SAN FRANCISQUITO CREEK
JOINT POWERS AUTHORITY
SFCJPA.ORG

May 7, 2014

Sent via email: no hardcopy to follow

Mr. Bruce Wolfe
Executive Officer
San Francisco Bay Regional Water Quality Control Board
1515 Clay Street, Suite 1400
Oakland, CA 94612

Dear Mr. Wolfe:

This letter, and its enclosures, serve as a follow-up to our March 19, 2014 meeting in which we agreed upon a final set of actions to be taken by the San Francisquito Creek Joint Powers Authority (SFCJPA) to enable the San Francisco Bay Regional Water Quality Control Board (Regional Water Board) to complete its 401 Water Quality Certification for our proposed San Francisquito Creek Flood Reduction, Ecosystem Restoration, and Recreation Project from San Francisco Bay to Highway 101 (Project). On March 31, 2014, I wrote to you and summarized this meeting; that letter contained specific language that we agreed to in regards to the actions listed below.

- A consultant to the SFCJPA will draft a Technical Memorandum describing our proposal to fill a low point in the levee separating the creek from the Faber Tract marsh to the north, in order to reduce the volume of creek flow into that marsh. On April 14, 2014, I e-mailed that Technical Memorandum to you and Shin-Roei Lee.
- The SFCJPA would describe the technical basis for the 7,400 cfs maximum flow that could reach the Faber Tract after all foreseeable projects are constructed and the Middlefield Road Bridge is the upstream constriction in the floodplain area. Our description of this begins on page 2 of this letter.
- The SFCJPA would provide a table summarizing all of the project elements considered for the Bay-Highway 101 area against a list of the criteria used to evaluate those alternatives. This table is enclosed.
- The SFCJPA would provide justification that the proposed Project is the Least Environmentally Damaging Practicable Alternative (LEDPA) based on analyses of the Project and two specific alternatives requested by you at the March 19, 2014 meeting. This correspondence constitutes our analysis of your two alternatives:

  1. Widening the Creek Mouth Alternative: Downstream of the project area, widen the channel slightly by continuing the new Palo Alto side levee in the Palo Alto Golf Course to the location just upstream of where the Golf Course meets the northern end of the Palo Alto Airport. This alternative would lower the levee between the creek and marsh to allow fluvial flows into the triangular area of marsh to the east of the Faber Tract. Hereafter, these two project elements are referred to as the Levee Setback Extension and Bay Levee Degrade.

  2. Embarcadero Road Bypass Alternative: Construct a bypass channel to divert some of the flow from San Francisquito Creek to a floodwater detention basin at the City of Palo Alto Baylands Athletic Center ball fields and the potential future sports fields near the downstream end of the proposed floodwall. Floodwaters would exit the detention basin into a bypass channel that would continue along the southern boundary of the golf course along Embarcadero Road, cut through the airport property, and discharge to the tidal marsh south of the airport runway.

We further agreed that two weeks after your receipt of this letter and enclosures, your staff would meet with Santa Clara Valley Water District (SCVWD) staff and SFCJPA staff and consultants to discuss the above-mentioned issues and the overall hydraulic performance of the project, and that this meeting is intended to be the final meeting to discuss this project prior to Certification. All of the enclosures listed on page 5 are contained within this one PDF document.

An element of our original project design submitted for 401 Certification in March 2013 recreated the historic connection between this creek and the Faber Tract marsh during very high creek flows in order to provide some flood control benefit. This connection also would restore the deposition of fluvial sediment into, and therefore enhance the long-term sustainability of, the Faber Tract marsh. Due to concerns about more immediate impacts to protected species expressed by the U.S. Fish & Wildlife Service, in January 2014 we altered our design to eliminate this increased connectivity, and then in late February 2014 we proposed to go a step further and fill in a low point of the levee downstream of the project that separates the creek and marsh.

At our March 19, 2014 meeting, you expressed that your primary concern with the project remains the impact of San Francisquito Creek flows on the Faber Tract marsh, and you requested that we examine alternatives that may reduce those flows further within a LEDPA analysis. As mentioned on the previous page, our technical analysis of the project design options assumes a maximum creek flow of 7,400 cubic feet per second (cfs) in the creek adjacent to Faber Tract, and a range of tides; below I describe why that is the maximum foreseeable flow at that location.

Basis for selecting 7,400 cfs and three tidal scenarios for our analysis

The 1% flow event for San Francisquito Creek at the Faber Tract was estimated in the hydraulic model, which was certified by the U.S. Army Corps of Engineers in 2009, to be 9,400 cfs. The Project was designed to convey this flow, coincident with a 1% tide plus 26 inches of Sea Level Rise, which is equal to a 12.5' (NAVD 88) tidal elevation.

In previous modeling efforts to test the project's design and respond to requests by the Regional Water Board and other regulatory agencies, we used a likely worst-case scenario of 9,400 cfs at a 12.5' tide in order to establish and communicate the maximum potential impacts of the Project. At our March meeting, you asked that our future analyses be based upon a more common creek flow event under a range of more common tidal conditions.

Thus, we chose three tidal conditions for our modeling of the information presented in HDR's April 14, 2014 Technical Memorandum regarding filling in the Faber Tract levee, and for the analysis presented here:

- 4.0' tide, which is the daily Mean Tidal Level or arithmetic mean of mean high water and mean low water,
- 7.1' tide, which is Mean Higher High Water or the average of the higher high water height of each tidal day observed over the National Tidal Datum Epoch, and
- 9.6' tide, which is considered the 10-year tide with a 10% chance of occurring in any given year.

For these analyses, we assumed a maximum creek flow of 7,400 cfs to the Faber Tract area, because it represents the maximum flow level that could be delivered there if this Project and all of the currently planned and funded improvements upstream of this Project were to be built. It is worth noting that in the 84 years that flow rates have been measured on San Francisquito Creek by the US Geological Survey, 7,400 cfs has been recorded only once, during the flood of record in 1998. Also, the Project's proposed levee crown elevations are controlled by tides and Sea Level Rise, and would not change based on the maximum flow that could be delivered to the Project.

The figures included in the enclosed May 5, 2014 HDR Technical Memorandum entitled "Widening the Creek Mouth Alternative," show that the proposed project will convey greater flow to the Faber Tract area than under existing conditions. This is because water currently overtops and seeps through sub-standard levees and floods homes in East Palo Alto, as well as businesses, a school, US Postal Service site, and parkland in Palo Alto. The Project will improve these conditions and convey flow within the channel to the Bay.

The foreseeable improvements upstream of this project include a Caltrans project to replace bridges at Highway 101 and adjacent frontage roads, the replacement of bridges at Newell Road and Pope-Chaucer Streets, and channel widening in strategic areas between Highway 101 and Pope-Chaucer. Other than the Caltrans project, which is anticipated to begin construction this year, these projects are in the planning stage, and we will seek input from the Regional Water Board and other agencies as part of the planning process.

Following the implementation of the project elements listed in the preceding paragraph, the existing Middlefield Road Bridge will be the most significant creek constriction upstream of the Project. With the bridge at Middlefield Road as the upstream hydraulic control, assuming that all constrictions below its capacity downstream are removed or improved, we can calculate the future maximum flow to reach the creek adjacent to the Faber Tract.

Per the Corps of Engineers existing conditions hydraulic model, the maximum flow that can pass under the Middlefield Road Bridge is 6,700 cfs. As we saw during the flood of 1998, a flow exceeding 6,700 cfs at that location will overtop the banks and flood streets and homes, and not return to the creek channel.

The Corps of Engineers model also looked at the amount of flow that is added to the creek in different reaches, and concluded that between the Middlefield Road Bridge and the Palo Alto Airport downstream, a maximum of 100 cfs could enter the system. This relatively small amount is due to the fact that in these downstream reaches, the creek is a "perched" system, where the tops of the banks are at a higher elevation than the surrounding landscape and thus the creek does not receive overland drainage input. Additionally, during a large storm event, storm drain outfalls to the creek are well below the water surface elevation in the channel, and thus they do not contribute additional flows downstream of Middlefield Road.

Because of this, both the cities of Palo Alto and East Palo Alto have built pump stations to discharge storm water into the creek. These pump stations, which are located between Highway 101 and the Faber Tract, can each deliver a maximum of 300 cfs to the channel upstream of the Faber Tract. Therefore, the maximum flow that could reach the levee separating the creek from Faber Tract after the proposed project is completed, and if all upstream improvements are made, was calculated in cubic feet per second as follows:

	Middlefield Road conveyance	6,700 cfs
+	Additional flow between Middlefield Road and Palo Alto Airport	100 cfs
+	Palo Alto Pump Station max discharge	300 cfs
+	East Palo Alto's O'Connor Pump Station max discharge	300 cfs
=	Maximum flow delivered to creek adjacent to Faber Tract	7,400 cfs

Summary of Findings

On March 19, 2014, you requested that we provide a LEDPA analysis of the proposed Project and two alternatives, which we have called "Widening the Creek Mouth" and "Embarcadero Road Bypass." Below is a narrative summary of these findings for the LEDPA analysis.

The Widening the Creek Mouth Alternative is made up of two distinct elements suggested by the Regional Water Board – the Levee Setback Extension and SF Bay Levee Degrade. We evaluated both in terms of their hydraulic performance, environmental considerations, and cost; and enclosed are technical memoranda, plan views and profiles from HDR and SCVWD engineers.

Widening the Creek Mouth Alternative

As described in the enclosed May 5, 2014 HDR Technical Memorandum entitled "Widening the Creek Mouth Alternative," the project element suggested by the Regional Water Board to degrade the levee between the creek and the triangular marshland north of the creek and east of the Faber Tract has a beneficial hydraulic impact by lowering the water surface elevation in the channel. This is beneficial in terms of flood protection and further reduces the creek discharge into the Faber Tract. If certain potential concerns are addressed, including this project element as part of the Project may be advisable. The potential concerns include increased creek discharge to the marshland area north of the Creek and east of Faber Tract and potential impacts to the endangered salt marsh harvest mouse and California clapper rail populations in that area, loss of upland refugia as a result of the levee degrade, exposure of two PG&E towers near the Bayside end of the degrade to increased hydraulic forces, and impacts to PG&E's ability to access their existing tower via the levee immediately adjacent to the Faber Tract.

Should it be practical to address these environmental and utility related concerns, we believe that the cost to design and implement this project element is within the funding available to the Project, and thus it could be part of the Least Environmentally Damaging Practicable Alternative.

The project element to extend the Levee Setback in the golf course and tie-in the new levee with the existing levee just upstream of the Palo Alto Airport will lower the water surface elevation by about six inches upstream of Friendship Bridge, but also increase fluvial discharge into Faber Tract. This is due to the fact that the flow rate slows at the point at which the setback levee ties back into the existing levee and upstream of there, which raises water surface elevation adjacent to the Faber Tract levee. This impact is made clear in Table 4 of the HDR Memorandum.

Extending the levee setback would place wetlands and native plant areas adjacent to and within the new Palo Alto Golf Course beneath the new wider levee, which would be somewhat, but not completely, mitigated by the wetlands created within the wider channel at that location. Finally, the extending the levee setback is not practicable, as it would cause the Project to substantially exceed available funding.

In summary, because the project element to extend the levee setback in the golf course has an adverse impact on water surface elevation adjacent to the Faber Tract and would introduce more water into that marsh and thus exacerbate your primary concern, and because it would result in a new loss of wetlands, and because it would result in a substantial increase in project costs and exceeds available funds, this project element would not be part of the Least Environmentally Damaging Practicable Alternative.

Embarcadero Road Bypass Alternative

This alternative suggested by the Regional Water Board can divert and convey flows sufficient to eliminate discharge to Faber Tract, but to do so would require the construction of substantial above ground structures. A below-grade structure, such as an in-ground or underground culvert, could not deliver flows to San Francisco Bay due to the existing ground topography. In order to provide sufficient flow, approximately 8-foot tall floodwalls would need to be constructed around the proposed overflow basin and along Embarcadero Road. It is not possible to contain this channel within above ground levees, because the land use and transportation of the surrounding area would be severely impacted by the footprint of these levees. The environmental impacts of this alternative, even with the smaller footprint of floodwalls, would be significant, including impacts to trees, vehicular transportation, recreational amenities, aesthetics, and to San Francisco Bay into which the bypass flows. In order to support fish species, the bypass would require resting places for fish, making the design more complex. To date, the issue of terrestrial fauna habitat has not been examined in detail, but the bypass channel and the detention basin floodwalls would restrict habitat access. Implementing this action would not obviate the need to rebuild the creek levees, as they are in poor condition and, if left alone, would cause the community to remain at high risk. In part because of the need to build two channels with structure that provide certified protection, this alternative would cost more than 50% more than the cost of the proposed Project, and thus it is not practicable.

