3.9 Hydrology and Water Quality

3.9.1 Introduction

This section describes existing hydrology and water quality in the project area, including wastewater and stormwater management, existing and future flooding, groundwater conditions, and the existing regulatory framework governing these topics. Potential hydrology and water quality impacts that could result from construction and operation of the project and mitigation measures to avoid or reduce significant adverse impacts are then discussed, as appropriate.

3.9.2 Scoping Comments

Comments related to hydrology and water quality impacts were received during the public scoping process. These comments and the location where they are addressed in the hydrology and water quality analysis are provided in Table 3.9-1.

Table 3.9-1 Hydrology and Water Quality Scoping Comments

Agency/ Entity	Comment	Location in Hydrology and Water Quality Section that Comment is Addressed
Leslie and J. Bradley O'Connell	Removal of the concrete channel in Ross, which has functioned well, will expose some homes on Sir Francis Drake to the prospect of greater flooding. Will the County or Town of Ross be responsible for these damages? The County's model as to the reduction in flooding does nothing to address the flooding caused by overland or runoff water. It is acknowledged as a problem in the previous EIR draft, but no specific approaches were suggested. The FAP flood wall design has not taken into account the possible introduction of increased flooding caused by overland water or creek overflow water trapped behind the walls. Project would introduce the possibility of greater harm during floods, greater harm to fish and trees, and greater risk throughout the year for families and homes becoming more vulnerable to flooding.	Impact 3.9-5
Garril Page	The project team has not performed an interior drainage analysis to determine if there is need.	Impact 3.9-5
Garril Page	The Oct 2018 EIR/IS predicted increased flooding downstream of Ross and specifically in the College of Marin area. By removing the channel walls in the lower Unit 2 channel, approximately the areas extending from Stations 332+00 to 320+00, increases the potential for toxic waste entering the natural creek habitat. The College of Marin's dumping facility, a.k.a. trash transfer station, has	Impact 3.9-1 Impact 3.9-3 Impact 3.9-5

Agency/ Entity	Comment	Location in Hydrology and Water Quality Section that Comment is Addressed
	been a source of protest and concern. The facility is wrapped within the channel's curve. Lowering walls, and widening banks destabilizes existing conditions and increases potential encroachment of flood waters into this COM facility.	
Garril Page	The cumulative effect of removing San Anselmo's Azalea, Madrone, Nokomis, Center/ Sycamore and Ross' Winship bridges, plus removal of the fish ladder constraint, is to increase downstream flood flows. This increases potential flooding at the trash transfer station, spilling toxic waste into the surrounding habitat.	Chapter 2 Project Description Impact 3.9-5
Garril Page	The EIR/EIS states Alt J induces more frequent flooding downstream of Ross at, for example, the College of Marin per Appendix A sections 7.1,7.5.6, 8.2, 9.1 and in Areas of Controversy #5 above. Induced flooding is a significant adverse consequence, an added risk, and must be identified as such.	Impact 3.9-5
Garril Page	The proposed FAP Riparian Corridor lies within a watershed unique due to the quantity of sediment shed into its waterways. Prior projects repeatedly have miscalculated the effects of erosion and aggregation, and also have used incorrect, challenged Mannings 'n' values with resultant flawed concepts, dysfunction, and failed performance.	3.9.5 Impact Assessment Methodology
Garril Page	Partial consideration wherein only certain aspects and areas of the channel are included in studies and reports ensures continued failure: Winship Bridge to Lagunitas Bridge must be included the proposed project.	3.9.5 Impact Assessment Methodology
Garril Page	Adding 11 -17 new larger fish resting pools to the channel bottom has unknown effect on flow, sediment transport and sedimentation. Since formulas used to model proposals are limited by data uncertainty, odds of selecting correct assumption(s) essential to determining the appropriate computer programming lessen exponentially with additional unquantified designs.	3.9.5 Impact Assessment Methodology Impact 3.9-5 Impact 3.9-6
Garril Page	The new larger fish resting pools in the channel bottom creates unknown effect on the existing concrete structure's stability, coefficient of roughness, profile at the time of any given flood event. Therefore, reliable, accurate predictions of potential turbulence and other hydraulic effects become less likely.	3.9.5 Impact Assessment Methodology Impact 3.9-5 Impact 3.9-6
Samantha Hobart	Advise each property owner where the flood elevations are before and after any creek work is completed. Be able to	Impact 3.9-2

Agency/ Entity	Comment	Location in Hydrology and Water Quality Section that Comment is Addressed
	discuss changes to individual's properties and not only a select few property owners like with the San Anselmo Flood Risk Reduction Project. Provide a Fish Ladder removal-only alternative. The root systems of the mature trees in Frederick Allen Park are an integral part of flood prevention and protection; removing these trees and their root systems will cause significant damage and increased risk to flooding and the erosion.	Impact 3.9-5 See also Chapter 5 Alternatives
Doug Ryan	What does the model being used show as the water level and flood levels before the San Anselmo Creek project and after? Does the impact of the Winship Bridge replacement have a similar effect on the houses downstream in the scope of this project and how is this accounted for? Why is so-called beautification being included as part of a flood control project? Resources are scarce and should be focused on flood control and nothing else. What does the beautification project do to reduce flooding?	Impact 3.9-5
Charles Goodman	The County is using the Army Corps EIR/EIS Plan J Bypass as the basis for their own EIR/EIS. This is flawed because the County has left out all of the residents of Sylvan Lane and Shady Lane from hydraulics and hydrology.	3.9.5 Impact Assessment Methodology, Impact 3.9-5
Charles Goodman	They have failed to account for any overload water flows from Bolinas Avenue, Fernhill, Southwood, Norwood, Ames or Lagunitas Road.	3.9.5 Impact Assessment Methodology
Charles Goodman	The EIR/EIS must address the significant impact on reducing the flow through Fred Allen Park, from supercritical flow to a 10-25 year level of Flood Protection (per comment from Liz Lewis, at the July 9, 2020 Ross Town Council Meeting). The number of 10-25 year is baseless and has not been verified by the County.	3.9.5 Impact Assessment Methodology
Charles Goodman	"The County must address sediment removal. (""This study's uncalibrated sediment budget estimates that the Corte Madera Creek Watershed supplies about 7,250 tons of bedload each year to the reach above Ross. The calibrated Parker-Klingerman sediment transport model estimated average bedload sediment inflow at Ross is about 6,750 tons/year. Using an average of the two results, the study estimates that about 7,000 tons/year of bed load are delivered to Ross, or about 450 tons/sq. mi. /year."") Source: Geomorphic Assessment of the Corte Madera Creek Watershed, final report. To remove 7,000 sediment at 20 tons per truck= 350 trucks (loads). Load 6 trucks per hour, (1 every 10 minutes) equals 58 hours or over 7 works days for	Impact 3.9-2

Agency/ Entity	Comment	Location in Hydrology and Water Quality Section that Comment is Addressed
	removal. How does the County plan to mitigate this substantial disruption of removing sediment from the Town?"	
California State Lands Commission	"Sea-Level Rise: A tremendous amount of State-owned lands and resources under the Commission's jurisdiction will be impacted by rising sea levels. Because of their nature and location, these lands and resources are already vulnerable to a range of natural events, such as storms and extreme high tides. The State of California released the 2018 Update to the Safeguarding California Plan in January 2018 to provide policy guidance for state decision-makers as part of continuing efforts to prepare for climate risks. The Safeguarding Plan sets forth "actions needed" to safeguard ocean and coastal ecosystems and resources as part of its policy recommendations for state decision-makers. In addition, Governor Brown issued Executive Order B-30-15 in April 2015, which directs state government to fully implement the Safeguarding Plan and factor in climate change preparedness in planning and decision making. Commission staff believes the goals of the proposed Project are consistent with the guidance and recommendations presented in the Safeguarding Plan, and that Project would benefit coastal management agencies' efforts to plan for more resilient shorelines and minimize adverse ecosystem impacts resulting from sea-level rise. Please note that when considering lease applications, Commission staff will (1) request information from applicants concerning the potential effects of sea-level rise on their proposed projects, (2) if applicable, require applicants to indicate how they plan to address sea-level rise and what adaptation strategies are planned during the projected life of their projects, and (3) where appropriate, recommend project modifications that would eliminate or reduce potentially adverse impacts from sea-level rise, including adverse impacts on public access. Therefore, this information should be included in the Draft EIR."	3.9.5 Impact Assessment Methodology
CDFW	The State of California Sea-Level Rise Guidance/2018 Update (California Natural Resources Agency, 2018) provides a science-based methodology for state and local governments to analyze and assess the risks associated with sea-level rise and incorporate sea-level rise into their planning, permitting, and investment decisions. The Marin Shoreline Sea Level Rise Vulnerability Assessment/Bay Waterfront Adaptation & Vulnerability Evaluation (BayWAVE) (Marin County, 2017) provides context and	3.9.3 Environmental Setting – Sea Level Rise; 3.9.5 Approach to Impact Analysis

