth of 2 feet), and in downtown Mountain View near Evelyn Avenue and Franklin Street (to a depth of 1 foot). Flooding in the vicinity of Bayshore Highway resulted in significant damage to both residential and agricultural properties. Damages in the Permanente watershed were totaled at $95,200 in 1958 dollars.

Permanente Watershed – January 1963. Minor street flooding occurred in the Permanente watershed in January 1963.

Permanente Watershed – January 1968. Minor street flooding occurred in Mountain View and Los Altos due to 1.48 inches of rain which fell within a 24 hour period.

Permanente Diversion – March 2, 1983. On March 2, 1983, Permanente Diversion overtopped its banks and flooded Blach Jr. High School to a depth of 1/2 foot. Street flooding also occurred, as well as minor mud damage to the garages of three homes on Altamead Drive. The flooding was related to operations conducted at the Kaiser Cement Plant located in the upper Permanente Watershed. Immediately after the flood, Kaiser staff reported that the outlet to a large water "retention structure" had become plugged. On March 2, the plug burst, which resulted in the release of a large slug of water to Permanente Creek. County Communications reported that a large (about 20-foot deep) "wall" of water was observed traveling down Permanente Creek from Kaiser Cement. (Internal District memo, April 29, 1983) When the slug of water reached the box culvert near Blach Jr. High School, the water overtopped the banks. The capacity of the box culvert was significantly reduced due to sediment which had accumulated within the culvert. See Figure 3.1 for a map of the affected area.

Permanente Creek and Hale Creek – January 1995. The storm of January 9-10, 1995, resulted in flooding on Permanente and Hale Creeks. Permanente Creek overflowed its banks causing damage to two units of an apartment building on Park Drive in Mountain View. The flood water in the apartments rose to a level of about 2 feet, and also inundated the adjoining garage, driveway, and a parking area. Hale Creek overbanked at Covington Road in Los Altos, resulting in street flooding. See Figure 3.1 for a map of the affected area.

***Permanente Creek and Hale Creek – February 1998**.* The storms of February 2 through February 7, 1998 resulted in over-banking of the west levee of Permanente Creek, immediately downstream of Amphitheater Parkway in the City of Mountain View. Floodwaters just barely spilled over the bank and into an empty lot adjacent to the creek. Permanente Creek also overtopped its banks just upstream of Park Avenue; minor flooding of a parking lot occurred. During the storm of February 2-3, 1998, Hale Creek overflowed its banks at Covington Road, Rosita Avenue, Arboleda Drive, and at the intersection of Mountain View Avenue and Raymundo Avenue. This resulted in minor street flooding. See Figure 3.1 for a map of the affected area.

3.1.2 Future Flooding Potential

Although it is impossible to determine the exact location of future flood events, potential flooding problems along Permanente Creek, Hale Creek, and Permanente Diversion can be identified by developing maps of the expected flooding using hydraulic engineering numerical analysis software. The one-percent flood is the design flood for this project per the project objectives. The one-percent flood is defined as a flood that has a one percent probability of occurrence in any given year. This flood does not necessarily happen once in a hundred years; it can occur in consecutive years or even twice in the same year.

Figure 3.2 depicts the areas subject to flooding from a one-percent event based on Federal Emergency Management Agency (FEMA) versus the District's definition of flooding. The major difference between the two flood mappings is that the District considers all areas that are inundated as flooded, while FEMA maps only show areas that experience greater than 0.3 meter (1 foot) flooding. Numerical models of Permanente and Hale Creeks and the Permanente Diversion show that approximately 3,200 parcels would be subject to flooding from a one-percent flood.

3.1.3 Reach Capacities

Table 3.2 shows the results of a numerical modeling analysis showing the current capacities versus one-percent flows for all of the reaches of Permanente Creek in the project area. Reaches that do not have one-percent capacity are highlighted in red. As can be seen, most reaches of Permanente Creek are far below the capacity required for the one-percent flood. This is especially true in the middle creek reaches built in the 1960s. For Hale Creek, approximately half of the concrete portion and the majority of the natural portion cannot pass the one-percent flow. Permanente Diversion can generally pass the one-percent flow, with the exception of the portion between Grant Rd. and the Diversion's upstream end. There is a choke-point built into the channel upstream of Grant Rd. which controls the channel to 40 cubic meters per second (cms). This was built into the channel purposely to avoid induced flooding downstream in Stevens Creek. Stevens Creek currently does not have sufficient capacity to carry the one-percent flow (even with zero freeboard).

3.1.4 Manning's Roughness Coefficients

Hydraulic calculations depend on appropriate modeling of channel conditions. One of the main channel parameters is the channel roughness factor, which is called the "Manning's n" number in the appropriate hydraulic formula. Proper selection of Manning's n is crucial for the correct determination of channel capacity. For the Permanente Creek project, the following Manning's n numbers were used for the various channel types listed below.

Table 3.1. Manning's n Factors

Channel Type		Existing Conditions "n"
A	Concrete	0.015
B	Concrete with sediment	0.025
C	Shot concrete (rough)	0.020
D	Stacked Concrete Wall (made by property owners)	0.035
E	Sacked Concrete Slope Protection (SCSP)	0.030
F	Sacked Concrete Slope Protection (SCSP) with grass	0.035
G	Groynes	0.035
H	Silty muddy sediment invert	0.025
I	Gravel-sized sediment invert	0.025
J	Cobble-sized sediment invert	0.030
K	Large rocks/boulder sediment invert	0.035
L	Existing natural vegetation (solid vegetation)	0.100
M	Existing natural vegetation (limited undergrowth)	0.070
N	Mature trees without ground cover	0.050
O	Grass	0.035
P	Earth bench with grass/weeds	0.035
Q	Excavated earth	0.030
R	Maintenance roads	0.025
S	Overbank sections	0.025

For channels composed of more than one type of material, composite roughness factor was calculated using appropriate equations. The resulting Manning's n factors were used in the numerical modeling software to calculate creek capacities on a reach by reach basis, so that individual reach and bridge capacities could be calculated without interference from downstream or upstream reaches. The results are summarized in Table 3.2.

Figure 3.2. FEMA and District Floodplains

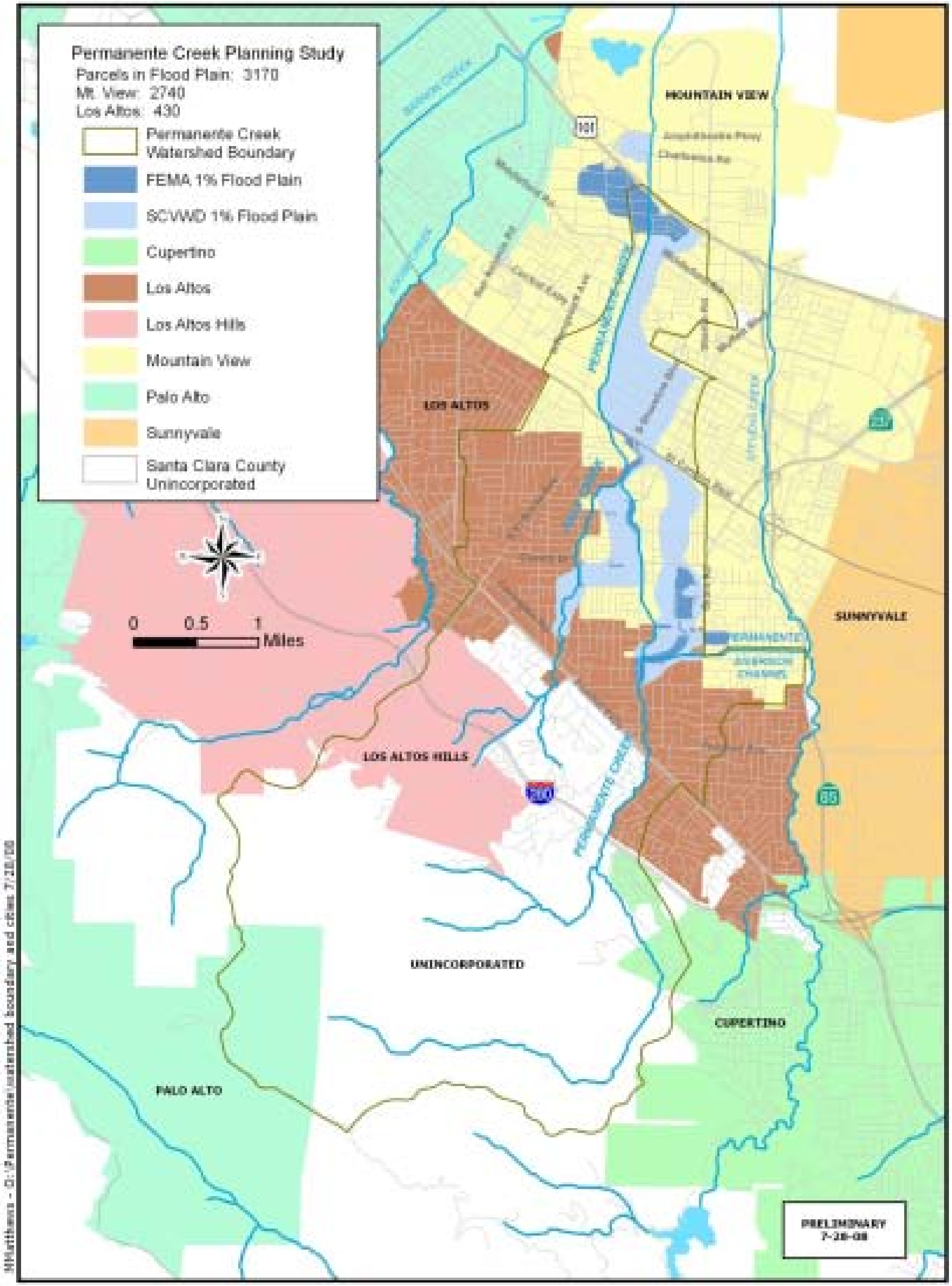

Table 3.2. Current Creek Reach Capacities

Permanente Creek Location:	1% Flow CMS	1% Flow CFS	Reach Capacity CMS	Reach Capacity CFS
San Francisco Bay to U/S end of Salt Ponds	74	2600	26	900
Salt Ponds to Boat Pond	74	2600	30	1050
Boat pond Bridge	74	2600	35	1200
Boat Pond to Shoreline	74	2600	148	5200
Shoreline Parkway Bridge	74	2600	100	3500
Shoreline to Rengstorff	74	2600	100	3500
Rengstorff Walkway Bridge	74	2600	100	3500
Rengstorff to Golf Course	74	2600	57	2000
Golf Course Bridge	74	2600	64	2250
Golf Course to New Ditch	74	2600	66	2300
New Ditch Bridge	74	2600	44	1550
New Ditch to Amphitheater	74	2600	43	1500
Amphitheater Parkway Bridge	74	2600	131	4600
Amphitheater to Charleston	74	2600	44	1550
Charleston Road Bridge	74	2600	73	2600
Charleston to Hwy 101	74	2600	40	1400
Highway 101 Bridge	74	2600	42	1500
Hwy 101 to Old Middlefield	71	2500	40	1400
Old Middlefield Way Bridge	71	2500	27	950
Old Middlefield to Rock	71	2500	52	1850
Rock Street Bridge	71	2500	35	1250
Rock to Middlefield	71	2500	58	2050
Middlefield Road Bridge	71	2500	38	1350
Middlefield to San Ramon	71	2500	65	2300
San Ramon Avenue Bridge	71	2500	37	1300
San Ramon to San Luis	71	2500	47	1650
San Luis Avenue Bridge	71	2500	51	1800
San Luis to Montecito	71	2500	50	1750
Montecito Avenue Bridge	71	2500	43	1500
Montecito to Hackett	71	2500	53	1900
Hackett Avenue Bridge	71	2500	55	1950
Hackett to Hetch Hetchy	71	2500	57	2000
Hetch Hetchy Bridge	71	2500	27	950
Hetch Hetchy to Central	71	2500	31	1100
Central Expressway Bridge	71	2500	33	1150
Central to SPRR	65	2300	92	92
SPRR Bridge	65	2300	38	1350
SPRR to Villa	65	2300	28	1000
Villa Street Culvert	65	2300	34	1200

Table 3.2. Current Creek Reach Capacities (continued)

Permanente Creek Location:	1% Flow CMS	1% Flow CFS	Reach Capacity CMS	Reach Capacity CFS
Villa Culvert to El Camino Culvert	65	2300	34	1200
El Camino Real Culvert	65	2300	34	1200
El Camino Real to Private Bridge	65	2300	36	1250
Private Bridge	65	2300	36	1250
Private Bridge to Park	65	2300	36	1250
Park Drive Bridge	65	2300	28	1000
Park to Mountain View	65	2300	18	650
Mountain View Avenue Bridge	65	2300	21	750
Mountain View to Hale Creek Confluence	65	2300	18	650
Hale Creek Confluence to Marilyn	40	1400	10	350
Marilyn Drive Bridge	40	1400	8	300
Marilyn to Barbara	40	1400	6	200
Barbara Avenue Bridge	40	1400	7	250
Barbara to Miramonte/Cuesta	40	1400	8	300
Miramonte/Cuesta Culvert	40	1400	12	400
Miramonte/Cuesta to Villa Siena	37	1300	16	550
Villa Siena Bridge	37	1300	17	600
Villa Siena to St. Francis Walkway	37	1300	19	650
St. Francis Walkway Bridge	37	1300	25	900
St. Francis Walkway to St. Francis Exit	37	1300	25	900
St. Francis Exit Bridge	37	1300	25	900
St. Francis Exit to St. Francis Entrance	37	1300	27	950
St. Francis Entrance Bridge	37	1300	20	700
St. Francis Entrance to Abandoned Bridge #30	37	1300	25	900
Abandoned Bridge #30	37	1300	40	1400
Abandoned Bridge #30 to Abandoned Bridge #31	37	1300	35	1250
Abandoned Bridge #31	37	1300	23	800
Abandoned Bridge #31 to Covington	37	1300	16	550
Covington Road Bridge	37	1300	14	500
Covington to 54” Diversion Pipe	37	1300	9	300
54” CMP (note: pipe regularly clogs with sediment)	37	1300	6	200
Diversion to Gage	76	2700	48	1700
Gage Bridge	76	2700	159	5600
Gage to Portland	76	2700	82	2900
Portland Avenue Bridge	76	2700	59	2100
Portland to Aura	76	2700	27	950

Table 3.2. Current Creek Reach Capacities (continued)

	1% Flow		Reach Capacity	
	CMS	CFS	CMS	CFS
Aura Way Bridge	76	2700	90	3200
Aura to Fremont	76	2700	134	4700
Fremont Avenue Bridge	76	2700	182	6400
Fremont to Foothill	76	2700	172	6100
Hale Creek Location:				
Permanente Creek to Mt. View	31	1100	56	2000
Mt. View Avenue Bridge	31	1100	22	800
Mt. View to Arroyo	31	1100	22	800
Arroyo Road Bridge	31	1100	52	1850
Arroyo to Marilyn	31	1100	35	1250
Marilyn Drive Bridge	31	1100	35	1250
Marilyn to 7th Day Adventist	31	1100	41	1450
7th Day Adventist Bridge	31	1100	18	650
7th Day Adventist to North Sunshine	31	1100	26	900
North Sunshine Drive Bridge	31	1100	18	650
North Sunshine to South Sunshine	31	1100	26	900
South Sunshine Drive Bridge	31	1100	42	1500
South Sunshine to Springer	31	1100	25	900
Springer Road Bridge	31	1100	23	800
Springer to 400 Springer	31	1100	30	1050
400 Springer Road Bridge	31	1100	26	900
400 Springer to Cuesta	31	1100	42	1500
Cuesta Avenue Bridge	31	1100	21	750
Cuesta to Arboleda	31	1100	28	1000
Arboleda Avenue Bridge	31	1100	23	800
Arbolida to Rosita (including 4 private bridges)	31	1100	20	700
Rosita Avenue Bridge	31	1100	23	800
Rosita to Rock Rip-Rap Section	24	830	15	550
Rock Rip-Rap Section	24	830	25	900
Rock Rip-Rap Section to Covington	24	830	15	550
Covington Road Bridge	24	830	10	350
Covington to Foothill Expressway	24	830	11	400
Permanente Diversion Location:				
Hwy 85 Bridge	40	1400	65	2300
Hwy 85 to Diericx	40	1400	113	4000
Diericx Drive Bridge	40	1400	51	1800
Diericx to Grant	40	1400	68	2400
Grant Road Bridge	40	1400	105	3700
Grant to Permanente Creek	40	1400	40	1400

Stevens Creek Location:				
San Francisco Bay to Highway 101	229	8100	164	5800
Highway 101 to El Camino Real	221	7800	108	3800
El Camino Real to Permanente Diversion	218	7700	227	8000

3.2 Local Drainage Conditions

Local drainage is not identified as a major problem in the Permanente Creek watershed. The majority of the watershed area drains to the creek system either through overland flow (in the undeveloped upper watershed) or through city storm drain systems. The levee portion of the watershed north of Highway 101 also drains to the creek through gravity flows, which becomes ineffective when creek levels are high.

3.3 Maintenance Access

In order to maintain the creek, maintenance staff must be able to access the creek. Access to Hale Creek, and access to Permanente Creek upstream of Highway 101 is difficult, costly, and often severely limited because the District holds a very narrow maintenance easement along the creeks.

Downstream of Highway 101, maintenance roads located on the top of the levees provide access to most of Permanente Creek. Since crews and equipment can operate on the top of the levees, out of the creek bed, access to the creek is generally possible year-round. Along Hale Creek, and along Permanente Creek upstream of Highway 101, there are no maintenance roads; creeks are generally accessed at bridge crossings. In order to maintain the creek between bridges, equipment must be moved along the bottom of the creek bed, which typically prohibits maintenance of these areas during periods of medium and high flows. In most areas where the creeks flow through concrete channels, vehicular access is possible during periods of low flows by driving along the invert of the creek. In areas were the creeks are in a semi-natural state, no vehicular access is possible.

A brief description of existing maintenance access for each section of Permanente and Hale Creeks within the project study area is presented below.

PERMANENTE CREEK

Reach P1:
Maintenance access is poor; the levees are owned by US Fish and Wildlife Service and vegetation is not regularly controlled to allow for vehicular access.

Reach P2:
Maintenance access to this area is available along maintenance roads located on the tops of the levees.

Reach P3:
Maintenance ramps located at several locations allow maintenance vehicles access to the creek during periods of low flow. During periods of medium and high flows there is limited access to the creek because maintenance crews cannot move along the bottom of the channel.

Reach P4:
Maintenance ramps allow limited access to the downstream end of the Villa St. culvert and the upstream end of the California/El Camino culvert during low flows. There is no access to the remainder of the culvert, with the exception of a few drop inlets.

Reach P5:
This section can be accessed only by a maintenance ramp located at Mountain View Avenue. During periods of medium and high flows there is limited access to the creek because maintenance crews cannot move along the bottom of the channel.

Reaches P6 and P7:
There is very little access for maintenance vehicles along these entire reaches. Access is limited to the areas next to Miramonte Avenue.

Reach P8:
Maintenance ramps allow access to the invert of the creek in the downstream portions of the reach; however, vehicular access may be impaired by drop structures. There is little access in the upstream portion of the reach.

HALE CREEK

Reach H1:
Maintenance ramps located at several locations allow maintenance vehicles access to the creek during periods of low flow. During periods of medium and high flows there is limited access to the creek because maintenance crews cannot move along the bottom of the channel.

Reach H2:
There is very little access for maintenance vehicles along the entire reach other than at bridge crossings.

PERMANENTE DIVERSION

Reach PD:
Maintenance ramps located at several locations allow maintenance vehicles access to the creek during periods of low flow. During periods of medium and high flows there is limited access to the creek because maintenance crews cannot move along the bottom of the channel. There is some top of bank room available.

3.4 Erosion and Sedimentation

Due to the shearing effects of the highly active local fault zones, creeks originating in the Santa Cruz Mountains typically have high amounts of natural sediments associated with high volume flow events. In addition to this natural background level sediment production, three factors increase sedimentation in the Permanente/Hale watersheds.

Hanson Permanente Cement Plant

The plant operates on the southern fork of the upper Permanente watershed. The mining activities generate tremendous amounts of “waste rock”, which are stored on site, sometimes in very close proximity to the creek. The activities also produce smaller sand particulates and dust, which can be carried to the creek during storm events. In response to concerns from the public and regulatory agencies such as the Regional Water Quality Control Board (RWQCB), the plant has devised various methods to trap the waste materials and dust from being carried into the creek. These methods include interception ponds, flow diversion from work sites, in-stream sediment catch basins, etc. The plant reports annually to the RWQCB on how they are meeting their storm water pollution prevention plan (SWPPP) goals.

Urbanization

Urbanization also causes increased sediment production in Santa Clara Valley. Urbanization causes dramatically more rapid and higher peaks in creeks for the more frequent flows (1- to 10- year events). The higher flows cause a response in natural channels, which classically consists of down-cutting (getting deeper) and then bank erosion (getting wider) to be able to handle the increased flows. During this channel adjustment period, which can occur over decades even if urbanization has been completed, the deepening and widening creates much higher than normal sediment loads for downstream sections.

The other effect of urbanization is to route road deposits such as metals and petroleum products into storm drains and thus into the receiving waters. This issue has previously been identified as a source of pollution to both creeks and the southern San Francisco Bay.

Tidal Sedimentation

In the reaches of Permanente Creek subject to tidal influence (approximately upstream to Highway 101), tidal sedimentation is a maintenance concern. Generally, the process for tidal sediment creation involves waves in the shallow southern sections of San Francisco Bay stirring up very fine sediments (bay mud) from the bottom of the Bay. The diurnal tides carry this sediment up the various creek channels. As the tides turn, the flow velocity drops to near zero, and a small amount of sediment can deposit on the channel bottom. These sediments would generally wash away during severe winter events; however, the sediments tend to attract saltwater marsh vegetation, such as bulrush and cordgrass, which stabilize the sediments in place. Sedimentation in the tidal sloughs thus tends to occur inward from the banks.

3.4.1 Sedimentation Locations

Significant sediment deposition has historically occurred at two locations (see Figure 3.3) in the Permanente watershed: 1) on Permanente Creek near Highway 101; and 2) in the Permanente Diversion and in Permanente Creek immediately upstream of the Diversion. Minor sedimentation problems also occur along Hale Creek and its tributaries.

Significant sedimentation problems in the Permanente Watershed are described below.

Permanente Creek - San Francisco Bay to Highway 101

Significant sediment deposition occurs along the lower reach of Permanente Creek from the San Francisco Bay upstream to Highway 101.

In South San Francisco Bay, a large percentage of the fine sediments found in tidal reaches are transported from the Sacramento Delta down to the South Bay where the sediments are deposited in areas sheltered from waves and tidal currents (Krone 1972). Most of the sediment removed from Permanente Creek downstream of Highway 101 consists of fine clays and silts, and it is therefore likely that tidal action is responsible for the majority of sedimentation downstream of Highway 101.

Periodic sediment removal between Amphitheater Parkway and Highway 101 has been performed by the District in order to increase the carrying capacity of the creek and minimize the threat of flooding. Between May 1979 and May 1998, sediment removal was conducted on seven different occasions between Amphitheater Parkway and Highway 101. A total of 3,640 cubic meters (4,758 cubic yards) of sediment have been removed over the 19 year period; the average volume of sediment removed from this area is 190 cubic meters (250 cubic yards) per year.

Permanente Diversion and Permanente Creek near the Diversion

Significant sediment deposition also occurs along Permanente Diversion and along Permanente Creek immediately upstream and downstream of the Diversion. This sediment has been transported downstream from the upper reaches of the Permanente watershed. Sediment deposition occurs along the U-frame portion of the Diversion due to the mild slope of the channel combined with a larger than average bottom width. Sedimentation also occurs in the 54-inch culvert on Permanente Creek which crosses under Eastwood Drive. The pipe is located just downstream of the beginning of the Permanente Diversion Channel. The Diversion was designed so that the base flows would be carried by Permanente Creek, and higher flows would be carried by the Diversion. However, heavy sediment deposition within the 54" culvert has repeatedly blocked it and prevented flows from traveling down Permanente Creek.

District maintenance staff reports that one or two large storms are enough to completely fill the culvert with sediment and block all flows through it. Removing the sediment from the culvert has proved to be very difficult and costly. Due to these problems, the District's present mode of operation is to close the gate to the 54" culvert every year between October 15 and April 15, in order to minimize sediment deposition in it. Periodic sediment removal along Permanente Diversion and Permanente Creek (between Eastwood Drive and Portland Avenue) has been performed by the District in order to maintain the capacity of the creek and minimize the threat of flooding. Between May 1979 and May 1998, sediment removal was conducted on 22 different occasions along Permanente Diversion and Permanente Creek between Eastwood Drive and Portland Avenue. A total of 35,000 cubic meters (45,800 cubic yards) of sediment have been removed over the 19 year period, the average volume of sediment removed from this area is 1840 cubic meters (2,410 cubic yards) per year. It should be noted that very little sediment removal occurred from the mid 1980's through 1991. This period coincided with a drought in Santa Clara County. Decreased stream flows typically result in decreased sedimentation and erosion; therefore, it is likely that the drought contributed to the reduced need for sediment removal during this period.

Hale Creek and Tributaries

Sedimentation occurs along Hale Creek and its tributaries; however, the rate of sedimentation is much less than the upper reaches of Permanente Creek. Between May 1979 and May 1998 there is only record of a single sediment removal activity, which occurred (outside of the project reach) on Magdalena Creek in 1988.

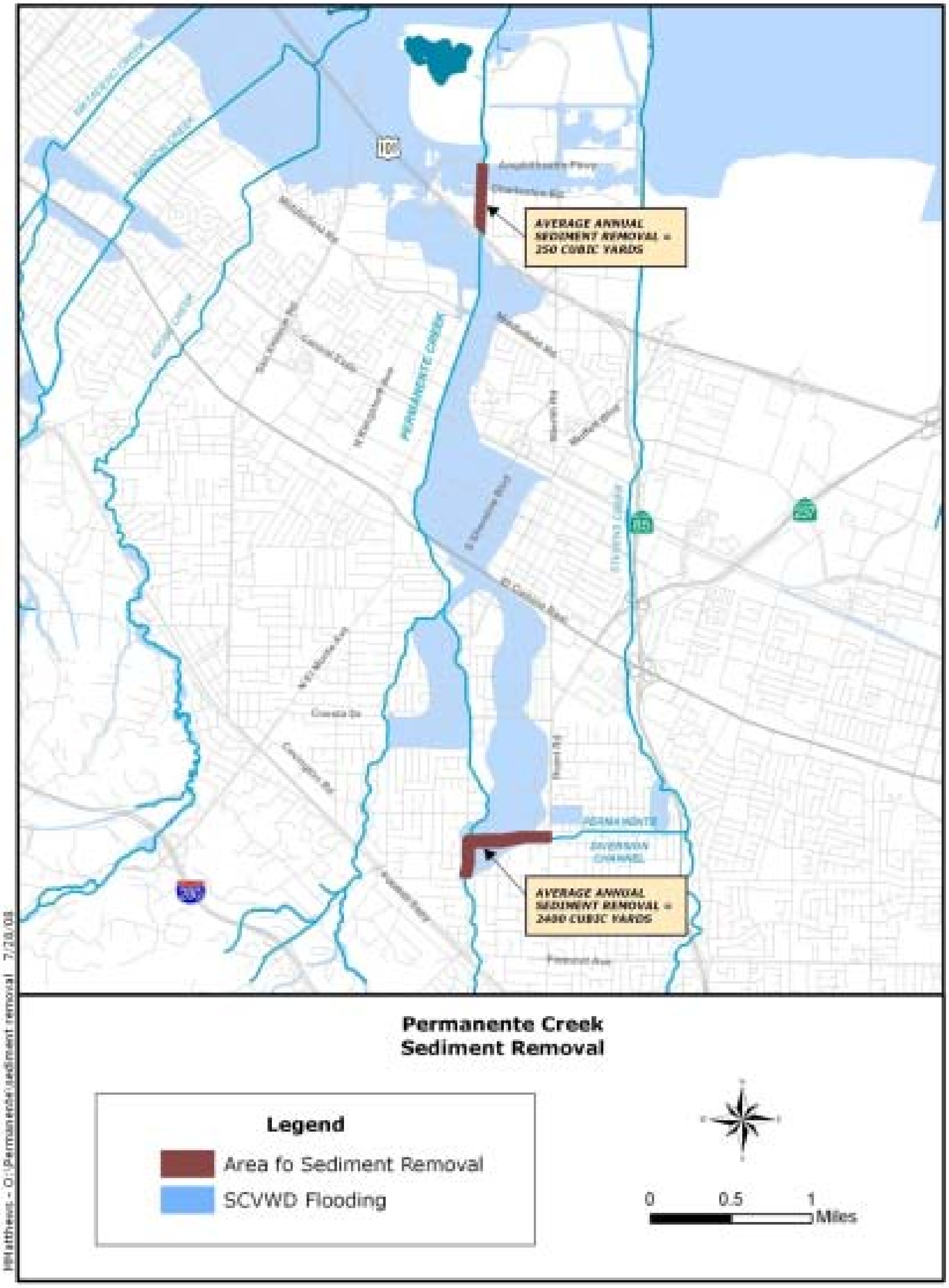

Figure 3.3. Sediment Removal Locations

3.4.2 Bank and Invert Erosion

Within the Permanente watershed study area there is significant erosion in many of the semi-natural earthen channels. There are four stretches of semi-natural earthen channels within the study area: Permanente Creek from San Francisco Bay to Highway 101; Permanente Creek from the Hale Creek confluence to the Permanente Diversion Channel; Permanente Creek from Portland Avenue to Foothill Expressway, and Hale Creek from Rose/Rosita Avenue to Foothill Expressway.

Permanente Creek – San Francisco Bay to Highway 101

Minor levee erosion occurs in the area at several outfalls. There is no evidence of invert erosion.

Permanente Creek – Hale Creek Confluence to Permanente Diversion Channel

Some erosion of the creek banks occurs throughout this reach. The creek channel is very narrow, and is highly encroached upon by surrounding residential properties. Bank slopes are typically steep. In many areas the slopes approach vertical. Numerous patchwork attempts at bank stabilization have been made in this area by the District and by private parties. Bank stabilization methods used in this area include sacked concrete, wooden retaining walls, and concrete rubble and rock retaining walls.
There is very little evidence of invert erosion along this reach.

Permanente Creek – Portland Avenue to Foothill Expressway

Some minor erosion of the creek banks occurs throughout this reach. Although the creek bed is significantly wider in this reach than in the downstream reaches, the channel is very deep and the banks are steep.

There is scattered use of sacked concrete in this reach, especially at creek bends along the outside bank. In several areas the toe of the sacked concrete has become undercut by some mild invert erosion. The invert erosion appears to be progressing very slowly, if at all, indicating that the channel may be establishing dynamic equilibrium post-urbanization.

Hale Creek – Rose/Rosita Avenue to Foothill Expressway

Some relatively minor erosion of the creek banks occurs throughout this reach. The creek channel is narrow, and is highly encroached upon by surrounding residential properties. Bank slopes are steep in many areas, especially at creek bends.

Patchwork attempts at bank stabilization have been made in this area by the District and by private parties. Bank stabilization methods used in this area include sacked concrete, wooden retaining walls, and concrete rubble and rock retaining walls.

There is little evidence of invert erosion along this reach.

Permanente and Hale Creek – Upper Watershed Areas

This reach of the watershed is technically outside of the project area, as defined by the Clean, Safe Creeks project objectives. The creeks in this reach are experiencing bank and invert erosion associated with increased flow due to urbanization. The District has recently conducted bank and invert stabilization projects for both Hale Creek and Permanente Creek. On-going monitoring and maintenance activities may be required into the foreseeable future.

3.5 Structural Deterioration of Previous Work

The Permanente Diversion was constructed in 1959 and most of the remaining concrete channel work was completed in the early 1960's (see Figure 3.4 – Channel Types). Engineering projects are built with assumed life spans, although many perform their intended service far longer than planned. Permanente Creek and Hale Creek, however, have deteriorated to the point that some reaches are in severe risk of failure.

A structural study of the channels was commissioned in 1999. The structural engineering firm of Biggs Cardosa Associates conducted a thorough study of the current condition of the channels, predicted future performance, and recommended certain possible rehabilitation or replacement options.

The study found that much of the work conducted in the 1960's has deteriorated and significant lengths of the constructed channels are in danger of failure. The failure mechanisms vary, with the most worrisome being vertical banks toppling into channels.

The study also developed a mechanism for estimating the remaining service life for the channels (See Figure 3.5 – Remaining Service Life). A small percentage of channel length was thought to be in danger of imminent failure; but the majority of channel length was determined to be in high risk of failure during the next 15 years (from 1999).

3.6 Permanente Diversion Flow Split

Due to poor design, the 54" culvert (which represents Permanente Creek) does not function as intended at the point of the diversion to Stevens Creek. The inlet to the culvert (at the bottom of the channel) as well as the culvert itself are severely prone to sedimentation and are extremely difficult to restore once silted in. To avoid this problem, the culvert is screened off from flows every winter, in effect making the diversion to Stevens Creek the only conveyance for upper watershed flow. Thus, lower Permanente Creek typically conveys very little of its upper watershed flow. This is not the way the flow split at the diversion was envisioned. Approximately half of the flow was to be conveyed via the diversion, with the half flowing down Permanente Creek. This incorrect flow split further reduces the already limited capacity of the Permanente Diversion by eliminating any flow from being carried by the natural channel downstream. The effect is that the capacity of this location is reduced to just the capacity of the Diversion (see above).

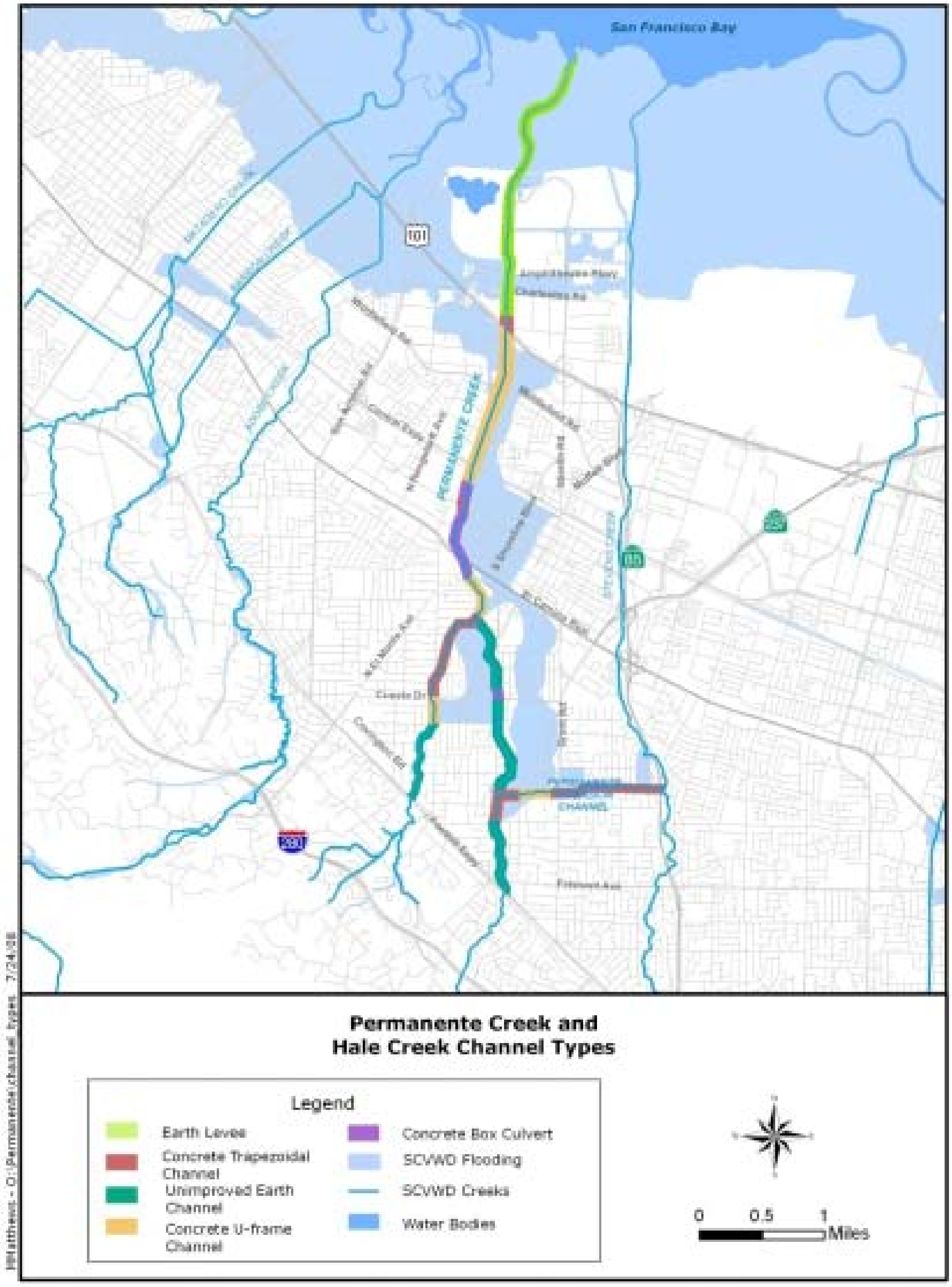

Figure 3.4. Channel Types

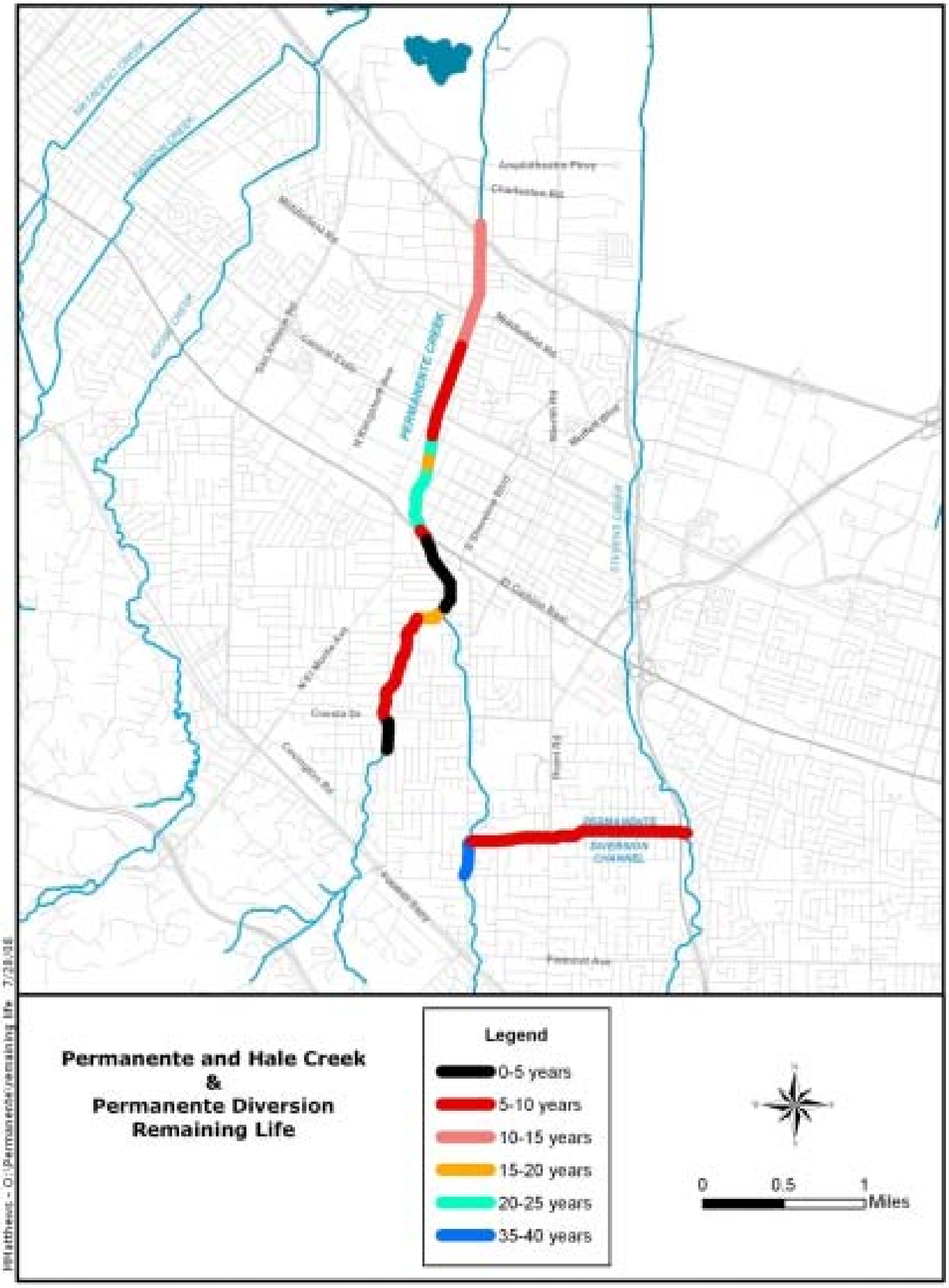

Figure 3.5. Remaining Service Life

3.7 Sea Level Rise

The levee portion of the watershed (north of Highway 101) is subject to bay tidal influence. Therefore, any rise in sea levels due to climatic variations or other causes could increase the starting downstream water surface elevation and increase the risk of flooding. Increases in sea level could also result in more extensive landward encroachment of tidal processes, including salinity and bay sediment deposition.

CHAPTER 4
FORMULATION OF ALTERNATIVES

This chapter describes the range of alternatives considered for the Permanente Creek Flood Protection Project and the methodology followed to determine the recommended project.

4.1 Alternatives Approach

The alternatives development approach for the project was as follows:

- Identify all conceptual project elements capable of meeting the project objectives, whether reach-oriented (e.g. channel improvements), regional (e.g. flood detention), or property-specific (e.g. flood proofing)
- Identify potential opportunities for environmental enhancement project elements
- Construct conceptual alternatives made up of one or more of the project elements identified, representing possible solutions to the project's objectives
- Conduct level 1 screening, identifying which conceptual alternatives are feasible for further consideration
- Rate the feasible alternatives as to how well they meet the District's Natural Flood Protection (NFP) objectives
- Select the recommended alternative based on the outcome of the NFP objectives rating

4.2 Conceptual Project Elements

Throughout the project planning phases, the project team has worked to identify a number of approaches to meet the project's flood protection and environmental enhancement objectives. Each of these approaches was referred to as a *conceptual project element* (CPE). Some of the CPEs were capable of offering a stand-alone solution, while others were intended to be used as building blocks that could be combined to form a variety of integrative solutions addressing the project's objectives. That is, the proposed project would consist of one or a combination of several separate elements addressing the needs of different parts of the creeks. Some of the constraints placed on project element identification included:

- The project cannot exacerbate the flooding issue in the Stevens Creek watershed; the project must solve Permanente Creek's flooding problems within the Permanente watershed.
- The project does not need to address the general tidal flooding problem; however, the project should be compatible with future tidal flood protection efforts.

Sources of information used to create the CPEs included previous District studies, input from resource agencies, local jurisdictions, and members of the public. Hydraulic, hydrologic, wetlands, habitat research, and other work supported the CPE identification effort. There are four basic categories of flood protection improvement project elements:

- Structural improvement: project elements such as channel widening and steepening, levee and floodwall raising, and bridge and culvert replacement. The aim is to increase the amount of flow the channel can carry.

- Bypasses and diversions: the concept is to route excess (flooding) flows around low-capacity portions of the creek through a new channel separate from the creek itself. This is frequently useful in increasing the effective capacity of the creek in reaches where the creek itself cannot be changed, due to concerns about environmental or utility impacts.

- Flood peak detention: the concept is to reduce the peak flowrate downstream by storing the peak of the flood in an off-stream or instream detention area. The reduced flows then can pass safely though existing creek infrastructure downstream, reducing the need for structural improvements.

- Flood proofing: the concept is to protect the areas in danger of flooding instead of preventing creek flooding itself. Structures can be raised on new foundations, moved from the flood-prone area, or shielded from flood flows.

After the early planning phase of analyzing the watershed's hydrologic and hydraulic characteristics, the following observations and conclusions were made:

- The flooding problem is widespread in the project area. Except for a few short reaches, the entire channel length lacks the capacity to pass the one-percent flow downstream. This means that structural/bypass project alternatives will involve a very significant and widespread effort.

- Analysis of the pattern of flooding reveals that during the large flood events, the initial breakout points are far upstream in the project reach. Hale Creek would initially break out of the channel at Covington Road and Permanente Creek would break out at Blach School.

- Due to the watershed topography and lack of creek capacity downstream, once floodwaters break out, they don't return to the channel, but flow parallel to the creek in a generally northward direction towards Highway 101, where they pond against the higher ground. Therefore, simply improving the channel structure from the Bay to El Camino Real, as was originally envisioned in the Clean, Safe Creeks measure, would not remove any of the floodplain area; a floodplain interceptor channel would be needed to catch the floodplain flows and convey them to the improved channels.

- Hydrology analysis reveals that the peaks of the design floods, especially the peak between the ten-percent and one-percent flows, is quite sharp. That is, the period of time it takes the flow to go from ten-percent to one-percent and back down again is a matter of a few hours. For example, South Branch Permanente Creek in the vicinity of Rancho San Antonio goes from the ten-percent flow to the one-percent flow and back down to ten-percent in three hours. This observation implies that relatively little storage volume is required in order to significantly reduce peak flows downstream through flow detention. Therefore, the potential for flow detention project elements should be fully investigated.

4.3 Conceptual Project Elements Development

A total of 21 CPEs were identified (CPE 1 to CPE 21). Broad, qualitative data was used to identify as wide a variety of approaches as practicable. The first set of 18 CPEs was presented to the Permanente Creek Task Force (Task Force) in September 2004 and subsequently presented to the Public in November 2004. Additional CPEs have been developed over the following years. The identified CPEs (see Appendix A for information sheets on the first 18 CPEs; CPEs 19, 20, and 21 are covered under feasible alternatives) were:

CPE 1: No Project: This project element would continue the current maintenance program for the watershed area. Current sediment, vegetation, and bank repair efforts would continue. Additionally, the current monitoring of the deteriorating concrete channels built in the 1960's and their replacement as needed would continue.

CPE 2: South Branch Dam: This project element would involve building a 100-foot high by (approximately) 500-foot wide concrete dam on the South Branch Permanente Creek in lands owned by Hanson Permanente Cement Plant. The storage volume at the spillway elevation would be approximately 325 acre-feet with an inundation area of approximately 12 acres. The dam would have an opening sized to permit up to 50 cubic feet per second (cfs) to freely outflow; therefore the dam storage area would be empty most of the time (when flows are less than 50 cfs). This project element would reduce the flood peak downstream by approximately 500 cfs.

CPE 3: Rancho San Antonio Flood Detention: This project element would involve building an 8-acre flood detention area adjacent to South Branch Permanente Creek in Rancho San Antonio Park. The detention area would be in a current meadow location between Gate of Heaven Cemetery and the park's equestrian parking area. The detention area would be 15 feet deep, with variable, mild side slopes and invert to resemble natural relief and could be vegetated as desired. Flows higher than approximately the ten-year event would spill into a diversion swale and be temporarily stored in the detention area. Once the flood peak would pass, the stored flood flows would drain back into the creek (by gravity flow) and the detention area would be empty again in 1-2 days (depending on the flood event). This project element would reduce the flood peak downstream by approximately 700 cfs.

CPE 4: Grant Road Flood Detention: This project element would involve building a detention pond in the 15-acre parcel located on Grant Road near the Permanente Diversion. The size and depth of the detention varies from 3 acres and 15 feet deep to the full site at 20 feet deep, depending on the alternative. The detention area invert would be converted to athletic fields or other open space uses.

CPE 5 McKelvey Park Flood Detention: This project element would involve building a detention pond in the 5-acre baseball facility owned by the City of Mountain View. The park is located at the corner of Park Drive and Miramonte Avenue. The entire park would be lowered approximately 15 feet deep, with all-new facilities built at the new field level. Flows higher than approximately the ten-year event would spill over a weir and into an energy dissipation area. From there, flood waters would spread into the detention area for temporary storage. Once the flood peak would pass, the stored flood flows would drain back into the creek (by gravity flow) and the detention area would be empty again in 1-2 days (depending on the flood event). The fields would be cleaned up by the District and readied for play. This project element would reduce downstream peak flow by approximately 400 cfs.

CPE 6: Hale Creek Diversion*:* An 8-foot by 8-foot concrete culvert 4000 feet long would be built to convey peak flows to Permanente Creek upstream of the Permanente Diversion. The concept was to reduce the peak flows in Hale Creek sufficiently such that very little structural improvement work would be needed downstream.

CPE 7: Hale Creek Bypass*:* This project element proposed to build a high-flow under street culvert to bypass the natural portion of Hale Creek (from south of Covington Road to Rosita Avenue). The bypass would be approximately 8-foot by 8-foot and 3000 feet long. The concept was to increase creek capacity while avoiding impacts to the natural portion of Hale Creek.

CPE 8: Permanente Bypass*:* This project element proposed to build a high-flow under street culvert to bypass the natural portion of Permanente Creek. The length, size, and route of the culvert are variable, depending on the particular alternative. The concept was to increase creek capacity while avoiding impacts to the natural portion of the creek.

CPE 9: Floodwalls*:* This project element can be divided into two main reaches: north of Highway 101 and South of the Highway. North of Highway 101, the project element involved building floodwalls on top of the existing levees north to the high grounds of Shoreline Park (just north of Amphitheater Parkway). The height of these floodwalls varies between 5-7 feet for structural alternatives and 2-3 feet for flow detention alternatives. South of Highway 101, the concept would be to remove the existing concrete channels and replace them with concrete floodwall channels. The floodwalls would range from 8 feet high downstream to higher than 20 feet high near El Camino Real.

CPE 10: Channel Widening*:* This project element involves the concrete channels along reaches P3, P5, and H1. The concept was to increase channel capacity by widening and steepening (removing drop structures) the existing concrete channels and bridges within existing District right-of-way. The specific work reaches and bridges impacted vary depending on the specific alternative.

CPE 11: Geomorphic Stream Restoration*:* All existing concrete channels in reaches P3, P5, and H1 would be removed. A row of parcels next to the creek channel in these reaches would be acquired and the existing structures removed. A meandering natural creek channel with appropriate dimensions, layout shape, floodplain, and flood bench would be built. All bridges and culverts along the reaches would be modified appropriately for floodway connectivity.

CPE 12: Riparian Restoration*:* The original concept was for the deteriorating existing concrete channels in reaches P3 and H1 to be removed and replaced with earth channels with riparian vegetation. This could only be done in conjunction with flood detention project elements, since the peak flows would have to be reduced to make the concept work.

CPE 13: Non-structural (flood proofing)*:* The parcels in the floodplain would be directly protected through structural elevation or flood shielding. Structural elevation would involve raising the structures above the flood elevation and placing them on new foundations. Flood shielding would involve surrounding the perimeters of the flooding properties with waterproof shielding.

CPE 14: Seventh Day Adventist Church Flood Detention*:* An off-stream detention facility would be created on the back-lot of the 7th Day Adventist Church property on Springer Road. The back parcel is approximately 1.7 acres in size. The average depth would be 10 feet, producing 17 acre-feet of volume. The existing house on the parcel would have to be removed and replaced with a new house in the neighborhood. This CPE could reduce peak flows in Hale Creek by 200 cfs.

CPE 15: El Camino Bypass*:* An underground bypass consisting of a 10-foot by 10-foot box culvert would be constructed under existing streets around the current El Camino Real to Villa Street culverts. The length of the bypass would vary, depending on the alternative. The aim would be to increase channel capacity such that the existing culverts would not need to be improved.

CPE 16: El Camino Culvert*:* The existing culverts from El Camino Real to Villa Street would be improved from within (enlarged) by having their inverts lowered by 3-10 feet. This would increase the culvert capacity such that the entire one-percent flows could be contained.

CPE 17: Hale Creek Improvements*:* The existing concrete channel along Reach H1 would be improved by the invert section being lowered and drop structures removed to within existing District right-of-way. This would improve capacity to the full one-percent flow rate.

CPE 18: Flood Collection Channel*:* A new underground 8-foot by 8-foot box culvert would be installed under one lane of El Camino Real to capture floodwaters from upstream flood breakout points and convey them to the improved concrete channels. Grated inlets installed along El Camino Real would capture the flood flows and convey them to the culvert.

CPE 19: New Diversion Structure*:* The existing flow diversion structure at the upstream end of the Permanente Diversion Channel does not function as intended. Currently, all flows, including low flows continue down the Diversion Channel to Stevens Creek. The new diversion structure would correctly split the flow between the natural portion of Permanente Creek and the Diversion Channel such that low flows would flow down the natural Permanente Creek. The exact dimensions of the new structure would vary, depending on the alternative.

CPE 20: Cuesta Park Annex Flood Detention*:* This project element would involve building a flood detention area in portions of the Cuesta Park Annex and, in some alternatives, the parking area of Cuesta Park itself. The detention area would be 15 to 20 feet deep, with variable, mild side slopes and invert to resemble natural relief and could be vegetated as desired. Flows higher than approximately the ten-year event would be temporarily stored in the detention area. Once the flood peak would pass, the stored flood flows would drain back into the creek (by gravity flow) and the detention area would be empty again in 1-2 days (depending on the flood event).

CPE 21: Blach School Flood Detention*:* This project element would involve building a flood detention area in the football field/track portion of Blach School's open space area. The detention area would be 15 feet deep, with 2:1 side slopes and the football field and track area rebuilt at the bottom of the detention area. Flows higher than approximately the ten-year event would be diverted out of the Permanente Diversion and temporarily stored in the detention area. Once the flood peak would pass, the stored flood flows would drain back out of the area (by gravity flow) and the detention area would be empty again in 1-2 days (depending on the flood event). The fields would be cleaned up by the District and readied for play.

4.4 Conceptual Alternatives Development

Once the potential CPEs were identified, conceptual alternatives were identified by combining the CPEs in various sets. Although a very large number of potential combinations are theoretically possible, many of the combinations would not make sense in terms of meeting the project objectives. This is because many of the CPEs provide benefits in certain locations and in certain combinations and are superfluous when combined with other CPEs. A total of 26 conceptual alternatives (alternatives A through Z) were identified. Note that all conceptual alternatives, other than alternative A (No Project) include CPE 19, which proposes to replace the existing flow split structure at the upstream end of the Permanente Diversion with a new flow structure that would provide a more effective flow split with reduced maintenance issues.

The figures provided for the cost estimates were order of magnitude costs produced for the rough conceptual alternatives stage in 2005 dollars. Since the CSC aim of the design/construction phase of the project is protection of all the floodplain north of El Camino Real, the alternatives that exceeded the project budget of approximately $35 million were further analyzed as to the cost necessary for the portions needed to meet CSC goals. That cost is also reported below.

The following is a description of the conceptual alternatives analyzed:

CONCEPTUAL ALTERNATIVE A

Alternative Description

Under conceptual alternative A, no new project elements would be implemented in the study area. Flood flows would continue to overtop channel banks and inundate adjacent properties, resulting in flood-related damages to residences and businesses. The existing concrete facilities in Permanente and Hale Creeks, and the Diversion Channel would be monitored and rebuilt as needed and current sediment removal and vegetation maintenance practices would be continued.

Conceptual Alternative A is composed of CPE 1: No Project.

Technical Feasibility

All project elements are technically feasible with current construction techniques.

Costs

Capital costs would be $0.
Maintenance costs would be $280,000 annually.

CONCEPTUAL ALTERNATIVE B

Alternative Description

This alternative combines floodwall and bypass channel elements to increase the capacity of all project reaches to the design flows. Conceptual alternative B is composed of the following CPEs:

- ***CPE 7 – Hale Bypass:***

  An underground bypass consisting of an 8-foot by 8-foot concrete box culvert would be constructed a length of approximately 3,000 feet. The bypass would be constructed under local residential roadways from a few hundred feet downstream of Foothill Expressway to the beginning of the concrete Hale Creek section at Rosita Avenue.

- ***CPE 8 – Permanente Bypass:***

  An underground bypass consisting of a 10-foot by 10-foot concrete box culvert would be constructed a length of approximately 11,500 feet from Reach P8 to Reach P5. The proposed bypass culvert would begin upstream of the Permanente Diversion, follow Miramonte Avenue to Park Drive and reconnect to the Permanente Creek channel just upstream of El Camino Real.

- ***CPE 9 – Floodwalls:***

  Reach P2 would be modified by the addition of 5-foot to 7-foot floodwalls to the top of the existing levees. All other existing concrete U-frame channels (Reaches P3, P5, and H1) would be removed and rebuilt with floodwalls from 8 to 30 feet above adjacent ground.

- ***CPE 16 – El Camino Culvert:***

  The underground box culverts between El Camino Real and Villa Street would be enlarged by lowering the bottom of the culverts by approximately 3 to 10 feet.

- ***CPE 19 – New Diversion Structure:***

  The existing diversion structure and 54-inch pipeline would be abandoned and replaced by a new structure. The inlet to the new structure would be along Miramonte Avenue just upstream of the current eastward bend. A new 8-foot by 8-foot box culvert would convey the flows under Miramonte Avenue to connect with the creek at Eastwood Place.

Technical Feasibility

Due to the very high floodwall heights, this alternative is not considered technically feasible.

Costs

Capital cost for the entire alternative would be: $81,500,000.
Capital cost for the portion required under CSC would be: $37,500,000.

CONCEPTUAL ALTERNATIVE C

Alternative Description

This alternative combines floodwall and bypass channel elements to increase the capacity of all project reaches to the design flows. Conceptual alternative C is composed of the following CPEs:

- ***CPE 7 – Hale Bypass:***
  An underground bypass consisting of an 8-foot by 8-foot concrete box culvert would be constructed a length of approximately 3,000 feet. The bypass would be constructed under local residential roadways from a few hundred feet downstream of Foothill Expressway to the beginning of the concrete Hale Creek section at Rosita Avenue.

- ***CPE 8 – Permanente Bypass:***
  An underground bypass consisting of a 10-foot by 10-foot concrete box culvert would be constructed a length of approximately 11,500 feet from Reach P8 to Reach P5. The proposed bypass culvert would begin upstream of the Permanente Diversion, follow Miramonte Avenue to Park Drive and reconnect to the Permanente Creek channel just upstream of El Camino Real.

- ***CPE 9 – Floodwalls:***
  Reach P2 would be modified by the addition of 5-foot to 7-foot floodwalls to the top of the existing levees. All other existing concrete U-frame channels (Reaches P3, P5, and H1) would be removed and rebuilt with floodwalls from 8 to 30 feet above adjacent ground.

- ***CPE 15 – El Camino Bypass:***
  An underground bypass consisting of a 10-foot by 10-foot concrete box culvert would be constructed a length of approximately 4000 feet around the existing El Camino to Villa Street culverts. The new culvert will start just south of El Camino Real and go north and west along local streets and reconnect with the existing channel at Villa Street.

- ***CPE 19 – New Diversion Structure:***
  The existing diversion structure and 54-inch pipeline would be abandoned and replaced by a new structure. The inlet to the new structure would be along Miramonte Avenue just upstream of the current eastward bend. A new 8-foot by 8-foot box culvert would convey the flows under Miramonte Avenue to connect with the creek at Eastwood Place.

- ***CPE 18 – El Camino Collection Channel:***
  A new 8-foot by 8-foot box culvert would also be installed under one lane of southbound El Camino Real. Grated inlets would be installed along El Camino Real to allow flood waters from upstream flooding to be captured by the new culvert.

Technical Feasibility

Due to the very high floodwall heights, this alternative is not considered technically feasible.

Costs

Capital cost for the entire alternative would be: $77,000,000.
Capital cost for the portion required under CSC would be: $33,000,000.

CONCEPTUAL ALTERNATIVE D

Alternative Description

This alternative combines channel expansion and bypass elements to increase the capacity of all channel reaches to the design flows. Conceptual alternative D is composed of the following Conceptual Project Elements:

- ***CPE 7 – Hale Bypass:***
  An underground bypass consisting of an 8-foot by 8-foot concrete box culvert would be constructed a length of approximately 3,000 feet. The bypass would be constructed under local residential roadways from a few hundred feet downstream of Foothill Expressway to the beginning of the concrete Hale Creek section at Rosita Avenue.

- ***CPE 8 – Permanente Bypass:***
  An underground bypass consisting of a 10-foot by 10-foot concrete box culvert would be constructed a length of approximately 11,500 feet from Reach P8 to Reach P5. The proposed bypass culvert would begin upstream of the Permanente Diversion, follow Miramonte Avenue to Park Drive and reconnect to the Permanente Creek channel just upstream of El Camino Real.

- ***CPE 9 – Floodwalls:***
  Permanente Creek down-stream of Highway 101 (Reach P2) would be modified by the addition of 5-foot to 7-foot floodwalls to the top of the existing levees. There would be up to 8-foot floodwalls needed in Reach P3.

- ***CPE 10 – Channel Widening:***
  All existing concrete U-frame channels (Reaches P3, P5, and H1) would be removed and rebuilt wider. In addition, several bridges and culverts in the project area would be similarly modified (widened/enlarged) to contain the one-percent design flow.

- ***CPE 16 – El Camino Culvert:***
  The underground box culverts between El Camino Real and Villa Street would be enlarged by being lowered by approximately 3 to 10 feet.

- ***CPE 19 – New Diversion Structure:***
  The existing diversion structure and 54-inch pipeline would be abandoned and replaced by a new structure. The inlet to the new structure would be along Miramonte Avenue just upstream of the current eastward bend. A new 8-foot by 8-foot box culvert would convey the flows under Miramonte Avenue to connect with the creek at Eastwood Place.

- ***CPE 18 – El Camino Collection Channel:***
  A new 8-foot by 8-foot box culvert would also be installed under one lane of southbound El Camino Real. Grated inlets would be installed along El Camino Real to allow flood waters from upstream flooding to be captured by the new culvert.

Technical Feasibility

All project elements are technically feasible. The El Camino Real Culvert expansion element would require some special construction techniques.

Costs

Capital cost for the entire alternative would be: $82,500,000.

Capital cost for the portion required under CSC would be: $39,500,000.

CONCEPTUAL ALTERNATIVE E

Alternative Description

This alternative combines channel expansion and bypass elements to increase the capacity of all channel reaches to the design flows. Conceptual alternative E is composed of the following Conceptual Project Elements:

- ***CPE 7 – Hale Bypass:***
  An underground bypass consisting of an 8-foot by 8-foot concrete box culvert would be constructed a length of approximately 3,000 feet. The bypass would be constructed under local residential roadways from a few hundred feet downstream of Foothill Expressway to the beginning of the concrete Hale Creek section at Rosita Avenue.

- ***CPE 8 – Permanente Bypass:***
  An underground bypass consisting of a 10-foot by 10-foot concrete box culvert would be constructed a length of approximately 11,500 feet from Reach P8 to Reach P5. The proposed bypass culvert would begin upstream of the Permanente Diversion, follow Miramonte Avenue to Park Drive and reconnect to the Permanente Creek channel just upstream of El Camino Real.

- ***CPE 9 – Floodwalls:***
  Permanente Creek down-stream of Highway 101 (Reach P2) would be modified by the addition of 5-foot to 7-foot floodwalls to the top of the existing levees. There would be up to 8-foot floodwalls needed in Reach P3.

- ***CPE 10 – Channel Widening:***
  All existing concrete U-frame channels (Reaches P3, P5, and H1) would be removed and rebuilt wider. In addition, several bridges and culverts in the project area would be similarly modified (widened/enlarged) to contain the one-percent design flow.

- ***CPE 15 – El Camino Bypass:***
  An underground bypass consisting of a 10-foot by 10-foot concrete box culvert would be constructed a length of approximately 4000 feet around the existing El Camino to Villa Street culverts. The new culvert will start just south of El Camino Real and go north and west along local streets and reconnect with the existing channel at Villa Street.

- ***CPE 19 – New Diversion Structure:***
  The existing diversion structure and 54-inch pipeline would be abandoned and replaced by a new structure. The inlet to the new structure would be along Miramonte Avenue just upstream of the current eastward bend. A new 8-foot by 8-foot box culvert would convey the flows under Miramonte Avenue to connect with the creek at Eastwood Place.

- ***CPE 18 – El Camino Collection Channel:***
  A new 8-foot by 8-foot box culvert would also be installed under one lane of southbound El Camino Real. Grated inlets would be installed along El Camino Real to allow flood waters from upstream flooding to be captured by the new culvert.

Technical Feasibility

All project elements are technically feasible.

Costs

Capital cost for the entire alternative would be: $78,000,000.
Capital cost for the portion required under CSC would be: $35,000,000.

CONCEPTUAL ALTERNATIVE F

Alternative Description

This alternative combines geomorphic stream restoration and bypass elements to increase the capacity of all channel reaches to the design flows and to restore habitat values. Conceptual alternative F is composed of the following Conceptual Project Elements:

- ***CPE 7 – Hale Bypass:***
  An underground bypass consisting of an 8-foot by 8-foot concrete box culvert would be constructed a length of approximately 3,000 feet. The bypass would be constructed under local residential roadways from a few hundred feet downstream of Foothill Expressway to the beginning of the concrete Hale Creek section at Rosita Avenue.

- ***CPE 8 – Permanente Bypass:***
  An underground bypass consisting of a 10-foot by 10-foot concrete box culvert would be constructed a length of approximately 11,500 feet from Reach P8 to Reach P5. The proposed bypass culvert would begin upstream of the Permanente Diversion, follow Miramonte Avenue to Park Drive and reconnect to the Permanente Creek channel just upstream of El Camino Real.

- ***CPE 9 – Floodwalls:***
  Permanente Creek down-stream of Highway 101 (Reach P2) would be modified by the addition of 5-foot to 7-foot floodwalls to the top of the existing levees.

- ***CPE 11 – Geomorphic Stream Restoration:***
  All existing concrete U-frame channels (Reaches P3, P5, and H1) would be removed. A row of parcels next to the creek channel would be purchased and the existing improvements removed. A new meandering natural channel with appropriate wavelength and floodplain would be built. In addition, the many bridges and culverts in these reaches would be modified; culverts would be installed under the roadways to connect the floodplain areas on either side of the bridges.

- ***CPE 19 – New Diversion Structure:***
  The existing diversion structure and 54-inch pipeline would be abandoned and replaced by a new structure. The inlet to the new structure would be along Miramonte Avenue just upstream of the current eastward bend. A new 8-foot by 8-foot box culvert would convey the flows under Miramonte Avenue to connect with the creek at Eastwood Place.

- ***CPE 18 – El Camino Collection Channel:***

A new 8-foot by 8-foot box culvert would also be installed under one lane of southbound El Camino Real. Grated inlets would be installed along El Camino Real to allow flood waters from upstream flooding to be captured by the new culvert.

Technical Feasibility

All project elements are technically feasible. Some specialized design assistance may be necessary for the detailed design of the geomorphic channel.

Costs

Capital cost for the entire alternative would be: $146,000,000.
Capital cost for the portion required under CSC would be: $73,000,000.

CONCEPTUAL ALTERNATIVE G

Alternative Description

This alternative combines flow detention, bypass, and riparian restoration elements to reduce design flows such that existing and restored channel reaches can convey flows safely downstream. Conceptual alternative G is composed of the following Conceptual Project Elements:

- ***CPE 2 – Flow Detention South Branch Dam:***
  A new concrete dam would be built in the far upstream reach of South Branch Permanente Creek in the Hanson Permanente Quarry. The dam would be approximately 100 feet high and 500 feet wide at the top. The dam outlet would be open at all times such that the dam would only impound water during rainfall events that cause flows in excess of 50 cubic feet per second (cfs).

- ***CPE 3 – Flow Detention Rancho San Antonio:***
  An off-stream detention facility would be created on a parcel owned by the County of Santa Clara Parks Department next to the Rancho San Antonio County Park. The average depth of the approximately 5 acre detention facility would be 15 feet, producing approximately 75 acre-feet of storage volume. The site would be contoured to resemble natural relief.

- ***CPE 5 – Flow Detention McKelvey Park:***
  An off-stream detention facility would be created on the current baseball fields at McKelvey Park in the city of Mountain View. The average depth of the approximately 5 acre detention facility would be approximately 13 feet, producing approximately 60 acre-feet of storage volume.

- ***CPE 7 – Hale Bypass:***
  An underground bypass consisting of an 8-foot by 8-foot concrete box culvert would be constructed a length of approximately 3,000 feet. The bypass would be constructed under local residential roadways from a few hundred feet downstream of Foothill Expressway to the beginning of the concrete Hale Creek section at Rosita Avenue.

- ***CPE 9 – Floodwalls:***

Downstream of Highway 101 along Reach P2 would be modified by the addition of 1-foot to 3-foot high concrete floodwalls to the levee channels.

- ***CPE 12 – Riparian Restoration:***
  The existing concrete channel in reaches P3 and P5 would be replaced with an earth channel with riparian vegetation. The channel invert may require rock lining, based on velocity parameters.

- ***CPE 17 – Hale Improvement:***
  The existing concrete channel in reach H1 would be improved by lowering the bottom of the channel and removing drop structures within the existing District right-of-way. This would improve the capacity of the reach to the full design flow.

- ***CPE 19 – New Diversion Structure:***
  The existing diversion structure and 54-inch pipeline would be abandoned and replaced by a new structure. The inlet to the new structure would be along Miramonte Avenue just upstream of the current eastward bend. A new 8-foot by 8-foot box culvert would convey the flows under Miramonte Avenue to connect with the creek at Eastwood Place.

Technical Feasibility

All project elements are technically feasible.

Costs

Capital cost for the entire alternative would be: $26,000,000.

CONCEPTUAL ALTERNATIVE H

Alternative Description

This alternative combines flow detention, diversion, and riparian restoration elements to reduce design flows such that existing and restored channel reaches can convey flows safely downstream. Conceptual alternative H is composed of the following Conceptual Project Elements:

- ***CPE 4 – Flow Detention Grant Road:***
  Fifteen acres of the Grant Road farm parcel site would be cleared and excavated to a depth of 20 feet, producing approximately 300 acre-feet of storage volume. A new 10-foot by 10-foot culvert would convey flows under Grant Road to connect the farm parcel to the Permanente Diversion. The existing Permanente Diversion concrete channel would be improved to carry the full flood flows to Grant Road.

- ***CPE 6 – Hale Diversion:***
  An underground diversion channel consisting of an 8-foot by 8-foot concrete box culvert would be constructed a length of approximately 4,000 feet. The diversion would be constructed under local residential roadways from a few hundred feet downstream of Foothill Expressway to the just upstream of the Permanente Diversion channel.