Proposed Project

The LEDPA analysis of the proposed Project was originally completed for, and included in, Chapter 6, *Alternatives*, of the Draft and Final Environmental Impact Report under the section "Identification of Environmentally Superior Alternative." This chapter is enclosed with this letter. In general, the project concept and design remain consistent with the project description in the EIR, which has several environmental advantages over other identified alternatives. These include the restoration or creation of 15 acres of tidal marshland that would lie within the new widened channel, the improved recreational amenities of the San Francisco Bay Trail and the enabling of an improved Palo Alto Golf Course, and improvements to water quality conditions by conveying flow that currently floods developed areas, picking up pollutants before being discharged directly to the Bay.

During the permit process, we have incorporated specific modifications to the design that have improved the project. These include: not degrading the levee separating the creek and Faber Tract; filling the lowest point of the Faber Tract levee, which will reduce the frequency, volume and velocity of creek flows into Faber Tract compared to current conditions; and the reduction of rock slope protection. The additional project element suggested by the Regional Water Board to degrade the levee north of the Creek and east of the Faber Tract, if agreeable to other agencies, would nearly eliminate creek discharge to Faber Tract under all flow and tide conditions.

The process of analyzing the additional project alternatives suggested by the Regional Water Board has strengthened our confidence that the proposed Project is the Least Environmental Damaging Practicable Alternative. Small modifications that have resulted from this process have served to improve and solidify that designation.

Listed below my signature are several documents that provide technical background to the information contained in this letter. As we discussed, these documents represent the Regional Water Board's final request for technical information related to this project, and we both have stated our commitment to making the next meeting our final one prior to 401 Certification.

Therefore, it is important that your staff review these documents prior to the meeting scheduled on May 21, 2014 and that they come to that meeting sharing your commitment to completing the Certification process quickly. It is also very important that your staff notify me at least three business days prior to the meeting if they have questions regarding this letter or the enclosures so that we may come to the meeting prepared to answer those questions.

Thank you again for your commitment to completing the permit process on this critical and timely project for our communities. Project delays increase the inherent, immediate, and severe threat to property and human life facing a disadvantaged community we both serve. Downstream (east) of Highway 101, the real threat to water quality is also the threat to lives and property. Currently water overtops creek banks and passes through homes, garages, businesses and streets before entering S.F. Bay. The Project will improve these conditions because after our project is built, these waters will flow over a new marsh within the creek channel and into the Bay. We know you share our desire to quickly move forward with a project that provides multiple benefits, and following this correspondence and our meeting in two weeks, we are confident that we will do so.

Sincerely,

Len Materman
Executive Director

cc: Magda Gonzalez, City Manager, East Palo Alto
Jim Keene, City Manager, Palo Alto
Norma Camacho, Chief Operating Officer, Watersheds, Santa Clara Valley Water District
Shin-Roei Lee, Watersheds Division Chief, San Francisco Bay Regional Water Quality Control Board

Enclosures: May 5, 2014 HDR Technical Memo "Widening the Creek Mouth Alternative" with plan view and figures

May 5, 2014 SCVWD Technical Memo "Embarcadero Road Bypass Alternative" with plan, profile and cross section views

S.F. Bay-Highway 101 Preliminary Alternatives Evaluation Table

October 2012 Final Environmental Impact Report, Chapter 6 *Alternatives*

May 5, 2014

SAN FRANCISQUITO CREEK FLOOD REDUCTION, ECOSYSTEM RESTORATION AND RECREATION PROJECT

Widening the Creek Mouth Alternative

Reviewed by: Serge Jimenez, P.E.

Prepared by: Elizabeth Mesbah, P.E.

Hydraulic Analysis Summary

This Technical Memorandum presents a summary of the hydraulic analysis completed to compare existing channel conditions to the proposed levee alignment options at a particular riverine event with different concurrent tidal events. The riverine flow of 7,400 cubic feet per second (cfs) was selected for comparison purposes since this is the estimated maximum flow that can reach the downstream portion of San Francisquito Creek after all foreseeable projects are designed and constructed. The three tidal events were selected to illustrate the impacts of tidal condition on the overall Creek water surface profile.

The project steady-state HEC-RAS model was used to compute and compare water surface elevation profile results. Table 1 summarizes the riverine and tidal events considered.

Table 1 - Riverine and Tidal Events

Riverine Flow (cfs)	Tidal Elevation (ft)	Tidal Elevation Description
7,400	9.6	10-Year Tide
7,400	7.1	Mean Higher High Water[1] (MHHW)
7,400	4.0	Mean Tidal Level[2] (MTL)

Three levee improvement project elements have been considered and were modeled jointly as options to evaluate impacts to the water surface elevation profiles.

Element 1 consists of filling a low spot of the existing Faber Tract levee at approximate R-Line Levee Station 27+00 as part of the tie-in of the new and existing levee. By doing so, breakout flows into the Faber Tract decrease and occur farther downstream at a slightly higher location. This was the subject of HDR's April 14, 2014 Technical Memorandum, "Comparison of Results between Existing and Proposed Conditions."

Element 2 consists of degrading the existing San Francisco Bay levee from R-Line Levee Station 2+50 to 10+50 to the existing marsh elevation of 7.1'. The marsh to the north of this levee segment is considered part of the Bay, and not considered part of the Faber Tract. By degrading this levee, Creek

[1] Mean Higher High Water is defined as the average of the higher high water height of each tidal day observed over the National Tidal Datum Epoch.
[2] Mean Tidal Level is defined as the arithmetic mean of mean high water and mean low water.

flows will be allowed to expand out into the San Francisco Bay northerly marsh. The levee would not be degraded immediately adjacent to the PG&E towers to prevent any impact to the tower structures. PG&E's maintenance access to the towers will need to be maintained.

Element 3 consists of setting back the L-Line Levee into the Palo Alto Municipal Golf Course from Station 14+50 to 28+00. The new levee would be setback approximately 40 feet from the centerline of the existing levee, extending from the proposed Boardwalk Bridge abutment transitioning back to the existing levee alignment before crossing the Palo Alto Airport Building Restriction Line as shown in the Plan View that follows this Technical Memorandum.

Table 2 provides a short description of the three elements. Table 3 provides the components of each option modeled.

Table 2 - Proposed Project Elements

Element Name	Element Description	Abbreviation
Element 1	Low spot of Faber Tract R- Line Levee filled from Station 22+00 - 28+00	FT Levee Filled
Element 2	R-Line Levee degraded into the San Francisco Bay from Station 2+50 – 10+50	SF Bay Levee Degrade
Element 3	L-Line Levee setback into the Palo Alto Municipal Golf Course from Station 14+50 - 28+00	GC Setback Levee

Table 3 - Modeled Options

Option Name	Option Components
Option 1	Element 1
Option 2	Element 1 + Element 2
Option 3	Element 1 + Element 3
Option 4	Element 1 + Element 2 + Element 3

Results

A modeling parameter that is evaluated is the overtopping of Creek flows into the Faber Tract. To compare overtopping results between existing and proposed options, lateral structures were added to the HEC-RAS model geometry to compute the quantity of flow overtopping the levees. It is assumed for this modeling effort that all flow that overtops the levee leaves the system and does not return to the channel downstream. The elevations of the floodplain areas are lower than the tops of levee throughout the project reach. The height of the lateral structures were modeled using the top of levee elevation at each cross section after confirming that only minor changes in elevation occur between cross sections. Cross sections are spaced at approximately every 180 feet.

Table 4 below shows the comparison of flows overtopping the levee into the Faber Tract for each of the four options considered.

Table 4 - Faber Tract Overtopping Flow Comparison

Modeled Riverine Flow Event & Concurrent Tidal Event	Existing Condition Flows into Faber Tract (cfs)	Proposed Option 1 (Element 1) (cfs)	Proposed Option 2 (Elem 1 + Elem 2) (cfs)	Proposed Option 3 (Elem 1 + Elem 3) (cfs)	Proposed Option 4 (Elem 1 + Elem 2 + Elem 3) (cfs)
7,400 at 9.6'	255	175	10	265	45
7,400 at 7.1'	155	125	5	205	25
7,400 at 4.0'	155	125	5	205	25

It is important to identify that significant flow does spill out of the Creek channel into developed areas of East Palo Alto and Palo Alto under existing conditions before reaching the Faber Tract. Therefore, under existing conditions there is less flow within the Creek at the Faber Tract than under all proposed options. Proposed options 1, 2 and 4 effectively reduce overtopping flows into the Faber Tract.

Results for the 7,400 cfs at 7.1' and 4.0' produce the same results due to the Creek controlling the water surface all the way into the San Francisco Bay.

Proposed Option 1 decreases the flows spilling into the Faber Tract when compared to the existing condition due to the widening and deepening of the San Francisquito Creek channel as well as filling in a low area along the Faber Tract levee.

Proposed Option 2 decreases the flows into the Faber Tract the greatest as compared to existing conditions. This is because it allows the flow to expand out into the San Francisco Bay farther upstream than under Proposed Option 1.

Proposed Option 3 increases flows into the Faber Tracts compared to all other proposed options and existing conditions. The reason for this increase is that the setback levee merges back into the existing levee alignment immediately upstream of the airport and across from the lowest spot of the Faber Tract levee. This slight raise in water surface elevation in this specific area allows more flows to spill into the Faber Tract.

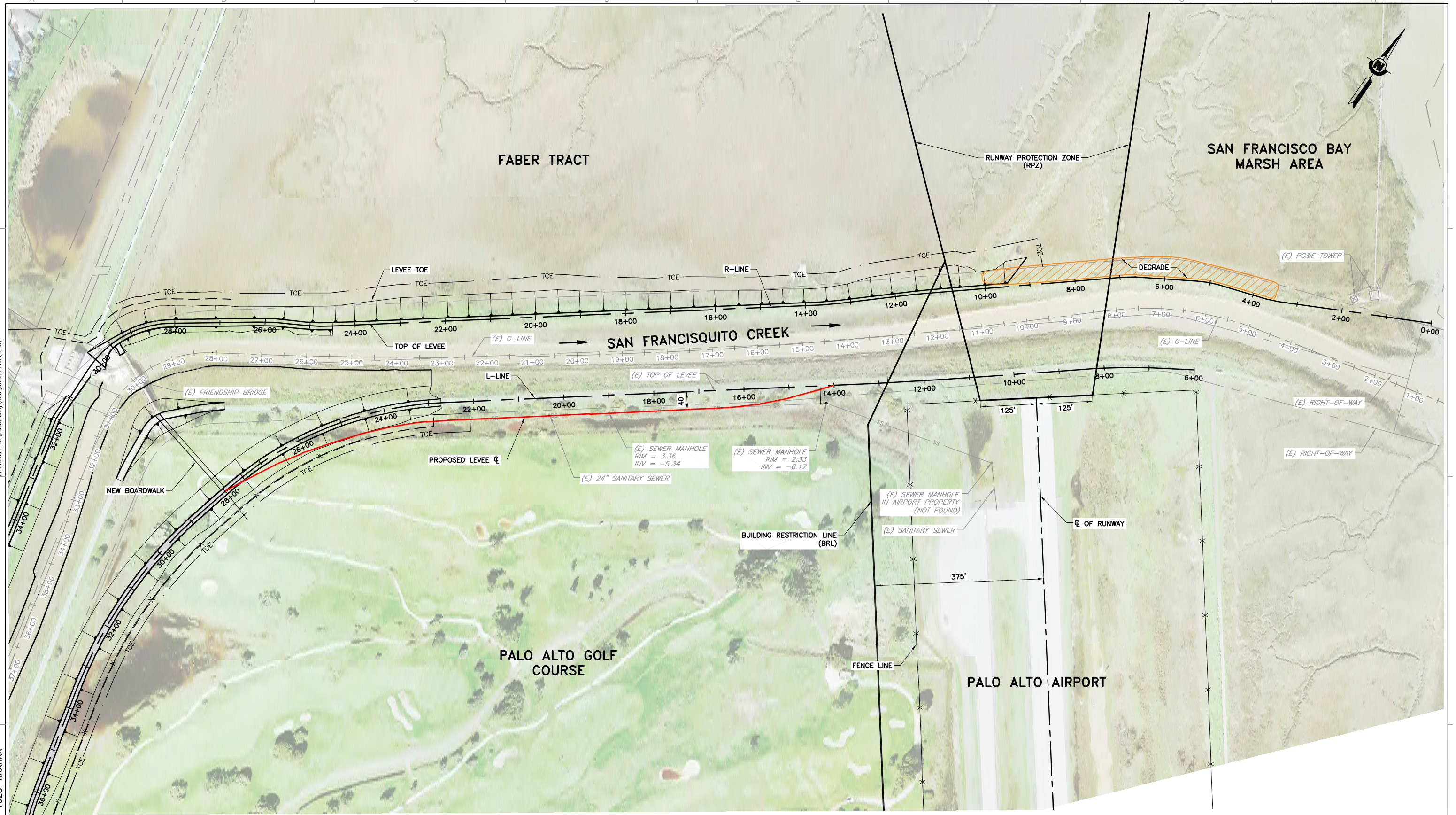
Proposed Option 4 slightly increases creek flows into the Faber Tract compared to Option 2 since the setback levee merges back into the existing levee alignment immediately upstream of the airport squeezing the channel back to the existing width, however, benefits from the drop in water surface elevation due to the degrade into the San Francisco Bay.