Agency/ Entity	Comment	Location in Hydrology and Water Quality Section that Comment is Addressed
	estimates of the physical and fiscal impacts across the County's bayside shoreline over the coming decades. It includes sea level rise scenarios ranging from 10 inches in the near-term (15 years) to 20 inches in the medium-term (mid-century) and to 60 inches in the long-term (end of century). Since the purpose of the Project is to reduce long-term flood risk, and a portion of this downstream channel is tidal, CDFW recommends incorporating the long-term (end of century) scenarios for sea level rise, beyond the 15 year estimate, to fully evaluate Project impacts.	
Town of Ross	The EIR should identify all the potential CEQA impacts related to replacing the existing Park with the proposed floodplain park including the following information: – The impact of sediment buildup within the proposed floodplain and associated maintenance responsibilities – Mechanisms and procedures to keep the public safe during high water events.	Impact 3.9-2
Town of Ross	The EIR should illustrate the comparison of the 10-year and the 25-year flood risk reduction benefits under existing, existing with cumulative impacts, and proposed project conditions for all alternatives and including the "fish ladder only" alternative for the entire reach of Corte Madera Creek between San Anselmo and Kentfield and including all drainage tributaries within Ross.	Impact 3.9-5 Chapter 5 Alternatives
Marin Conservation League	Does the Project modeling and planning take into account the likelihood of greatly increased extreme storms and rainfall and how could these affect Project efficacy?	3.9.5 Impact Assessment Methodology
Marin Conservation League	What effect if any would the proposed Project have on sediment accumulation in the concrete channel and downstream in the natural channel bed?	Impact 3.9-2
Marin Conservation League	How do elements of the Project affect flood risk on Kent Avenue?	Impact 3.9-5
Marin Audubon Society	Guidelines of first finished floor as a mitigation measure for hydrology. Require a 1-foot margin of floor if District wishes to use first finished floor as a measure. Requests measure reflects first finished floor less 1-foot to protect the residents	3.9.5 Impact Assessment Methodology Impact 3.9-5
Marin Audubon Society	No mention of the over ground water and how that will be dealt with. The whole modeling has been so inconsistent as seen with the San Anselmo area, could be inaccurate. If you cause more flooding, who will be responsible?	3.9.5 Impact Assessment Methodology

Agency/ Entity	Comment	Location in Hydrology and Water Quality Section that Comment is Addressed
Marin Audubon Society	Concerned about hydraulics and design of the project. When you have larger fish resting pools, it changes the way the water and the sediment moves in the channel.	Impact 3.9-2, Impact 3.9-5
Marin Audubon Society	In the watershed there is local drainage and a large source of flooding in Ross. Not considering the watershed, because not considering any local drainage.	3.9.5 Impact Assessment Methodology
Marin Audubon Society	Would like to see some specifics, what is the regrading of the fish ladder? How much regrading? Regrading affects the function; the function affects the hydraulics, and the hydraulics affects the results.	Project Description, 2.5 Project Elements and Design; Impact 3.9-2, Impact 3.9-5
Marin Audubon Society	Don't agree with the calculations of volume coming out of the creek – new Lagunitas Bridge will not handle that water. Water comes out at Lagunitas and Sylvan Lane and will flood all houses on Poplar. Homes not protected by project. Continually will not address the interior drainage that has no way of getting back into the concrete channel.	3.9.5 Impact Assessment Methodology Impact 3.9-5
Marin Audubon Society	Talk about sediment dynamics, want an explanation of what sediment dynamics consists of.	3.9.3 Erosion and Sedimentation
Marin Audubon Society	Modeling seems to be inaccurate and/or changing and people need to be aware there could be changes that may impact them negatively.	3.9.5 Impact Assessment Methodology

3.9.3 Environmental Setting

Corte Madera Creek Watershed Creeks and Drainage

Corte Madera Creek is in the Corte Madera Creek watershed (also referred to as the Ross Valley watershed) located in central eastern Marin County. The total watershed contains approximately 44 linear miles of stream channels and has a total land area of approximately 28.6 square miles, including portions of unincorporated Marin County and the towns of Corte Madera, Ross, San Anselmo, and Fairfax. The drainage basin extends approximately 8 miles on a northwest-southeast axis and averages approximately 3 miles in width. Elevations within the basin range from sea level at San Francisco Bay to 2,600 feet above mean sea level (msl) at Mount Tamalpais. Fifty percent of the basin lies below elevation 300 feet msl and 90 percent below elevation 1,000 feet msl. Streambed slopes range from 0 feet per mile in the lower reach of Corte Madera Creek, along the USACE Corte Madera Creek Flood Control Project (USACE Project) Units 1, 2, and 3, up to 20 feet per mile in the upper portions of Corte Madera Creek (USACE, 1966).

Corte Madera Creek and San Anselmo Creek are perennial streams and form the mainstem waterway of the watershed. San Anselmo Creek and its tributaries drain the northwestern portion of the watershed. Ross Creek and its tributaries drain the northern slope of Mount Tamalpais, joining San Anselmo Creek from the west in the central part of the watershed. Downstream of the confluence of Ross Creek and San Anselmo Creek, the mainstem channel is known as Corte Madera Creek, which continues through the project area (Figure 3.9-1). The project is located in USACE Project Units 2, 3, and 4 within a portion of Corte Madera Creek that extends from just upstream of Lagunitas Road Bridge to approximately 500 feet downstream of Stadium Avenue. Approximately 18.1 square miles, or 63.3 percent of the total watershed area is tributary to the project area.

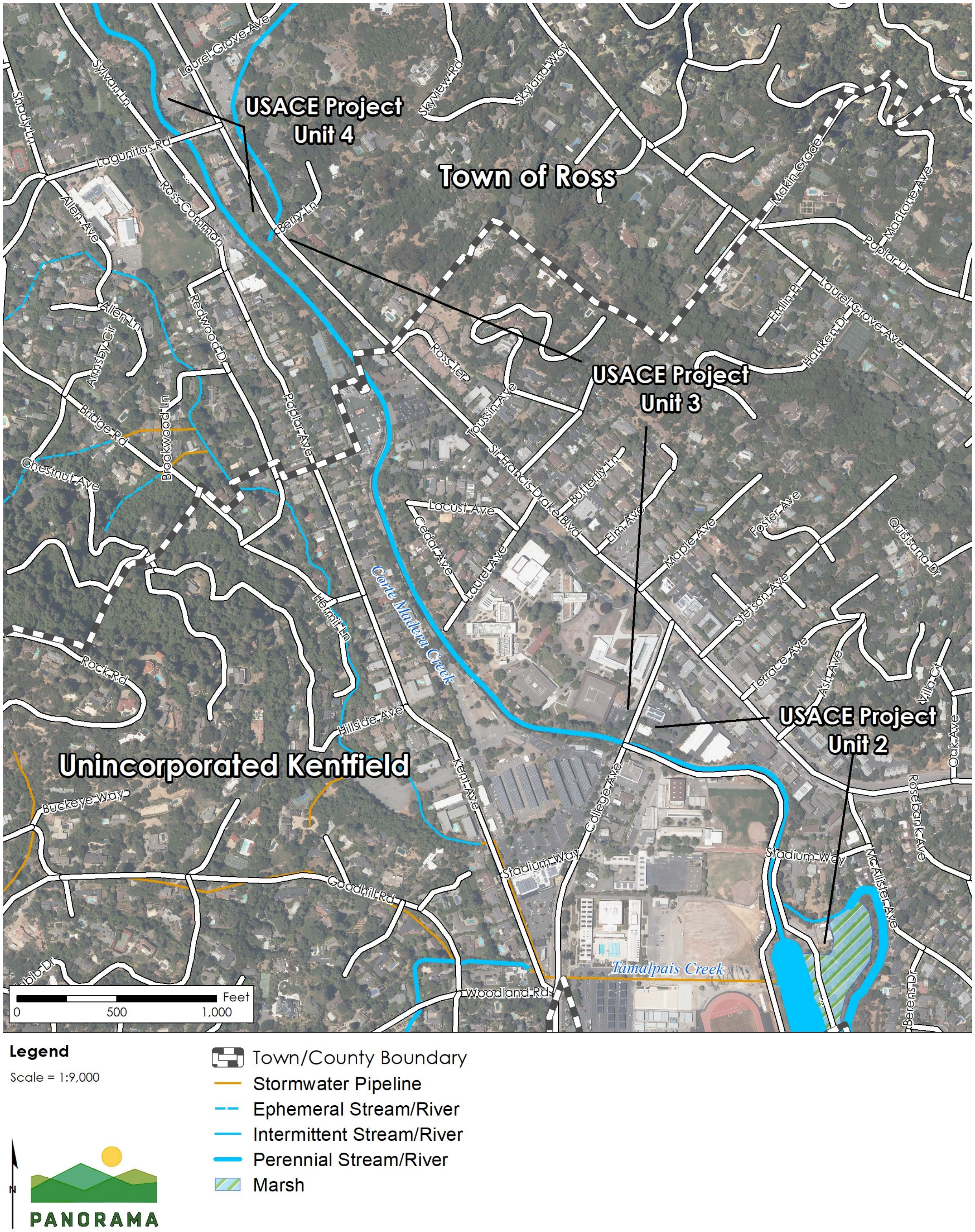
Hydrology and Geomorphology of the Corte Madera Creek Watershed

Marin County is characterized as having a temperate Mediterranean climate, with heavy rain in the winter and warm, arid summers. Eighty-three percent of the precipitation occurs during the months of November through March with less than 1 percent occurring from June through September (USACE, 1966; USACE, 2000a). Coastal fog is most common in summer, when it provides a minor source of precipitation, which is accentuated through leaf drip. Mean annual precipitation for the project area is 48 inches per year (WRCC, 2020). Snowfall is rare within the watershed and has no significant effect on flood peaks.

The upper parts of the watershed are hilly and mostly wooded (USACE, 2000a). The lower ridges and valley areas of the watershed are highly developed suburban residential and commercial areas. Development in the communities of Fairfax, San Anselmo, Ross, Kentfield, Larkspur, and Greenbrae has increased the area of impervious surfaces within the watershed, decreasing the amount of rainfall that can infiltrate into the soil. These changes in urban hydrology result in more runoff and higher peak flows than those which would occur under natural conditions (Royston 1977, in (USACE, 2010)).