- ***CPE 9 – Floodwalls:***

Downstream of Highway 101 along Reach P2 would be modified by the addition of 1-foot to 3-foot high concrete floodwalls to the levee channels.

- ***CPE 12 – Riparian Restoration:***
  The existing concrete channel in reaches P3 and P5 would be replaced with an earth channel with riparian vegetation. The channel invert may require rock lining, based on velocity parameters.

- ***CPE 19 – New Diversion Structure:***
  The existing diversion structure and 54-inch pipeline would be abandoned and replaced by a new structure. The inlet to the new structure would be along Miramonte Avenue just upstream of the current eastward bend. A new 8-foot by 8-foot box culvert would convey the flows under Miramonte Avenue to connect with the creek at Eastwood Place.

Technical Feasibility

All project elements are technically feasible.

Costs

Capital cost for the entire alternative would be: $51,000,000.

CONCEPTUAL ALTERNATIVE I

Alternative Description

This alternative combines flow detention, bypass, and riparian restoration elements to reduce design flows such that existing and restored channel reaches can convey flows safely downstream. Conceptual alternative I is composed of the following Conceptual Project Elements:

- ***CPE 2 – Flow Detention South Branch Dam:***
  A new concrete dam would be built in the far upstream reach of South Branch Permanente Creek in the Hanson Permanente Quarry. The dam would be approximately 100 feet high and 500 feet wide at the top. The dam outlet would be open at all times such that the dam would only impound water during rainfall events that cause flows in excess of 50 cubic feet per second.

- ***CPE 4 – Flow Detention Grant Road:***
  Three acres of the Grant Road farm parcel site would be cleared and excavated to a depth of 20 feet, producing approximately 60 acre-feet of storage volume. A new 10-foot by 10-foot culvert would convey flows under Grant Road to connect the farm parcel to the Permanente Diversion. The existing Permanente Diversion concrete channel would be improved to carry the full flood flows to Grant Road.

- ***CPE 5 – Flow Detention McKelvey Park:***
  An off-stream detention facility would be created on the current baseball fields at McKelvey Park in the city of Mountain View. The average depth of the approximately 5 acre detention facility would be approximately 13 feet, producing approximately 60 acre-feet of storage volume.

- ***CPE 7 –- Hale Bypass:***
  An underground bypass consisting of an 8-foot by 8-foot concrete box culvert would be constructed a length of approximately 3,000 feet. The bypass would be constructed under local residential roadways from a few hundred feet downstream of Foothill Expressway to the beginning of the concrete Hale Creek section at Rosita Avenue.

- ***CPE 9 – Floodwalls:***
  Downstream of Highway 101 along Reach P2 would be modified by the addition of 1-foot to 3-foot high concrete floodwalls to the levee channels.

- ***CPE 12 – Riparian Restoration:***
  The existing concrete channel in reaches P3 and P5 would be replaced with an earth channel with riparian vegetation. The channel invert may require rock lining, based on velocity parameters.

- ***CPE 17 – Hale Improvement:***
  The existing concrete channel in reach H1 would be improved by lowering the bottom of the channel and removing drop structures within the existing District right-of-way. This would improve the capacity of the reach to the full design flow.

- ***CPE 19 – New Diversion Structure:***
  The existing diversion structure and 54-inch pipeline would be abandoned and replaced by a new structure. The inlet to the new structure would be along Miramonte Avenue just upstream of the current eastward bend. A new 8-foot by 8-foot box culvert would convey the flows under Miramonte Avenue to connect with the creek at Eastwood Place.

Technical Feasibility

All project elements are technically feasible.

Costs

Capital cost for the entire alternative would be: $35,000,000.

CONCEPTUAL ALTERNATIVE J

Alternative Description

This alternative combines flow detention, bypass, and riparian restoration elements to reduce design flows such that existing and restored channel reaches can convey flows safely downstream. Conceptual alternative J is composed of the following Conceptual Project Elements:

- ***CPE 3 – Flow Detention Rancho San Antonio:***
  An off-stream detention facility would be created on a parcel owned by the County of Santa Clara Parks Department next to the Rancho San Antonio County Park. The average depth of the approximately 5 acre detention facility would be 15 feet, producing approximately 75 acre-feet of storage volume. The site would be contoured to resemble natural relief.

- ***CPE 4 – Flow Detention Grant Road:***
  Three acres of the Grant Road farm parcel site would be cleared and excavated to a depth of 20 feet, producing approximately 60 acre-feet of storage volume. A new 10-foot by 10-foot culvert would convey flows under Grant Road to connect the farm parcel to the Permanente Diversion. The existing Permanente Diversion concrete channel would be improved to carry the full flood flows to Grant Road.

- ***CPE 5 – Flow Detention McKelvey Park:***
  An off-stream detention facility would be created on the current baseball fields at McKelvey Park in the city of Mountain View. The average depth of the approximately 5 acre detention facility would be approximately 13 feet, producing approximately 60 acre-feet of storage volume.

- ***CPE 7 – Hale Bypass:***
  An underground bypass consisting of an 8-foot by 8-foot concrete box culvert would be constructed a length of approximately 3,000 feet. The bypass would be constructed under local residential roadways from a few hundred feet downstream of Foothill Expressway to the beginning of the concrete Hale Creek section at Rosita Avenue.

- ***CPE 9 – Floodwalls:***
  Downstream of Highway 101 along Reach P2 would be modified by the addition of 1-foot to 3-foot high concrete floodwalls to the levee channels.

- ***CPE 12 – Riparian Restoration:***
  The existing concrete channel in reaches P3 and P5 would be replaced with an earth channel with riparian vegetation. The channel invert may require rock lining, based on velocity parameters.

- ***CPE 17 – Hale Improvement:***
  The existing concrete channel in reach H1 would be improved by lowering the bottom of the channel and removing drop structures within the existing District right-of-way. This would improve the capacity of the reach to the full design flow.

- ***CPE 19 – New Diversion Structure:***
  The existing diversion structure and 54-inch pipeline would be abandoned and replaced by a new structure. The inlet to the new structure would be along Miramonte Avenue just upstream of the current eastward bend. A new 8-foot by 8-foot box culvert would convey the flows under Miramonte Avenue to connect with the creek at Eastwood Place.

Technical Feasibility

All project elements are technically feasible.

Costs

Capital cost for the entire alternative would be: $35,000,000.

CONCEPTUAL ALTERNATIVE K

Alternative Description

This alternative combines flow detention, diversion, and riparian restoration elements to reduce design flows such that existing and restored channel reaches can convey flows safely downstream. Conceptual alternative K is composed of the following Conceptual Project Elements:

- ***CPE 2 – Flow Detention South Branch Dam:***
  A new concrete dam would be built in the far upstream reach of South Branch Permanente Creek in the Hanson Permanente Quarry. The dam would be approximately 100 feet high and 500 feet wide at the top. The dam outlet would be open at all times such that the dam would only impound water during rainfall events that cause flows in excess of 50 cubic feet per second.

- ***CPE 3 – Flow Detention Rancho San Antonio:***
  An off-stream detention facility would be created on a parcel owned by the County of Santa Clara Parks Department next to the Rancho San Antonio County Park. The average depth of the approximately 5 acre detention facility would be 15 feet, producing approximately 75 acre-feet of storage volume. The site would be contoured to resemble natural relief.

- ***CPE 4 – Flow Detention Grant Road:***
  2.5 acres of the Grant Road farm parcel site would be cleared and excavated to a depth of 20 feet, producing approximately 50 acre-feet of storage volume. A new 10-foot by 10-foot culvert would convey flows under Grant Road to connect the farm parcel to the Permanente Diversion. The existing Permanente Diversion concrete channel would be improved to carry the full flood flows to Grant Road.

- ***CPE 6 – Hale Diversion:***
  An underground diversion channel consisting of an 8-foot by 8-foot concrete box culvert would be constructed a length of approximately 4,000 feet. The diversion would be constructed under local residential roadways from a few hundred feet downstream of Foothill Expressway to the just upstream of the Permanente Diversion channel.

- ***CPE 9 – Floodwalls:***
  Downstream of Highway 101 along Reach P2 would be modified by the addition of 1-foot to 3-foot high concrete floodwalls to the levee channels.

- ***CPE 12 – Riparian Restoration:***
  The existing concrete channel in reaches P3 and P5 would be replaced with an earth channel with riparian vegetation. The channel invert may require rock lining, based on velocity parameters.

- ***CPE 19 – New Diversion Structure:***
  The existing diversion structure and 54-inch pipeline would be abandoned and replaced by a new structure. The inlet to the new structure would be along Miramonte Avenue just upstream of the current eastward bend. A new 8-foot by 8-foot box culvert would convey the flows under Miramonte Avenue to connect with the creek at Eastwood Place.

Technical Feasibility

All project elements are technically feasible.

Costs

Capital cost for the entire alternative would be: $30,500,000.

CONCEPTUAL ALTERNATIVE L

Alternative Description

This alternative combines flow detention, diversion, and riparian restoration elements to reduce design flows such that existing and restored channel reaches can convey flows safely downstream. Conceptual Alternative L is composed of the following Conceptual Project Elements:

- ***CPE 2 – Flow Detention South Branch Dam:***
  A new concrete dam would be built in the far upstream reach of South Branch Permanente Creek in the Hanson Permanente Quarry. The dam would be approximately 100 feet high and 500 feet wide at the top. The dam outlet would be open at all times such that the dam would only impound water during rainfall events that cause flows in excess of 50 cubic feet per second.

- ***CPE 4 – Flow Detention Grant Road:***
  Six acres of the Grant Road farm parcel site would be cleared and excavated to a depth of 20 feet, producing approximately 120 acre-feet of storage volume. A new 10-foot by 10-foot culvert would convey flows under Grant Road to connect the farm parcel to the Permanente Diversion. The existing Permanente Diversion concrete channel would be improved to carry the full flood flows to Grant Road.

- ***CPE 6 – Hale Diversion:***
  An underground diversion channel consisting of an 8-foot by 8-foot concrete box culvert would be constructed a length of approximately 4,000 feet. The diversion would be constructed under local residential roadways from a few hundred feet downstream of Foothill Expressway to the just upstream of the Permanente Diversion channel.

- ***CPE 9 – Floodwalls:***
  Downstream of Highway 101 along Reach P2 would be modified by the addition of 1-foot to 3-foot high concrete floodwalls to the levee channels.

- ***CPE 12 – Riparian Restoration:***
  The existing concrete channel in reaches P3 and P5 would be replaced with an earth channel with riparian vegetation. The channel invert may require rock lining, based on velocity parameters.

- ***CPE 19 – New Diversion Structure:***
  The existing diversion structure and 54-inch pipeline would be abandoned and replaced by a new structure. The inlet to the new structure would be along Miramonte Avenue

just upstream of the current eastward bend. A new 8-foot by 8-foot box culvert would convey the flows under Miramonte Avenue to connect with the creek at Eastwood Place.

Technical Feasibility

All project elements are technically feasible.

Costs

Capital cost for the entire alternative would be: $35,000,000.

CONCEPTUAL ALTERNATIVE M

Alternative Description

This alternative combines flow detention, diversion, and riparian restoration elements to reduce design flows such that existing and restored channel reaches can convey flows safely downstream. Conceptual alternative M is composed of the following Conceptual Project Elements:

- ***CPE 3 – Flow Detention Rancho San Antonio:***
  An off-stream detention facility would be created on a parcel owned by the County of Santa Clara Parks Department next to the Rancho San Antonio County Park. The average depth of the approximately 5 acre detention facility would be 15 feet, producing approximately 75 acre-feet of storage volume. The site would be contoured to resemble natural relief.

- ***CPE 4 – Flow Detention Grant Road:***
  Six acres of the Grant Road farm parcel site would be cleared and excavated to a depth of 20 feet, producing approximately 120 acre-feet of storage volume. A new 10-foot by 10-foot culvert would convey flows under Grant Road to connect the farm parcel to the Permanente Diversion. The existing Permanente Diversion concrete channel would be improved to carry the full flood flows to Grant Road.

- ***CPE 6 – Hale Diversion:***
  An underground diversion channel consisting of an 8-foot by 8-foot concrete box culvert would be constructed a length of approximately 4,000 feet. The diversion would be constructed under local residential roadways from a few hundred feet downstream of Foothill Expressway to the just upstream of the Permanente Diversion channel.

- ***CPE 9 – Floodwalls:***
  Downstream of Highway 101 along Reach P2 would be modified by the addition of 1-foot to 3-foot high concrete floodwalls to the levee channels.

- ***CPE 12 – Riparian Restoration:***
  The existing concrete channel in reaches P3 and P5 would be replaced with an earth channel with riparian vegetation. The channel invert may require rock lining, based on velocity parameters.

- ***CPE 19 – New Diversion Structure:***

The existing diversion structure and 54-inch pipeline would be abandoned and replaced by a new structure. The inlet to the new structure would be along Miramonte Avenue just upstream of the current eastward bend. A new 8-foot by 8-foot box culvert would convey the flows under Miramonte Avenue to connect with the creek at Eastwood Place.

Technical Feasibility

All project elements are technically feasible.

Costs

Capital cost for the entire alternative would be: $35,000,000.

CONCEPTUAL ALTERNATIVE N

Alternative Description

This alternative combines flow detention, bypass, and riparian restoration elements to reduce design flows such that existing and restored channel reaches can convey flows safely downstream. Conceptual alternative N is composed of the following Conceptual Project Elements:

- ***CPE 2 – Flow Detention South Branch Dam:***
  A new concrete dam would be built in the far upstream reach of South Branch Permanente Creek in the Hanson Permanente Quarry. The dam would be approximately 100 feet high and 500 feet wide at the top. The dam outlet would be open at all times such that the dam would only impound water during rainfall events that cause flows in excess of 50 cubic feet per second.

- ***CPE 3 – Flow Detention Rancho San Antonio:***
  An off-stream detention facility would be created on a parcel owned by the County of Santa Clara Parks Department next to the Rancho San Antonio County Park. The average depth of the approximately 5 acre detention facility would be 15 feet, producing approximately 75 acre-feet of storage volume. The site would be contoured to resemble natural relief.

- ***CPE 7 – Hale Bypass:***
  An underground bypass consisting of an 8-foot by 8-foot concrete box culvert would be constructed a length of approximately 3,000 feet. The bypass would be constructed under local residential roadways from a few hundred feet downstream of Foothill Expressway to the beginning of the concrete Hale Creek section at Rosita Avenue.

- ***CPE 9 – Floodwalls:***
  Downstream of Highway 101 along Reach P2 would be modified by the addition of 1-foot to 3-foot high concrete floodwalls to the levee channels.

- ***CPE 12 – Riparian Restoration:***
  The existing concrete channel in reaches P3 and P5 would be replaced with an earth channel with riparian vegetation. The channel invert may require rock lining, based on velocity parameters.

- ***CPE 14 – Flow Detention 7th Day Adventist Church:***
  An off-stream detention facility would be created on the back lot of the Seventh Day Adventist Church property on Springer Road. The back parcel is approximately 1.7 acres in size. The average depth would be approximately 10 feet, producing approximately 17 acre-feet of storage volume. The existing house on the parcel would have to be replaced with an equivalent house in the neighborhood.

- ***CPE 17 – Hale Improvement:***
  The existing concrete channel in reach H1 would be improved by lowering the bottom of the channel and removing drop structures within the existing District right-of-way. This would improve the capacity of the reach to the full design flow.

- ***CPE 19 – New Diversion Structure:***
  The existing diversion structure and 54-inch pipeline would be abandoned and replaced by a new structure. The inlet to the new structure would be along Miramonte Avenue just upstream of the current eastward bend. A new 8-foot by 8-foot box culvert would convey the flows under Miramonte Avenue to connect with the creek at Eastwood Place.

Technical Feasibility

All project elements are technically feasible.

Costs

Capital cost for the entire alternative would be: $24,500,000.

CONCEPTUAL ALTERNATIVE O

Alternative Description

This alternative combines flow detention, bypass, and riparian restoration elements to reduce design flows such that existing and restored channel reaches can convey flows safely downstream. Conceptual alternative O is composed of the following Conceptual Project Elements:

- ***CPE 2 – Flow Detention South Branch Dam:***
  A new concrete dam would be built in the far upstream reach of South Branch Permanente Creek in the Hanson Permanente Quarry. The dam would be approximately 100 feet high and 500 feet wide at the top. The dam outlet would be open at all times such that the dam would only impound water during rainfall events that cause flows in excess of 50 cubic feet per second.

- ***CPE 3 – Flow Detention Rancho San Antonio:***
  An off-stream detention facility would be created on a parcel owned by the County of Santa Clara Parks Department next to the Rancho San Antonio County Park. The average depth of the approximately 5 acre detention facility would be 15 feet, producing approximately 75 acre-feet of storage volume. The site would be contoured to resemble natural relief.

- ***CPE 7 – Hale Bypass:***

An underground bypass consisting of an 8-foot by 8-foot concrete box culvert would be constructed a length of approximately 3,000 feet. The bypass would be constructed under local residential roadways from a few hundred feet downstream of Foothill Expressway to the beginning of the concrete Hale Creek section at Rosita Avenue.

- ***CPE 9 – Floodwalls:***
  Downstream of Highway 101 along Reach P2 would be modified by the addition of 1-foot to 3-foot high concrete floodwalls to the levee channels.

- ***CPE 12 – Riparian Restoration:***
  The existing concrete channel in reaches P3 and P5 would be replaced with an earth channel with riparian vegetation. The channel invert may require rock lining, based on velocity parameters.

- ***CPE 14 – Flow Detention 7th Day Adventist Church:***
  An off-stream detention facility would be created on the back lot of the Seventh Day Adventist Church property on Springer Road. The back parcel is approximately 1.7 acres in size. The average depth would be approximately 10 feet, producing approximately 17 acre-feet of storage volume. The existing house on the parcel would have to be replaced with an equivalent house in the neighborhood.

- ***CPE 19 – New Diversion Structure:***
  The existing diversion structure and 54-inch pipeline would be abandoned and replaced by a new structure. The inlet to the new structure would be along Miramonte Avenue just upstream of the current eastward bend. A new 8-foot by 8-foot box culvert would convey the flows under Miramonte Avenue to connect with the creek at Eastwood Place.

Technical Feasibility

All project elements are technically feasible.

Costs

Capital cost for the entire alternative would be: $26,000,000.

CONCEPTUAL ALTERNATIVE P

Alternative Description

This alternative combines flow detention, bypass, and riparian restoration elements to reduce design flows such that existing and restored channel reaches can convey flows safely downstream. Conceptual alternative P is composed of the following Conceptual Project Elements:

- ***CPE 4 – Flow Detention Grant Road:***
  Ten acres of the Grant Road farm parcel site would be cleared and excavated to a depth of 20 feet, producing approximately 200 acre-feet of storage volume. A new 10-foot by 10-foot culvert would convey flows under Grant Road to connect the farm parcel to the Permanente Diversion. The existing Permanente Diversion concrete channel would be improved to carry the full flood flows to Grant Road.

- ***CPE 7 – Hale Bypass:***
  An underground bypass consisting of an 8-foot by 8-foot concrete box culvert would be constructed a length of approximately 3,000 feet. The bypass would be constructed under local residential roadways from a few hundred feet downstream of Foothill Expressway to the beginning of the concrete Hale Creek section at Rosita Avenue.

- ***CPE 9 – Floodwalls:***
  Downstream of Highway 101 along Reach P2 would be modified by the addition of 1-foot to 3-foot high concrete floodwalls to the levee channels.

- ***CPE 12 – Riparian Restoration:***
  The existing concrete channel in reaches P3 and P5 would be replaced with an earth channel with riparian vegetation. The channel invert may require rock lining, based on velocity parameters.

- ***CPE 14 – Flow Detention 7th Day Adventist Church:***
  An off-stream detention facility would be created on the back lot of the 7th Day Adventist Church property on Springer Road. The back parcel is approximately 1.7 acres in size. The average depth would be approximately 10 feet, producing approximately 17 acre-feet of storage volume. The existing house on the parcel would have to be replaced with an equivalent house in the neighborhood.

- ***CPE 17 – Hale Improvement:***
  The existing concrete channel in reach H1 would be improved by lowering the bottom of the channel and removing drop structures within the existing District right-of-way. This would improve the capacity of the reach to the full design flow.

- ***CPE 19 – New Diversion Structure:***
  The existing diversion structure and 54-inch pipeline would be abandoned and replaced by a new structure. The inlet to the new structure would be along Miramonte Avenue just upstream of the current eastward bend. A new 8-foot by 8-foot box culvert would convey the flows under Miramonte Avenue to connect with the creek at Eastwood Place.

Technical Feasibility

All project elements are technically feasible.

Costs

Capital cost for the entire alternative would be: $45,500,000.

CONCEPTUAL ALTERNATIVE Q

Alternative Description

This alternative uses flood-proofing elements to protect the properties in the floodplain from damages during flood events. Conceptual alternative Q is composed of the following Conceptual Project Element:

- ***CPE 13 – Non-Structural (Floodproofing):***

The 2,778 parcels in the one-percent floodplain would be protected by either of two means: structural elevation or flood shielding. Structural elevation would be achieved by raising parcel improvements (actual house structures) above the flood elevation and placing them on new foundations. Flood shielding would protect parcels by surrounding the perimeters of properties with water proof shielding to an elevation higher than the flood elevation.

Technical Feasibility

This project element is technically feasible with current construction techniques.

Costs

Capital costs would be $112,500,000.
Capital costs for the CSC portion would be $66,500,000.

CONCEPTUAL ALTERNATIVE R

This alternative involved work with the First Baptist Church of Los Altos. The right-of-way required by the alternative was not available; therefore, the alternative was removed from further consideration.

CONCEPTUAL ALTERNATIVE S

Alternative Description

This alternative combines flow detention, bypass, and riparian restoration elements to reduce design flows such that existing and restored channel reaches can convey flows safely downstream. Conceptual alternative S is composed of the following Conceptual Project Elements:

- ***CPE 3 – Flow Detention Rancho San Antonio:***
  An off-stream detention facility would be created on a parcel owned by the County of Santa Clara Parks Department next to the Rancho San Antonio County Park. The average depth of the approximately 5 acre detention facility would be 15 feet, producing approximately 75 acre-feet of storage volume. The site would be contoured to resemble natural relief.

- ***CPE 5 – Flow Detention McKelvey Park:***
  An off-stream detention facility would be created on the current baseball fields at McKelvey Park in the city of Mountain View. The average depth of the approximately 5 acre detention facility would be approximately 13 feet, producing approximately 60 acre-feet of storage volume.

- ***CPE 7 – Hale Bypass:***
  An underground bypass consisting of an 8-foot by 8-foot concrete box culvert would be constructed a length of approximately 3,000 feet. The bypass would be constructed under local residential roadways from a few hundred feet downstream of Foothill Expressway to the beginning of the concrete Hale Creek section at Rosita Avenue.

- ***CPE 8 – Permanente Bypass:***

An underground bypass consisting of a 8-foot by 6-foot diameter box culvert would be constructed a length of approximately 2200 feet from the St. Francis School bridge to the Cuesta Park Annex under Miramonte Avenue and Cuesta Drive.

- ***CPE 9 – Floodwalls:***
  Downstream of Highway 101 along Reach P2 would be modified by the addition of 1-foot to 3-foot high concrete floodwalls to the levee channels.

- ***CPE 12 – Riparian Restoration:***
  The existing concrete channel in reaches P3 and P5 would be replaced with an earth channel with riparian vegetation. The channel invert may require rock lining, based on velocity parameters.

- ***CPE 17 – Hale Improvement:***
  The existing concrete channel in reach H1 would be improved by lowering the bottom of the channel and removing drop structures within the existing District right-of-way. This would improve the capacity of the reach to the full design flow.

- ***CPE 19 – New Diversion Structure:***
  The existing diversion structure and 54-inch pipeline would be abandoned and replaced by a new structure. The inlet to the new structure would be along Miramonte Avenue just upstream of the current eastward bend. A new 8-foot by 8-foot box culvert would convey the flows under Miramonte Avenue to connect with the creek at Eastwood Place.

- ***CPE 20 – Flood Detention Cuesta Park Annex:***
  A flood detention facility would be created on the Cuesta Park Annex property of the City of Mountain View. The average depth of the 12-acre facility would be 15 feet, producing approximately 130 acre-feet of storage volume. 10-year or higher flow events would be routed to the facility. A 36-inch outlet pipe would drain the stored volume back to the creek, once the peak flows would pass.

Technical Feasibility

This project element is technically feasible with current construction techniques.

Costs

Capital costs would be $60,000,000.
Capital costs for the CSC portion would be $36,000,000.

CONCEPTUAL ALTERNATIVE T

Alternative Description

This alternative combines flow detention, bypass, and riparian restoration elements to reduce design flows such that existing and restored channel reaches can convey flows safely downstream. Conceptual alternative T is composed of the following Conceptual Project Elements:

- ***CPE 5 – Flow Detention McKelvey Park:***

An off-stream detention facility would be created on the current baseball fields at McKelvey Park in the city of Mountain View. The average depth of the approximately 5 acre detention facility would be approximately 13 feet, producing approximately 60 acre-feet of storage volume.

- ***CPE 7 – Hale Bypass:***
  An underground bypass consisting of an 8-foot by 8-foot concrete box culvert would be constructed a length of approximately 3,000 feet. The bypass would be constructed under local residential roadways from a few hundred feet downstream of Foothill Expressway to the beginning of the concrete Hale Creek section at Rosita Avenue.

- ***CPE 8 – Permanente Bypass:***
  This bypass would consist of two different sizes. The upstream portion would be an 8-foot by 7-foot box culvert bypass channel from Eastwood Drive to St. Francis School. The downstream portion would consist of a 12-foot by 7-foor box culvert from the school to Cuesta Park Annex. The channel along Reach P8 from the Diversion to Portland Avenue would also have to be improved by replacing the concrete channel.

- ***CPE 9 – Floodwalls:***
  Downstream of Highway 101 along Reach P2 would be modified by the addition of 1-foot to 3-foot high concrete floodwalls to the levee channels.

- ***CPE 12 – Riparian Restoration:***
  The existing concrete channel in reaches P3 and P5 would be replaced with an earth channel with riparian vegetation. The channel invert may require rock lining, based on velocity parameters.

- ***CPE 17 – Hale Improvement:***
  The existing concrete channel in reach H1 would be improved by lowering the bottom of the channel and removing drop structures within the existing District right-of-way. This would improve the capacity of the reach to the full design flow.

- ***CPE 19 – New Diversion Structure:***
  The existing diversion structure and 54-inch pipeline would be abandoned and replaced by a new structure. The inlet to the new structure would be along Miramonte Avenue just upstream of the current eastward bend. A new 8-foot by 8-foot box culvert would convey the flows under Miramonte Avenue to connect with the creek at Eastwood Place.

- ***CPE 20 – Flood Detention Cuesta Park Annex:***
  A flood detention facility would be created on the Cuesta Park Annex property of the City of Mountain View. The average depth of the 12-acre facility would be 15 feet, producing approximately 130 acre-feet of storage volume. Ten-years or higher flow events would be routed to the facility. A 36-inch outlet pipe would drain the stored volume back to the creek, once the peak flows would pass.

Technical Feasibility

All project elements are technically feasible.

Costs

Capital costs would be $60,000,000.
Capital costs for the CSC portion would be $26,000,000.

CONCEPTUAL ALTERNATIVE U

Alternative Description

This alternative combines structural improvement, flow detention, and bypass elements to meet the project goals. Conceptual alternative U is composed of the following Conceptual Project Elements:

- ***CPE 2 – Flow Detention South Branch Dam:***
  A new concrete dam would be built in the far upstream reach of South Branch Permanente Creek in the Hanson Permanente Quarry. The dam would be approximately 100 feet high and 500 feet wide at the top. The dam outlet would be open at all times such that the dam would only impound water during rainfall events that cause flows in excess of 50 cubic feet per second (cfs).

- ***CPE 3 – Flow Detention Rancho San Antonio:***
  An off-stream detention facility would be created on a parcel owned by the County of Santa Clara Parks Department next to the Rancho San Antonio County Park. The average depth of the approximately 5 acre detention facility would be 15 feet, producing approximately 75 acre-feet of storage volume. The site would be contoured to resemble natural relief.

- ***CPE 7 – Hale Bypass:***
  An underground bypass consisting of an 8-foot by 8-foot concrete box culvert would be constructed a length of approximately 3,000 feet. The bypass would be constructed under local residential roadways from a few hundred feet downstream of Foothill Expressway to the beginning of the concrete Hale Creek section at Rosita Avenue.

- ***CPE 9 – Floodwalls:***
  Downstream of Highway 101 along Reach P2 would be modified by the addition of 3-foot to 4-foot high concrete floodwalls to the levee channels.

- ***CPE 10 – Channel Widening:***
  The existing concrete channel in reaches P3, P5, and H1 would be replaced with a larger concrete channel. In addition, several bridges along these reaches would need to be removed and replaced by larger structures.

- ***CPE 19 – New Diversion Structure:***
  The existing diversion structure and 54-inch pipeline would be abandoned and replaced by a new structure. The inlet to the new structure would be along Miramonte Avenue just upstream of the current eastward bend. A new 8-foot by 8-foot box culvert would convey the flows under Miramonte Avenue to connect with the creek at Eastwood Place.

Technical Feasibility

All project elements are technically feasible.

Costs

Capital cost for the entire alternative would be: $62,000,000.
Capital costs for the CSC portion would be $46,000,000.

CONCEPTUAL ALTERNATIVE V

Alternative Description

This alternative combines flow detention, bypass, and riparian restoration elements to reduce design flows such that existing and restored channel reaches can convey flows safely downstream. Conceptual alternative V is composed of the following Conceptual Project Elements:

- ***CPE 2 – Flow Detention South Branch Dam:***
  A new concrete dam would be built in the far upstream reach of South Branch Permanente Creek in the Hanson Permanente Quarry. The dam would be approximately 100 feet high and 500 feet wide at the top. The dam outlet would be open at all times such that the dam would only impound water during rainfall events that cause flows in excess of 50 cubic feet per second (cfs).

- ***CPE 3 – Flow Detention Rancho San Antonio:***
  An off-stream detention facility would be created on a parcel owned by the County of Santa Clara Parks Department next to the Rancho San Antonio County Park. The average depth of the approximately 5 acre detention facility would be 15 feet, producing approximately 75 acre-feet of storage volume. The site would be contoured to resemble natural relief.

- ***CPE 7 – Hale Bypass:***
  An underground bypass consisting of an 8-foot by 8-foot concrete box culvert would be constructed a length of approximately 3,000 feet. The bypass would be constructed under local residential roadways from a few hundred feet downstream of Foothill Expressway to the beginning of the concrete Hale Creek section at Rosita Avenue. For this alternative, Hale Bypass would be extended for an additional 4400 feet along Cuesta Drive to Cuesta Park Annex.

- ***CPE 9 – Floodwalls:***
  Downstream of Highway 101 along Reach P2 would be modified by the addition of 1-foot to 3-foot high concrete floodwalls to the levee channels.

- ***CPE 12 – Riparian Restoration:***
  The existing concrete channel in reaches P3 and P5 would be replaced with an earth channel with riparian vegetation. The channel invert may require rock lining, based on velocity parameters.

- ***CPE 19 – New Diversion Structure:***
  The existing diversion structure and 54-inch pipeline would be abandoned and replaced by a new structure. The inlet to the new structure would be along Miramonte Avenue

just upstream of the current eastward bend. A new 8-foot by 8-foot box culvert would convey the flows under Miramonte Avenue to connect with the creek at Eastwood Place.

- ***CPE 20 – Flood Detention Cuesta Park Annex:***
  A flood detention facility would be created on the Cuesta Park Annex property of the City of Mountain View. The average depth of the 6-acre facility would be 10 feet, producing approximately 60 acre-feet of storage volume. 10-year or higher flow events would be routed to the facility. A 24-inch outlet pipe would drain the stored volume back to the creek, once the peak flows would pass.

Technical Feasibility

All project elements are technically feasible.

Costs

Capital cost for the entire alternative would be: $55,000,000.
Capital costs for the CSC portion would be $33,000,000.

CONCEPTUAL ALTERNATIVE W

Alternative Description

This alternative combines flow detention, bypass, and riparian restoration elements to reduce design flows such that existing and restored channel reaches can convey flows safely downstream. Conceptual alternative W is composed of the following Conceptual Project Elements:

- ***CPE 2 – Flow Detention South Branch Dam:***
  A new concrete dam would be built in the far upstream reach of South Branch Permanente Creek in the Hanson Permanente Quarry. The dam would be approximately 100 feet high and 500 feet wide at the top. The dam outlet would be open at all times such that the dam would only impound water during rainfall events that cause flows in excess of 50 cubic feet per second (cfs).

- ***CPE 5 – Flow Detention McKelvey Park:***
  An off-stream detention facility would be created on the current baseball fields at McKelvey Park in the city of Mountain View. The average depth of the approximately 5 acre detention facility would be approximately 13 feet, producing approximately 60 acre-feet of storage volume.

- ***CPE 7 – Hale Bypass:***
  An underground bypass consisting of an 8-foot by 8-foot concrete box culvert would be constructed a length of approximately 3,000 feet. The bypass would be constructed under local residential roadways from a few hundred feet downstream of Foothill Expressway to the beginning of the concrete Hale Creek section at Rosita Avenue.

- ***CPE 8 – Permanente Bypass:***
  This bypass would consist of two different sizes. The upstream portion would be a 54-inch pipe culvert bypass channel from Eastwood Drive to St. Francis School. The downstream portion would consist of an 8-foot by 6-foor box culvert from the school to

Cuesta Park Annex. The channel along Reach P8 from the Diversion to Portland Avenue would also have to be improved by replacing the concrete channel.

- ***CPE 9 – Floodwalls:***
  Downstream of Highway 101 along Reach P2 would be modified by the addition of 1-foot to 3-foot high concrete floodwalls to the levee channels.

- ***CPE 12 – Riparian Restoration:***
  The existing concrete channel in reaches P3 and P5 would be replaced with an earth channel with riparian vegetation. The channel invert may require rock lining, based on velocity parameters.

- ***CPE 17 – Hale Improvement:***
  The existing concrete channel in reach H1 would be improved by lowering the bottom of the channel and removing drop structures within the existing District right-of-way. This would improve the capacity of the reach to the full design flow.

- ***CPE 19 – New Diversion Structure:***
  The existing diversion structure and 54-inch pipeline would be abandoned and replaced by a new structure. The inlet to the new structure would be along Miramonte Avenue just upstream of the current eastward bend. A new 8-foot by 8-foot box culvert would convey the flows under Miramonte Avenue to connect with the creek at Eastwood Place.

- ***CPE 20 – Flood Detention Cuesta Park Annex:***
  A flood detention facility would be created on the Cuesta Park Annex property of the City of Mountain View. The average depth of the 7-acre facility would be 10 feet, producing approximately 70 acre-feet of storage volume. 10-year or higher flow events would be routed to the facility. A 24-inch outlet pipe would drain the stored volume back to the creek, once the peak flows would pass.

Technical Feasibility

All project elements are technically feasible.

Costs

Capital costs would be $58,000,000.
Capital costs for the CSC portion would be $26,000,000.

CONCEPTUAL ALTERNATIVE X

Alternative Description

This alternative combines flow detention, bypass, and riparian restoration elements to reduce design flows such that existing and restored channel reaches can convey flows safely downstream. Conceptual alternative X is composed of the following Conceptual Project Elements:

- ***CPE 2 – Flow Detention South Branch Dam:***

A new concrete dam would be built in the far upstream reach of South Branch Permanente Creek in the Hanson Permanente Quarry. The dam would be approximately 100 feet high and 500 feet wide at the top. The dam outlet would be open at all times such that the dam would only impound water during rainfall events that cause flows in excess of 50 cubic feet per second (cfs).

- ***CPE 7 – Hale Bypass:***
  An underground bypass consisting of an 8-foot by 8-foot concrete box culvert would be constructed a length of approximately 3,000 feet. The bypass would be constructed under local residential roadways from a few hundred feet downstream of Foothill Expressway to the beginning of the concrete Hale Creek section at Rosita Avenue. For this alternative, Hale Bypass would be extended for an additional 4400 feet along Cuesta Drive to Cuesta Park Annex.

- ***CPE 8 – Permanente Bypass:***
  This bypass would consist of two different sizes. The upstream portion would be a 54-inch pipe culvert bypass channel from Eastwood Drive to St. Francis School. The downstream portion would consist of an 8-foot by 6-foor box culvert from the school to Cuesta Park Annex. The channel along Reach P8 from the Diversion to Portland Ave would also have to be improved by replacing the concrete channel.

- ***CPE 9 – Floodwalls:***
  Downstream of Highway 101 along Reach P2 would be modified by the addition of 1-foot to 3-foot high concrete floodwalls to the levee channels.

- ***CPE 12 – Riparian Restoration:***
  The existing concrete channel in reaches P3 and P5 would be replaced with an earth channel with riparian vegetation. The channel invert may require rock lining, based on velocity parameters.

- ***CPE 19 – New Diversion Structure:***
  The existing diversion structure and 54-inch pipeline would be abandoned and replaced by a new structure. The inlet to the new structure would be along Miramonte Avenue just upstream of the current eastward bend. A new 8-foot by 8-foot box culvert would convey the flows under Miramonte Avenue to connect with the creek at Eastwood Place.

- ***CPE 20 – Flood Detention Cuesta Park Annex:***
  A flood detention facility would be created on the Cuesta Park Annex property of the City of Mountain View. The average depth of the 12-acre facility would be 15 feet, producing approximately 130 acre-feet of storage volume. 10-year or higher flow events would be routed to the facility. A 36-inch outlet pipe would drain the stored volume back to the creek, once the peak flows would pass.

Technical Feasibility

All project elements are technically feasible.

Costs

Capital cost for the entire alternative would be: $60,000,000.

Capital costs for the CSC portion would be $30,000,000.

CONCEPTUAL ALTERNATIVE Y

Alternative Description

This alternative combines flow detention, bypass, and riparian restoration elements to reduce design flows such that existing and restored channel reaches can convey flows safely downstream. Conceptual alternative Y is composed of the following Conceptual Project Elements:

- ***CPE 3 – Flow Detention Rancho San Antonio:***
  An off-stream detention facility would be created on a parcel owned by the County of Santa Clara Parks Department next to the Rancho San Antonio County Park. The average depth of the approximately 5 acre detention facility would be 15 feet, producing approximately 75 acre-feet of storage volume. The site would be contoured to resemble natural relief.

- ***CPE 7 – Hale Bypass:***
  An underground bypass consisting of an 8-foot by 8-foot concrete box culvert would be constructed a length of approximately 3,000 feet. The bypass would be constructed under local residential roadways from a few hundred feet downstream of Foothill Expressway to the beginning of the concrete Hale Creek section at Rosita Avenue. For this alternative, Hale Bypass would be extended for an additional 4,400 feet along Cuesta Drive to Cuesta Park Annex.

- ***CPE 8 – Permanente Bypass:***
  An underground bypass consisting of a 6-foot diameter pipe culvert would be constructed a length of approximately 3400 feet from the Blach School detention area to the Cuesta Park Annex under local streets.

- ***CPE 9 – Floodwalls:***
  Downstream of Highway 101 along Reach P2 would be modified by the addition of 1-foot to 3-foot high concrete floodwalls to the levee channels.

- ***CPE 12 – Riparian Restoration:***
  The existing concrete channel in reaches P3 and P5 would be replaced with an earth channel with riparian vegetation. The channel invert may require rock lining, based on velocity parameters.

- ***CPE 19 – New Diversion Structure:***
  The existing diversion structure and 54-inch pipeline would be abandoned and replaced by a new structure. The inlet to the new structure would be along Miramonte Avenue just upstream of the current eastward bend. A new 8-foot by 8-foot box culvert would convey the flows under Miramonte Avenue to connect with the creek at Eastwood Place.

- ***CPE 20 – Flood Detention Cuesta Park Annex:***
  A flood detention facility would be created on the Cuesta Park Annex property of the City of Mountain View. The average depth of the 12-acre facility would be 15 feet, producing approximately 130 acre-feet of storage volume. 10-year or higher flow events would be

routed to the facility. A 36-inch outlet pipe would drain the stored volume back to the creek, once the peak flows would pass.

- ***CPE 21 – Flood Detention Blach School:***
  A flood detention facility would be created in Blach Jr. High School's athletic fields. The average depth of the 5-acre facility would be 15 feet, producing approximately 65 acre-feet of storage volume. 10-year or higher flow events would be routed to the facility from Permanente Diversion, which would be modified for this purpose at this location.

Technical Feasibility

This project element is technically feasible with current construction techniques.

Costs

Capital costs would be $57,000,000.
Capital costs for the CSC portion would be $48,000,000.

CONCEPTUAL ALTERNATIVE Z

Alternative Description

This alternative combines flow detention, bypass, and riparian restoration elements to reduce design flows such that existing and restored channel reaches can convey flows safely downstream. Conceptual alternative Z is composed of the following Conceptual Project Elements:

- ***CPE 3 – Flow Detention Rancho San Antonio:***
  An off-stream detention facility would be created on a parcel owned by the County of Santa Clara Parks Department next to the Rancho San Antonio County Park. The average depth of the approximately 5 acre detention facility would be 15 feet, producing approximately 75 acre-feet of storage volume. The site would be contoured to resemble natural relief.

- ***CPE 5 – Flow Detention McKelvey Park:***
  An off-stream detention facility would be created on the current baseball fields at McKelvey Park in the city of Mountain View. The average depth of the approximately 5 acre detention facility would be approximately 13 feet, producing approximately 60 acre-feet of storage volume.

- ***CPE 7 – Hale Bypass:***
  An underground bypass consisting of an 8-foot by 8-foot concrete box culvert would be constructed a length of approximately 3,000 feet. The bypass would be constructed under local residential roadways from a few hundred feet downstream of Foothill Expressway to the beginning of the concrete Hale Creek section at Rosita Avenue.

- ***CPE 8 – Permanente Bypass:***
  An underground bypass consisting of a 6-foot diameter pipe culvert would be constructed a length of approximately 3400 feet from the Blach School detention area to the Cuesta Park Annex under local streets.

- ***CPE 9 – Floodwalls:***
  Downstream of Highway 101 along Reach P2 would be modified by the addition of 1-foot to 3-foot high concrete floodwalls to the levee channels.

- ***CPE 12 – Riparian Restoration:***
  The existing concrete channel in reaches P3 and P5 would be replaced with an earth channel with riparian vegetation. The channel invert may require rock lining, based on velocity parameters.

- ***CPE 17 – Hale Improvement:***
  The existing concrete channel in reach H1 would be improved by lowering the bottom of the channel and removing drop structures within the existing District right-of-way. This would improve the capacity of the reach to the full design flow.

- ***CPE 19 – New Diversion Structure:***
  The existing diversion structure and 54-inch pipeline would be abandoned and replaced by a new structure. The inlet to the new structure would be along Miramonte Avenue just upstream of the current eastward bend. A new 8-foot by 8-foot box culvert would convey the flows under Miramonte Avenue to connect with the creek at Eastwood Place.

- ***CPE 20 – Flood Detention Cuesta Park Annex:***
  A flood detention facility would be created on the Cuesta Park Annex property of the City of Mountain View. The average depth of the 7-acre facility would be 10 feet, producing approximately 65 acre-feet of storage volume. 10-year or higher flow events would be routed to the facility. A 36-inch outlet pipe would drain the stored volume back to the creek, once the peak flows would pass.

- ***CPE 21 – Flood Detention Blach School:***
  A flood detention facility would be created in Blach Jr. High School's athletic fields. The average depth of the 5-acre facility would be 15 feet, producing approximately 65 acre-feet of storage volume. 10-year or higher flow events would be routed to the facility from Permanente Diversion, which would be modified for this purpose at this location.

Technical Feasibility

This project element is technically feasible with current construction techniques.

Costs

Capital costs would be $50,000,000.
Capital costs for the CSC portion would be $34,000,000

4.5 Conceptual Alternatives Screening Methodology

Screening during the conceptual alternatives phase of the project is defined as Level 1 screening. Level 1 screening focuses on the project objectives, costs, technical feasibility, and right-of-way availability. The Level 1 screening criteria are described below.

Project Objectives*:* Conceptual alternatives must satisfy the project objectives in order to be carried forward to the feasible analysis stage. Thus, each alternative was analyzed as to whether it met the project's objectives.

Project Cost*:* The project's budget for detailed design and construction is approximately $35 million. To allow for evaluation of a full range of alternatives for the District Board, the affordability cut off line for conceptual alternatives was set at double the project budget ($70 million). Alternatives that provide the flood protection and other project objectives required for under $70 million were considered for feasibility. Note that all costs are in 2005 $.

Technical Feasibility*:* This parameter indicates if all project elements can be actually built using widely available construction materials and know-how. Alternatives that were determined to be technically feasible could be allowed to continue to the feasible alternatives phase.

Right-of-Way Availability*:* This parameter refers to whether or not the non-District owned right-of-way required by the alternative is likely to be available for the intended District use. Conceptual alternatives that would likely have available rights-of-way could be carried forward into the feasibility analysis stage.

Of the 26 conceptual alternatives analyzed, the 11 alternatives that satisfied all of the Level 1 screening criteria (see Table 4.1) plus the "no project" alternative were carried forward into the feasible alternatives stage of the project. Alternatives that failed to satisfy any one of the above four criteria were eliminated from further consideration.

4.6 Feasible Alternatives Description

The 11 feasible alternatives and the no project alternative were analyzed in more detail. Some of the elements were changed to reflect better design or to meet actual site conditions. Some of the bypass sizes were changed and floodwall lengths and heights were refined. Two of the CPEs were more radically altered:

CPE 12: Riparian Restoration – After more detailed analysis, it became clear that the extent of possible riparian restoration had to be reduced. The limited right-of-way available along most of the concrete channels did not allow adequate space for both a restored channel and maintenance access. Since maintenance access would be crucial to the long-term success of the restoration, it was decided that the maximum extent of this project element would be from Highway 101 to Middlefield Road, approximately 2,300 feet.

CPE 17: Hale Improvements – After discussions with structural experts, it was determined that this CPE was not technically as feasible as full removal and reconstruction of the trapezoidal concrete channels along Hale Creek would be. Therefore, the alternatives containing CPE 17 were edited to include CPE 10 (channel widening) instead.

Once the required changes were made, the "no project" alternative and the other 11 alternatives which passed the level 1 screening were analyzed in detail. These alternatives are described below and are summarized in Table 4.2 - Summary of Feasible Alternatives. Maps for all the feasible alternatives are provided in Appendix B.

ALTERNATIVE A

Description

This is the “no project” alternative. This alternative proposes to continue the current level of sediment, bank, and vegetation maintenance effort. This alternative would also include continuous monitoring of the concrete channel reaches in order to determine if reaches are nearing preset failure thresholds (see September 2000 Biggs Cardosa Structural Integrity Study) and replacing channels in-kind once they do reach that threshold. It is anticipated that half of the current concrete channel length in reaches P3, P5, and H1 will fail over the project life (next 50 years).

Construction Schedule

There would be no new capital work involved with this alternative.

Operation and Maintenance (O&M)

Existing O&M activities include sediment removal in the Permanente Diversion and in Permanente Creek downstream of Highway 101. They also include typical maintenance activities such as trash and debris removal, graffiti removal, vegetation (overgrowth) removal, and erosion repair in natural sections.

Land Ownership/Access

No new right-of-way acquisition would be required.

Costs

Capital cost for this alternative would be: $0
50 year maintenance cost (current maintenance activities) would be $29 million.
See Appendix E for costs details.

Preliminary Environmental Review

Preliminary environmental review has revealed potential for impacts to biological resources and water quality. Detailed results will not be available until an evaluation of potential impacts and mitigation measures has been carried out through the California Environmental Quality Act (CEQA) process.

ALTERNATIVE D

Description

This alternative combines channel expansion, floodwall and bypass elements to increase the capacity of all channel reaches to the design flows, while avoiding major impacts to existing creek resources. *The project elements shown in italic font below are those that would not be constructed in the current CSC phase*. See Appendix B for a map showing all project elements and flood benefit areas (note that map element shown in blue are those that would be built in the current CSC phase, while those displayed in red would be built in potential future phases). Alternative D is composed of the following project elements:

- ***Hale Bypass:***

An underground bypass consisting of an 8-foot by 6-foot concrete box culvert 3,700 feet long would be constructed. The bypass would be constructed under local residential roadways from just downstream of Foothill Expressway to the beginning of the concrete Hale Creek section at Rosita Avenue.

- ***Permanente Bypass:***
  An underground bypass consisting of an 8-foot by 6.5-foot concrete box culvert for 4000 feet plus a 10-foot by 7-foot concrete box culvert for 5800 feet would be constructed from Reach P8 to Reach P5. The proposed bypass culvert would begin upstream of the Permanente Diversion, follow Miramonte Avenue to Trophy Drive and reconnect to the Permanente Creek channel just upstream of El Camino Real.

- **Floodwalls:**
  Permanente Creek downstream of Highway 101 along Reach P2 and the lower portion of Reach P3 would be modified by the addition of 5-foot to 8-foot high floodwalls to the top of the existing levees.

- **Channel Widening:**
  All existing concrete U-frame channels (Reaches P3*, P5, and H1*) would be removed and rebuilt wider. In addition, most bridges and culverts in the project area would be similarly enlarged to contain the one-percent design flow.

- **El Camino Bypass:**
  An underground bypass consisting of a 10-foot by 8-foot concrete box culvert approximately 2500 feet long would be constructed around a portion of the existing El Camino Real culvert. The new culvert would start at El Camino Real and go north and west along local streets and reconnect with the existing culvert at Latham Street.

- **El Camino Culvert:**
  The portion of underground box culvert between Latham and Villa Street would be enlarged by the addition of a new 10-foot by 10-foot box culvert.

- **El Camino Collection Channel:**
  1400 feet of 5-foot diameter and 1600 feet of 9-foot diameter reinforced concrete pipe (RCP) culvert would be installed under one lane of northbound El Camino Real. Grated inlets would be installed along El Camino Real to allow flood waters from upstream flooding to be captured by the new culvert.

- ***New Diversion Structure:***
  The existing diversion structure and 54-inch pipeline would be abandoned. There would be a new outlet to the natural channel at Eastwood Drive provided through a small culvert from the Permanente Bypass described above.

Construction Schedule

Constructing floodwalls would likely take 1 to-2 years. Construction of the bypasses and flood collection channel would be completed in 2 to 4 years, depending on difficulties with existing utilities located beneath the local roadways. Channel widening would take 3-4 years, in stages.

Operation and Maintenance

Existing O&M activities are expected to continue on the rebuilt concrete channels; no additional maintenance activities would be required. Typical maintenance activities include trash and debris removal, graffiti removal, vegetation (overgrowth) removal, erosion repair in natural sections, and sediment removal in the Permanente Diversion and Reach P2. Operation and maintenance of the bypasses would be minimal. The bypass culverts would be designed to have adequate slope for sediment control. Operation and maintenance for the new Latham to Villa Street culvert would be similar to existing culvert. The culvert would be designed to have adequate slope for sediment passage.

Costs

Capital cost for the entire alternative would be: $118 million (2008 dollars).
Capital cost for the portion required under CSC would be: $59 million.
50 year maintenance cost (including current maintenance activities) would be $27 million.
See Appendix E for costs details for all alternatives.

Preliminary Environmental Review

Preliminary environmental review has revealed potential for impacts to hydrology and water quality, biological resources, cultural resources, aesthetics, traffic/utilities, noise, air quality, health and safety, and recreation. Detailed results will not be available until an evaluation of potential impacts and mitigation measures has been carried out through the California Environmental Quality Act (CEQA) process.

ALTERNATIVE E

Description

This alternative is very similar to alternative D. It combines channel expansion and bypass elements to increase the capacity of all channel reaches to the design flows, while avoiding major impacts to existing creek resources. *The project elements shown in italic font are those that would not be constructed in the current CSC phase*. See Appendix B for a map showing all project elements and flood benefit areas. Alternative E is composed of the following project elements:

- ***Hale Bypass:***
  *See A*lternative *D.*

- ***Permanente Bypass:***
  *See A*lternative *D.*

- **Floodwalls:**
  See Alternative D.

- **Channel Widening:**
  See Alternative D.

- **El Camino Bypass:**
  An underground bypass consisting of a 10-foot by 8-foot concrete box culvert approximately 4800 feet long would be constructed around the existing El Camino to

Villa Street culverts. The new culvert would start just north of El Camino Real and go north and west along local streets and reconnect with the existing channel at Villa Street.

- **El Camino Collection Channel:**
  See alternative D.

- ***New Diversion Structure:***
  *See A*lternative *D.*

Construction Schedule

See Alternative D.

Operation and Maintenance

See Alternative D.

Costs

Capital cost for the entire alternative would be: $121 million (2008 dollars).
Capital cost for the portion required under CSC would be: $62 million.
50-year maintenance costs (including current maintenance) would be $27 million.
See Appendix E for cost estimate details.

Preliminary Environmental Review

See Alternative D.

ALTERNATIVE G

Alternative Description

This alternative combines flow detention, bypass, and riparian restoration elements to reduce design flows such that existing and restored channel reaches could convey flows safely downstream. *The project elements shown in italic font are those that would not be constructed in the current CSC phase*. See Appendix B for a map showing all project elements and flood benefit areas. Alternative G is composed of the following project elements:

- **Flow Detention South Branch Dam:**
  A new concrete dam would be built in the far upstream reach of South Branch Permanente Creek in the Hanson Permanente Quarry. The dam would be approximately 100 feet high and 500 feet wide at the top, with a storage volume of more than 300 acre-feet and impoundment surface area of approximately 11 acres. The dam outlet would be open at all times such that the dam would begin to impound water during rainfall events that cause flows in excess of 50 cubic feet per second (cfs), which is a yearly flow event.

- **Flow Detention Rancho San Antonio:**
  An off-stream detention facility would be created on a parcel owned by the County of Santa Clara in Rancho San Antonio County Park. The average depth of the approximately 8-acre detention facility would be 15 feet, producing approximately

100 acre-feet of storage volume. The site would be contoured to resemble natural relief. Only 10-year or higher flow events would be diverted into the facility. A 24-inch outlet pipe would drain the pond back into the creek, once peak flows passed. The inlet would be by way of a rebuilt bridge a few hundred feet upstream of the pond. The current low flow crossing would be replaced by an at-grade bridge, with fill (from the pond excavation) placed on the West bank to confine high flows. The new culvert would be sized for the design flow split, forcing excess flows to spill into a side channel located on the East side of the creek.

- **Flow Detention McKelvey Park:**
  An off-stream detention facility would be created on the current baseball fields at McKelvey Park in the city of Mountain View. The average depth of the approximately 5-acre detention facility would be approximately 13.5 feet, producing approximately 60 acre-feet of storage volume. Only 10-year or higher flow events would be diverted into the facility. A 24-inch outlet pipe would drain the flood flows back to the creek once the peak flows passed.

- ***Hale Bypass:***
  *See A*lternative *D.*

- **Floodwalls:**
  Permanente Creek from down-stream of Amphitheater Parkway to Highway 101 would be modified by the addition of floodwalls averaging 2 feet high to the top of the existing levees.

- **Channel Widening:**
  Existing concrete channels along reaches P5 *and H1* would be removed and rebuilt wider. In addition, several bridges and culverts in the project area would be similarly modified (widened/enlarged) to contain the one-percent design flow.

- ***Riparian Restoration:***
  The existing concrete channel in reach P3 from Highway 101 to Middlefield Road would be replaced with a combined concrete and earth channel with riparian vegetation. The channel would be hardened on one side (concrete @ 1:2 side slopes) with a natural bottom, bankfull channel with (partial) floodplain, and vegetated earth bank @ 1.5:1 side slopes.

- **New Diversion Structure:**
  The existing diversion structure would be abandoned and replaced by a new pipe connection to the existing 54-inch pipe. The inlet to the new structure would be along Miramonte Avenue just upstream of the current eastward bend (looking downstream) of the creek.

Construction Schedule

Construction of the dam would likely take two years. The Rancho San Antonio and McKelvey Park detention sites would likely take one year each. Construction and installation of the bypass would be completed in 2 to 4 years, depending on difficulties with existing utilities located beneath the local roadways. Construction of the riparian earth channel would occur over stages in 4 to 8 years. The diversion structure improvement could be built in 1/2 year. Channel widening and floodwalls would take 1-2 years, in stages.

Operation and Maintenance

The new dam and its outlet would have to be maintained in good and safe conditions. The inlet area and the outlet would have to be cleared of sediment as needed. The Rancho San Antonio detention pond would only need regular maintenance for its inlet/outlet works. The pond area itself would need minimal maintenance, as vegetation and sediment can be allowed to accumulate over time.

The McKelvey Park detention area would have to be maintained for its intended use as a baseball facility. Thus, the area would have to be quickly cleared of silt and other flood debris after any flooding event, and the playing surfaces (dirt areas, chalk lines, etc.) would be restored. A maintenance agreement could be set up with a private company, which would relieve District crews from having to add this non-typical work to their flood fighting duties.

Existing sediment O&M activities in the Permanente Diversion would be reduced somewhat due to the reduced flow peaks from the dam upstream. Typical maintenance activities include trash and debris removal, graffiti removal, vegetation (overgrowth) removal, erosion repair in natural sections, and sediment removal in the Permanente Diversion and Reach P2. Operation and maintenance of the bypass would be limited to inlet/outlet vegetation and sediment control. The bypass culvert would be designed to have adequate slope for sediment control. Operation and maintenance of the riparian channel would be to encourage appropriate vegetation growth and to repair bank failures. Activities would be limited by access issues along most reaches.

Costs

Capital cost for the entire alternative would be: $50 million (2008 dollars).
Capital cost for the CSC portion of the work would be $32 million.
50-year cost for maintenance (including current work) would be $30 million.
See Appendix E for cost estimate details.

Preliminary Environmental Review

See Alternative D.

ALTERNATIVE S

Alternative Description

This alternative is very similar to alternative G. It combines flow detention, bypass, and riparian restoration elements to reduce design flows such that existing and restored channel reaches could convey flows safely downstream. *<u>The project elements shown in italic font are those that would not be constructed in the current CSC phase</u>*. See Appendix B for a map showing all project elements and flood benefit areas. Alternative S is composed of the following project elements:

- **Flow Detention Rancho San Antonio:**
  See Alternative G.

- **Flow Detention McKelvey Park:**
  See Alternative G.

- ***Hale Bypass:***
  See Alternative D.

- ***Permanente Bypass:***
  An 8' by 5.5' bypass channel would be constructed for a length of 2200' from the St. Francis School bridge to the Cuesta Park Annex under Miramonte and Cuesta Avenues.

- **Floodwalls:**
  See Alternative G.

- **Channel Widening:**
  See Alternative G.

- ***Riparian Restoration:***
  See Alternative G.

- ***New Diversion Structure:***
  The existing diversion structure and pipeline would be abandoned. The inlet to the new structure would be along Miramonte Avenue just upstream of the current eastward bend of the creek (looking downstream). A new 8-foot diameter RCP culvert would convey the flows under Miramonte Avenue to connect with the creek at Eastwood Drive.

- **Flow Detention Cuesta Park Annex:**
  An off-stream detention facility would be created on the Cuesta Park Annex property of the City of Mountain View. There would be an open part of the storage on the north side of Cuesta Park Annex, which would be composed of approximately 5 acres excavated to 20 feet deep and landscaped with park vegetation and features. There would also be an underground portion, located under the parking lot area in the developed part of Cuesta Park. This area would be excavated 30 feet deep, with the parking lot replaced on top of the detention area. The total storage volume would be approximately 130 acre-feet. Only 10-year or higher flow events would be diverted into the facility. A 36-inch outlet pipe would drain the flood flows back to Permanente Creek, once the flood peak passed. The outlet pipe would go West to Miramonte Ave, North to Trophy Drive and West to Permanente Creek.

Construction Schedule

See Alternative G. Cuesta Park Annex detention sites would likely take one year to build.

Operation and Maintenance

See Alternative G. The Cuesta Park Annex detention pond would have to be maintained for its intended use as a public facility. Thus, the area would have to be cleared of silt and other flood debris after any flooding event and the surfaces restored.

Costs

Capital cost for the entire alternative would be: $67 million (2008 dollars).
Capital cost for the CSC portion of the work would be $41 million.
50-year cost for maintenance (including current work) would be $21 million.
See Appendix E for cost estimate details.

Preliminary Environmental Review

See Alternative D.

ALTERNATIVE T

Alternative Description

This alternative is very similar to Alternative G. It combines flow detention, bypass, and riparian restoration elements to reduce design flows such that existing and restored channel reaches could convey flows safely downstream. *The project elements shown in italic font are those that would not be constructed in the current CSC phase*. See Appendix B for a map showing all project elements and flood benefit areas. Alternative T is composed of the following project elements:

- **Flow Detention McKelvey Park:**
  See Alternative G.

- ***Hale Bypass:***
  *See A*lternative *D.*

- ***Permanente Bypass:***
  This bypass would consist of two different sizes. The upstream half would consist of an 8' by 7' bypass channel from Eastwood Dr. to St. Francis School. The downstream half would consist of a 12' by 7' bypass channel from St. Francis School to Cuesta Park Annex. This project element would also include improving the channel portion from upstream of Portland Ave to the Permanente Diversion by rebuilding the concrete channel.

- **Floodwalls:**
  See Alternative G.

- **Channel Widening:**
  See Alternative G.

- ***Riparian Restoration:***
  *See A*lternative *G.*

- ***New Diversion Structure:***
  *See A*lternative *S.*

- **Flow Detention Cuesta Park Annex**
  An off-stream detention facility would be created on the Cuesta Park Annex property of the City of Mountain View. The average depth of the approximately 12-acre detention facility would be approximately 20 feet, producing approximately 240 acre-feet of storage

volume. Only 10-year or higher flow events would be diverted into the facility. A 48-inch outlet pipe would drain the flood flows back to the creek, once the flood peak passed. The outlet pipe would go West to Miramonte Ave, North to Trophy Drive and West to Permanente Creek.

Construction Schedule

See Alternative S.

Operation and Maintenance

See Alternative S. No impacts at Rancho San Antonio.

Costs

Capital cost for the entire alternative would be: $68 million (2008 dollars).
Capital cost for the CSC portion of the work would be $29 million.
50-year cost for maintenance (including current work) would be $22 million.
See Appendix E for cost estimate details.

Preliminary Environmental Review

See Alternative D.

ALTERNATIVE U

Alternative Description

This alternative combines flow detention, bypass, and channel enlargement elements to partially reduce design flows such that the expanded channel portions could convey flows safely downstream. *The project elements shown in italic font are those that would not be constructed in the current CSC phase*. See Appendix B for a map showing all project elements and flood benefit areas. Alternative U is composed of the following project elements:

- **Flow Detention South Branch Dam:**
  See Alternative G.

- **Flow Detention Rancho San Antonio:**
  See Alternative G.

- ***Hale Bypass:***
  See Alternative D.

- **Floodwalls:**
  Permanente Creek from down-stream of Amphitheater Parkway to Highway 101 along Reach P2 would be modified by the addition of floodwalls averaging 3 feet high to the top of the existing levees.

- **Channel Widening:**

Existing concrete channels along reaches P3, P5 *and H1* would be removed and rebuilt wider. In addition, several bridges and culverts in the project area would be similarly modified (widened/enlarged) to contain the one-percent design flow.

- **El Camino Bypass:**
  An underground bypass consisting of a 6-foot diameter reinforced concrete pipe (RCP) approximately 4800 feet long would be constructed around the existing El Camino to Villa Street culverts. The new culvert will start just north of El Camino Real and go north and west along local streets and reconnect with the existing channel at Villa Street.

- **New Diversion Structure:**
  See Alternative G.

Construction Schedule

Construction of the dam would likely take two years. The Rancho San Antonio detention site would likely take one year. Construction and installation of the bypasses would each be completed in 2 to 4 years, depending on difficulties with existing utilities located beneath the local roadways. The diversion structure improvement could be built in 1/2 year.

Operation and Maintenance

See Alternative G.

Costs

Capital cost for the entire alternative would be: $69 million (2008 dollars).
Capital cost for the CSC portion of the work would be $51 million.
50-year cost for maintenance (including current work) would be $29 million.
See Appendix E for cost estimate details.

Preliminary Environmental Review

See Alternative D.

ALTERNATIVE V

Alternative Description

This alternative combines flow detention, bypass, and riparian restoration elements to reduce design flows such that existing and restored channel reaches could convey flows safely downstream. *The project elements shown in italic font are those that would not be constructed in the current CSC phase*. See Appendix B for a map showing all project elements and flood benefit areas. Alternative V is composed of the following project elements:

- **Flow Detention South Branch Dam:**
  See Alternative G.

- **Flow Detention Rancho San Antonio:**
  See Alternative G.

- **Flow Detention Cuesta Park Annex**
  An off-stream detention facility would be created on the Cuesta Park Annex property of the City of Mountain View. The maximum depth of the approximately 5-acre detention facility would be 12 feet, producing approximately 60 acre-feet of storage volume. Only 10-year or higher flow events would be diverted into the facility. A 24-inch outlet pipe would drain the flood flows back to the creek, once the flood peak passed. The outlet pipe would go West to Miramonte Avenue North to Trophy Drive and West to Permanente Creek.

- ***Hale Bypass:***
  *See A*lternative *D.*

- **Extended Hale Bypass:**
  A 7' by 6' box culvert approximately 4400 feet long would be constructed under local streets from the end of the Hale Bypass channel to the Cuesta Park Annex detention site. The bypass route would follow Springer Road and Cuesta Avenue.

- **Floodwalls:**
  See Alternative G.

- **Channel Widening:**
  The existing concrete channel along reach P5 would be removed and rebuilt wider. In addition, two bridges in Reach H1 would be similarly modified (widened/enlarged) to contain the one-percent design flow.

- ***Riparian Restoration:***
  *See A*lternative *G.*

- **New Diversion Structure:**
  See Alternative G.

Construction Schedule

See Alternative S. The extended bypass would require 1 to 2 years of construction.

Operation and Maintenance

See Alternative S.

Costs

Capital cost for the entire alternative would be: $47 million (2008 dollars).
Capital cost for the CSC portion of the work would be $37 million.
50-year cost for maintenance (including current work) would be $29 million.
See Appendix E for cost estimate details.

Preliminary Environmental Review

See Alternative D.

ALTERNATIVE W

Alternative Description

This alternative combines flow detention, bypass, and riparian restoration elements to reduce design flows such that existing and restored channel reaches could convey flows safely downstream. *The project elements shown in italic font are those that would not be constructed in the current CSC phase*. See Appendix B for a map showing all project elements and flood benefit areas. Alternative W is composed of the following project elements:

- **Flow Detention South Branch Dam:**
  See Alternative G.

- **Flow Detention McKelvey Park:**
  See Alternative G.

- ***Hale Bypass:***
  *See A*lternative *D.*

- ***Permanente Bypass:***
  This bypass would consist of two different sizes. The upstream half would consist of a 54-inch RCP bypass channel from Eastwood Dr. to St. Francis School. The downstream half would consist of an 8' by 6' bypass channel from St. Francis School to Cuesta Park Annex.

- **Floodwalls:**
  See Alternative G.

- **Channel Widening:**
  See Alternative G.

- ***Riparian Restoration:***
  *See A*lternative *G.*

- ***New Diversion Structure:***
  *See A*lternative *S.*

- **Flow Detention Cuesta Park Annex**
  An off-stream detention facility would be created on the Cuesta Park Annex property of the City of Mountain View. The average depth of the approximately 5-acre detention facility would be 13 feet, producing approximately 70 acre-feet of storage volume. Only 10-year or higher flow events would be diverted into the facility. A 24-inch outlet pipe would drain the flood flows back to the creek, once the flood peak passed. The outlet pipe would go West to Miramonte Ave, North to Trophy Drive and West to Permanente Creek.

Construction Schedule

See Alternative S.

Operation and Maintenance

See Alternative S.

Costs

Capital cost for the entire alternative would be: $56 million (2008 dollars).
Capital cost for the CSC portion of the work would be $29 million.
50-year cost for maintenance (including current work) would be $31 million.
See Appendix E for cost estimate details.

Preliminary Environmental Review

See Alternative D.

ALTERNATIVE X

Alternative Description

This alternative combines flow detention, bypass, and riparian restoration elements to reduce design flows such that existing and restored channel reaches could convey flows safely downstream. *The project elements shown in italic font are those that would not be constructed in the current CSC phase*. See Figure Appendix B for a map showing all project elements and flood benefit areas. Alternative X is composed of the following project elements:

- **Flow Detention South Branch Dam:**
  See Alternative G.
- ***Hale Bypass:***
  See Alternative D.
- **Extended Hale Bypass:**
  See Alternative V.
- ***Permanente Bypass:***
  See Alternative W.
- **Floodwalls:**
  See Alternative G.
- **Channel Widening:**
  See Alternative V.
- ***Riparian Restoration:***
  See Alternative G.
- ***New Diversion Structure:***
  See Alternative S.
- **Flow Detention Cuesta Park Annex**

See Alternative S.

Construction Schedule

See Alternative V.

Operation and Maintenance

See Alternative V.

Costs

Capital cost for the entire alternative would be: $63 million.
Capital cost for the CSC portion of the work would be $44 million.
50-year cost for maintenance (including current work) would be $29 million.
See Appendix E for cost estimate details.

Preliminary Environmental Review

See Alternative D.

ALTERNATIVE Y

Alternative Description

This alternative combines flow detention, bypass, and riparian restoration elements to reduce design flows such that existing and restored channel reaches could convey flows safely downstream. *The project elements shown in italic font are those that would not be constructed in the current CSC phase*. See Appendix B for a map showing all project elements and flood benefit areas. Alternative Y is composed of the following project elements:

- **Flow Detention Rancho San Antonio:**
  See Alternative G.

- **Flow Detention Blach Intermediate School:**
  An underground detention pond would be created on 5 acres of Blach School's athletic fields. The area would be excavated to a depth of 30 feet with 1:1 side slopes lined with rock. The athletic fields would be rebuilt on top of a concrete deck which would be constructed over the pond area on piers. The flow inlet would be through an overflow weir from the adjacent Permanente Diversion Channel and the outlet would be directly to the Diversion Channel using built in place pumps.

- ***Hale Bypass:***
  See Alternative D.

- **Extended Hale Bypass:**
  See Alternative V.

- **Permanente Bypass:**

An 8-foot diameter concrete pipe culvert would connect the Blach School flood detention site with Cuesta Park Annex flood detention site. The pipe would run under local streets (Covington, Thatcher, and Hospital) for 3400 feet.

- **Floodwalls:**
  See Alternative G. Additional floodwalls would be needed just upstream of Blach School.