Figures

Using data output from the model runs, figures were developed to illustrate the difference in water surface elevation between existing and the proposed design condition for the entire project reach as well as the difference in results for the proposed options.

- Figure 1 illustrates the Existing versus Proposed Option 1 for 7,400 cfs with the 10-Year Tide of 9.6'.
  - The proposed water surface profile is higher than the existing conditions profile from approximately STA 52+00 and then begins to converge to the 10-Year tidal elevation of 9.6'. More flow is being contained in the channel under the proposed condition. The Creek is controlling the water surface elevation profile to approximately Station 8+00 where the tidal condition begins to control.
- Figure 2 illustrates the Proposed Option comparison for 7,400 cfs with the 10-Year Tide of 9.6'.
  - The proposed water surface profile for the four options is shown for the downstream portion of the Creek.

- Figure 3 illustrates the Proposed Option comparison for 7,400 cfs with the Mean Higher High Water (MHHW) of 7.1' and Mean Tidal Level (MTL) of 4.0'.
  - Benefits of the element components are the same as for the 10-Year tidal condition shown in Figure 2. The results for both lower tidal conditions are the same since the Creek is controlling the water surface elevation profile to the confluence with the San Francisco Bay.



PLAN
SCALE: 1"=100'

REV	DESCRIPTION	DATE	APPR.
	DRAFT 100% 05-05-2014		

HDR Engineering, Inc.

DATE	09-30-12
DESIGN	L. JONES
DRAWN	H. SUAREZ
CHECKED	P. HRADILEK

ENGINEERING CERTIFICATION
REGISTERED PROFESSIONAL ENGINEER LANCE M. JONES 88374 Exp. 9-30-15 CIVIL STATE OF CALIFORNIA
PRELIMINARY
PROJECT ENGINEER DATE

SAN FRANCISQUITO CREEK JOINT POWERS AUTHORITY
ACCEPTED BY DISTRICT
PROJECT ENGINEER DATE

PROJECT NAME AND SHEET DESCRIPTION:
SAN FRANCISQUITO CREEK FLOOD REDUCTION, ECOSYSTEM RESTORATION, & RECREATION PROJECT
UTILITY PLAN
STA 1+00 TO STA 32+00 (C-LINE)

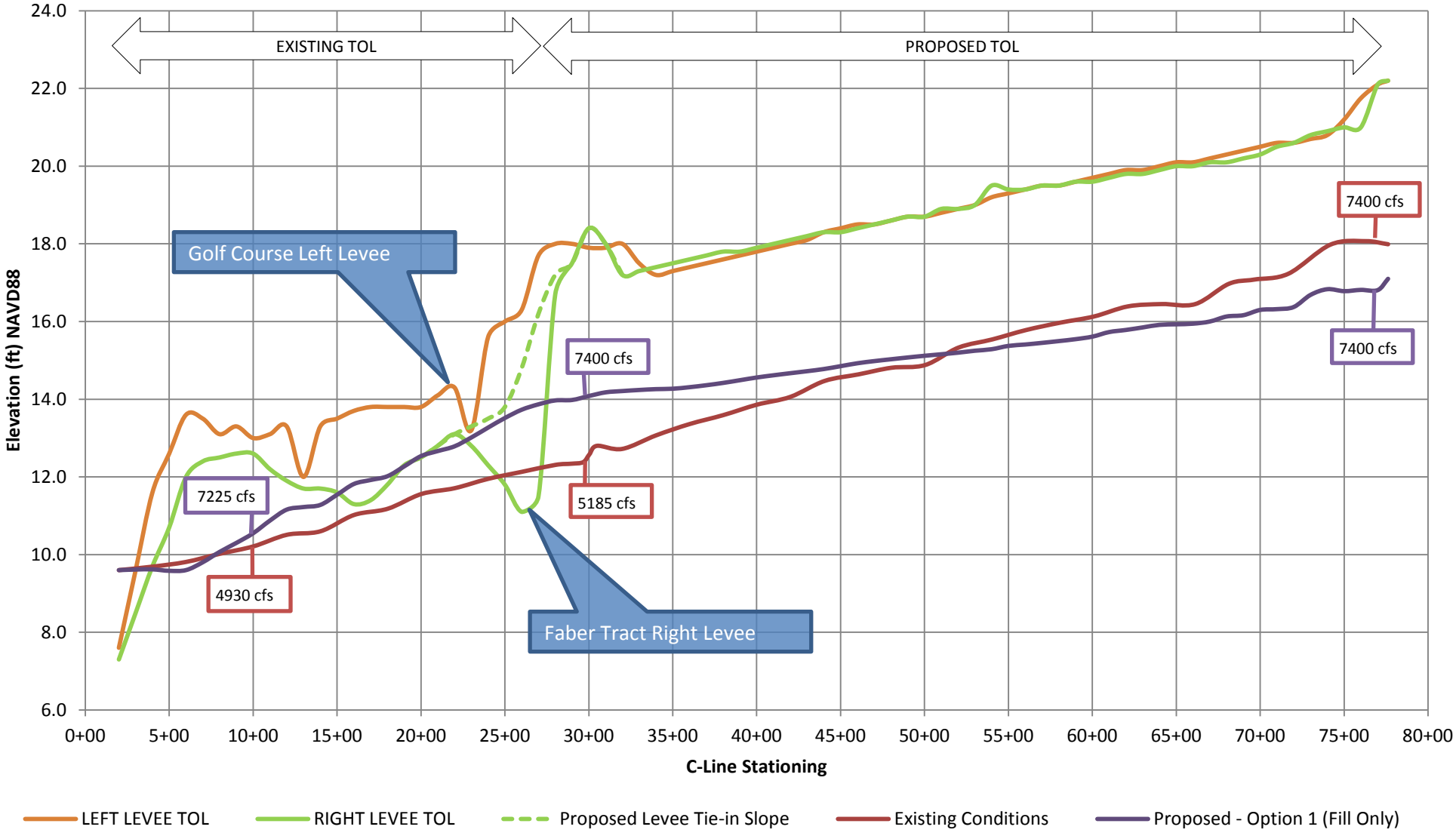
SCALE: 1" = 100'
VERIFY SCALES: 0 1" BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

PROJECT NUMBER: 26284002
SHEET CODE: C-37
SHEET NUMBER: 50 OF 118

DOCUMENT NUMBER: SFC_LP-C-1028-XXXXXX

FIGURE 1

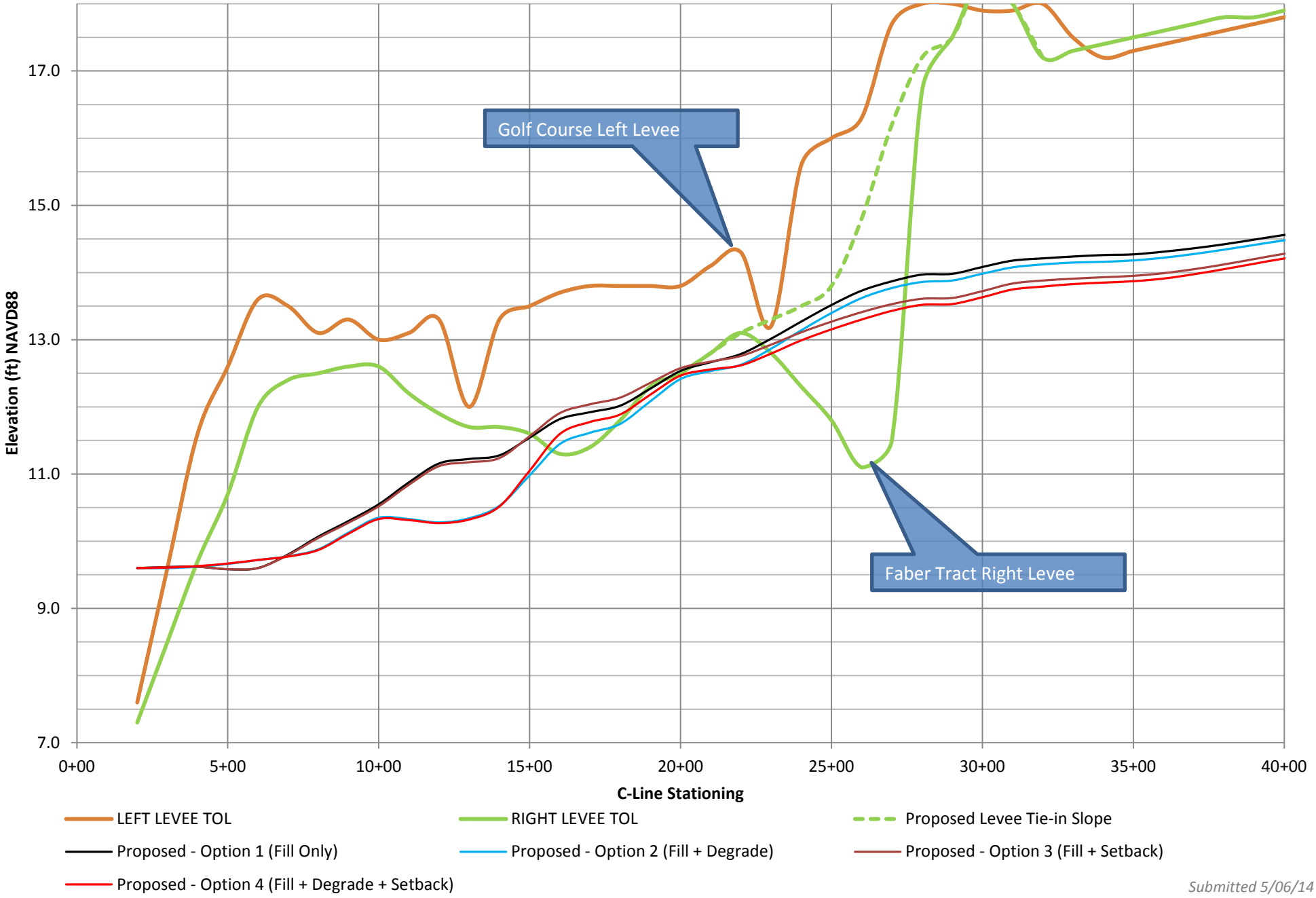
San Francisquito Creek
Existing Condition versus Proposed Project
Low area of Faber Tract levee filled (Proposed Option 1)
7400 cfs Riverine Event with 9.6' Tidal Event (10-Year Tide)