Major runoff events occur during the rainy winter and spring seasons. Floods attributable to Corte Madera Creek are generally flashy and of short duration, whereby the creek water surface level rises quickly with the peak of the storm event and then recedes soon after. Flashy runoff patterns in the Ross Valley result from intense rainfall, the shape and steepness of the upper watershed surrounding the valley, and the lack of significant detention and infiltration in the urbanized valley. Tributaries rise rapidly so that flooding can begin a few hours after the occurrence of heavy rainfall (FEMA 2009a, in (USACE, 2010)). Streamflow peaks may occur generally within 3 to 5 hours after periods of intense rainfall and recede within 24 hours after the end of such storms (USACE, 1966). Historical accounts indicate that major storms occurred in 1951, 1960, 1966, 1982–1983, 1986, and 2005 (USACE, 1966; FEMA 2009a, in (USACE, 2010); Stetson 2009, 2011, 2007, in (USACE, 2010)). During the summer months and dry years, there is little rainfall-runoff inflow to Corte Madera Creek, but the creek is supported by baseflow and aquifer storage.

Figure 3.9-1 Corte Madera Creek – Waterbodies in Project Vicinity



Sources: (USGS 2020, USFWS 2020) (US Geological Survey 2013, U.S. Geological Survey 2016, Tele Atlas North America, Inc. 2020, Bay Area Open Space Council 2011)

Corte Madera Creek has a natural channel bottom through Unit 4 of the project area and is concrete lined through Unit 3 and portions of Unit 2, a distance of over 1 mile. At the terminus of the concrete-lined segment, the creek opens to an earthen channel and is joined by Larkspur and Tamalpais creeks before flowing into San Francisco Bay at the Corte Madera Marsh State Marine Park.

The District maintains a rainfall gage in Kentfield. Stage data at the Corte Madera Creek Ross Gage (Site ID: 5255) is published by the District. The United States Geological Survey (USGS) also maintains a stream gage on Corte Madera Creek in Ross (11460000).

Storm Drainage System

The municipal storm drainage system for the Town of Ross and unincorporated Kentfield area collects overland flow from stormwater runoff in storm drains. The runoff is piped under roads or in rights-of-way and outfalls into Corte Madera Creek. More than 10 existing outfalls are located within Units 2, 3, and 4 as shown in Section 3.15 Utilities and Service Systems, Figures 3.15-1 through 3.15-3. The pipe outfalls range from 18 to 72 inches in diameter and enter from both sides of the channel. For Corte Madera Creek watershed, overland flooding is caused by inadequate channel capacity and poor drainage in areas close to the stream (FEMA 2009a, in (USACE, 2010)).

There are two mechanisms for overland flow and flooding in the watershed. The first mechanism is when stormwater runoff collects from drainage areas throughout the watershed, route through the municipal storm drain system, then discharge to Corte Madera Creek. During this process, when the downstream storm drain system has inadequate capacity, the conveyance creates a backwater effect and stormwater either ponds and/or sheetflows overland in the drainage areas. The second mechanism is when Corte Madera Creek does not have sufficient capacity to convey collected stormwater runoff from the municipal storm drain system, the creek overtops and inundates the adjacent floodplain. The focus of this project is to address the second mechanism of overland flooding, which is due to capacity constraints at Corte Madera Creek.

Channel Morphology and Conveyance

Corte Madera Creek from Sir Francis Drake Boulevard to the Denil fish ladder (i.e., Unit 4) is primarily a natural channel with vegetated banks and a gravel bed. Structural elements include the bridge abutments at Lagunitas Road Bridge and retaining walls along much of Unit 4. The longitudinal slope of the channel is fairly consistent. The vertical drop from Sir Francis Drake Boulevard to the concrete-lined channel is 11.3 feet. The horizontal distance for this change is 4,050 feet, resulting in a slope of 0.28 percent. The land immediately adjacent to Corte Madera Creek generally appears flat but there is topographical variation that becomes important during flood stage (Royston 1977, in (USACE, 2010)).

From the confluence with Ross Creek downstream to the Lagunitas Road Bridge, the channel cross sections are fairly consistent. The channel is deeply incised 12 to 15 feet below the banks. The channel bottom is about 20 to 25 feet across. Banks along this section of Corte Madera Creek range from 5:1 (horizontal: vertical) slope where concrete retaining walls are built (PWA, 2009a). The channel bed is characterized by 30- to 150-foot-long and 15- to 20-foot-wide lateral scour pool/riffle sequences with depths ranging from 0.5 to 1.5 feet average depth. Scour pools contain large woody debris, root wads, and substrate composed of small gravel, sand, and silt. The area has abundant shade (Rich, 2000). The Lagunitas Road Bridge was replaced in 2010 with a higher soffit that increased the creek capacity at the bridge crossing.

Downstream of the Lagunitas Road Bridge to the Denil fish ladder, the channel remains incised though the depth from the bank to channel bed begins to decrease (10 to 12 feet). The creek banks vary in steepness from a steep 2:1 vegetated slope to vertical retaining walls along the private properties at Sir Francis Drake Boulevard. The channel bed tapers from approximately 30 feet in width at the bridge to 15 feet in width at the downstream end of Unit 4. The channel bed is characterized by long (80 to 100 feet), shallow (from a few inches to about 1.5 feet average depth) alternating lateral scour pool and riffle sequences; riffles are very narrow (3 to 6 feet wide) and shallow. The low streamflows, riprap, and condition of the wooden retaining walls result in fairly stagnant pool areas. Riffle areas are extremely shallow. Substrate in the pool areas consists of sand, silt, and organic detritus; in the riffles, small gravel is the predominant substrate (Rich, 2000).

The creek channel, within and upstream of Unit 4, has considerable vegetation, primarily on the natural banks. This vegetation provides some protection to the underlying soil against erosion from water flowing in the creek. In addition, many homeowners have placed rock, timber, concrete and other materials on the creek banks to protect against scour and erosion (Royston 1977, in (USACE, 2010)). However, despite the vegetation and placed bank materials, the streambanks in Unit 4 are actively eroding along approximately 7,200 linear feet of bank. Royston (1977, in (USACE, 2010)) estimated that roughly 20 percent of the total length of bank would be subject to 1 foot of erosion per year.

In 1989 and 2000, soil conditions within Corte Madera Creek were evaluated (Copeland, 2000; Copeland & Thomas, Cortland, 1986). Streambed soils were found to be shallow with limited absorbing capacity. The basic purpose of the field survey was to determine where erosion problems might develop and to visually determine the types of soil exposed in the banks and in the creek bottom. Surveys indicated that generally the banks consist of clayey sands and sandy clays of relatively low plasticity. In the creek bottom, well-graded gravels were observed (Royston 1977, in (USACE, 2010)). Subsurface exploration near the town limits of Ross determined that the subsurface materials consist predominately of clays, sandy clays, and clayey sands. In general, the materials were firm or stiff except for the soft clay (Bay Mud) within Unit 2 (USACE, 1966).

Erosion and Sedimentation

Sediment dynamics refers to the process of erosion, transport and deposition of sediment in alluvial stream channels. Fluvial sediment processes are an important component of fluvial function; the fluvial process both creates the channel and floodplain form and transports nutrients and pollutants downstream. Sediment processes within a watershed are typically divided into three classes: sediment generation zones (typically highest in the upper watershed), sediment transport zones (typically upper and mid watershed areas), and sediment deposition zones (typically in the lower watershed areas of the creek). These tendencies can vary highly across a watershed depending on geology, soils, historic land uses, and other factors.

Sediment originates in the steeper, upper watershed areas of Corte Madera Creek, and is transported to Units 2, 3, and 4. Sediment transported to and deposited in Corte Madera Creek affects the conveyance capacity of the channel. Sediment deposition has historically occurred in the creek at the Lagunitas Road Bridge and farther downstream in Units 1, 2, 3, and 4, including the concrete-lined channel (Copeland, 2000). Sediment deposition in the concrete-lined channel ranged from 0 feet at the Kentfield Hospital Bridge to 4.65 feet at the downstream end of the concrete channel in 2015 (Stetson, 2015).

Sediment yield from the upper watershed is high due to a combination of geology and historic land uses. Natural landslides and earth flows in the upper watershed areas also periodically overwhelm the creeks with large volumes of fine-grained sediment (Stetson, 2000). In the description of the Corte Madera Watershed in the Integrated Regional Water Management Plan Report (Marin County, 2013), two highly erosive subwatersheds were identified. The Sleepy Hollow Creek subwatershed is identified as contributing 26 percent of total coarse-grained bedload sediment (as compared to fine-grained suspended sediment) inflow at the Town of Ross. The most probable sources of sediment are identified as active hillslope processes (e.g., slumps/land sliding). The San Anselmo Creek subwatershed is described as contributing 29 percent of total coarse-grained bedload sediment inflow to the creek within the project area (Marin County, 2013).

Sediment deposition rates are high in Units 2 and lower Unit 3 of Corte Madera Creek because of the combined influence of low channel slope in the concrete-lined channel and tides. More gentle sloped channels, other things being equal, have less driving energy and stream velocities. Lower stream velocities together with the stream meeting an incoming tide makes sediment fallout of suspension or transport and deposit. Incoming sediment from Corte Madera Creek and San Francisco Bay is conveyed on incoming tides, adding to the sediment load.

After USACE construction of the lower portions (Units 1, 2, and 3) of the Corte Madera Creek Flood Control Project (CMCFCP) in the 1970’s, the channel began to aggrade at rates much greater than anticipated and the District was unable to maintain the channel at its design depth. Nonetheless, the earthen channel section in Units 1 and 2 (i.e., downstream of the stilling basin) contained the 1 percent AEP flood event that occurred in December 2005 without overbank flow. In an attempt to restore the original channel design depth, Units 1 and 2 were dredged in 1986, and the stilling basin was dredged again in 1998. Unit 4 below Sir Francis Drake Boulevard, upstream of the concrete-lined channel, is also depositional, with the channel bed aggrading (Stetson, 2000).