- **Channel Widening:**
  See Alternative V.

- ***Riparian Restoration:***
  *See A*lternative *G.*

- **New Diversion Structure:**
  See Alternative G.

- **Flow Detention Cuesta Park Annex**
  See Alternative S.

Construction Schedule

See Alternative S.

Operation and Maintenance

See Alternative S. Instead of McKelvey Park, it is Blach School that would need to be maintained and restored to playable conditions post any flood events.

Costs

Capital cost for the entire alternative would be: $66 million (2008 dollars).
Capital cost for the CSC portion of the work would be $55 million.
50-year cost for maintenance (including current work) would be $21 million.
See Appendix E for cost estimate details.

Preliminary Environmental Review

See Alternative D.

ALTERNATIVE Z

Alternative Description

This alternative combines flow detention, bypass, and riparian restoration elements to reduce design flows such that existing and restored channel reaches could convey flows safely downstream. *The project elements shown in italic font are those that would not be constructed in the current CSC phase*. See Appendix B for a map showing all project elements and flood benefit areas. Alternative Z is composed of the following project elements:

- **Flow Detention Rancho San Antonio:**

See Alternative G.

- **Flow Detention Blach Intermediate School:**
  See Alternative Y.

- **Flow Detention McKelvey Park:**
  See Alternative G.

- ***Hale Bypass:***
  *See A*lternative *D*.

- **Permanente Bypass:**
  See Alternative Y.

- **Floodwalls:**
  See Alternative Y.

- **Channel Widening:**
  See Alternative G.

- ***Riparian Restoration:***
  *See A*lternative *G.*

- **New Diversion Structure:**
  See Alternative G.

Construction Schedule
See Alternative S. Blach School detention construction would likely take approximately one year.

Operation and Maintenance
See Alternative Y. McKelvey Park would need to be maintained post-flood as well.

Costs
Capital cost for the entire alternative would be: $58 million (2008 dollars).
Capital cost for the CSC portion of the work would be $40 million.
50-year cost for maintenance (including current work) would be $22 million.
See Appendix E for cost estimate details.

Preliminary Environmental Review
See Alternative D.

4.7 Alternative Ranking Methodology

4.7.1 Natural Flood Protection

The District Board of Directors has adopted an Ends Policy that requires “natural flood protection” to be the method the District uses to provide flood protection to the citizens of the County. Ends Policy 2.2.1 states: “There is natural flood protection that balances environmental quality, community benefit and protection from creek flooding in a cost effective manner. In providing flood protection, balance the following multiple objectives:

1. Homes, schools, businesses, and transportation networks are protected from flooding and erosion.

2. Ecological functions and processes are supported.

3. Physical stream functions and processes are integrated.

4. Maintenance requirements are minimized.

5. Projects are integrated within the watershed as a whole.

6. The quality and availability of water is protected.

7. Cooperation with local agencies achieves mutually beneficial goals.

8. Community benefits beyond flood protection.

9. Life-cycle costs are minimized."

To comply with this ends policy, a Natural Flood Protection (NFP) procedure was developed. This report used the NFP procedure (see August 2005 "Guidance on Alternative Evaluation and Selection for natural Flood Protection Projects") to rate and compare the feasible alternatives.

4.7.2 Summary of the NFP Procedure

As required by the ends policy, the procedure balances the nine NFP objectives. Various criteria (as few as one to as many as seven) were developed to help rate each objective. These criteria were:

Objective 1: provide protection from flood damage
Criterion 1: safety – protection of public safety if conditions exceed design assumptions
Criterion 2: economic protection – protection from damage due to floodwaters, erosion or sediment
Criterion 3: durability – future effort required to maintain design level of protection
Criterion 4: resiliency – adaptability to future changes
Criterion 5: local drainage – support of local storm drain systems
Criterion 6: time to implementation – how quickly flood protection elements could become effective

Objective 2: support ecological functions and processes
Criterion 1: local habitat goals – ability to meet habitat goals as defined from examining the watershed as a whole
Criterion 2: habitat provided – quality of habitat provided by alternative
Criterion 3: sustainability of habitat – intensity of future action required to maintain design habitat quality
Criterion 4: connectivity of habitat – integration of habitat elements into surrounding landscape

Objective 3: physical stream functions and processes

Criterion 1: floodplain – inclusion of appropriately sized floodplain
Criterion 2: active channel – appropriateness of size and configuration of active channel
Criterion 3: stable side slopes – stability of side slopes
Criterion 4: transitions – stability of channel's integration with upstream and downstream reaches

Objective 4: minimize maintenance requirements
Criterion 1: structural features – maintenance associated with structural features
Criterion 2: natural processes – maintenance associated with vegetation, erosion and sediment
Criterion 3: urban flows – maintenance resulting from small storms and outfall flows
Criterion 4: access – incorporation of adequate access for maintenance crews and equipment

Objective 5: integrate within watershed
Criterion 1: meets watershed goals – ability to meet watershed goals as defined in a process that examines the watershed as a whole

Objective 6: protect the quality and availability of water
Criterion 1: water availability – impact on groundwater recharge
Criterion 2: instream water quality – water quality protected through vegetation and instream hydraulic complexity
Criterion 3: offstream water management – ability to enhance water supply and quality and reduce peak flows through local retention of rainfall
Criterion 4: flow regime – ability to maintain geomorphically and biologically appropriate range of flows

Objective 7: cooperate with other local agencies to achieve mutually beneficial goals
Criterion 1: mutual local goals – ability to achieve project-specific goals and objectives developed jointly by the District and local agencies
Criterion 2: supports general plan – ability to support goals and policies as stated in general plans of partner agencies

Objective 8: community benefits beyond flood protection
Criterion 1: community safety – overall safety for appropriate access and recreation
Criterion 2: recreation – quality of recreation experience provided by alternative
Criterion 3: aesthetics – quality of aesthetic form provided by alternative
Criterion 4: social and cultural benefits – opportunity to provide community involvement
Criterion 5: local economic effects – potential effect on property values and/or local business climate
Criterion 6: open space – inclusion of open space into alternative
Criterion 7: community support – alternative reflects community developed objectives and ideas

Objective 9: minimize life-cycle costs
Criterion 1: net present value of lifetime costs

Some of the criteria required comparative ratings between the alternatives (for example, which alternative has the least or the most cost) while others were stand-alone ratings (for example, how well does the alternative meet community goals). Each alternative was rated as to how well it accomplished each criterion. A scoring system assigned various weights to the criteria and calculated the objective score (see Appendix F for NFP rating details) for each alternative. The result is a matrix (see Table 4.3: Feasible Alternatives Summary NFP Ratings) which shows a comparison of how well the alternatives rated on each of the nine NFP objectives.

Community input was used to determine whether some NFP objectives should be considered more important than others. The Permanente Creek Task Force was asked to rate the nine objectives as to their relative importance: high, medium or low. The watershed manager approved the resulting rating, which is shown on Table 4.3.

4.7.3 Environmental Concerns

The NFP objectives do not explicitly rate the environmental impacts of project alternatives. An alternative may rate very high even if it would have significant negative environmental impacts. Since environmental impacts are a significant factor in decision making, the project team developed criteria for rating feasible alternative environmental impacts.

It was decided that the criteria for consideration should mirror the criteria that will be used later in the environmental impact report project analysis. Therefore, each alternative was rated on how well it avoided impacts for the following categories:

Hydrology and Water Quality
Biological Resources
Cultural Resources
Aesthetics
Traffic/Utilities
Noise
Air Quality
Health and Safety
Recreation

Each alternative was rated on each criterion and an environmental impacts objective rating was calculated (see Appendix F).

4.8 Staff Recommended Alternative Selection

The staff recommended alternative was selected based on a comparison of the NFP ratings of all the alternatives (see Tables 4.3 and 4.4) as follows:

The nine NFP objectives were rated as High, Medium or Low by District staff and the Task Force committee (Task Force ratings were used upon approval of the watershed manager). Alternatives A, D, E, and U were rated “unacceptable” in one or more “high” rank objective(s). Due to this, these alternatives were therefore considered to be unfit for selection as the staff recommended alternative.

Alternative T requires extensive impacts to the mature oak trees existing on the South and West portions of the Cuesta Park Annex. Both the community and the District strongly oppose significant impacts to this area; therefore, this alternative was eliminated from consideration as the staff recommended alternative.

The remaining seven alternatives were compared to each other (see Table 4.4). Alternatives G and V rank best for one objective (cost), though this is deceptive since the mitigation costs of the dam alternative are very difficult to calculate and have been neglected up to this point. Alternative Z is very close in its cost rating, with the cost being more reliable, since it does not include the dam project element.

Alternatives S, Y, and Z tie for best ranking for two objectives (ecological functions and integration within the watershed context), chiefly because they are the three alternatives out of the seven that do not include the dam project element. Alternative Z also ranks best in terms of avoiding environmental impacts, because it is the only alternative that does not include the dam and also only impacts the Annex portion of Cuesta Park.

So, comparing alternatives G, S, V, Y and Z, alternative Z stands out because:

- ***Impacts**:* Alternative Z would avoid impacts at the Cuesta Park parking lot area, which would include removal of approximately 100 park trees.
- ***Ecological Functions**:* Alternative Z does not include the dam project element.
- ***Cost**:* second best rating on cost, does not suffer from the uncertain costs of the dam project element.
- ***Early flood protection**:* second best in terms of post CSC Phase 1 number of parcels protected from one-percent flooding.
- ***Technical feasibility**:* all project elements are simple and technically unambiguous; the lack of the dam project element means project design would be straightforward.

Thus, using the NFP process, Alternative Z is, on balance, the best of the proposed project's feasible alternatives.

Table 4.1: Conceptual Alternatives Level 1 Screening Table

	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E	Alt. F	Alt. G	Alt. H	Alt. I	Alt. J	Alt. K	Alt. L	Alt. M	Alt. N	Alt. O	Alt. P	Alt. Q	Alt. R	Alt. S	Alt. T	Alt. U	Alt. V	Alt. W	Alt. X	Alt. Y	Alt. Z
Alt. Provides flood protection to 1,664 parcels (Bay to El Camino Real)?	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Alt. Prevents flooding of Middlefield Road and Central Expressway?	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	**No**	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Alt. addresses the structural deterioration of existing concrete channels?	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	**No**	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Alt. minimizes long-term maintenance costs?	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	**No**	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Alt. provides opportunity for continuous maintenance corridor?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	**No**	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Alt. protects current environmental resources and provides opportunities for enhancements?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	**No**	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Alternative meets all objectives?	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Alternative Captial Cost (millions):	$0.0	$81.5	$77.0	$82.5	$78.0	$146.0	$26.0	$51.0	$35.0	$35.0	$30.5	$35.0	$35.0	$24.5	$26.0	$45.5	$112.5	$35.0	$60.0	$60.0	$62.0	$55.0	$58.0	$60.0	$57.0	$50.0
Capital Cost for CSC Portion (millions):	N/A	$37.5	$33.0	$39.5	$35.0	$73.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$66.5	N/A	$36.0	$26.0	$46.0	$33.0	$26.0	$30.0	$48.0	$34.0
Alternative meets cost criteria ($70 million)?	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
R/W available for alternative?	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**Yes**	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Alternative technically feasible?	**Yes**	**No**	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Alternative meets all criteria?	**No**	**No**	**No**	**Yes**	**Yes**	**No**	**Yes**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**

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Table 4.2 - Summary of Feasible Alternatives

Alternative:	A	D	E	G	S	T
Alternative Description:	No new construction; continue current maintenance; monitor and replace aging concrete channels as needed	Hale and Permanente Creek bypasses around natural channel; Floodwalls d/s of Hwy 101; Concrete channel enlargement; El Camino culvert bypass; El Camino culvert enlargement; El Camino flood collection channel; New diversion structure	Hale and Permanente Creek bypasses around natural channel; Floodwalls d/s of Hwy 101; Concrete channel enlargement; El Camino culvert bypass; El Camino flood collection channel; New diversion structure	Flow detention at Hanson dam, Rancho San Antonio, and McKelvey Park; Hale Creek bypass; concrete channel enlargement; floodwalls d/s of Hwy 101; new diversion structure; optional concrete channel removal and revegetation	Flow detention at Cuesta Park Annex and Park, Rancho San Antonio, and McKelvey Park; Permanente and Hale Creek bypasses; concrete channel enlargement; floodwalls d/s of Hwy 101; new diversion structure; optional concrete channel removal and revegetation	Flow detention at Cuesta Park Annex and McKelvey Park; Permanente and Hale Creek bypasses; concrete channel enlargement; floodwalls d/s of Hwy 101; new diversion structure; optional concrete channel removal and revegetation
Operation & Maintenance:	Concrete channel maintenance; existing sediment removal and vegetation maintenance; trash and debris removal; bank erosion repair in natural channels	New culverts designed with adequate slope for sediment passage; concrete channel maintenance; existing sediment removal and vegetation maintenance; trash and debris removal; bank erosion repair in natural channels	New culverts designed with adequate slope for sediment passage; concrete channel maintenance; existing sediment removal and vegetation maintenance; trash and debris removal; bank erosion repair in natural channels	Dam maintenance and upkeep; maintenance of detention pond inlets and outlets; bypass designed with adequate slope for sediment passage; concrete channel maintenance; existing sediment removal and vegetation maintenance; trash and debris removal; bank erosion repair in natural channels	Maintenance of detention pond inlets and outlets; bypasses designed with adequate slope for sediment passage; concrete channel maintenance; existing sediment removal and vegetation maintenance; trash and debris removal; bank erosion repair in natural channels	Maintenance of detention pond inlets and outlets; bypasses designed with adequate slope for sediment passage; concrete channel maintenance; existing sediment removal and vegetation maintenance; trash and debris removal; bank erosion repair in natural channels
Socio-Cultural Environment:						
(A) Land Ownership/ Access/ Right of way:	None needed	Easements required from City of Mtn. View and Los Altos, Caltrans, and private property owners	Easements required from City of Mtn. View and Los Altos, Caltrans, and private property owners	Acquisition of dam innundation area and access easements; easements from City of Mtn. View, County, and one private property	Easements from City of Mtn. View, County, and one private property	Easements from City of Mtn. View and one private property
(B) Aesthetics:	current values maintained	up to 8 ft high concrete floodwall heights built	up to 8 ft high concrete floodwall heights built	up to 4 ft high concrete floodwall heights built. Potential for concrete channel restoration	up to 4 ft high concrete floodwall heights built. Potential for concrete channel restoration	up to 4 ft high concrete floodwall heights built. Potential for concrete channel restoration
(C) Recreation Potential:	Potential for extending Permanente Trail south of Old Middlefield Road	Potential for extending Permanente Trail south of Old Middlefield Road	Potential for extending Permanente Trail south of Old Middlefield Road	Potential for extending Permanente Trail south of Old Middlefield Road	Potential for extending Permanente Trail south of Old Middlefield Road	Potential for extending Permanente Trail south of Old Middlefield Road
Physical Environment:						
(A) Sedimentation:	Current sediment removal activities would continue	Current sediment removal activities would continue	Current sediment removal activities would continue	Current sediment removal activities would continue somewhat reduced due to reduced flows	Current sediment removal activities would continue somewhat reduced due to reduced flows	Current sediment removal activities would continue
(B) Water Quality:	Sites of potential concern were considered of moderate risk or lower	Sites of potential concern were considered of moderate risk or lower	Sites of potential concern were considered of moderate risk or lower	Sites of potential concern were considered of moderate risk or lower	Sites of potential concern were considered of moderate risk or lower	Sites of potential concern were considered of moderate risk or lower
(C) Geology and Soils:	n/a	Site-specific geotechnical analysis would be conducted	Site-specific geotechnical analysis would be conducted	Site-specific geotechnical analysis would be conducted. Dam area would be extensively studied.	Site-specific geotechnical analysis would be conducted	Site-specific geotechnical analysis would be conducted
Environmental Review:						
(A) Biological Resources:	n/a	bypass inlet locations in riparian habitat areas	bypass inlet locations in riparian habitat areas	Dam site located in undisturbed upland habitat. Other detention ponds and bypass inlets also located in riparian habitat areas.	Detention ponds and bypass inlets located in riparian habitat areas.	Detention ponds and bypass inlets located in riparian habitat areas.
(B) Cultural Resources	n/a	Project elements involve disturbace to native undisturbed soils in bypass excavation areas	Project elements involve disturbace to native undisturbed soils in bypass excavation areas	Project elements involve disturbace to native undisturbed soils in bypass and flood detention excavation areas	Project elements involve disturbace to native undisturbed soils in bypass and flood detention excavation areas	Project elements involve disturbace to native undisturbed soils in bypass and flood detention excavation areas
(D) Public Services, Utilitites and Traffic	none	Bypasses constructed under active roadways and utility corridors.	Bypasses constructed under active roadways and utility corridors.	Bypasses constructed under active roadways and utility corridors.	Bypasses constructed under active roadways and utility corridors.	Bypasses constructed under active roadways and utility corridors.
Project Costs:						
Capital Costs:	$0	$118 million	$121 million	$50 million	$67 million	$68 million
Maintenance Costs:	$29 million	$27 million	$27 million	$30 million	$21 million	$22 million
Total Project Cost:	$29 million	$145 million	$148 million	$83 million	$92 million	$93 million
CSC Capital Cost:	n/a	$59 million	$62 million	$32 million	$41 million	$29 million

Notes:
All costs in 2008 $.
Maintenance costs are for 50-year project life.

Alternative:	U	V	W	X	Y	Z
Alternative Description:	Flow detention at Hanson dam and Rancho San Antonio; Hale Creek bypass; concrete channel enlargement; floodwalls d/s of Hwy 101; new diversion structure; El Camino bypass	Flow detention at Hanson dam, Rancho San Antonio, and Cuesta Park Annex; extended Hale Creek bypass; concrete channel enlargement; floodwalls d/s of Hwy 101; new diversion structure; optional concrete channel removal and revegetation	Flow detention at Hanson dam, Cuesta Park Annex, and McKelvey Park; Permanente and Hale Creek bypasses; concrete channel enlargement; floodwalls d/s of Hwy 101; new diversion structure; optional concrete channel removal and revegetation	Flow detention at Hanson dam and Cuesta Annex and Park; Permanente and extended Hale Creek bypasses; concrete channel enlargement; floodwalls d/s of Hwy 101; new diversion structure; optional concrete channel removal and revegetation	Flow detention at Cuesta Park Annex and Park, Blach School, and Rancho San Antonio; Permanente and extended Hale Creek bypasses; concrete channel enlargement; floodwalls d/s of Hwy 101; new diversion structure; optional concrete channel removal and revegetation	Flow detention at Blach School, Rancho San Antonio, Cuesta Annex, and McKelvey Park; Hale Creek bypass; concrete channel enlargement; floodwalls d/s of Hwy 101; new diversion structure; optional concrete channel removal and revegetation
Operation & Maintenance:	Dam maintenance and upkeep; maintenance of detention pond inlet and outlet; bypasses designed with adequate slope for sediment passage; concrete channel maintenance; existing sediment removal and vegetation maintenance; trash and debris removal; bank erosion repair in natural channels	Dam maintenance and upkeep; maintenance of detention pond inlets and outlets; bypass designed with adequate slope for sediment passage; concrete channel maintenance; existing sediment removal and vegetation maintenance; trash and debris removal; bank erosion repair in natural channels	Dam maintenance and upkeep; maintenance of detention pond inlets and outlets; bypasses designed with adequate slope for sediment passage; concrete channel maintenance; existing sediment removal and vegetation maintenance; trash and debris removal; bank erosion repair in natural channels	Dam maintenance and upkeep; maintenance of detention pond inlet and outlet; bypasses designed with adequate slope for sediment passage; concrete channel maintenance; existing sediment removal and vegetation maintenance; trash and debris removal; bank erosion repair in natural channels	Maintenance of detention pond inlets and outlets; bypasses designed with adequate slope for sediment passage; concrete channel maintenance; existing sediment removal and vegetation maintenance; trash and debris removal; bank erosion repair in natural channels	Maintenance of detention pond inlets and outlets; bypass designed with adequate slope for sediment passage; concrete channel maintenance; existing sediment removal and vegetation maintenance; trash and debris removal; bank erosion repair in natural channels
Socio-Cultural Environment:						
(A) Land Ownership/ Access/ Right of way:	Acquisition of dam innundation area and access easements; easements from County and one private property	Acquisition of dam innundation area and access easements; easements from County and City of Mtn. View and one private property	Acquisition of dam innundation area and access easements; easements from City of Mtn. View and one private property	Acquisition of dam innundation area and access easements; easements from City of Mtn. View and one private property	Easements from County, City of Mtn. View, Los Altos School District, and one private property	Easements from Los Altos School District, City of Mtn. View, County, and one private property
(B) Aesthetics:	up to 5 ft high concrete floodwall heights built	up to 4 ft high concrete floodwall heights built. Potential for concrete channel restoration	up to 4 ft high concrete floodwall heights built. Potential for concrete channel restoration	up to 4 ft high concrete floodwall heights built. Potential for concrete channel restoration	up to 4 ft high concrete floodwall heights built. Potential for concrete channel restoration	up to 4 ft high concrete floodwall heights built. Potential for concrete channel restoration
(C) Recreation Potential:	Potential for extending Permanente Trail south of Old Middlefield Road	Potential for extending Permanente Trail south of Old Middlefield Road	Potential for extending Permanente Trail south of Old Middlefield Road	Potential for extending Permanente Trail south of Old Middlefield Road	Potential for extending Permanente Trail south of Old Middlefield Road	Potential for extending Permanente Trail south of Old Middlefield Road
Physical Environment:						
(A) Sedimentation:	Current sediment removal activities would continue somewhat reduced due to reduced flows	Current sediment removal activities would continue somewhat reduced due to reduced flows	Current sediment removal activities would continue somewhat reduced due to reduced flows	Current sediment removal activities would continue somewhat reduced due to reduced flows	Current sediment removal activities would continue somewhat reduced due to reduced flows	Current sediment removal activities would continue somewhat reduced due to reduced flows
(B) Water Quality:	Sites of potential concern were considered of moderate risk or lower	Sites of potential concern were considered of moderate risk or lower	Sites of potential concern were considered of moderate risk or lower	Sites of potential concern were considered of moderate risk or lower	Sites of potential concern were considered of moderate risk or lower	Sites of potential concern were considered of moderate risk or lower
(C) Geology and Soils:	Site-specific geotechnical analysis would be conducted. Dam area would be extensively studied.	Site-specific geotechnical analysis would be conducted. Dam area would be extensively studied.	Site-specific geotechnical analysis would be conducted. Dam area would be extensively studied.	Site-specific geotechnical analysis would be conducted. Dam area would be extensively studied.	Site-specific geotechnical analysis would be conducted	Site-specific geotechnical analysis would be conducted
Environmental Review:						
(A) Biological Resources:	Dam site located in undisturbed upland habitat. Other detention ponds and bypass inlets also located in riparian habitat areas.	Dam site located in undisturbed upland habitat. Other detention ponds and bypass inlets also located in riparian habitat areas.	Dam site located in undisturbed upland habitat. Other detention ponds and bypass inlets also located in riparian habitat areas.	Dam site located in undisturbed upland habitat. Other detention ponds and bypass inlets also located in riparian habitat areas.	Detention ponds and bypass inlets located in riparian habitat areas.	Detention ponds and bypass inlets located in riparian habitat areas.
(B) Cultural Resources	Project elements involve disturbace to native undisturbed soils in bypass and flood detention excavation areas	Project elements involve disturbace to native undisturbed soils in bypass and flood detention excavation areas	Project elements involve disturbace to native undisturbed soils in bypass and flood detention excavation areas	Project elements involve disturbace to native undisturbed soils in bypass and flood detention excavation areas	Project elements involve disturbace to native undisturbed soils in bypass and flood detention excavation areas	Project elements involve disturbace to native undisturbed soils in bypass and flood detention excavation areas
(D) Public Services, Utilitites and Traffic	Bypasses constructed under active roadways and utility corridors.	Bypasses constructed under active roadways and utility corridors.	Bypasses constructed under active roadways and utility corridors.	Bypasses constructed under active roadways and utility corridors.	Bypasses constructed under active roadways and utility corridors.	Bypasses constructed under active roadways and utility corridors.
Project Costs:						
Capital Costs:	$69 million	$47 million	$56 million	$63 million	$66 million	$58 million
Maintenance Costs:	$29 million	$29 million	$31 million	$29 million	$21 million	$22 million
Total Project Cost:	$102 million	$79 million	$90 million	$96 million	$90 million	$84 million
CSC Capital Cost:	$51 million	$37 million	$29 million	$44 million	$55 million	$40 million

Notes:

All costs in 2008 $.

Maintenance costs are for 50-year project life.

Table 4.3 - Feasible Alternatives NFP Objective Ratings

District Ends Policy 2.2.1 (Natural Flood Protection):	Objective Weight Rank:	Alt. A	Alt. D	Alt. E	Alt. G	Alt. S	Alt. T	Alt. U	Alt. V	Alt. W	Alt. X	Alt. Y	Alt. Z
1. Provide protection from flood damage	High	Fair	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate
2. Support ecological functions and processes	High	Unacceptable	Unacceptable	Unacceptable	Fair	Adequate	Adequate	Unacceptable	Fair	Fair	Fair	Adequate	Adequate
3. Integrate physical stream functions and processes	Med	Unacceptable	Poor	Poor	Adequate	Adequate	Adequate	Poor	Adequate	Adequate	Adequate	Adequate	Adequate
4. Minimize maintenance requirements	High	Poor	Poor	Poor	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair
5. Integrate within the context of the watershed	Med	Unacceptable	Unacceptable	Unacceptable	Adequate	Very Good	Very Good	Unacceptable	Adequate	Adequate	Adequate	Very Good	Very Good
6. Protect the quality and availability of water	High	Fair	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate
7. Cooperate with other local agencies to achieve mutual goals	Med	Unacceptable	Poor	Poor	Fair	Fair	Fair	Poor	Fair	Fair	Fair	Fair	Fair
8. Maximize community benefits beyond flood protection	Med	Fair	Fair	Fair	Adequate	Adequate	Adequate	Fair	Adequate	Adequate	Adequate	Adequate	Adequate
9. Minimize life-cycle costs	High	Outstanding	Unacceptable	Unacceptable	Outstanding	Adequate	Adequate	Fair	Outstanding	Adequate	Fair	Poor	Very Good
Preliminary environmental impacts analysis	NA	Outstanding	Very Good	Very Good	Poor	Fair	Fair	Poor	Poor	Poor	Poor	Fair	Adequate

Ratings Key:

Outstanding: ● Very Good: Adequate: Fair: Poor: ○ Unacceptable: ⊗

Note: Objective weight ranks from Permanente Creek Task Force meeting

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Table 4.4 - Recommended Alternative Selection Table

District Ends Policy 2.2.1 (Natural Flood Protection):	Objective Weight Rank:	Alt. A	Alt. D	Alt. E	Alt. G	Alt. S	Alt. T	Alt. U	Alt. V	Alt. W	Alt. X	Alt. Y	Alt. Z
1. Provide protection from flood damage	High	Fair	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate
2. Support ecological functions and processes	High	Unacceptable	Unacceptable	Unacceptable	Fair	**Adequate**	Adequate	Unacceptable	Fair	Fair	Fair	**Adequate**	**Adequate**
3. Integrate physical stream functions and processes	Med	Unacceptable	Poor	Poor	Adequate	Adequate	Adequate	Poor	Adequate	Adequate	Adequate	Adequate	Adequate
4. Minimize maintenance requirements	High	Poor	Poor	Poor	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair
5. Integrate within the context of the watershed	Med	Unacceptable	Unacceptable	Unacceptable	Adequate	**Very Good**	Very Good	Unacceptable	Adequate	Adequate	Adequate	**Very Good**	**Very Good**
6. Protect the quality and availability of water	High	Fair	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate
7. Cooperate with other local agencies to achieve mutual goals	Med	Unacceptable	Poor	Poor	Fair	Fair	Fair	Poor	Fair	Fair	Fair	Fair	Fair
8. Maximize community benefits beyond flood protection	Med	Fair	Fair	Fair	Adequate	Adequate	Adequate	Fair	Adequate	Adequate	Adequate	Adequate	Adequate
9. Minimize life-cycle costs	High	Outstanding	Unacceptable	Unacceptable	**Outstanding**	Adequate	Adequate	Fair	**Outstanding**	Adequate	Fair	Poor	Very Good
Preliminary environmental impacts analysis	NA	Outstanding	Very Good	Very Good	Poor	Fair	Fair	Poor	Poor	Poor	Poor	Fair	**Adequate**

Ratings Key:

Outstanding: ●
Very Good:
Adequate:
Fair:
Poor: ○
Unacceptable: ⊗

(purple) Alternatives eliminated based on impacts or one or more "unacceptable" ratings
(yellow) Alternatives rated best for each objective

Note: Objective weight ranks from Permanente Creek Task Force meeting

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CHAPTER 5
PROJECT OUTREACH

Throughout the planning process, outreach activities have been carried out to inform the public of project progress and solicit public feedback. Several public meetings were held at crucial milestones along the planning process. A citizen's task force committee was set up early in the planning process to provide focused review and discussion. Finally, specific outreach activities have been conducted with local groups, environmental groups, and resource agencies.

5.1 Public Meetings

Public meetings were held at all crucial project milestones. In each case, the public was invited to the meetings through a letter mailed to all property owners and residents living adjacent to the creeks or in the Permanente Creek one-percent floodplain.

- ***Problem definition and initial project scoping meeting (January 2002)***: this was the kickoff meeting for the project and the public attendees heard about project objectives and the preliminary planning schedule.

- ***Refined problem definition and potential alternatives meeting (March 2003)***: this meeting covered the one-percent flood definition and discussed some of the potential alternatives arising from the special characteristics of Permanente Creek watershed. This was also the meeting in which the Permanente Creek Task Force was initially recruited.

- ***Conceptual Project Elements town hall meetings (June 2004)***: a series of four meetings were held at community locations dispersed along the watershed. The initial 17 CPEs were discussed with the public and feedback/comments were solicited.

- ***Conceptual alternatives meeting (November 2004)***: The conceptual alternatives, consisting of various combinations of CPEs were discussed with the public and feedback/comments were solicited.

- ***Feasible alternatives meeting (May 2007)***: The feasible alternatives, including the most highly ranked alternatives according to the NFP objectives rating were discussed and public feedback/comments were sought.

5.2 Permanente Creek Task Force

A task force composed of public volunteers and members of the city staff of Mountain View and Los Altos was established in 2003. The aim of the Task Force was to be a smaller representative of the general public and city staff. Such a Task Force would allow more frequent meetings to be scheduled and more meaningful and detailed comments and concerns could be collected. The Task Force was composed of Mountain View and Los Altos citizens, city staff from Mountain View and Los Altos, and District staff. The Task Force roster can be seen on the acknowledgements section of this report.

Task Force meetings were held at the following dates:

- June 2003: Task Force set up
- October 2003: Field trip to look at various watershed features and potential project element locations
- March 2004: CPE introduction meeting
- September 2004: Conceptual alternatives
- March 2005: More refined conceptual alternatives
- July 2005: More refined conceptual alternatives
- February 2006: Initial meeting on feasible alternatives
- July 2006: Feasible alternatives and project selection process
- July 2007: Staff recommended alternative

The Task Force provided invaluable assistance and feedback throughout the planning process. The project team would like to especially thank Task Force member John Benza of the First Baptist Church of Los Altos for his generous help in providing a wonderful meeting location (at the church).

5.3 Outreach to Cities and County

As the planning process progressed, meetings were held with the various affected local jurisdictions. These meetings were opportunities to discuss potential project benefits and impacts with the cities and collect early feedback and comments.

- January 2007: Mountain View City Council workshop
- March 2007: Cupertino City Council presentation
- March 2007: Los Altos City Council presentation
- March 2007: County of Santa Clara Board of Supervisors presentation
- May 2007: Project scoping meetings in Los Altos and Mountain View
- February 2008: Mountain View City Council workshops (two meetings)
- April 2008: Los Altos City Council presentation

Further outreach will continue, culminating in the official CEQA process.

5.4 Resource Agencies

Various resource agency permits will be required to be obtained by the project prior to construction. Therefore, in order to improve the project and expedite future review, early meetings were held with the various resource agencies in advance of the CEQA process. The project team met with the resource agencies in August 2004 to discuss general project issues. This was followed in July of 2006 with a discussion of the feasible alternatives. Generally, the agencies have been supportive of the NFP decision making process. They pointed out that the upper watershed area contains valuable habitat and may contain endangered species such as the California Red-Legged Frog. They therefore expressed serious concern regarding the Hanson Dam project element.

5.5 Meetings With Watershed Stakeholders

The project team has conducted wide-ranging outreach with various environmental and civic stakeholders in the project area. This effort was undertaken to inform the stakeholders of the project and its progress and to solicit early feedback. Some of the organizations contacted include:

- ***Stevens and Permanente Creek Watersheds Council (SPCWC)***: two presentations have been made to the SPCWC. They have been keenly interested in the project. A particular interest of the group is the restoration of the connection between Permanente Creek and Stevens Creek through the restoration of the Permanente Diversion.

- ***Save Open Space (SOS)***: Save Open Space has taken a very active role in the project. Their particular concern regards the Cuesta Park Annex. SOS played a very active role during the City of Mountain View's conceptual planning of the Annex site in 2006, supporting the eventual City Council selection of "Concept B" for the Annex. Later, as the District continued outreach activities and indicated staff would be very willing to work with SOS to develop a more detailed vision of the Annex with flood detention as an added element, SOS assisted the District's consultant with designing the Annex area. SOS has supported the project at meetings with the Cuesta Park Neighborhood Association and at Mountain View City Council meetings.

- ***Mountain View Chamber of Commerce (MVCOC)***: Meetings were held with the MVCOC in December 2006 and February 2007. The MVCOC has been supportive of efforts to protect Mountain View residential and business areas from flooding.

- ***Blach Junior High School***: an initial meeting was held with the school in August 2007. The school expressed strong concern regarding losing the football field and track area for extended periods of time. The design concept was changed to minimize the construction period required, thus reducing the instructional impact to Blach students. Follow-up meetings will be held once better visual renderings of the site are available for discussion.

- ***Gate of Heaven Cemetery***: The cemetery is immediately adjacent to the Rancho San Antonio flood detention site. A meeting was held with cemetery staff in August 2007. The cemetery expressed concerns regarding impact to water wells located in the proposed detention pond area and impacts to their property access. The water wells will be relocated to another appropriate site prior to excavation of the pond site and a new bridge will be built over the creek improving the cemetery's access to maintenance buildings to the west of the creek as part of the Rancho San Antonio project.

- ***Community for Green Foothills***: a presentation was provided in December 2007. Also present at the meetings were attendees from the Audubon Society. There were concerns raised about entraining fish in bypasses and detention sites. There was interest expressed at restoration opportunities for the concrete lined channels.

- ***Hanson Permanente Cement Quarry***: Various meetings have been held with the Quarry. A geophysical investigation of the potential dam area was conducted in 2006. Habitat and wetlands mapping work was also conducted at this time.

CHAPTER 6
RECOMMENDED PROJECT

The design basis, recommended project elements, and construction procedures are described in this chapter. See Appendix H (bound separately) for the engineering drawings of the recommended project. A description of the maintenance guidelines for the recommended project is provided in Chapter 7.

6.1 Design Basis

The overall design basis for the recommended alternative is to utilize four off-stream flow detention alternatives in order to reduce the peak design flows sufficiently so that very little channel improvement work is necessary downstream of El Camino Real. The detention basins at Rancho San Antonio Park, Blach School, and Cuesta Park Annex reduce the peak flows in Permanente Creek by 34 cms (1200 cfs) and the detention basin at McKelvey Park would reduce the peak flow from Hale Creek by 11 cms (400 cfs). With those elements in place, the only downstream improvements needed for flood protection would be floodwalls along Reach P2. Table 6.1 provides a comparison of the pre-project versus post-project design flow situation for the various watershed reaches.

Table 6.1 – Design Flows Pre- and Post-Project (cms/cfs)

	Pre-Project		Post-Project	
Location:	**1%**	**10%**	**1%**	**10%**
Rancho San Antonio:	48 / 1700	27 / 950	28 / 1000	27 / 950
@ Permanente Diversion:	76 / 2700	42 / 1500	57 / 2000	42 / 1500
Downstream of Blach School:	40 / 1400	31 / 1100	40 / 1400	40 / 1400
Permanente u/s of Hale:	40 / 1400	14 / 500	6 / 200	6 / 200
Hale u/s of Permanente:	31 / 1100	19 / 670	No Change	
Permanente d/s of Hale:	65 / 2300	27 / 950	25 / 900	25 / 900
Permanente Reach P3	71 / 2500	31 / 1100	31 / 1100	31 / 1100
Permanente Reach P2	74 / 2600	34 / 1200	34 / 1200	34 / 1200

As can be seen, the general effect of the flow detention sites would be to reduce the one-percent flow to approximately the level of the 10-percent flow.

6.2 Recommended Project

6.2.1 Floodwalls (Reach P2 and PD)

With 1 percent flows reduced to 34 cms (1200 cfs) due to upstream flow detention, the design water surface would be below the current levee elevations along most of the reach. However, the FEMA and District freeboard requirement of 1.2 meters (4 feet) would not be met for most of the levee channels of Reach P2. Thus, a concrete floodwall would be built on top of the existing levees, bringing the top of bank up to the required freeboard elevation. The downstream end of the floodwall protection would be in the high grounds of the Shoreline Park. These same highlands will most likely be used as part of the Bay Levee being currently studied by the U.S.

Army Corps of Engineers. Thus, when the Bay Levee is completed, seamless tidal flood protection would be provided.

Previous geotechnical investigations have indicated that the existing levees are generally in good condition. The floodwall work would begin approximately 120 meters (400 feet) north of Amphitheater Parkway and continue for about 850 meters (2800 feet) upstream to Highway 101. The floodwall heights would range from zero (where levee freeboard is adequate) to a maximum of approximately 1.2 meters (4 feet), with an average elevation of .6 meters (2 feet). Typical construction procedures would include trench excavation, form work installation, concrete pouring, backfill, and aesthetic texturing on the exposed faces of the floodwall. Please see Figure 6.1 for a rendering of the floodwalls and Appendix H for detailed plans and sections. Maintenance procedures would include weed and graffiti control and repair/replacement of the wall, as needed. To address the prospect of long-term sea level rise, the foundations of the floodwalls would be designed such that the walls could be raised by up to 0.6 meters (2 feet), as needed.

Approximately 200m (650 ft) of floodwalls would also be needed in Reach PD just upstream of the Blach School area. The water surface in this area is slightly above adjacent ground and therefore a floodwall with the required freeboard is needed to provide adequate protection for adjacent properties. Please see Appendix H for plans and sections.

6.2.2 Riparian Restoration (Reach P3)

With 1 percent design flows reduced to 31 cms (1100 cfs) in Reach P3, it would be possible to replace the aging concrete channels along the downstream 700 meters (2300 feet) of Reach P3 (between Highway 101 and Middlefield Road) with a partially natural channel, while extending an existing pedestrian trail. *This project element is not needed as a flood protection element; this element provides an opportunity for environmental enhancement and public trail extension, at the District Board's discretion*.

The construction procedure would be as follows. The existing concrete channel would be removed. A new concrete bank would be built at ½:1 side slope on the east side of the channel. An earth bankfull channel would be built sized to carry the 1.5-year flow (approximately 5 cms or 180 cfs), with a vegetated floodplain and vegetated bank on the west side of the channel. At every 0.15 meter (1/2 foot) rise in the invert, a rock riffle invert stabilization structure would be built. A 3.7 meter wide (12 foot) combination pedestrian/maintenance trail would be built on the concrete bank side of the channel, with a safety railing built into the concrete lining's top. Please see Figure 6.2 for a visual rendering of this project element and Appendix H for detailed plans and sections. Maintenance required would include weed and graffiti control for the trail and concrete bank, bank repair for the natural bank as needed over time, and vegetation maintenance (limited to removal of hazard trees and control of invasive non-natives) in the vegetated section.

Figure 6.1. Floodwalls
(Note that the lower floodwall elevation would be used)

Permanente Creek – Existing View North of Hwy 101

Permanente Creek – North of Hwy 101 with 7-foot Floodwall Concept

Permanente Creek – North of Hwy 101 with 3-foot Floodwall Concept

Permanente Creek – Existing View Looking North from Middlefield Way

Permanente Creek – Future View with Channel Restoration Concept

Figure 6.2. Riparian Restoration and Trail Extension

6.2.3 Channel Widening (Reach P5)

The work involves deepening and enlarging the current concrete channel from just upstream of Park Drive to upstream of the confluence with Hale Creek. This work would replace the most degraded part of the concrete channels built in the 1960s, thus addressing the most urgently needed part of the concrete channel restoration. It would also increase channel capacity upstream of McKelvey Park so that the full one-percent flows can reach the McKelvey Park flood detention site. The Mountain View Avenue bridge invert would be lowered by approximately 0.6 meters (2 feet). The bridge structure itself would not be removed; rather, the invert would be excavated and a new U-frame concrete channel would be built inside the bridge structure.

Due to the very limited right-of-way available and the deteriorated condition of the existing channel, temporary shoring would be needed prior to removal of the existing channel. The new channel built would lower the invert upstream of Park Drive by eliminating the drop structure located there currently. The upstream grade would be steepened so that it would conform to existing invert at the Hale Creek confluence. The 24-inch RCP outlet pipe for McKelvey would be built alongside the new channel during the channel construction. See Appendix H for engineering drawings of the work and several typical sections. Maintenance requirements would include graffiti control and typical long-term maintenance of the concrete channel.

6.2.4 Channel Widening (Reach H1)

This work involves increasing the capacity of some sections of reach H1, which currently do not have full one-percent capacity. The sections are:

- Mountain View Avenue Bridge
- Channel reach from Mountain View Avenue to Arroyo Drive
- 7th Day Adventist Bridge
- Channel section from 7th Day Bridge to North Sunshine Drive
- North Sunshine Drive Bridge
- Channel section from North Sunshine Drive to South Sunshine Drive
- Channel section from South Sunshine Drive to Springer Road
- Springer Road Bridge
- Channel section from Springer Rd to private bridge at 400 Springer Road
- 400 Springer Road Bridge
- Cuesta Drive Bridge
- Channel section from Cuesta Drive to Arboleda Avenue
- Arboleda Avenue Bridge
- Channel section from Arboleda Avenue to Rosita Avenue (including four private bridges)

The portions needing to be designed and built to meet CSC commitments of flood protection north of El Camino Real are the first two bullets only. The remainder of the work would be needed for full flood protection in the upper watershed.

The proposed work would involve deepening and steepening the channel through elimination of drop structures upstream of several of the bridges mentioned above. The existing concrete trapezoidal channels, which are worn and require repair or replacement soon, would be removed and replaced with a new concrete trapezoidal channel to the 10-percent flood elevation (approximately 1.2 meters or 4 feet deep) with 1:1 side slopes. The top of the channel would be lined with rip-rap protection to the top of bank. In areas where the existing access ramps create poor hydraulic conditions due to large expansion/contraction losses, the channel would be rebuilt such that the ramp area is blocked off the creek channel except during actual maintenance operations. See Appendix H for engineering drawings of the work and several typical sections. Maintenance requirements would include graffiti control and typical long-term maintenance of the concrete channel.

6.2.5 Hale Creek Bypass

Since the existing natural channel along Reach H2 cannot pass the full one-percent flowrate and it is undesirable and environmentally damaging to disturb the natural creek channel by expansion and steepening, a bypass channel is proposed to span the low flow section of the creek. *The design and construction of this project element is not required to meet the project's CSC requirements for flood protection north of El Camino Real. It would be needed to provide full flood protection in the upper portion of the watershed*.

The inlet structure would be built along the existing storm drain outlet pipe located at 1140 Riverside Drive (currently occupied by "Marti's Dance"). The City of Los Altos has a storm drain easement that could be used to accommodate the culvert. The inlet would be set at the 1.5-year flood elevation so that all low flows would continue down the natural channel. All flows greater than the 1.5-year flow event would be split between the natural channel and the culvert. The culvert would be 2.4-meters wide by 2-meters high (8 feet X 6.5 feet) and 1130 meters (3700 feet) long from the inlet to the connection to the creek just downstream of Rosita Avenue. The path followed would be north on Riverside Drive, east on Covington Road, and south on Springer Road. See Appendix H for engineering drawings of the work and several typical sections. Maintenance requirements would include vegetation and sediment control at the inlet and typical long-term maintenance of the concrete culvert. Due to the adequate slope, the culvert would not likely have sediment maintenance issues.

6.2.6 McKelvey Park Flood Detention

Approximately 74,000 cubic meters (60 acre-feet) of storage volume would be created in the 2 hectare (5 acre) site. The site would be excavated approximately 15 feet deep, with vertical sides (supported by retaining walls) in order to maintain the baseball field dimensions as existing. The parking lot area would be reconfigured such that it would slope down at 5 percent slope down to the new field level. There would be stairs down to field level placed at various points along the perimeter, as well as two handicapped accessible ramps at Park Drive and Miramonte Avenue.

The restrooms and concession facilities would be built at existing ground level to protect from inundation during the flood events. The inlet and outlet would be located in the southwest corner of the property in the triangular parcel owned by the District. The weir inlet would be designed to spill at 25 cms (900 cfs), which is slightly lower (more frequent) than the 10-year frequency event. Thus, it is expected that the site would, on average, get flooded once every nine to ten years over a long period of time. The site would drain back to the inlet area stilling basin, where a 610 mm (24 inch) RCP would drain the site. The pipe would be installed parallel (and lower than) the replaced concrete channel downstream to Park Drive, where it could connect to the channel. This would also be the normal drainage outlet for rainfall and local inflow water. The site would drain completely in 1-2 days, depending on the flood event.

Since the site sees heavy use almost all year, proper procedure for post-flood maintenance and cleanup would be crucial. A maintenance contract would be developed between the District, the City of Mountain View, and a maintenance company such that cleanup activities would be started immediately after any inundation event. Excess sediment would be scraped off the fields, any remaining sediment brushed or washed off, and the fields' dirt areas and lines restored. The retaining walls would be faced with decorative treatment (bricks or other) and maintained free of graffiti. See Figure 6.3 for a rendering of the site and Appendix H for engineering drawings and sections.

Figure 6.3. McKelvey Park

Existing View From the Left Field Line Looking South

Visual Simulation of Possible Project

6.2.7 Cuesta Park Annex Flood Detention

Approximately 80,000 cubic meters (65 acre-feet) of storage volume would be created on the northern 2.5 hectares (6 acres) of the Cuesta Park Annex. The site would be excavated approximately 6.5 meters (20 feet) deep with variable gentle side slopes averaging 4:1. Various park features such as trails, picnic areas, a seasonal streambed, boulder outcrops, etc. could be built into the detention area. Ramps would be constructed at 5% slope to promote handicapped access to all features. The detailed features of the park would be determined during the design phase of the project in workshops with the community, city staff, and elected leaders.

The inlet would be located at the southeast corner of the detention area, where the inlet pipe would open out into the seasonal streambed feature. The outlet would be into a 914 mm (36-inch) RCP pipe at the northwest corner of the site. Regular site drainage for rainwater and local groundwater inflow would also be through this outlet pipe. The outlet pipe would continue west down Cuesta Drive and north on Miramonte to Marilyn Drive, where it would continue west to meet Permanente Creek for a total length of approximately 1200 meters (3900 feet). The site would drain in 1-2 days, depending on the flood event.

This site would receive the overflow flood flows from the Blach School detention area. Thus, only when the Blach School site would be full would this site be impacted, reducing the flood frequency to the 50-year or above events. Over time, the site would likely be inundated once every 50 years, on average. Post flood maintenance would include sediment removal and repair of any damaged paths, plants, or structures. See Figures 6.4, 6.5, and 6.6 for several renderings of what the site could look like and Appendix H for engineering drawings and sections.

6.2.8 Blach School Flood Detention and Permanente Bypass

Approximately 80,000 cubic meters (65 acre-feet) of storage volume would be created on approximately 2 hectares (5 acres) of Blach Junior High School's football field and track area. The site would be excavated approximately 4.5 meters (15 feet) deep with 2:1 side slopes. All existing facilities (football field and track) would be restored at the bottom of the excavated pond area. Ramps would be constructed at 5% slope to promote handicapped access to all features. The detailed features of the park would be determined during the design phase of the project in workshops with the school, the community, and School Board officials.

The inlet would be located on the south side of the parcel, adjacent to the District's Permanente Diversion. The District would build an overflow weir spilling into a stilling basin, which would dissipate the fall energy and ensure even spread of flows into the detention area. The outlet would be into a 2.4 meter (8-foot) diameter RCP pipe on the north side of the site, which would be designed as another overflow weir (with a smaller opening at the bottom for normal drainage). Regular site drainage for rainwater and local groundwater inflow would also be through this outlet pipe. The outlet pipe (called the Permanente Bypass) would continue north under Thatcher Drive and Hospital Drive to Cuesta Park Annex for a total length of approximately 1200 meters (3900 feet). The site would drain in approximately one day, depending on the flood event.

Figure 6.4. Cuesta Park Annex

2. View from Lookout platform along Cuesta Drive. Looking south.

Figure 6.5. Cuesta Park Annex

3. View along basin trail, with Council Circle and riparian area below. Steps into basin seen in lower right. Looking northwest.

Figure 6.6. Cuesta Park Annex

4. Inside basin along riparian area. Boardwalk in middleground with museum building beyond. Existing parking lot is behind trees in upper left. Looking southeast.

The overflow weir from the Diversion would be set at 40 cms (1400 cfs), which is equal to the current capacity of the channel at Blach School. Thus, the site would only begin flooding at the event that it would flood prior to the project. The only difference is that pre-project flooding would spread across the entire school grounds and the local neighborhood, while post-project flooding would be confined to the detention area only. 40 cms (1400 cfs) plus the 3 cms (100 cfs) continuing down the natural Permanente Creek channel is the 10% flow at this location. Thus, over a long period of time, the detention area would be flooded once every ten years, on average.

Post flood maintenance would include sediment removal, restoration of the play fields to good condition, and repair of any damages. See Appendix H for engineering drawings and sections.

6.2.9 Rancho San Antonio Flood Detention

Approximately 120,000 cubic meters (100 acre-feet) of storage volume would be created on approximately 3.5 hectares (8.5 acres) of Rancho San Antonio Park adjacent to the Gate of Heaven cemetery. The site would be excavated approximately 4.5 meters (15 feet) deep with variable natural side slopes. Native trees and other appropriate vegetation would be planted on the side slopes and the bottom of the detention area. A meandering low flow channel feature would be created both to promote wetland development and rainy season drainage. An existing natural gas line crossing the site would be clearly marked and avoided. Water wells and pipes serving the cemetery would be relocated to new sites slightly south out of the excavation area. The existing hiking trails would be realigned with the detention area.

The inlet would be located southeast of the detention area along the creek, where a low flow crossing currently serves as access to the west side of the channel where the cemetery has various maintenance structures. The crossing would be rebuilt as an at grade culvert with the capacity of the culvert set at 28 cms (1000 cfs). Flows in excess of the design flow would spill into a side channel and get transmitted to the detention area through a pipe and swale. In order to ensure flows would be contained on the lower west bank of the creek, some of the excavated soil from the detention area would be placed on the west bank of the bridge and vegetated with native trees. This would confine flows to the appropriate path up to the one-percent event. The outlet would be through a 610 mm (24-inch) RCP pipe at the northwest corner of the site, which would drain to an outfall under the existing pedestrian bridge just south of the site. Regular site drainage for rainwater and local groundwater inflow would also be through this outlet pipe.

Construction and haul access would be through existing access south along the creek to Stevens Creek Road. The access may need to be improved to tolerate truck traffic. Large equipment access will not be allowed from Cristo Rey Drive.

The design spill event would be slightly higher than the 10% event; thus, over time, the site would likely be inundated once every 10 years, on average. Post flood maintenance would be limited to repair of any damaged paths, plants, or inlet/outlet structures. See Figure 6.7 for a rendering of what the site could look like and Appendix H for engineering drawings and sections.

Figure 6.7. Rancho San Antonio

Existing view from Cristo Rey Drive looking southwest

Visual simulation of proposed project

ENVIRONMENTAL VISION

Visual Simulation
Rancho San Antonio Pond
Santa Clara County, California

6.2.10 New Diversion Structure

The existing diversion structure (at the upstream end of the Permanente Diversion) does not function correctly currently. The low flow intake was built into the invert of the channel and tends to silt up very quickly during winter flows. The diversion was modified later into an overflow weir parallel to the flow path; but that structure does not allow for low flows to continue down the natural Permanente Creek (Reach P7). Thus, the current flow profile at this location is that all flows, low and high, continue to Stevens Creek.

The new diversion structure would be constructed with the following aims:

- Very low flows should flow into Reach P7;
- One-percent flow break should be 54 cms (1900 cfs) down Permanente Diversion and 3 cms (100 cfs) down Reach P7; and
- Since sediment issues cannot be avoided, good access to maintain the low flow capability in the winter season should be provided.

The existing invert flow inlet would be filled in and the existing diversion structure removed. The new diversion structure would be protected by an overflow weir separating the main flow of the diversion from the flow to be routed to Reach P7 up to the full one-percent flow. This overflow weir would have a low-flow opening in the bottom of it allowing all low flows (under the weir) to pass through to the new diversion structure. There would be a maintenance ramp off Miramonte Ave down to the invert of the vault protecting the new diversion structure to provide adequate maintenance access. A 1.2 meter (4-foot) diameter RCP pipe would connect the new diversion structure to the existing 1.4 meter (54-inch) diameter pipe connecting to Reach P7 downstream of Eastwood Drive. See Appendix H for engineering drawings and sections.

6.3 Right-of-Way Requirements

The right-of-way required by the recommended alternative for each project element is detailed below (see Appendix H for plans):

- ***Floodwalls***: Portions of the floodwall length north of Highway 101 lie on City of Mountain View property. The District would need to acquire flood control easements for these areas.
- ***Riparian Restoration***: Portions of the right-of-way needed for this project element is currently owned by the City of Mountain View. The District would need to acquire flood control easements for these areas.
- ***Channel Widening (Reaches P5 and H1)***: This work would take place entirely on existing District right-of-way.
- ***Hale Creek Bypass***: For the inlet location, a District easement would be needed covering the existing storm water utility easement owned by the City of Los Altos. Otherwise, for the main culvert portion under local streets, a temporary construction access easement followed by a long term maintenance agreement would be sought.

- ***McKelvey Park Flood Detention***: The inlet/outlet area is already District owned. A flood control easement covering the portions of the site used for flood storage would be sought to allow for long term site access and maintenance activities.

- ***Cuesta Park Annex Flood Detention***: A flood control easement covering the portions of the site used for flood storage would be sought to allow for long term site access and maintenance activities.

- ***Blach School Flood Detention***: A flood control easement covering the portions of the site used for flood storage would be sought to allow for long term site access and maintenance activities.

- ***Permanente Bypass***: For the main culvert portion under local streets, a temporary construction access easement followed by a long term maintenance agreement would be sought.

- ***Rancho San Antonio Flood Detention***: A flood control easement covering the portions of the site used for flood storage would be sought to allow for long term site access and maintenance activities.

- ***New Diversion Structure***: This work would take place entirely within existing District right-of-way.

6.4 Best Management Practices

The District's Best Management Practices (BMP) handbook (District Document No. W751M01) will be used during the construction activities.

6.5 Climate Change

There is a potential for climate change and associated sea level rise to impact future flood protection for this project. Therefore, the project will use adaptive design to allow future modifications to increase channel capacity, as needed. Specifically, the floodwalls north of Highway 101 would be built with adequate foundations to allow raising the floodwall heights.

CHAPTER 7
MAINTENANCE PROGRAM

7.1 Maintenance History

Regular maintenance work has been conducted within the Permanente Creek watershed over the past few decades. This work can be divided into creek processes maintenance (sediment removal and vegetation control) and infrastructure replacement maintenance.

7.1.1 Historic Creek Processes Maintenance

Due to the shearing effects of the highly active local fault zones, activities of the cement plant in the upper watershed, hydrologic effects due to urbanization, and tidal effects, sedimentation has long been a major issue in the watershed. As described in more detail in Chapter 3, significant sediment deposition has historically occurred at two locations in the Permanente watershed: (1) on Permanente Creek near Highway 101; and (2) in the Permanente Diversion and in Permanente Creek immediately upstream of the Diversion. Minor sedimentation problems also occur along Hale Creek and its tributaries. The significance of the sediment removal efforts can be shown by the volume of sediment removed from the watershed over time. Figures 7.1 and 7.2 show the sediment removal volumes at the two most significant locations over a long period.

Figure 7.1 - Sediment Removal 1980 - 2000
Permanente Creek Downstream of Highway 101

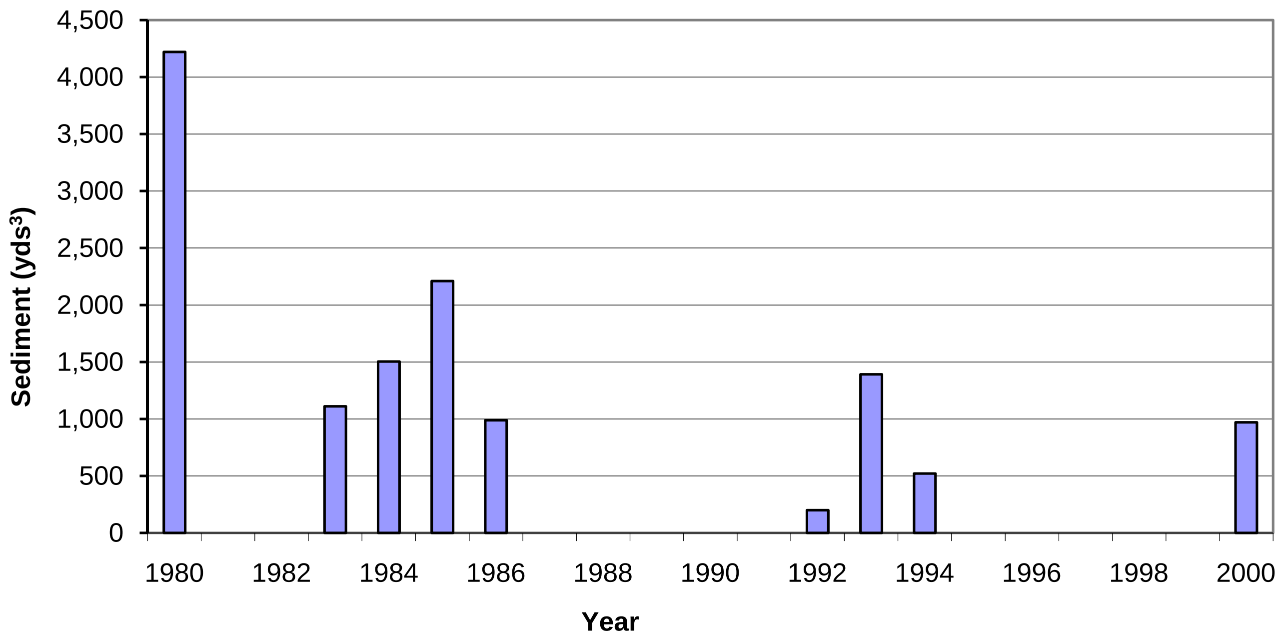
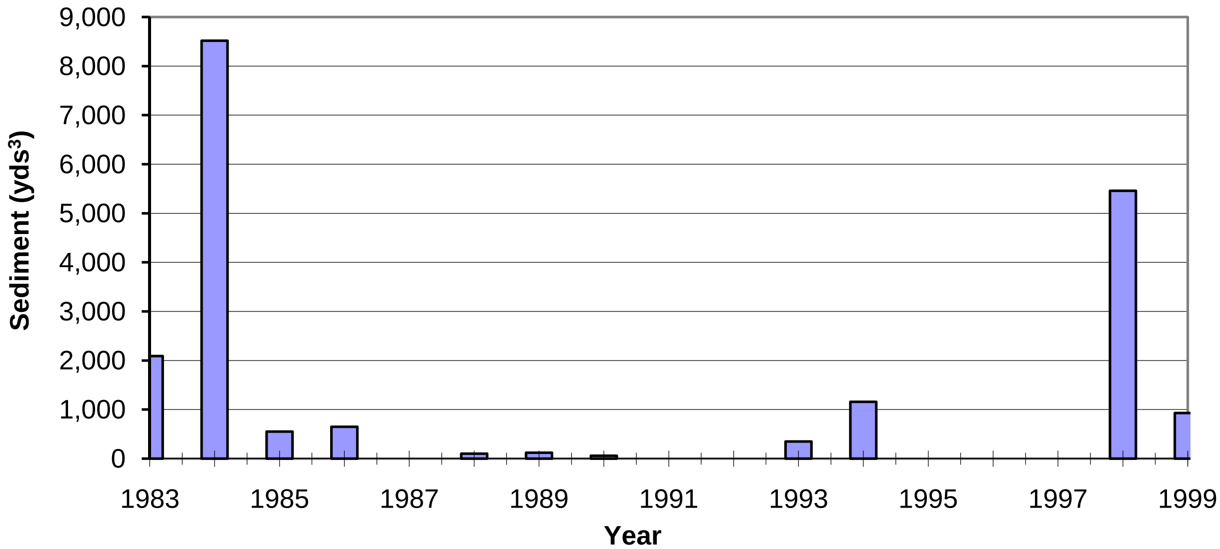


Figure 7.2 - Sediment Removal 1983 - 1999
Permanente Diversion



Sediment removal at Permanente Diversion, which is by far the larger of the two sediment zones, is closely correlated with strong rainfall years. The two biggest sediment removal years were following the 1983 and 1998 El Nino seasons. Sediment removal downstream of Highway 101 is mostly associated with tidal issues and therefore does not correlate with strong winter precipitation years.

The average annual sediment removal at the Diversion is 1840 cubic meters (2400 cubic yards), while the annual removal downstream of Highway 101 has been 190 cubic meters (250 cubic yards). So the average annual sediment removal needed for the watershed has been approximately 2000 cubic meters (2600 cubic yards).

7.1.2 Historic Infrastructure Maintenance

As reported in Chapter 3, a detailed structural analysis of the concrete channel sections built in the 1960s revealed that much of the work conducted has deteriorated and significant lengths of the constructed channels are in danger of failure. As the facilities continue to deteriorate through various failure mechanisms, the danger of catastrophic channel failure (collapse of walls, possibly during a large flow event) becomes ever more possible. The District has been regularly monitoring the concrete channels over the past eight years, measuring wall deflections and assessing failure potential. A 65-meter (212 foot) length of the concrete channel between Mountain View Ave and Park Drive was judged to be close to collapse and was replaced in 2003, at a cost of approximately $640,000. Piecemeal replacement of channels combined with very difficult site access and limited right-of-way combine to create very expensive repair and replacement conditions.

7.2 Continuing Project Maintenance Activities

The Permanente Creek maintenance program provides long term maintenance guidance for routine and long term stream maintenance work.

7.2.1 Ongoing Sediment Maintenance

It is anticipated that the existing level of sediment maintenance work, mostly concentrated in the Permanente Diversion and Permanente Creek just downstream of Highway 101 would continue into the foreseeable future. The flood detention project elements may reduce sediment generation from the very largest storms; however, since the target flowrates will typically be ten-year or above flows, there would be only minor reductions expected in average annual sediment removal needed. Thus, the conditions to trigger maintenance activity would be:

- Greater than 0.3 meter (1-foot) average sediment depth in the Permanente Diversion (above the invert grade shown on the project plans).
- Greater than 0.3 meter (1-foot) average sediment depth in Permanente Creek (above the invert grade shown on project plans) between Highway 101 and Charleston Road.
- Other improved channel reaches (Reaches P2, P3, P4, P5, H1, P8, and the length of the Permanente Diversion) would continue to be monitored for sediment maintenance. These reaches are not anticipated to require regular maintenance; however, greater than 0.3 meter (1-foot) average sediment depth at these locations would be a maintenance activity trigger.

If any of these conditions are met, the response would be maintenance to restore the channel to design condition at the earliest opportunity, generally the following summer.

7.2.2 Ongoing Vegetation Maintenance

The current level of vegetation maintenance would be continued in the future.

- Levees (annual cycle): continue to prevent vegetation growth along top of levee maintenance roads, prevent woody vegetation establishment and growth on levee slopes or top.
- Concrete channel reaches (annual cycle): continue to maintain access areas and adjacent right-of-way clear of weeds and remove woody vegetation from within 1.5 meters (5 feet) of vertical walled concrete channels.
- Natural channel reaches (annual cycle): monitor within District right-of-way areas for hazardous tree conditions, channel blockages, etc.

7.2.3 Ongoing Structural Maintenance

The concrete channel reaches experiencing the most structural deterioration (portions of Reach P5 and the upstream end of Reach H1) would be replaced by new structures as part of the capital work. Thus, the most pressing portion of addressing the structural deterioration of the 1960s channels would be accomplished. Also, the lower part of Reach P3 (Highway 101 to

Middlefield Road) would be replaced by a partially natural channel per the riparian restoration project element.

The remaining concrete channels would be monitored annually by District maintenance. Wall deflections would be measured and compared with safety criteria at channel monitoring locations established by the District's structural engineering unit. The "impending failure" rate would be 0.175 (deflection from plumb / wall height). Therefore, any measurements close to this rating would be inspected more frequently. Ongoing deterioration close to the failure limit would trigger channel replacement.

Levee elevations would be monitored once every five years and restored to design elevation if measured elevation varies from the elevation shown on project plans by more than 0.3 meters (1 foot).

7.3 Maintenance Activities for New Project Elements

Maintenance activities for new project elements would be as follows.

7.3.1 Floodwalls

In addition to typical levee maintenance (see above), new maintenance would include:

- Visual inspection and monitoring: Floodwalls would be visually inspected on a monthly basis and graffiti control measures taken as needed.

- Floodwall elevations would be monitored through surveying identified control points once every five years. If measured elevations vary from the as-built elevations by more than .15 m (6 inches), the floodwalls would be analyzed by a competent structural engineer for foundation problems. If measured elevations vary from as-built by more than 0.3 m (1 foot), then elevations would be restored to design elevation.

7.3.2 Riparian Restoration

The reach would be visually inspected annually and the following work completed as needed:

- Access road / public trail would be maintained free of weeds and other vegetation.

- Safety rail would be inspected and repaired as needed.

- Concrete channel bank would be inspected for visible scouring and wearing of concrete cover and repaired as needed. Graffiti would be controlled.

- Invert, floodbench, and restored bank would be left as natural as possible with no required regular maintenance. Hazardous trees would be removed and replaced as needed. Bank failures would be identified as early as possible and repaired as needed.

7.3.3 New Concrete Channels

The new channels along Reaches P5 and H1 would be maintained similarly to the current maintenance program. Annual inspections would be carried out to monitor for sedimentation, vegetation growth along maintenance access routes, and structural deterioration. The criteria detailed above for existing channels would be used to determine maintenance activities needed.

7.3.4 New Bypass Culverts

Bypass culverts would be designed with such grade that sediment buildup would be unlikely. The inlet and outlet locations would be inspected annually for evidence of sedimentation. If any sedimentation within the culvert would be suspected, they would be inspected. Average sediment depths greater than 0.15 meters (6-inches) would trigger maintenance action to restore the culverts back to design condition.

Inlets and outlets are far more likely locations for required maintenance activities over the long term:

- Sediment tends to drop out just upstream of inlet locations; therefore, these locations would be inspected annually. Sediment depths greater than 0.3 meters (1 foot) above design conditions would trigger maintenance action to restore the grade back to design condition.

- Bypass inlet locations would also be monitored for vegetation growth. Any woody vegetation or other impediment to clear flow into the inlet would be removed annually.

- Both bypasses propose to outlet into controlled locations (Hale Bypass into a concrete channel and Permanente Bypass into a rock-lined pool); therefore, it is unlikely there would be erosion issues at outlets. The Permanente Bypass outlet would be monitored for vegetation growth. Any woody vegetation obstructing flows would be removed annually.

7.3.5 McKelvey Park Detention Area

Day to day maintenance of park facilities including vegetation management would be conducted by the City of Mountain View. District maintenance responsibilities would lie in maintaining the inlet/outlet area adjacent to the creek and post-flood cleanup of the site after a flooding event.

The inlet/outlet and stilling basin locations would be maintained free of sediment and graffiti would be controlled. Access would be through the baseball field, so maintenance activities would be conducted during times when park is not in formal use. The outlet pipe would be maintained free of blockage and vegetation.

Post-flood maintenance would be conducted by a contractor. District maintenance would administer a contract with an appropriate landscaping contractor who would be on call to clean and restore the field after any flooding event. Activities would include removal of any deposited sediments from the site, restoration of any damaged items, restoration of damaged field areas (including the artificial turf, as needed), and repair of drainage facilities as needed.

7.3.6 Cuesta Park Annex Detention Area

Day to day maintenance of park facilities, including vegetation management would be conducted by the City of Mountain View. District maintenance responsibilities would lie in maintaining the inlet/outlet area adjacent to the creek and post-flood cleanup of the site after a flooding event.

The inlet/outlet locations would be maintained free of sediment. Access would be through the park paths, so large equipment would not be used. The inlet and outlet pipes would be maintained free of blockage and vegetation.

Post-flood maintenance would be limited to removal of deposited sediment from the site, restoration of any damaged items and bank failures, restoration of damaged vegetation, and repair of drainage facilities as needed.

7.3.7 Blach School Detention Area

Day to day maintenance of school fields and facilities including vegetation management would be conducted by the school. District maintenance responsibilities would lie in maintaining the inlet/outlet area adjacent to the creek and post-flood cleanup of the site after a flooding event.

The inlet/outlet and stilling basin locations would be maintained free of sediment and graffiti would be controlled. Access would be through District right of way. The outlet pipe and overflow weir area would be maintained free of blockage and vegetation.

Post-flood maintenance would be conducted by a contractor. District maintenance would administer a contract with an appropriate landscaping contractor who would be on call to clean and restore the field after any flooding event. Activities would include removal of any deposited sediments from the site, restoration of any damaged items, restoration of damaged field areas (including the artificial turf and track, as needed), and repair of drainage facilities as needed.

7.3.8 Rancho San Antonio Detention Area

Day to day maintenance of park facilities, including vegetation management and trail maintenance would be conducted by the County and the Open Space District. District maintenance responsibilities would lie in maintaining the inlet/outlet area adjacent to the creek and post-flood cleanup of the site after a flooding event.

The inlet/outlet locations would be maintained free of sediment. The inlet culvert area may be prone to sediment deposition. This area would be inspected annually and restored to design grade once sediment deposition would exceed 0.3 meters (1 foot). The inlet location would also be maintained free of any woody vegetation growth. The outlet pipe would be maintained free of blockage and vegetation.