Submitted 5/06/14

FIGURE 2

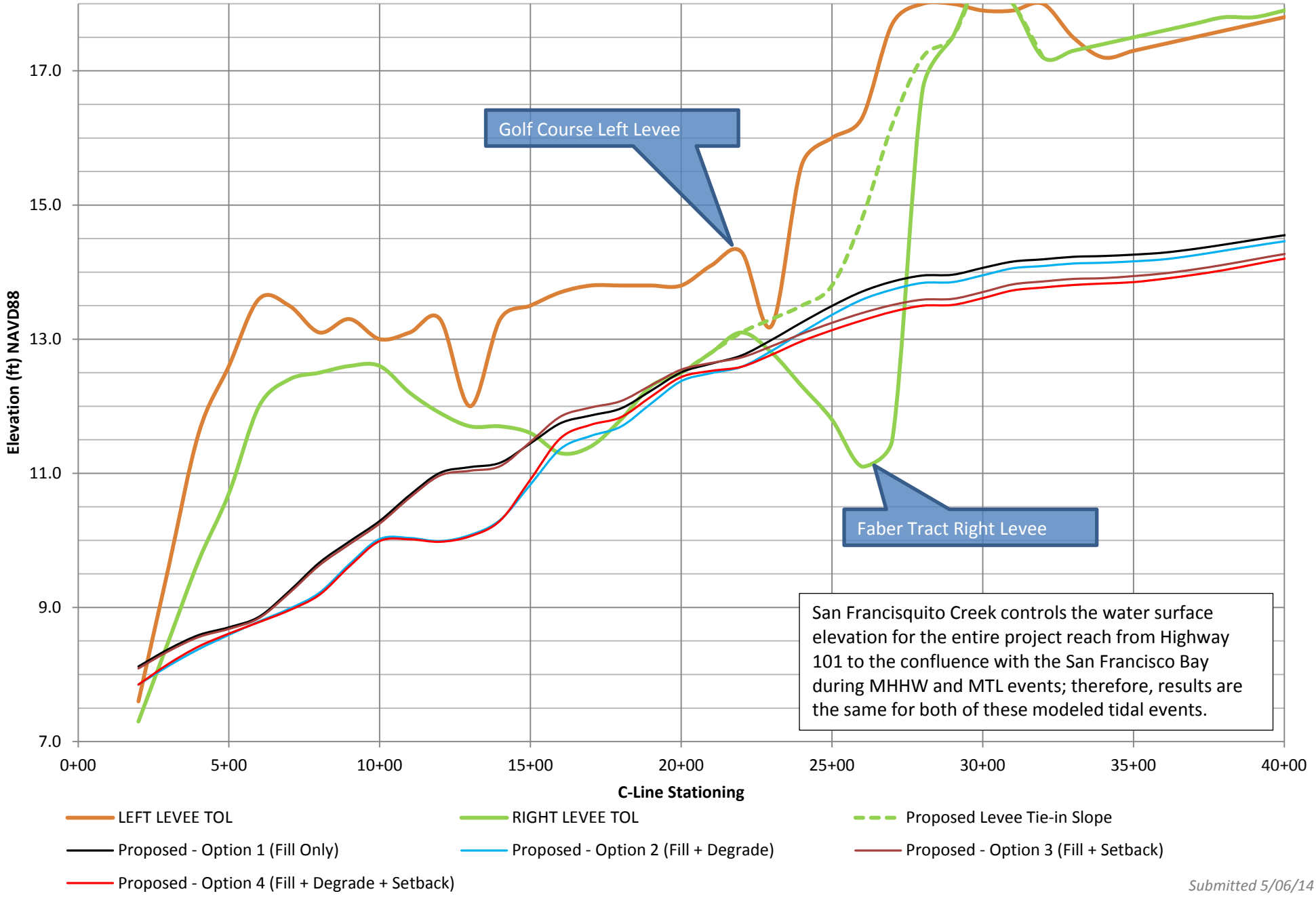
San Francisquito Creek - Proposed Project Options
7400 cfs Riverine Event with 9.6' Tidal Event (10-Year Tide)



Submitted 5/06/14

FIGURE 3

San Francisquito Creek - Proposed Project Options
7400 cfs Riverine Event with 7.1' (MHHW) and 4.0' (MTL) Tidal Events



Submitted 5/06/14

Santa Clara Valley Water District

TECHNICAL MEMORANDUM

TO: Saeid Hosseini, Len Materman

FROM: Kevin Sibley, P.E.

SUBJECT: San Francisquito Creek Flood Reduction, Ecosystem Restoration and Recreation Project -- Embarcadero Road Bypass Alternative

DATE: May 5, 2014

Background

The Santa Clara Valley Water District has performed hydraulic analysis to determine the feasibility of diverting flows from San Francisquito Creek (SFC) to the South San Francisco Bay with a bypass channel. The objective of the new bypass channel is to reduce the potential for downstream creek flooding at the Faber Tract.

The new alternative would divert peak flows from SFC with a spillway structure that would be constructed on the southerly levee adjacent to the existing City of Palo Alto Baylands Athletic Center baseball field at the end of Geng Road (see plan and profile). The existing baseball fields, associated parking area, and City of Palo Alto property east of the parking lot (a total of approximately 12.9 acres) would be encompassed by approximately 8-foot tall floodwalls (see cross section 44+20). This enclosed area would detain floodwater and outlet to a concrete u-frame structure. The u-frame would then convey 3,200 cfs by gravity for a distance of 3,900 feet to the tidal slough located at the end of Embarcadero Road (see plan and profile). Given the topography of the area and tidal elevations in San Francisco Bay, the bypass u-frame structure would be above ground for approximately one-half of its total length and below grade for the remainder. The diversion outlet would require a 430 foot long culvert beneath the existing roadway to deliver flows to the Bay (see attached plan and profile).

Per direction from the SFCJPA, the proposed bypass alignment for this analysis is positioned to minimize impacts to Embarcadero Road, the Palo Alto Water Plant, and the Palo Alto Airport. The following steps were taken to size the diversion weir structure, detention basin floodwalls, and concrete u-frame bypass channel.

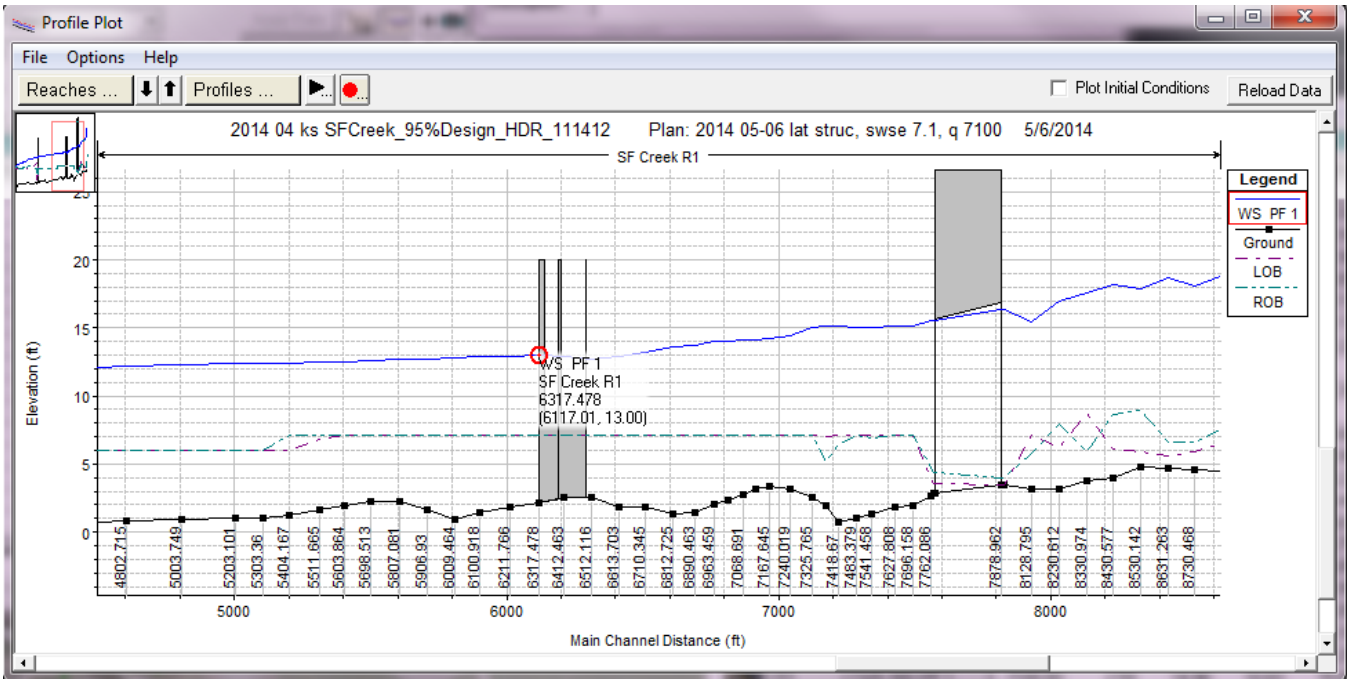
Hydraulic Parameters

Per discussion with the SFCJPA,

- design flow in SFC upstream from the new diversion structure is 7,100 cfs
- design flow in SFC downstream from the new diversion structure is 3,900 cfs
- design flow in the bypass structure is 3,200 cfs
- hydraulic analysis includes starting water surface elevations at San Francisco Bay equal to 4.0, 7.1, and 9.6 feet (NAVD).

Diversion Structure

Step 1: Two lateral weirs were added to the proposed 95% design steady state HEC-RAS model prepared by HDR in Dec 2012. Both weirs were coded to include 20-foot wide Broad Crested spillways with the standard weir equation and typical coefficients. Weir crest elevations and lengths were adjusted until the total loss equaled 3,200 cfs for SFC design flow equal to 7,100 cfs. The resulting lateral weirs both include crest elevations at elevation 8.0 ft (NAVD) and a combined spillway length equal to 147 feet.



Step 2: The water surface elevation in SFC (including the flow loss contributed by the weirs resulting from step 1) was determined to be 13.0 ft (NAVD).

Step 3: AutoCAD was used to measure the length of the new bypass channel (3,900 feet). With the water surface elevation from Step 2 and the highest downstream boundary condition (9.6), the bypass channel slope S was calculated to be 0.001 [i.e., S = (13.0 - 9.6)/3,900].

Step 4: The Manning's Equation, $Q = (1.49/n) \times A \times R^{2/3} \times S^{1/2}$, was solved for normal depth holding the following values constant:

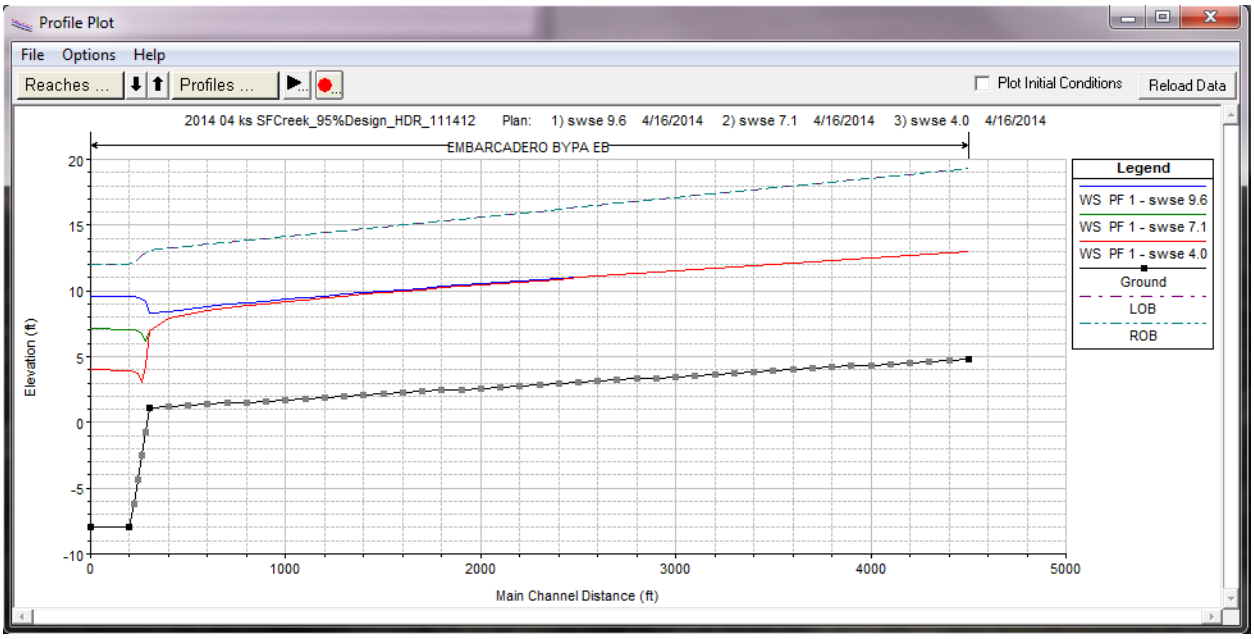
- Q = 3,200 cfs (flow)
- n = 0.015 (roughness coefficient)
- w = 40 ft (width)
- S = 0.001 (slope)

The resulting normal depth is 8.5 feet.