Flooding

Overbank flooding in Ross Valley, such as in 1982 to 1983, and 2005, occurs when streamflows exceed the conveyance capacity of the Corte Madera Creek channel. Structures on the creeks constrain flow causing water levels to rise and when flows are great enough, they breach the main channel transmitting flow into overflow paths (PWA 2000, in (USACE, 2010)). The Denil fish ladder, in its current condition, is a primary flow constriction for Unit 4 reach and upstream that causes extensive overbank flooding along Corte Madera Creek. The Denil fish ladder is also a barrier to fish passage. Bridge constrictions and poorly designed residential streambank stabilization structures have also exacerbated flooding on this naturally flood-prone system (Stetson 2006).

The USACE has conducted numerous studies focused on evaluating the performance of Units 3 and 4 since 1971 (USACE, 1966, 1974a, 1974b, 1987a, 1987b, 1988, 2000a, 2000b; Stetson 2008, in (USACE, 2010; USACE, 2018)). These studies identified a hydraulic constraint through the transition from Unit 4 to Unit 3 created by the existing Denil fish ladder and the narrow channel condition on the east and west bank.

The USACE has prepared several studies to assess the hydrologic conditions at Corte Madera Creek, beginning with those described in Design Memorandum No. 1 (USACE, 1966). The standard project flood (SPF)[1] discharges were estimated to be 7,500 cubic feet per second (cfs) for Corte Madera Creek within the project area, based on a 3-day reference storm that occurred in Hollister, California in December 1955 (USACE, 1966; USACE, 1988). The SPF estimate did not provide for upstream storage and assumed that the Corte Madera Creek channel and tributaries were fully modified upstream to Fairfax. Due to local opposition, the USACE's 1960's era concrete flood control channel construction ceased at the Town of Ross upstream of Unit 3.

Immediately upstream of where concrete flood control work on the channel stopped, channel capacity in the section of Corte Madera Creek between Lagunitas Road Bridge and the concrete channel currently ranges from about 3,300 to 4,000 cfs based on recent observations of when flow levels exceeded channel capacity and went overbank. The left bank (north side of creek toward Sir Francis Drake Boulevard) downstream of Lagunitas Road Bridge was overtopped during the December 15, 2016, January 10, 2017, and February 7, 2017, storm events when the observed peak discharges at the Ross Gage were about 3,380, 3,690, and 3,710 cfs respectively (Stetson, 2017).

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[1] The standard project flood is defined by USACE as that flood produced by the standard project storm which is the most critical storm on record within a region meteorologically homogeneous with the basin under study, or the most critical storm on record in adjacent regions that can be reliably transposed to the subject basin, occurring at a time when conditions for runoff are favorable.

Overbank and Floodplain Flow

Overbank flows on San Anselmo and Corte Madera Creeks have historically led to significant flooding in the towns of San Anselmo and Ross. Previous studies have been performed to assess the location and source of overbank flooding on these creeks (PWA 2009b; Stetson, 2011). The Ross Valley Capital Improvement Plan (CIP) study (Stetson, 2011) estimated that, with respect to flows exceeding 2,800 cfs, backwatering from the Madrone Avenue Bridge causes San Anselmo Creek to breach the right bank of the main channel at Nokomis Avenue. The diverted flow then travels as split flow through San Anselmo and rejoins the creek corridor near its confluence with Ross Creek. Additional overbank flow caused by backwater buildup at the Sycamore Avenue Bridge contributes to the overbank flow generated at Nokomis Avenue. In the Ross Valley CIP study (Stetson, 2011), it was estimated that split flow at Sycamore Avenue Bridge is likely to occur at flows exceeding 3,100 cfs at that location. Overbank flows originating near downtown San Anselmo run down San Anselmo Avenue and along Shady Lane in Ross where they join with overflow occurring upstream of Lagunitas Road Bridge. The combined floodwaters flow through Ross Commons and down Poplar Avenue in Ross and Kent Avenue in Kentfield before finally returning to the concrete-lined channel downstream of College Avenue in Kentfield.

Within Unit 4, a split flow condition has historically been exacerbated by backwater buildup at Lagunitas Road Bridge. The Lagunitas Road Bridge was replaced in 2010, which increased the flood capacity of the channel. With the current Lagunitas Road Bridge, a split flow is estimated to occur at flows exceeding 3,630 cfs where flows exit the creek channel and contribute to flooding in Ross and Kentfield (Stetson, 2017). The Lagunitas Road replacement bridge was designed to convey about 5,400 cfs before the water surface reaches the bridge soffit.

Historical Flooding

Corte Madera Creek has flooded numerous times over the past 70 years. Floods causing major damage occurred in 1951, 1955, 1960, and 1966 (pre-project), and 1982–1983, 1986, and 2005 (post-project) (USACE, 1966; FEMA 2009a, in (USACE, 2010)); Stetson 2007, 2009, 2011, and 2017). Before the initiation of the federal project (CMCFCP), in 1969, the most severe flood for which measurements were obtained occurred in December 1955 (FEMA 2009a, in (USACE, 2010)). This flood had an estimated maximum discharge of about 5,500 cfs at the U.S. Geological Survey (USGS) Ross gauging station (Ross Gage). The peak discharge of 5,500 cfs for the water year 1956 flood was estimated by interpolation based on the FEMA's flood frequency curve and FEMA's estimate of 1956 flood as a 4 percent AEP flood (FEMA). The USGS database shows that the water year 1956 flood had a peak discharge of 3,620 cfs at the Ross Gage, which did not account for out-of-channel flow (Stetson, 2007). Since the federal project was built, more severe floods occurred in 1982 and 2005. The January 3 to 5, 1982 storm produced the largest recorded flood flow at the Ross Gage. The runoff resulted from a 32-hour rainstorm that became stationary and produced a continuous downpour that averaged about ¾ inch per hour for six hours. Most of the rain gages overflowed during the storm, so reliable statistics were unavailable, though part of the basin had more than 15 inches of rainfall. The storm produced a peak flow at the Ross Gage estimated at 7,200 cfs with an estimated recurrence interval greater than 100 years (USACE, 2000a; USACE, 2000b). The flood inundated all of the low areas of the watershed, causing considerable damage in San Anselmo, Ross, Kentfield, and Larkspur. The December 31, 2005, storm produced the second largest recorded flood flow. The December 31, 2005 flood was estimated to be about 6,800 cfs at the Ross Gage, which included in-channel flow and out-of-channel flow (Stetson, 2007).

In 1953, the District Flood Zone 9 was created and in 1969 the USACE began construction of the flood control project that included Units 1, 2, and 3. Construction at the downstream end created a trapezoidal earthen channel and, further upstream, a concrete-lined channel part way through the Town of Ross. In 1982, up to 5 feet of flood water caused considerable damage in San Anselmo, Ross, Kentfield, and Larkspur. On January 1, 2006, flooding caused over $70 million in damage when the creek overtopped the banks and destroyed properties in San Anselmo and nearby communities (District, 2000; Friends of Corte Madera Creek, 2004; FEMA 2009a, in (USACE, 2010)). In response to the urgency created by this flood, the County of Marin authorized the development of the Ross Valley Flood Protection Program to respond to the concerns of business owners and residents in Ross Valley. The Ross Valley Flood Protection and Watershed Program utilizes a community-based participatory planning and design process that incorporates input from Ross Valley residents and stakeholders to help shape and implement solutions which significantly reduce local flood risk (District, 2020).

Flooding Near Project Elements

The threat of flooding is a significant problem in the project area. Several existing flood management focused documents ((USACE, 2010), (PWA, 2009b); (USACE, 2000a), (USACE, 2000b); Stetson 2006, 2009, 2011, 2007 and 2008, in (USACE, 2010) (USACE, 2018)) have evaluated flooding conditions in the project area. Historical flooding from Corte Madera Creek was primarily due to the relatively small capacity of the creek channel within Unit 4, the historical constriction of flow from the insufficient opening under the old Lagunitas Road Bridge, and backwater created from the transition into the concrete-lined Unit 3 channel and from the downstream inter-tidal mixing zone.

Historically, flows greater than about 3,200 cfs to 3,600 cfs overtopped Sylvan Lane upstream of the old Lagunitas Road Bridge. The current channel hydraulic capacity with the 2010 replaced Lagunitas Road Bridge in place is estimated to be about 3,630 cfs at the most constrictive location of the channel (Stetson, 2017).

Flood Hazard Areas

Following development of the SPF, several flood frequency analysis methods were used to study Corte Madera Creek stream flow data collected at the Ross Gage. A 1999 flood frequency analysis, conducted by the USACE, relied on USGS streamflow measurements associated with the original 1951 rating curve (Stetson 2006). Over the subsequent four decades of monitoring the channel had aggraded nearly 4 feet (Stetson 2007, in (USACE, 2010)). The USGS did not update the rating curve until 1987 to account for the cross-sectional change at the gage due to the deposited sediment. These bed level changes were reported to have affected the accuracy of the historical measurements taken at the Ross Gage and the reliability of the USACE's 1999 flood frequency analysis and flood frequency curve (Stetson 2006). The study published an updated stage-discharge rating curve (low-flow range) for the gage based on field measurements of discharges at different creek stages. The rating curve for the Ross Gage was evaluated for its peak stage measurements at the gage to determine annual peak flow discharges after 1993. Using this data of annual peak discharges, a flood frequency analysis was conducted using the 1987 version of HEC-WRC[2] program (Dawdy 2006, in (USACE, 2010)). The 2006 analysis relied on 55 years of data (including the historic USGS data).