Post-flood maintenance would be limited to repair of any bank failures, restoration of damaged vegetation, and repair of inlet/outlet facilities as needed. Sediment deposited in the detention area would be left in place.

7.3.9 New Diversion Structure

The new diversion structure would likely require regular maintenance activity to perform as designed. Maintenance access would be provided to the vault area protecting the new diversion pipe as well as the main channel area (see Appendix H for engineering drawings). Both sides of the separation wall would be potential sediment deposition areas. Therefore, annual maintenance of this area would be required. Any sediment deposited would be removed.

7.4 Long Term Infrastructure Maintenance

Like all man-made structures, the new culverts, channel reaches, and other infrastructure that would be built by this project would eventually require replacement. Therefore, the calculated project maintenance costs (see below) include provisions for structural replacement costs estimated for the next 50 years, the project's design lifespan.

7.5 Maintenance Cost

Maintenance costs for the recommended alternative's project elements were calculated as follows:

- ***Continuing sediment and vegetation maintenance***: Based on a recent 10-year period, the annual cost of maintenance is approximately $120,000. This cost is not expected to change significantly due to the project.

- ***Rancho San Antonio detention***: It is estimated that vegetation maintenance would be required at the inlet and outlet approximately once every 2-3 years, costing approximately $30,000. Annual costs would therefore be $10,000.

- ***McKelvey Park detention***: Significant maintenance would only be needed once every ten years, on average. However, the maintenance may include partial to full replacement of the artificial play surface. The one-time cost is estimated at $150,000, with an annual cost of $15,000. There would also be typical maintenance of the inlet outlet area, graffiti control, etc. estimated at $5,000 annually.

- ***Hale Bypass and Permanente Bypass***: for bypasses, a yearly maintenance $5,000 is estimated for inlet/outlet cleanup. Minimal regular maintenance would be needed for the culvert body; however, the structure would deteriorate with time, incurring replacement costs for the District. It is assume that 25 percent of the culvert length would fail over the first 100 years of project life. Thus, to fairly estimate the real long term costs of structural solutions, a structural replacement cost was added to the maintenance cost. For Hale Bypass this cost would be $22,750 annually; while for the Permanente bypass it would be $11,500 annually.

- ***Floodwalls***: There would be a $10,000 annual cost for graffiti and weed control. The structural replacement cost would assume that 50 percent of the floodwall would need to be replaced in 100 years. Therefore, the annual cost for structural replacement would be $22,500.

- ***Channel widening***: Annual sediment/vegetation maintenance would be zero (included in the continuing maintenance costs above). However, the structural replacement cost for open channels would assume that 50 percent of the channel will fail over 100 years (based on previous District jobs). Therefore, the annual structural replacement cost would be $66,500.

- ***Riparian Restoration***: Annual vegetation and bank repair cost is estimated at $20,000.

- ***New Diversion Structure***: The annual sediment maintenance cost is estimated at $10,000. The structural replacement cost assumes 25 percent replacement every 100 years or $1,500 per year.

- ***Cuesta Annex Flood Detention***: Annual maintenance for inlet/outlet area clearing is estimated at $5,000. Post-flood cleanup is estimated at $150,000 per event, with a 2 percent annual event probability giving an annual cost of $3,000.

- ***Blach School Flood Detention***: Annual maintenance for inlet/outlet area clearing is estimated at $5,000. Post-flood cleanup is estimated at $150,000 per event, with a 10 percent annual event probability giving an annual cost of $15,000.

- ***Structural Replacement Cost***: As described in Section 6.2, the most deteriorated portions of the 1960s concrete channels will be replaced as part of this project. However, significant lengths of the concrete channels will remain and will continue to deteriorate with time, eventually requiring replacement. It is estimated that 25 percent of the remaining (not rebuilt) concrete channels (totaling 1600 feet) will fail over the next 50 years. Since these would be replaced as emergency projects, the costs are significantly greater than a planned construction project. Based on the 2003 channel replacement, the cost is estimated at $3000 per foot of channel. Therefore, the annual cost would be $96,000.

In summary, the annual sediment and vegetation maintenance costs for the project would be approximately $228,000. The annual structural replacement costs would be approximately $211,000. The total annual cost would be $439,000 with a 50-year cost of approximately $22 million. Please see Appendix E for details of maintenance cost estimates.

CHAPTER 8
PROJECT COST, FUNDING, AND SCHEDULE

8.1 Project Cost

The overall capital cost for the recommended project would be $58 million in 2008 dollars, including design, construction, and contingencies. Of that, $40 million would be needed to meet the project's CSC commitments. Since the project's budget is limited, it is recommended that only the project elements needed to meet CSC commitments be designed and built at this time, saving the remainder of the project elements for future design/construction efforts.

The capital design/construction estimate is summarized below in Table 8.1. The detailed cost estimate is provided in Appendix E. The project elements in normal font would be the ones recommended for current phase design and construction, while the elements in *italics* font are for potential future design and construction phases.

Table 8.1 – Summary of Design/Construction Costs

Project Element	Design/Construction Cost (millions 2008 $)
Flow detention – Rancho San Antonio	$5.5
Flow detention – McKelvey Park	$9.1
Hale Bypass	*$10.2*
Permanente Bypass	$5.2
Floodwalls	$2.8
Channel widening Reach P5	$5.2
Channel widening Reach H1	$1.6
Channel widening Reach H1	*$8.2*
New diversion structure	$0.7
Flow detention – Cuesta Park Annex	$3.6
Flow detention – Blach School	$6.3

8.1.1 Potential Enhancement Opportunity

It would be possible to restore riparian values and extend public trails along approximately 700 meters (2300 feet) of current concrete-lined channel between Highway 101 and Middlefield Road. Doing this would also permanently address the deteriorating concrete channels along this reach of Permanente Creek. This project element would cost an additional $3.5 million.

Another potential enhancement opportunity would be restoration of the Permanente Diversion Channel to a riparian habitat connecting the natural upper portions of Permanente Creek with Stevens Creek. This would also provide an opportunity to extend a public trail from the Stevens Creek area to upper Permanente Creek. This would also address the deteriorating concrete channels along the Permanente Diversion channel. The cost for doing this restoration would be quite substantial, though grant funding from various State of California initiatives may partially offset some of the costs.

8.2 Project Funding

The design and construction phases of the Permanente Creek project would be paid by funds from the voter approved CSC Measure B ballot measure. Funds from the Measure have begun accumulating in the project's budget and would be used through the design and construction phases. The expected total budget available to this project by the end of the Measure's existence in 2016 is approximately $38.6 million.

8.3 Project Schedule

Detailed project design is expected to begin in the second half of 2008. The overall project will be split into three design/construction phases, based on the type of work and the anticipated complexity of the design effort. These phases will be as follows:

8.3.1 Phase 1

This phase will include mostly concrete channel improvements. The design and plans would be done by District staff. Project elements included are the new diversion structure, floodwalls, and the channel improvements in Reaches P5 and H1.

Design and plans and specifications preparation would be conducted from January 2009 to June 2010. Construction, including revegetation would be conducted from January 2011 through June 2012.

8.3.2 Phase 2

This phase would concentrate on the Rancho San Antonio flood detention project element. Since this area is to remain in natural condition, the design and plans work could be done by District staff and do not require specialized parks design expertise.

Design and plans and specifications preparation would be conducted from January 2009 to December 2010. Construction, including revegetation would be conducted from June 2011 through April 2012.

8.3.3 Phase 3

This phase would be composed of the other three flood detention sites, which generally require a level of landscaping and park design expertise not readily available at the District and the Permanente Bypass culvert, which would connect the Cuesta Park Annex site with the Blach School site. This work would be expected to take a somewhat longer design time. The project elements included would be Blach School detention, McKelvey Park detention, Cuesta Park Annex detention, and the Permanente Bypass.

Design and plans and specifications preparation would be conducted from January 2009 to July 2011. Construction, including revegetation would be conducted from February 2012 through 2015.

CHAPTER 9
CONCLUSIONS AND RECOMMENDATIONS

The existing flow carrying capacities of Permanente Creek, Hale Creek, and Permanente Diversion are far below the design flow rate. If the flood protection is not improved, 3,170 parcels located in Mountain View and Los Altos would be flooded by a one-percent flow event.

The recommended project would provide protection to the community from the design flood and accomplish the District's CSC natural flood protection objectives. The following would be the beneficial impacts of the project:

- ***Flood protection*****:** The full project would protect all 3,170 parcels subject to one-percent flooding in the watershed. The CSC phase design and construction recommended would protect 2,470 parcels, including all of the approximately 1,670 parcels in the floodplain north of El Camino Real.

- ***Flood protection*****:** The project would protect Highway 101, Central Expressway, and Middlefield Road from flooding due to the one-percent event.

- ***Environmental enhancement / trails*****:** The project would provide an opportunity for riparian restoration and trail extension for approximately 700 meters (2300 feet) of existing concrete channels.

- ***Concrete channel deterioration / asset protection*****:** The project would replace the most significantly damaged sections of the old concrete channels and provide a monitoring/replacement plan for long term maintenance.

- ***Maintenance*****:** While the annual sediment and vegetation maintenance is not expected to change from existing practice, the project would address the structural deterioration maintenance concern.

The project meets all the specific project objectives and balances the NFP objectives adopted by the District Board better than all other feasible alternatives. Therefore, it is recommended that the project should be approved and that detailed plans and specifications be developed for its construction.

APPENDIX A

Conceptual Alternative Figures

CPE 1: No Project

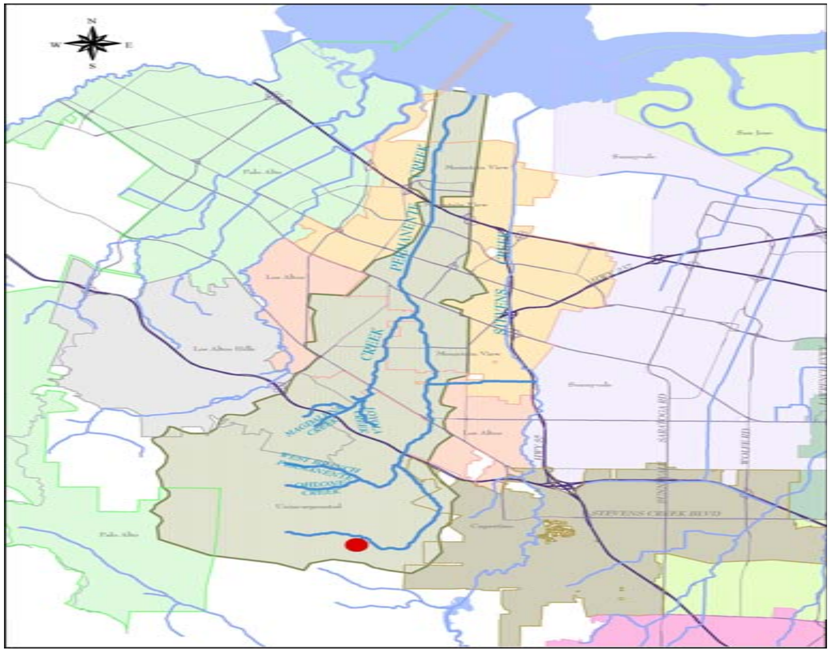
Benefits:

- No new impacts

Concerns:

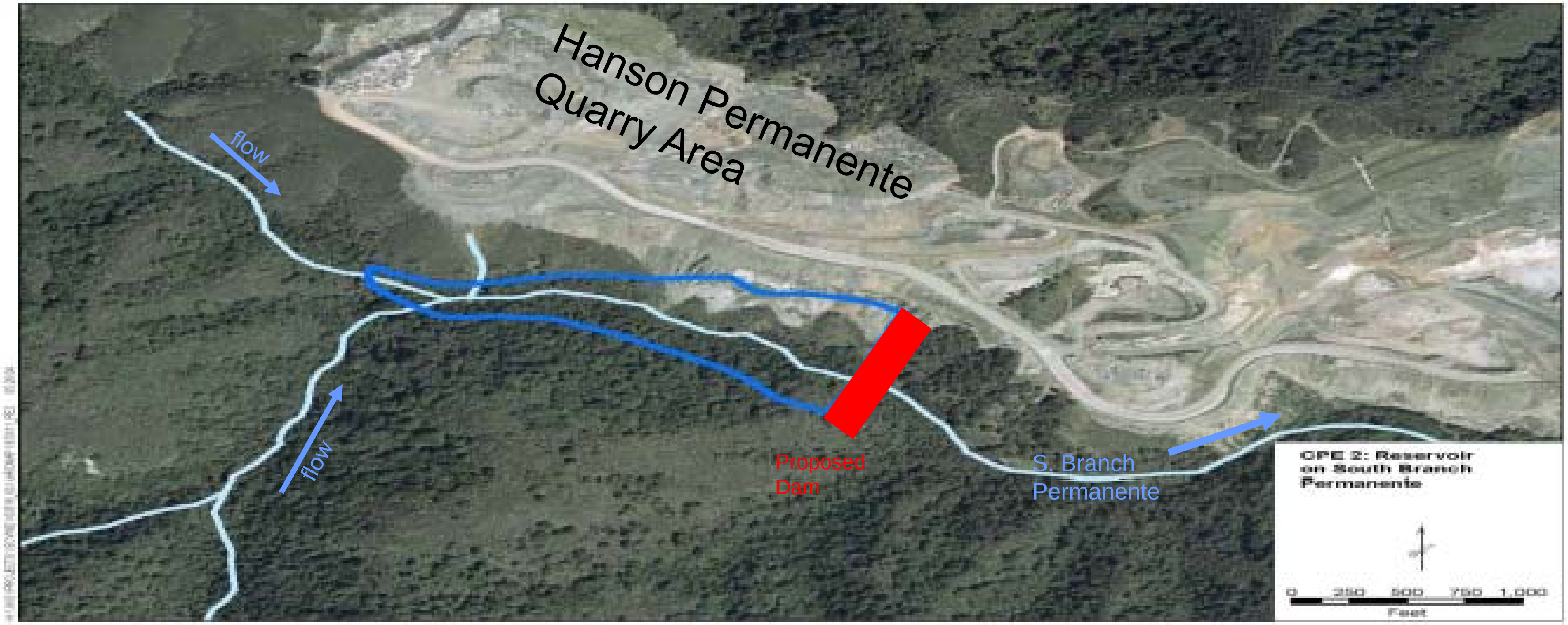
- Does not meet flood protection objectives
- Does not meet long-term maintenance requirements
- Structural failure addressed on as-needed basis

CPE 2: Flow Detention in South Branch Dam



Benefits:
- Flood benefit: flow reduction in Permanente Creek
- Flow reduction allows riparian restoration downstream

Concerns:
- Habitat impact



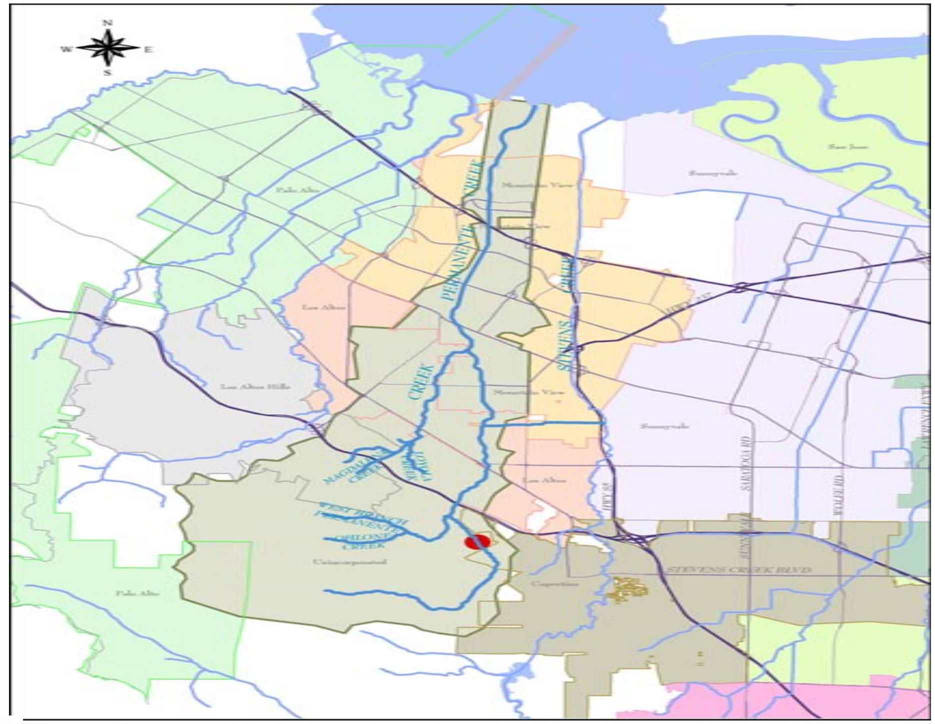
CPE 3: Flow Detention on Rancho San Antonio

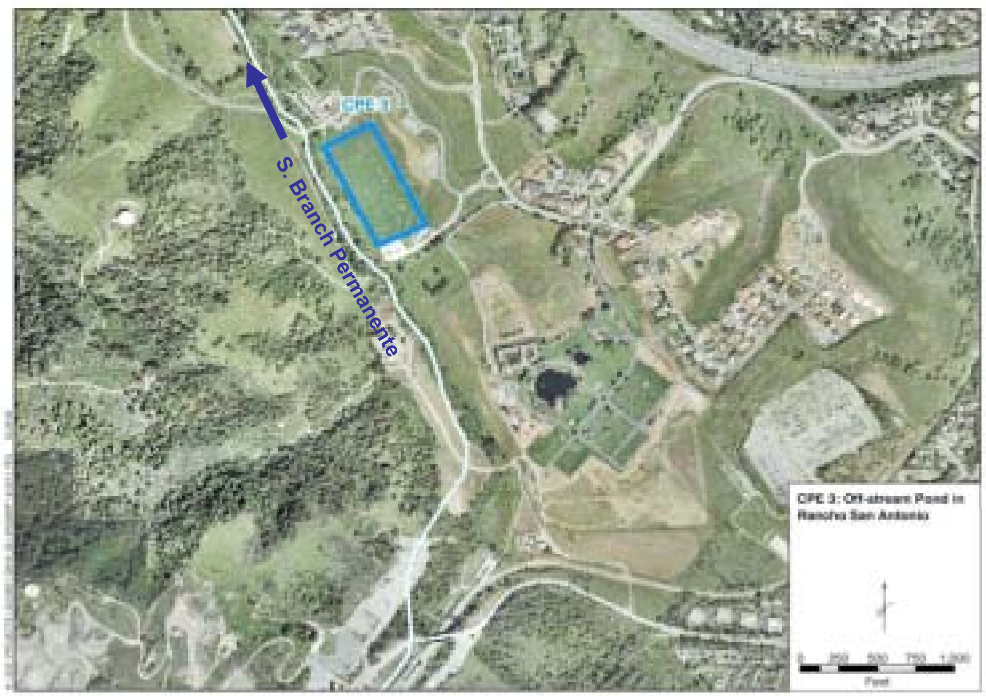
Benefits:

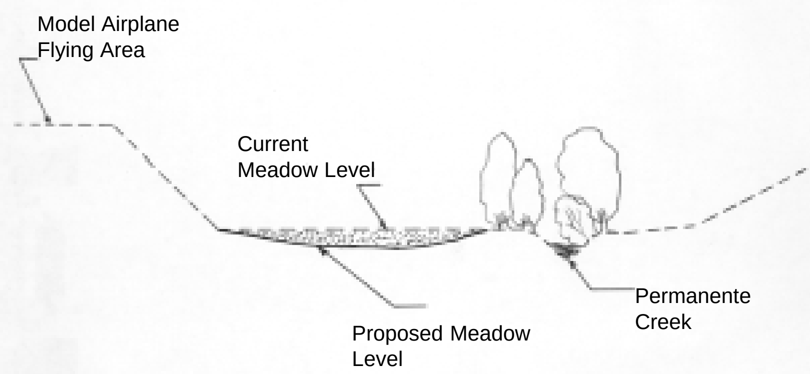
- Flood benefit: flow reduction in Permanente Creek
- Flow reduction allows riparian restoration Downstream

Concerns:

- Traffic: construction traffic impact
- Temporary impact on use of facility

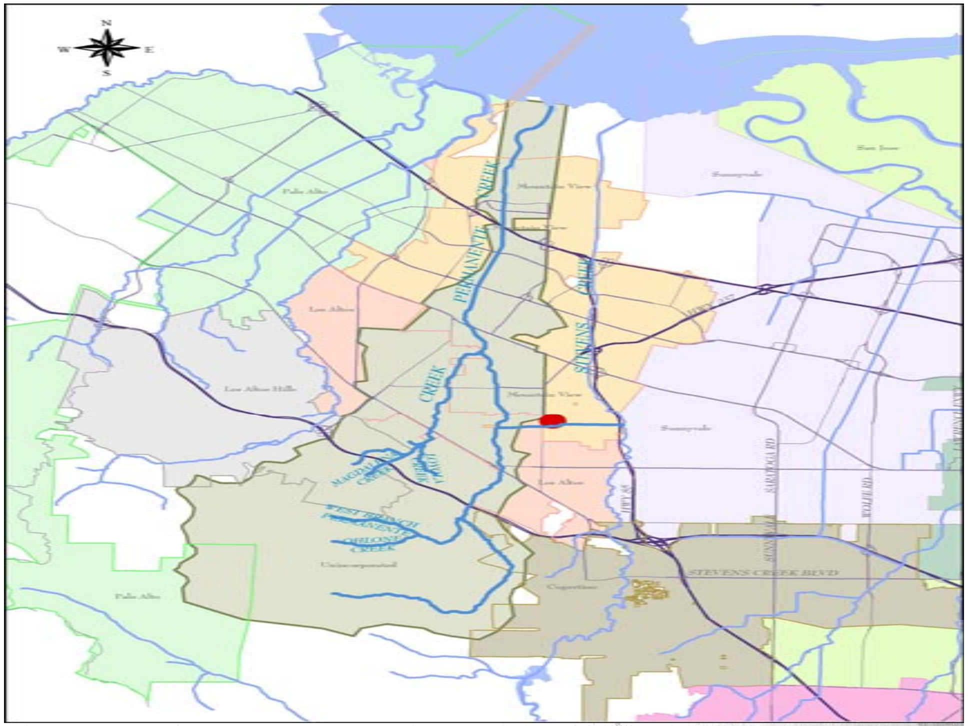






Cross-section of CPE 3

CPE 4: Flow Detention on Grant Road

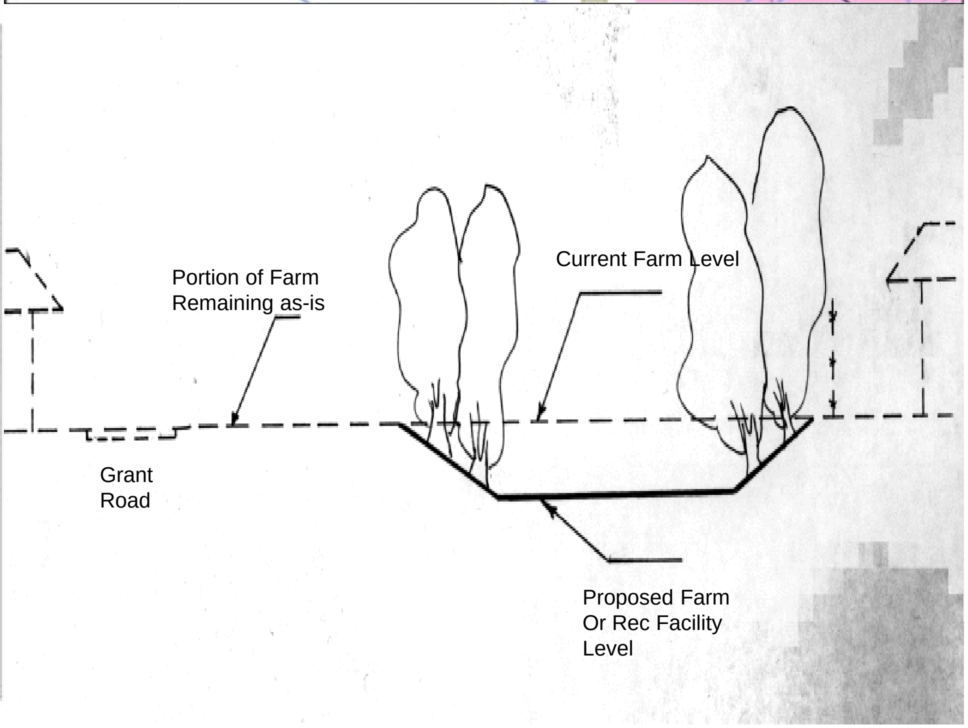


Benefits:

- Flood benefit: flow reduction in Permanente Creek
- Flow reduction allows riparian restoration downstream
- Recreational facilities developed

Concerns:

- Traffic: construction traffic impact
- Farm activities reduced



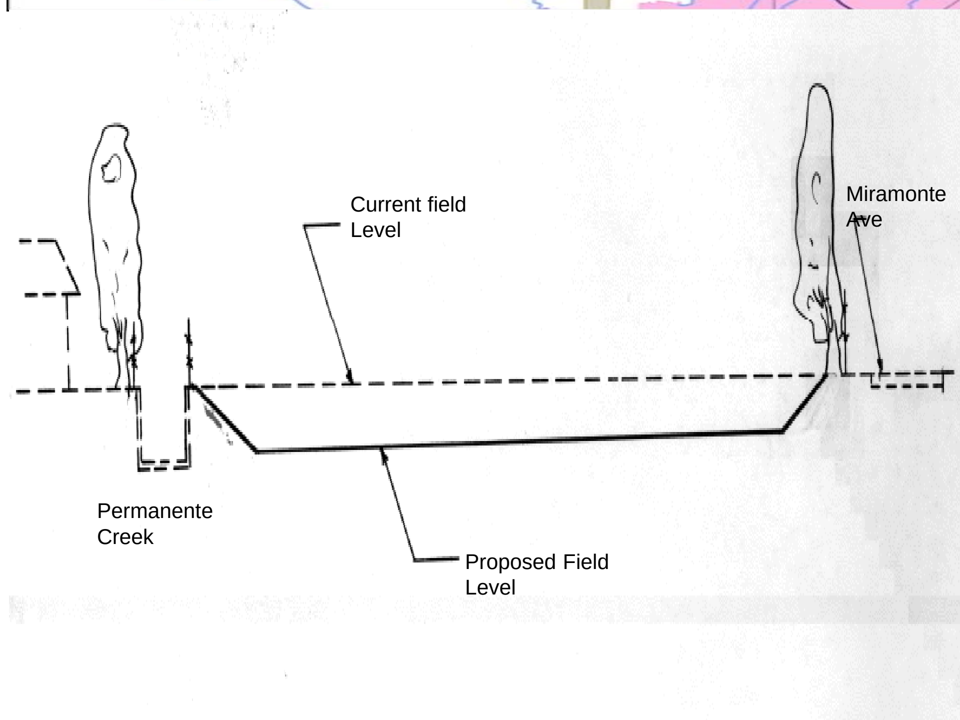
CPE 5: Flow Detention on McKelvey Park

Benefits:

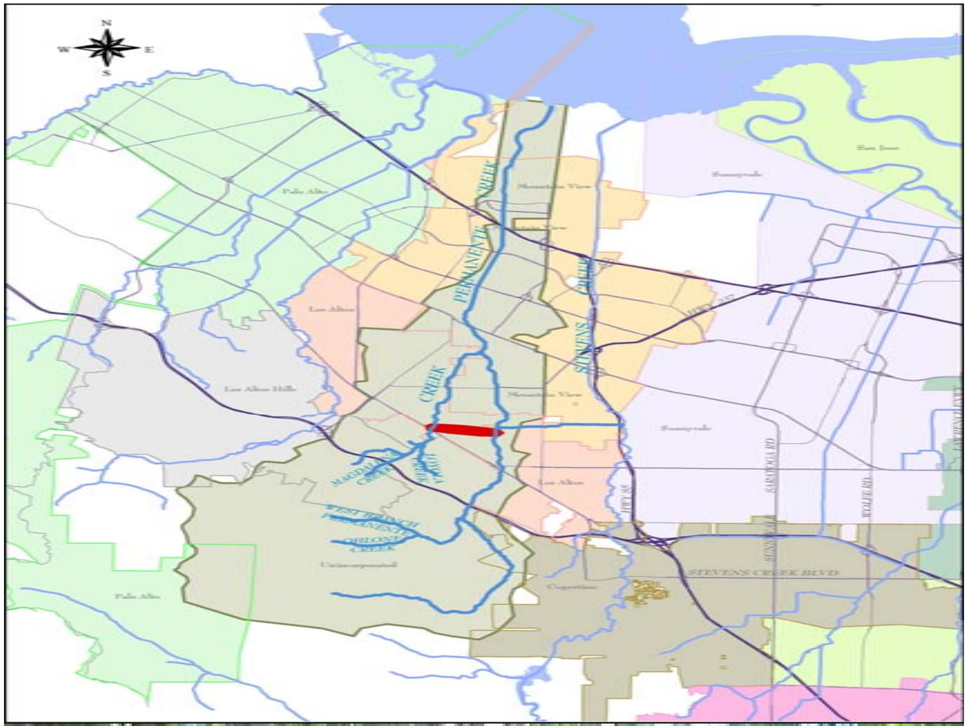
- Flood benefit: flow reduction downstream
- Flow reduction allows riparian restoration
- Recreational facilities improved

Concerns:

- Traffic: construction traffic impact
- Construction period impact on facility use



CPE 6: Hale Creek Diversion

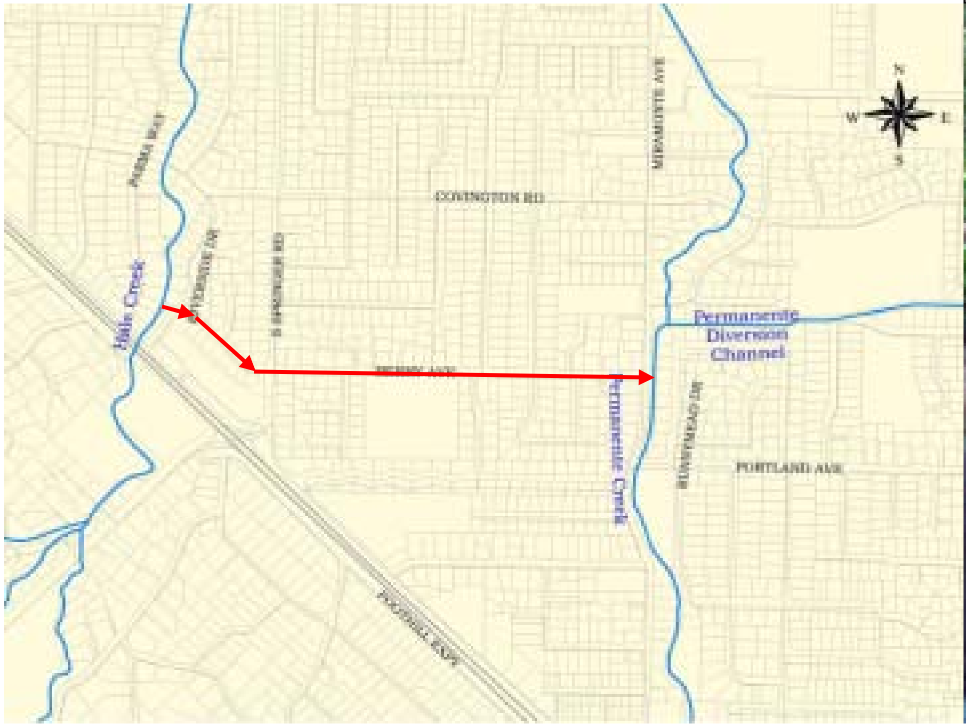


Benefits:

- Hale Creek flooding addressed
- No impact to Hale natural channel

Concerns:

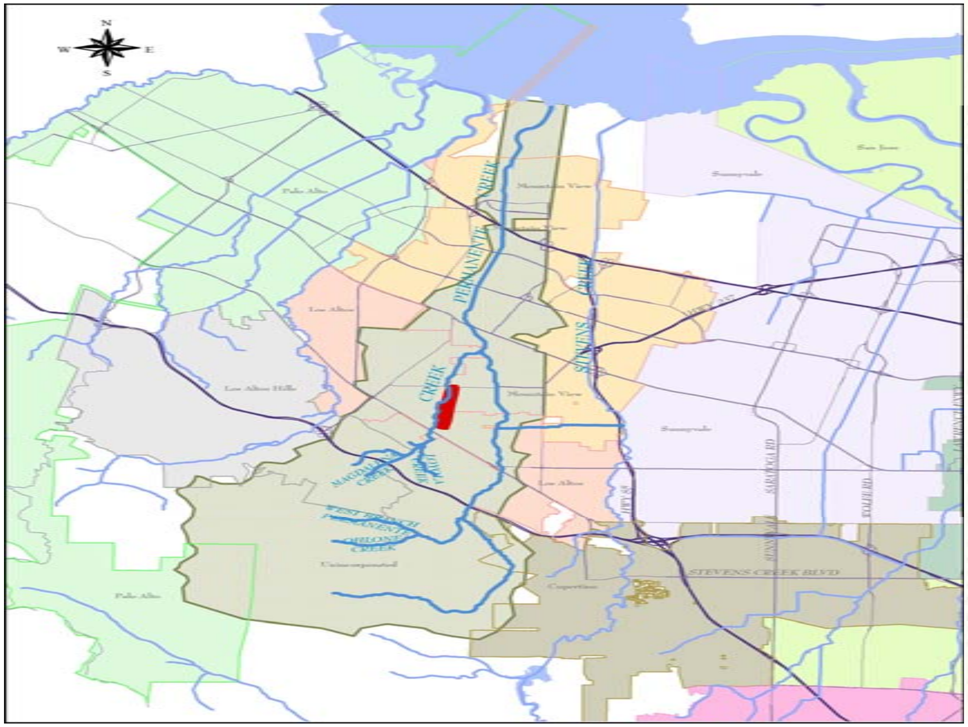
- Traffic impact (Berry Ave.) during construction
- Increased flow in Permanente



CPE 7: Hale Creek Bypass

Benefits:
- Upper Hale Creek flooding addressed
- No impact to Hale natural channel

Concerns:
- Traffic impact during construction



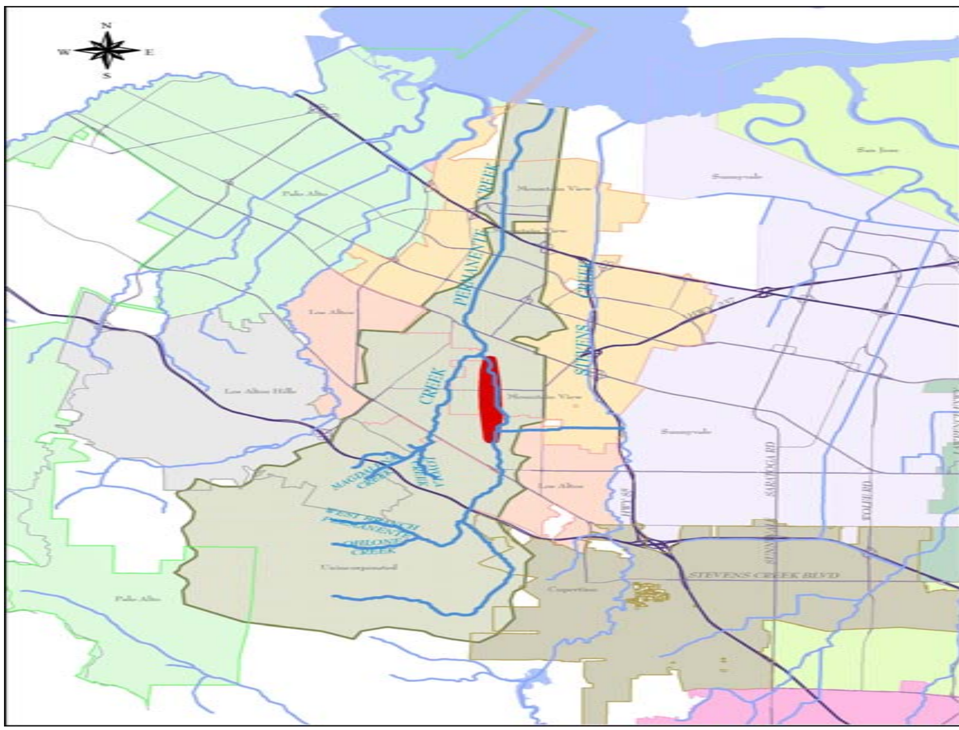
CPE 8: Permanente Creek Bypass

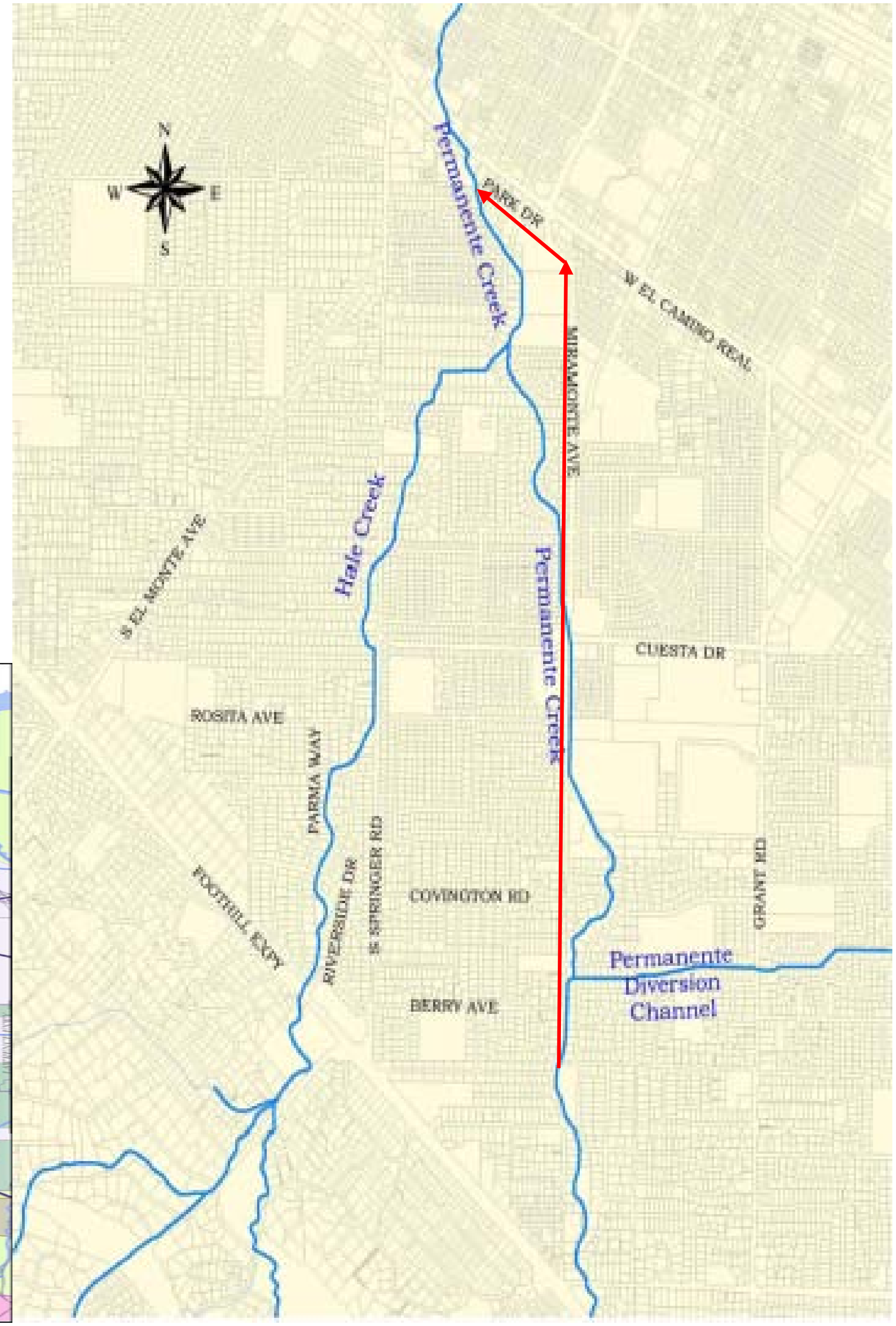
Benefits:

- Upper Permanente Creek flooding addressed
- No impact to Permanente natural channel

Concerns:

- Traffic impact (Miramonte/Park) during construction
- Cost

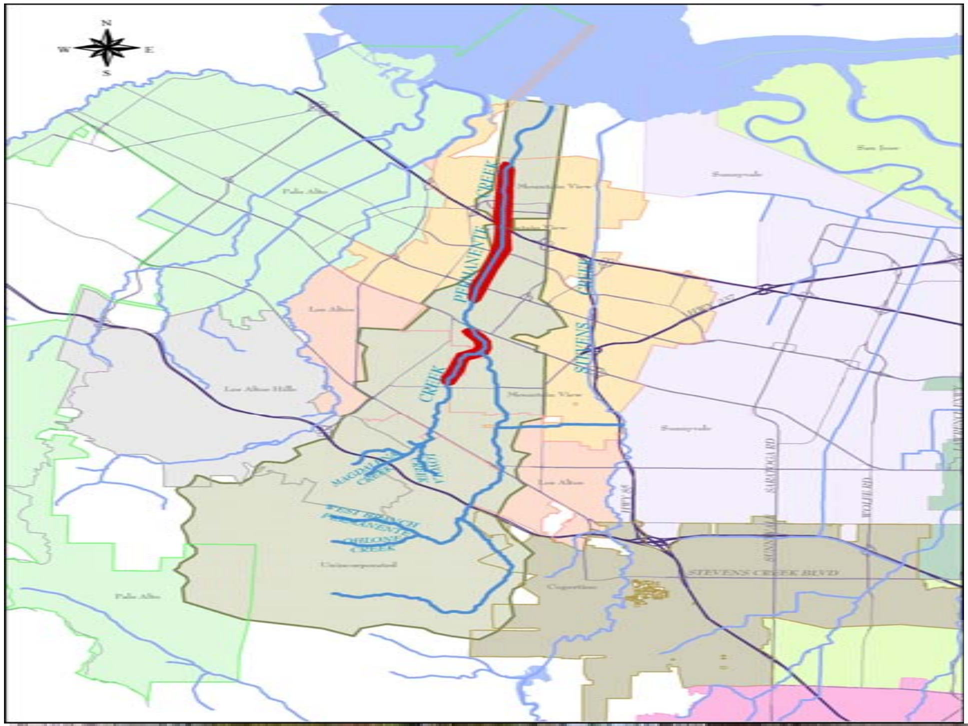


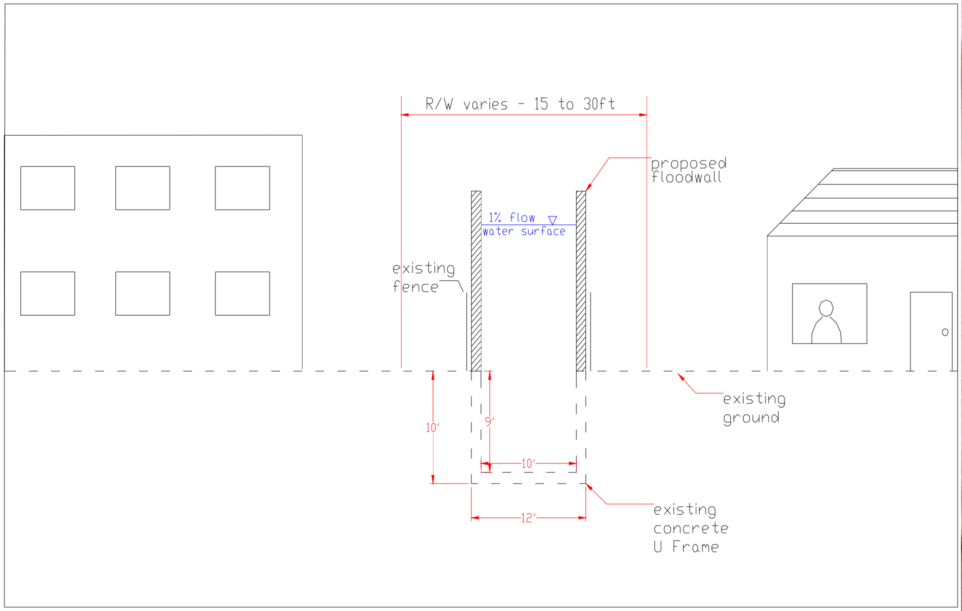


CPE 9: Floodwalls

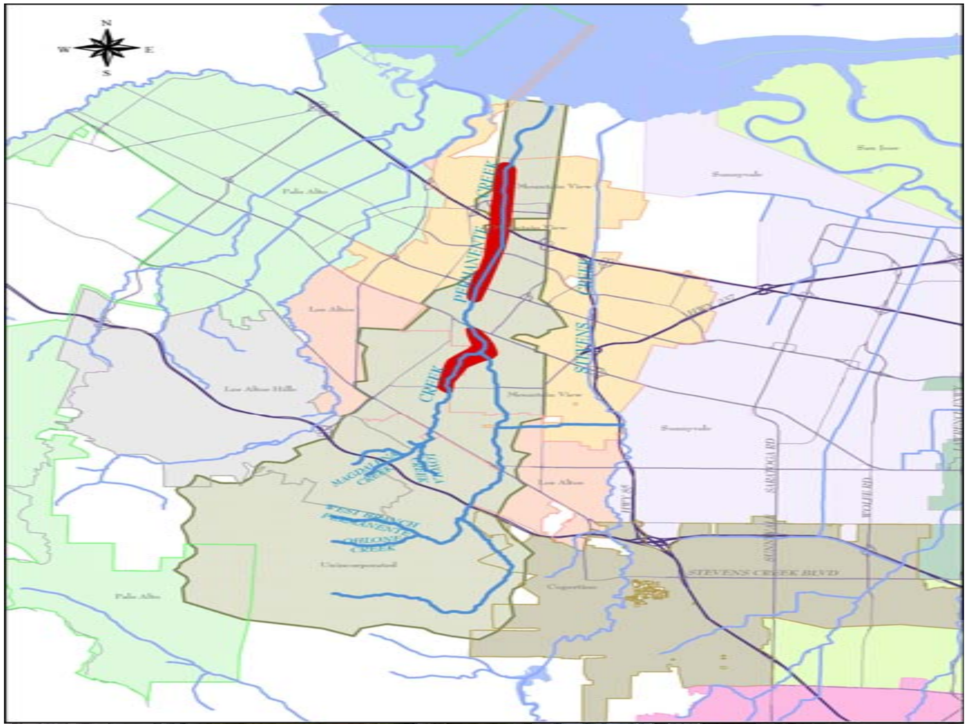
Benefits:
- Lower Permanente and Hale flooding addressed
- Concrete channel rebuilt

Concerns:
- Visual: very high floodwalls (5'-30')
- Traffic: 25 bridges need work
- Majority of flooded area not improved
- High Cost





CPE 10: Channel Widening

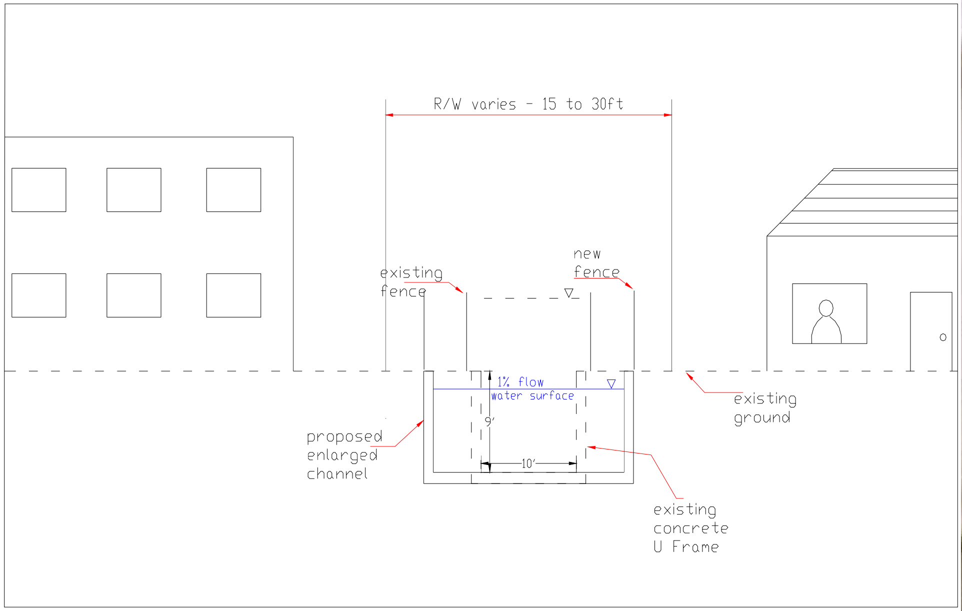


Benefits:

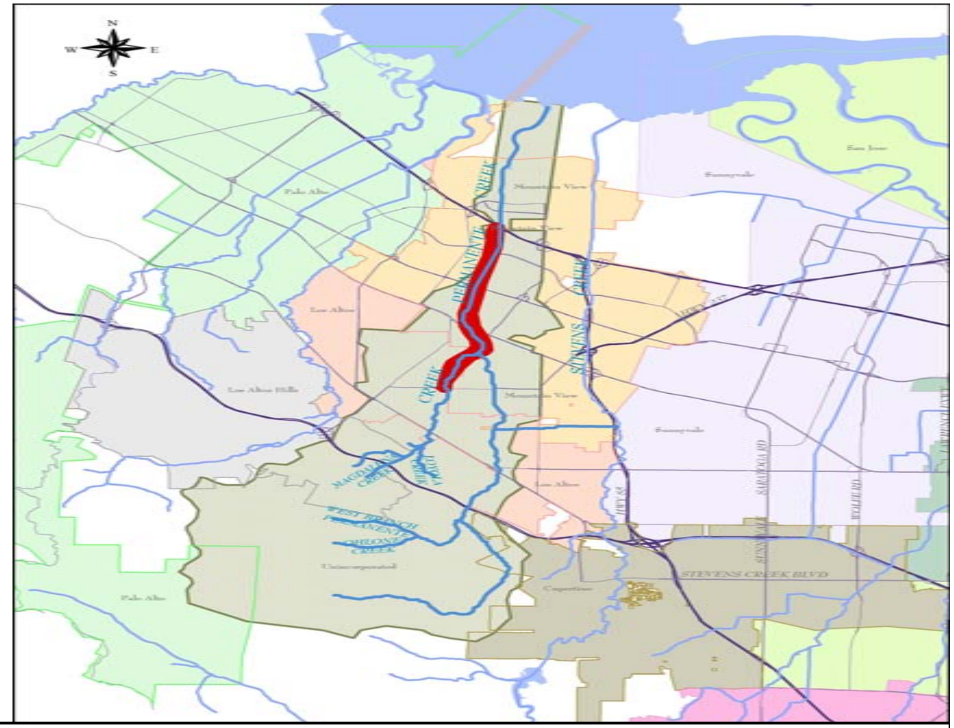
- Lower Permanente and Hale flooding addressed
- Concrete channel rebuilt

Concerns:

- Traffic: 25 bridges need work
- Majority of flooded area not improved
- High Cost



CPE 11: Geomorphic Stream Restoration

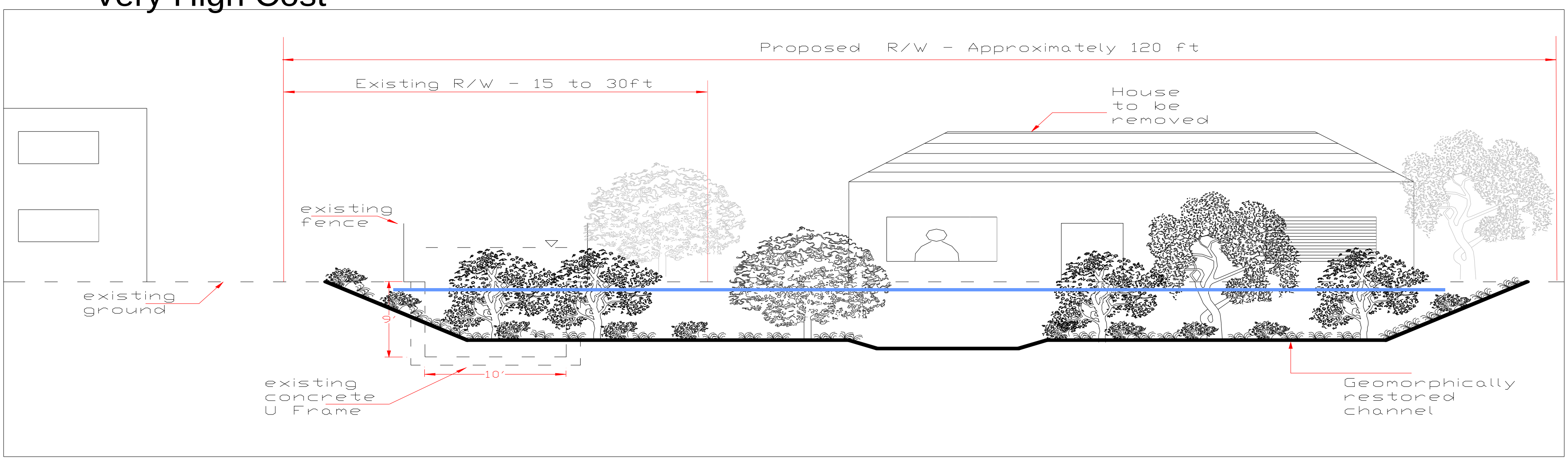


Benefits:

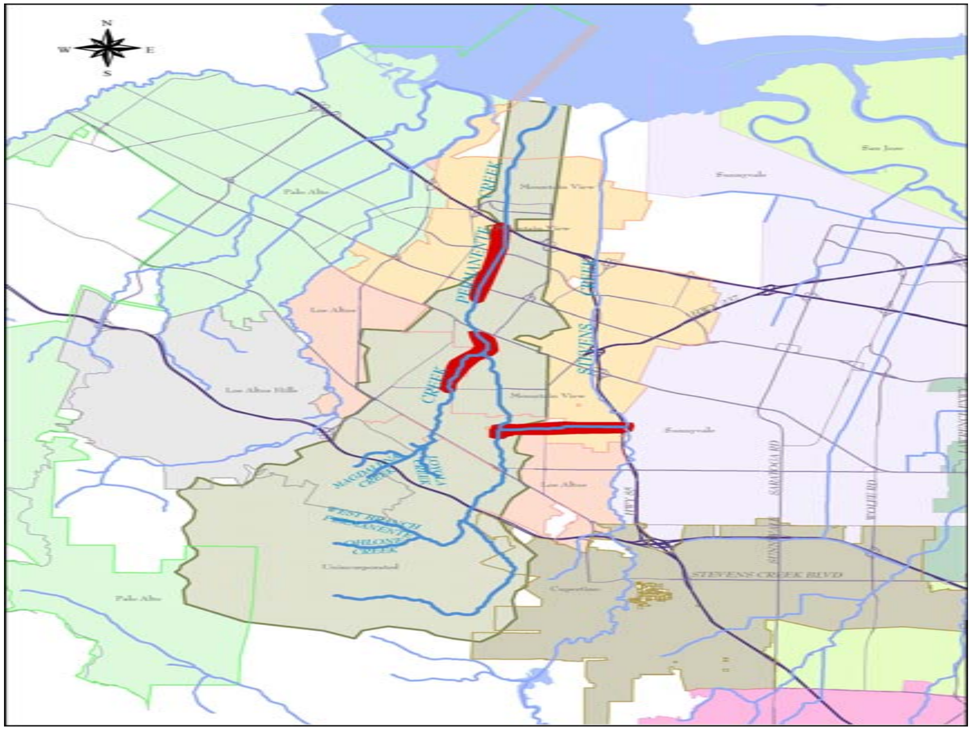
- Lower Permanente and Hale flooding addressed
- Concrete channel rebuilt
- Acres of habitat created
- Enhanced physical stream functions

Concerns:

- Housing: upwards of 120 homes impacted
- Majority of flooded area not improved
- Very High Cost



CPE 12: Riparian Restoration

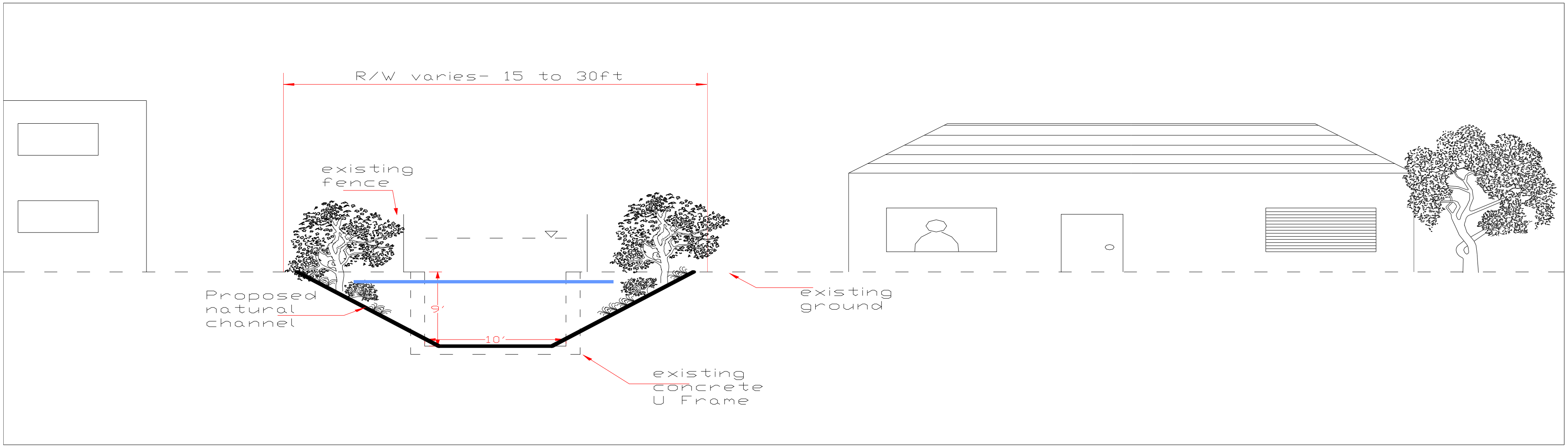


<u>Benefits:</u>

- Concrete channel rebuilt
- Acres of habitat created
- Some enhanced physical stream functions
- Some improvement in current capacity

<u>Concerns:</u>

- Flooding not fully addressed



CPE 13: Flood Proofing

Benefits:

- Structures in floodplain removed from threat of flooding
- Would facilitate channel repair or replacement with natural channels

Concerns:

- Streets and other infrastructure still under threat of flooding
- Some methods would require resident's participation to make method work

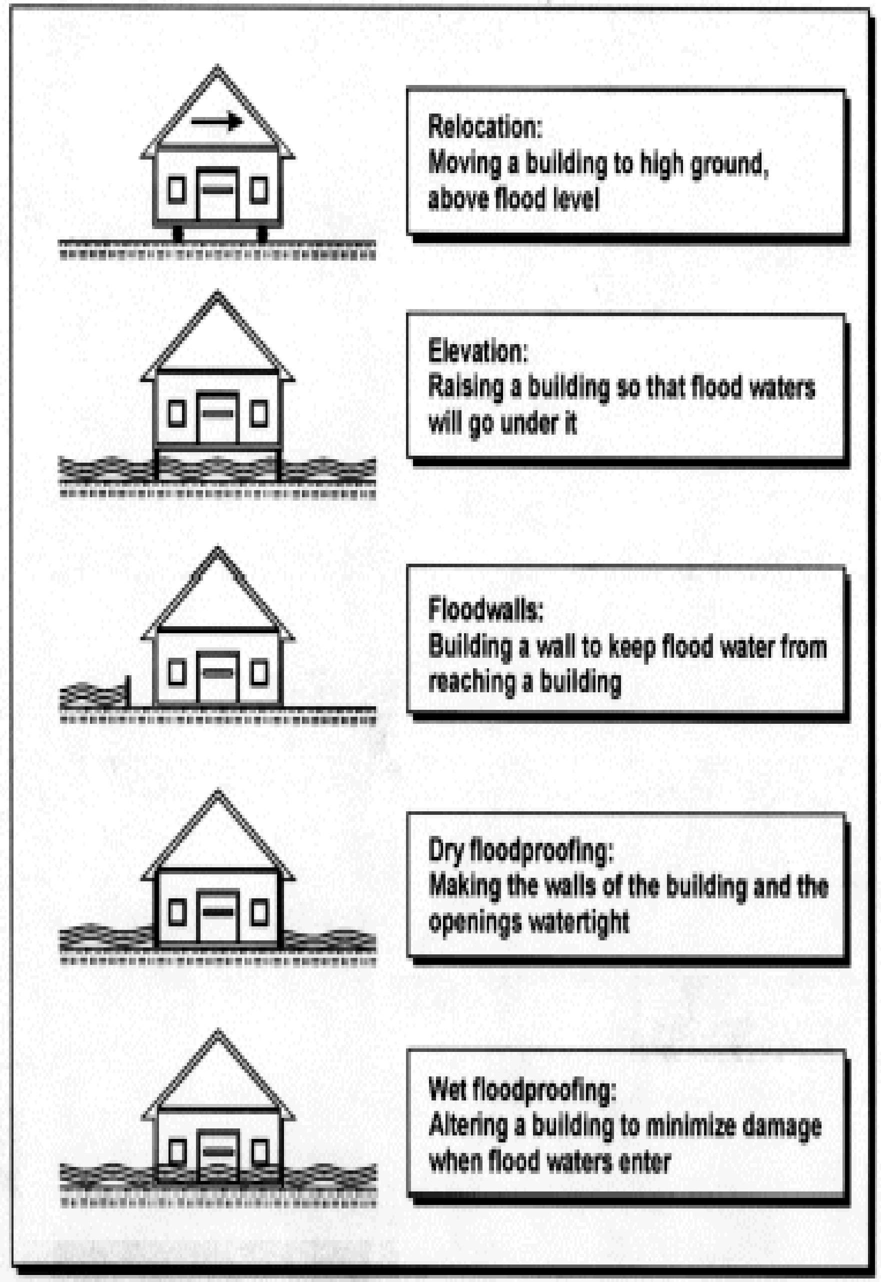
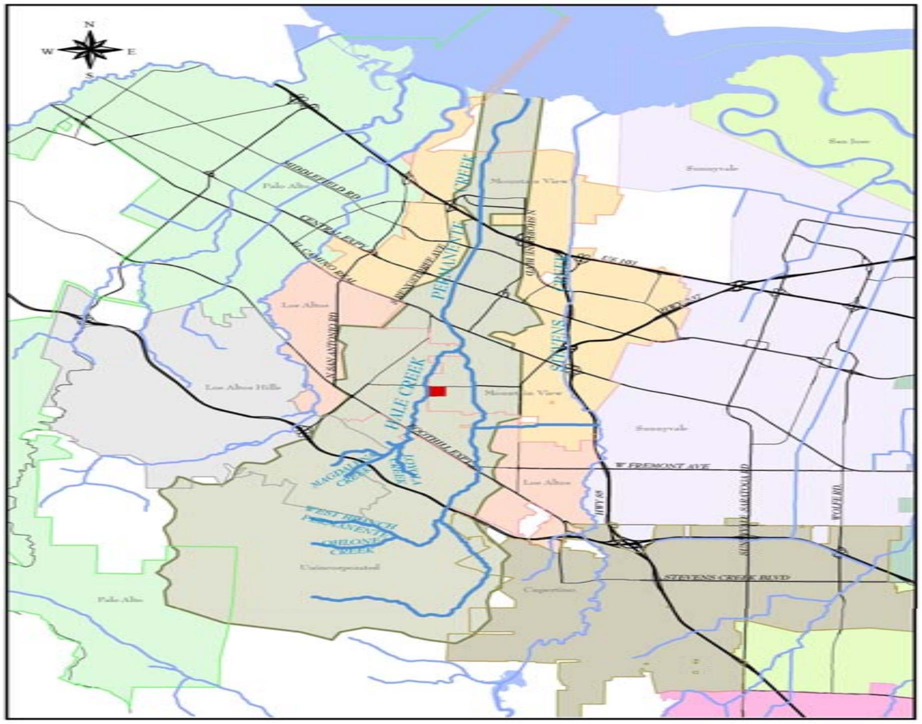


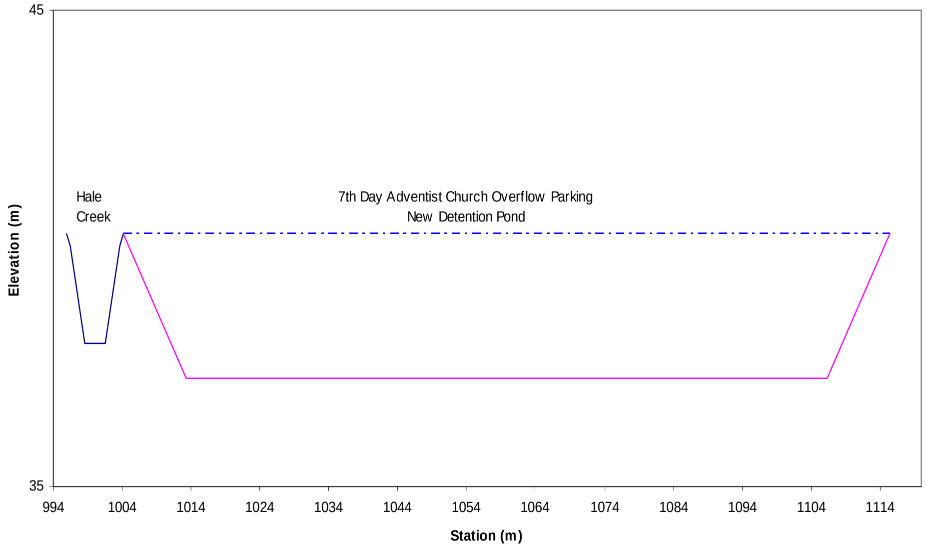
Fig. 7.1. Examples of flood proofing (UNESCO, 1995)

CPE 14: Flow Detention on 7th Day Adventist Church

Benefits:
- Flood Benefit: flow reduction downstream.
- Flow reduction allows riparian restoration.