Step 5: A separate steady state HEC-RAS model was constructed to model the bypass channel with the following design parameters:

- Q = 3,200 cfs
- n = 0.015
- w = 40 ft
- S = 0.001
- Upstream invert = 13.3 – 8.5 = 4.8 ft (NAVD)
- Downstream invert = 9.6 – 8.5 = 1.1 ft (NAVD)

Model results confirm a normal depth of 8.2 feet at the upstream limit with an average channel velocity ranging from 1.3 to 13.7 feet per second.



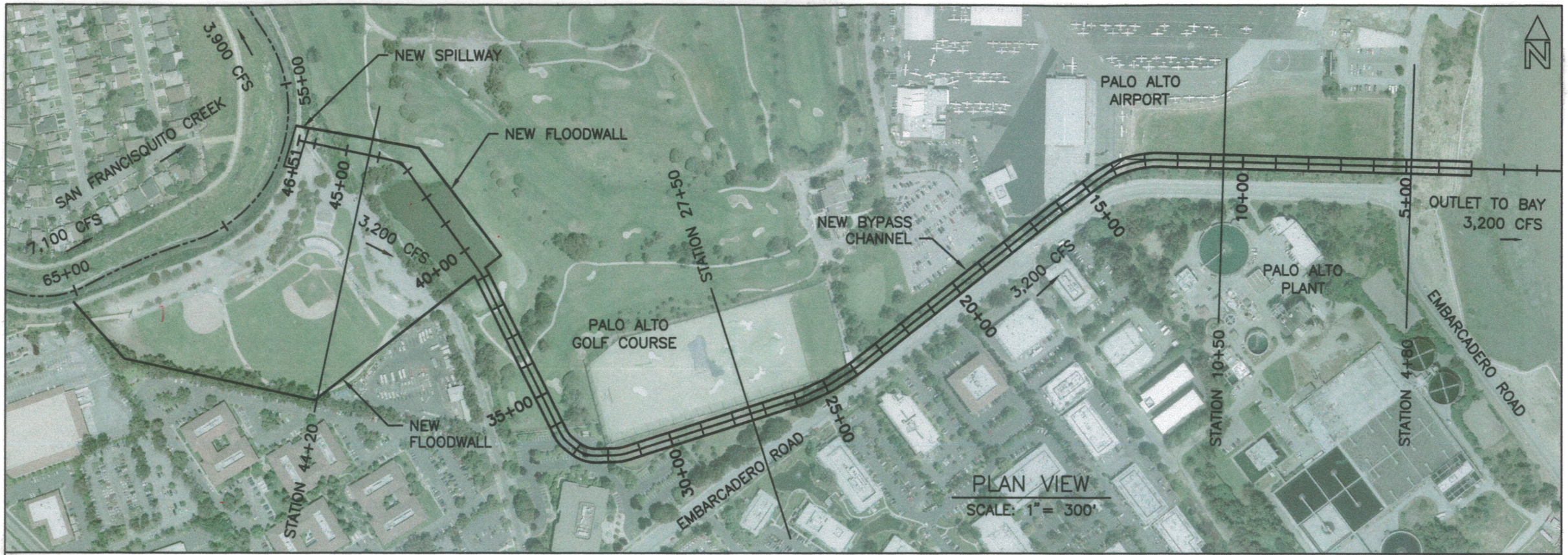
Conclusion

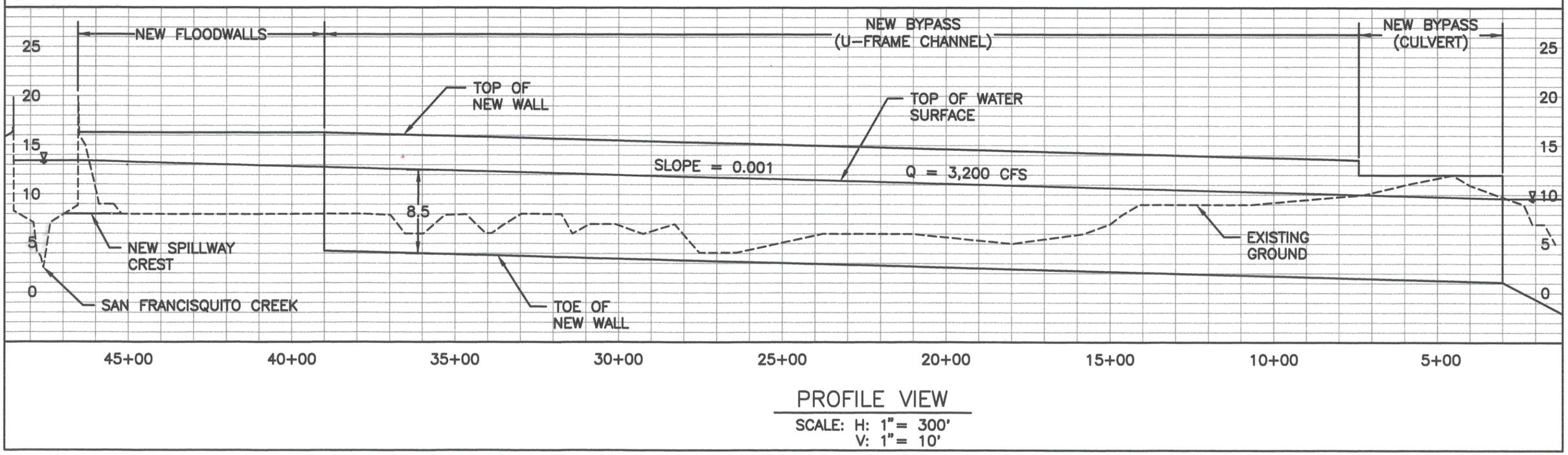
Hydraulic analyses indicate that two lateral weirs with crest elevations at 8.0 ft (NAVD) and a combined spillway length of 147 feet could be constructed to divert 3,200 cfs under SFC flow equal to 7,100 cfs with a starting water surface elevation equal to 7.1 (NAVD) at the Bay. The spillway structure would effectively reduce the flow in SFC from 7,100 cfs to 3,900 cfs at the point of the diversion. An additional 300 cfs coming from the O'Connor Pump Station downstream of the diversion brings flows reaching the Faber Tract area to the design flow of 4200 cfs.

Flow over the spillway (3,200 cfs) could then be detained by constructing 8-foot high floodwalls around the existing baseball park, parking area, and a portion of the golf course. An outlet structure and open channel bypass channel (u-frame) could be constructed to convey 3,200 cfs from the existing playing fields to the Bay. The final 450 feet of the bypass channel would be conveyed by an underground culvert.

Special Concerns

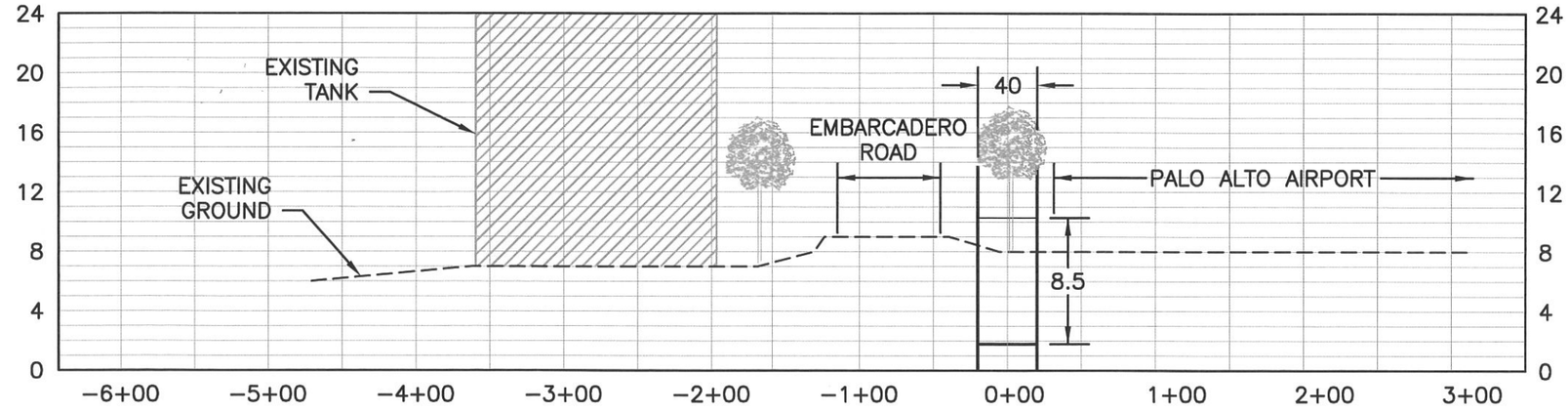
1. The proposed detention basin will impact 12.9 acres from City of Palo Alto property including the ball fields, parking area and area east of the parking area.
2. The proposed bypass channel structure will require 2.5 acres of Palo Alto Golf Course property.
3. The proposed bypass channel structure will require 1.5 acres of Palo Alto Airport property.
4. The proposed detention basin floodwalls will be approximately 8 feet high, which will present visual aesthetic impacts, access limitations, and impacts to existing trees.
5. The proposed bypass channel structure will extend up to 11 feet above the ground, which will present visual aesthetic impacts, access limitations, and impacts to existing trees.
6. The proposed bypass channel structure will require passive floodwall gates to cross the golf course entrance, the airport entrance, and Geng Road. This technology may be difficult to certify under FEMA.
7. The proposed weir crest elevation is 8.0 ft (NAVD). The SFC invert at the weirs is approximately 2.0 ft (NAVD). As a result, the diversion structure may pose a hazard to fish migration in SFC.
8. The proposed bypass structure outlet invert elevation is 1.1 ft (NAVD). Portions of the baseball park area may flood when tides are greater than 8.0 ft (NAVD).
9. The bypass structure will typically be affected by daily tidal fluctuation. This may cause sedimentation issues and hazards to aquatic organisms.



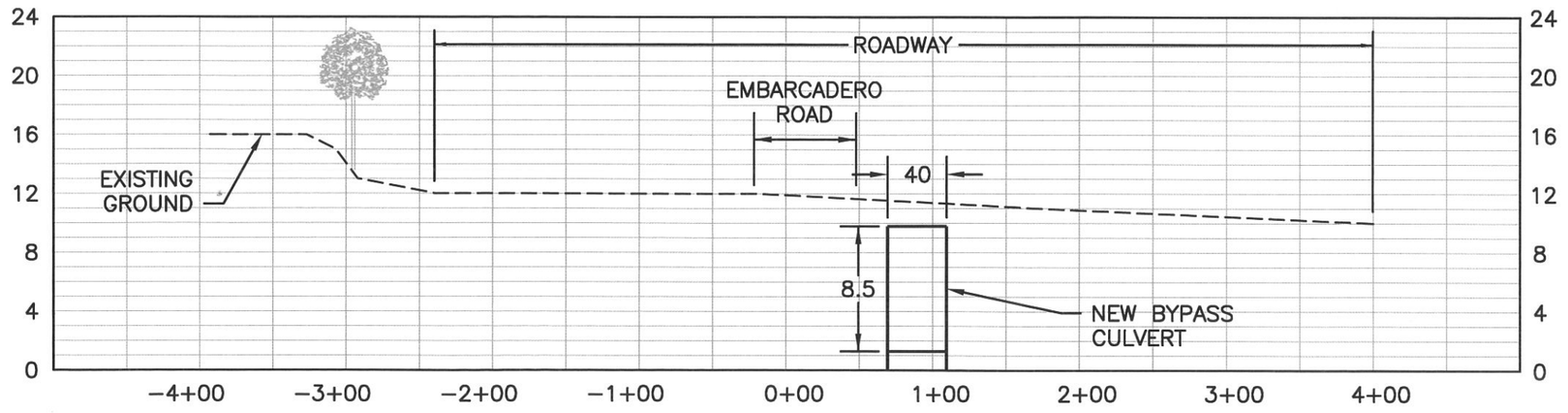


PROFILE VIEW

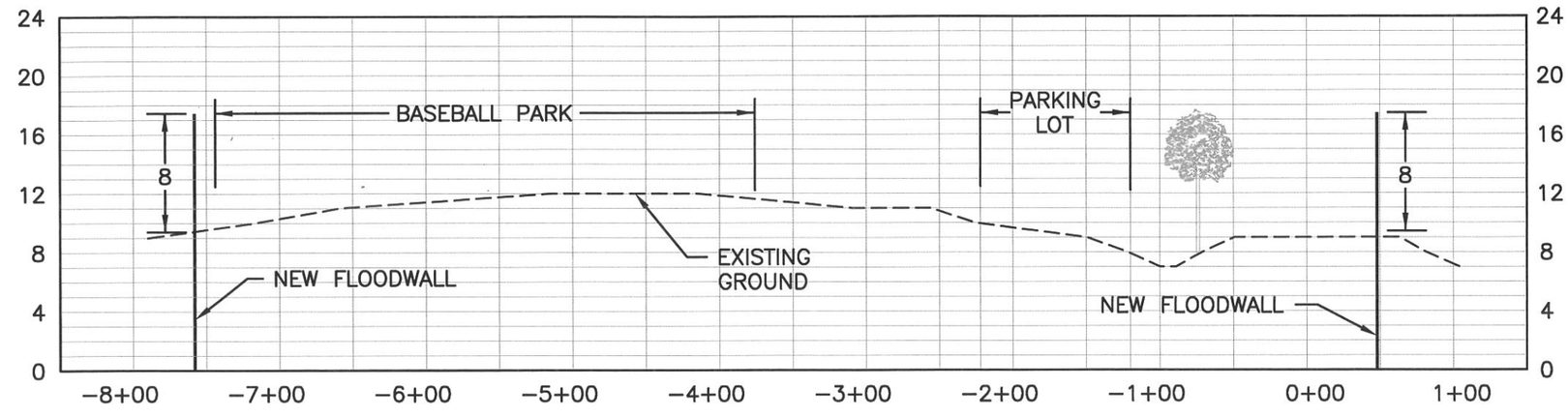
SCALE: H: 1" = 300'
V: 1" = 10'