The USACE performed statistical analyses using HEC-SSP[3] to develop relationships between the magnitude of flood flow and probability of occurrence in any given year (USACE, 2008). The updated USACE analysis included 57 years of data and relied on the published USGS historical peak flow values. The minor differences between the results of the 2006 and 2008 analyses reflect datasets, model selection (Firth, 2010), and computed versus expected probability used in each study.

More recent flood frequency analysis was performed using HEC-flood frequency analysis, as described in Technical Memorandum No. 1 of the 2011 Ross Valley CIP study (Stetson, 2011), using historical annual peak discharges at the Ross Gage. The flood frequency analysis is shown in Figure 3.9-2. Table 3.9-2 presents the flood frequency analysis results for each of the published flood frequency analysis studies, as well as the published FEMA values, where available. The peak discharge estimates at the Ross Gage under existing conditions in the Stetson 2011 CIP Study (as shown in Table 3.9-2 below) were adopted for this EIR analysis in order to match the flood frequency data used by countywide flood management programs[4].

A 1977 report estimated the 1 percent AEP flood flows entering the project area to be 3,700 cfs from San Anselmo Creek, 900 cfs from Ross Creek, and a combined overland flow of 2,300 cfs for a total of 6,900 cfs (Royston 1977, (USACE, 2010). The USACE estimated that approximately 4,700 cfs remained in-channel and 2,500 cfs flowed out-of-channel during the 1982 flood (USACE, 2000a). This channel flow estimate corresponds to an approximate 10-year peak flood discharge.

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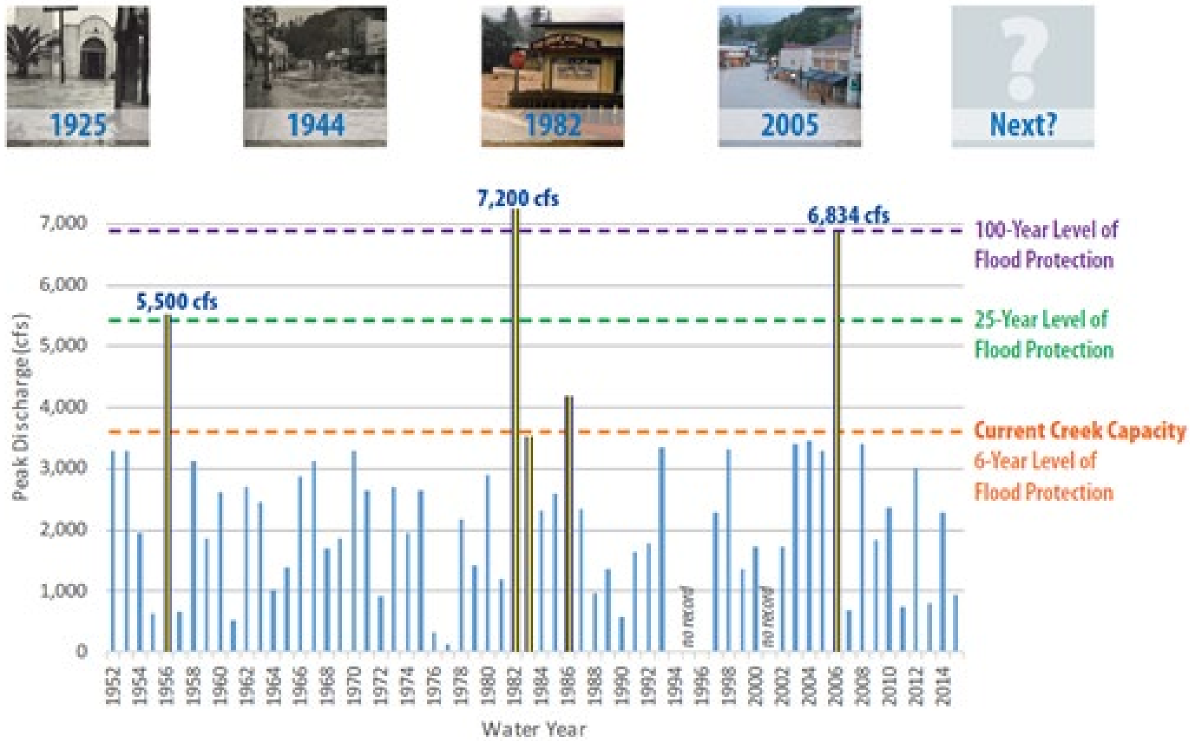
[2] The HEC-WRC program has included several updates since its inception in 1978. The program is currently called HEC-flood frequency analysis which reflects techniques described in the revised, “Guidelines for Determining Flood Flow Frequency,” Bulletin 17B, 1982.

[3] HEC-SSP is software developed by USACE to perform statistical analyses of hydrologic data. The current version of HEC-SSP can perform flood flow frequency analysis based on Bulletin 17B. The program can perform generalized frequency analysis on flow data and a volume-duration frequency analysis on high and low flows.

[4] The Stetson 2011 CIP Study used the available historical annual peak discharges up to 2010. At this time no attempt was made to update the FFA using the data collected since 2010. This way the 2018 EIS/EIR used the same flood frequency data as the countywide flood management programs. It would be expected that the flood frequency would have little change even if the data collected since 2010 were used. This is because no major floods have occurred since 2010.

Figure 3.9-2 Corte Madera Creek Historical Peak Annual Discharge



Source: (District, 2020)

The current (effective) Marin County Flood Insurance Study and countywide Flood Insurance Rate Map were issued on August 15, 2017 (FEMA, 2017). Peak discharge data were published for Corte Madera Creek in the effective Flood Insurance Study (FEMA, 2017).

Floodway and Tsunami Inundation Zones

Given that project construction would involve~~s~~ work in or along the creek channel, the project area at least partially would overlap~~s~~ the regulatory floodway. A small portion of Unit 2, Lower Corte Madera Creek, is in the Tsunami Inundation Area (California Emergency Management Agency, 2009) (see Figure 3.9-3 below). Any locations where the proposed project would cause an increase in the 100-year base flood elevation within the regulatory floodway would require a Conditional Letter of Map Revision from FEMA.

Groundwater

Groundwater and surface water are often hydraulically connected to some degree in natural streams. Surface water may infiltrate and become groundwater, or groundwater may discharge to the surface and become surface water. During the dry season, groundwater normally has cooler temperatures than the surface water flowing in the creek and, thus, groundwater discharge to the surface has a cooling effect, which makes the stream more suitable for cold freshwater habitat. While the project has primarily surface water components, information on groundwater hydrology has been included in this document as necessary to determine its relationship to surface water in the creek.

Table 3.9-2 Comparison of Peak Flood Discharges

	Dawdy, 2006 (cfs)	USACE, 2008 (cfs)	Stetson CIP, 2011 (cfs)	FEMA Flood Insurance Study 2009 (cfs)	FEMA Flood Insurance Study 2014 (cfs)	FEMA Flood Insurance Study 2017 (cfs)
2-year	2,130	2,106	2,130	—	—	—
5-year	3,630	3,620	3,490	—	—	—
10-year	4,520	4,555	4,370	4,060	3,871	4,060
20-year	5,280	5,368	5,180	—	—	
50-year	6,120	6,295	6,180	6,200	6,022	6,200
100-year	6,650	6,903	6,890	6,900	7,049	6,900
200-year	7,120	7,442	7,560	—	—	—
500-year	7,630	8,063	8,400	8,400	9,334	8,400

Notes:

[a] All peak flood discharges were calculated based on historical discharges at the Ross Gage (USACE, 1966).

[b] Results from the Stetson 2011 CIP Study were adopted for this analysis because they were recent and comprehensive.

[c] All analyses except the FEMA 2014 Flood Insurance Study used the Log-Pearson III Method to derive the peak flow estimates.