Concerns:
- Construction Traffic Impact

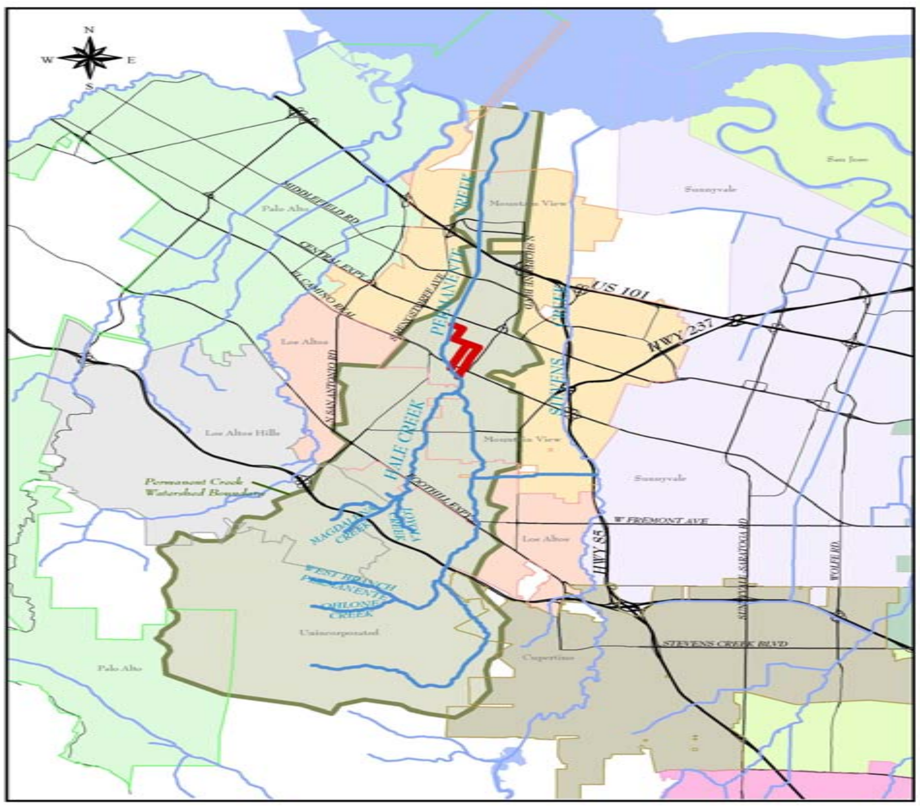


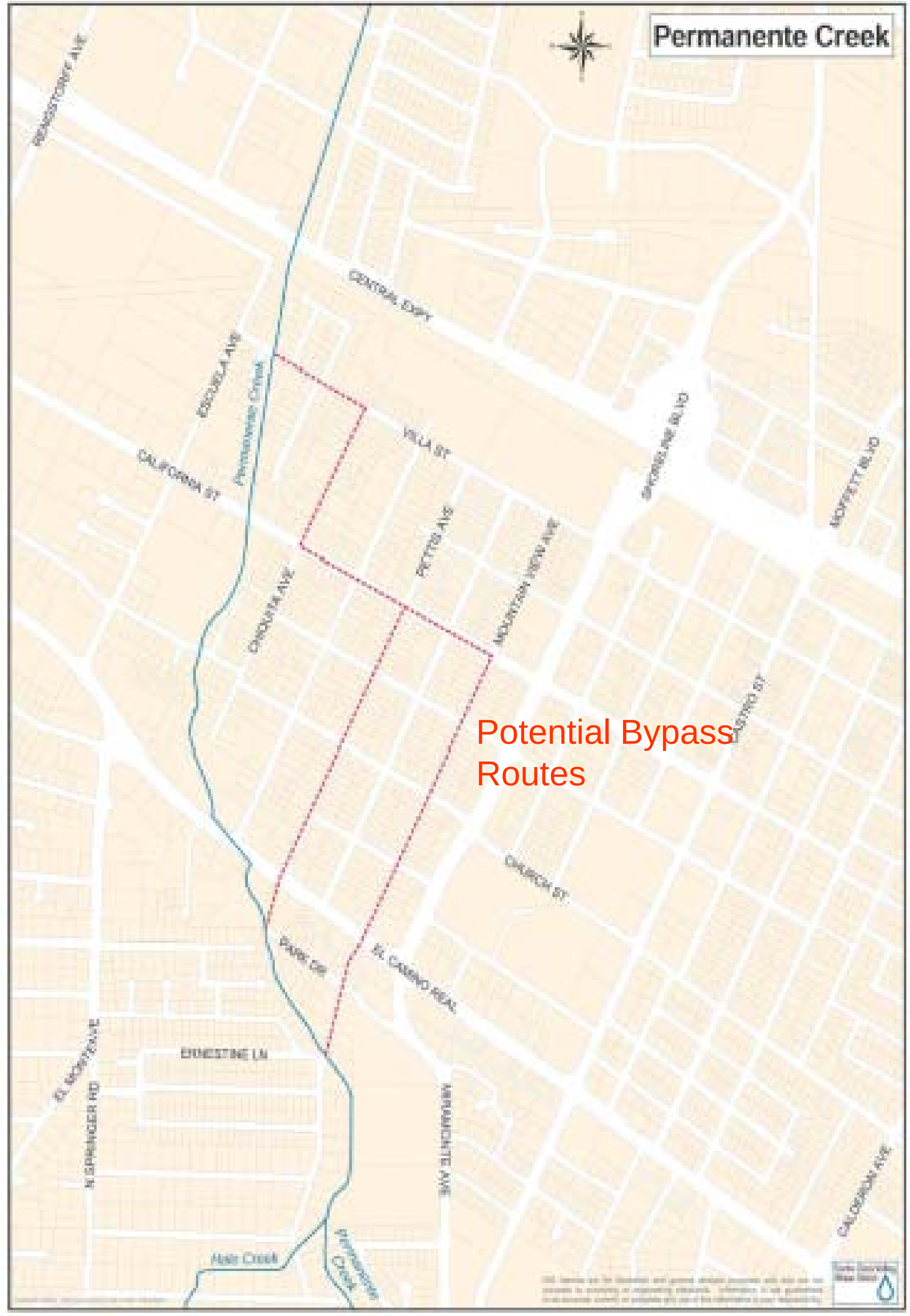


CPE 15: El Camino Bypass

Benefits:
•Increases Capacity and reduces upstream floodwall heights

Concerns:
•Traffic impact over widespread area

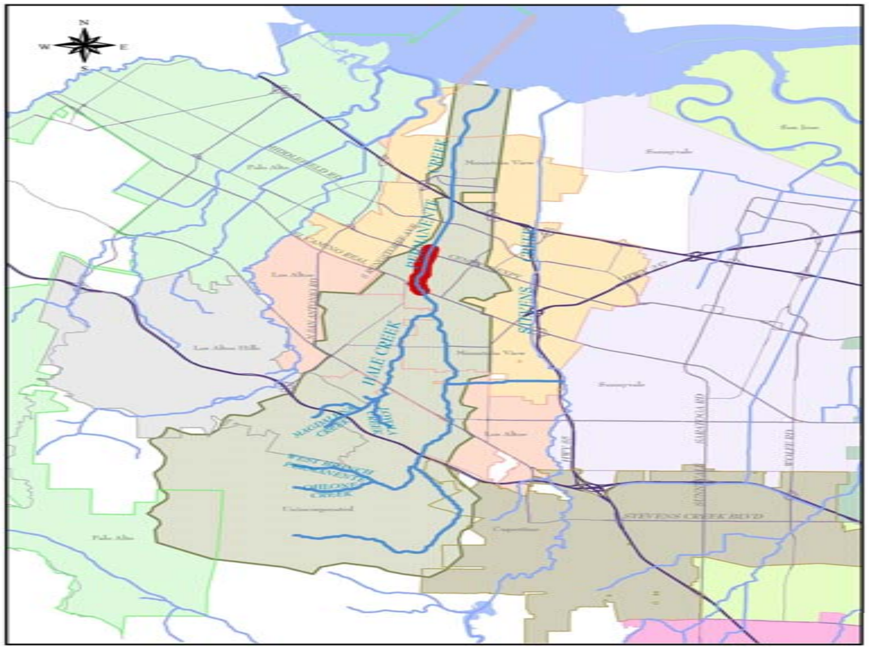


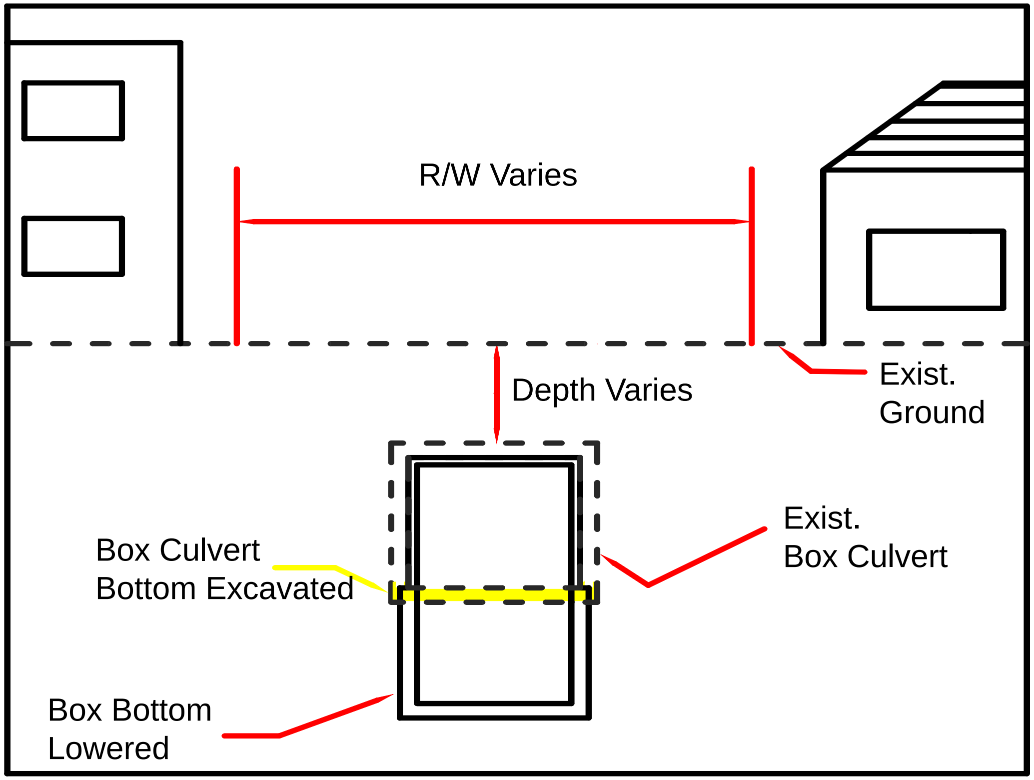


CPE 16: El Camino Culvert

Benefits:
- Increases culvert capacity, reducing upstream floodwall heights.
- Works within existing channel right-of-way.

Concerns:
- Difficult and relatively expensive construction.
- Traffic impacts at access locations.





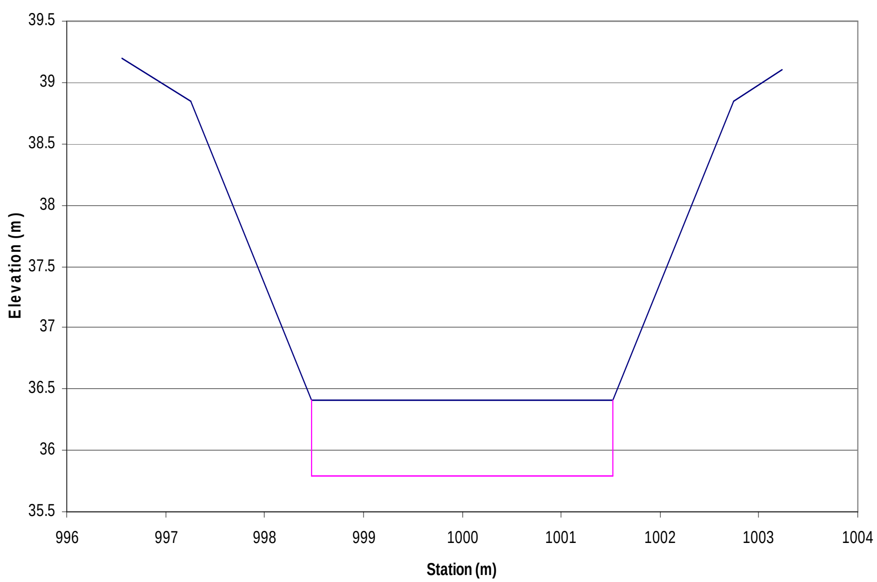
CPE 17: Hale Creek Improvements

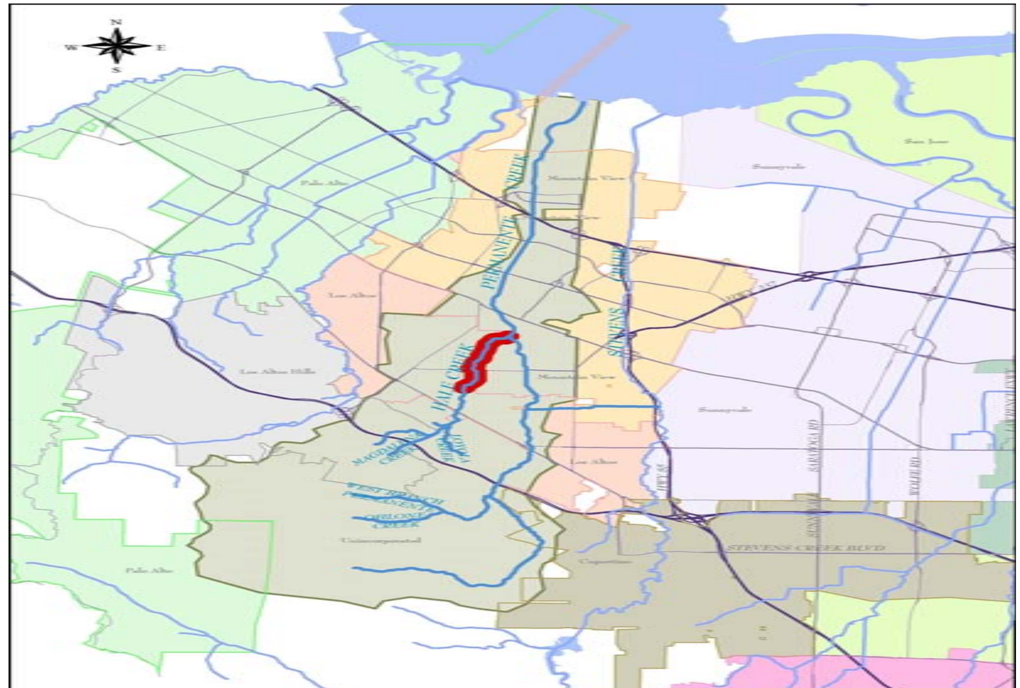
Benefits:

- Increases Hale Creek capacity.
- Works within existing right-of-way

Concerns:

- Traffic impacts at access locations.

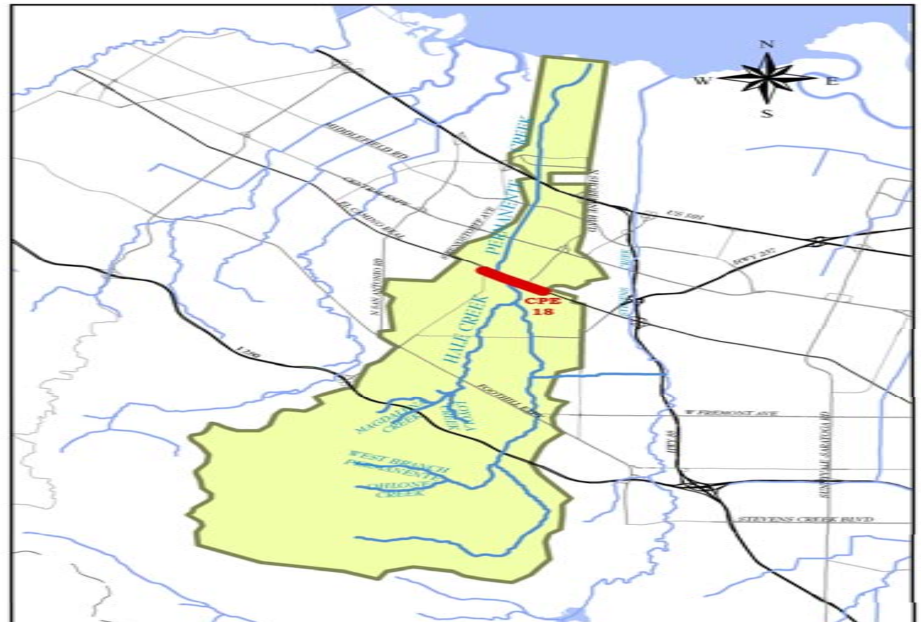


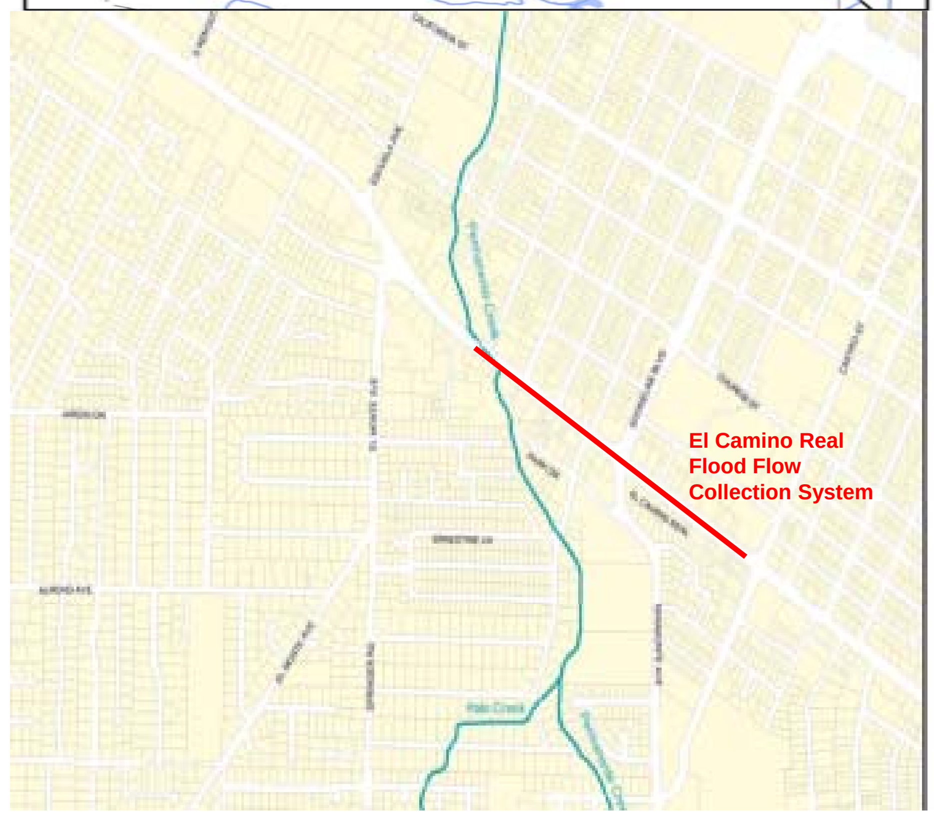


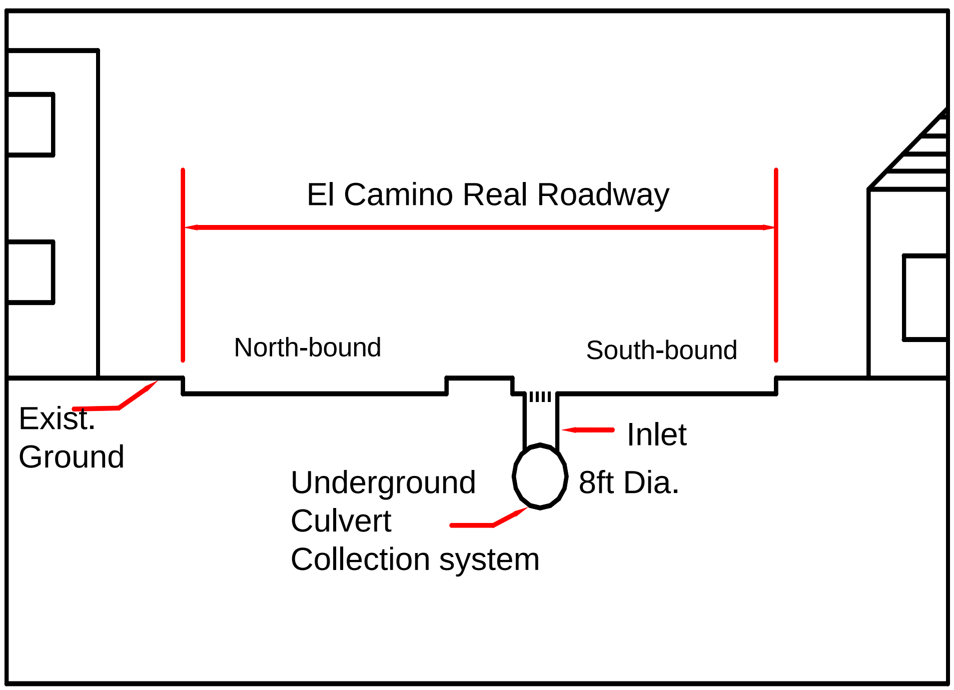
CPE 18: El Camino Collection Channel

Benefits:
• Prevents flooding north of El Camino Real

Concerns:
• Traffic impacts

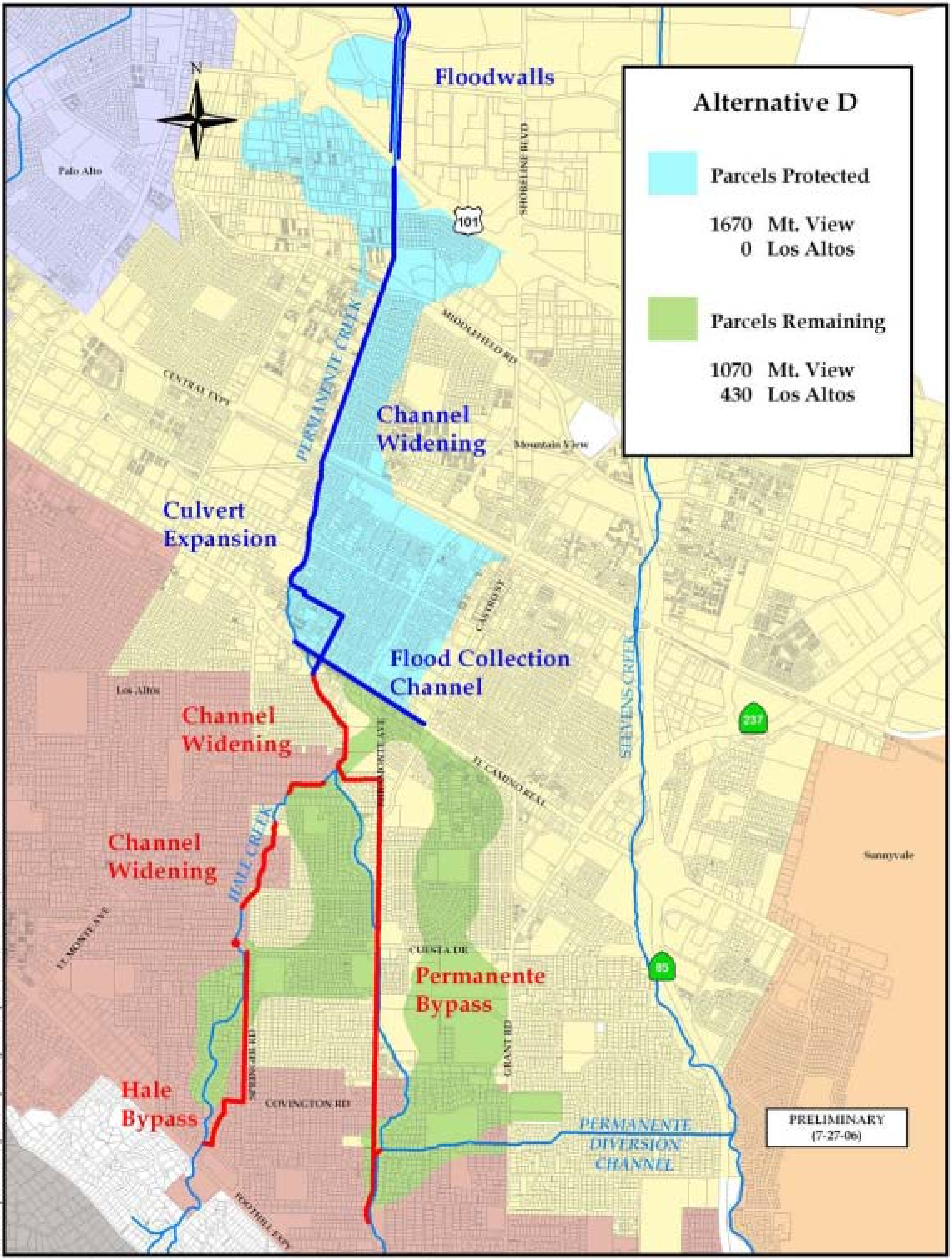




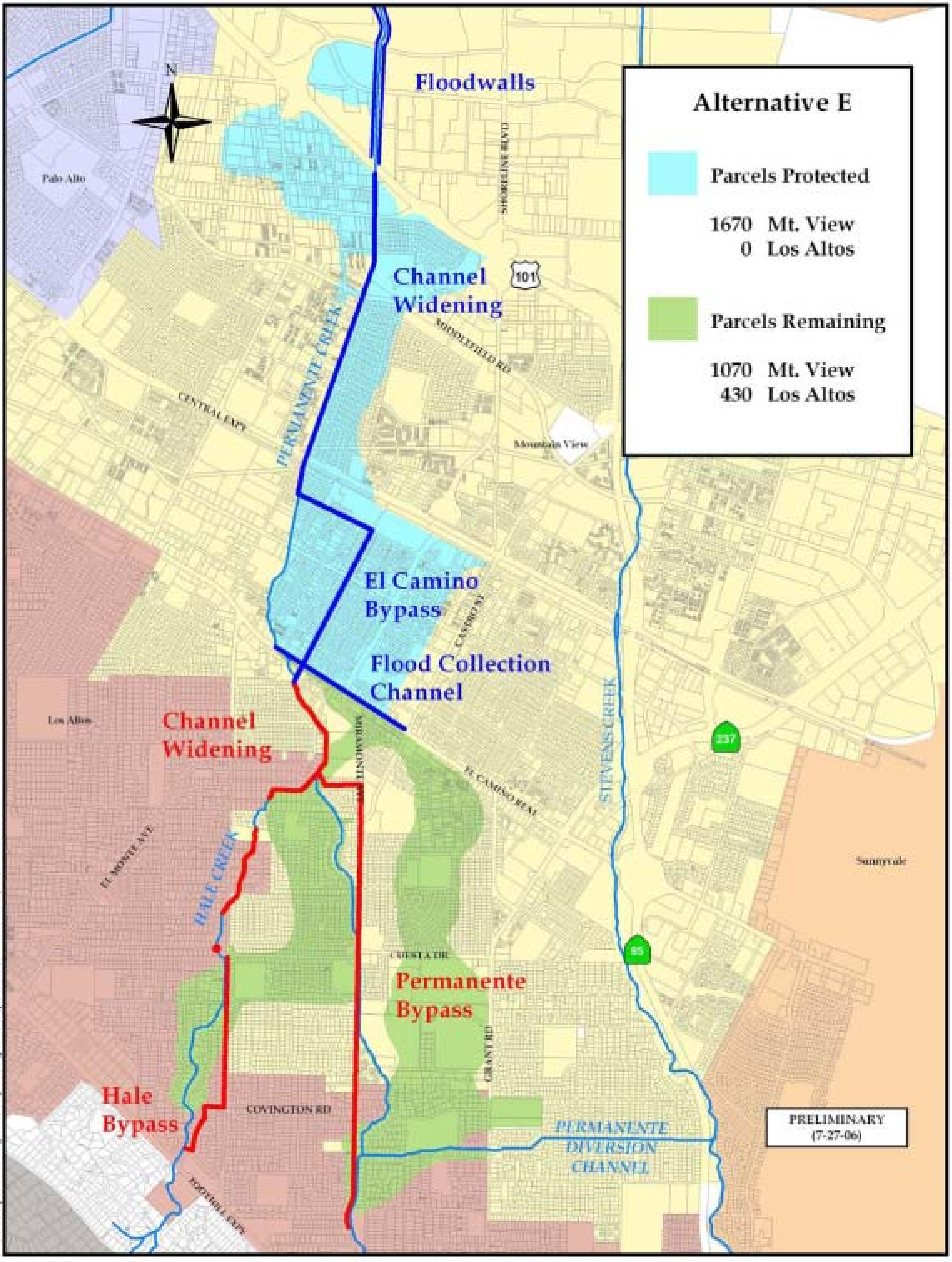


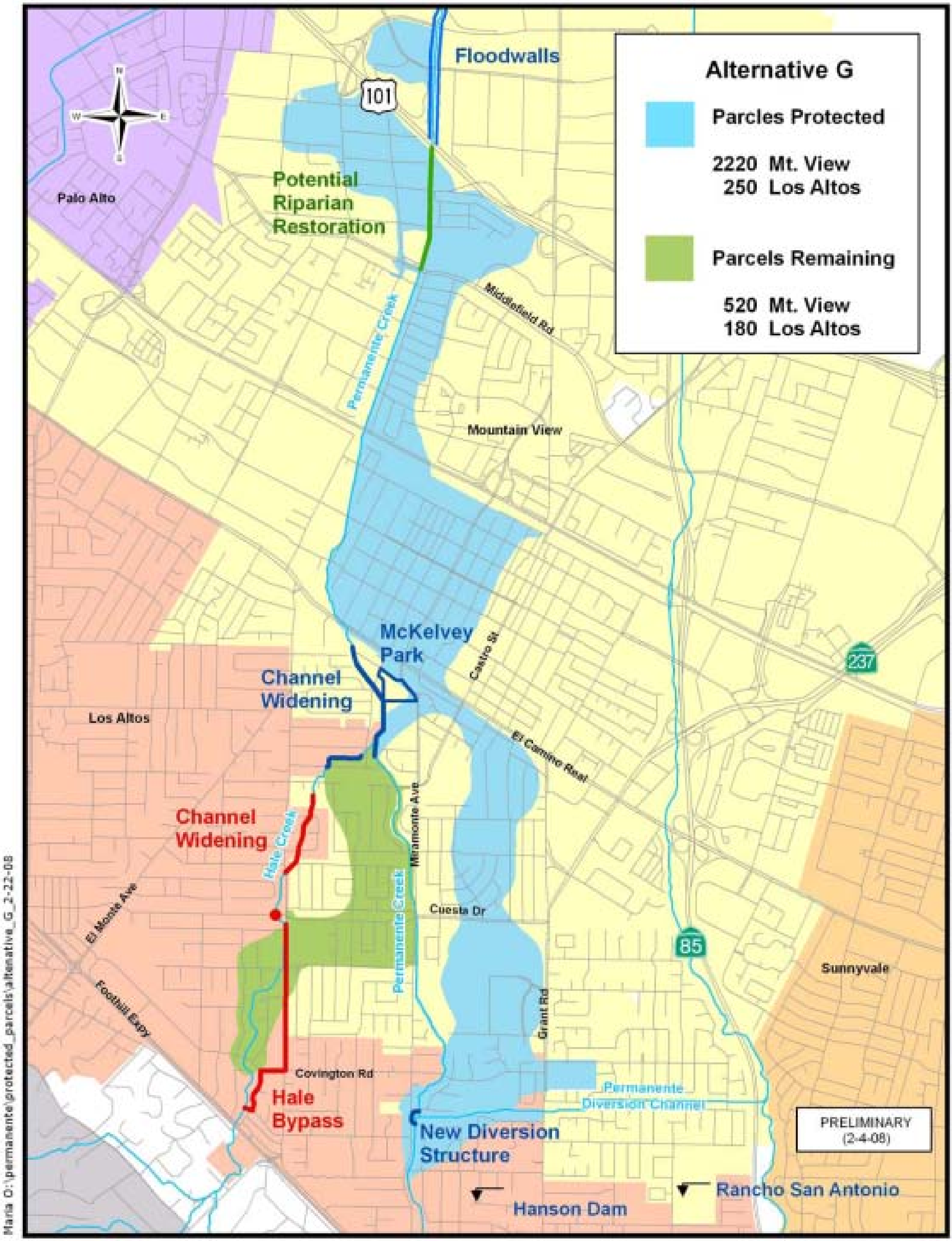
APPENDIX B

Feasible Alternatives Maps

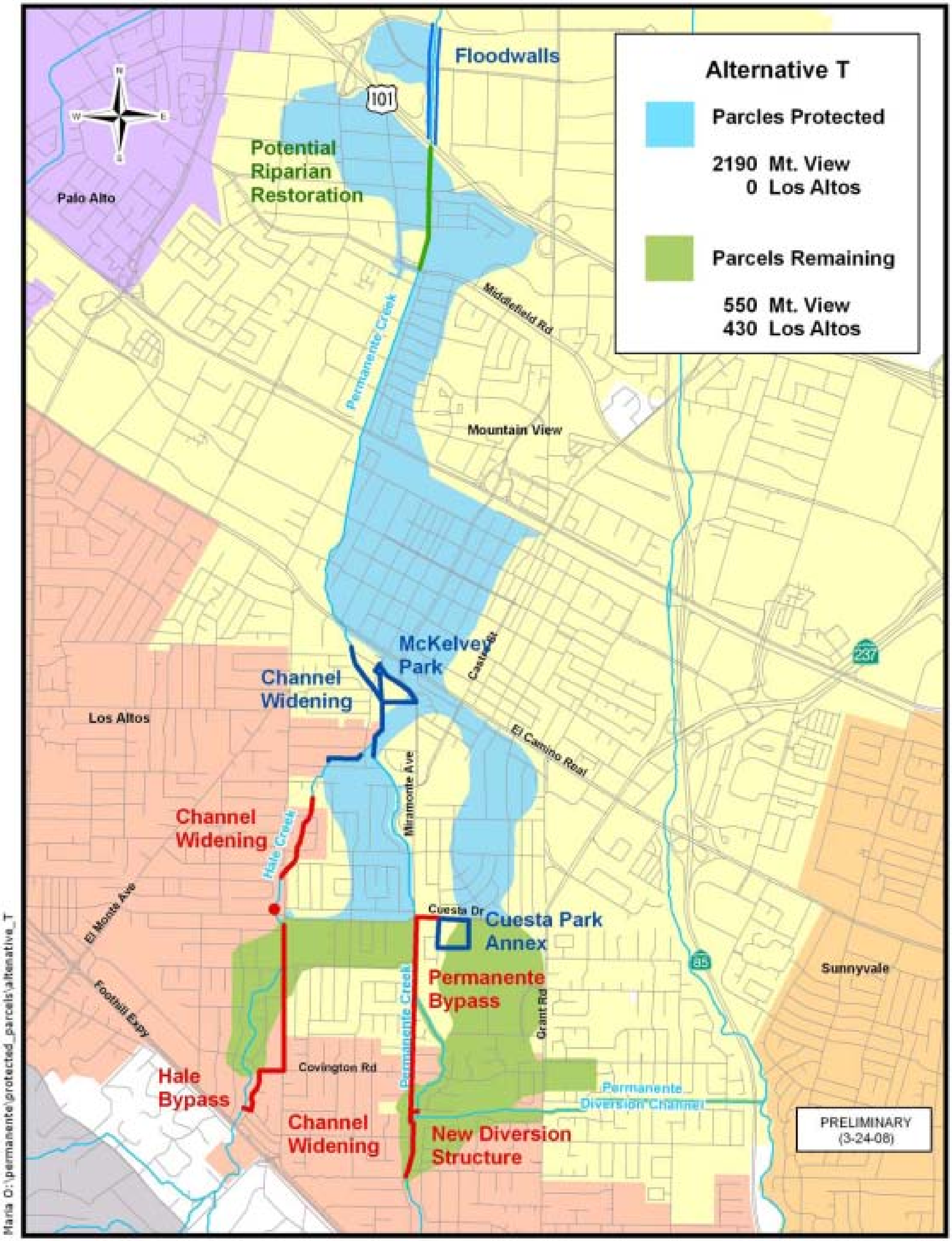


Alternative D
Parcels Protected
1670 Mt. View
0 Los Altos
Parcels Remaining
1070 Mt. View
430 Los Altos
Floodwalls
Channel Widening
Culvert Expansion
Flood Collection Channel
Channel Widening
Channel Widening
Permanente Bypass
Hale Bypass
PERMANENTE CREEK
HALE CREEK
STEVENS CREEK
PERMANENTE DIVERSION CHANNEL
Palo Alto
Los Altos
Mountain View
Sunnyvale
101
237
85
N
SHORELINE BLVD
MIDDLEFIELD RD
CENTRAL EXPY
CASTRO ST
EL CAMINO REAL
CUESTA DR
GRANT RD
COVINGTON RD
SPRINGER RD
FOOTHILL EXPY
EL MONTE AVE
PRELIMINARY
(7-27-06)

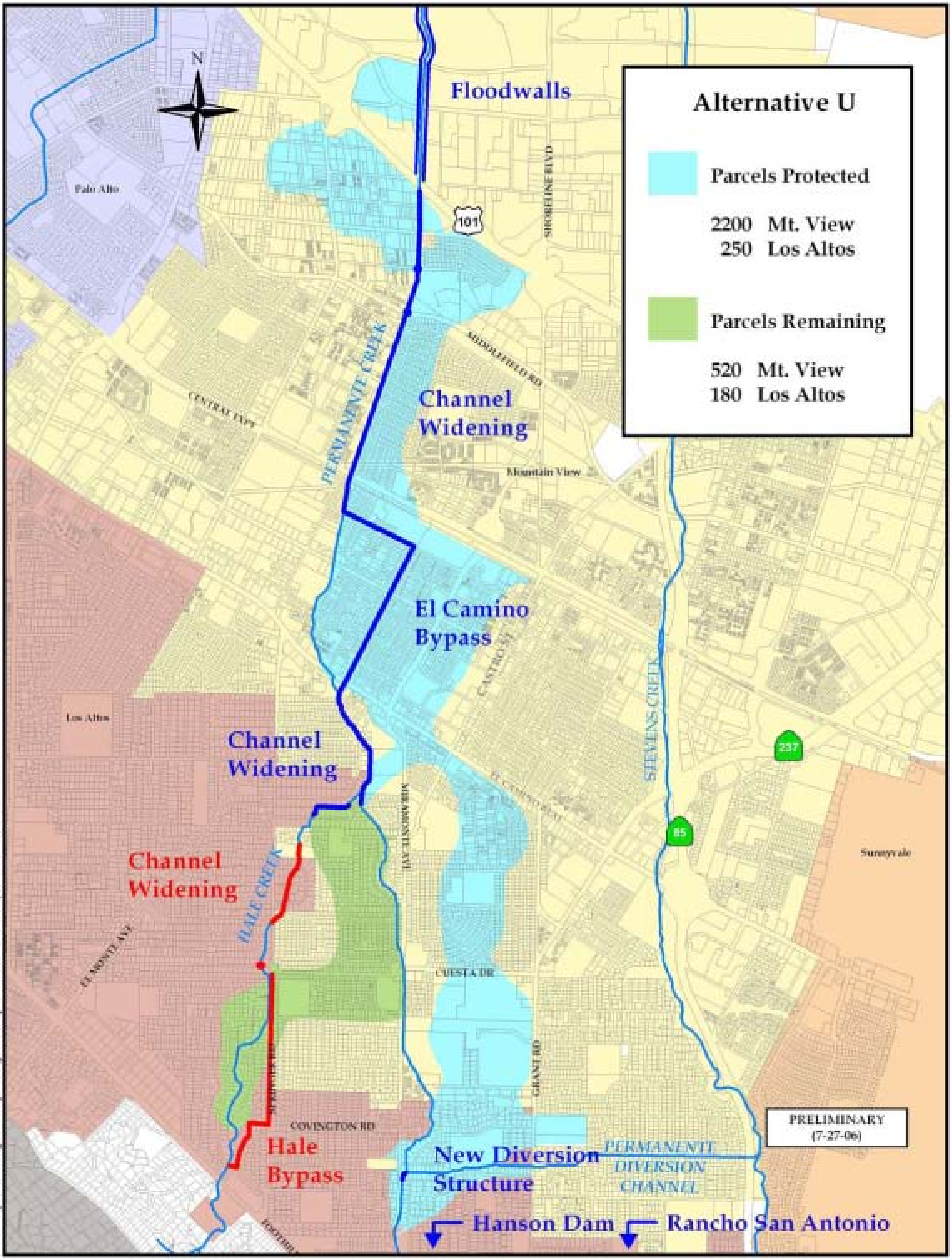

Alternative E
Parcels Protected
1670 Mt. View
0 Los Altos
Parcels Remaining
1070 Mt. View
430 Los Altos
Floodwalls
Channel Widening
El Camino Bypass
Flood Collection Channel
Channel Widening
Permanente Bypass
Hale Bypass
PERMANENTE CREEK
HALE CREEK
STEVENS CREEK
PERMANENTE DIVERSION CHANNEL
Palo Alto
Mountain View
Los Altos
Sunnyvale
SHORELINE BLVD
MIDDLEFIELD RD
CENTRAL EXPY
CASTRO ST
EL CAMINO REAL
MIRAMONTE AVE
EL MONTE AVE
CUESTA DR
GRANT RD
COVINGTON RD
FOOTHILL EXPY
101
237
85
N
PRELIMINARY
(7-27-06)


Alternative G
Parcles Protected
2220 Mt. View
250 Los Altos
Parcels Remaining
520 Mt. View
180 Los Altos
Floodwalls
101
Potential
Riparian
Restoration
Palo Alto
Middlefield Rd
Permanente Creek
Mountain View
McKelvey
Park
Castro St
237
Channel
Widening
Los Altos
El Camino Real
Channel
Widening
Hale Creek
Miramonte Ave
Permanente Creek
Cuesta Dr
El Monte Ave
Foothill Expy
85
Sunnyvale
Grant Rd
Covington Rd
Hale
Bypass
Permanente
Diversion Channel
PRELIMINARY
(2-4-08)
New Diversion
Structure
Hanson Dam
Rancho San Antonio
Maria O:\permanente\protected_parcels\altenative_G_2-22-08

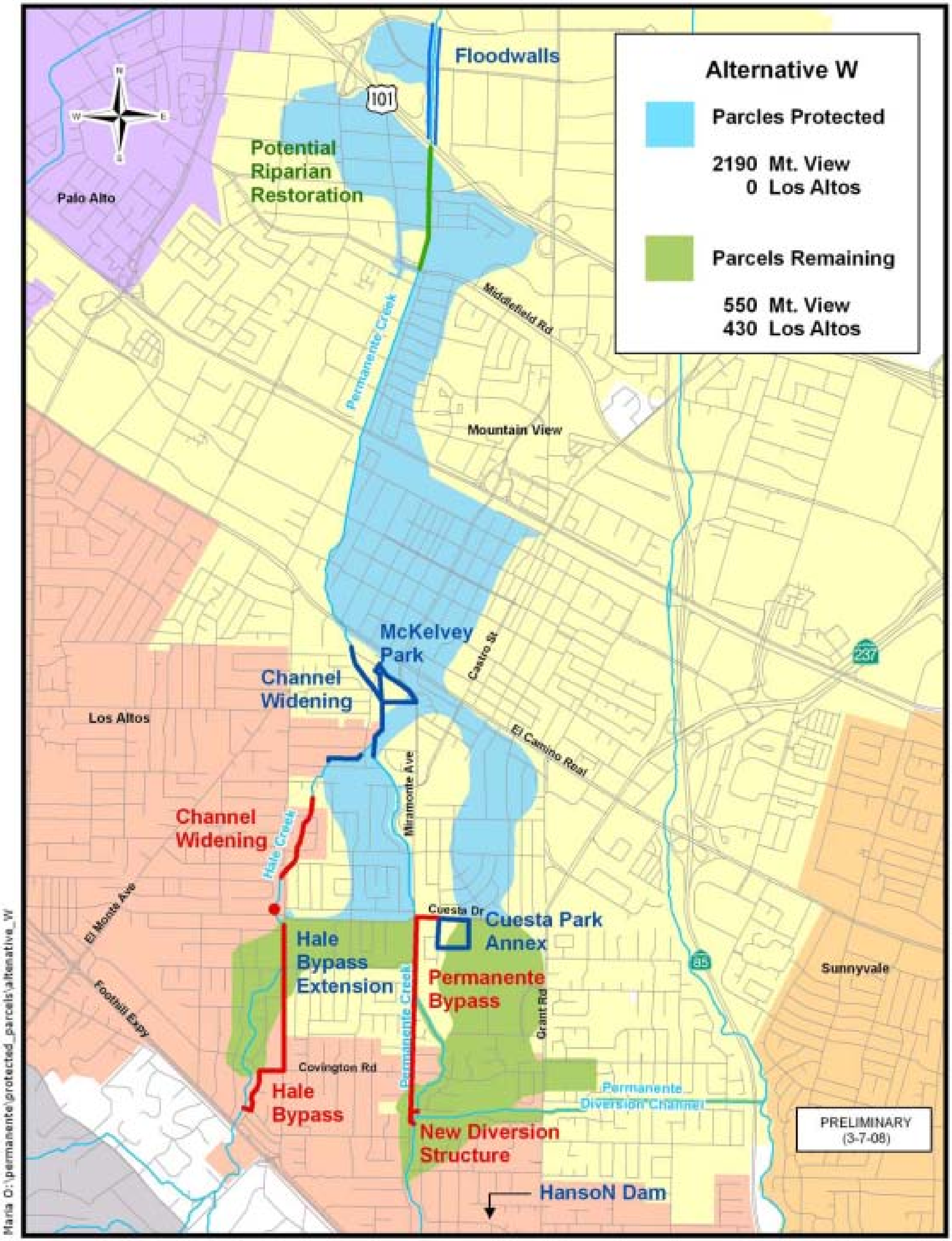
Maria O:\permanente\protected_parcels\altenative_S_2-22-08



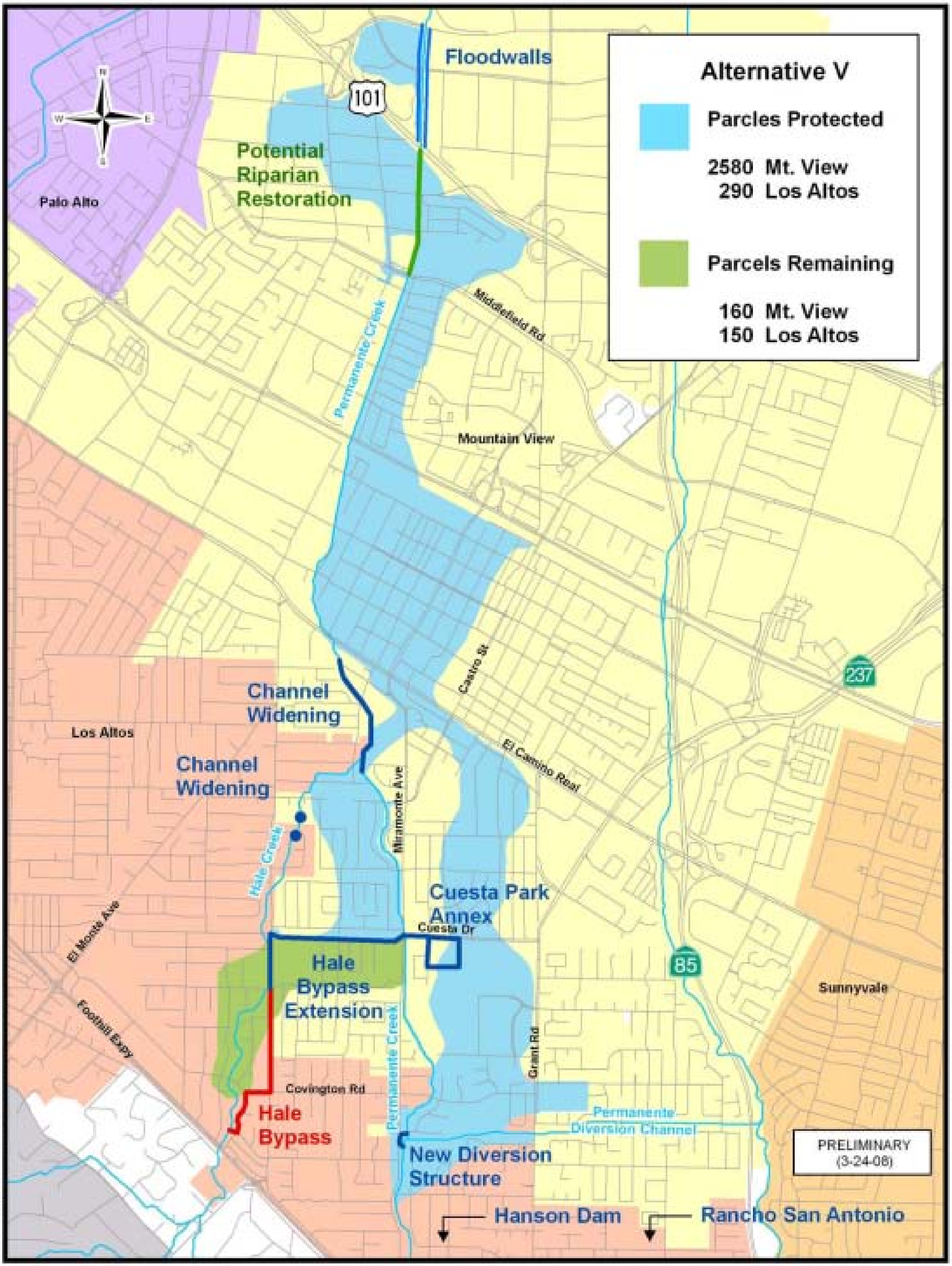
Alternative T
Parcles Protected
2190 Mt. View
0 Los Altos
Parcels Remaining
550 Mt. View
430 Los Altos
Floodwalls
101
Potential
Riparian
Restoration
Palo Alto
Middlefield Rd
Permanente Creek
Mountain View
McKelvey
Park
Castro St
237
Channel
Widening
Los Altos
El Camino Real
Miramonte Ave
Channel
Widening
Hale Creek
El Monte Ave
Cuesta Dr
Cuesta Park
Annex
85
Sunnyvale
Permanente
Bypass
Grant Rd
Foothill Expy
Permanente Creek
Covington Rd
Hale
Bypass
Permanente
Diversion Channel
PRELIMINARY
(3-24-08)
Channel
Widening
New Diversion
Structure
Maria O:\permanente\protected_parcels\altenative_T



Alternative U
Parcels Protected
2200 Mt. View
250 Los Altos
Parcels Remaining
520 Mt. View
180 Los Altos
Floodwalls
Channel Widening
El Camino Bypass
Channel Widening
Channel Widening
Hale Bypass
New Diversion Structure
PERMANENTE DIVERSION CHANNEL
Hanson Dam
Rancho San Antonio
PRELIMINARY (7-27-06)
PERMANENTE CREEK
HALE CREEK
STEVENS CREEK
Palo Alto
Los Altos
Mountain View
Sunnyvale
101
85
237
N
SHORELINE BLVD
MIDDLEFIELD RD
CENTRAL EXPY
CASTRO ST
EL CAMINO REAL
MIRAMONTE AVE
CUESTA DR
GRANT RD
COVINGTON RD
EL MONTE AVE

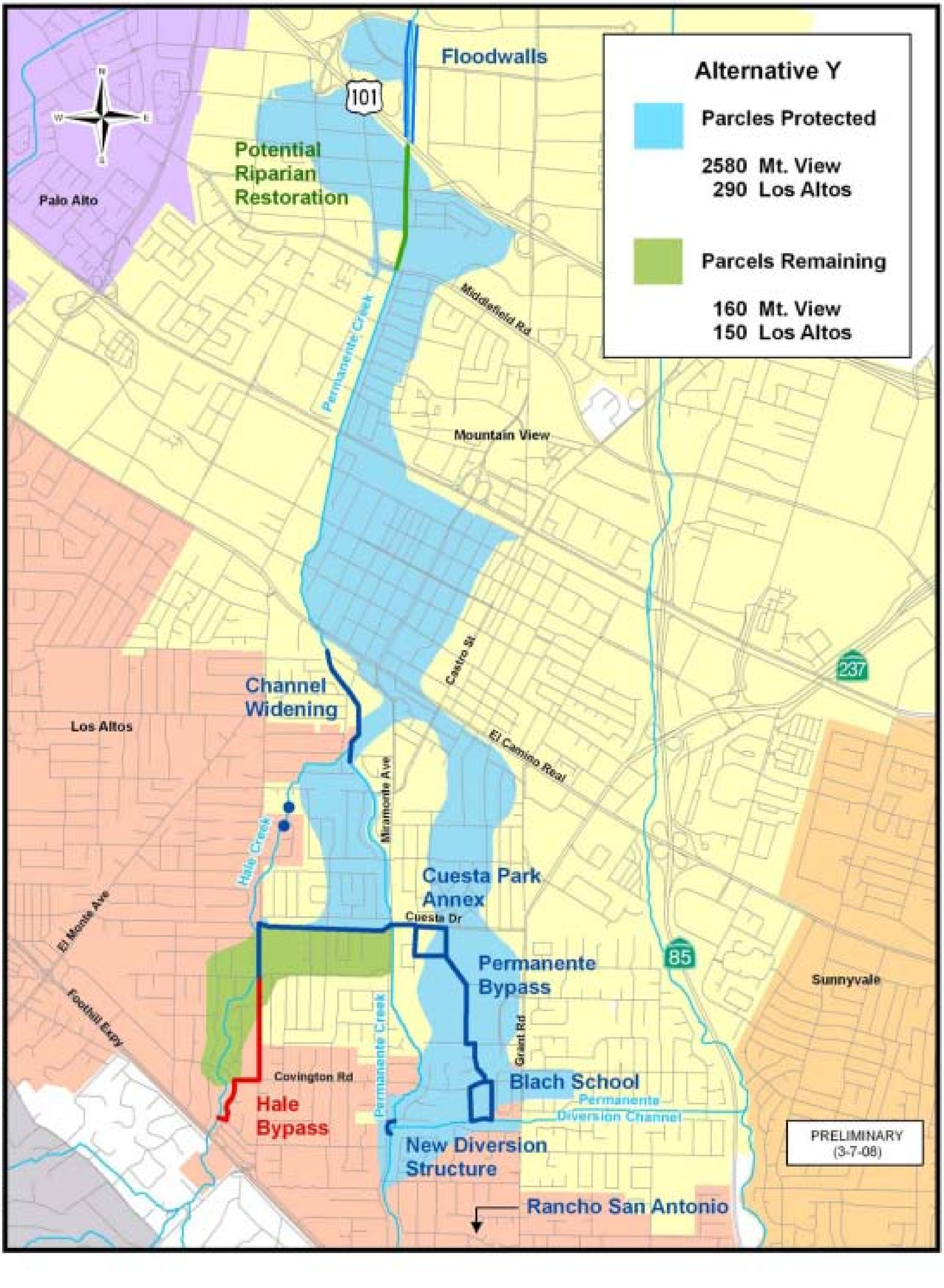


Alternative W
Parcles Protected
2190 Mt. View
0 Los Altos
Parcels Remaining
550 Mt. View
430 Los Altos
Floodwalls
Potential Riparian Restoration
Palo Alto
Middlefield Rd
Permanente Creek
Mountain View
McKelvey Park
Channel Widening
Castro St
El Camino Real
Los Altos
Miramonte Ave
Channel Widening
Hale Creek
El Monte Ave
Cuesta Dr
Cuesta Park Annex
Hale Bypass Extension
Permanente Bypass
Sunnyvale
Grant Rd
Foothill Expy
Covington Rd
Permanente Creek
Hale Bypass
Permanente Diversion Channel
New Diversion Structure
HansoN Dam
PRELIMINARY
(3-7-08)
Maria O:\permanente\protected_parcels\altenative_W



Alternative V
Parcles Protected
2580 Mt. View
290 Los Altos
Parcels Remaining
160 Mt. View
150 Los Altos
Floodwalls
101
Potential Riparian Restoration
Palo Alto
Permanente Creek
Middlefield Rd
Mountain View
Castro St
237
El Camino Real
Channel Widening
Los Altos
Channel Widening
Miramonte Ave
Hale Creek
Cuesta Park Annex
Cuesta Dr
El Monte Ave
Hale Bypass Extension
85
Sunnyvale
Foothill Expy
Grant Rd
Covington Rd
Permanente Creek
Permanente Diversion Channel
Hale Bypass
New Diversion Structure
PRELIMINARY
(3-24-08)
Hanson Dam
Rancho San Antonio
Maria O:\permanente\protected_parcels\altenative_V

Alternative X
Parcles Protected
2540 Mt. View
40 Los Altos
Parcels Remaining
200 Mt. View
400 Los Altos
Floodwalls
101
Potential Riparian Restoration
Palo Alto
Middlefield Rd
Permanente Creek
Mountain View
Castro St
237
Channel Widening
Los Altos
El Camino Real
Miramonte Ave
Hale Creek
Cuesta Dr
Cuesta Park Annex
Hale Bypass Extension
Permanente Creek
Permanente Bypass
Grant Rd
85
Sunnyvale
El Monte Ave
Foothill Expy
Covington Rd
Hale Bypass
Permanente Diversion Channel
New Diversion Structure
PRELIMINARY (3-7-08)
Hanson Dam
Maria O:\permanente\protected_parcels\altenative_X



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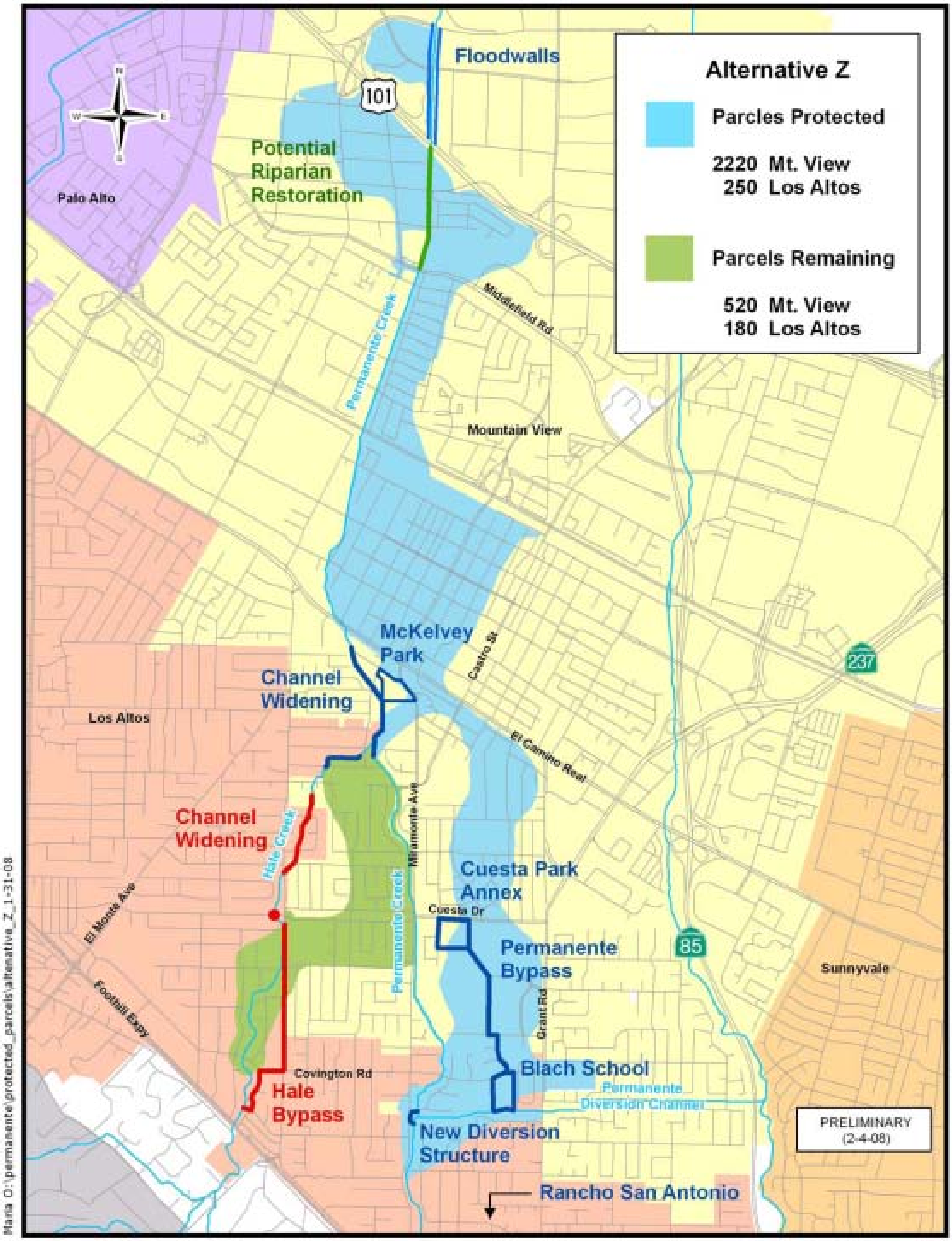
Alternative Z
Parcles Protected
2220 Mt. View
250 Los Altos
Parcels Remaining
520 Mt. View
180 Los Altos
Floodwalls
101
Potential Riparian Restoration
Palo Alto
Middlefield Rd
Permanente Creek
Mountain View
McKelvey Park
Channel Widening
Castro St
237
Los Altos
El Camino Real
Channel Widening
Hale Creek
Miramonte Ave
Permanente Creek
Cuesta Park Annex
Cuesta Dr
Permanente Bypass
El Monte Ave
85
Sunnyvale
Foothill Expy
Grant Rd
Blach School
Permanente Diversion Channel
Covington Rd
Hale Bypass
New Diversion Structure
PRELIMINARY (2-4-08)
Rancho San Antonio
Maria O:\permanente\protected_parcels\altenative_Z_1-31-08

APPENDIX C

Organizations and Persons Contacted During Preparation of This Report

The following is a partial list of the organizations and persons contacted during the preparation of this report:

Organization:	Person:
City of Mountain View:	Kevin Duggan Cathy Lazarus David Muela Tim Ko Mike Fuller Bob Kagiyama Sean Rose
City of Los Altos:	Doug Schmitz Starla Jerome-Robinson Larry Lind
City of Cupertino:	Dave Knapp Ralph Qualls
County of Santa Clara:	Lisa Killough Mark Frederick
Permanente Creek Task Force:	Donald Anderson John Benza Vivian Bloomenkamp Dennis Buranek Gloria Burke Warren Carlson Henry Cooper Susan Culazzo Linda DeMichiel Ali Gharibian Mike Hammes Rex Hinkle Tom Horan Bob Kagiyama Larry Lang Sue LaTourrette Leland Lera

Organization:	Person:
Permanente Creek Task Force (cont.):	Larry Lind Libby Lucas Steve McSharry Timothy Sandis Tracey Schwartz
RWQCB	Paul Amato
USF&WS	Mike Thomas
CDF&G	Tammy Shane
Corps	Molly Martindale
EPA	Luisa Valiela
SPCWC	Mondy Lariz
SOS	Kevin McBride Justine Fenwick
MVHA	Bob Weaver
CGF	Brian Schmidt

APPENDIX D

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The following is a list of some of the sources used during the preparation of this report:

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APPENDIX E

Cost Estimate

The following is a detailed cost estimate for the various feasible alternatives for the Permanente Creek Flood Protection project. The data is summarized in four tables:

Table E1: Unit Costs – developed from recent District projects and published cost databases

Table E2: Cost Details per Project Element – each project element cost calculated for each specific alternative

Table E3: Maintenance Cost Details – including typical annual sediment and vegetation maintenance, as well as long term infrastructure replacement projections

Table E4: Summary Cost Table – summary costs for the 12 feasible alternatives, updated from the original 2005 cost estimates to 2008 time frame.

Notes:

1) Unit costs were developed from recent District projects, costs databases, etc.

2) Unit amounts were calculated using typical sections and preliminary plans

3) Assumed typical rates for mobilization (10%), Contingency (10%), Design (10%), Geotech (5%) and Inspection (10%) based on previous District cost estimates.

4) See notes at end of maintenance cost table for criteria used

5) Costs updated from 2005 to 2008 for Table E4 using ENR Construction Cost Index as follows. The July 2005 cost index was 8271 and the July 2008 index was 9286. The % change in cost was therefore 112%. Thus, all project element costs calculated for 2005 were multiplied by 112% to derive the estimated cost for 2008.

Permanente Creek

2005 Unit Cost Summary

Table E1 - Unit Costs

project	Item	Unit	Costs
	Excavation		
CO515	Channel Excavation	C.Y.	$ 26.17
CO508	Invert Excavation	C.Y.	$ 51.68
CO492	Excavation	C.Y.	$ 28.60
CO499	Excavation	C.Y.	$ 17.86
Perm	**export clean earth (field)**	**C.Y.**	**$ 15.00**
Perm	**export clean earth (channel)**	**C.Y.**	**$ 25.00**
Perm	**import earth**	**C.Y.**	**$ 25.00**
Perm	**concrete excavation**	**C.Y.**	**$ 50.00**
	Clearing and Grubbing		
Perm	**clearing**	**acre**	**$ 5,500.00**
	Buildings		
Perm	**Structures**	**ft^2**	**$ 250.00**
	Culverts (RS Means 2003 updated to 2005)		
Perm	**24" RCP**	**L.F.**	**$ 46.00**
Perm	**30" RCP**	**L.F.**	**$ 68.00**
Perm	**36" RCP**	**L.F.**	**$ 89.00**
Perm	**48" RCP**	**L.F.**	**$ 136.00**
Perm	**60" RCP**	**L.F.**	**$ 201.00**
Perm	**72" RCP**	**L.F.**	**$ 268.00**
Perm	**84" RCP**	**L.F.**	**$ 411.00**
Perm	**96" RCP**	**L.F.**	**$ 508.00**
Perm	**108" RCP (estimated)**	**L.F.**	**$ 650.00**
	Revegetation		
CO516	Planting - tree pot planting	Each	$ 26.87
CO515	Dee-pot containt plantings	Each	$ 14.48
CO515	Tree-pot containter plantings	Each	$ 20.22
CO513	Landscape and irrigation	Sq. Ft.	$ 5.12
CO516	PLANTING - willow watting/hydroseeding	Sq. Ft.	$ 1.03
CO516	PLANTING - wetland/ pickleweed planting	Sq. Ft.	$ 1.70
CO516	PLANTING - hydroseeding	Sq. Ft.	$ 0.41
Perm	**Landscape and irrigation**	**Sq. Ft.**	**$ 5.00**
Perm	**Hydroseeding**	**Sq. Ft.**	**$ 0.50**
Perm	**native tree planting**	**each**	**$ 20.00**
	Rock Lining		
CO512	Rock Slope Protection (1/2 T)	Tonne	$ 65.00
CO499	Rock Slope Protection (1/2 T)	Ton	$ 49.40
CO499	Rock Stabilizer	Ton	$ 53.56
CO489	1/4 - Ton Rock	Ton	$ 43.26
Perm	**Rock lining**	**Yds^3**	**$ 75.00**
Perm	**Rock lining**	**Tonne**	**$ 50.00**
	Fencing		
CO516	FENCING - CHAIN LINK FENCE AND GATE	L.F.	$ 28.80
CO515	TYPE CL- 6 FENCE	L.F.	$ 19.75
CO515	TYPE CL-3 1/2 FENCE	L.F.	$ 15.80
CO515	WOOD FENCE, 6 FOOT HIGH	L.F.	$ 40.00
CO515	SPLIT RAIL FENCE	L.F.	$ 26.75
CO503	CHAIN LINK FENCE (TYPE CL-3.5)	L.F.	$ 16.64
CO503	(TYPE CL-6 BLACK VINYL WITH BARBED	L.F.	$ 23.40
Perm	**chain link fencing (3.5ft high)**	**L.F.**	**$ 15.00**
	Traffic		
Perm	**traffic control (normal)**	**L.F.**	**$ 100.00**
Perm	**traffic control (El Camino Real)**	**L.F.**	**$ 200.00**
	Paving		
RSMeans*	Asphalt Pavement (3") - San Francisco	sf	$ 7.96
Bni**	Asphalt Paving (3" thick)	sf	$ 10.80
Perm* **	**Paving (3" thick)**	**sf**	**$ 10.00**
	Shoring		
Rsmeans*	cofferdams	S.F.	$ 18.60
Bni***	cofferdams	S.F.	$ 27.00
Perm* **	**cofferdams**	**S.F.**	**$ 20.00**
	Floodwalls		
CO480	Concrete Floodwalls	C.Y.	$ 1,189.54
CO479	Concrete Floodwall Caps	C.Y.	$ 1,124.86
Perm	**concrete floodwall**	**C.Y.**	**$ 700.00**
	Concrete Channel		
CO503	U Frame Channel	C.Y.	$ 1,175.79
CO501	U Frame Channel	C.Y.	$ 809.53
CO489	U Frame Channel	C.Y.	$ 860.41
CO492	Wall Construction	C.Y.	$ 827.69
CO489	Structural Concrete	C.Y.	$ 754.56
Perm	**concrete channel**	**C.Y.**	**$ 850.00**
Perm	**Bore & Jack concrete (3X normal)**	**C.Y.**	**$ 2,550.00**
Perm	**Architectural treated (+10%)**	**C.Y.**	**$ 935.00**
	Bridges		
Perm	**very small (<20ft, no utilities)**	**ea.**	**$ 100,000.00**
Perm	**small (20'-40')**	**ea.**	**$ 250,000.00**
Perm	**small/medium (40'-65')**	**ea.**	**$ 350,000.00**
Perm	**medium (65'-90')**	**ea.**	**$ 500,000.00**
Perm	**medium/large (90'-120')**	**ea.**	**$ 750,000.00**
Perm	**large (>120')**	**ea.**	**$ 1,000,000.00**
Perm	**very large (>200')**	**ea.**	**$ 1,500,000.00**

* RSMeans heavy Construction data 2003
** Bni - Building News Costbook 2003
*** Bni - Building News Costbook 2005

notes:

Shoring

Upper Guad - Reach 11 - 1995

shoring for retaining wall

	unit	unit cost		quantity
	S.F.	$11		1080
	2005	$16		

clearing and grubbing

		eng est	low bid	quantity	
co516	SF	$1	$ 0.64	86510	
	acre	$43,560	$27,878	2.0	seems expensive but small quantity

Upper Guad - Reach 11 - 1995

perm	acre	$ 5,500.00		12
	2005	$ 8,141.34		

Most projects put clearing and grubbing as lump sums.