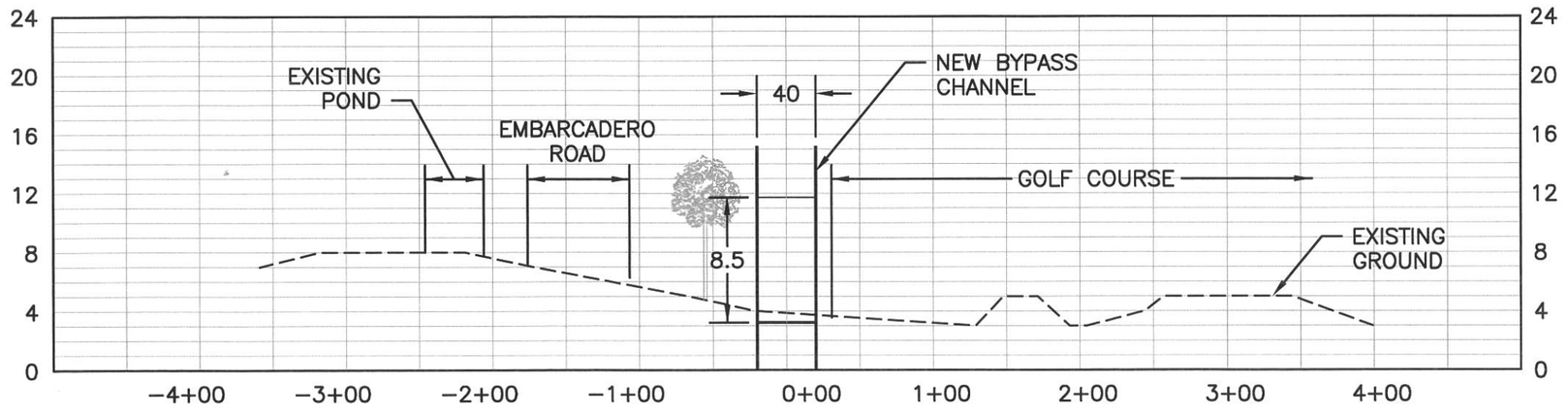
STATION 10+50



STATION 4+74



STATION 44+20



STATION 27+00

San Francisquito Creek S.F. Bay-Highway 101 Project
Preliminary Alternatives Evaluation Table

Alternatives	**Avoids flooding in other areas**	**Provides independent benefit and contributes to broader flood protection**	**Provides desired level of flood protection between Bay and Hwy. 101**	**Enhances water quality**	**Provides resilience against Sea Level Rise (SLR)**	**Enhances ecological function & processes**	**Reduces erosion and sedimentation**
Restore historic watercourse	Yes	No	Somewhat - also requires large floodwalls if waters are to be contained	Somewhat - floodwaters would still pass through developed areas but slower to Bay	No - would require additional actions to protect against SLR	Yes	Yes
Passive weirs to allow overflow into Golf Course, which acts as detention basin	No	No	No - after golf course fills flood protection is lost	No - diverted water would not infiltrate before being pumped to Bay	No	No	No - diversion would occur for a short time and not reduce velocities
Degrade levee between Creek and Faber Tract	Yes	Yes	Somewhat - lowers water surface elevation but other improvements needed	Yes - utilizes marshplain as buffer between creek and Bay	Somewhat - improves marsh resilience but not flood protection against SLR	Yes - restores creek-marsh interface & fluvial sediment source	Yes - by reducing flow velocities
Bypass channel through Golf Course	Yes	Yes	Yes	Somewhat - reduces scour of existing levees & floodwaters thru developed areas	No - requires improvements to existing levees along existing channel	Somewhat - if new marshplain is built within bypass channel	Yes - by reducing flow velocities
Widen channel downstream of Hwy. 101	Yes	Yes	Yes	Yes - utilizes marshplain as buffer between creek & Bay	Yes - if combined with levee raising	Yes - provides large channel marshplain	Yes - by reducing flow velocities
Increase levee heights downstream of Hwy. 101	Yes	Yes	Yes	No	Yes	No	No
Remove accumulated sediment in the tidal reach	Yes	Yes	No	No	No	Somewhat - small increase in marshplain	No
Redirect discharge from EPA pump station directly to Bay	Yes	Yes	No - max discharge 300 cfs	No	No	No	.
Build new pump stations to discharge floodwaters to Bay	Yes	No	No	No	No	No	No

The alternatives identified were developed in conjunction with the U.S. Army Corps of Engineers for the San Francisquito Creek Feasibility Study in 2008.

San Francisquito Creek S.F. Bay-Highway 101 Project
Preliminary Alternatives Evaluation Table

Alternatives	**Enhances recreation & community connectivity**	**Provides capacity downstream of Hwy. 101 to enable upstream flood protection**	**Reduces maintenance requirements / life cycle costs**	**Maximizes flexibility for adaptive management**	**Cost**	**Impacts to properties**	**Impacts on aesthetics / quality of life**
Restore historic watercourse	No - would eliminate creekside trails	No	Yes - eliminates levees, therefore maintenace is low	Low - historic watercourse would be allowed to migrate	Very High - would require acquisition of multiple properties	Very High - may require closing airport, water treatment plant, golf course, and other properties	Neutral - would increase natural setting but limit access
Passive weirs to allow overflow into Golf Course, which acts as detention basin	No	No	No - golf course must be repaired and levee maintained	No	High - requires new levee around golf course and new pump station	Moderate - golf course would need to be reconfigured	Low
Degrade levee between Creek and Faber Tract	No	Yes	Yes - reduces velocities and scour to levees	Yes - could be modified to manage creek and marsh connectivity	Low	Low	Low
Bypass channel through Golf Course	No	Yes	Yes - reduces scour on levees	No	High - requires regrading of golf course property	High - would require closure of golf course	High - would eliminate major recreational asset
Widen channel downstream of Hwy. 101	Yes, if trails are built on new levees	Yes	Yes - reduces scour on new levees built to higher standard	No	High - golf course reconfiguration and new levee construction	Low - requires golf course reconfiguration	Low
Increase levee heights downstream of Hwy. 101	Yes, if trails are built on new levees	Yes	Yes - new levees built to higher standard	No	Moderate - import of fill and property acquisition for larger levee footprint	Low	Low
Remove accumulated sediment in the tidal reach	No	No	No	No	Low	Low	Low
Redirect discharge from EPA pump station directly to Bay	No	No	No	No	Low	Low	Low
Build new pump stations to discharge floodwaters to Bay	No	No	No	No	Moderate	Moderate - requires property for pump station, well, & outfall	Moderate - construct new pump station at edge of baylands

The alternatives identified were developed in conjunction with the U.S. Army Corps of Engineers for the San Francisquito Creek Feasibility Study in 2008.

Final EIR

SAN FRANCISQUITO CREEK FLOOD REDUCTION, ECOSYSTEM RESTORATION, AND RECREATION PROJECT SAN FRANCISCO BAY TO HIGHWAY 101

SCH# 2010092048

October 2012

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Chapter 6
Alternatives

CEQA requires that a EIR evaluate a "reasonable range" of alternatives to a proposed project. An EIR is not required to consider every conceivable alternative to a project; rather, consideration should focus on alternatives that appear to be feasible, would meet the project objectives, and would avoid or substantially lessen at least one of the proposed project's significant environmental effects. In addition, although the No Project Alternative is not the baseline for determining whether impacts related to the proposed activities would be significant,[14] an EIR must evaluate the impacts of the No Project Alternative to allow decision makers to compare the impacts of approving the project to the impacts of not approving it.

EIRs are required to include sufficient information about each alternative to allow meaningful evaluation, analysis, and comparison with the proposed project or program (State CEQA Guidelines Section 15126.6[a], [d], [f]). This requirement enables the lead agency to identify the *environmentally superior alternative*—that is, the alternative that would least affect the environment while still accomplishing project objectives. If the No Project Alternative is identified as environmentally superior but would not meet project objectives, the lead agency must also identify the environmentally superior alternative that would implement the project (CEQA Guidelines Section 15126.6[e]).

This chapter provides the following:

- An overview of the alternatives development process for the entire watershed and the Project reach, including brief descriptions of approaches that were eliminated from further consideration, along with the reasons for their dismissal.
- Descriptions of the alternatives to the Project, including the No Project Alternative.

6.1 Alternatives Development Process

Since its formation in 1999, SFCJPA has pursued projects that would reduce flood risk for the entire watershed floodplain. In 2003 and 2005, watershed-wide solutions were reviewed with the USACE under a Continuing Authorities Program (CAP) 205 Project. This process resulted in two documents that evaluated and advanced alternatives that reduced flood risk within the overall watershed and in the Project reach:

- Report on Project Research and Scenarios for the U.S. Army Corps of Engineers Continuing Authority Program 205 (San Francisquito Creek Joint Powers Authority May 2003).
- San Francisquito Creek Flood Damage Reduction & Ecosystem Restoration General Investigations Program 905(b) Analysis Reconnaissance Study (U.S. Army Corps of Engineers March 2005).

[14] The *baseline* for impact analysis is defined as environmental conditions at the time the NOP was published.

Ultimately, both studies determined that capacity improvements must be implemented in the Project area in order to accommodate future upstream improvements intended to provide watershed wide flood protection benefits.

Continuing Authorities Program 205 Project Alternatives

As described in the SFCJPA report on the CAP 205 Project (San Francisquito Creek Joint Powers Authority 2003), the following alternatives were proposed for fluvial flooding within the Project area:

Widen Culvert at U.S. 101. Widening the culvert at U.S. 101 would consist of constructing an additional culvert barrel either to the north or south of the existing barrels. At the same location, the surface opening between U.S. 101 and West Bayshore Road would be closed. Under current conditions, widening the culverts alone would not decrease flooding. Covering the opening would allow pressure flow in the culverts, thus increasing the culvert capacity and stopping the flooding caused by overflow from this opening.

Raise Levees or Construct Floodwalls. Under this alternative, some levees downstream of U.S. 101 would be raised in some areas, and/or floodwalls would be constructed in other areas.

Construct Overflow to Open Space. Overflow would be diverted to two different locations downstream of U.S. 101: in the marshland area just east of the East Palo Alto residential area, and in the southwest portion of the Golf Course.

Widen Channel. Channel widening under this alternative would consist of widening the channel to the limits of the East Palo Alto residential development and constructing new levees. The channel would also be widened on the opposite side, and the new levees would be constructed on what now constitutes Golf Course land.

Construct Secondary Channel in Golf Course. Under this alternative, a secondary (parallel) channel would be constructed in the Golf Course as a means of increasing flow capacity for the reach.

Because Caltrans has since advanced a project that would widen the culvert at U.S. 101 as part of the replacement and upgrade of U.S. 101 and the East/West Bayshore frontage roads, the **Widen Culvert at U.S. 101 Alternative** is not considered further. The other alternatives were carried forward by SFCJPA for analysis in the development of the Project, either as stand-alone alternatives or as elements of blended alternatives.