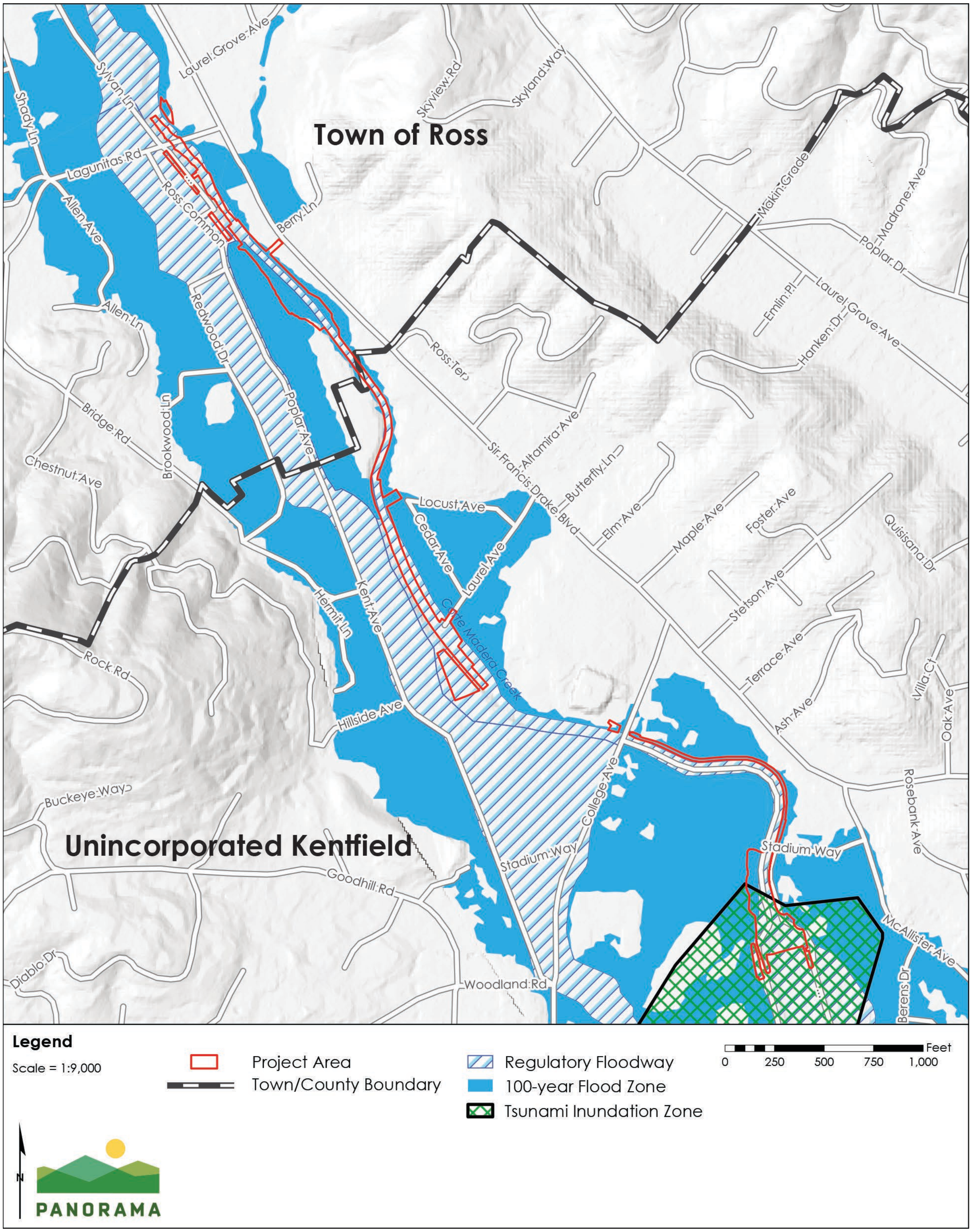
The FEMA 2014 Flood Insurance Study used a calibrated HEC-HMS model to simulate the peak flows for selected 24-hour design storms associated with the 10-, 2-, 1-, and 0.2-percent-annual-chance rainfall events (which are 6.03 inches, 8.09 inches, 9.0 inches, and 11.02 inches, respectively, in the HEC-HMS model; (PWA, 2009a)).

[d] Given that long-term historical annual peak flow records are available for the Ross Gage, use of the Log-Pearson III flood frequency analysis method based on historical annual peak flows is more reliable than 2014 FEMA's use of HEC-HMS hydrologic modeling based on selected 24-hour design storms. Rainfall-runoff modeling methods are normally used only for ungaged streams, not for gaged streams with long-term historical records of annual peak flows (FEMA, 2009b).

[e] The FEMA 2017 (effective) Flood Insurance Study directly used the results from the FEMA 2009 Flood Insurance Study. The peak flow estimates documented in the FEMA 2017 (effective) Flood Insurance Study are very close to those estimated by the Stetson 2011 CIP Study.

Source: (USACE, 2018)

Figure 3.9-3. Floodway and Tsunami Inundation Zones



Source: (GHD, 2020)

The Ross Valley groundwater basin underlies the downstream portion of Corte Madera Creek before its terminus at San Francisco Bay (SFBRWQCB, 2017). In the Project area, much of the Corte Madera Creek channel is concrete, which limits infiltration from the creek in the project area. Unit 4 is the only portion of the project area where creek infiltration can occur.

According to DWR, the project area is not located on a groundwater basin that produces, or has potential to produce, significant amounts of groundwater (DWR, 2019). While existing beneficial uses for the Ross Valley Groundwater Basin include municipal/domestic and agricultural water supply, and potential beneficial uses are industrial service water supply (without water quality limitations) and industrial process water supply (with water quality limitations) (SFBRWQCB, 2017), the groundwater basin is not a source of potable water and groundwater in Ross Valley is currently used only for landscape irrigation (Marin County 2005a). Examination of soil samples from borings and well data collected at the College of Marin from 2013 to 2015 indicates ground water level are expected to be 7.5 to 10.5 feet below the ground surface in the vicinity of the project area (Environmental Resource Group, Inc., 2013).

Additional groundwater basin characteristics were published in the Marin Countywide Plan (Marin County, 2007). The study found that the Ross Valley Groundwater Basin was located at a depth of 10 to 60 feet below ground surface. The basin's storage capacity was estimated at 1,380 acre-feet and covered an area of 18 square miles. The perennial safe yield was estimated at 350 acre-feet.

Tidal Influence

Corte Madera Creek is tidally influenced from the natural channel bottom brackish marsh in Unit 2 to approximately 400 feet downstream of the Kentfield Hospital bridge within the concrete-lined channel (Stillwater Sciences, 2020). Average tidal fluctuations in the concrete-lined channel range from 0.06 feet relative to the North American Vertical Datum of 1988 (NAVD88) at mean-lower low-water (MLLW) to 5.90 feet NAVD88 at mean-higher-high-water. The 1 percent AEP tide elevation is estimated to be 9.0 feet NAVD88 in the FEMA 2009 Flood Insurance Study. However, the FEMA 2017 Flood Insurance Study shows the 1 percent AEP tide elevation to be 9.7 feet NAVD88. An extreme high tide of 8.88 feet NAVD88 was measured during the January 27, 1983, coastal flood event at the San Francisco Bay tidal gage station (NOAA #9414290) over a period of record of more than 160 years dating back to 1855.

Sea Level Rise

Global sea levels are rising due to impacts from climate change and increased concentrations of atmospheric greenhouse gases. Both thermal expansion and melting land ice contribute to rising sea levels. Since Corte Madera Creek empties into San Francisco Bay and portions of the creek experience tidal effects, sea level rise will influence the hydrology of the creek. As sea level rises, tidal influences will increase in sections of the creek where they already occur, and tidal action will expand further upstream. Higher tides linked to sea level rise will also exacerbate flooding during major storm events. Estimates for sea level rise in the San Francisco Bay area vary greatly (Table 3.9-3) due to the complexity of, and uncertainty associated with, the variables used in present models. The sea level rise projection used in modeling for the project is based on the estimated relative sea level change from 1992, the last National Tidal Datum Epoch (NTDE), to 2067 at the San Francisco NOAA Tidal Gage (Station ID: 9414290).

Table 3.9-3 San Francisco Bay Sea Level Rise Estimates

Year	Bay Wave	CNRA 2018	NRC 2012 Projection	NRC 2012 Range	USACE 2019		
					Low	Int	High
2030	10″	0.5 feet	5.7″ ± 2″	2″-12″	3″	4.6″	9.5″
2050	20″	1.1 feet	11″ ± 3.6″	5″-24″	4.6″	8.2″	19.6″
2070		1.9 feet			6.1″	12.7″	33.2″
2100	60″	3.4 feet	36″ ± 10″	17″-66″	8.5″	21.0″	60.5″

[a] Bay Wave and NRC values relative to year 2000 and USACE values relative to 1992.

[b] CNRA 2018 values based on 2000 baseline year.

[c] Project lifespan expected to be roughly 50 years.

[d] USACE 2019: Used USACE Sea Level Change Calculator (2017.55), San Francisco Gauge, NOAA 2006 SLC Rates.

Sources: (Marin County, 2020c; Council, 2012; Engineers, 2019; CNRA, 2018)

The USACE intermediate curve for relative sea level change was used to estimate the 1.0-foot coastal water level increase, between 1992 and 2067. With the mean higher-high water level of 6.65 feet at the San Francisco Gage, the estimated coastal water level in 2067 is 7.65 feet (USACE 2018).

In order to better understand the long-term post-project condition with projected sea level rise, an additional sea level rise scenario is considered in this EIR. The additional projection of sea level rise reflects the year 2100 planning horizon. The projection is based on the 2018 Update of the State of California Sea-Level Rise Guidance (CNRA, 2018), under the likely range of 66 percent probability sea-level rise estimate with a high emissions projection. The sea level rise projection is 3.4 feet, from the baseline year of 2000. With the existing mean higher high water level of 5.95 feet and the interannual variation of 0.7 feet, the estimated coastal water level in year 2100 under this scenario is 10.05 feet.

Water Quality

Corte Madera Creek has a number of tributaries that flow from open space headwater areas through urbanized areas to San Francisco Bay. The creek experiences a variety of water quality problems related to nonpoint-source pollution from urban runoff (4.1 miles of storm sewers), septic systems, road and bank erosion; specific concerns include pesticides, bacteria, particulates (sediment), and nutrients (Town of Ross 2009, CCA 2002, in (USACE, 2010)). The SFBRWQCB provides information on sediment, pathogens, and diazinon as pollutants of concern. Pathogens of concern are Enterococcus (in Corte Madera Creek), and E. coli (in the tributaries) (Friends 2006, in (USACE, 2010)). Nutrient loading from runoff and sewage contribute to growth of algae and other aquatic plants in portions of Corte Madera Creek, particularly areas that are unshaded by riparian vegetation (Town of Ross 2009, in (USACE, 2010)).

Erosion originating primarily from headwater areas and, to a lesser extent, creek banks in the towns, result in increased sedimentation in the creeks (Stetson, 2000).

Marin County completed water quality testing in accordance with the Small MS4 General Stormwater Permit in 2016, including at one location along Corte Madera Creek (at Lagunitas Road Bridge). Constituents monitored included over one dozen pesticides (including diazinon); parameters also measured included organic carbon, suspended sediment, total dissolved solids, turbidity, water temperature, pH, electrical conductivity, and dissolved oxygen (MCSTOPPP and City of Petaluma, 2016). At the Lagunitas Road Bridge, diazinon was not detected during the three sampling events conducted, and dissolved oxygen concentrations met the water quality objective (MCSTOPPP and City of Petaluma, 2016).