#	YEAR	project	location
CO478	2001	GUADALUPE CREEK RESTORATION PROJECT	From Almaden Expressway To Masson Dam
CO479	2001	CONSTRUCTION OF LOS GATOS CREEK EROSION REPAIR	AT KIRK-PAGE TURNOUT CENTRAL FLOOD CONTROL ZONE
CO480	2001	CALERA CREEK FLOODWALLS AND ACCESS	BRIDGE AT UNION PACIFIC RAILROAD
CO485	2001	HQ REVEGETATION PROJ AROUND ALAMITOS POND, NORTH POND AND EAST BANK OF GUADALUPE RIVER, EXTENDING 1200FT SOUTH FROM BLOSSOM HILL	
CO488	2002	ADOBE CREEK FLOOD CONTROL PROJECT	AT EL CAMINO REAL
CO489	2002	CHANNEL IMPROVEMENTS	Coyote Creek To McKee Road
CO491	2002	STEVENS CREEK DROP STRUCTURE	UPSTREAM OF HIGHWAY 85
CO492	2002	SAN FRANCISQUITO CREEK LEVEE PROJECT	From Pedestrian Footbridge To 1400 Ft Upstream OF WEST BAYSHORE
CO499	2003	LOWER GUADALUPE RIVER FLOOD PROTECTION	PROJECT Alviso Marina To Interstate 880
CO501	2003	LOWER SILVER CREEK FLOOD PROTECTION AND	CREEK RESTORATION PROJECT, Reach 3, Phase 1 McKee Road To Alum Rock Avenue
CO502	2003	ADOBE CREEK, REACHES 1 - 4 FLOOD CONTROL	PROJECT AT FOOTHILL EXPRESSWAY
CO503	2003	MATADERO AND BARRON CREEKS REMEDIATION	PROJECT FROM PALO ALTO FOOD BASIN TO ALMA STREET
CO508	2003	ADOBE CREEK Reaches 1- 4 FOOTHILL MAINTENANCE RAMP AND CREEK EROSION CONTROL	
CO512	2003	STATE HWY 237 IN SANTA CLARA COUNTY FROM SOUTH ALVISO OVERHEAD TO .6KM EAST OF GUADALUPE RIVER BRIDGE	
CO513	2004	NEW WATER QUALITY LAB - BID REJECTED	
CO515	2004	LOWER SILVER CREEK FLOOD PROTECTION AND	CREEK RESTORATION PROJECT, Reach 3, Phase 2
CO516	2004	MATADERO/BARRON CREEK REVEGETATION PROJECT	2027 & 3021 EAST BAYSHORE ROAD, PALO ALTO

Permanente Creek

2004 Unit Cost Summary

project	Item	Unit	Costs
	Excavation		
Perm	earth (field)	C.Y.	$ 15.00
Perm	earth (channel)	C.Y.	$ 25.00
Perm	placed earth	C.Y.	$ 25.00
Perm	earth & concrete	C.Y.	$ 50.00
	Clearing and Grubbing		
Perm	clearing	acre	$ 5,500.00
	Revegetation		
Perm	Hydroseeding	Sq. Ft.	$ 0.50
Perm	tree native	Sq. Ft.	$ 20.00
	Rock Lining		
Perm	Rock lining	Tonne	$ 50.00
Perm	Drain Rock	C.Y.	$ 30.00
	Fencing		
Perm	chain link fencing (3.5ft high)	L.F.	$ 15.00
	Traffic		
Perm	traffic control	1,000ft	$ 100,000.00
	Paving		
Perm	Paving (3in thick)	C.Y.	$ 10.60
	Shoring		
Perm	cofferdams	S.F.	$ 26.00
	Floodwalls		
Perm	concrete floodwall	C.Y.	$ 700.00
	Concrete Channel		
Perm	concrete channel	C.Y.	$ 850.00
	Bridges		
Perm	very small (<20ft, no utilities)	ea.	$ 100,000.00
Perm	small (20'-40')	ea.	$ 250,000.00
Perm	small/medium (40'-65')	ea.	$ 350,000.00
Perm	medium (65'-90')	ea.	$ 500,000.00
Perm	medium/large (90'-120')	ea.	$ 750,000.00
Perm	large (>120')	ea.	$ 1,000,000.00
Perm	very large (>200')	ea.	$ 1,500,000.00

Permanente Creek

2004 Unit Cost Summary*

project	Item	Unit	Costs	tot quant	Note
	Excavation				
CO515	Channel Excavation	C.Y.	$ 26.17	55,500	
CO508	Invert Excavation	C.Y.	$ 51.68	1,491	
CO492	Excavation	C.Y.	$ 28.60	2,550	
CO499	EXCAVATION	C.Y.	$ 17.86	55,000	*
Perm	**soil**	**C.Y.**	**$ 15.00**	**500,000**	We have large volumes, so assumed unit cost
Perm	**soil & concrete**	**C.Y.**	**$ 17.00**	**500,000**	would be less than other projects
	Revegetation				
CO516	Planting - tree pot planting	Each	$ 26.87	122	
CO516	Planting - 15 gallon tree planting	Each	$ 95.82	131	
CO515	Dee-pot containt plantings	Each	$ 14.48	1,598	
CO515	Tree-pot containter plantings	Each	$ 20.22	741	
CO513	Landscape and irrigation	Sq. Ft.	$ 5.12	1,040	
CO485	Native grass plugs container	Each	$ 7.83	300	
CO480	Grass plugs planting	Each	$ 11.47	400	
CO516	PLANTING - willow cuttings/hydroseeding	Sq. Ft.	$ 19.06	1,040	
CO516	PLANTING - willow watting/hydroseeding	Sq. Ft.	$ 1.03	26,650	
CO516	PLANTING - wetland/ pickleweed planting	Sq. Ft.	$ 1.70	12,610	
CO516	PLANTING - hydroseeding	Sq. Ft.	$ 0.41	12,610	*
Perm	**Rancho - (~10acres)**	**Sq. Ft.**	**$ 1.50**	**435,600**	hadn't considered individual tree planting
Perm	**Grant - (~5acres)**	**Sq. Ft.**	**$ 0.50**	**217,800**	Grant - $0.50 - grass playing field
Perm	**riparian restor - (~6 acres)**	**Sq. Ft.**	**$ 1.50**	**270,000**	$1.50 - more extensive, grass, plants, trees
	Rock Lining				
CO512	Rock Slope Protection (1/2 T)	Tonne	$ 65.00	1,450	
CO499	Rock Slope Protection (1/2 T)	Ton	$ 49.40	64,700	*
CO499	Rock Stabilizer	Ton	$ 53.56	3,100	
CO489	1/4 - Ton Rock	Ton	$ 43.26	15,700	
Perm	**Rock lining**	**Tonne**	**$ 50.00**	**30,425**	close to other cost, just rounded to $50
	Fencing				
CO516	FENCING - CHAIN LINK FENCE AND GATE	L.F.	$ 28.80	336	
CO515	TYPE CL- 6 FENCE	L.F.	$ 19.75	2,211	
CO515	TYPE CL-3 1/2 FENCE	L.F.	$ 15.80	2,219	*
CO515	WOOD FENCE, 6 FOOT HIGH	L.F.	$ 40.00	330	
CO515	SPLIT RAIL FENCE	L.F.	$ 26.75	435	
CO503	CHAIN LINK FENCE (TYPE CL-3.5)	L.F.	$ 16.64	1,410	*
CO503	(TYPE CL-6 BLACK VINYL WITH BARBED WIRE)	L.F.	$ 23.40	3,200	
Perm	**fencing (structural)**	**L.F.**	**$ 7.50**	**15,000**	typical perm fencing goes from 15,000ft to 50,000ft
Perm	**fencing (ponds)**	**L.F.**	**$ 7.50**	**50,000**	considered 3.5ft fence with a much greater quantity
					assumed unit $ less than other projects
	Demolition				
	Wood frame	C.F.	$ 0.026		
	Concrete	C.F.	$ 0.039		
	Concrete	C.Y.	$ 1,000.00		
	Floodwalls				
CO489	Type I - height?	Ft.	$ 148.72	2,960	
CO489	Type II - height?	Sq. Ft.	$ 29.74	750	
CO488	Masonary Block Floodwall	Sq. Yd.	$ 306.45	360	
CO488	Masonary Block Floodwall	Sq. Ft.	$ 34.05	3,230	
CO480	Concrete Floodwalls	C.Y.	$ 1,189.54	50	*
CO479	Vinyl Sheet Piling Floodwalls	Sq. Ft.	$ 21.37	5,500	
CO479	Concrete Floodwall Caps	C.Y.	$ 1,124.86	16	*
Perm	**concrete floodwall (reach P2)**	**C.Y.**	**$ 700.00**	**2,530**	We have large volumes, so assumed unit cost
					would be less than other projects
	Concrete Channel				
CO503	U Frame Channel	C.Y.	$ 1,175.79	290	
CO501	U Frame Channel	C.Y.	$ 809.53	7,900	
CO489	U Frame Channel	C.Y.	$ 860.41	7,550	
CO492	Wall Construction	C.Y.	$ 827.69	501	
CO489	Structural Concrete	C.Y.	$ 754.56	340	
Perm	**concrete U Frame (widening)**	**C.Y.**	**$ 800.00**	**28,000**	large quantity, cheaper than other projs
Perm	**bypass (miramonte)**	**C.Y.**	**$ 700.00**	**19,000**	cheaper than U frame rebuild?
Perm	**hale improvement**	**C.Y.**	**$ 850.00**	**3,700**	more expensive because more difficult to build

Table E2 - Costs Per Project Element

Feasible Alternatives Costs:
CPE 2: South Branch Dam

Item	Unit	Unit Cost	Amount	Item Cost
Concrete for RCC Dam	Yards^3	$54.0	58000.0	$3,132,000
Total:				$3,132,000
Contingency for Geological Conditions (25%)				$783,000
Subtotal:				$3,915,000
Design (20%)				$783,000
Geotech (10%)				$391,500
Inspection (20%)				$783,000
Total:				**$5,872,500**
R/W : Negligible for creek land				**$0**
Grand Total:				**$5,872,500**

Note 1 - Design, geotech and inspection costs double normal due to dam construction
Note 2 - No contingency placed for environemental mitigation. Mitigation costs NOT accounted for.

Table E2 - Costs Per Project Element

Feasible Alternatives Costs:
CPE 3: Rancho San Antonio

Item	Unit	Unit Cost	Amount	Item Cost
Clearing & Grubbing	acre	$5,500.0	15.0	$82,500
Inlet @ Bridge Structure	LS	$500,000.0	1.0	$500,000
Excavated Earth	Yards^3	$15.0	163000.0	$2,445,000
Revegetation (hydroseed)	ft^2	$0.5	410000.0	$205,000
Revegetation (trees)	number	$20.0	410.0	$8,200
Outlet	ft	$89.0	300.0	$26,700
Total:				$3,267,400
Mobilization (10%)				$326,740
Contingency (10%)				$326,740
Subtotal:				$3,920,880
Design (10%)				$392,088
Geotech (5%)				$196,044
Inspection (10%)				$392,088
Total:				**$4,901,100**
R/W : County Parks Land				**$0**
Grand Total:				**$4,901,100**

Table E2 - Costs Per Project Element

Feasible Alternatives Costs:
CPE 5: McKelvey Park

Item	Unit	Unit Cost	Amount	Item Cost
Excavated Field	Yards^3	$15.0	97000.0	$1,455,000
Concrete Retaining Wall (architecturally treated)	Yards^3	$935.0	2600.0	$2,431,000
Replacement Facilities	ft^2	$250.0	2000.0	$500,000
Outlet	ft	$46.0	1300.0	$59,800
Field Restoration	ft^2	$5.0	174000.0	$870,000
Asphalt resurface	yd^2	$10.6	5000.0	$53,000
Total:				$5,368,800
Mobilization (10%)				$536,880
Contingency (10%)				$536,880
Subtotal:				$6,442,560
Design (10%)				$644,256
Geotech (5%)				$322,128
Inspection (10%)				$644,256
Total:				**$8,053,200**
R/W : City owned property				**$0**
Grand Total:				**$8,053,200**

Table E2 - Costs Per Project Element

Feasible Alternatives Costs:
CPE 5: McKelvey Park (underground option … 2 acres 30 feet deep)

Item	Unit	Unit Cost	Amount	Item Cost
Excavated Field	Yards^3	$15.0	97000.0	$1,455,000
Concrete Structure	Acres	$2,500,000.0	2.0	$5,000,000
Replacement Facilities	ft^2	$250.0	0.0	$0
Outlet	ft	$46.0	1300.0	$59,800
Field Restoration	ft^2	$5.0	87000.0	$435,000
Asphalt resurface	yd^2	$10.6	0.0	$0
Total:				$6,949,800
Mobilization (10%)				$694,980
Contingency (10%)				$694,980
Subtotal:				$8,339,760
Design (10%)				$833,976
Geotech (5%)				$416,988
Inspection (10%)				$833,976
Total:				**$10,424,700**
R/W : City owned property				**$0**
Grand Total:				**$10,424,700**

Table E2 - Costs Per Project Element

Feasible Alternatives Costs:
CPE 7: Hale Bypass

Item	Unit	Unit Cost	Amount	Item Cost
Box Culvert Concrete	Yards^3	$850.0	4400.0	$3,740,000
Export Soil	Yards^3	$25.0	11000.0	$275,000
Shoring	sf	$20.0	81000.0	$1,620,000
Asphalt replacement	yd^2	$10.6	4900.0	$51,940
Traffic	ft	$100.0	3700.0	$370,000
Total:				$6,056,940
Mobilization (10%)				$605,694
Contingency (10%)				$605,694
Subtotal:				$7,268,328
Design (10%)				$726,833
Geotech (5%)				$363,416
Inspection (10%)				$726,833
Total:				**$9,085,410**
R/W : City owned property				**$0**
Grand Total:				**$9,085,410**

Table E2 - Costs Per Project Element

Feasible Alternatives Costs:
CPE 7: Hale Bypass Extension to Cuesta Annex

Item	Unit	Unit Cost	Amount	Item Cost
Box Culvert Concrete	Yards^3	$850.0	4900.0	$4,165,000
Export Soil	Yards^3	$25.0	12000.0	$300,000
Shoring	sf	$20.0	123000.0	$2,460,000
Asphalt replacement	yd^2	$10.6	5400.0	$57,240
Traffic	ft	$100.0	4400.0	$440,000
Total:				$7,422,240
Mobilization (10%)				$742,224
Contingency (10%)				$742,224
Subtotal:				$8,906,688
Design (10%)				$890,669
Geotech (5%)				$445,334
Inspection (10%)				$890,669
Total:				**$11,133,360**
R/W : City owned property				**$0**
Grand Total:				**$11,133,360**

Table E2 - Costs Per Project Element

Feasible Alternatives Costs: Alt D
CPE 8: Permanente Bypass

Item	Unit	Unit Cost	Amount	Item Cost
Box Culvert Concrete	Yards^3	$850.0	13000.0	$11,050,000
Export Soil	Yards^3	$25.0	36000.0	$900,000
Shoring	sf	$20.0	230000.0	$4,600,000
Asphalt replacement	yd^2	$10.6	14000.0	$148,400
Traffic	ft	$100.0	9800.0	$980,000
Bridges				
Covington (small)	LS	$250,000.0	1.0	$250,000
Total:				$17,928,400
Mobilization (10%)				$1,792,840
Contingency (10%)				$1,792,840
Subtotal:				$21,514,080
Design (10%)				$2,151,408
Geotech (5%)				$1,075,704
Inspection (10%)				$2,151,408
Total:				**$26,892,600**
R/W : Parcel at Trophy and Permanente Crk	ea	$100,000.0	1.0	**$100,000**
Grand Total:				**$26,992,600**

Table E2 - Costs Per Project Element

Feasible Alternatives Costs: Alt S
CPE 8: Permanente Bypass to Cuesta with Rancho, no Dam

Item	Unit	Unit Cost	Amount	Item Cost
Box Culvert Concrete	Yards^3	$850.0	2500.0	$2,125,000
Export Soil	Yards^3	$25.0	6000.0	$150,000
Shoring	sf	$20.0	57000.0	$1,140,000
Paving replacement	sq yds	$10.6	2900.0	$30,740
Traffic	ft	$100.0	2200.0	$220,000
Bridges				
Covington (small)	LS	$250,000.0	1.0	$250,000
Total:				$3,915,740
Mobilization (10%)				$391,574
Contingency (10%)				$391,574
Subtotal:				$4,698,888
Design (10%)				$469,889
Geotech (5%)				$234,944
Inspection (10%)				$469,889
Total:				**$5,873,610**
R/W : City owned property				**$0**
Grand Total:				**$5,873,610**

Table E2 - Costs Per Project Element

Feasible Alternatives Costs: Alt T
CPE 8: Permanente Bypass to Cuesta no Dam no Rancho

Item	Unit	Unit Cost	Amount	Item Cost
Box Culvert Concrete	Yards^3	$850.0	6800.0	$5,780,000
Channel concrete	Yards^3	$850.0	1200.0	$1,020,000
Rock lining	Yards^3	$75.0	1900.0	$142,500
Export Soil	Yards^3	$25.0	19000.0	$475,000
Shoring	sf	$20.0	130000.0	$2,600,000
Traffic	ft	$100.0	4900.0	$490,000
Bridges:				
Covington (small)	LS	$250,000.0	1.0	$250,000
Portland	LS	$500,000.0	1.0	$500,000
Total:				$11,257,500
Mobilization (10%)				$1,125,750
Contingency (10%)				$1,125,750
Subtotal:				$13,509,000
Design (10%)				$1,350,900
Geotech (5%)				$675,450
Inspection (10%)				$1,350,900
Total:				**$16,886,250**
R/W : City owned property				**$0**
Grand Total:				**$16,886,250**

Table E2 - Costs Per Project Element

Feasible Alternatives Costs: Alt W
CPE 8: Permanente bypass to Cuesta with Hanson

Item	Unit	Unit Cost	Amount	Item Cost
Box Culvert Concrete	Yards^3	$850.0	2600.0	$2,210,000
54" RCP Culvert	ft	$168.5	2300.0	$387,550
Export Soil	Yards^3	$25.0	6500.0	$162,500
Shoring	sf	$20.0	60000.0	$1,200,000
Asphalt replacement	yd^2	$10.6	2900.0	$30,740
Traffic	ft	$100.0	2200.0	$220,000
Bridges				
Covington (small)	LS	$250,000.0	1.0	$250,000
Total:				$4,460,790
Mobilization (10%)				$446,079
Contingency (10%)				$446,079
Subtotal:				$5,352,948
Design (10%)				$535,295
Geotech (5%)				$267,647
Inspection (10%)				$535,295
Total:				**$6,691,185**
Grand Total:				**$6,691,185**

Table E2 - Costs Per Project Element

Feasible Alternatives Costs: Alt Z
CPE 8: Permanente bypass to Cuesta from Blach School

Item	Unit	Unit Cost	Amount	Item Cost
96" RCP Culvert	ft	$508.0	2600.0	$1,320,800
Export Soil	Yards^3	$25.0	4800.0	$120,000
Shoring	sf	$20.0	68000.0	$1,360,000
Asphalt replacement	yd^2	$10.6	3500.0	$37,100
Traffic	ft	$100.0	2000.0	$200,000
Total:				$3,037,900
Mobilization (10%)				$303,790
Contingency (10%)				$303,790
Subtotal:				$3,645,480
Design (10%)				$364,548
Geotech (5%)				$182,274
Inspection (10%)				$364,548
Total:				**$4,556,850**
Grand Total:				**$4,556,850**

Table E2 - Costs Per Project Element

Feasible Alternatives Costs:
CPE 9: Floodwalls Alt D (full flow)

Item	Unit	Unit Cost	Amount	Item Cost
Floodwall concrete	Yards^3	$700.0	6200.0	$4,340,000
Total:				$4,340,000
Mobilization (10%)				$434,000
Contingency (10%)				$434,000
Subtotal:				$5,208,000
Design (10%)				$520,800
Geotech (5%)				$260,400
Inspection (10%)				$520,800
Total:				**$6,510,000**
R/W : City owned property				**$0**
Grand Total:				**$6,510,000**

Table E2 - Costs Per Project Element

Feasible Alternatives Costs:
CPE 9: Floodwalls Alt G (Full reduced flow)

Item	Unit	Unit Cost	Amount	Item Cost
Floodwall concrete	Yards^3	$700.0	2400.0	$1,680,000
Total:				$1,680,000
Mobilization (10%)				$168,000
Contingency (10%)				$168,000
Subtotal:				$2,016,000
Design (10%)				$201,600
Geotech (5%)				$100,800
Inspection (10%)				$201,600
Total:				**$2,520,000**
R/W : City owned property				**$0**
Grand Total:				**$2,520,000**

Table E2 - Costs Per Project Element

Feasible Alternatives Costs:
CPE 9: Floodwalls - Alt U (reduced flow Permanente only)

Item	Unit	Unit Cost	Amount	Item Cost
Floodwall concrete	Yards^3	$700.0	4900.0	$3,430,000
Total:				$3,430,000
Mobilization (10%)				$343,000
Contingency (10%)				$343,000
Subtotal:				$4,116,000
Design (10%)				$411,600
Geotech (5%)				$205,800
Inspection (10%)				$411,600
Total:				**$5,145,000**
R/W : City owned property				**$0**
Grand Total:				**$5,145,000**

Table E2 - Costs Per Project Element

Feasible Alternatives Costs:
CPE 10: Concrete Channel Widening - Alt D (Reach P3)

Item	Unit	Unit Cost	Amount	Item Cost
1. Bridges				
Charleston Bridge	LS	$500,000.0	1.0	$500,000
Hwy 101 (very large)	LS	$1,500,000.0	1.0	$1,500,000
Old Middlefield Way (medium large)	LS	$750,000.0	1.0	$750,000
Rock Street (small medium)	LS	$350,000.0	1.0	$350,000
Middlefield Rd (medium large)	LS	$750,000.0	1.0	$750,000
San Ramon (small medium)	LS	$350,000.0	1.0	$350,000
San Luis (small medium)	LS	$350,000.0	1.0	$350,000
Montecito (small medium)	LS	$350,000.0	1.0	$350,000
Hackett (small medium)	LS	$350,000.0	1.0	$350,000
Hetch-Hetchy (small)	LS	$250,000.0	1.0	$250,000
Central Expwy (medium large)	LS	$750,000.0	1.0	$750,000
SPRR (small)	LS	$250,000.0	1.0	$250,000
2. Reach				
U-frame and Trapezoidal Concrete Channel	Yards^3	$850.0	12000.0	$10,200,000
Export Soil	Yards^3	$25.0	22000.0	$550,000
Shoring	sf	$20.0	32000.0	$640,000
Concrete Removal	Yards^3	$50.0	7000.0	$350,000
Total:				$18,240,000
Mobilization (10%)				$1,824,000
Contingency (10%)				$1,824,000
Subtotal:				$21,888,000
Design (10%)				$2,188,800
Geotech (5%)				$1,094,400
Inspection (10%)				$2,188,800
Total:				**$27,360,000**
R/W : District Fee & Easements				**$0**
Grand Total:				**$27,360,000**

Table E2 - Costs Per Project Element

Feasible Alternatives Costs:
CPE 10: Concrete Channel Widening - Alt U (Reach P3)

Item	Unit	Unit Cost	Amount	Item Cost
1. Bridges				
Old Middlefield Way (medium large)	LS	$750,000.0	1.0	$750,000
Rock Street (small medium)	LS	$350,000.0	1.0	$350,000
Middlefield Rd (medium large)	LS	$750,000.0	1.0	$750,000
San Ramon (small medium)	LS	$350,000.0	1.0	$350,000
Hetch-Hetchy (small)	LS	$250,000.0	1.0	$250,000
Central Expwy (medium large)	LS	$750,000.0	1.0	$750,000
SPRR (small)	LS	$250,000.0	1.0	$250,000
2. Reach				
Trapezoidal Concrete Channel	Yards^3	$850.0	8400.0	$7,140,000
Export Soil	Yards^3	$25.0	17900.0	$447,500
Shoring	sf	$20.0	0.0	$0
Concrete Removal	Yards^3	$50.0	7100.0	$355,000
Total:				$11,392,500
Mobilization (10%)				$1,139,250
Contingency (10%)				$1,139,250
Subtotal:				$13,671,000
Design (10%)				$1,367,100
Geotech (5%)				$683,550
Inspection (10%)				$1,367,100
Total:				**$17,088,750**
R/W : District Fee & Easements				**$0**
Grand Total:				**$17,088,750**

Table E2 - Costs Per Project Element

Feasible Alternatives Costs:
CPE 10: Concrete Channel Widening - Alt D (Reach P5)

Item	Unit	Unit Cost	Amount	Item Cost
1. Bridges				
Park Ave (small)	LS	$250,000.0	1.0	$250,000
Mt. View Ave (medium)	LS	$500,000.0	1.0	$500,000
2. Reach				
U-Frame Concrete Channel	Yards^3	$850.0	3300.0	$2,805,000
Export Soil	Yards^3	$25.0	7400.0	$185,000
Shoring	sf	$20.0	62000.0	$1,240,000
Concrete Removal	Yards^3	$50.0	2200.0	$110,000
Total:				$5,090,000
Mobilization (10%)				$509,000
Contingency (10%)				$509,000
Subtotal:				$6,108,000
Design (10%)				$610,800
Geotech (5%)				$305,400
Inspection (10%)				$610,800
Total:				**$7,635,000**
R/W : District Fee & Easements				**$0**
Grand Total:				**$7,635,000**

Table E2 - Costs Per Project Element

Feasible Alternatives Costs:
CPE 10: Concrete Channel Widening - Alt G (Reach P5)

Item	Unit	Unit Cost	Amount	Item Cost
1. Bridges				
Park Ave (small)	LS	$250,000.0	1.0	$250,000
Mt. View Ave (medium)	LS	$500,000.0	1.0	$500,000
2. Reach				
U-Frame Concrete Channel and McKelvey Diversi	Yards^3	$850.0	2500.0	$2,125,000
Export Soil	Yards^3	$25.0	3300.0	$82,500
Shoring	sf	$20.0	0.0	$0
Concrete Removal	Yards^3	$50.0	2200.0	$110,000
Total:				$3,067,500
Mobilization (10%)				$306,750
Contingency (10%)				$306,750
Subtotal:				$3,681,000
Design (10%)				$368,100
Geotech (5%)				$184,050
Inspection (10%)				$368,100
Total:				**$4,601,250**
R/W : District Fee & Easements				**$0**
Grand Total:				**$4,601,250**

Table E2 - Costs Per Project Element

Feasible Alternatives Costs:
CPE 10: Concrete Channel Widening - Alt U (Reach P5)

Item	Unit	Unit Cost	Amount	Item Cost
1. Bridges				
Park Ave (small)	LS	$250,000.0	1.0	$250,000
Mt. View Ave (medium)	LS	$500,000.0	1.0	$500,000
2. Reach				
U-Frame Concrete Channel	Yards^3	$850.0	2300.0	$1,955,000
Export Soil	Yards^3	$25.0	0.0	$0
Shoring	sf	$20.0	0.0	$0
Concrete Removal	Yards^3	$50.0	2200.0	$110,000
Total:				$2,815,000
Mobilization (10%)				$281,500
Contingency (10%)				$281,500
Subtotal:				$3,378,000
Design (10%)				$337,800
Geotech (5%)				$168,900
Inspection (10%)				$337,800
Total:				**$4,222,500**
R/W : District Fee & Easements				**$0**
Grand Total:				**$4,222,500**

Table E2 - Costs Per Project Element

Feasible Alternatives Costs:
CPE 10: Concrete Channel Widening - Alt D (Reach H1 - Confl to Marylin)

Item	Unit	Unit Cost	Amount	Item Cost
1. Bridges				
Mt. View Ave (small medium)	LS	$350,000.0	1.0	$350,000
2. Reach				
Trapezoidal Concrete Channel	Yards^3	$850.0	630.0	$535,500
Export Soil	Yards^3	$25.0	0.0	$0
Shoring	sf	$20.0	0.0	$0
Concrete Removal	Yards^3	$50.0	820.0	$41,000
Total:				$926,500
Mobilization (10%)				$92,650
Contingency (10%)				$92,650
Subtotal:				$1,111,800
Design (10%)				$111,180
Geotech (5%)				$55,590
Inspection (10%)				$111,180
Total:				**$1,389,750**
R/W : District Fee & Easements				**$0**
Grand Total:				**$1,389,750**

Table E2 - Costs Per Project Element

Feasible Alternatives Costs:
CPE 10: Concrete Channel Widening - Alt D (Reach H1 - Marylin to Rosita)

Item	Unit	Unit Cost	Amount	Item Cost
1. Bridges				
Seventh Day Bridge (v. small)	LS	$100,000.0	1.0	$100,000
North Sunshine (medium)	LS	$500,000.0	1.0	$500,000
Springer (large)	LS	$1,000,000.0	1.0	$1,000,000
400 Springer (very small)	LS	$100,000.0	1.0	$100,000
Cuesta (medium)	LS	$500,000.0	1.0	$500,000
Arboleda (medium)	LS	$500,000.0	1.0	$500,000
Private Bridge (very small)	LS	$100,000.0	1.0	$100,000
Private Bridge (very small)	LS	$100,000.0	1.0	$100,000
Private Bridge (very small)	LS	$100,000.0	1.0	$100,000
Private Bridge (very small)	LS	$100,000.0	1.0	$100,000
2. Reach				
Trapezoidal Concrete Channel	Yards^3	$850.0	1940.0	$1,649,000
Export Soil	Yards^3	$25.0	940.0	$23,500
Shoring	sf	$20.0	0.0	$0
Concrete Removal	Yards^3	$50.0	1800.0	$90,000
Total:				$4,862,500
Mobilization (10%)				$486,250
Contingency (10%)				$486,250
Subtotal:				$5,835,000
Design (10%)				$583,500
Geotech (5%)				$291,750
Inspection (10%)				$583,500
Total:				**$7,293,750**
R/W : District Fee & Easements				**$0**
Grand Total:				**$7,293,750**

Table E2 - Costs Per Project Element

Feasible Alternatives Costs:
CPE 10: Concrete Channel Widening - Alt V (Reach H1)

Item	Unit	Unit Cost	Amount	Item Cost
1. Bridges				
Seventh Day Bridge (v. small)	LS	$100,000.0	1.0	$100,000
North Sunshine (medium)	LS	$500,000.0	1.0	$500,000
Total:				$600,000
Mobilization (10%)				$60,000
Contingency (10%)				$60,000
Subtotal:				$720,000
Design (10%)				$72,000
Geotech (5%)				$36,000
Inspection (10%)				$72,000
Total:				**$900,000**
R/W : District Fee & Easements				**$0**
Grand Total:				**$900,000**

Table E2 - Costs Per Project Element

Feasible Alternatives Costs:
CPE 12: Riparian Restoration (Reach P3: Hwy 101 to Old Middlefield)

Item	Unit	Unit Cost	Amount	Item Cost
Export Soil	Yards^3	$25.0	6700.0	$167,500
Rock Weirs	LS	$2,000.0	4.0	$8,000
Concrete Bank	Yards^3	$850.0	611.0	$519,350
Reveg Hydroseed	sf	$0.5	26000.0	$13,000
Reveg Trees	each	$20.0	2600.0	$52,000
Bridge Conforms	each	$25,000.0	2.0	$50,000
Concrete Removal	Yards^3	$50.0	910.0	$45,500
Total:				$855,350
Mobilization (10%)				$85,535
Contingency (10%)				$85,535
Subtotal:				$1,026,420
Design (10%)				$102,642
Geotech (5%)				$51,321
Inspection (10%)				$102,642
Total:				**$1,283,025**
R/W : District Fee & Easements				**$0**
Grand Total:				**$1,283,025**

Table E2 - Costs Per Project Element

Feasible Alternatives Costs:
CPE 12: Riparian Restoration (Reach P3: Old Middlefield to Rock)

Item	Unit	Unit Cost	Amount	Item Cost
Export Soil	Yards^3	$25.0	4500.0	$112,500
Rock Weirs	LS	$2,000.0	2.0	$4,000
Concrete Bank	Yards^3	$850.0	470.0	$399,500
Reveg Hydroseed	sf	$0.5	17000.0	$8,500
Reveg Trees	each	$20.0	1700.0	$34,000
Bridge Conforms	each	$25,000.0	2.0	$50,000
Concrete Removal	Yards^3	$50.0	700.0	$35,000
Total:				$643,500
Mobilization (10%)				$64,350
Contingency (10%)				$64,350
Subtotal:				$772,200
Design (10%)				$77,220
Geotech (5%)				$38,610
Inspection (10%)				$77,220
Total:				**$965,250**
R/W : District Fee & Easements				**$0**
Grand Total:				**$965,250**

Table E2 - Costs Per Project Element

Feasible Alternatives Costs:
CPE 12: Riparian Restoration (Reach P3: Rock to Middlefield)

Item	Unit	Unit Cost	Amount	Item Cost
Export Soil	Yards^3	$25.0	5000.0	$125,000
Rock Weirs	LS	$2,000.0	5.0	$10,000
Concrete Bank	Yards^3	$850.0	628.0	$533,800
Reveg Hydroseed	sf	$0.5	18000.0	$9,000
Reveg Trees	each	$20.0	1800.0	$36,000
Bridge Conforms	each	$25,000.0	2.0	$50,000
Concrete Removal	Yards^3	$50.0	940.0	$47,000
Total:				$810,800
Mobilization (10%)				$81,080
Contingency (10%)				$81,080
Subtotal:				$972,960
Design (10%)				$97,296
Geotech (5%)				$48,648
Inspection (10%)				$97,296
Total:				**$1,216,200**
R/W : District Fee & Easements				**$0**
Grand Total:				**$1,216,200**

Table E2 - Costs Per Project Element

Feasible Alternatives Costs:
CPE 15: El Camino Bypass - Alt E (Pettis to Villa)

Item	Unit	Unit Cost	Amount	Item Cost
Bore and Jack Concrete (under ECR)	Yards^3	$2,550.0	440.0	$1,122,000
Box Culvert Concrete	Yards^3	$850.0	6700.0	$5,695,000
Export Soil	Yards^3	$25.0	21000.0	$525,000
Shoring	sf	$20.0	135000.0	$2,700,000
Asphalt replacement	yd^2	$10.6	7000.0	$74,200
Traffic	ft	$100.0	4500.0	$450,000
Total:				$10,566,200
Mobilization (10%)				$1,056,620
Contingency (10%)				$1,056,620
Subtotal:				$12,679,440
Design (10%)				$1,267,944
Geotech (5%)				$633,972
Inspection (10%)				$1,267,944
Total:				**$15,849,300**
R/W : City owned property				**$0**
Grand Total:				**$15,849,300**

Table E2 - Costs Per Project Element

Feasible Alternatives Costs:
CPE 15: El Camino Bypass - Alt D (Pettis to Latham)

Item	Unit	Unit Cost	Amount	Item Cost
Bore and Jack Concrete (under ECR)	Yards^3	$2,550.0	440.0	$1,122,000
Box Culvert Concrete	Yards^3	$850.0	3300.0	$2,805,000
Export Soil	Yards^3	$25.0	10000.0	$250,000
Shoring	sf	$20.0	66000.0	$1,320,000
Asphalt replacement	yd^2	$10.6	3400.0	$36,040
Traffic	ft	$100.0	2200.0	$220,000
Total:				$5,753,040
Mobilization (10%)				$575,304
Contingency (10%)				$575,304
Subtotal:				$6,903,648
Design (10%)				$690,365
Geotech (5%)				$345,182
Inspection (10%)				$690,365
Total:				**$8,629,560**
R/W : City owned property				**$0**
Grand Total:				**$8,629,560**

Table E2 - Costs Per Project Element

Feasible Alternatives Costs:
CPE 15: El Camino Bypass - Alt U (Pettis to Villa)

Item	Unit	Unit Cost	Amount	Item Cost
Bore and Jack 6' RCP (under ECR)	ft	$804.0	300.0	$241,200
6' RCP Culvert	ft	$268.0	4500.0	$1,206,000
Export Soil	Yards^3	$25.0	8900.0	$222,500
Shoring	sf	$20.0	99000.0	$1,980,000
Asphalt replacement	yd^2	$10.6	4000.0	$42,400
Traffic	ft	$100.0	4500.0	$450,000
Total:				$4,142,100
Mobilization (10%)				$414,210
Contingency (10%)				$414,210
Subtotal:				$4,970,520
Design (10%)				$497,052
Geotech (5%)				$248,526
Inspection (10%)				$497,052
Total:				**$6,213,150**
R/W : City owned property				**$0**
Grand Total:				**$6,213,150**

Table E2 - Costs Per Project Element

Feasible Alternatives Costs:
CPE 16: El Camino Culvert Expansion - Alt D (Latham to Villa)

Item	Unit	Unit Cost	Amount	Item Cost
Box Culvert Concrete	Yards^3	$850.0	3300.0	$2,805,000
Export Soil	Yards^3	$25.0	11000.0	$275,000
Shoring	sf	$20.0	0.0	$0
Asphalt replacement	yd^2	$10.6	0.0	$0
Traffic	LS	$0.0	0.0	$0
Total:				$3,080,000
Mobilization (10%)				$308,000
Contingency (10%)				$308,000
Subtotal:				$3,696,000
Design (10%)				$369,600
Geotech (5%)				$184,800
Inspection (10%)				$369,600
Total:				**$4,620,000**
R/W : City owned property				**$0**
Grand Total:				**$4,620,000**

Table E2 - Costs Per Project Element

Feasible Alternatives Costs:
CPE 18: El Camino Collection Channel - Alt D

Item	Unit	Unit Cost	Amount	Item Cost
5' Dia RCP Pipe	LF	$201.0	1400.0	$281,400
9' Dia RCP Pipe	LF	$650.0	1600.0	$1,040,000
Export Soil	Yards^3	$25.0	7600.0	$190,000
Shoring	sf	$20.0	88000.0	$1,760,000
Asphalt replacement	yd^2	$10.6	3700.0	$39,220
Traffic	ft	$200.0	3000.0	$600,000
Total:				$3,910,620
Mobilization (10%)				$391,062
Contingency (10%)				$391,062
Subtotal:				$4,692,744
Design (10%)				$469,274
Geotech (5%)				$234,637
Inspection (10%)				$469,274
Total:				**$5,865,930**
R/W : State of CA owned property				**$0**
Grand Total:				**$5,865,930**

Table E2 - Costs Per Project Element

Feasible Alternatives Costs:
CPE 19: New Diversion Structure - Alt G, U, V, Y, Z

Item	Unit	Unit Cost	Amount	Item Cost
Diversion Structure	yds^3	$850.0	300.0	$255,000
6' Dia RCP Pipe	LF	$268.0	250.0	$67,000
Export Soil	Yards^3	$25.0	260.0	$6,500
Shoring	sf	$20.0	5000.0	$100,000
Asphalt replacement	yd^2	$10.6	0.0	$0
Traffic	ft	$100.0	0.0	$0
Total:				$428,500
Mobilization (10%)				$42,850
Contingency (10%)				$42,850
Subtotal:				$514,200
Design (10%)				$51,420
Geotech (5%)				$25,710
Inspection (10%)				$51,420
Total:				**$642,750**
R/W : City owned property				**$0**
Grand Total:				**$642,750**

Table E2 - Costs Per Project Element

Feasible Alternatives Costs:
CPE 19: New Diversion Structure - Alt S, T, W, X

Item	Unit	Unit Cost	Amount	Item Cost
Diversion Structure	yds^3	$850.0	300.0	$255,000
8' Dia RCP Pipe	LF	$508.0	400.0	$203,200
Export Soil	Yards^3	$25.0	1200.0	$30,000
Shoring	sf	$20.0	9000.0	$180,000
Asphalt replacement	yd^2	$10.6	500.0	$5,300
Traffic	ft	$100.0	400.0	$40,000
Total:				$713,500
Mobilization (10%)				$71,350
Contingency (10%)				$71,350
Subtotal:				$856,200
Design (10%)				$85,620
Geotech (5%)				$42,810
Inspection (10%)				$85,620
Total:				**$1,070,250**
R/W : City owned property				**$0**
Grand Total:				**$1,070,250**

Table E2 - Costs Per Project Element

Feasible Alternatives Costs:
CPE 20: Flow Detention - Cuesta Annex - Alt S and Y

Item	Unit	Unit Cost	Amount	Item Cost
Clearing & Grubbing	acre	$5,500.0	10.0	$55,000
Outlet	ft	$89.0	3200.0	$284,800
Excavated Earth	Yards^3	$15.0	211000.0	$3,165,000
Revegetation (hydroseed)	ft^2	$0.5	436000.0	$218,000
Revegetation (trees)	number	$20.0	436.0	$8,720
Structural Concrete	acre	$2,500,000.0	2.5	$6,250,000
Total:				$9,981,520
Mobilization (10%)				$998,152
Contingency (10%)				$998,152
Subtotal:				$11,977,824
Design (10%)				$1,197,782
Geotech (5%)				$598,891
Inspection (10%)				$1,197,782
Total:				**$14,972,280**
R/W : City of Mountain View Land				**$0**
Grand Total:				**$14,972,280**

Table E2 - Costs Per Project Element

Feasible Alternatives Costs:
CPE 20: Flow Detention - Cuesta Annex - Alt T

Item	Unit	Unit Cost	Amount	Item Cost
Clearing & Grubbing	acre	$5,500.0	12.0	$66,000
Outlet	ft	$136.0	3200.0	$435,200
Excavated Earth	Yards^3	$15.0	363000.0	$5,445,000
Revegetation (hydroseed)	ft^2	$0.5	523000.0	$261,500
Revegetation (trees)	number	$20.0	523.0	$10,460
Total:				$6,218,160
Mobilization (10%)				$621,816
Contingency (10%)				$621,816
Subtotal:				$7,461,792
Design (10%)				$746,179
Geotech (5%)				$373,090
Inspection (10%)				$746,179
Total:				**$9,327,240**
R/W : City of Mountain View Land				**$0**
Grand Total:				**$9,327,240**

Table E2 - Costs Per Project Element

Feasible Alternatives Costs:
CPE 20: Flow Detention - Cuesta Annex - Alt V

Item	Unit	Unit Cost	Amount	Item Cost
Clearing & Grubbing	acre	$5,500.0	6.0	$33,000
Outlet	ft	$46.0	3200.0	$147,200
Excavated Earth	Yards^3	$15.0	97000.0	$1,455,000
Revegetation (hydroseed)	ft^2	$0.5	260000.0	$130,000
Revegetation (trees)	number	$20.0	260.0	$5,200
Total:				$1,770,400
Mobilization (10%)				$177,040
Contingency (10%)				$177,040
Subtotal:				$2,124,480
Design (10%)				$212,448
Geotech (5%)				$106,224
Inspection (10%)				$212,448
Total:				**$2,655,600**
R/W : City of Mountain View Land				**$0**
Grand Total:				**$2,655,600**

Table E2 - Costs Per Project Element

Feasible Alternatives Costs:
CPE 20: Flow Detention - Cuesta Annex - Alt W

Item	Unit	Unit Cost	Amount	Item Cost
Clearing & Grubbing	acre	$5,500.0	7.0	$38,500
Outlet	ft	$68.0	3200.0	$217,600
Excavated Earth	Yards^3	$15.0	111000.0	$1,665,000
Revegetation (hydroseed)	ft^2	$0.5	305000.0	$152,500
Revegetation (trees)	number	$20.0	305.0	$6,100
Total:				$2,079,700
Mobilization (10%)				$207,970
Contingency (10%)				$207,970
Subtotal:				$2,495,640
Design (10%)				$249,564
Geotech (5%)				$124,782
Inspection (10%)				$249,564
Total:				**$3,119,550**
R/W : City of Mountain View Land				**$0**
Grand Total:				**$3,119,550**

Table E2 - Costs Per Project Element

Feasible Alternatives Costs:
CPE 20: Flow Detention - Cuesta Annex - Alt X

Item	Unit	Unit Cost	Amount	Item Cost
Clearing & Grubbing	acre	$5,500.0	10.0	$55,000
Outlet	ft	$89.0	3200.0	$284,800
Excavated Earth	Yards^3	$15.0	208000.0	$3,120,000
Revegetation (hydroseed)	ft^2	$0.5	436000.0	$218,000
Revegetation (trees)	number	$20.0	436.0	$8,720
Structural Concrete	acre	$2,500,000.0	2.5	$6,250,000
Total:				$9,936,520
Mobilization (10%)				$993,652
Contingency (10%)				$993,652
Subtotal:				$11,923,824
Design (10%)				$1,192,382
Geotech (5%)				$596,191
Inspection (10%)				$1,192,382
Total:				**$14,904,780**
R/W : City of Mountain View Land				**$0**
Grand Total:				**$14,904,780**

Table E2 - Costs Per Project Element

Feasible Alternatives Costs:
CPE 21: Flow Detention - Blach School - Alt Z (Open, 65 AF)

Item	Unit	Unit Cost	Amount	Item Cost
Clearing & Grubbing	acre	$5,500.0	5.0	$27,500
Excavated Earth	Yards^3	$15.0	105000.0	$1,575,000
Revegetation (turf)	ft^2	$5.0	218000.0	$1,090,000
Revegetation (trees)	number	$20.0	50.0	$1,000
Channel work: Concrete Removal	Yards^3	$50.0	1000.0	$50,000
Channel work: New Concrete	Yards^3	$850.0	1000.0	$850,000
Floodwalls:	Yards^3	$700.0	220.0	$154,000
Total:				$3,747,500
Mobilization (10%)				$374,750
Contingency (10%)				$374,750
Subtotal:				$4,497,000
Design (10%)				$449,700
Geotech (5%)				$224,850
Inspection (10%)				$449,700
Total:				**$5,621,250**
R/W : Los Altos School District Land				**$0**
Grand Total:				**$5,621,250**

Table E2 - Costs Per Project Element

Feasible Alternatives Costs:
CPE 20: Flow Detention - Cuesta Annex - Alt S (65 AF open only)

Item	Unit	Unit Cost	Amount	Item Cost
Clearing & Grubbing	acre	$5,500.0	6.0	$33,000
Outlet	ft	$89.0	3200.0	$284,800
Excavated Earth	Yards^3	$15.0	105000.0	$1,575,000
Revegetation (hydroseed)	ft^2	$0.5	436000.0	$218,000
Revegetation (trees)	number	$20.0	500.0	$10,000
Total:				$2,120,800
Mobilization (10%)				$212,080
Contingency (10%)				$212,080
Subtotal:				$2,544,960
Design (10%)				$254,496
Geotech (5%)				$127,248
Inspection (10%)				$254,496
Total:				**$3,181,200**
R/W : City of Mountain View Land				**$0**
Grand Total:				**$3,181,200**

Feasible Alternatives Costs:
CPE 2: South Branch Dam

Item	Unit	Unit Cost	Amount	Item Cost
Concrete for RCC Dam	Yards^3	$54.0	58,000	$3,132,000
Total:				$3,132,000
Contingency for Mitigation (25%)				$783,000
Contingency for Geological Conditions (25%)				$783,000
Subtotal:				$4,698,000
Design (10%)				$469,800
Geotech (5%)				$234,900
Inspection (10%)				$469,800
Total:				**$5,872,500**
R/W : Negligible for creek land				**$0**
Grand Total:				**$5,872,500**

Feasible Alternatives Costs:
CPE 3: Rancho San Antonio

Item	Unit	Unit Cost	Amount	Item Cost
Clearing & Grubbing	acre	$5,500.0	9	$51,700
Inlet @ Bridge Structure	LS	$500,000.0	1	$500,000
Excavated Earth	Yards^3	$15.0	163,000	$2,445,000
Revegetation (hydroseed)	ft^2	$0.5	410,000	$205,000
Revegetation (trees)	number	$20.0	410	$8,200
Outlet	ft	$89.0	300	$26,700
Total:				$3,236,600
Mobilization (10%)				$323,660
Contingency (10%)				$323,660
Subtotal:				$3,883,920
Design (10%)				$388,392
Geotech (5%)				$194,196
Inspection (10%)				$388,392
Total:				**$4,854,900**
R/W : County Parks Land				**$0**
Grand Total:				**$4,854,900**

Feasible Alternatives Costs:
CPE 5: Mckelvey Park

Item	Unit	Unit Cost	Amount	Item Cost
Excavated Field	Yards^3	$15.0	97,000	$1,455,000
Concrete Retaining Wall (architecturally treated)	Yards^3	$935.0	2,600	$2,431,000
Replacement Facilities	ft^2	$250.0	2,000	$500,000
Outlet	ft	$46.0	1,300	$59,800
Field Restoration	ft^2	$5.0	174,000	$870,000
Asphalt resurface	yd^2	$10.6	5,000	$53,000
Total:				$5,368,800
Mobilization (10%)				$536,880
Contingency (10%)				$536,880
Subtotal:				$6,442,560
Design (10%)				$644,256
Geotech (5%)				$322,128
Inspection (10%)				$644,256
Total:				**$8,053,200**
R/W : City owned property				**$0**
Grand Total:				**$8,053,200**

Feasible Alternatives Costs:
CPE 7: Hale Bypass

Item	Unit	Unit Cost	Amount	Item Cost
Box Culvert Concrete	Yards^3	$850.0	4,400	$3,740,000
Export Soil	Yards^3	$25.0	11,000	$275,000
Shoring	sf	$20.0	81,000	$1,620,000
Asphalt replacement	yd^2	$10.6	4,900	$51,940
Traffic	ft	$100.0	3,700	$370,000
Total:				$6,056,940
Mobilization (10%)				$605,694
Contingency (10%)				$605,694
Subtotal:				$7,268,328
Design (10%)				$726,833
Geotech (5%)				$363,416
Inspection (10%)				$726,833
Total:				**$9,085,410**
R/W : City owned property				**$0**
Grand Total:				**$9,085,410**

Feasible Alternatives Costs:
CPE 7: Hale Bypass Extension to Cuesta Annex

Item	Unit	Unit Cost	Amount	Item Cost
Box Culvert Concrete	Yards^3	$850.0	4,900	$4,165,000
Export Soil	Yards^3	$25.0	12,000	$300,000
Shoring	sf	$20.0	123,000	$2,460,000
Asphalt replacement	yd^2	$10.6	5,400	$57,240
Traffic	ft	$100.0	4,400	$440,000
Total:				$7,422,240
Mobilization (10%)				$742,224
Contingency (10%)				$742,224
Subtotal:				$8,906,688
Design (10%)				$890,669
Geotech (5%)				$445,334
Inspection (10%)				$890,669
Total:				**$11,133,360**
R/W : City owned property				**$0**
Grand Total:				**$11,133,360**

Feasible Alternatives Costs: Alt D
CPE 8: Permanente Bypass

Item	Unit	Unit Cost	Amount	Item Cost
Box Culvert Concrete	Yards^3	$850.0	13,000	$11,050,000
Export Soil	Yards^3	$25.0	36,000	$900,000
Shoring	sf	$20.0	230,000	$4,600,000
Asphalt replacement	yd^2	$10.6	14,000	$148,400
Traffic	ft	$100.0	9,800	$980,000
Bridges				
Covington (small)	LS	$250,000.0	1	$250,000
Total:				$17,928,400
Mobilization (10%)				$1,792,840
Contingency (10%)				$1,792,840
Subtotal:				$21,514,080
Design (10%)				$2,151,408
Geotech (5%)				$1,075,704
Inspection (10%)				$2,151,408
Total:				**$26,892,600**
R/W : Parcel at Trophy and Permanente Crk	ea	$100,000.0	1.0	**$100,000**
Grand Total:				**$26,992,600**

Feasible Alternatives Costs: Alt S
CPE 8: Permanente Bypass to Cuesta with Rancho, no Dam

Item	Unit	Unit Cost	Amount	Item Cost
Box Culvert Concrete	Yards^3	$850.0	2,500	$2,125,000
Export Soil	Yards^3	$25.0	6,000	$150,000
Shoring	sf	$20.0	57,000	$1,140,000
Paving replacement	sq yds	$10.6	2,900	$30,740
Traffic	ft	$100.0	2,200	$220,000
Bridges				
Covington (small)	LS	$250,000.0	1	$250,000
Total:				$3,915,740
Mobilization (10%)				$391,574
Contingency (10%)				$391,574
Subtotal:				$4,698,888
Design (10%)				$469,889
Geotech (5%)				$234,944
Inspection (10%)				$469,889
Total:				**$5,873,610**
R/W : City owned property				**$0**
Grand Total:				**$5,873,610**

Feasible Alternatives Costs: Alt T
CPE 8: Permanente Bypass to Cuesta no Dam no Rancho

Item	Unit	Unit Cost	Amount	Item Cost
Box Culvert Concrete	Yards^3	$850.0	6,800	$5,780,000
Channel concrete	Yards^3	$850.0	1,200	$1,020,000
Rock lining	Yards^3	$75.0	1,900	$142,500
Export Soil	Yards^3	$25.0	19,000	$475,000
Shoring	sf	$20.0	130,000	$2,600,000
Traffic	ft	$100.0	4,900	$490,000
Bridges:				
Covington (small)	LS	$250,000.0	1	$250,000
Portland	LS	$500,000.0	1	$500,000
Total:				$11,257,500
Mobilization (10%)				$1,125,750
Contingency (10%)				$1,125,750
Subtotal:				$13,509,000
Design (10%)				$1,350,900
Geotech (5%)				$675,450
Inspection (10%)				$1,350,900
Total:				**$16,886,250**
R/W : City owned property				**$0**
Grand Total:				**$16,886,250**

Feasible Alternatives Costs: Alt W
CPE 8: Permanente bypass to Cuesta with Hanson

Item	Unit	Unit Cost	Amount	Item Cost
Box Culvert Concrete	Yards^3	$850.0	2,600	$2,210,000
54" RCP Culvert	ft	$168.5	2,300	$387,550
Export Soil	Yards^3	$25.0	6,500	$162,500
Shoring	sf	$20.0	60,000	$1,200,000
Asphalt replacement	yd^2	$10.6	2,900	$30,740
Traffic	ft	$100.0	2,200	$220,000
Bridges				
Covington (small)	LS	$250,000.0	1	$250,000
Total:				$4,460,790
Mobilization (10%)				$446,079
Contingency (10%)				$446,079
Subtotal:				$5,352,948
Design (10%)				$535,295
Geotech (5%)				$267,647
Inspection (10%)				$535,295
Total:				**$6,691,185**
Grand Total:				**$6,691,185**

Feasible Alternatives Costs:
CPE 9: Floodwalls Alt D (full flow)

Item	Unit	Unit Cost	Amount	Item Cost
Floodwall concrete	Yards^3	$700.0	6,200	$4,340,000
Total:				$4,340,000
Mobilization (10%)				$434,000
Contingency (10%)				$434,000
Subtotal:				$5,208,000
Design (10%)				$520,800
Geotech (5%)				$260,400
Inspection (10%)				$520,800
Total:				**$6,510,000**
R/W : City owned property				**$0**
Grand Total:				**$6,510,000**

Feasible Alternatives Costs:
CPE 9: Floodwalls Alt G (Full reduced flow)

Item	Unit	Unit Cost	Amount	Item Cost
Floodwall concrete	Yards^3	$700.0	2,400	$1,680,000
Total:				$1,680,000
Mobilization (10%)				$168,000
Contingency (10%)				$168,000
Subtotal:				$2,016,000
Design (10%)				$201,600
Geotech (5%)				$100,800
Inspection (10%)				$201,600
Total:				**$2,520,000**
R/W : City owned property				**$0**
Grand Total:				**$2,520,000**

Feasible Alternatives Costs:
CPE 9: Floodwalls - Alt U (reduced flow Permanente only)

Item	Unit	Unit Cost	Amount	Item Cost
Floodwall concrete	Yards^3	$700.0	4,900	$3,430,000
Total:				$3,430,000
Mobilization (10%)				$343,000
Contingency (10%)				$343,000
Subtotal:				$4,116,000
Design (10%)				$411,600
Geotech (5%)				$205,800
Inspection (10%)				$411,600
Total:				**$5,145,000**
R/W : City owned property				**$0**
Grand Total:				**$5,145,000**

Feasible Alternatives Costs:
CPE 10: Concrete Channel Widening - Alt D (Reach P3)

Item	Unit	Unit Cost	Amount	Item Cost
1. Bridges				
Charleston Bridge	LS	$500,000.0	1	$500,000
Hwy 101 (very large)	LS	$1,500,000.0	1	$1,500,000
Old Middlefield Way (medium large)	LS	$750,000.0	1	$750,000
Rock Street (small medium)	LS	$350,000.0	1	$350,000
Middlefield Rd (medium large)	LS	$750,000.0	1	$750,000
San Ramon (small medium)	LS	$350,000.0	1	$350,000
San Luis (small medium)	LS	$350,000.0	1	$350,000
Montecito (small medium)	LS	$350,000.0	1	$350,000
Hackett (small medium)	LS	$350,000.0	1	$350,000
Hetch-Hetchy (small)	LS	$250,000.0	1	$250,000
Central Expwy (medium large)	LS	$750,000.0	1	$750,000
SPRR (small)	LS	$250,000.0	1	$250,000
2. Reach				
U-frame and Trapezoidal Concrete Channel	Yards^3	$850.0	12,000	$10,200,000
Export Soil	Yards^3	$25.0	22,000	$550,000
Shoring	sf	$20.0	32,000	$640,000
Concrete Removal	Yards^3	$50.0	7,000	$350,000
Total:				$18,240,000
Mobilization (10%)				$1,824,000
Contingency (10%)				$1,824,000
Subtotal:				$21,888,000
Design (10%)				$2,188,800
Geotech (5%)				$1,094,400
Inspection (10%)				$2,188,800
Total:				**$27,360,000**
R/W : District Fee & Easements				**$0**
Grand Total:				**$27,360,000**

Feasible Alternatives Costs:
CPE 10: Concrete Channel Widening - Alt U (Reach P3)

Item	Unit	Unit Cost	Amount	Item Cost
1. Bridges				
Old Middlefield Way (medium large)	LS	$750,000.0	1	$750,000
Rock Street (small medium)	LS	$350,000.0	1	$350,000
Middlefield Rd (medium large)	LS	$750,000.0	1	$750,000
San Ramon (small medium)	LS	$350,000.0	1	$350,000
Hetch-Hetchy (small)	LS	$250,000.0	1	$250,000
Central Expwy (medium large)	LS	$750,000.0	1	$750,000
SPRR (small)	LS	$250,000.0	1	$250,000
2. Reach				
Trapezoidal Concrete Channel	Yards^3	$850.0	3,200	$2,720,000
Export Soil	Yards^3	$25.0	6,700	$167,500
Shoring	sf	$20.0	0	$0
Concrete Removal	Yards^3	$50.0	2,700	$135,000
Total:				$6,472,500
Mobilization (10%)				$647,250
Contingency (10%)				$647,250
Subtotal:				$7,767,000
Design (10%)				$776,700
Geotech (5%)				$388,350
Inspection (10%)				$776,700
Total:				**$9,708,750**
R/W : District Fee & Easements				**$0**
Grand Total:				**$9,708,750**

Feasible Alternatives Costs:
CPE 10: Concrete Channel Widening - Alt D (Reach P5)

Item	Unit	Unit Cost	Amount	Item Cost
1. Bridges				
Park Ave (small)	LS	$250,000.0	1	$250,000
Mt. View Ave (medium)	LS	$500,000.0	1	$500,000
2. Reach				
U-Frame Concrete Channel	Yards^3	$850.0	3,300	$2,805,000
Export Soil	Yards^3	$25.0	7,400	$185,000
Shoring	sf	$20.0	62,000	$1,240,000
Concrete Removal	Yards^3	$50.0	2,200	$110,000
Total:				$5,090,000
Mobilization (10%)				$509,000
Contingency (10%)				$509,000
Subtotal:				$6,108,000
Design (10%)				$610,800
Geotech (5%)				$305,400
Inspection (10%)				$610,800
Total:				**$7,635,000**
R/W : District Fee & Easements				**$0**
Grand Total:				**$7,635,000**

Feasible Alternatives Costs:
CPE 10: Concrete Channel Widening - Alt G (Reach P5)

Item	Unit	Unit Cost	Amount	Item Cost
1. Bridges				
Park Ave (small)	LS	$250,000.0	1	$250,000
Mt. View Ave (medium)	LS	$500,000.0	1	$500,000
2. Reach				
U-Frame Concrete Channel and McKelvey Diversi	Yards^3	$850.0	2,500	$2,125,000
Export Soil	Yards^3	$25.0	3,300	$82,500
Shoring	sf	$20.0	0	$0
Concrete Removal	Yards^3	$50.0	2,200	$110,000
Total:				$3,067,500
Mobilization (10%)				$306,750
Contingency (10%)				$306,750
Subtotal:				$3,681,000
Design (10%)				$368,100
Geotech (5%)				$184,050
Inspection (10%)				$368,100
Total:				**$4,601,250**
R/W : District Fee & Easements				**$0**
Grand Total:				**$4,601,250**

Feasible Alternatives Costs:
CPE 10: Concrete Channel Widening - Alt U (Reach P5)

Item	Unit	Unit Cost	Amount	Item Cost
1. Bridges				
Park Ave (small)	LS	$250,000.0	1	$250,000
Mt. View Ave (medium)	LS	$500,000.0	1	$500,000
2. Reach				
U-Frame Concrete Channel	Yards^3	$850.0	2,300	$1,955,000
Export Soil	Yards^3	$25.0	0	$0
Shoring	sf	$20.0	0	$0
Concrete Removal	Yards^3	$50.0	2,200	$110,000
Total:				$2,815,000
Mobilization (10%)				$281,500
Contingency (10%)				$281,500
Subtotal:				$3,378,000
Design (10%)				$337,800
Geotech (5%)				$168,900
Inspection (10%)				$337,800
Total:				**$4,222,500**
R/W : District Fee & Easements				**$0**
Grand Total:				**$4,222,500**

Feasible Alternatives Costs:
CPE 10: Concrete Channel Widening - Alt D (Reach H1 - Confl to Marylin)

Item	Unit	Unit Cost	Amount	Item Cost
1. Bridges				
Mt. View Ave (small medium)	LS	$350,000.0	1	$350,000
2. Reach				
Trapezoidal Concrete Channel	Yards^3	$850.0	630	$535,500
Export Soil	Yards^3	$25.0	0	$0
Shoring	sf	$20.0	0	$0
Concrete Removal	Yards^3	$50.0	820	$41,000
Total:				$926,500
Mobilization (10%)				$92,650
Contingency (10%)				$92,650
Subtotal:				$1,111,800
Design (10%)				$111,180
Geotech (5%)				$55,590
Inspection (10%)				$111,180
Total:				**$1,389,750**
R/W : District Fee & Easements				**$0**
Grand Total:				**$1,389,750**

Feasible Alternatives Costs:
CPE 10: Concrete Channel Widening - Alt D (Reach H1 - Marylin to Rosita)

Item	Unit	Unit Cost	Amount	Item Cost
1. Bridges				
Seventh Day Bridge (v. small)	LS	$100,000.0	1	$100,000
North Sunshine (medium)	LS	$500,000.0	1	$500,000
Springer (large)	LS	$1,000,000.0	1	$1,000,000
400 Springer (very small)	LS	$100,000.0	1	$100,000
Cuesta (medium)	LS	$500,000.0	1	$500,000
Arboleda (medium)	LS	$500,000.0	1	$500,000
Private Bridge (very small)	LS	$100,000.0	1	$100,000
Private Bridge (very small)	LS	$100,000.0	1	$100,000
Private Bridge (very small)	LS	$100,000.0	1	$100,000
Private Bridge (very small)	LS	$100,000.0	1	$100,000
2. Reach				
Trapezoidal Concrete Channel	Yards^3	$850.0	1,940	$1,649,000
Export Soil	Yards^3	$25.0	940	$23,500
Shoring	sf	$20.0	0	$0
Concrete Removal	Yards^3	$50.0	1,800	$90,000
Total:				$4,862,500
Mobilization (10%)				$486,250
Contingency (10%)				$486,250
Subtotal:				$5,835,000
Design (10%)				$583,500
Geotech (5%)				$291,750
Inspection (10%)				$583,500
Total:				**$7,293,750**
R/W : District Fee & Easements				**$0**
Grand Total:				**$7,293,750**

Feasible Alternatives Costs:
CPE 10: Concrete Channel Widening - Alt V (Reach H1)

Item	Unit	Unit Cost	Amount	Item Cost
1. Bridges				
Seventh Day Bridge (v. small)	LS	$100,000.0	1	$100,000
North Sunshine (medium)	LS	$500,000.0	1	$500,000
Total:				$600,000
Mobilization (10%)				$60,000
Contingency (10%)				$60,000
Subtotal:				$720,000
Design (10%)				$72,000
Geotech (5%)				$36,000
Inspection (10%)				$72,000
Total:				**$900,000**
R/W : District Fee & Easements				**$0**
Grand Total:				**$900,000**

Feasible Alternatives Costs:
CPE 12: Riparian Restoration (Reach P3: Hwy 101 to Old Middlefield)

Item	Unit	Unit Cost	Amount	Item Cost
Export Soil	Yards^3	$25.0	6,700	$167,500
Rock Weirs	LS	$2,000.0	4	$8,000
Concrete Bank	Yards^3	$850.0	611	$519,350
Reveg Hydroseed	sf	$0.5	26,000	$13,000
Reveg Trees	each	$20.0	2,600	$52,000
Bridge Conforms	each	$25,000.0	2	$50,000
Concrete Removal	Yards^3	$50.0	910	$45,500
Total:				$855,350
Mobilization (10%)				$85,535
Contingency (10%)				$85,535
Subtotal:				$1,026,420
Design (10%)				$102,642
Geotech (5%)				$51,321
Inspection (10%)				$102,642
Total:				**$1,283,025**
R/W : District Fee & Easements				**$0**
Grand Total:				**$1,283,025**

Feasible Alternatives Costs:
CPE 12: Riparian Restoration (Reach P3: Old Middlefield to Rock)

Item	Unit	Unit Cost	Amount	Item Cost
Export Soil	Yards^3	$25.0	4,500	$112,500
Rock Weirs	LS	$2,000.0	2	$4,000
Concrete Bank	Yards^3	$850.0	470	$399,500
Reveg Hydroseed	sf	$0.5	17,000	$8,500
Reveg Trees	each	$20.0	1,700	$34,000
Bridge Conforms	each	$25,000.0	2	$50,000
Concrete Removal	Yards^3	$50.0	700	$35,000
Total:				$643,500
Mobilization (10%)				$64,350
Contingency (10%)				$64,350
Subtotal:				$772,200
Design (10%)				$77,220
Geotech (5%)				$38,610
Inspection (10%)				$77,220
Total:				**$965,250**
R/W : District Fee & Easements				**$0**
Grand Total:				**$965,250**

Feasible Alternatives Costs:
CPE 12: Riparian Restoration (Reach P3: Rock to Middlefield)

Item	Unit	Unit Cost	Amount	Item Cost
Export Soil	Yards^3	$25.0	5,000	$125,000
Rock Weirs	LS	$2,000.0	5	$10,000
Concrete Bank	Yards^3	$850.0	628	$533,800
Reveg Hydroseed	sf	$0.5	18,000	$9,000
Reveg Trees	each	$20.0	1,800	$36,000
Bridge Conforms	each	$25,000.0	2	$50,000
Concrete Removal	Yards^3	$50.0	940	$47,000
Total:				$810,800
Mobilization (10%)				$81,080
Contingency (10%)				$81,080
Subtotal:				$972,960
Design (10%)				$97,296
Geotech (5%)				$48,648
Inspection (10%)				$97,296
Total:				**$1,216,200**
R/W : District Fee & Easements				**$0**
Grand Total:				**$1,216,200**

Feasible Alternatives Costs:
CPE 12: Riparian Restoration (Reach P3: Middlefield to Central)

Item	Unit	Unit Cost	Amount	Item Cost
Export Soil	Yards^3	$25.0	9,740	$243,500
Rock Weirs	LS	$2,000.0	24	$48,000
Concrete Bank	Yards^3	$850.0	2,280	$1,938,000
Reveg Hydroseed	sf	$0.5	44,000	$22,000
Reveg Trees	each	$20.0	4,400	$88,000
Bridge Conforms	each	$25,000.0	12	$300,000
Concrete Removal	Yards^3	$50.0	3,400	$170,000
Total:				$2,809,500
Mobilization (10%)				$280,950
Contingency (10%)				$280,950
Subtotal:				$3,371,400
Design (10%)				$337,140
Geotech (5%)				$168,570
Inspection (10%)				$337,140
Total:				**$4,214,250**
R/W : District Fee & Easements				**$0**
Grand Total:				**$4,214,250**

Feasible Alternatives Costs:
CPE 12: Riparian Restoration (Reach P3: SPRR to Villa)

Item	Unit	Unit Cost	Amount	Item Cost
Export Soil	Yards^3	$25.0	1,820	$45,500
Rock Weirs	LS	$2,000.0	4	$8,000
Concrete Bank	Yards^3	$850.0	430	$365,500
Reveg Hydroseed	sf	$0.5	8,200	$4,100
Reveg Trees	each	$20.0	820	$16,400
Bridge Conforms	each	$25,000.0	2	$50,000
Concrete Removal	Yards^3	$50.0	630	$31,500
Total:				$521,000
Mobilization (10%)				$52,100
Contingency (10%)				$52,100
Subtotal:				$625,200
Design (10%)				$62,520
Geotech (5%)				$31,260
Inspection (10%)				$62,520
Total:				**$781,500**
R/W : District Fee & Easements				**$0**
Grand Total:				**$781,500**

Feasible Alternatives Costs:
CPE 12: Riparian Restoration (Reach H1: Confl. To Arroyo)

Item	Unit	Unit Cost	Amount	Item Cost
Export Soil	Yards^3	$25.0	1,000	$25,000
Rock Weirs	LS	$2,000.0	7	$14,000
Concrete Bank	Yards^3	$850.0	744	$632,400
Reveg Hydroseed	sf	$0.5	20,000	$10,000
Reveg Trees	each	$20.0	2,000	$40,000
Bridge Conforms	each	$25,000.0	3	$75,000
Concrete Removal	Yards^3	$50.0	1,200	$60,000
Total:				$856,400
Mobilization (10%)				$85,640
Contingency (10%)				$85,640
Subtotal:				$1,027,680
Design (10%)				$102,768
Geotech (5%)				$51,384
Inspection (10%)				$102,768
Total:				**$1,284,600**
R/W : District Fee & Easements				**$0**
Grand Total:				**$1,284,600**

Feasible Alternatives Costs:
CPE 12: Riparian Restoration (Reach H1: Arroyo to S. Sunshine)

Item	Unit	Unit Cost	Amount	Item Cost
Export Soil	Yards^3	$25.0	0	$0
Rock Weirs	LS	$2,000.0	16	$32,000
Concrete Bank	Yards^3	$850.0	1,072	$911,200
Reveg Hydroseed	sf	$0.5	11,000	$5,500
Reveg Trees	each	$20.0	1,100	$22,000
Bridge Conforms	each	$25,000.0	6	$150,000
Concrete Removal	Yards^3	$50.0	1,800	$90,000
Total:				$1,210,700
Mobilization (10%)				$121,070
Contingency (10%)				$121,070
Subtotal:				$1,452,840
Design (10%)				$145,284
Geotech (5%)				$72,642
Inspection (10%)				$145,284
Total:				**$1,816,050**
R/W : District Fee & Easements				**$0**
Grand Total:				**$1,816,050**

Feasible Alternatives Costs:
CPE 12: Riparian Restoration (Reach H1: S. Sunshine to Springer)

Item	Unit	Unit Cost	Amount	Item Cost
Export Soil	Yards^3	$25.0	0	$0
Rock Weirs	LS	$2,000.0	2	$4,000
Concrete Bank	Yards^3	$850.0	240	$204,000
Reveg Hydroseed	sf	$0.5	5,000	$2,500
Reveg Trees	each	$20.0	500	$10,000
Bridge Conforms	each	$25,000.0	2	$50,000
Concrete Removal	Yards^3	$50.0	395	$19,750
Total:				$290,250
Mobilization (10%)				$29,025
Contingency (10%)				$29,025
Subtotal:				$348,300
Design (10%)				$34,830
Geotech (5%)				$17,415
Inspection (10%)				$34,830
Total:				**$435,375**
R/W : District Fee & Easements				**$0**
Grand Total:				**$435,375**

Feasible Alternatives Costs:
CPE 12: Riparian Restoration (Reach H1: Springer to Cuesta)

Item	Unit	Unit Cost	Amount	Item Cost
Export Soil	Yards^3	$25.0	0	$0
Rock Weirs	LS	$2,000.0	8	$16,000
Concrete Bank	Yards^3	$850.0	524	$445,400
Reveg Hydroseed	sf	$0.5	10,700	$5,350
Reveg Trees	each	$20.0	1,070	$21,400
Bridge Conforms	each	$25,000.0	2	$50,000
Concrete Removal	Yards^3	$50.0	870	$43,500
Total:				$581,650
Mobilization (10%)				$58,165
Contingency (10%)				$58,165
Subtotal:				$697,980
Design (10%)				$69,798
Geotech (5%)				$34,899
Inspection (10%)				$69,798
Total:				**$872,475**
R/W : District Fee & Easements				**$0**
Grand Total:				**$872,475**

Feasible Alternatives Costs:
CPE 15: El Camino Bypass - Alt E (Pettis to Villa)

Item	Unit	Unit Cost	Amount	Item Cost
Bore and Jack Concrete (under ECR)	Yards^3	$2,550.0	440	$1,122,000
Box Culvert Concrete	Yards^3	$850.0	6,700	$5,695,000
Export Soil	Yards^3	$25.0	21,000	$525,000
Shoring	sf	$20.0	135,000	$2,700,000
Asphalt replacement	yd^2	$10.6	7,000	$74,200
Traffic	ft	$100.0	4,500	$450,000
Total:				$10,566,200
Mobilization (10%)				$1,056,620
Contingency (10%)				$1,056,620
Subtotal:				$12,679,440
Design (10%)				$1,267,944
Geotech (5%)				$633,972
Inspection (10%)				$1,267,944
Total:				**$15,849,300**
R/W : City owned property				**$0**
Grand Total:				**$15,849,300**

Feasible Alternatives Costs:
CPE 15: El Camino Bypass - Alt D (Pettis to Latham)

Item	Unit	Unit Cost	Amount	Item Cost
Bore and Jack Concrete (under ECR)	Yards^3	$2,550.0	440	$1,122,000
Box Culvert Concrete	Yards^3	$850.0	3,300	$2,805,000
Export Soil	Yards^3	$25.0	10,000	$250,000
Shoring	sf	$20.0	66,000	$1,320,000
Asphalt replacement	yd^2	$10.6	3,400	$36,040
Traffic	ft	$100.0	2,200	$220,000
Total:				$5,753,040
Mobilization (10%)				$575,304
Contingency (10%)				$575,304
Subtotal:				$6,903,648
Design (10%)				$690,365
Geotech (5%)				$345,182
Inspection (10%)				$690,365
Total:				**$8,629,560**
R/W : City owned property				**$0**
Grand Total:				**$8,629,560**

Feasible Alternatives Costs:
CPE 15: El Camino Bypass - Alt U (Pettis to Villa)

Item	Unit	Unit Cost	Amount	Item Cost
Bore and Jack 6' RCP (under ECR)	ft	$804.0	300	$241,200
6' RCP Culvert	ft	$268.0	4,500	$1,206,000
Export Soil	Yards^3	$25.0	8,900	$222,500
Shoring	sf	$20.0	99,000	$1,980,000
Asphalt replacement	yd^2	$10.6	4,000	$42,400
Traffic	ft	$100.0	4,500	$450,000
Total:				$4,142,100
Mobilization (10%)				$414,210
Contingency (10%)				$414,210
Subtotal:				$4,970,520
Design (10%)				$497,052
Geotech (5%)				$248,526
Inspection (10%)				$497,052
Total:				**$6,213,150**
R/W : City owned property				**$0**
Grand Total:				**$6,213,150**

Feasible Alternatives Costs:
CPE 16: El Camino Culvert Expansion - Alt D (Latham to Villa)

Item	Unit	Unit Cost	Amount	Item Cost
Box Culvert Concrete	Yards^3	$850.0	3,300	$2,805,000
Export Soil	Yards^3	$25.0	11,000	$275,000
Shoring	sf	$20.0	0	$0
Asphalt replacement	yd^2	$10.6	0	$0
Traffic	LS	$0.0	0	$0
Total:				$3,080,000
Mobilization (10%)				$308,000
Contingency (10%)				$308,000
Subtotal:				$3,696,000
Design (10%)				$369,600
Geotech (5%)				$184,800
Inspection (10%)				$369,600
Total:				**$4,620,000**
R/W : City owned property				**$0**
Grand Total:				**$4,620,000**

Feasible Alternatives Costs:
CPE 18: El Camino Collection Channel - Alt D

Item	Unit	Unit Cost	Amount	Item Cost
5' Dia RCP Pipe	LF	$201.0	1,400	$281,400
9' Dia RCP Pipe	LF	$650.0	1,600	$1,040,000
Export Soil	Yards^3	$25.0	7,600	$190,000
Shoring	sf	$20.0	88,000	$1,760,000
Asphalt replacement	yd^2	$10.6	3,700	$39,220
Traffic	ft	$200.0	3,000	$600,000
Total:				$3,910,620
Mobilization (10%)				$391,062
Contingency (10%)				$391,062
Subtotal:				$4,692,744
Design (10%)				$469,274
Geotech (5%)				$234,637
Inspection (10%)				$469,274
Total:				**$5,865,930**
R/W : State of CA owned property				**$0**
Grand Total:				**$5,865,930**

Feasible Alternatives Costs:
CPE 19: New Diversion Structure - Alt G

Item	Unit	Unit Cost	Amount	Item Cost
Diversion Structure	yds^3	$850.0	300	$255,000
6' Dia RCP Pipe	LF	$268.0	400	$107,200
Export Soil	Yards^3	$25.0	600	$15,000
Shoring	sf	$20.0	8,000	$160,000
Asphalt replacement	yd^2	$10.6	500	$5,300
Traffic	ft	$100.0	400	$40,000
Total:				$582,500
Mobilization (10%)				$58,250
Contingency (10%)				$58,250
Subtotal:				$699,000
Design (10%)				$69,900
Geotech (5%)				$34,950
Inspection (10%)				$69,900
Total:				**$873,750**
R/W : City owned property				**$0**
Grand Total:				**$873,750**

Feasible Alternatives Costs:
CPE 19: New Diversion Structure - Alt S

Item	Unit	Unit Cost	Amount	Item Cost
Diversion Structure	yds^3	$850.0	300	$255,000
8' Dia RCP Pipe	LF	$508.0	400	$203,200
Export Soil	Yards^3	$25.0	1,200	$30,000
Shoring	sf	$20.0	9,000	$180,000
Asphalt replacement	yd^2	$10.6	500	$5,300
Traffic	ft	$100.0	400	$40,000
Total:				$713,500
Mobilization (10%)				$71,350
Contingency (10%)				$71,350
Subtotal:				$856,200
Design (10%)				$85,620
Geotech (5%)				$42,810
Inspection (10%)				$85,620
Total:				**$1,070,250**
R/W : City owned property				**$0**
Grand Total:				**$1,070,250**

Feasible Alternatives Costs:
CPE 20: Flow Detention - Cuesta Annex - Alt S

Item	Unit	Unit Cost	Amount	Item Cost
Clearing & Grubbing	acre	$5,500.0	10	$55,000
Outlet	ft	$89.0	3,200	$284,800
Excavated Earth	Yards^3	$15.0	211,000	$3,165,000
Revegetation (hydroseed)	ft^2	$0.5	436,000	$218,000
Revegetation (trees)	number	$20.0	436	$8,720
Total:				$3,731,520
Mobilization (10%)				$373,152
Contingency (10%)				$373,152
Subtotal:				$4,477,824
Design (10%)				$447,782
Geotech (5%)				$223,891
Inspection (10%)				$447,782
Total:				**$5,597,280**
R/W : City of Mountain View Land				**$0**
Grand Total:				**$5,597,280**

Feasible Alternatives Costs:
CPE 20: Flow Detention - Cuesta Annex - Alt T

Item	Unit	Unit Cost	Amount	Item Cost
Clearing & Grubbing	acre	$5,500.0	12	$66,000
Outlet	ft	$136.0	3,200	$435,200
Excavated Earth	Yards^3	$15.0	363,000	$5,445,000
Revegetation (hydroseed)	ft^2	$0.5	523,000	$261,500
Revegetation (trees)	number	$20.0	523	$10,460
Total:				$6,218,160
Mobilization (10%)				$621,816
Contingency (10%)				$621,816
Subtotal:				$7,461,792
Design (10%)				$746,179
Geotech (5%)				$373,090
Inspection (10%)				$746,179
Total:				**$9,327,240**
R/W : City of Mountain View Land				**$0**
Grand Total:				**$9,327,240**

Feasible Alternatives Costs:
CPE 20: Flow Detention - Cuesta Annex - Alt V

Item	Unit	Unit Cost	Amount	Item Cost
Clearing & Grubbing	acre	$5,500.0	6	$33,000
Outlet	ft	$46.0	3,200	$147,200
Excavated Earth	Yards^3	$15.0	97,000	$1,455,000
Revegetation (hydroseed)	ft^2	$0.5	260,000	$130,000
Revegetation (trees)	number	$20.0	260	$5,200
Total:				$1,770,400
Mobilization (10%)				$177,040
Contingency (10%)				$177,040
Subtotal:				$2,124,480
Design (10%)				$212,448
Geotech (5%)				$106,224
Inspection (10%)				$212,448
Total:				**$2,655,600**
R/W : City of Mountain View Land				**$0**
Grand Total:				**$2,655,600**

Feasible Alternatives Costs:
CPE 20: Flow Detention - Cuesta Annex - Alt W

Item	Unit	Unit Cost	Amount	Item Cost
Clearing & Grubbing	acre	$5,500.0	7	$38,500
Outlet	ft	$68.0	3,200	$217,600
Excavated Earth	Yards^3	$15.0	111,000	$1,665,000
Revegetation (hydroseed)	ft^2	$0.5	305,000	$152,500
Revegetation (trees)	number	$20.0	305	$6,100
Total:				$2,079,700
Mobilization (10%)				$207,970
Contingency (10%)				$207,970
Subtotal:				$2,495,640
Design (10%)				$249,564
Geotech (5%)				$124,782
Inspection (10%)				$249,564
Total:				**$3,119,550**
R/W : City of Mountain View Land				**$0**
Grand Total:				**$3,119,550**

Feasible Alternatives Costs:
CPE 20: Flow Detention - Cuesta Annex - Alt X

Item	Unit	Unit Cost	Amount	Item Cost
Clearing & Grubbing	acre	$5,500.0	10	$55,000
Outlet	ft	$89.0	3,200	$284,800
Excavated Earth	Yards^3	$15.0	208,000	$3,120,000
Revegetation (hydroseed)	ft^2	$0.5	436,000	$218,000
Revegetation (trees)	number	$20.0	436	$8,720
Total:				$3,686,520
Mobilization (10%)				$368,652
Contingency (10%)				$368,652
Subtotal:				$4,423,824
Design (10%)				$442,382
Geotech (5%)				$221,191
Inspection (10%)				$442,382
Total:				**$5,529,780**
R/W : City of Mountain View Land				**$0**
Grand Total:				**$5,529,780**

Feasible Alternatives Costs:
CPE 20: Flow Detention - Cuesta Annex - Alt Y

Item	Unit	Unit Cost	Amount	Item Cost
Clearing & Grubbing	acre	$5,500.0	12	$66,000
Outlet	ft	$136.0	3,200	$435,200
Excavated Earth	Yards^3	$15.0	308,000	$4,620,000
Revegetation (hydroseed)	ft^2	$0.5	523,000	$261,500
Revegetation (trees)	number	$20.0	523	$10,460
Total:				$5,393,160
Mobilization (10%)				$539,316
Contingency (10%)				$539,316
Subtotal:				$6,471,792
Design (10%)				$647,179
Geotech (5%)				$323,590
Inspection (10%)				$647,179
Total:				**$8,089,740**
R/W : City of Mountain View Land				**$0**
Grand Total:				**$8,089,740**

CPE's cost updated
same as CPE's cost, except updated the channel widening cost of Alt U
Needed to update to include all of reach P3.