San Francisquito Creek Flood Reduction Alternatives Analysis

SFCJPA had an Alternatives Analysis prepared to advance and evaluate the CAP 205 Project alternatives' ability to reduce out-of-bank flooding in the Project area (Philip Williams & Associates, Ltd. 2009). Project alternatives from the CAP 205 Project were evaluated against flood management objectives within the infrastructure and habitat constraints of the Project area. In order to contain peak water levels during floods relative to existing conditions, all of the advanced alternatives increased channel conveyance through a combination of the concepts advanced from the CAP 205 Project. The Alternatives evaluated are summarized below.

Alternative 1

Alternative 1 included a reach of flood walls downstream of U.S. 101, lowered terraces in the middle and upper reaches, levee setbacks in the middle reach, and an overflow bypass channel adjacent to Friendship Bridge.

The elevation of the marshplain terraces would intersect the main low-flow channel of the Creek at approximately the MHHW elevation and would extend outward from the channel at this elevation to the toe of the levees. In the middle reach, the levees would extend upward from the channel at a slope of 2:1 (horizontal to vertical). In the upper reach, the levees would extend vertically from the marshplain terrace to the existing levee tops. Vertical floodwalls are required to maximize the flow conveyance in the upper reach.

The height of the levees on the left and right sides of the channel in the upper reach would not be modified under Alternative 1 (or either of the other two alternatives). In the middle reach, the levee heights would not be adjusted, except at locations where the right levee, which is adjacent to homes in East Palo Alto, is found to be lower than the left levee, which is adjacent to the Golf Course. The relative heights of the levees would be adjusted to ensure that during extreme flood events, flooding would occur preferentially into the Golf Course, rather than East Palo Alto.

For Alternative 1, the levees would not be set back in the upper reach, but would be set back from the main channel in the middle reach to increase conveyance area. The distance that the right and left levees are shifted varies from location to location, depending on what is adjacent to the outboard side of the existing levees.

On the right (west) side of the channel, the levee would be shifted to be parallel to the backyard fence line of the homes on Jasmine Way and Camellia Drive in East Palo Alto. The City of East Palo Alto owns the land between these homes and the outboard side of the right levee, which consists of open grassland and fill of unknown origin. The Creek meanders slightly through this reach and at the location where it is farthest from the homeowner's fence line, the levee would be set back by approximately 175 feet to the west. This width is available at the upstream and downstream ends of the middle reach. Near the center of the middle reach, where the existing levee abuts the fence line, the right levee would remain in its current location.

The left levee in the middle reach would be shifted eastward toward the Golf Course. The amount of setback would vary, depending on the distance between the existing levee and the Golf Course greens. The low-lying areas between the existing outboard levee slope and the Golf Course are degraded, non-tidal seasonal wetlands, some of which remain wet from artificial irrigation from the Golf Course. These areas would either be converted to tidal marsh as part of the in-channel marshplain terrace or be converted to upland habitat on the levee. Levee setback distances range from 25 feet in the narrowest location arid 125 feet at the widest location.

The final element of the Alternative 1 design is an overflow bypass terrace running along the left side of the channel at Friendship Bridge. This overflow channel provides a wider flow area by allowing high flows to circumvent the constricted portion of the channel at the bridge. The terrace would be at an elevation of 9.8 feet NAVD, which is slightly less than 3 feet above the proposed marshplain terraces adjacent to the channel and potentially elevated enough to allow for the bypass channel to be incorporated into the existing Golf Course. The terrace would remain dry during normal flow events, but would get activated during fluvial flows higher than approximately a 7-year

event (based on Santa Clara Valley Water District 2007) or during tides greater than approximately a 10-year event (Philip Williams & Associates, Ltd. 2006).

Friendship Bridge, its abutment and the high portion of the levee where the bridge connects to the existing levee road would not be modified except for armoring to prevent scour in high flow events. On the outboard side of the bypass terrace, a levee would be constructed at an elevation approximately equal to the existing left levee to protect the main portion of the Golf Course from flooding. This levee would tie into Alternative 1's proposed left levee upstream of Friendship Bridge. A boardwalk, similar to that described for the Project, would be constructed from the new left levee to the remnant portion of the old left levee to maintain access between Palo Alto and East Palo Alto.

Alternative 2

Alternative 2 is similar to Alternative 1, but modified to further reduce peak floodwater levels relative to existing conditions. This alternative includes levee setbacks in the upper reach, increased levee setbacks in the middle reach, and an overflow terrace at a marsh elevation.

To maximize flow conveyance in the upper reach, the channel would be widened to include any available open space on the outboard sides of the left and right levees. This includes the crescent-shaped parcel, owned by the District, on the right bank where Verbena Drive dead ends and a sliver of land that is parallel to Daphne Way near the beginning of the middle reach. On the left bank, the channel would be widened by 30 feet beginning at San Francisquito Creek Pump Station in Palo Alto and ending near the basketball court next to the International School. Downstream of this, the right levee would be shifted back by 50 feet, through the reach adjacent to the post office parking lot and the baseball field overflow parking lot. Similar to Alternative 1, the interior sides of the left and right levees would be vertical and the marshplain terraces in the channel would extend from the low-flow channel to the edge of the floodwalls.

In the middle reach, the right levee alignment for Alternative 2 would be the same as the right levee for Alternative 1. The left levee, however, would extend further east by approximately 45 feet. This may require a minor realignment of one of the holes at the Golf Course. Adjacent to Friendship Bridge, Alternative 2's overflow terrace would have the same footprint and a similar design to Alternative 1's overflow terrace, but would be graded to an elevation equal to the MHHW elevation (7.1 feet NAVD). This would create a continuous tidal marsh beginning in the downstream reach, surrounding Friendship Bridge's right approach, and extending upstream along the Creek's left bank to U.S. 101. The bypass terrace would be inundated during spring tides and most moderate fluvial flow events. Vehicle access would be limited to the levee on the left side of the bypass, but pedestrians would be able to access Friendship Bridge by means of a boardwalk second bridge span over the marshplain bypass terrace. The boardwalk would most likely not survive a large flood event and have to be replaced periodically.

Alternative 3

Alternative 3 includes in-channel marshplain terraces and a large bypass channel extending across the center of the Golf Course. It does not include levee setbacks in either the middle or upper reaches.

Alternative 3 has the same terracing and vertical flood wall alignment as Alternative 1 in the upper reach. In the middle reach, Alternative 3 includes marshplain terraces excavated in the existing channel, but without realigning the existing levee layout. The existing levee crests would not be

modified (except at locations where the East Palo Alto levees are lower than the Golf Course levees) and the inboard levee sides would be re-graded to 2:1 slopes.

The primary feature of Alternative 3 is a large bypass channel extending from south to north through the center of the Golf Course. This bypass reach would intersect the existing channel at Station 56 + 04and reconnect with the main channel near the airport runway. During both normal daily flows and fluvial flood events, a portion of upstream flows would be diverted through the bypass channel, thereby significantly reducing water levels in the middle reach.

The bypass reach would be designed with a low- flow channel, floodplain terraces at marshplain elevation, and levees on the right and left sides, with a total width between levees equal to 300 feet. The size of the low-flow channel was designed using empirical hydraulic geometry relationships that were developed for tidal marshes in San Francisco Bay (Williams and Others 2002). The depth and top width of the low-flow channel, calculated from the total marsh area in the bypass reach, would be 6.5 feet and 30 feet, respectively. The low-flow channel is the channel below the marsh elevation of the MHHW elevation and was assumed to be parabolic in shape. Marshplain terraces would extend from the right and left channel banks for a distance of approximately 115 feet on each side, until intersecting with the toes of the levees. Inboard levee sides would be at 2:1 slopes. Levee crests were assumed to be comparable in elevation to the levee crest elevations in the main channel at parallel locations. The outboard levee sides slope very gradually downward at a 2 percent grade to the existing Golf Course elevations so that the levees could be integrated into the Golf Course and would not be too steep for playing. Because the Golf Course is at a fairly low elevation (approximately 4 feet NAVD) relative to the proposed bypass channel levee tops, the overall footprint of these levees are much larger than the existing and proposed main channel levees.

Alternatives Carried Forward for Analysis

The study concluded that Alternative 2 was determined to be the preferred alternative and advanced as the Project. Of the three alternatives evaluated, Alternative 2 provided the greatest reduction in peak water levels for the storm events modeled. Hydraulic modeling of Alternative 2 indicated that it would contain the 100-year design storm within the channel throughout the study reach. Alternative 3 provided similar reductions if the bypass channel was combined with the channel modifications assumed for the upper reach under Alternative 2. Alternative 3 is significantly more costly than either of the other two alternatives, but does still meet the purpose and need. Model results indicated that the 100-year design storm may not be fully contained at U.S. 101 under Alternative 1. Alternative 1 was not advanced for further analysis.

As carried forward, Alternative 2 is the basis of design for the Project. Alternative 3, while significantly more expensive than the proposed Project, meets the purpose and need. Thus, Alternative 3 was advanced as Alternative 1, the only feasible action Alternative that meets the purpose and need.

6.2 Alternatives to the Proposed Project

No Project Alternative

With the No Project Alternative it is assumed that no long-term actions would be taken to provide flood control improvements along San Francisquito Creek. Flood control improvements would consist of emergency fixes to damaged areas, consistent with available funding.

Under existing conditions, San Francisquito Creek does not have adequate capacity to convey the flood event associated with an expected annual probability of 1 percent (the 100-year event) of 9,400 cfs at several locations downstream of El Camino Real (San Francisquito Creek Joint Powers Authority 2009). While none of the bridges across the San Francisquito Creek downstream of El Camino Real can convey the 1 00-year flood event, the most problematic areas affecting Palo Alto and Menlo Park are the bridges at Middlefield Road and Pope-Chaucer Street. The approximate channel capacity at these locations is 6,000 cfs, which is commensurate with the 15-year event. The bridges at these two locations restrict the flow in the channel, inducing flooding in the overbank (U.S. Army Corps of Engineers 2000).

If the 100-year event in San Francisquito Creek is 9,400 cfs, and the Creek capacity upstream of the Project reach is actually 6,000 cfs, the excess (3,400 cfs) is overflowing at various points upstream of the Project reach, and in various directions. Capacity of the West Bayshore Road/U.S. 101 crossing is approximately 4,500 cfs and under high tide conditions, and would cause additional upstream overflow upstream of the ~~project~~Project reach if the 100-year event occurred during a high tide. The Palo Alto area southeast of U.S. 101, including the Baylands Athletic Center, the Golf Course, and the Palo Alto Airport, floods to a depth of approximately 2 feet when the Project reach overflows. During the 50-year event (7,500 cfs) and above, that depth increases to approximately 4 feet (2 additional feet) from upstream channel overflow. Any additional overflow runs in the direction of the U.S. 101/State Route (SR) 84 interchange, causing additional flooding not associated with capacity in the Project reach.

Conditions are expected to remain the same or worsen without efforts to alleviate the flooding along San Francisquito Creek. If modifications are not made to Searsville Reservoir, for example, additional bedload sediments could change conditions in the Project reach. Property damages would continue to occur during significant storm events, and erosion and scour would continue to occur in certain locations. The levees constructed within the Project reach do not contain the 100-year flood event, and the short-term (emergency) fixes that have been placed in the Creek in other reaches do not provide a long-term solution to flooding, hence the continued flooding that has occurred along the entire Creek.

Alternative 3 (Golf Course Bypass)

Alternative 1 includes in-channel marshplain terraces, similar to the Project and a large bypass channel extending across the center of the Golf Course. It does not include levee setbacks in either the middle or upper reaches as set forth in the Project.

Alternative 1 has the same terracing and vertical flood wall alignment as the Project in the upper reach. In the middle reach, Alternative 1 includes marshplain terraces excavated in the existing channel, but without realigning the existing levee layout. The existing levee crests would be rebuilt to meet USACE standards and the inboard levee sides would be re-graded to be at 2:1 slopes.

The differentiating feature of Alternative 1 is a large bypass channel extending from south to north through the center of the Golf Course. This bypass reach would intersect the existing channel just downstream of the Baylands Athletic Center and reconnect with the main channel near the airport runway. During both normal daily flows and fluvial flood events, a portion of upstream flows would be diverted through the bypass channel, therefore significantly reducing water levels in the middle reach and conveying a large percentage of flows away from the residences of East Palo Alto.