Corte Madera Creek is on the USEPA-approved 303(d) List of Water Quality Limited Segments. Corte Madera Creek is tributary to the San Francisco Bay and the San Francisco Bay is also listed on the approved 303(d) list. Table 3.9-4 lists the beneficial uses and impairment status of water bodies in the project area, including the pollutants that cause the impairments. Once a water body is placed on the 303(d) List of Water Quality Limited Segments, it remains on the list until a Total Maximum Daily Load (TMDL) is adopted and the water quality standards are attained or there are sufficient data to demonstrate that water quality standards have been met and delisting should take place.

Corte Madera Creek is impaired for the pesticide diazinon, although this listing may be related to the overall impairment of the San Francisco Bay rather than specific measurements for diazinon within Corte Madera Creek. The SFBRWQCB 2005 plan amendment cites earlier data showing no detectable diazinon (less than 30 nanograms/liter) in water samples from Corte Madera Creek. A TMDL has been approved in the Basin Plan for all urban creeks to address the impairment (SFBRWQCB, 2017). An attainment strategy to achieve the TMDL has identified the sources of diazinon loading in the watershed and specified actions to address them; public participation has been important in setting effective and achievable TMDLs and attainment strategies (Marin County, 2005a; Marin County, 2007b) and will continue to be central to improving water quality.

High coliform bacteria counts have been detected during the winter months in various segments of the creek (Marshall et al. 1994, as cited in (Rich, 2000)). Friends of Corte Madera Creek Watershed (2006) found elevated levels of both E. coli and Enterococcus at several stations within Corte Madera Creek. Although the Friends of Corte Madera Creek Watershed (2006) study found Enterococcus counts to be highly variable, these counts periodically exceeded federal contact recreational criteria. Corte Madera Creek also exhibits high water temperatures. These increased temperatures have been attributed to urbanization of the watershed, specifically the reduction of shaded stream surface area due to loss of riparian vegetation and increased channel width, although less so within Unit 4 (Friends 2008a, in (USACE, 2010). Increased temperatures also have been attributed to low streamflow, caused by groundwater pumping for irrigation, and lack of infiltration, caused by extensive impermeable surfaces. Measured water temperatures in the project area are high beginning in late May and extending through September, ranging from 65 to 75 degrees Fahrenheit (°F) (Rich, 2000), with higher temperatures being recorded within the concrete-lined sections of Corte Madera Creek. These higher temperatures are stressful for migrating salmonids, but thermal refugia may be available to fish either due to the presence of pockets with limited mixing, combined with daily temperature fluctuations, or the presence of deeper pools in areas of the creek which are not concrete-lined (Rich, 2000). Elevated water temperatures may also exacerbate existing problems with algae and aquatic plant growth (Town of Ross 2009, in (USACE, 2010)).

Table 3.9-4 Beneficial Uses and Impairment Status

Water Body	Beneficial Use(s)	Impairment Status	Pollutants
Corte Madera Creek	COMM, COLD, MIGR, RARE, SPWN, WARM, WILD, REC-1, REC-2, NAV	303(d) List, Category 4a - Being addressed with USEPA approved TMDL	Diazinon
Ross Valley Groundwater Basin	Existing - MUN, AGR Potential – PRO, IND		
San Francisco Bay, Central	IND, PRO, COMM, SHELL, EST, MIGR, RARE, SPWN, WILD, REC-1, REC-2, NAV	303(d) List, Category 5	Chlordane, DDT, Dieldrin, Dioxin compounds, Furan compounds, Invasive Species, Mercury, PCBs, PCBs (dioxin-like), Selenium, and Trash
AGR – Agricultural Supply COMM – Commercial and Sport Fishing, COLD – Cold Freshwater Habitat EST - Estuarine Habitat IND - Industrial Service Suppl MIGR - Fish Migration MUN – Municipal and Domestic Supply PRO – Industrial Process Supply		RARE – Preservation of Rare and Endangered Species SHELL – Shellfish Harvesting SPWN – Fish Spawning WARM – Warm Freshwater Habitat WILD – Wildlife Habitat REC-1 – Water Contact Recreation REC-2 – Noncontact Water Recreation NAV – Navigation	

Sources: (SWRCB, 2018), (DWR, 2019), (SFBRWQCB, 2017)

3.9.4 Regulatory Setting

The following laws, statutes, regulations, codes, and policies would apply to the project and are defined as standard conditions for the project.

Federal Regulations

Clean Water Act

Under the Clean Water Act (CWA) of 1977, the U.S. Environmental Protection Agency (USEPA) seeks to restore and maintain the chemical, physical, and biological integrity of the nation's waters by implementing water quality regulations. Multiple sections of the CWA apply to activities near or within surface or ground water.

Section 404 of the CWA authorizes the U.S. Army Corps of Engineers (USACE) to regulate the discharge of dredged or fill material to waters of the U.S., including wetlands (33 U.S.C. Section 1344). The USACE issues site-specific individual or general (i.e., Nationwide) permits for such discharges.

Under Section 401 of the CWA, any applicant for a federal license or permit to conduct any activity that may result in any discharge into navigable waters must provide the licensing or permitting agency with a certification that the discharge would comply with the applicable CWA provisions (33 U.S.C. Section 1341). If a federal permit is required, such as a USACE Section 404 Nationwide Permit for dredge and fill discharges, the Project proponent must also obtain a Section 401 Water Quality Certification from the RWQCB.

Section 402(p) of the CWA regulates discharges to surface waters through the National Pollutant Discharge Elimination System (NPDES) Program, a nationwide surface water discharge permit program for municipal and industrial point sources. In California, NPDES permitting authority is delegated to and administered by the nine RWQCBs. Under Section 402, the SFBRWQCB has set standard conditions for each permittee in the Bay Area, including effluent limitation and monitoring programs. In addition to their responsibility to issue and enforce compliance with NPDES permits, the RWQCBs are responsible for preparation and revision of the relevant regional Water Quality Control Plan, also known as the Basin Plan (discussed further under State regulations).

Section 303(d) of the CWA requires that each State identify water bodies or segments of water bodies that are "impaired" (i.e., do not meet one or more of the water quality standards established by the State, even after point sources of pollution have been equipped with the minimum required levels of pollution control technology). USEPA must approve the 303(d) List before it is considered final. Inclusion of a water body on the Section 303(d) List of Impaired Water Bodies triggers development of a TMDL for that water body and a plan to control the associated pollutant/stressor on the list. The TMDL is the maximum amount of a pollutant/stressor that a water body can assimilate and still meet the water quality standards. Typically, a TMDL is the sum of the allowable loads of a single pollutant from all contributing point and nonpoint sources. The Basin Plan is amended to legally establish the TMDL and to specify regulatory compliance, including specification of waste load allocations for entities that have permitted discharges.

Federal Antidegradation Policy

The federal Antidegradation Policy, established in 1968 under Section 303 of the Clean Water Act, is designed to protect existing uses and water quality and national water resources. Implementation of antidegradation by the states is based on a set of procedures to be followed when evaluating activities that may impact the quality of the waters of the U.S. Antidegradation implementation is an integral component of a comprehensive approach to protecting and enhancing water quality of both surface water and groundwater.

Rivers and Harbors Act of 1899

The Rivers and Harbors Act of 1899, as amended and codified in 33 U.S.C. Section 408 provides that USACE may grant permission for another party to alter a Civil Works project upon a determination that the alteration proposed will not be injurious to the public interest and will not impair the usefulness of the Civil Works project.

National Flood Insurance Program

The FEMA determines flood elevations and floodplain boundaries based on USACE studies. FEMA also distributes the flood insurance rate maps used in the NFIP. These maps identify the locations of special flood hazard areas, including 100-year floodplains. Federal regulations governing development in a floodplain are set forth in Title 44, Part 60 of the Code of Federal Regulations. Those regulations enable FEMA to require municipalities participating in the NFIP to adopt certain flood hazard reduction standards for construction and development in 100-year floodplains. These standards are included below in Local Regulations.

The NFIP sometimes further divides the one percent annual chance floodplain on a river into a floodway and floodway fringe (FEMA, 2016). The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights (FEMA, 2016). The area between the floodway and the 100-year floodplain boundaries is termed the floodway fringe, which encompasses the portion of the floodplain that could be completely obstructed without increasing the water surface elevation (WSE) of the 100-year flood by more than 1 foot at any point (FEMA, 2016).

Pursuant to 44 CFR 60.3(d)(3), encroachments including fill, new construction, substantial improvements, and other development within the adopted regulatory floodway are prohibited unless it has been demonstrated through hydrologic and hydraulic analyses that the encroachment would not result in any increase in flood levels. FEMA requires revisions to the Flood Insurance Rate Maps for encroachments into the floodway that cause base flood elevations to increase within the floodway. An application for a conditional letter of map revision must be filed with the Federal Insurance Administrator consistent with FEMA guidelines prior to floodway encroachment.

State Regulations

Porter-Cologne Water Quality Control Act

The State of California's Porter-Cologne Water Quality Control Act provides the basis for water quality regulation within California and assigns primary responsibility for the protection and enhancement of water quality to the California State Water Resources Control Board (SWRCB) and the nine RWQCBs. Under the Porter-Cologne Act, the SWRCB and RWQCBs also have the responsibility of granting CWA NPDES permits and Waste Discharge Requirements (WDRs) for certain point-source and non-point discharges to waters. The Porter-Cologne Act allows the SWRCB to adopt statewide Water Quality Control Plans and Basin Water Quality Control Plans, which serve as the legal, technical, and programmatic basis of water quality regulation statewide or for a particular region. The water quality control plans limit impacts on water quality from a variety of sources. The Basin Plan for the San Francisco Bay and the relevant permits are described below.