Table E3 - Feasible Alts Maintenance Costs

Alternative:	CPE:	Yearly Maintenance Cost:	Yearly Replacement Cost for Improvements:	Total Yearly Cost:	Cost over 50-year Lifespan:
A	1	$120,000	$460,500	$580,500	$29,025,000
D	1	$120,000	$0	$120,000	$6,000,000
	7	$5,000	$22,750	$27,750	$1,387,500
	8	$5,000	$67,500	$72,500	$3,625,000
	9	$10,000	$32,500	$42,500	$2,125,000
	10	$0	$218,500	$218,500	$10,925,000
	15	$5,000	$21,500	$26,500	$1,325,000
	16	$0	$11,500	$11,500	$575,000
	18	$5,000	$14,750	$19,750	$987,500
Total:		**$150,000**	**$389,000**	**$539,000**	**$26,950,000**
E	1	$120,000	$0	$120,000	$6,000,000
	7	$5,000	$22,750	$27,750	$1,387,500
	8	$5,000	$67,500	$72,500	$3,625,000
	9	$10,000	$32,500	$42,500	$2,125,000
	10	$0	$218,500	$218,500	$10,925,000
	15	$5,000	$39,500	$44,500	$2,225,000
	18	$5,000	$14,750	$19,750	$987,500
Total:		**$150,000**	**$395,500**	**$545,500**	**$27,275,000**
G	1	$90,000	$0	$90,000	$4,500,000
	2	$200,000	$29,500	$229,500	$11,475,000
	3	$10,000	$0	$10,000	$500,000
	5	$20,000	$0	$20,000	$1,000,000
	7	$5,000	$22,750	$27,750	$1,387,500
	9	$10,000	$12,500	$22,500	$1,125,000
	10	$0	$66,500	$66,500	$3,325,000
	12	$20,000	$0	$20,000	$1,000,000
	19	$10,000	$1,500	$11,500	$575,000
	Structural		$96,000	$96,000	$4,800,000
Total:		**$365,000**	**$132,750**	**$497,750**	**$29,687,500**
S	1	$120,000	$0	$120,000	$6,000,000
	3	$10,000	$0	$10,000	$500,000
	5	$20,000	$0	$20,000	$1,000,000
	7	$5,000	$22,750	$27,750	$1,387,500
	8	$5,000	$14,750	$19,750	$987,500
	9	$10,000	$12,500	$22,500	$1,125,000

Table E3 - Feasible Alts Maintenance Costs

	10	$0	$66,500	$66,500	$3,325,000
	12	$20,000	$0	$20,000	$1,000,000
	19	$10,000	$2,750	$12,750	$637,500
	20	$8,000	$0	$8,000	$400,000
	Structural		$96,000	$96,000	$4,800,000
Total:		**$208,000**	**$119,250**	**$327,250**	**$21,162,500**
T	1	$120,000	$0	$120,000	$6,000,000
	5	$20,000	$0	$20,000	$1,000,000
	7	$5,000	$22,750	$27,750	$1,387,500
	8	$5,000	$42,250	$47,250	$2,362,500
	9	$10,000	$12,500	$22,500	$1,125,000
	10	$0	$66,500	$66,500	$3,325,000
	12	$20,000	$0	$20,000	$1,000,000
	19	$10,000	$2,750	$12,750	$637,500
	20	$8,000	$0	$8,000	$400,000
	Structural		$96,000	$96,000	$4,800,000
Total:		**$198,000**	**$146,750**	**$344,750**	**$22,037,500**
U	1	$90,000	$0	$90,000	$4,500,000
	2	$200,000	$29,500	$229,500	$11,475,000
	3	$10,000	$0	$10,000	$500,000
	7	$5,000	$22,750	$27,750	$1,387,500
	9	$10,000	$25,500	$35,500	$1,775,000
	10	$0	$150,000	$150,000	$7,500,000
	15	$5,000	$15,500	$20,500	$1,025,000
	19	$10,000	$1,500	$11,500	$575,000
Total:		**$330,000**	**$244,750**	**$574,750**	**$28,737,500**
V	1	$90,000	$0	$90,000	$4,500,000
	2	$200,000	$29,500	$229,500	$11,475,000
	3	$10,000	$0	$10,000	$500,000
	7	$5,000	$22,750	$27,750	$1,387,500
	7 ext.	$5,000	$27,750	$32,750	$1,637,500
	9	$10,000	$12,500	$22,500	$1,125,000
	10	$0	$25,500	$25,500	$1,275,000
	12	$20,000	$0	$20,000	$1,000,000
	19	$10,000	$1,500	$11,500	$575,000
	20	$8,000	$0	$8,000	$400,000
	Structural		$96,000	$96,000	$4,800,000

Table E3 - Feasible Alts Maintenance Costs

Total:		**$358,000**	**$119,500**	**$477,500**	**$28,675,000**
W	1	$90,000	$0	$90,000	$4,500,000
	2	$200,000	$29,500	$229,500	$11,475,000
	5	$20,000	$0	$20,000	$1,000,000
	7	$5,000	$22,750	$27,750	$1,387,500
	8	$5,000	$16,750	$21,750	$1,087,500
	9	$10,000	$12,500	$22,500	$1,125,000
	10	$0	$66,500	$66,500	$3,325,000
	12	$20,000	$0	$20,000	$1,000,000
	19	$10,000	$2,750	$12,750	$637,500
	20	$8,000	$0	$8,000	$400,000
	Structural		$96,000	$96,000	$4,800,000
Total:		**$368,000**	**$150,750**	**$518,750**	**$30,737,500**
X	1	$90,000	$0	$90,000	$4,500,000
	2	$200,000	$29,500	$229,500	$11,475,000
	7	$5,000	$22,750	$27,750	$1,387,500
	7 ext.	$5,000	$27,750	$32,750	$1,637,500
	8	$5,000	$16,750	$21,750	$1,087,500
	9	$10,000	$12,500	$22,500	$1,125,000
	10	$0	$25,500	$25,500	$1,275,000
	12	$20,000	$0	$20,000	$1,000,000
	19	$10,000	$2,750	$12,750	$637,500
	20	$8,000	$0	$8,000	$400,000
	Structural		$96,000	$96,000	$4,800,000
Total:		**$353,000**	**$137,500**	**$490,500**	**$29,325,000**
Y	1	$120,000	$0	$120,000	$6,000,000
	3	$10,000	$0	$10,000	$500,000
	7	$5,000	$22,750	$27,750	$1,387,500
	7 ext.	$5,000	$27,750	$32,750	$1,637,500
	8	$5,000	$11,500	$16,500	$825,000
	9	$10,000	$12,500	$22,500	$1,125,000
	10	$0	$25,500	$25,500	$1,275,000
	12	$20,000	$0	$20,000	$1,000,000
	19	$10,000	$1,500	$11,500	$575,000
	20	$8,000	$0	$8,000	$400,000
	21	$20,000	$0	$20,000	$1,000,000
	Structural		$96,000	$96,000	$4,800,000

Table E3 - Feasible Alts Maintenance Costs

Total:		**$213,000**	**$101,500**	**$294,500**	**$20,525,000**
Z	1	$120,000	$0	$120,000	$6,000,000
	3	$10,000	$0	$10,000	$500,000
	5	$20,000	$0	$20,000	$1,000,000
	7	$5,000	$22,750	$27,750	$1,387,500
	8	$5,000	$11,500	$16,500	$825,000
	9	$10,000	$12,500	$22,500	$1,125,000
	10	$0	$66,500	$66,500	$3,325,000
	12	$20,000	$0	$20,000	$1,000,000
	19	$10,000	$1,500	$11,500	$575,000
	20	$8,000	$0	$8,000	$400,000
	21	$20,000	$0	$20,000	$1,000,000
	Structural		$96,000	$96,000	$4,800,000
Total:		**$228,000**	**$210,750**	**$438,750**	**$21,937,500**

Basis:

CPE #	Description:
1:	Current maintenance cost based on sed. And veg. maint. costs over recent 10-year period. Alts with dam reduce by 25%. Diversion restoration reduces by 75%. No project structural replacement cost assumes 50% of the existing channels (15,350 feet) will fail over next 50 years and must be replaced @ $3000 per foot (per 2002 maint. project in Reach P5).
2:	Yearly maintenance for dam is $200,000 incl. sed., veg., and safety programs. Structural replacement cost assumes 50% replacement over 100 years.
3:	Yearly maintenance is $5000 for inlet/outlet and $5000 for very limited veg. maint.
5:	Yearly maintenance is $5000 for inlet/outlet and $15000 for post-flood field clean-up maintenance (assumed 150,000 per event @ 10% per year chance).
7, 8, 15, 16:	For all bypasses and diversions, yearly maintenance is $5000 for inlet/outlet. Structural replacement cost assumes 25% replacement over 100 years.
9:	Yearly maintenance is $10,000 for graffitti and weed control. Structural replacement cost assumes 50% replacement over 100 years.
10:	Yearly maintenance is zero, since it is accounted for in item #1. Structural replacement cost assumes 50% replacement over 100 years.
12:	Yearly maintenance is $20,000 for veg. management and bank repair for alts with riparian restoration.
19:	For new diversion structure, yearly maintenance is $10,000 for inlet/outlet. Structural replacement cost assumes 25% replacement over 100 years.
20:	Yearly maintenance is $5000 for inlet/outlet and $3000 for post-flood field clean-up maintenance (assumed 150,000 per event @ 2% per year chance).
21:	Yearly maintenance is $5000 for inlet/outlet and $15000 for post-flood field clean-up maintenance (assumed 150,000 per event @ 10% per year chance).
Structural:	Since the worst portions of deteriorating concrete channels are removed, it is assumed that approximately 25% of the 4200 feet of channel from Middlefield rd to Villa Street and 25% of the remaining 2300 feet of H1 (not rebuilt) totalling 1600 feet would be replaced over 50 years as needed @ $3000 per foot

Table E.4 - Feasible Alternatives Costs Summary Table

Project Element:	Alt. D	Alt. E	Alt. G	Alt. S	Alt. T	Alt. U	Alt. V	Alt. W	Alt. X	Alt. Y	Alt. Z
	Channel Widening, El Camino Bypass, El Camino Culvert, Floodwalls, Flood Collection Channel, Permanente and Hale Bypasses	Channel Widening, El Camino Bypass, Floodwalls, Flood Collection Channel, Permanente and Hale Bypasses	Flow Detention (Hanson Dam, Rancho San Antonio, McKelvey Park), Hale Bypass, Hale Channel Widening	Flow Detention (Rancho San Antonio, Cuesta Annex, McKelvey), Hale Bypass, Hale Channel Widening	Flow Detention (Cuesta Annex, McKelvey), Hale Bypass, Hale Channel Widening	Flow Detention (Hanson Dam, Rancho San Antonio), Channel Widening, El Camino Culvert, Permanente and Hale Bypasses	Flow Detention (Hanson Dam, Rancho San Antonio, Cuesta Annex), Ext. Hale Bypass	Flow Detention (Hanson Dam, Cuesta Annex, McKelvey), Hale Bypass, Hale Channel Widening	Flow Detention (Hanson Dam, Cuesta Annex), Ext. Hale Bypass	Flow Detention (Rancho San Antonio, Cuesta Annex), Ext. Hale Bypass	Flow Detention (Rancho San Antonio, Blach School, McKelvey, Cuesta), Hale Bypass
2: Flow Detention - South Branch Dam			**$6.6**			**$6.6**	**$6.6**	**$6.6**	**$6.6**		
3: Flow Detention - Rancho San Antonio			**$5.5**	**$5.5**		**$5.5**	**$5.5**			**$5.5**	**$5.5**
5: Flow Detention - McKelvey Park			**$9.1**	**$9.1**	**$9.1**			**$9.1**			**$9.1**
7: Hale Bypass	*$10.2*	*$10.2*	*$10.2*	*$10.2*	*$10.2*	*$10.2*	*$10.2*	*$10.2*	*$10.2*	*$10.2*	*$10.2*
7: Hale Bypass Extension to Cuesta							**$12.4**		**$12.4**	**$12.4**	
8: Permanente Bypass	*$30.2*	*$30.2*		*$6.6*	*$18.9*			*$7.5*	*$7.5*	**$5.2**	**$5.2**
9: Floodwalls (d/s of Hwy 101)	**$7.3**	**$7.3**	**$2.8**	**$2.8**	**$2.8**	**$5.7**	**$2.8**	**$2.8**	**$2.8**	**$2.8**	**$2.8**
10: Channel Widening (Reach P3)	**$30.7**	**$30.7**				**$19.2**					
10: Channel Widening (Reach P5)	*$8.5*	*$8.5*	**$5.2**	**$5.2**	**$5.2**	**$4.7**	**$4.7**	**$5.2**	**$4.7**	**$4.7**	**$5.2**
10: Channel Widening (Reach H1: confl to Marilyn)	*$1.6*	*$1.6*	**$1.6**	**$1.6**	**$1.6**	**$1.6**		**$1.6**			**$1.6**
10: Channel Widening (Reach H1: Marilyn to Rosita)	*$8.2*	*$8.2*	*$8.2*	*$8.2*	*$8.2*	*$8.2*	**$1.0**	*$8.2*	**$1.0**	**$1.0**	*$8.2*
15: El Camino Bypass	**$9.6**	**$17.7**				**$6.9**					
16: El Camino Culvert Expansion	**$5.2**										
18: Flood Collection Channel	**$6.6**	**$6.6**									
19: New Diversion Structure			**$0.7**	*$1.2*	*$1.2*	**$0.7**	**$0.7**	*$1.2*	*$1.2*	**$0.7**	**$0.7**
20. Flow Detention - Cuesta Annex				**$16.8**	**$10.4**		**$3.0**	**$3.5**	**$16.7**	**$16.8**	**$3.6**
21. Blach School Detention										**$6.3**	**$6.3**
Current Clean Safe Creeks Phase Cost (for protection up to El Camino Real):	**$59.4**	**$62.3**	**$31.5**	**$41.0**	**$29.1**	**$50.9**	**$36.7**	**$28.8**	**$44.2**	**$55.4**	**$40.0**
Estimated number of Parcels Protected:	**1,670**	**1,670**	**2,470**	**2,190**	**2,190**	**2,470**	**2,870**	**2,190**	**2,570**	**2,870**	**2,470**
Estimated parcels Remaining in SCVWD Floodplain:	1,500	1,500	700	980	980	700	310	980	600	310	700
Additional Capital Funds Needed to provide protection up to Foothill Ex.:	*$58.7*	*$58.7*	*$18.4*	*$26.2*	*$38.5*	*$18.4*	*$10.2*	*$27.1*	*$18.9*	*$10.2*	*$18.4*
Concrete Channel Removal and Revegetation:	**$0.0**	**$0.0**	**$3.5**	**$3.5**	**$3.5**	**$3.5**	**$3.5**	**$3.5**	**$3.5**	**$3.5**	**$3.5**
Total Capital Cost:	**$118.1**	**$121.0**	**$49.9**	**$67.2**	**$67.6**	**$69.3**	**$46.9**	**$55.9**	**$63.1**	**$65.6**	**$58.4**
50-year Estimated Maintenance Cost:	**$27.0**	**$27.3**	**$29.7**	**$21.2**	**$22.0**	**$28.7**	**$28.7**	**$30.7**	**$29.3**	**$20.5**	**$21.9**
Total 50-year Cost:	**$145.1**	**$148.3**	**$83.1**	**$91.9**	**$93.1**	**$101.5**	**$79.1**	**$90.1**	**$95.9**	**$89.6**	**$83.8**
Issues:	Exceeds CSC Funds	Exceeds CSC Funds	Dam, County, McKelvey	County, McKelvey, Cuesta	McKelvey, Cuesta	Dam, County, exceeds funds	Dam, County, Cuesta	Dam, McKelvey, Cuesta	Dam, Cuesta	County, Cuesta	County, McKelvey, Blach, Cuesta

Note: all costs in millions (2008 $)

CSC costs (shown in BOLD blue font) address the improvements that are needed for protection d/s of El Camino Real

Non-CSC costs (shown in italicized red font) are for additional elements.

mitigation costs for south branch dam not included

APPENDIX F

NFP Details

The following details the NFP ratings process followed by the project team. The project team rated each criterion for each feasible project alternative. This is the basis of the summary tables provided in the main text of the engineers report.

Table F1: NFP Criteria Ratings
Table F2: NFP Objective Rating Calculation

Notes:

1) Criteria were rated by the project team, other District experts, and Jones and Stokes

2) The environmental impacts objective was rated by project manager

3) The objective ratings calculation is per the August 2005 NFP manual

Permanente Creek Planning Study

Natural Flood Protection (NFP) Criteria Ratings

Notes:

(1) Each NFP criterion is rated for each alternative

(2) Criterion rating guidance is from August 2005 NFP manual

(3) The ratings are according to the following key:

0 = Unacceptable
1 = Poor
2 = Fair
3 = Adequate
4 = Very good
5 = Outstanding

Objective 1—Provide Protection from Flood Damage

Criterion 1: Safety – Protection of public safety if conditions exceed design assumptions

Rating Guidance:

Outstanding: Alternative continues to provide for public safety when flows exceed design flow

Adequate: Alternative improves safety compared to existing conditions when flows exceed design flow

Poor: Alternative provides safety only up to design flow

Unacceptable: Flood hazard is increased relative to existing conditions for flows exceeding design flow

Alternative	Rating	Score	Comments
A	Fair	2	Does not improve on current conditions
D	Adequate	3	Cost prohibits designing to exceed the Adequate level. Rebuilt concrete channels remove threat of structural failure.
E	Adequate	3	Same as alt D.
G	Poor	1	Small but catastrophic risk of dam failure introduced. However, alternative also includes means to reduce peak flows downstream.
S	Adequate	3	Alternative includes means to reduce peak flows downstream.
T	Adequate	3	Same as Alt S.
U	Poor	1	Same as Alt G.
V	Poor	1	Same as Alt G.
W	Poor	1	Same as Alt G.
X	Poor	1	Same as Alt G.
Y	Adequate	3	Same as Alt S.
Z	Adequate	3	Same as Alt S.

Objective 1—Flooding

Criterion 2: Economic Protection – Protection from damage due to floodwater, erosion or sediment for homes, schools, businesses, transportation systems and other infrastructure

Rating guidance:

Outstanding: exceeds federal and local standards for flood protection facilities.

Adequate: meets federal standards for flood protection facilities.

Poor: floods less than design flood may cause damage to instream features

Unacceptable: flows less than the design flood would likely cause substantial damage to instream features

Alternative	Rating	# Score	Comments
A	Unacceptable	0	Channel features are likely to fail due to less than design flood flows.
D	Very Good	4	All features will be designed to meet Corps of Engineers, FEMA, and local standards.
E	Very Good	4	Same as alt D.
G	Very Good	4	Same as alt D.
S	Very Good	4	Same as alt D.
T	Very Good	4	Same as alt D.
U	Very Good	4	Same as alt D.
V	Very Good	4	Same as alt D.
W	Very Good	4	Same as alt D.
X	Very Good	4	Same as alt D.
Y	Very Good	4	Same as alt D.
Z	Very Good	4	Same as alt D.

Objective 1—Flooding

Criterion 3: Durability – Future District effort required to maintain design level of protection

Rating Guidelines:

Outstanding: level of protection virtually independent of future actions

Adequate: level of protection dependent on future actions which are realistic to apply

Poor: level of protection dependent on future actions which may be difficult to apply

Unacceptable: level of protection dependent on intense level of future action which may fail

Alternative	Rating	# Score	Comments
A	Poor	1	Channel monitoring and replacement needed on yearly basis due to danger of imminent structural failure.
D	Fair	2	Current sediment maintenance would continue. Some additional maintenance needed in bypass inlets. Channel failure problem addressed. Concrete channels would need to be replaced in time.
E	Fair	2	Same as alt D.
G	Fair	2	Dam would require frequent maintenance. Slightly reduced d/s sediment maintenance. Dam would need to be repaired or replaced with time.
S	Adequate	3	Current sediment maintenance would continue.
T	Adequate	3	Same as alt S.
U	Fair	2	Same as alt G.
V	Fair	2	Same as alt G.
W	Fair	2	Same as alt G.
X	Fair	2	Same as alt G.
Y	Adequate	3	Same as alt S.
Z	Adequate	3	Same as alt S.

Objective 1—Flooding

Criterion 4: Resiliency – Adaptability to future changes

Rating guidance:

Outstanding: Channel design would accommodate additional future features such as added capacity if needed.

Adequate: Channel design conveys runoff for the full buildout condition.

Poor: Channel designed to convey runoff from existing development.

Unacceptable: Channel design does not convey current design flows.

Alternative	Rating	# Score	Comments
A	Unacceptable	0	Channel cannot carry design flows.
D	Outstanding	5	Channels could carry added capacity by floodwall additions.
E	Outstanding	5	Same as alt D.
G	Adequate	3	Added future capacity would require overall system improvements, since detention alts are built for a specific flow profile.
S	Adequate	3	Same as alt G.
T	Adequate	3	Same as alt G.
U	Adequate	3	Same as alt G.
V	Adequate	3	Same as alt G.
W	Adequate	3	Same as alt G.
X	Adequate	3	Same as alt G.
Y	Adequate	3	Same as alt G.
Z	Adequate	3	Same as alt G.

Objective 1—Flooding

Criterion 5: Local Drainage – Support of local storm drain systems

Rating guidance:

Outstanding: alternative design improves local drainage in storm sewers

Adequate: alternative accommodates drainage input and does not exacerbate local flooding

Poor: alternative accommodates local drainage but may increase local flooding somewhat

Unacceptable: alternative does not accommodate local drainage systems

Alternative	Rating	# Score	Comments
A	Adequate	3	Current system.
D	Adequate	3	Would increase channel capacity but not substantially lower water depths.
E	Adequate	3	Same as alt D.
G	Very good	4	Would reduce flowrates and thus substantially improve local drainage (during major storms only).
S	Very good	4	Same as alt G.
T	Very good	4	Same as alt G.
U	Very good	4	Same as alt G.
V	Very good	4	Same as alt G.
W	Very good	4	Same as alt G.
X	Very good	4	Same as alt G.
Y	Very good	4	Same as alt G.
Z	Very good	4	Same as alt G.

Objective 1—Flooding

Criterion 6: Time to Implementation – How quickly could flood protection elements become effective

Rating guidance:

Outstanding: least amount of time to implementation compared to other alternatives

Adequate: average amount of time compared to other alternatives

Poor: longest amount of time compared to other alternatives

Unacceptable: Indefinite time

Alternative	Rating	# Score	Comments
A	Outstanding	5	Matches existing setup; therefore, no time needed.
D	Fair	2	Construction techniques very straightforward; however, extreme and unfunded expenses of the work required under this alternative would cause a rating of poor. Also, very long bypass channels and bypass under El Camino Real.
E	Fair	2	Same as alt D.
G	Fair	2	Detention alts would provide rapid (immediately post-construction) flood reduction. Dam will require long study/design time. Bypass channels will take time. McKelvey Park may require long lead time.
S	Adequate	3	Detention alts would provide immediate flood reduction. Bypass channels will take time. Cuesta and McKelvey may require long lead time.
T	Adequate	3	Same as alt S.
U	Fair	2	Same as alt G.
V	Fair	2	Same as alt G.
W	Fair	2	Same as alt G.
X	Fair	2	Same as alt G.
Y	Adequate	3	Same as alt T.
Z	Adequate	3	Same as alt S.

Objective 2—Support Ecologic Functions and Processes

Criterion 1: Meets Local Habitat Goals – Ability to meet habitat goals as defined from examining the watershed as a whole

Rating guidance:

Outstanding: alternative meets or exceeds local habitat goals

Adequate: alternative meets some local habitat goals and is not in conflict with others

Poor: alternative is in conflict with a few local habitat goals

Unacceptable: alternative is in conflict with most local habitat goals

Alternative	Rating	# Score	Comments
A	Unacceptable	0	See breakdown on Habitat Goals Checklist (next page). This alt generally keeps the status quo and protects existing habitat values with no restoration.
D	Unacceptable	0	Protects existing habitat values with no restoration.
E	Unacceptable	0	Same as alt D.
G	Poor		Dam would impact potentially critical (special species) habitat area. Riparian restoration downstream left to maintenance program and is not budgeted under CSC program.
S	Adequate	3	No dam impacts. Riparian restoration downstream.
T	Adequate	3	Same as alt S.
U	Unacceptable	0	Combines non-restoration elements of alt D with dam impacts of alt G.
V	Poor	1	Same as alt G.
W	Poor	1	Same as alt G.
X	Poor	1	Same as alt G.
Y	Adequate	3	Same as alt S.
Z	Adequate	3	Same as alt S.

Habitat Goals Checklist

Source	Goal	Status of Feasible Alternatives											
		A	D	E	G	S	T	U	V	W	X	Y	Z
Santa Clara County General Plan	*Water supply resources*												
	Restore wetlands, riparian areas, and other habitats that improve Bay water quality.	X	X	X	*	*	*	X	*	*	*	*	*
	Habitat and biodiversity												
	Improve current knowledge and awareness of habitats and natural areas.	X	X	X	*	*	*	X	*	*	*	*	*
	Protect the biological integrity of critical habitat areas.	**	**	**	X	**	**	X	X	X	X	**	**
	Encourage habitat restoration.	X	X	X	*	*	*	X	*	*	*	*	*
Mountain View General Plan	Preserve and enhance the diversity of biological resources in Mountain View.	*	*	*	*	*	*	X	*	*	*	*	*
Los Altos General Plan	Preserve and protect natural areas—natural creek channels, topography, and vegetation—which are valuable natural resources,	**	**	**	X	**	**	X	X	X	X	**	**
Watershed Management Initiative	Protect and/or restore streams, reservoirs, wetlands and the Bay for the benefit of fish, wildlife and human uses.	X	X	X	*	**	**	X	*	*	*	**	**
SCVWD Lower Peninsula Watershed Stewardship Plan	No independent goals, but requires consistency with District's Ends Policies.	X	X	X	*	**	**	*	*	*	*	**	**
SCVWD Ends Policies	E-2.2.2—There is a balance between the contributions of watersheds and streams in providing for public health and safety and in providing protection of natural resource benefits.	X	X	X	*	**	**	X	*	*	*	**	**

Key to Status:

*** = would exceed goal   ** = would meet goal   * = would partially meet goal

X = would not meet goal

Objective 2—Support Ecologic Functions and Processes

Criterion 2: Habitat Provided – Assesses quality of habitat provided by alternative

Rating guidance:

Outstanding: relatively undisturbed habitat, native plants, high potential to meet needs of fish and wildlife in all phases of lifecycle

Adequate: Adequately support the needs of fish and wildlife in all phases of lifecycle

Poor: Alternative focuses primarily on special needs of threatened or endangered species

Unacceptable: does not provide any habitat value

Alternative	Rating	# Score	Comments
A	Unacceptable	0	No new habitat values provided.
D	Unacceptable	0	Same as alt A.
E	Unacceptable	0	Same as alt A.
G	Fair	2	Partial riparian restoration opportunity in lower part of reach P3. Restoration is part of long term maintenance program and will be implemented on as-needed and as-funds-available basis.
S	Fair	2	Same as alt G.
T	Fair	2	Same as alt G.
U	Unacceptable	0	Same as alt A.
V	Fair	2	Same as alt G.
W	Fair	2	Same as alt G.
X	Fair	2	Same as alt G.
Y	Fair	2	Same as alt G.
Z	Fair	2	Same as alt G.

Objective 2—Support Ecologic Functions and Processes

Criterion 3: Sustainability of Habitat – Assesses intensity of future actions required to maintain design habitat quality

Rating guidance:

Outstanding: minimal channel maintenance, banks dynamically stable, vegetation to be self-sustaining

Adequate: periodic selective thinning of vegetation, banks dynamically stable, short-term establishment period needed

Poor: regular maintenance anticipated, channel banks may require stabilization over time, intervention needed to maintain vegetation over long term

Unacceptable: regular vegetation removal, unstable banks, constant irrigation needed

Alternative	Rating	# Score	Comments
A	N/A	N/A	No new plantings provided.
D	N/A	N/A	Same as alt A.
E	N/A	N/A	Same as alt A.
G	Adequate	3	Periodic selective thinning of vegetation until plant maturity and establishment. Stable bank side slopes.
S	Adequate	3	Same as alt G.
T	Adequate	3	Same as alt G.
U	N/A	N/A	Same as alt A.
V	Adequate	3	Same as alt G.
W	Adequate	3	Same as alt G.
X	Adequate	3	Same as alt G.
Y	Adequate	3	Same as alt G.
Z	Adequate	3	Same as alt G.

Objective 2—Support Ecologic Functions and Processes

Criterion 4: Connectivity of Habitat – Assesses integration of habitat elements into surrounding landscape

Rating guidance:

Outstanding: continuous riparian corridor appropriately integrated, creek and floodplain connected laterally

Adequate: contiguous wildlife-accessible corridor connected to habitat mosaic, floodplain not fully connected (and not fully unconnected) to riparian zone

Poor: non-contiguous riparian wildlife corridor, floodplain not connected to riparian zone

Unacceptable: not integrated into surrounding habitat

Alternative	Rating	# Score	Comments
A	Poor	1	No new plantings provided. Current culverts and concrete channel reaches unchanged.
D	Poor	1	Same as alt A.
E	Poor	1	Same as alt A.
G	Fair	2	Riparian restoration would offer localized habitat. But long underground culverts and lack of floodplain connectivity would continue.
S	Fair	2	Same as alt G.
T	Fair	2	Same as alt G.
U	Poor	1	Same as alt A.
V	Fair	2	Same as alt G.
W	Fair	2	Same as alt G.
X	Fair	2	Same as alt G.
Y	Fair	2	Same as alt G.
Z	Fair	2	Same as alt G.

Objective 3—Physical Stream Functions and Processes

Criterion 1: Floodplain – Inclusion of appropriately sized floodplain

Rating guidance:

Outstanding: active channel connected to floodplain at bankfull level, floodplain has adequate width.

Adequate: modified floodplain, active channel, limited r/w may require containment means, or bypass channel used

Poor: flow will not spread out laterally, multi-stage channel, but not at bankfull level

Unacceptable: single-phase channel

Alternative	Rating	# Score	Comments
A	Unacceptable	0	Single-phase channel.
D	Poor	1	Single-phase concrete channel. Bypass channels u/s remove stress from natural channels and serve modified floodplain function.
E	Poor	1	Same as alt D.
G	Adequate	3	Detention ponds and bypass channels act as surrogate floodplains and remove stress from active channel. Riparian restoration areas built with multi-stage channels but lack adequate floodplain width due to limited r/w available.
S	Adequate	3	Same as alt G.
T	Adequate	3	Same as alt G.
U	Fair	2	Same as alt D, except also floodplain function provided by detention.
V	Adequate	3	Same as alt G.
W	Adequate	3	Same as alt G.
X	Adequate	3	Same as alt G.
Y	Adequate	3	Same as alt G.
Z	Adequate	3	Same as alt G.

Objective 3—Physical Stream Functions and Processes

Criterion 2: Active Channel – Appropriateness of size and configuration of active channel

Rating guidance:

Outstanding: appropriate active channel shape, meander length, curve radius, amplitude, belt width, sediment carrying capability, mobile bed, pool riffle sequence, tidal processes. Control structures unnecessary.

Adequate: active channel with stable width and depth, rock or other hardscape used to prevent erosion, small drops, hardened one-side channels to maximize floodplain width

Poor: active channel incorporated, unknown if effective

Unacceptable: no active channel

Alternative	Rating	# Score	Comments
A	Unacceptable	0	Single-phase channel.
D	Unacceptable	0	Same as alt A.
E	Unacceptable	0	Same as alt A.
G	Adequate	3	Restoration areas would include active channel with hardened one-bank design to accommodate widest possible floodplain bench. Excessive slope energy dissipated using small controlled drops.
S	Adequate	3	Same as alt G.
T	Adequate	3	Same as alt G.
U	Unacceptable	0	Same as alt A.
V	Adequate	3	Same as alt G.
W	Adequate	3	Same as alt G.
X	Adequate	3	Same as alt G.
Y	Adequate	3	Same as alt G.
Z	Adequate	3	Same as alt G.

Objective 3—Physical Stream Functions and Processes

Criterion 3: Stable Side Slopes – Stability of side slopes

Rating guidance:

Outstanding: all side slopes stable through use of proper slope ratios, materials, and vegetation

Adequate: side slopes protected through biotech means

Poor: side slopes protected using hardscape

Unacceptable: side slopes unstable and unprotected

Alternative	Rating	# Score	Comments
A	Poor	1	Side slopes concrete lined or protected with other hardscape.
D	Poor	1	Same as alt A.
E	Poor	1	Same as alt A.
G	Adequate	3	Restoration area side slopes would be laid back to 1.5:1 side slopes which would require biotech stabilization.
S	Adequate	3	Same as alt G.
T	Adequate	3	Same as alt G.
U	Poor	1	Same as alt A.
V	Adequate	3	Same as alt G.
W	Adequate	3	Same as alt G.
X	Adequate	3	Same as alt G.
Y	Adequate	3	Same as alt G.
Z	Adequate	3	Same as alt G.

Objective 3—Physical Stream Functions and Processes

Criterion 4: Transitions – Stability of channel’s integration with upstream and downstream reaches

Rating guidance:

Outstanding: invert integrated so that it transitions seamlessly with stable u/s and d/s reaches, no abrupt changes in grade or direction of flow

Adequate: requires small stabilizing grade controls (<18”)

Poor: large (>18”) hardscaped grade control needed

Unacceptable: unstable transitions between u/s and d/s reaches

Alternative	Rating	# Score	Comments
A	Poor	1	Large stable drop structures needed.
D	Poor	1	Same as alt A.
E	Poor	1	Same as alt A.
G	Adequate	3	Riparian restoration areas designed with <18” drops.
S	Adequate	3	Same as alt G.
T	Adequate	3	Same as alt G.
U	Poor	1	Same as alt A.
V	Adequate	3	Same as alt G.
W	Adequate	3	Same as alt G.
X	Adequate	3	Same as alt G.
Y	Adequate	3	Same as alt G.
Z	Adequate	3	Same as alt G.

Objective 4—Minimize Maintenance Requirements

Criterion 1: Structural Features – Maintenance associated with structures

Rating guidance:

Outstanding: no structural features requiring maintenance

Adequate: need for features requiring maintenance reduced compared to existing

Poor: maintenance required roughly similar to existing

Unacceptable: more structural features than existing

Alternative	Rating	# Score	Comments
A	Unacceptable	0	Large amount of maintenance due to failing structures.
D	Unacceptable	0	More structures than existing features. Structural failure issue addressed but only temporarily (by construction of more structural features). New structures will fail in time requiring replacement.
E	Unacceptable	0	Same as alt D.
G	Poor	1	Some structural features removed and concrete channel failure issue addressed. Many new features (bypasses, detention basins, and the dam) added. On balance, similar effort to current expected.
S	Adequate	3	Same as alt G but no dam. Therefore, somewhat lower level of maintenance effort than current.
T	Adequate	3	Same as alt S.
U	Unacceptable	0	Even worse than alt D, since dam is added.
V	Poor	1	Same as alt G.
W	Poor	1	Same as alt G.
X	Poor	1	Same as alt G.
Y	Adequate	3	Same as alt S.
Z	Adequate	3	Same as alt S.

Objective 4 – Minimize Maintenance Requirements

Criterion 2: Natural Processes – Maintenance associated with vegetation, erosion, and sediment

Rating guidance:

Outstanding: sediment and vegetation removal and bank repair not expected in 100 yeas

Adequate: sediment and vegetation removal and bank repair expected to be infrequent (about 10 years apart), multi-stage channel used

Poor: sediment and vegetation removal and bank repair expected on about three year cycle, no multi-stage channel

Unacceptable: yearly maintenance expected, single-phase channel

Alternative	Rating	# Score	Comments
A	Unacceptable	0	Yearly maintenance required with single-stage channel.
D	Poor	1	Current near-yearly sediment maintenance would continue. Bypasses would relieve some stress from natural channels. Single-stage channels.
E	Poor	1	Same as alt D.
G	Fair	2	Sediment control would reduce somewhat due to dam. More veg maintenance due to riparian areas. Reduced stress on natural channels due to bypasses and detention. Multi-stage channel in riparian areas.
S	Poor	1	Same as alt G but no dam. Therefore, current sediment removal effort would continue.
T	Poor	1	Same as alt S.
U	Fair	2	Same as D, however, flow reduction would reduce sediment production and further reduce stress on channels.
V	Fair	2	Same as alt G.
W	Fair	2	Same as alt G.
X	Fair	2	Same as alt G.
Y	Poor	1	Same as alt S.
Z	Poor	1	Same as alt S.

Objective 4—Minimize Maintenance Requirements

Criterion 3: Urban Flows – Maintenance resulting from small storms and outfall flows

Rating guidance:

Outstanding: maintenance requirements would be significantly reduced using outfall design, off-stream detention, grade control

Adequate: maintenance requirements would be somewhat reduced

Poor: maintenance requirements would be about the same

Unacceptable: much worse than current conditions

Alternative	Rating	# Score	Comments
A	Poor	1	Current conditions.
D	Poor	1	Essentially unchanged from current conditions.
E	Poor	1	Same as alt D.
G	Poor	1	Same as alt D.
S	Poor	1	Same as alt D.
T	Poor	1	Same as alt D.
U	Poor	1	Same as alt D.
V	Poor	1	Same as alt D.
W	Poor	1	Same as alt D.
X	Poor	1	Same as alt D.
Y	Poor	1	Same as alt D.
Z	Poor	1	Same as alt D.

Objective 4—Minimize Maintenance Requirements

Criterion 4: Access – Incorporation of adequate access for maintenance crews and equipment

Rating guidance:

Outstanding: multi-function access corridors optimized based on expected project needs

Adequate: complies with District policy 3-410

Poor: access corridors provided but does not comply with 3-410

Unacceptable: inadequate or no access provided

Alternative	Rating	# Score	Comments
A	Fair	2	Current access unchanged.
D	Fair	2	Would allow compliance with 3-410 in most reaches, but not all.
E	Fair	2	Same as alt D.
G	Adequate	3	Very good access would be provided in detention ponds and outlets. Adequate access in riparian restoration areas.
S	Adequate	3	Same as alt G.
T	Adequate	3	Same as alt G.
U	Adequate	3	Same as D, with outstanding access provided at detention areas.
V	Adequate	3	Same as alt G.
W	Adequate	3	Same as alt G.
X	Adequate	3	Same as alt G.
Y	Adequate	3	Same as alt G.
Z	Adequate	3	Same as alt G.

Objective 5—Integrate within the Watershed

Criterion 1: Meets Local Watershed Goals – Ability to meet watershed goals as defined in a process that examines the watershed as a whole

Rating guidance:

Outstanding: the alternative substantially advances watershed goals

Adequate: the alternative advances some goals and is not in conflict with any

Poor: the alternative is in conflict with a few major watershed goals

Unacceptable: the alternative is in conflict with several watershed goals

Alternative	Rating	# Score	Comments
A	Unacceptable	0	Conflicts with several major watershed goals (see spreadsheet on next pages for watershed goals assessment).
D	Unacceptable	0	Same as alt A.
E	Unacceptable	0	Same as alt A.
G	Adequate	3	Alternative would partially or fully advance multiple watershed goals and is not in conflict with any. However, dam would cause impacts is upper watershed.
S	Very good	4	Same as alt G. However no dam impacts.
T	Very good	4	Same as alt S.
U	Unacceptable	0	Same as alt A.
V	Adequate	3	Same as alt G.
W	Adequate	3	Same as alt G.
X	Adequate	3	Same as alt G.
Y	Very good	4	Same as alt S.
Z	Very good	4	Same as alt S.

Watershed Goals Checklist

Source	Goal	A	D	E	G	S	T	U	V	W	X	Y	Z
Santa Clara County General Plan	*Water quality and watershed management*												
	Reduce non-point source pollution.	X	X	X	**	**	**	**	**	**	**	**	**
	Prepare and implement comprehensive watershed management plans.	*	*	*	*	*	*	*	*	*	*	*	*
Mountain View General Plan	Protect residents and their property from flood hazards.	*	**	**	**	**	**	**	**	**	**	**	**
Los Altos General Plan	*Reduce the potential for flooding along creeks that traverse Los Altos*												
	… continue to discourage concrete lining of creek beds, and… encourage the Santa Clara Valley Water District to use environmentally sensitive solutions to control local erosion problems.	X	X	X	**	**	**	X	**	**	**	**	**
	… encourage the Santa Clara Valley Water District to regularly maintain creek banks, to clear drainage channels of silt and debris, and to minimize disruption to riparian habitat in an environmentally sensitive manner.	*	*	*	*	**	**	*	*	*	*	**	**
Watershed Management Initiative	Balance the objectives of water supply management, habitat protection, flood management and land use to protect and enhance water quality.	*	*	*	**	**	**	*	**	**	**	**	**
SCVWD Lower Peninsula Watershed Stewardship Plan	*Incorporates District's Ends Policies (see following).*												
SCVWD Ends Policies	E-2.2.1—The cost of reducing the potential for flood damages is balanced with benefits (including possible environmental restoration and enhancement).	X	X	X	**	**	**	X	**	**	**	**	**
	E-2.2.2—There is a balance between the contributions of watersheds and streams in providing for public health and safety and in providing protection of natural resource benefits.	X	X	X	*	**	**	X	*	*	*	**	**
	E-3.1. Watersheds, streams, and the natural resources therein are protected and when appropriate enhanced or restored.	X	X	X	*	**	**	X	*	*	*	**	**

Key to Status:

*** = would exceed goal   ** = would meet goal   * = would partially meet goal   X = would not meet goal

Objective 6—Protect the Quality and Availability of Water

Criterion 1: Water Availability – Impact on groundwater recharge

Rating guidance:

Outstanding: alternative would result in a net increase in recharge potential and improve functionality and performance of diversions

Adequate: no net change in recharge potential, diversions not negatively impacted

Poor: would reduce the potential for recharge, diversions not negatively impacted

Unacceptable: substantially reduces opportunity for recharge or degrade performance of diversions

Alternative	Rating	# Score	Comments
A	Adequate	3	Would not change groundwater recharge capability.
D	Adequate	3	Same as alt A.
E	Adequate	3	Same as alt A.
G	Adequate	3	Same as alt A.
S	Adequate	3	Same as alt A.
T	Adequate	3	Same as alt A.
U	Adequate	3	Same as alt A.
V	Adequate	3	Same as alt A.
W	Adequate	3	Same as alt A.
X	Adequate	3	Same as alt A.
Y	Adequate	3	Same as alt A.
Z	Adequate	3	Same as alt A.

Objective 6—Protect the Quality and Availability of Water

Criterion 2: Instream Water Quality – Water quality protection through vegetation and instream hydraulic complexity

Rating guidance:

Outstanding: alternative would improve water quality by creating a hydraulically complex channel and including native riparian vegetation in appropriate locations

Adequate: alternative would maintain current water quality conditions

Poor: alternative would reduce streamside vegetation and hydraulic complexity

Unacceptable: alternative would result in significant loss of vegetation, alternative would provide little or no hydraulic complexity

Alternative	Rating	# Score	Comments
A	Adequate	3	Would maintain current water quality conditions.
D	Adequate	3	Same as alt A.
E	Adequate	3	Same as alt A.
G	Very good	4	Would provide substantial new vegetation and hydraulic complexity in restored lower reach P3. However, this is dependent on uncertain future implementation.
S	Very good	4	Same as alt G.
T	Very good	4	Same as alt G.
U	Adequate	3	Same as alt A.
V	Very good	4	Same as alt G.
W	Very good	4	Same as alt G.
X	Very good	4	Same as alt G.
Y	Very good	4	Same as alt G.
Z	Very good	4	Same as alt G.

Objective 6—Protect the Quality and Availability of Water

Criterion 3: Offstream Water Management – Ability to enhance water supply and quality and reduce peak flows through local retention of rainfall

Rating guidance:

Outstanding: alternative contains elements that significantly increase retention and use of rainwater, significantly reduces peak flows, includes educational programs

Adequate: moderately increases retention and use of rainwater, moderately reduces peak flows to the creeks, includes educational programs

Poor: alternative does not contain any such elements

Unacceptable: alternative would discourage local capture of rainfall/runoff

Alternative	Rating	# Score	Comments
A	Poor	1	Would not contain any local water capture or peak reduction elements.
D	Poor	1	Same as alt A.
E	Poor	1	Same as alt A.
G	Fair	2	Would not provide any local water capture for water supply purpose; however, would reduce peak flows during severe storms through instream/offstream detention.
S	Fair	2	Same as alt G.
T	Fair	2	Same as alt G.
U	Fair	2	Same as alt G.
V	Fair	2	Same as alt G.
W	Fair	2	Same as alt G.
X	Fair	2	Same as alt G.
Y	Fair	2	Same as alt G.
Z	Fair	2	Same as alt G.

Objective 6—Protect the Quality and Availability of Water

Criterion 4: Flow Regime – Ability to maintain geomorphically and biologically appropriate range of flows

Rating guidance:

Outstanding: alternative maintains locally appropriate seasonal variation in flows that will support an appropriate physical channel configuration and habitat

Adequate: alternative includes modification to the locally appropriate flow regime with no significant impact on channel stability or habitat

Poor: alternative includes significant modifications to natural flow regime which is likely to have an impact on channel stability or habitat

Unacceptable: modifications to flow regime are likely to have a significant impact on channel stability or habitat

Alternative	Rating	# Score	Comments
A	Poor	1	Permanente Diversion impacts d/s natural channels significantly.
D	Adequate	3	The Permanente Diversion issue would be addressed. Bypasses operate at moderate to high flows, keeping low flows in natural channels.
E	Adequate	3	Same as alt D.
G	Poor	1	Dam detention would significantly impact flow regime even during normal large storms, thus impacting d/s seasonal variation and habitat.
S	Adequate	3	Same as alt D. Flow detention would only operate during 10-year or above storm events, thus minimizing d/s impact on flow regime.
T	Adequate	3	Same as alt S.
U	Poor	1	Same as alt G.
V	Poor	1	Same as alt G.
W	Poor	1	Same as alt G.
X	Poor	1	Same as alt G.
Y	Adequate	3	Same as alt S.
Z	Adequate	3	Same as alt S.

Objective 7—Cooperate with Other Local Agencies to Achieve Mutually Beneficial Goals

Criterion 1: Mutual Local Goals – ability to achieve project-specific goals and objectives developed jointly by the District and local agencies

Rating guidance:

Outstanding: all goals and objectives developed in a Memorandum of Consensus (MOC) are met

Adequate: some goals and objectives developed in the MOC of all agencies are met

Poor: MOC is developed but only District goals and objectives are met

Unacceptable: few objectives met, or no MOC developed

Alternative	Rating	# Score	Comments
A	Unacceptable	0	No MOC developed.
D	Unacceptable	0	No MOC developed.
E	Unacceptable	0	No MOC developed.
G	Unacceptable	0	No MOC developed.
S	Unacceptable	0	No MOC developed.
T	Unacceptable	0	No MOC developed.
U	Unacceptable	0	No MOC developed.
V	Unacceptable	0	No MOC developed.
W	Unacceptable	0	No MOC developed.
X	Unacceptable	0	No MOC developed.
Y	Unacceptable	0	No MOC developed.
Z	Unacceptable	0	No MOC developed.

Objective 7—Supports General Plan – Ability to support goals and policies as stated in general plans of partner agencies

Rating guidance:

Outstanding: supports all pertinent general plan elements

Adequate: supports some general plan elements

Poor: does not support some general plan elements, is in conflict with few

Unacceptable: significant conflicts with major elements in general plans

Criterion 2: Supports General Plan

Alternative	Rating	# Score	Comments
A	Unacceptable	0	Conflicts with several major general plan elements (see general plans goals checklist attached).
D	Poor	1	Supports some elements, is in conflict with a few.
E	Poor	1	Same as alt D.
G	Very good	4	Partially or (mostly) fully supports all elements.
S	Very good	4	Same as alt G.
T	Very good	4	Same as alt G.
U	Poor	1	Same as alt D.
V	Very good	4	Same as alt G.
W	Very good	4	Same as alt G.
X	Very good	4	Same as alt G.
Y	Very good	4	Same as alt G.
Z	Very good	4	Same as alt G.

General Plan Goals Checklist

Source	Goal	A	D	E	G	S	T	U	V	W	X	Y	Z
Santa Clara County General Plan	Develop parks and public open space lands.	X	X	X	*	*	*	*	*	*	*	*	*
	Minimize the resident population within high hazard areas.	*	**	**	**	**	**	**	**	**	**	**	**
	Reduce the magnitude of the hazard, if feasible.	X	**	**	**	**	**	**	**	**	**	**	**
Mountain View General Plan	Promote the visibility of and safe physical access to San Francisco Bay, the baylands, Stevens Creek, and other natural resources in the city.	*	*	*	*	*	*	*	*	*	*	*	*
	Improve open space areas to provide a diversity of recreational and leisure opportunities for the community.	X	X	X	*	*	*	X	*	*	*	*	*
	Protect residents and their property from flood hazards.	*	**	**	**	**	**	**	**	**	**	**	**
Los Altos General Plan	Preserve the natural beauty and rural-suburban atmosphere and the high quality of residential neighborhoods in Los Altos.	**	**	**	**	**	**	**	**	**	**	**	**
	Preserve and protect natural areas—natural creek channels, topography, and vegetation—which are valuable natural resources.	**	**	**	*	**	**	*	*	*	*	**	**
	Minimize the risk of hazards to Los Altos residents.	*	**	**	*	**	**	*	*	*	*	**	**
	Reduce the potential for flooding along the creeks that traverse Los Altos.	X	**	**	**	**	**	**	**	**	**	**	**

Key to Status:

*** = would exceed goal
** = would meet goal
* = would partially meet goal
X = would not meet goal
NA = goal not applicable (included to show context of other related goals)

Objective 8—Community Benefits beyond Flood Protection

Criterion 1: Community Safety – Overall safety for appropriate access and recreation

Rating guidance:

Outstanding: all safety issues identified by public safety officials during their review is addressed

Adequate: most safety issues identified addressed, explanation provided for features deemed inappropriate or infeasible

Poor: few if any recommendations incorporated into alternative

Unacceptable: alternative was not reviewed by public safety officials

Alternative	Rating	# Score	Comments
A	Adequate	3	See below
D	Adequate	3	See below
E	Adequate	3	See below
G	Adequate	3	See below
S	Adequate	3	See below
T	Adequate	3	See below
U	Adequate	3	See below
V	Adequate	3	See below
W	Adequate	3	See below
X	Adequate	3	See below
Y	Adequate	3	See below
Z	Adequate	3	See below

No comments have thus far been received from City public safety officials. All such comments will be addressed.

Objective 8—Community Benefits beyond Flood Protection

Criterion 2: Recreation – Quality of recreation experience provided by alternative

Rating guidance:

Outstanding: project would provide unique quality recreational opportunities or a variety of opportunities with good public access and amenities

Adequate: some recreational opportunities incorporated into alternative, access may be limited

Poor: few or no recreational facilities incorporated into alternative

Unacceptable: existing recreational facilities are removed

Alternative	Rating	# Score	Comments
A	Poor	1	No rec facilities foreseen for no project alt.
D	Fair	2	Potential for top of bank trail along lower Permanente Creek upstream to Middlefield Rd. Limited access probable.
E	Fair	2	Same as alt D
G	Fair	2	Same as alt D
S	Fair	2	Same as alt D
T	Fair	2	Same as alt D
U	Fair	2	Same as alt D
V	Fair	2	Same as alt D
W	Fair	2	Same as alt D
X	Fair	2	Same as alt D
Y	Fair	2	Same as alt D
Z	Fair	2	Same as alt D

Objective 8—Community Benefits beyond Flood Protection

Criterion 3: Aesthetics – Assesses quality of aesthetic form provided by alternative

Rating guidance:

Outstanding: this criteria is a qualitative assessment some features to consider include harmonizing with landscape, emulating the natural environment, unexpected large/small features, concrete textured or formed to mimic natural features, park-like setting, art use, amenities such as benches, is clever.

Unacceptable: hardscape significantly greater than greenscape, visual monotony, heavy use of plain concrete

Alternative	Rating	# Score	Comments
A	Unacceptable	0	As described above with added element of concrete channel failure and degradation further reducing aesthetic quality
D	Poor	1	Much hardscape including new floodwalls, no new vegetation, visual monotony, heavy use of concrete, some of the concrete may be colored or use texturing.
E	Poor	1	Same as alt D
G	Very good	4	Restored features would offer substantial improvement in aesthetics, though not complete restoration. Restoration work uncertain, not funded.
S	Very good	4	Same as alt G
T	Very good	4	Same as alt G
U	Poor	1	Same as alt D
V	Very good	4	Same as alt G
W	Very good	4	Same as alt G
X	Very good	4	Same as alt G
Y	Very good	4	Same as alt G
Z	Very good	4	Same as alt G

Objective 8—Community Benefits beyond Flood Protection

Criterion 4: Social and Cultural Benefits – Opportunity to promote community involvement

Rating guidance:

Outstanding: includes appropriate infrastructure to support full range of social and cultural benefits

Adequate: includes appropriate infrastructure to support some social and cultural benefits

Poor: does not include appropriate infrastructure

Unacceptable: eliminates existing features or includes inappropriate features

Alternative	Rating	# Score	Comments
A	Poor	1	No new community involvement features.
D	Poor	1	Same as alt A.
E	Poor	1	Same as alt A.
G	Fair	2	Restored features could offer opportunities for citizen involvement and school activities. None planned as part of alternative.
S	Fair	2	Same as alt G
T	Fair	2	Same as alt G
U	Poor	1	Same as alt A
V	Fair	2	Same as alt G
W	Fair	2	Same as alt G
X	Fair	2	Same as alt G
Y	Fair	2	Same as alt G
Z	Fair	2	Same as alt G

Objective 8—Community Benefits beyond Flood Protection

Criterion 5: Local Economic Effects – Potential effect on property values and/or local business climate

Rating guidance:

Outstanding: probably increase in value of adjacent properties, commercial benefits to local businesses such as increased foot traffic, alternative increases development possibilities

Adequate: no measurable change to property values or local businesses

Poor: no change to property values, businesses negatively impacted

Unacceptable: decrease in property values and commercial access

Alternative	Rating	# Score	Comments
A	Adequate	3	No change.
D	Very good	4	Probable increase in home values for parcels protected from flooding and not needing FEMA flood insurance. No commercial benefits other than elimination of flooding impact on roads and utilities.
E	Very good	4	Same as alt D.
G	Very good	4	Same as alt D.
S	Very good	4	Same as alt D.
T	Very good	4	Same as alt D.
U	Very good	4	Same as alt D.
V	Very good	4	Same as alt D.
W	Very good	4	Same as alt D.
X	Very good	4	Same as alt D.
Y	Very good	4	Same as alt D.
Z	Very good	4	Same as alt D.

Objective 8—Community Benefits beyond Flood Protection

Criterion 6: Open Space – Incorporation of open space into alternative design

Rating guidance:

Outstanding: ensures long-term protection of existing open space, creates new open space

Adequate: reserves existing open space in project area

Poor: existing open space would be degraded

Unacceptable: significant loss of existing open space

Alternative	Rating	# Score	Comments
A	Fair	2	Would not reduce existing open space; but no new open space.
D	Fair	2	Same as alt A.
E	Fair	2	Same as alt A.
G	Adequate	3	Reserves open space. No new open space created other than riparian restoration channels.
S	Adequate	3	Same as alt G.
T	Adequate	3	Same as alt G.
U	Fair	2	Same as alt A.
V	Adequate	3	Same as alt G.
W	Adequate	3	Same as alt G.
X	Adequate	3	Same as alt G.
Y	Adequate	3	Same as alt G.
Z	Adequate	3	Same as alt G.

Objective 8—Community Benefits beyond Flood Protection

Criterion 7: Community Support – Alternative reflects community developed objectives and ideas

Rating guidance:

Outstanding: relative to other alternatives, community indicates preference for this alt

Adequate: community indicates acceptance of the alternative

Poor: community lacks support for the alternative

Unacceptable: community finds alternative unacceptable

Alternative	Rating	# Score	Comments
A	Poor	1	Continued flood damages not supported by community.
D	Fair	2	No real support; but not too much negative either.
E	Fair	2	Same as alt D.
G	Fair	2	Rancho and Hanson dam have some support and some negative comments. McKelvey not supported by some but is by others. Restoration supported, though some areas may not be applicable, due to use of easement area by home owners.
S	Fair	2	Cuesta Annex use not supported by City of MV and some citizens, is supported by others
T	Fair	2	Same as alt S.
U	Fair	2	Same as alt D.
V	Fair	2	Same as alt S, except no McKelvey Park.
W	Fair	2	Same as alt S.
X	Fair	2	Same as alt S.
Y	Fair	2	Same as alt S.
Z	Fair	2	Same as alt S; Blach School may be opposed by some community members.

Objective 9—Minimize Life-Cycle Costs

Criterion 1: Net Present Value of Estimated Cost

Rating guidance: see below.

Alternative	Rating	# Score	Comments
A	Outstanding	5	Maintenance-only cost of $29 million
D	Unacceptable	0	Overall cost $145 million, CSC cost of $59 million
E	Unacceptable	0	Overall cost $148 million, CSC cost of $62 million
G	Outstanding	5	Overall cost of $83 million; CSC phase cost of $32 million.
S	Adequate	3	Overall cost $92 million, CSC phase cost of $41 million
T	Adequate	3	Overall cost $93 million, CSC phase cost of $29 million
U	Fair	2	Overall cost of $102 million, CSC phase cost of $51 million
V	Outstanding	5	Overall cost of $79 million; CSC phase cost of $37 million.
W	Adequate	3	Overall cost of $90 million, CSC phase cost of $29 million
X	Fair	2	Overall cost of $96 million, CSC phase cost of $44 million
Y	Poor	1	Overall cost of $90 million, CSC phase cost of $55 million
Z	Very Good	4	Overall cost of $84 million, CSC phase cost of $40 million.

Lowest overall cost (50-year total cost capital and maintenance) is: $79 million for Alt V.

Within 5% = less than $83 million	Outstanding
Within 10% = less than $87 million	Very Good
Within 20% = less than $95 million	Adequate
Within 35% = less than $107 million	Fair
Within 50% = less than $118 million	Poor
Over $118 million =	unacceptable

Re CSC budget: budget is $38.6 million

Under the budget = less than $38.6 million	Outstanding
Within 5% of the budget = less than $40.5 million	Very Good
Within 10% = less than $42.5 million	Adequate
Within 35% = less than $52 million	Fair
Within 50% = less than $58 million	Poor
More than $58 million =	unacceptable

Lower score from the two criteria is applied for the alternative. For example, if the total cost is very good but the CSC cost is only fair, then the “fair” rating is applied.

Note: all costs are 2008 $.

Preliminary Environmental Impacts Analysis

Criterion 1: Hydrology and Water Quality

Rating guidance:

Outstanding: no impacts foreseen

Very good: foreseen impacts are minor and short-term

Adequate: foreseen impacts minor but long-term

Fair: foreseen impacts major but short-term

Poor: foreseen impacts are major and long-term

Unacceptable: same as under "poor" except impacts to endangered or threatened species

Alternative	Rating	# Score	Comments
A	Adequate	3	Minor, long-term impacts due to sediment/veg maintenance activities continuing
D	Adequate	3	Same as alt A
E	Adequate	3	Same as alt A
G	Poor	1	Significant long-term impact due to new dam
S	Adequate	3	Hydrology impact to higher than 10-year flows only.
T	Adequate	3	Same as alt S
U	Poor	1	Same as alt G
V	Poor	1	Same as alt G
W	Poor	1	Same as alt G
X	Poor	1	Same as alt G
Y	Adequate	3	Same as alt S
Z	Adequate	3	Same as alt S

Preliminary Environmental Impacts Analysis

Criterion 2: Potential Impact to Biological Resources

Rating guidance:

Outstanding: no impacts foreseen

Very good: foreseen impacts are minor and short-term

Adequate: foreseen impacts minor but long-term

Fair: foreseen impacts major but short-term

Poor: foreseen impacts are major and long-term

Unacceptable: same as under "poor" except impacts to endangered or threatened species

Alternative	Rating	# Score	Comments
A	Outstanding	5	No impacts foreseen
D	Outstanding	5	Same as alt A
E	Outstanding	5	Same as alt A
G	Unacceptable	0	Dam would have significant impact in potential red-legged frog habitat area
S	Poor	1	Long-term impact in Cuesta, short term in Rancho
T	Poor	1	Long term impact at Cuesta Annex
U	Unacceptable	0	Same as alt G
V	Unacceptable	0	Same as alt G
W	Unacceptable	0	Same as alt G
X	Unacceptable	0	Same as alt G
Y	Poor	1	Same as alt S
Z	Very good	4	Only short term impacts at all sites.