The bypass reach would be designed with a low-flow channel, floodplain terraces at marshplain elevation, and levees on the right and left sides, with a total width between levees equal to 300 feet. The size of the low-flow channel would be designed to carry excess flow equivalent to the 10-year event, which cannot be accommodated by the existing channel within the rebuilt levees. The depth and top width of the low-flow channel, calculated from the total marsh area in the bypass reach, would be 6.5 feet and 30 feet, respectively. The low-flow channel is the channel below the marsh MHHW elevation and was assumed to be parabolic in shape. Marshplain terraces would extend from the right and left channel banks for a distance of approximately 115 feet on each side until intersecting with the toes of the levees.

Inboard levee sides would be at 2:1 slopes. Levee crests were assumed to be comparable in elevation to the levee crest elevations in the main channel at parallel locations. The outboard levee sides slope very gradually downward at a 2 percent grade to the existing Golf Course elevations so that the levees could be integrated into the Golf Course and would not be too steep for playing. Because the Golf Course is at a fairly low elevation (approximately 4 feet NAVD) relative to the proposed bypass channel levee tops, the overall footprint of these levees are much larger than the existing and proposed main channel levees.

Maintenance and operations of Alternative 1 would be identical to those of the Project.

6.3 Impacts of Alternatives

Table 6-1 describes and compares the anticipated impacts of Alternative 1 and the No Project Alternative.

Table 6-1. Anticipated Environmental Impacts of Alternative 1 and the No Project Alternative

Resource	Alternative 3 (Golf Course Bypass)	No Project
	Direct bypass channel from Geng Road terminus to edge of Palo Alto Municipal Airport. Allows for existing channel to largely be retained with floodwalls in upper reach. Reduced overflow into Faber Tract Baylands in comparison to the proposed Project.	No flood protection improvements to San Francisquito Creek.
	Approach to Analysis	*Approach to Analysis*
	The key difference between Alternative 1 and the proposed Project is that Alternative 1 would not widen the existing channel, but rather would divert flows across the existing Golf Course and input flow closer to San Francisco Bay, resulting in reduced overflow fluvial inputs into Faber Tract in comparison to the proposed Project. For the most part, impact mechanisms and construction durations would be similar under Alternative 1 to those identified for the proposed Project. Floodwalls would still be necessary upstream of Geng Road, and all levees would still need to be rebuilt to USACE standards. Analysis therefore concentrated on new impacts created by the bypass channel and the effects of moving flood flows away from residences and reduced fluvial flows into Faber Tract.	Under the No Project Alternative, no new flood protection infrastructure would be installed in San Francisquito Creek. For the immediately foreseeable future, the channel would remain in its present condition, and operations and maintenance (i.e., inspections and minimal vegetation management) would be similar to current activities. Over the longer term, properties within the floodplain would continue to be at risk regardless of upstream improvements. The full timing, details, and outcomes of future upstream projects are not foreseeable at this time. Analysis therefore concentrated primarily on the impacts that would be avoided by not constructing new flood protection infrastructure.
Aesthetics	For the most part, aesthetic impacts of the elements included in Alternative 1 would be the same as those identified for the proposed Project. Overall visual impacts would be similar under Alternative 1 to those described for the proposed Project but could be somewhat greater on balance due to the new bypass channel proposed under Alternative 1. Both Alternative 1 and the proposed Project include floodwalls.	The No Project Alternative would not alter the visual characteristics of the Project corridor. If the proposed Project is not implemented, existing infrastructure in the Project corridor would continue to age, becoming less visually intact and eventually requiring repair or replacement under separate project efforts. However, although it is reasonable to project that repairs or replacements may be needed, the timing, details, and visual outcomes of such projects cannot be foreseen at this time.

Resource	Alternative 3 (Golf Course Bypass)	No Project
Air Quality	Air quality impacts would be similar under Alternative 1 to those described for the proposed Project. Both would result in significant NO_X.emissions.	Under the No Project Alternative, no new flood protection infrastructure would be installed in San Francisquito Creek. There would be no new impact on air quality under the No Project Alternative.
Biological Resources	Impacts on biological resources would be similar under Alternative 1 to those identified for the proposed Project. The potential for impacts to mammals and birds that occur in the Faber Tract would be lessened due to the greater fluvial flow being diverted down the bypass channel and overflow into the Faber Tract. Alternative 1 would likely result in greater marsh creation resulting from the new bypass channel. Overall, Alternative 1 would be slightly superior to the proposed Project.	Under the No Project Alternative, no new flood protection infrastructure would be installed in San Francisquito Creek. There would be no new or substantially altered impact on biological resources under the No Project Alternative.
Cultural and Paleontological Resources	Impacts on cultural and paleontological resources would be similar under Alternative 1 to those identified for the proposed Project. Because Alternative 1 would have a similar overall footprint to the proposed Project (with the exception that it would result in a large new bypass channel), all of the areas subject to ground disturbance under Alternative 1 have some level of sensitivity for buried cultural resources. Significant impacts on cultural resources are therefore possible under this alternative and would be mitigated by the same strategy identified for the Project. Because of the overall similarity in footprint and geologic substrate, impacts on paleontological resources under Alternative 1 would be similar to those described for the proposed Project.	Under the No Project Alternative, there would be no immediate ~~project~~Project-related ground disturbance. Over the long-term, repair and/or piecemeal replacement of aging flood protection infrastructure could result in ground disturbance, with some potential to disturb buried cultural and paleontological resources. The extent and severity of disturbance are not foreseeable at this time, but there would likely be some potential for significant impacts on cultural and paleontological resources, although it is unclear whether this potential would increase relative to the current baseline.
Geology and Soils	Impacts related to geology, soils, and geologic hazards would be similar under Alternative 1 to those identified for the proposed Project. Impacts for Alternative 1 would be the same as those described for the proposed Project, and the same mitigation approaches would apply.	Under the No Project Alternative, no new flood protection infrastructure would be installed in San Francisquito Creek. There would be no impact related to geology or soils.
Greenhouse Gases and Climate Change	Greenhouse gas and climate change impacts would be similar under Alternative 1 to those described for the proposed Project.	Under the No Project Alternative, no new flood protection infrastructure would be installed in San Francisquito Creek. There would be no new or substantially altered impact on greenhouse gases or climate

Resource	Alternative 3 (Golf Course Bypass)	No Project
		change.
Hazardous Materials and Public Health	Public health and safety impacts under Alternative 1 would be similar to those described for the proposed Project, and the same mitigation strategies would apply. The principal concerns related to known hazardous materials contamination focus on the floodwall reach upstream of Geng Road. Alternative 1 would entail the same activities in this area as would the proposed Project.	The No Project Alternative would not result in any foreseeable activities expected to release hazardous materials or change public health conditions relative to the current baseline.
Hydrology and Water Quality	Although the ~~project~~Project footprint would differ somewhat, overall impacts related to hydrology and water quality would be similar under Alternative 1 to those described for the proposed Project.	Under the No Project Alternative, no new flood protection infrastructure would be installed in San Francisquito Creek. There would be no new or substantially altered impact on hydrologic function or water quality under the No Project Alternative. Under the No Project Alternative, flood protection would not be improved, and the ~~project~~Project area would not have the capacity to accommodate proposed future improvements.
Land Use	Alternative 1 land use impacts are greater, potentially substantially greater, than overall impacts for the proposed Project. Alternative 1 would involve more significant impacts at the Palo Alto Municipal Golf Course and thus would require substantial evaluation of land use in the vicinity of the ~~project~~Project, including the long term viability of recreation within the designated land use area occupied by the Golf Course.	Under the No Project Alternative, no new flood protection infrastructure would be installed in San Francisquito Creek. There would be no new or substantially altered impact on land uses in the Project Area.
Noise and Vibration	Alternative 1 construction noise impacts are likely to be similar to or slightly greater than impacts for the proposed Project. Alternative 1 would affect impact the same sensitive receptors as the proposed Project. However, the duration of impacts resulting from bypass construction would be longer than under the proposed Project because of the expanded facility footprint.	Over the short-term, there would be no new construction and thus no impact on noise generation under the No Project Alternative. Over the longer term, as existing infrastructure continues to age, more extensive and frequent maintenance, repairs, and/or replacement are likely to be needed, and noise generation would increase. As with traffic, increases could be less than under the proposed Project, until or unless replacement of facilities becomes necessary.

Resource	Alternative 3 (Golf Course Bypass)	No Project
Public Services	Overall impacts related to public services would be very similar under Alternative 1 to those described for the proposed Project.	The No Project Alternative would not place any immediate demands on public services. If the proposed Project is not implemented, existing infrastructure in the Project corridor would continue to age, becoming less viable over time and eventually requiring emergency repair or result in emergencies from future floods that require increased public service response. However, although it is reasonable to project that repairs or emergencies may occur, the timing, details, and visual outcomes of such projects cannot be foreseen at this time.
Recreation	Overall Alternative 1 recreation impacts would be substantially greater than overall impacts for the proposed Project. Alternative 1 would involve more significant construction and requisite mitigation at the Palo Alto Municipal Golf Course. Alternative 1, as with the proposed Project, would result in significant and unavoidable impacts to recreation resulting from impacts to the Golf Course for which replacement would ultimately be the responsibility of another agency. Further, impacts related to construction staging at the Baylands Athletic Center and disruption of that facility's use would likely be increased somewhat due to the larger bypass channel and longer construction window.	The No Project Alternative would have no foreseeable impact on recreational facilities or uses and thus would have reduced recreational impacts in comparison with the proposed Project.
Transportation and Traffic	In general, impacts on traffic and transportation would be similar under Alternative 1 to those described for the proposed Project. Traffic impacts related to construction staging at the Baylands Athletic Center would likely be increased somewhat due to the larger bypass channel and longer construction window.	Over the short-term, the No Project Alternative would have no impact on traffic or transportation because there would be no new construction and thus no construction-related traffic. Over the longer term, as existing infrastructure continues to age, more extensive and frequent maintenance, repairs, and/or replacement are likely to be needed, so traffic related to flood protection operations could increase by comparison with the current baseline condition. Increases could be less than under the proposed

Resource	Alternative 3 (Golf Course Bypass)	No Project
		Project, until replacement of facilities becomes necessary. Future replacement of aging facilities could generate enough construction traffic to result in significant impacts on traffic and transportation, but details are not foreseeable at this time.
Utilities and Service Systems	Although the ~~project~~Project footprint would differ between Alternative 1 and the proposed Project, overall impacts related to utilities and service systems would be similar under Alternative 1 to those described for the proposed Project.	The No Project Alternative would have no foreseeable impact on utilities and service facilities and thus would reduce impacts by comparison with the proposed Project.

6.4 Identification of Environmentally Superior Alternative

Approach

Detailed analysis of the proposed Project's impacts is presented in Chapter 3.Table 6-1 summarizes environmental outcomes expected for Alternative 1 and the No Project Alternative and compares them with those anticipated under the proposed Project. The analysis and comparison in Table 6-1 were used to identify the alternative that would be environmentally superior for each resource considered. Resource-specific results were then integrated to identify the alternative offering the best overall outcome across all resources.

Results

Table 6-1 presents a summary comparison of the proposed Project, Alternative 1, and the No Project Alternative, on a resource-by-resource basis. Based on the comparison in Table 6-1, the No Project Alternative was identified as environmentally superior for most resources because it would not change baseline conditions in the Project corridor. However, it would not satisfy Project goals and objectives and, under the State's CEQA Guidelines (Sec. 15126.6 [e][2]), cannot be identified as environmentally superior.

Of those outcomes resulting from implementation of a project (as opposed to outcomes resulting from the No Project Alternative), impacts on the following resources would be very similar under Alternative 1 and the proposed Project (see Chapter 3 for impact analysis).

- Air quality.
- Geology and soils.
- Greenhouse gases and climate change.
- Hazardous material and public health.
- Hydrology and water quality.

- Public services.

Alternative 1 would be slightly superior with respect to impacts on biological resources.

The proposed Project would be superior with respect to impacts on the following resources.

- Aesthetics.
- Cultural and paleontological resources.
- Land use.
- Noise and vibration.
- Recreation.
- Transportation and traffic.

Specifically, although Alternative 1 would avoid potential impacts associated with the increased inundation of the Faber Tract under the proposed Project, it would increase several key impacts associated with construction and use of a new bypass channel.

In summary, although Alternative 1 would accomplish Project goals and objectives and reduce impacts on several resources, Alternative 1 would result in greater impacts in multiple resource areas and in the severity of the of impacts to those resource areas. Consequently, the proposed Project is identified as environmentally superior.