Preliminary Environmental Impacts Analysis

Criterion 3: Potential Impact to Cultural Resources

Rating guidance:

Outstanding: no impacts foreseen

Very good: foreseen impacts are minor and short-term

Adequate: foreseen impacts minor but long-term

Fair: foreseen impacts major but short-term

Poor: foreseen impacts are major and long-term

Unacceptable: same as under “poor” except impacts to endangered or threatened species

Alternative	Rating	# Score	Comments
A	Outstanding	5	No impacts foreseen
D	Outstanding	5	Bypass routes only potential source of impact.
E	Outstanding	5	Same as alt D
G	Poor	1	Rancho impacts potentially significant.
S	Poor	1	Same as alt G + Cuesta Annex potential impact
T	Poor	1	Same as alt S – No impact in Rancho
U	Poor	1	Same as alt G
V	Poor	1	Same as alt G
W	Very Good	4	No Rancho. Potential impact in Cuesta.
X	Very Good	4	Same as alt W
Y	Poor	1	Same as alt S
Z	Poor	1	Same as alt S

Preliminary Environmental Impacts Analysis

Criterion 4: Potential Impact to Aesthetics

Rating guidance:

Outstanding: no impacts foreseen

Very good: foreseen impacts are minor and short-term

Adequate: foreseen impacts minor but long-term

Fair: foreseen impacts major but short-term

Poor: foreseen impacts are major and long-term

Unacceptable: same as under "poor" except impacts to endangered or threatened species

Alternative	Rating	# Score	Comments
A	Outstanding	5	No impacts foreseen
D	Poor	1	High floodwalls (up to 8' high) and large new concrete channels
E	Poor	1	Same as alt D
G	Fair	2	Short-term impacts in Rancho and McKelvey. Dam site has very minor viewership (one house and quarry workers).
S	poor	1	Long term impact in Cuesta Annex, short term in Rancho, and McKelvey.
T	Poor	1	Major impact in Cuesta Annex (Oak meadow area)
U	Poor	1	Same as alt D
V	Fair	2	Same as alt G. Cuesta impact in open area only
W	Fair	2	Same as alt V
X	Poor	1	Same as alt S
Y	Poor	1	Same as alt S
Z	fair	2	Short term impacts to Cuesta open area, McKelvey, Rancho and Blach school.

Preliminary Environmental Impacts Analysis

Criterion 5: Potential Impact to Traffic and Utilities

Rating guidance:

Outstanding: no impacts foreseen

Very good: foreseen impacts are minor and short-term

Adequate: foreseen impacts minor but long-term

Fair: foreseen impacts major but short-term

Poor: foreseen impacts are major and long-term

Unacceptable: same as under “poor” except impacts to endangered or threatened species

Alternative	Rating	# Score	Comments
A	Outstanding	5	No impacts foreseen
D	Fair	2	Traffic and utilities impacts of bypass construction are likely to be major but short-term for each community.
E	Fair	2	Same as alt D
G	Fair	2	Same as alt D. Less bypass length but added truck traffic for detention basin construction.
S	Fair	2	Same as alt G
T	Fair	2	Same as alt G
U	Fair	2	Same as alt G
V	Fair	2	Same as alt G
W	Fair	2	Same as alt G
X	Fair	2	Same as alt G
Y	Fair	2	Same as alt G
Z	Fair	2	Same as alt G

Preliminary Environmental Impacts Analysis

Criterion 6: Potential Impact to Noise

Rating guidance:

Outstanding: no impacts foreseen

Very good: foreseen impacts are minor and short-term

Adequate: foreseen impacts minor but long-term

Fair: foreseen impacts major but short-term

Poor: foreseen impacts are major and long-term

Unacceptable: same as under “poor” except impacts to endangered or threatened species

Alternative	Rating	# Score	Comments
A	Fair	2	Major, short term impact due to Channel replacement activities in each community
D	Fair	2	Bypass and concrete channel construction noise are likely to be major but short-term for each community.
E	Fair	2	Same as alt D
G	Fair	2	Bypass construction length reduced but added noise due to detention basin construction.
S	Fair	2	Same as alt G
T	Fair	2	Same as alt G
U	Fair	2	Same as alt G
V	Fair	2	Same as alt G
W	Fair	2	Same as alt G
X	Fair	2	Same as alt G
Y	Fair	2	Same as alt G
Z	Fair	2	Same as alt G.

Preliminary Environmental Impacts Analysis

Criterion 7: Potential Impact to Air Quality

Rating guidance:

Outstanding: no impacts foreseen

Very good: foreseen impacts are minor and short-term

Adequate: foreseen impacts minor but long-term

Fair: foreseen impacts major but short-term

Poor: foreseen impacts are major and long-term

Unacceptable: same as under "poor" except impacts to endangered or threatened species

Alternative	Rating	# Score	Comments
A	Outstanding	5	No impacts foreseen
D	Fair	2	Impacts of bypass construction on air quality are likely to be major but short-term for each community.
E	Fair	2	Same as alt D
G	Fair	2	Same as alt D, less bypass length but more traffic due to detention site construction
S	Fair	2	Same as alt G
T	Fair	2	Same as alt G
U	Fair	2	Same as alt G
V	Fair	2	Same as alt G
W	Fair	2	Same as alt G
X	Fair	2	Same as alt G
Y	Fair	2	Same as alt G
Z	Fair	2	Same as alt G

Preliminary Environmental Impacts Analysis

Criterion 8: Potential Impact to Public Health and Safety

Rating guidance:

Outstanding: no impacts foreseen

Very good: foreseen impacts are minor and short-term

Adequate: foreseen impacts minor but long-term

Fair: foreseen impacts major but short-term

Poor: foreseen impacts are major and long-term

Unacceptable: same as under “poor” except impacts to endangered or threatened species

Alternative	Rating	# Score	Comments
A	Outstanding	5	No impacts foreseen
D	Outstanding	5	No impacts foreseen
E	Outstanding	5	No impacts foreseen
G	Poor	1	Dam would introduce major, long-term impact
S	Very Good	4	Impacts due to construction activities minor and short-term
T	Very Good	4	Same as alt S
U	Poor	1	Same as Alt G
V	Poor	1	Same as Alt G
W	Poor	1	Same as Alt G
X	Poor	1	Same as Alt G
Y	Very Good	4	Same as alt S
Z	Very Good	4	Same as alt S

Preliminary Environmental Impacts Analysis

Criterion 9: Potential Impact to Recreation

Rating guidance:

Outstanding: no impacts foreseen

Very good: foreseen impacts are minor and short-term

Adequate: foreseen impacts minor but long-term

Fair: foreseen impacts major but short-term

Poor: foreseen impacts are major and long-term

Unacceptable: same as under “poor” except impacts to endangered or threatened species

Alternative	Rating	# Score	Comments
A	Outstanding	5	No impacts foreseen
D	Outstanding	5	No impacts foreseen
E	Outstanding	5	No impacts foreseen
G	Fair	2	Major, short-term (1 year) impact to McKelvey Park. Minor long-term impact (flooding/cleanup on 10-year average intervals) to McKelvey.
S	Fair	2	Same as alt G
T	Fair	2	Same as alt G
U	Adequate	3	Minor, long term impact in Rancho SA.
V	Adequate	3	Minor long term impact in Cuesta and Rancho
W	Fair	2	Same as alt G
X	Adequate	3	Minor long term impact in Cuesta
Y	Adequate	3	Minor long term impact in Cuesta
Z	Fair	2	Same as alt G

Table F2 - NFP Objective Ratings Calculation

	Factor	Alt A	Alt D	Alt E	Alt G	Alt S	Alt T	Alt U	Alt V	Alt W	Alt X	Alt Y	Alt Z
Objective 1: Flood Protection													
1.1 Safety	**0.30**	2.00	3.00	3.00	1.00	3.00	3.00	1.00	1.00	1.00	1.00	3.00	3.00
1.2 Economic Protection	**0.30**	0.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
1.3 Durability	**0.10**	1.00	2.00	2.00	2.00	3.00	3.00	2.00	2.00	2.00	2.00	3.00	3.00
1.4 Resiliency	**0.10**	0.00	5.00	5.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
1.5 Local Drainage	**0.10**	3.00	3.00	3.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
1.6 Time to Implementation	**0.10**	5.00	2.00	2.00	2.00	3.00	3.00	2.00	2.00	2.00	2.00	3.00	3.00
Objective Score:		**1.50**	**3.30**	**3.30**	**2.60**	**3.40**	**3.40**	**2.60**	**2.60**	**2.60**	**2.60**	**3.40**	**3.40**
Objective 2: Ecological Functions													
2.1 Local Habitat Goals	**0.25**	0.00	0.00	0.00	1.00	3.00	3.00	0.00	1.00	1.00	1.00	3.00	3.00
2.2 Habitat Provided	**0.25**	0.00	0.00	0.00	2.00	2.00	2.00	0.00	2.00	2.00	2.00	2.00	2.00
2.3 Sustainability of Habitat	**0.25**	NA	NA	NA	3.00	3.00	3.00	NA	3.00	3.00	3.00	3.00	3.00
2.4 Connectivity of Habitat	**0.25**	1.00	1.00	1.00	2.00	2.00	2.00	1.00	2.00	2.00	2.00	2.00	2.00
Objective Score:		**0.33**	**0.33**	**0.33**	**2.00**	**2.50**	**2.50**	**0.33**	**2.00**	**2.00**	**2.00**	**2.50**	**2.50**
Objective 3: Physical Stream Functions													
3.1 Floodplain	**0.35**	0.00	1.00	1.00	3.00	3.00	3.00	2.00	3.00	3.00	3.00	3.00	3.00
3.2 Active Channel	**0.30**	0.00	0.00	0.00	3.00	3.00	3.00	0.00	3.00	3.00	3.00	3.00	3.00
3.3 Stable Side Slopes	**0.20**	1.00	1.00	1.00	3.00	3.00	3.00	1.00	3.00	3.00	3.00	3.00	3.00
3.4 Transitions	**0.15**	1.00	1.00	1.00	3.00	3.00	3.00	1.00	3.00	3.00	3.00	3.00	3.00
Objective Score:		**0.35**	**0.70**	**0.70**	**3.00**	**3.00**	**3.00**	**1.05**	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**
Objective 4: Maintenance													
4.1 Structural Features	**0.25**	0.00	0.00	0.00	1.00	3.00	3.00	0.00	1.00	1.00	1.00	3.00	3.00
4.2 Natural Processes	**0.25**	0.00	1.00	1.00	2.00	1.00	1.00	2.00	2.00	2.00	2.00	1.00	1.00
4.3 Urban Flows	**0.25**	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
4.4 Access	**0.25**	2.00	2.00	2.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Objective Score:		**0.75**	**1.00**	**1.00**	**1.75**	**2.00**	**2.00**	**1.50**	**1.75**	**1.75**	**1.75**	**2.00**	**2.00**
Objective 5: Integrate Within Watershed													
5.1 Meets Local Watershed Goals	**1.00**	0.00	0.00	0.00	3.00	4.00	4.00	0.00	3.00	3.00	3.00	4.00	4.00
Objective Score:		**0.00**	**0.00**	**0.00**	**3.00**	**4.00**	**4.00**	**0.00**	**3.00**	**3.00**	**3.00**	**4.00**	**4.00**
Objective 6: Water Quality													
6.1 Water Availability (GW Recharge)	**0.30**	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
6.2 Instream WQ (Channel, Veg)	**0.40**	3.00	3.00	3.00	4.00	4.00	4.00	3.00	4.00	4.00	4.00	4.00	4.00
6.3 Offstream Water Mgmt (Runoff, Pollution)	**0.20**	1.00	1.00	1.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
6.4 Flow Regime	**0.10**	1.00	3.00	3.00	1.00	3.00	3.00	1.00	1.00	1.00	1.00	3.00	3.00
Objective Score:		**2.40**	**2.60**	**2.60**	**3.00**	**3.20**	**3.20**	**2.60**	**3.00**	**3.00**	**3.00**	**3.20**	**3.20**
Objective 7: Local Agency Cooperation													
7.1 Mutual Local Goals	**0.50**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7.2 Supports General Plan	**0.50**	0.00	1.00	1.00	4.00	4.00	4.00	1.00	4.00	4.00	4.00	4.00	4.00
Objective Score:		**0.00**	**0.50**	**0.50**	**2.00**	**2.00**	**2.00**	**0.50**	**2.00**	**2.00**	**2.00**	**2.00**	**2.00**
Objective 8: Community Benefits													
8.1 Community Safety (for Access and Rec)	**0.15**	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
8.2 Recreation	**0.20**	1.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
8.3 Aesthetics	**0.15**	0.00	1.00	1.00	4.00	4.00	4.00	1.00	4.00	4.00	4.00	4.00	4.00
8.4 Social and Cultural Benefits	**0.05**	1.00	1.00	1.00	2.00	2.00	2.00	1.00	2.00	2.00	2.00	2.00	2.00
8.5 Local Economic Effects	**0.15**	3.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
8.6 Open Space	**0.15**	2.00	2.00	2.00	3.00	3.00	3.00	2.00	3.00	3.00	3.00	3.00	3.00
8.7 Community Support	**0.15**	1.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Objective Score:		**1.60**	**2.25**	**2.25**	**2.90**	**2.90**	**2.90**	**2.25**	**2.90**	**2.90**	**2.90**	**2.90**	**2.90**
Objective 9: Cost													
9.1 Total Lifetime Cost	**1.00**	5.00	0.00	0.00	5.00	3.00	3.00	2.00	5.00	3.00	2.00	1.00	4.00
Objective Score:	**1.00**	**5.00**	**0.00**	**0.00**	**5.00**	**3.00**	**3.00**	**2.00**	**5.00**	**3.00**	**2.00**	**1.00**	**4.00**
Preliminary Impacts Assessment													
Hydrology and water quality	**0.05**	3.00	3.00	3.00	1.00	3.00	3.00	1.00	1.00	1.00	1.00	3.00	3.00
Biological resources	**0.30**	5.00	5.00	5.00	0.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	4.00
Cultural resources	**0.05**	5.00	5.00	5.00	1.00	1.00	1.00	1.00	1.00	4.00	4.00	1.00	1.00
Aesthetics	**0.10**	5.00	1.00	1.00	2.00	1.00	1.00	1.00	2.00	2.00	1.00	1.00	2.00
Traffic/Utilities	**0.10**	5.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Noise	**0.10**	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Air quality	**0.10**	5.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Health and Safety	**0.10**	5.00	5.00	5.00	1.00	4.00	4.00	1.00	1.00	1.00	1.00	4.00	4.00
Recreation	**0.10**	5.00	5.00	5.00	2.00	2.00	2.00	3.00	3.00	2.00	3.00	3.00	2.00
Objective Score:	**1.00**	**4.60**	**3.60**	**3.60**	**1.20**	**1.80**	**1.80**	**1.20**	**1.30**	**1.35**	**1.35**	**1.90**	**2.80**

Ratings Key: 5.0 = Outstanding; 4.0 = Very good; 3.0 = Adequate; 2.0 = Fair; 1.0 = Poor; 0.0 = Unacceptable
Objective Score Key: 4.5 to 5 = Outstanding; 3.5 to 4.49 = Very good; 2.5 to 3.49 = Adequate; 1.5 to 2.49 = Fair; 0.5 to 1.49 = Poor; 0 to 0.49 = Unacceptable

APPENDIX G

One-Percent Flood

The one-percent flood, otherwise called the 1 percent flood and the 100-year flood is defined as the flood event that has a 1 percent probability of occurrence in any given year. Over a very long period of time, it is the flow event that would, on average, occur once per hundred years; however, over a short time span, it can occur more than once in a single year or not at all for several hundred years.

For the Permanente Creek Flood Protection Project, the design flood is the one-percent flood per the CSC program.

APPENDIX H

Engineering Drawings (Bound Separately)

SANTA CLARA VALLEY WATER DISTRICT

STEVENS AND PERMANENTE CREEKS HYDROLOGY REPORT

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November, 2007

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SANTA CLARA VALLEY WATER DISTRICT

STEVENS AND PERMANENTE CREEKS HYDROLOGY REPORT

1. INTRODUCTION

This report summarizes the work completed on the Stevens and Permanente Creeks hydrology. Stevens and Permanente Creeks are within the Santa Clara Valley Water District's Lower Peninsula Watershed. Presented in the report are recommended design flows for Stevens, Permanente Creeks and each of their respective tributaries.

The following is a list of the tributaries analyzed in this study:

Stevens and Permanente Creeks Hydrology

- Hale Creek
- Permanente Creek
- Permanente Diversion
- Stevens Creek

2. HYDROLOGIC MODEL

This section provides a summary of the method and procedures developed and used for the hydrology study that yield this report. Refer to the District's publication entitled "Hydrology Procedures (Saah et al, 2006)" for more detailed information.

2.1 Design Storm Precipitation

The design storm precipitation has been obtained by using the Global Regional Equations (Saah et al, 1996) to estimate the flood runoff magnitude applying an appropriate rainfall-runoff model.

From the isohyetal map of mean annual precipitation (MAP), locate the specific location of the site and determine the MAP. Some interpolation may be required to obtain the MAP.

Given the mean annual precipitation for the ungaged site, the precipitation intensity is calculated as:

$$i_{T,D} = \frac{a_1 T^{a_2} \exp[SD_e^{\,2}/2]}{D^{a_3}} \qquad \textbf{(1)}$$

Where:

$i_{T,D}$ = the predicted precipitation intensity in inches per hour or inches per day at return period T

T = return period in years as the recurrence intervals

D = duration D in hours or days

$[a_1, a_2, a_3]$ = model coefficients

SD_e = the standard deviation of the model residuals (random term).

The precipitation depth (in inches) $x_{T,D}$ can be simply obtained from the precipitation intensity $i_{T,D}$ by the following relation:

$$x_{T,D} = i_{T,D}.D \qquad (2)$$

For short duration rainfall of a 1% event (specifically for durations of 5 minutes, 10 minutes, up to as much as 24 hours), the model parameters $[a_1, a_2, a_3]$ and SD_e are estimated as follows:

$$\begin{aligned} a_1 &= 0.2675 + 0.01199 \cdot MAP + 0.00002472 \cdot E \\ a_2 &= 0.167033 \\ a_3 &= 0.5853 - 0.004155 \cdot MAP - 0.000001096 \cdot E \\ SD_e &= 0.120039 \end{aligned} \qquad (3)$$

Where:

MAP = the mean annual precipitation in inches
E = the elevation of the ungaged site in feet.

Note that D for short duration rainfall analysis in Eq. (1) is in terms of hours.

To illustrate the use of Eq. (1), the example of estimating the 24-hour, 100-year return period storm rainfall at the sub basin H2 in the Stevens Creek watershed is used.
Given parameters are

$$\begin{aligned} T &= 100\text{-year} \\ D &= 24\text{-hour} \\ SD_e &= 0.120039. \end{aligned} \qquad (4)$$

And basin characteristics of sub basin A are

$$\begin{aligned} E &= 1123 \text{ feet} \\ MAP &= 33.36 \text{ inches.} \end{aligned} \qquad (5)$$

Substitute basin characteristics (5) into Eq. (3) then the coefficients are

$$\begin{aligned} a_1 &= 0.2675 + 0.01199 \times 33.36 + 0.00002472 \times 1123 = 0.695247 \\ a_2 &= 0.167033 \\ a_3 &= 0.5853 - 0.004155 \times 33.36 - 0.000001096 \times 1123 = 0.445458 \end{aligned}$$

substitues numerical parameters (4) and the coefficients into Eq. (1), then

$$i_{T,D} = \frac{0.695247 \times 100^{0.167033} \exp[0.120039^2 / 2]}{24^{0.445458}} = 0.366866 \quad \textit{inches per hour}$$

substitues precipitaion intensity result into Eq. (2), then precipitation depth of the 24-hour, 100-year return period storm rainfall at the sub basin H2 in the Stevens Creek watershed is 8.80 inches.

$$x_{T,D} = 0.366866 \times 24 = 8.80 \ \ inches$$

The precipitation depth obtained from the Global equations may be checked with nearby rainfall gage stations. Refer to section 4 for further information.

2.2 Flood Flow Regression Model

Since the early 1970s, the District has utilized regional regression and correlation techniques to estimate design flows at ungaged locations. The regional regression equations are formulas consisting of flow information such as values from gaged stations as dependent variables and measurable watershed characteristics as independent variables. The application of these equations on ungaged locations will result in estimates of flood flow from any watershed for certain selected frequencies (e.g. 1% or 10% design flows). Regional equations usually apply to rural watersheds. Most of the subbasins are in the urbanized areas where the regression equations do not apply. Only two subbasins in the upper watersheds are considered as rural subbasins where regional regression equations can be applied.

The District updated the regional regression equations in 2003 to include data through 2000 based on historical data from Santa Clara County and Santa Cruz County. The outcomes of this study are documented in a report entitled *Development of Regional Regression Equations to Calculate Flood Quantiles in Santa Clara County* (Saah et al, 2003). The updated regional regression equations to estimate 24-hr peaks and 1-day volumes for both the 1% and 10% quantiles are as shown below:

FOR 24-hr PEAKS in cfs:

$$Q_{1\%} = 11.22 \times A^{0.954} \times MAP^{1.03}$$
$$Q_{10\%} = 2.985 \times A^{0.988} \times MAP^{1.173}$$

Where:

A = the watershed area in square miles
MAP = the mean annual precipitation in inches

FOR 1-day VOLUMES in cfs/day:

$$V_{1\%} = 2.254 \times A^{0.964} \times MAP^{1.187}$$
$$V_{10\%} = 0.895 \times A^{0.933} \times MAP^{1.244}$$

Where:

A = the watershed area in square miles
MAP = the mean annual precipitation in inches

Note: The 24-hr volume may be approximated by multiplying the 1-day volume by a factor of 1.15.

2.3 Loss Rates

The loss rates for the rural and pervious parts of sub-watersheds are calculated using the Soil Conservation Service (SCS) Curve Number (CN) method. For all impervious areas, loss rates are assumed to be minimal. The hydrologic soil type, the Antecedent Moisture Content (AMC) and the ground cover are defined for each sub-watershed and are used to determine the respective Initial Abstraction (Ia) and the CN values.

The Antecedent Moisture Conditions are further calibrated for various watershed conditions and various frequencies of occurrences using the flood volumes obtained from the regression equations and those obtained from the rainfall-runoff model. Based on this information, the Ia and CN values for the updated AMC are calculated and input into the HEC-1 model. A map of hydrologic soil types for each watershed is included in the appendices.

For the rural and pervious parts of the watershed, the loss parameters are validated or adjusted based on the calibration process with flood flow regression equations. This process of calibration has made the rainfall-generated flood quantiles more reliable.

2.4 Clark's Synthetic Hydrograph Parameters (Tc and R)

The unit hydrograph parameters applicable to this study are calculated and presented for each creek. Rural, pervious and impervious parts of each sub-watershed are considered separately. The Time of Concentration (Tc) is calculated using Kirby Hathaway's formula:

$$Tc = 0.01377[(L * n)^{0.47} S^{-0.235}]$$

Where:

L=distance of overland flow in feet (ft)
n=Manning's watershed roughness coefficient
S=average slope in ft/ft

The Routing Coefficient (R) is calculated based on an acceptable routing indicator: R/(Tc+R). This indicator directly impacts the peaking characteristics of hydrographs. For rural and pervious sub-sub-watersheds, the indicator is ranging between 0.5 and 0.9 based on the calibration process with regression quantiles. For impervious sub-sub watersheds, the indicator is generally ranging between 0.1 and 0.5.

2.5 Urban Hydrology

In 1996, an urban hydrology procedure (Wang and Saah 1996) was developed which addressed the impact of urban growth on flood flows. This procedure accounts for the effects on runoff due to two major urban changes: increased imperviousness and increased channelization. Increased imperviousness reduces the overland flow travel time and thus increases the volume of flow. Increased channelization addresses the impact of conveyance through gutters and storm drains together with the increased storage capability of these facilities. Imperviousness represents coverage from streets, buildings and other lot coverage. The coverage from streets in urban residential areas ranges from 2% to 25%, while for other land uses the value can be as high as 95% of the total lot area. The concept of "Equivalent Street" is obtained from the land use requirements for ratio of streets as a part of the total urban sub-watershed. Based on this equivalent street concept, the length and width of streets in an urbanized area are defined and, hence, the unit hydrograph parameters are calculated. The following are the formulas used in this study to calculate unit hydrograph parameters as input to HEC-1.

Equivalent street length (all measurements are in ft or square ft) is calculated by the equation:

$$L_{st}=A_{st}/W_{st}$$

Where:
- L_{st} = the equivalent street length
- A_{st} = area of streets, (from land use guidelines)
- W_{st} = width of streets (from traffic guidelines)

Overland flow length is calculated by the equations:

$$L_i = (A_i - A_{st})/2L_{st}$$
$$L_p = A_p/2L_{st}$$

Where:
- L_i = length of overland flow of impervious area
- A_i = impervious area, (from land use guidelines)
- L_p = length of overland flow of pervious area
- A_p = pervious area

The impervious length of overland flow is given by the equation $L_{imp} = L_i + L_{Cb}$ where L_{Cb} is the length of flow to the first catch basin (normally less than 300 ft), and L_i is defined above. The pervious length is given by the equation $L_{perv} = L_p + L_{imp}$.

The Time of Concentration (Tc) is calculated separately for pervious and impervious areas using Kirby-Hathaway's formula as defined in Section 2.4. Time of Concentration for impervious areas is calculated as:

$$Tc_{imp} = Tc_i + Tc_{cb}$$

Where:
- Tc_{imp} = Time of Concentration for the impervious area
- Tc_i = Time of Concentration of overland flow over impervious area
- Tc_{cb} = Time of Concentration of flow length to first catch basin

Time of concentration for pervious areas is calculated as:

$$Tc_{perv} = Tc_p + Tc_{imp}$$

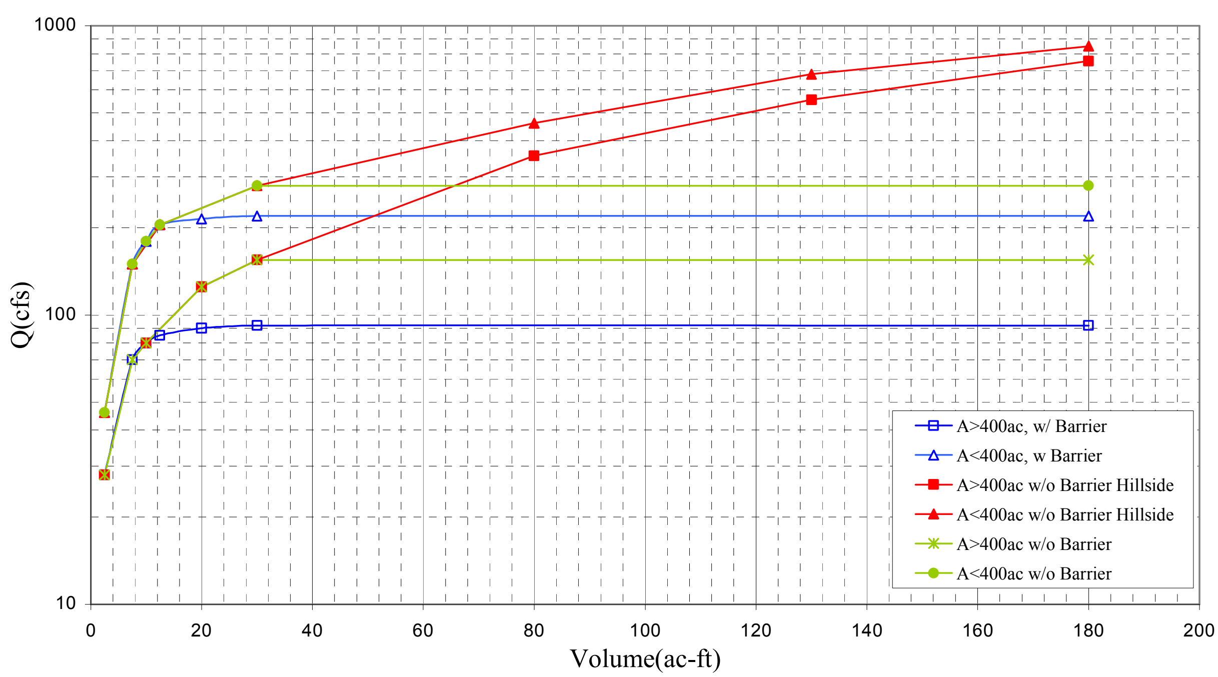
Where:
- Tc_{perv} = Time of Concentration for pervious area
- Tc_p = Time of Concentration of overland flow over pervious area
- Tc_{imp} = Time of Concentration of the impervious length of overland flow

2.6 Routing Procedures

Most of the flood waters from urban areas are conveyed to flood control channels via storm drain systems. Storage-discharge rating curves based on Santa Clara Valley's storm drain system for average condition are presented in Figure 1. It shows the general unitized (prorated to one square mile of an area) storage-discharge rating curves that may be applied to valley urban areas. However, to minimize the impact from diversified design frequencies and/or criteria for the existing storm drain system, it is recommended that more detailed analysis of the storm drain storage-discharge relationship be performed for the specific project if a higher degree of accuracy is desired. The combined pervious and impervious inflow hydrographs for a study area are routed through the storm drains using the modified puls routing method. The storage-discharge relationship for that area is calculated from a unitized relationship and applied to obtain the outflow from the storm drain system. The storage routing usually consists of two types of boundary conditions: namely, "with barrier" (eg. berms, levees, houses and etc.) and "without barrier" conditions. The "with barrier" conditions can be found in the lower parts of a watershed, where the lay of the land has flat or mild slopes (generally less than 0.02). Here, the urban runoff can only reach the creeks through the storm drain system, without the possibility of overland connections. The "without barrier" condition generally exists at the upper part of a watershed where slopes are steep (generally greater than 0.02), or in areas without flood control improvements. Runoff water from these areas without barriers normally finds its overland course and eventually reaches the creek channels.

For channel routing, Muskingum-Cunge Routing method was used. Refer to Appendix A-9 for the channel routing parameters applied.

Figure 1. General Unitized Storage-Discharge Rating Curve (prorated to one square mile of an area)



3. DESIGN HYDROGRAPH ESTIMATION FOR RURAL AND URBAN WATERSHEDS

The hydrologic modeling tool adopted for this study is the HEC-1 Flood Hydrograph Package developed by the U.S. Army Corps of Engineers (1990).

The HEC-1 model has several optional procedures to simulate the various components of the rainfall-runoff process in a watershed. Based on previous modeling studies of rural and urban watersheds around the Santa Clara Valley, the approach adopted by the District in the use of the HEC-1 model for rainfall-runoff modeling is summarized as follows:

- The land use is based on the generalized land use information from Association of Bay Area Governments (ABAG 1999), Santa Clara County Parcel Data (2001), and Santa Clara County Ortho Photos (2001).
- The SCS curve number is calculated based on Hydrologic Soil Groups from Soil Survey of San Mateo County by United States Department of Agriculture, Natural Resources Conservation Service (1998) and Santa Clara County published by the United States Department of Agriculture, Soil Conservation Service.
- The longest flow path is defined as a sum of the main channel length and overland flow length. The slope for the basin is calculated using the elevation difference divided by the longest length.
- A watershed boundary is delineated using the 7.5-minute Digital Elevation Model available from USGS. For rural areas, the boundary will follow the contour lines. For urban areas, the boundary will follow the street, storm drain system and the contour.
- *SCVWD Maps of Flood Control Facilities and Limits of 1% Flooding* is utilized for geometric elements of the channel sections.

The District does not anticipated major land use change in Stevens and Permanente Creeks watersheds for the next ten years, since they are mostly urban and fully developed.

4. STEVENS CREEK AND PERMANENTE CREEK HYDROLOGY

The Stevens Creek watershed lies on the northeastern slopes of the Santa Cruz Mountains in Santa Clara County between Permanente Creek and Calabazas Creek. Stevens Creek runs easterly from its headwaters to Stevens Creek Reservoir. The reservoir was constructed in 1934. In 1985, an additional 231,000 cubic yards of material was added to the dam, and raised it by 10 feet. The reservoir capacity is approximately 3,100 acre-feet of water with its surface area close to 90 acres.

Downstream of the reservoir, the creek runs northerly through Sunnyvale and Mountain View. It discharges into South San Francisco Bay through Whisman Slough just to the east of Permanente Creek. The total drainage area of the watershed upstream of Highway 101 is 46 square miles.

In addition to various concrete culverts and channel modifications, the flow in the creek is affected by the presence of Stevens Creek Reservoir with 3,100 acre-feet capacity. In 1960, a flood control diversion structure was constructed to divert a portion of high flows from Upper Permanente Creek to Stevens Creek. Therefore, Permanente Creek upstream of the diversion is considered as a part of the Stevens Creek watershed, and the lower part of Permanente Creek watershed is analyzed separately.

The mean annual precipitation on the basin varies from a high of about 50 inches on the upper slopes of the Santa Cruz Mountains, to a low of about 13.5 inches on the valley floor near the Bay. The majority of this precipitation occurs in the rainy season between November and April. The watershed's elevation ranges from 2,300 feet at the upper watershed, down to near sea level at the bay. The upper elevations are characterized by moderately dense forests and steep slopes. The valley floor is marked by moderate to high urbanization and a gentle slope towards the Bay.

There are many precipitation stations that collectively represent the precipitation patterns on the watershed. These stations are listed below with the 24 -hour, 1% and 10% rainfall depth totals.

Gage Station Number	Gage Station Name	24 hrs 1% Rainfall Depth (inches)	24 hrs 10% Rainfall Depth (inches)
21	Los Gatos Summit, Santa Cruz County	11.25	7.98
24	Dahl Ranch, S.C.V.W.D. Recording	6.67	4.85
53	Maryknoll, S.C.V.W.D. Recording	4.16	3.10
77	Valley Christian, S.C.V.W.D. Recording	9.10	7.05
100	Stevens Creek, S.C.V.W.D. Recording	6.30	4.92
121	Mtn. View Corp. Yard, S.C.V.W.D. Recording	3.70	2.56

The weighted rainfalls from the surrounding precipitation stations were applied to the rainfall-runoff model. These rainfalls were closely in comparisons with the estimates obtained from the global equations. The rainfall input range for 24-hr duration varies from 11.3 inches (1%) and 8.0 inches (10%) for sub-basin H1 to 4.2 inches (1%) and 3.1 inches (10%) for sub-basin N. The results are listed in Appendix A-7 and A-8.

Appendix A contains tables and figures that represent the hydrologic characteristics and design flows for Stevens and Permanente Creeks.

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APPENDIX A
STEVENS CREEK AND PERMANENTE CREEK
HYDROLOGY INFORMATION

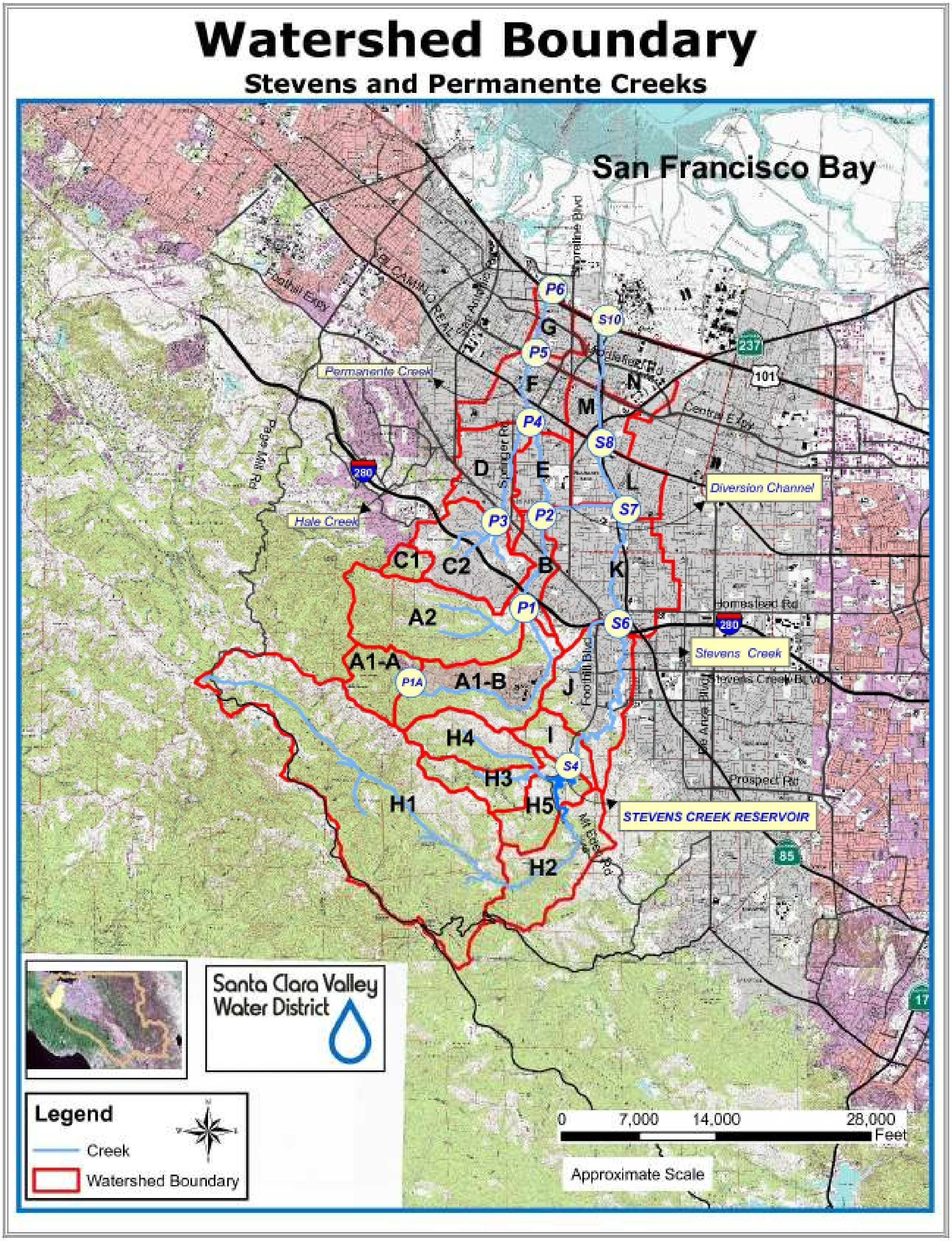
The following Table shows the design flows for Stevens Creek and Permanente creek at various catch points using the procedures as presented in this report:

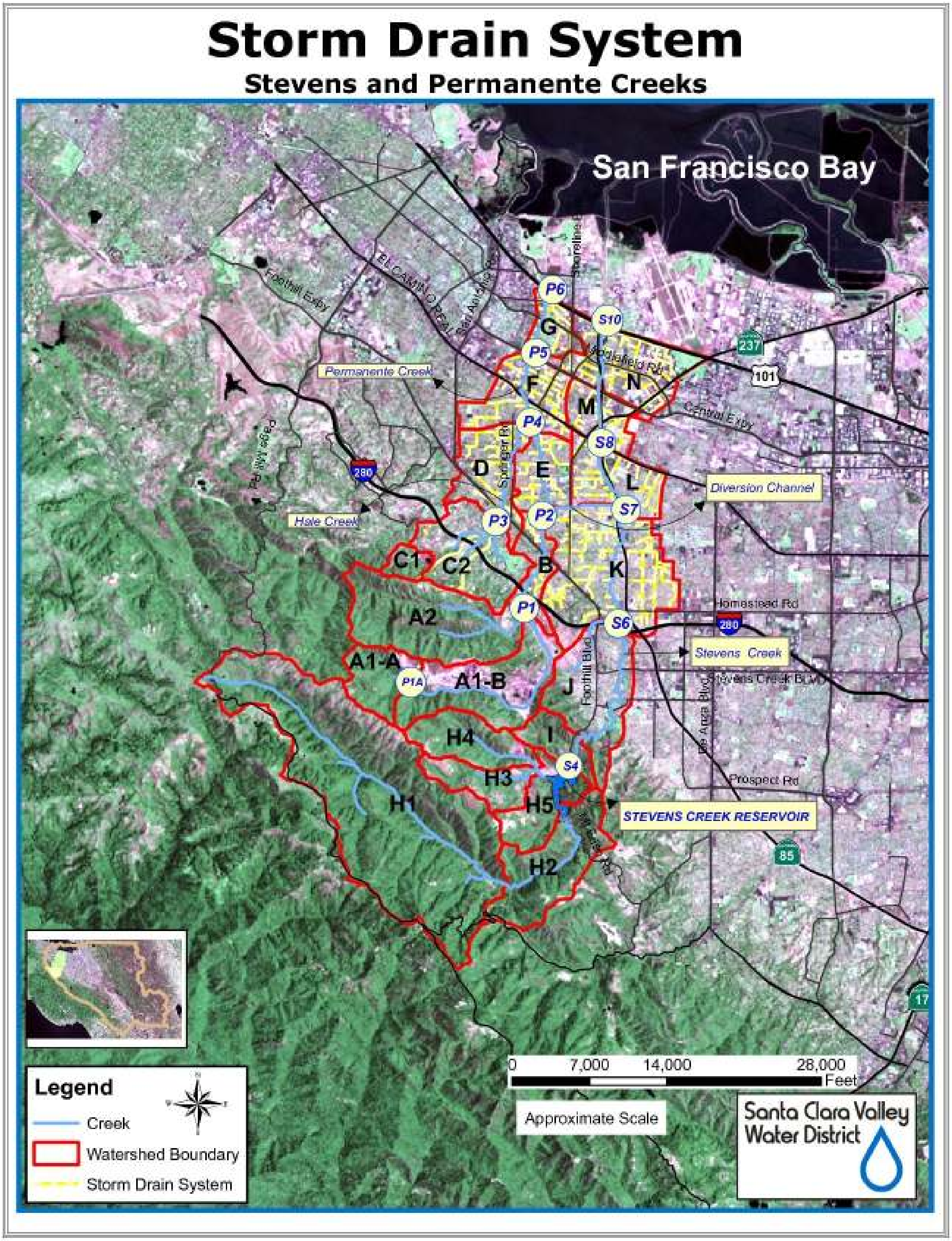
Design Flows for Stevens Creek and Permanente Creek

Location	Drainage Area mi^2	PEAK FLOW (cfs)					
		2.33 year(*) Q 43%	5 year(*) Q 20%	10 year Q 10%	25 year(*) Q 4%	50 year(*) Q 2%	100 year Q 1%
Stevens Creek u/s Reservoir	17.26	1,300	2,300	3,100	4,200	4,900	5,700
Stevens Creek d/s Reservoir(S4)	17.26	1,300	2,200	3,000	4,000	4,800	5,500
Stevens Creek @ I-280(S6)	20.69	1,400	2,400	3,200	4,300	5,100	5,900
West Branch Permanente Creek	3.51	140	270	400	590	730	880
Upper Permanente Creek u/s West Branch Permanente Creek(P1A)	1.17	230	330	400	490	550	600
Lower Permanente Creek u/s West Branch Permanente Creek	2.84	290	480	630	830	960	1,100
Permanente Creek u/s West Branch Permanente Creek(P1)	4.01	450	730	970	1,300	1,500	1,700
Permanente Creek d/s West Branch Permanente Creek	7.52	630	1,000	1,400	1,900	2,200	2,500
Permanente Creek @ Diversion(P2)	8.41	670	1,100	1,500	2,000	2,400	2,700
Permanente Diversion to Stevens Creek		790	1,000	1,100	1,200	1,300	1,400
Stevens Creek d/s Diversion(S7)	24.92	2,200	3,400	4,500	5,800	6,800	7,700
Stevens Creek @El Camino Real(S8)	26.49	2,200	3,500	4,600	5,900	6,900	7,800
Stevens Creek @ US 101(S10)	29.79	2,500	3,800	4,900	6,300	7,200	8,100
Permanente Creek u/s Hale Creek	9.60	110	280	480	810	1,100	1,400
Hale Creek @ Fremont S.C. #33(P3)	2.70	210	340	460	610	720	830
Hale Creek u/s Permanente Creek	4.39	340	520	670	850	1,000	1,100
Permanente Creek d/s Hale Creek(P4)	13.98	300	630	970	1,500	1,900	2,300
Permanente Creek @ Central Expy(P5)	15.76	360	730	1,100	1,600	2,100	2,500
Permanente Creek @ US 101(P6)	16.53	420	810	1,200	1,700	2,200	2,600

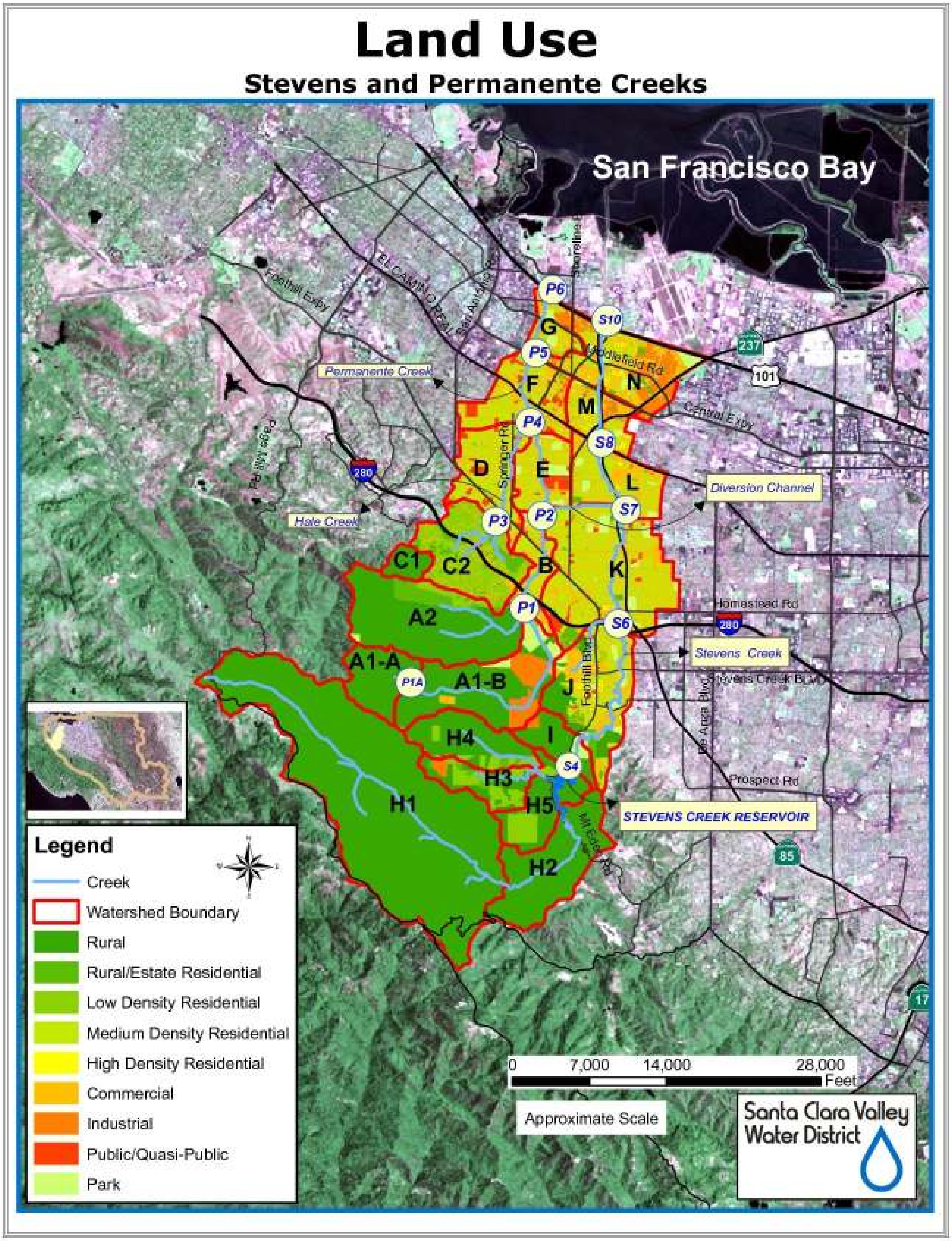
(*) extrapolated and interpolated by using log Pearson Type III distribution.

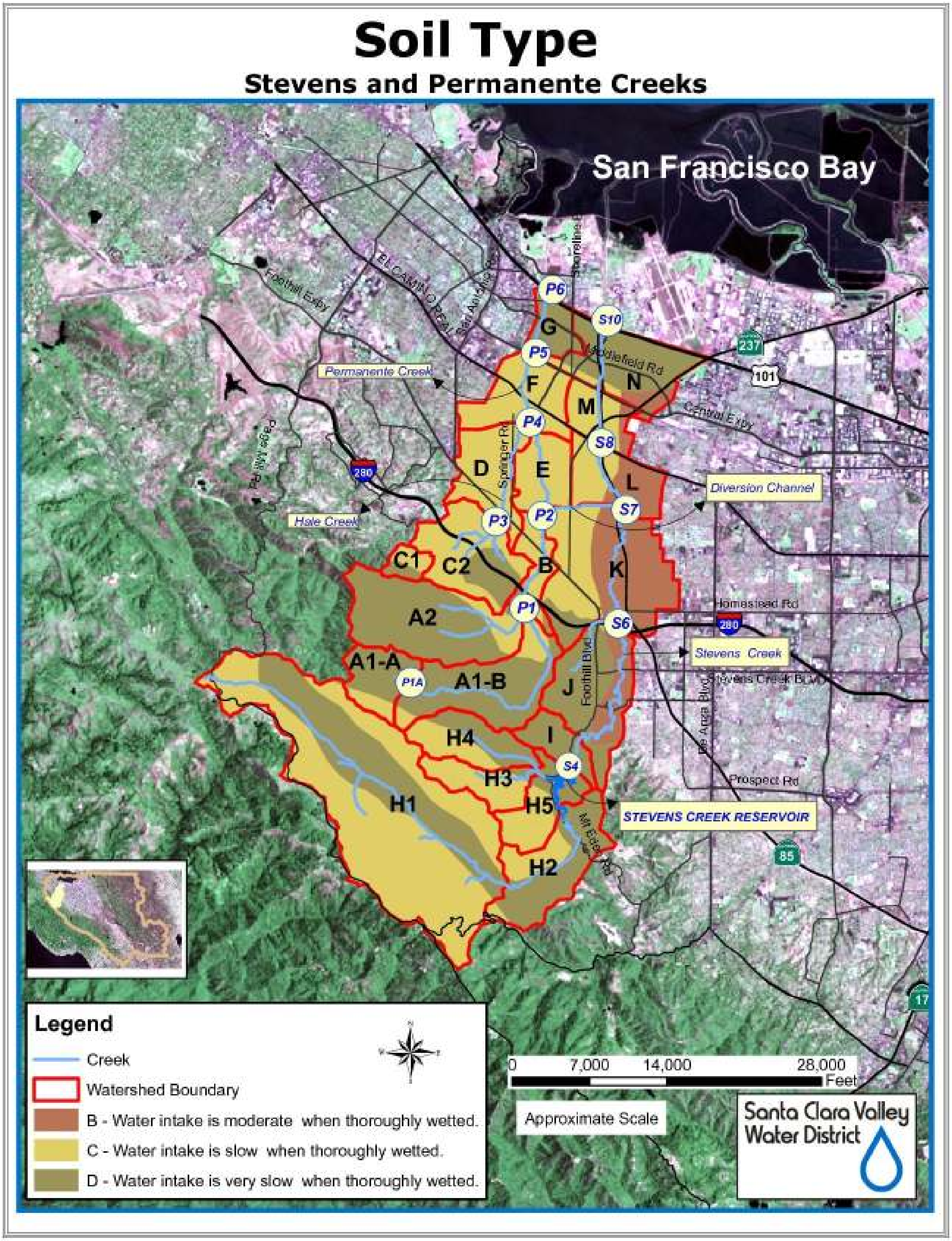
- The initial storage for Stevens Creek Reservoir was at 3,138 acre-feet for both 1% and 10% design flow calculation.

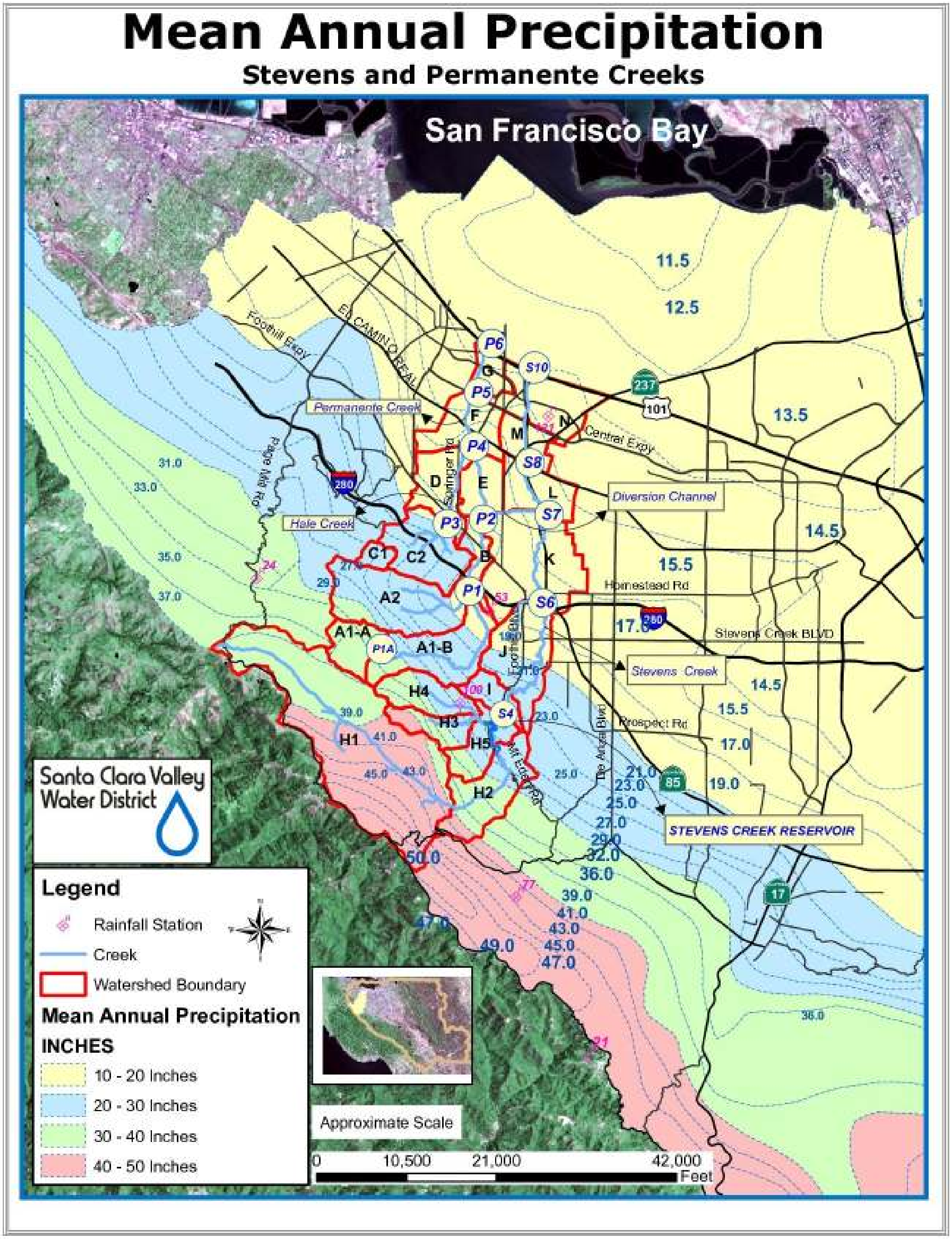

Watershed Boundary
Stevens and Permanente Creeks
San Francisco Bay
Permanente Creek
Hale Creek
Diversion Channel
Stevens Creek
STEVENS CREEK RESERVOIR
P6
P5
P4
P3
P2
P1
P1A
S10
S8
S7
S6
S4
G
F
N
M
D
E
L
C1
C2
B
K
A2
A1-A
A1-B
J
I
H4
H3
H5
H1
H2
Foothill Expy
El Camino Real
Shoreline Blvd
Central Expy
Page Mill Rd
Foothill Blvd
Homestead Rd
Stevens Creek Blvd
Prospect Rd
Mt Eden Rd
280
237
101
85
17
Santa Clara Valley Water District
Legend
Creek
Watershed Boundary
0
7,000
14,000
28,000
Feet
Approximate Scale



Storm Drain System
Stevens and Permanente Creeks
San Francisco Bay
Permanente Creek
Hale Creek
Diversion Channel
Stevens Creek
STEVENS CREEK RESERVOIR
P6
S10
G
P5
F
N
M
P4
S8
D
E
L
P3
P2
S7
C1
C2
B
K
P1
S6
A2
A1-A
P1A
A1-B
J
H4
I
S4
H3
H5
H1
H2
0
7,000
14,000
28,000
Feet
Approximate Scale
Legend
Creek
Watershed Boundary
Storm Drain System
Santa Clara Valley
Water District


Land Use
Stevens and Permanente Creeks
San Francisco Bay
Foothill Expy
EL CAMINO REAL
San Antonio Rd
Shoreline
Middlefield Rd
Central Expy
Permanente Creek
Page Mill Rd
Springer Rd
Diversion Channel
Hale Creek
Homestead Rd
Stevens Creek
Stevens Creek Blvd
Foothill Blvd
De Anza Blvd
Prospect Rd
STEVENS CREEK RESERVOIR
Mt Eden Rd
P6
P5
P4
P3
P2
P1
P1A
S10
S8
S7
S6
S4
G
F
N
M
D
E
L
C1
C2
B
K
A2
A1-A
A1-B
J
H4
I
H3
H5
H1
H2
Legend
Creek
Watershed Boundary
Rural
Rural/Estate Residential
Low Density Residential
Medium Density Residential
High Density Residential
Commercial
Industrial
Public/Quasi-Public
Park
0 7,000 14,000 28,000
Feet
Approximate Scale
Santa Clara Valley Water District


Soil Type
Stevens and Permanente Creeks
San Francisco Bay
Foothill Expy
EL CAMINO REAL
San Antonio Rd
Shoreline
Middlefield Rd
Central Expy
Permanente Creek
Page Mill Rd
Springer Rd
Diversion Channel
Hale Creek
Homestead Rd
Stevens Creek
Stevens Creek Blvd
Foothill Blvd
De Anza Blvd
Prospect Rd
Mt Eden Rd
STEVENS CREEK RESERVOIR
P6
S10
G
P5
N
F
M
P4
S8
D
E
L
P3
P2
S7
C1
C2
B
K
P1
A2
S6
A1-A
P1A
A1-B
J
H4
I
S4
H3
H1
H5
H2
237
101
280
85
17
Legend
Creek
Watershed Boundary
B - Water intake is moderate when thoroughly wetted.
C - Water intake is slow when thoroughly wetted.
D - Water intake is very slow when thoroughly wetted.
0
7,000
14,000
28,000
Feet
Approximate Scale
Santa Clara Valley Water District


Mean Annual Precipitation
Stevens and Permanente Creeks
San Francisco Bay
Santa Clara Valley Water District
Legend
Rainfall Station
Creek
Watershed Boundary
Mean Annual Precipitation
INCHES
10 - 20 Inches
20 - 30 Inches
30 - 40 Inches
40 - 50 Inches
Approximate Scale
0 10,500 21,000 42,000 Feet
Permanente Creek
Hale Creek
Diversion Channel
Stevens Creek
STEVENS CREEK RESERVOIR
Foothill Expy
EL CAMINO REAL
Central Expy
Homestead Rd
Stevens Creek BLVD
Prospect Rd
Page Mill Rd
De Anza Blvd
Foothill Blvd
11.5
12.5
13.5
14.5
15.5
17.0
19.0
21.0
23.0
25.0
27.0
29.0
32.0
36.0
39.0
41.0
43.0
45.0
47.0
49.0
50.0
P6
P5
P4
P3
P2
P1
P1A
S10
S8
S7
S6
S4
A1-A
A1-B
A2
C1
C2
H1
H2
H3
H4
H5

Stevens and Permante Creek (1% HEC-1 Input Data)

BASIN	Total Area	Rural Area	Perv Area	Imp. Area	Rural Ia -Calc	Rural CN	Perv Ia -Calc	Perv CN	Imp Ia -Calc	Imp CN	Rural Tc	Rural R	Perv Tc	Perv R	Imp Tc	Imp R	Rainfall using Global Eq.	Applied Weighted Rainfall	AMC
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
A1-A	1.17	1.17			0.50	80					0.47	0.76					9.52	9.10	2.25
A1-B	2.84	1.95	0.31	0.57	0.50	80	0.32	86	0.04	98	0.53	0.87	0.34	0.56	0.22	0.15	6.84	6.86	2.25
A2	3.51	2.97	0.40	0.13	0.62	76	0.42	83	0.04	98	0.66	2.66	0.45	1.82	0.21	0.14	6.79	6.67	2.25
B	0.89		0.27	0.62			0.56	78	0.04	98			0.40	0.93	0.24	0.16	5.20	5.42	2.25
E	1.19		0.36	0.83			0.56	78	0.04	98			0.39	0.90	0.24	0.16	4.83	5.00	2.25
C1	0.37	0.37			0.76	73					0.23	1.05					6.79	5.92	2.25
C2	2.33		1.40	0.93			0.50	80	0.04	98			0.36	1.64	0.20	0.13	5.88	5.92	2.25
D	1.69		0.42	1.26			0.56	78	0.04	98			0.35	2.56	0.23	0.15	4.98	5.12	2.25
F	1.78		0.36	1.42			0.56	78	0.04	98			0.36	0.85	0.24	0.16	4.63	4.74	2.25
G	0.77		0.19	0.58			0.42	83	0.04	98			0.42	0.97	0.25	0.17	4.30	4.48	2.25
H1	10.93	10.93			0.76	73					1.21	4.82					11.66	11.25	2.25
H2	2.44	2.44			0.65	75					0.92	3.68					8.80	9.10	2.25
H3	1.05	0.52	0.31	0.21	0.88	70	0.53	79	0.04	98	0.48	1.92	0.32	1.28	0.20	0.13	9.39	9.10	2.25
H4	1.50	1.22	0.18	0.10	0.72	74	0.48	81	0.04	98	0.44	1.77	0.39	1.56	0.21	0.14	8.53	9.10	2.25
H5	1.34	1.02	0.23	0.10	0.72	74	0.53	79	0.04	98	0.34	1.35	0.40	1.61	0.21	0.14	7.60	7.70	2.25
I	0.81	0.64	0.10	0.06	0.59	77	0.40	84	0.04	98	0.45	8.63	0.42	7.91	0.22	0.15	6.35	6.30	2.25
J	2.63	0.53	0.74	1.37	0.72	74	0.59	77	0.04	98	0.60	11.48	0.32	6.15	0.21	0.14	5.50	5.23	2.25
K	4.23		1.27	2.96			0.80	72	0.04	98			0.38	7.29	0.23	0.16	4.78	4.74	2.25
L	1.57		0.39	1.18			0.80	72	0.04	98			0.40	7.59	0.25	0.16	4.59	4.74	2.25
M	1.02		0.25	0.76			0.62	76	0.04	98			0.38	7.27	0.24	0.16	4.55	4.74	2.25
N	2.28		0.46	1.82			0.48	81	0.04	98			0.38	7.26	0.25	0.16	4.35	4.16	2.25

1. Total area of the sub-watershed in square miles
2. The rural part of the sub-watershed, area in square miles
3. The pervious part of the sub-watershed, area in square mile
4. The impervious part of the sub-watershed, area in square miles
5. Initial Abstraction (Ia) for rural area
6. Curve Number(CN) for rural area
7. Initial Abstraction (Ia) for pervious area
8. Curve Number(CN) for pervious area
9. Initial Abstraction (Ia) for impervious area
10. Curve Number(CN) for impervious area
11. Times of Concentration(Tc) for rural area
12. Clark's Storage Routing Coefficient R for rural area
13. Times of Concentration(Tc) for pervious area
14. Clark's Storage Routing Coefficient R for pervious area
15. Times of Concentration(Tc) for impervious area
16. Clark's Storage Routing Coefficient R for impervious area
17. Rainfall using Global Equation in inches
18. Applied Weighted Rainfall in inches
19. Antecedent Moisture Condition

Stevens and Permante Creek (10% HEC-1 Input Data)

BASIN	Total Area	Rural Area	Perv Area	Imp. Area	Rural Ia - Calc	Rural CN	Perv Ia -Calc	Perv CN	Imp Ia -Calc	Imp CN	Rural Tc	Rural R	Perv Tc	Perv R	Imp Tc	Imp R	Rainfall using Global Eq.	Applied Weighted	AMC
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
A1-A	1.17	1.17			0.99	67					0.47	0.47					6.48	7.05	1.5
A1-B	2.84	1.95	0.31	0.57	0.99	67	0.68	75	0.04	98	0.53	0.53	0.34	0.34	0.22	0.15	4.65	4.87	1.5
A2	3.51	2.97	0.40	0.13	1.21	62	0.86	70	0.04	98	0.66	1.99	0.45	1.36	0.21	0.14	4.62	4.85	1.5
B	0.89		0.27	0.62			1.09	65	0.04	98			0.40	0.93	0.24	0.16	3.54	3.98	1.5
E	1.19		0.36	0.83			1.09	65	0.04	98			0.39	0.90	0.24	0.16	3.29	3.44	1.5
C1	0.37	0.37			1.45	58					0.23	1.05					4.62	4.06	1.5
C2	2.33		1.40	0.93			0.99	67	0.04	98			0.36	1.64	0.20	0.13	4.01	4.06	1.5
D	1.69		0.42	1.26			1.09	65	0.04	98			0.35	2.56	0.23	0.15	3.39	3.41	1.5
F	1.78		0.36	1.42			1.09	65	0.04	98			0.36	0.85	0.24	0.16	3.15	3.26	1.5
G	0.77		0.19	0.58			0.86	70	0.04	98			0.42	0.97	0.25	0.17	2.92	3.09	1.5
H1	10.93	10.93			1.17	63					1.21	4.82					7.94	7.98	1.75
H2	2.44	2.44			1.03	66					0.92	3.68					5.99	7.05	1.75
H3	1.05	0.52	0.31	0.21	1.33	60	0.84	71	0.04	98	0.48	1.92	0.32	1.28	0.20	0.13	6.39	7.05	1.75
H4	1.50	1.22	0.18	0.10	1.13	64	0.76	73	0.04	98	0.44	1.77	0.39	1.56	0.21	0.14	5.80	7.05	1.75
H5	1.34	1.02	0.23	0.10	1.13	64	0.84	71	0.04	98	0.34	1.35	0.40	1.61	0.21	0.14	5.18	5.69	1.75
I	0.81	0.64	0.10	0.06	0.93	68	0.65	76	0.04	98	0.45	8.63	0.42	7.91	0.22	0.15	4.32	4.32	1.75
J	2.63	0.53	0.74	1.37	1.13	64	0.93	68	0.04	98	0.60	11.48	0.32	6.15	0.21	0.14	3.75	3.71	1.75
K	4.23		1.27	2.96			1.23	62	0.04	98			0.38	7.29	0.23	0.16	3.26	3.26	1.75
L	1.57		0.39	1.18			1.23	62	0.04	98			0.40	7.59	0.25	0.16	3.12	3.26	1.75
M	1.02		0.25	0.76			0.98	67	0.04	98			0.38	7.27	0.24	0.16	3.10	3.26	1.75
N	2.28		0.46	1.82			0.76	73	0.04	98			0.38	7.26	0.25	0.16	2.96	3.10	1.75

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14. Clark's Storage Routing Coefficient R for pervious area
15. Times of Concentration(Tc) for impervious area
16. Clark's Storage Routing Coefficient R for impervious area
17. Rainfall using Global Equation in inches
18. Applied Weighted Rainfall in inches
19. Antecedent Moisture Condition

Channel Routing Parameters

BASIN	Channel Length (ft)	Channel Slope	Manning's n	Channel Width (ft)	Channel Side Slope	Channel Shape	FROM	TO
A1-A	22970	0.05233	0.062	8.6	1.0	TRAP	P1A	P1
A1-B								
A2	10013	0.01032	0.057	12.0	1.5	TRAP	P1	P2
B	8375	0.00764	0.055	5.0	1.0	TRAP	P2	P4
E								
C1	8569	0.02421	0.044	6.4	1.0	TRAP	P21	P3
C2	10078	0.00606	0.021	10.0	1.0	TRAP	P3	P4
D	6845	0.00747	0.012	11.0	1.0	TRAP	P4	P5
F	6089	0.00552	0.014	12.0	1.0	TRAP	P5	P6
G								
H1	14063	0.02432	0.063	25.0	2.0	TRAP	S1	S2
H2								
H3								
H4								
H5	2892	0.02168	0.057	25.0	1.5	TRAP	S4	S5
I	18078	0.00758	0.050	11.0	1.5	TRAP	S5	S6
J	13847	0.00749	0.037	15.0	1.5	TRAP	S6	S7
K	6536	0.00868	0.044	19.0	1.0	TRAP	S7	S8
L	5325	0.01000	0.029	18.0	1.0	TRAP	S8	S9
M	5667	0.00852	0.026	23.0	1.0	TRAP	S9	S10
N								

APPENDIX J

List of Technical Terms and Acronyms

ADA	Americans With Disabilities Act
Bay	San Francisco Bay
BMP(s)	Best Management Practice(s)
CDFG	California Department of Fish and Game
CEQA	California Environmental Quality Act
CGF	Committee for Green Foothills
cfs	Cubic feet per second
CIP	Capital Improvement Project
cm	Centimeters
cms	Cubic meters per second
Corps	U.S. Army Corps of Engineers
County	County of Santa Clara
CSC	Clean, Safe Creeks and Natural Flood Protection Measure B
CWA	Clean Water Act
District	Santa Clara Valley Water District
(D)EIR	(Draft) Environmental Impact Report
EOP	Emergency Operations Plan
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FEMA	Federal Emergency Management Agency
fps	Feet per second
ft	Feet
ha	Hectare
km	Kilometer
m	Meter
MBTA	Migratory Bird Treaty Act
MCE	Maximum Credible Earthquake
MMP	Mitigation Monitoring plan
MOU	Memorandum of Understanding
MVHA	Mountain View Historical Association
NAVD	North America Vertical Datum

NEPA	National Environmental Policy Act
NFIP	National Flood Insurance Program
NFP	Natural Flood Protection
NHI	National Heritage Institute
NHPA	National Heritage Preservation Act
NMFS	National Marine Fisheries Service
NOP	Notice of Preparation
NPDES	National Pollution Discharge Elimination System
NRHP	National Register of Historic Places
O&M	Operations and Maintenance
OSHA	Occupational Safety and Health Act
PGA	Peak Ground Acceleration
ROW	Right-of-Way
RWQCB	Regional Water Quality Control Board
SMP	Stream Maintenance Program
SOS	Save Open Space
SPCWC	Stevens and Permanente Creeks Watershed Council
SRA	Shaded Riverine Aquatic
SWPPP	Stormwater Pollution Prevention Plan
SWRCB	State Water Resources Control Board
TCE	Temporary Construction Easement
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WMI	Watershed Management Initiative

APPENDIX K

Persons to Contact for More Information

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