San Francisco Bay Water Quality Control Plan (Basin Plan)

San Francisco Bay waters are under the jurisdiction of the SFBRWQCB, which established regulatory standards and objectives for water quality in the Bay in the Water Quality Control Plan for the San Francisco Bay Basin, commonly referred to as the Basin Plan. The Basin Plan identifies existing and potential beneficial uses for surface and ground waters and provides numerical and narrative water quality objectives designed to protect those uses. The preparation and adoption of water quality control plans is required by the California Water Code (Section 13240) and supported by the federal CWA. Because beneficial uses, together with their corresponding water quality objectives, can be defined pursuant to federal regulations as water quality standards, the Basin Plan is a regulatory reference for meeting the state and federal requirements for water quality control. Adoption or revision of surface water standards is subject to the approval of the USEPA.

NPDES General Permit and Waste Discharge Requirements for Stormwater Discharges from Small Municipal Separate Storm Sewer Systems (Order No. 2013-0001-DWQ)

In 2003, the SWRCB required small municipal storm drainage systems, including those in Marin, to be regulated under a statewide NPDES Small Municipal Separate Storm Sewer Systems (MS4s) General Permit. Areas that drain to separate stormwater collection systems, such as those within Marin County, were subject to this permit. The Marin County Stormwater Pollution Prevention Program (MCSTOPPP) Action Plan 2010 is the approved Storm Water Management Plan required under the 2003 MS4 permit. Each municipality complied with the 2003 MS4 permit by implementing Action Plan 2010 through a local stormwater program and through the collaborative efforts of MCSTOPPP (MCSTOPPP, 2013).

On February 5, 2013, the SWRCB adopted the General Permit for Waste Discharge Requirements for Stormwater Discharges from Small Municipal Separate Storm Sewer Systems, Order No. 2013-001-DWQ (2013 MS4 permit; (SWRCB, 2013)). The 2013 MS4 permit modified the 2003 MS4 permit by establishing the storm water management program requirements in the Order and defining the minimum acceptable elements of the municipal storm water management program (SWRCB, 2013). The required program includes specific elements related to program management, education and outreach on stormwater impacts, public involvement/participation, illicit discharge detection and elimination, construction site stormwater runoff and control, pollution prevention/good housekeeping for permittee operations, post-construction stormwater management for new development and redevelopment, water quality monitoring requirements, program effectiveness assessment, and annual reporting. For renewal permittees such as Marin County, Fairfax, Ross, and San Anselmo, the guidance document must identify and describe Best Management Practices (BMPs) included in their previous Stormwater Management Plan that may be more protective of water quality than the minimum requirements of the updated permit, and identify whether the permittee proposes to maintain, reduce, or cease implementation of the BMPs.

NPDES General Permit for Discharges of Stormwater Associated with Construction Activities

The Construction General Permit (Order 2009-0009-DWQ, NPDES No. CAS000002; as amended by Orders 2010-0014-DWQ and 2012-006-DWQ) regulates discharges of pollutants in stormwater associated with construction activity to waters of the U.S. from construction sites that disturb 1.0 or more acres of land surface, or that are part of a common plan of development or sale that disturbs more than one acre of land surface. The permit regulates stormwater discharges associated with construction or demolition activities, such as clearing and excavation; construction of buildings; and linear underground projects, including installation of water pipelines and other utility lines. This General Permit requires that storm water discharges and authorized non-storm water discharges must not contain pollutants that cause or contribute to an exceedance of any applicable water quality objective or water quality standards (identified in the Basin Plan).

The Construction General Permit requires the development and implementation of a Stormwater Pollution Prevention Plan (SWPPP) that includes specific BMPs designed to prevent sediment and pollutants from contacting stormwater as well as non-storm water, and from moving offsite into receiving waters. The BMPs fall into several categories, including erosion control, sediment control, waste management and good housekeeping/site management practices. Routine inspection of all BMPs is required under the provisions of the Construction General Permit. In addition, the SWPPP is required to contain a visual monitoring program, a chemical monitoring program for non-visible pollutants, and a sediment monitoring plan if the site discharges directly to a water body listed on the 303(d) list for sediment.

Receiving water risk is based on whether the project drains to a sediment-sensitive water body. A sediment-sensitive water body is one that appears on the most recent 303(d) list for water bodies as impaired for sediment, has a USEPA-approved TMDL implementation plan for sediment, or has the beneficial uses of cold freshwater habitat, fish migration, and fish spawning. As shown in Table 3.9-4, while none of the water bodies near or downstream of the project sites are listed as impaired for sediment or have a TMDL implementation plan for sediment, Corte Madera Creek has the beneficial uses of cold freshwater habitat, fish migration, and fish spawning and thus would be considered a sediment-sensitive water body under the Construction General Permit.

Examples of typical construction BMPs include scheduling or limiting certain activities to dry periods, installing sediment barriers such as silt fence and fiber rolls, and maintaining equipment and vehicles used for construction. Non-stormwater management measures include installing specific discharge controls during certain activities, such as paving operations, vehicle and equipment washing and fueling. The Construction General Permit also sets post-construction standards (i.e., implementation of BMPs to reduce pollutants in stormwater discharges from the site following construction).

In addition to stormwater discharges, the Construction General Permit also covers other non-stormwater discharges including irrigation of vegetative erosion control measures, water to control dust, uncontaminated ground water from dewatering, and other discharges not subject to a separate general NPDES permit adopted by the Regional Water Board. The discharge of non-storm water is authorized under the following conditions:

1. The discharge does not cause or contribute to a violation of any water quality standard;
2. The discharge does not violate any other provision of the General Permit;
3. The discharge is not prohibited by the applicable Basin Plan;
4. The discharger has included and implemented specific BMPs required by the General Permit to prevent or reduce the contact of the non-storm water discharge with construction materials or equipment.
5. The discharge does not contain toxic constituents in toxic amounts or (other) significant quantities of pollutants;
6. The discharge is monitored and meets the applicable NALs; and
7. The discharger reports the sampling information in the Annual Report.

In the project area, the Construction General Permit is implemented and enforced by the San Francisco Bay RWQCB, which administers the stormwater permitting program. Dischargers are required to electronically submit a notice of intent (NOI) and permit registration documents (PRDs) in order to obtain coverage under this Construction General Permit. Dischargers are responsible for notifying the RWQCB of violations or incidents of non-compliance, as well as for submitting annual reports identifying deficiencies of the BMPs and how the deficiencies were corrected. The risk assessment and SWPPP must be prepared by a state Qualified SWPPP Developer and implementation of the SWPPP must be overseen by a state Qualified SWPPP Practitioner. A Legally Responsible Person, who is legally authorized to sign and certify PRDs, is responsible for obtaining coverage under the permit.

Waste Discharge Requirements and Water Quality Certification for Stream Maintenance Program

The Flood Control District has an existing Water Quality Certification (Clean Water Act Section 401) and Waste Discharge Requirements issued by the RWQCB to permit actions associated with its Stream Maintenance Program (SMP; SMP; Order No. R2-2017-0028). The

SMP addresses actions necessary to continue providing flood protection and to maintain channel conveyance capacity while enhancing natural resources within subject streams. The routine management actions covered by this permit include sediment management, vegetation management, bank stabilization, and associated actions. This permit is renewed every 5 years, most recently in 2017. The details of the permit's terms and conditions come largely from the Marin County Stream Maintenance Program Manual, which can be revised as needed (subject to RWQCB approval) to add new streams or new activities. The five categories of maintenance actions covered are (1) vegetation management, (2) sediment and debris removal, (3) erosion control, (4) maintenance and repair of flood control structures, and (5) levee maintenance. These activities can occur in flood control channels, natural channels, and other facilities on an as-needed basis.

The permit includes certain limits on the extents of channels and the volumes of material that can be addressed in a given year. Those limits are as follows:

1. Maximum length of maintenance within a concrete engineered flood control channels is 2,800 contiguous linear feet;
2. Maximum length of maintenance within an earthen engineered flood control channel is 800 contiguous linear feet;
3. Maximum length of maintenance within a natural channel is 600 contiguous linear feet;
4. Maximum volume of debris or sediment removed from any site is 2,100 cubic yards.

These activities may not exceed a program wide cumulative annual total of 5,000 linear feet of creek channel and 11,000 cubic yards of sediment and debris. Over the Order's 5-year term, these activities may not exceed a program wide cumulative total of 25,000 linear feet and 55,000 cubic yards of sediment and debris. Exceptions to these limits may be approved by the RWQCB on a case-by-case basis.

Lake and Streambed Alternation Agreement for Routine Maintenance Activities
The District has an existing Lake and Streambed Alteration Agreement issued by CDFW under California Fish and Game Code Section 1602. This agreement/permit covers several categories of actions that are implemented regularly for ongoing flood control purposes. These activities are (1) vegetation management, (2) sediment and debris removal, (3) erosion control, (4) maintenance and repair of flood control structures, and (5) levee maintenance. Under this permit, the District develops an annual work plan for the necessary activities and submits it to CDFW with follow-up reporting on those activities actually performed. This permit is renewed every 5 years, most recently in 2016.

Regional and Local Regulations

Marin County Stormwater Pollution Prevention Program (MCSTOPPP)
In 1993 MCSTOPPP was created to prevent stormwater pollution, protect and enhance water quality in creeks and wetlands, preserve beneficial uses of local waterways, and comply with

State and federal regulations governing water quality. MCSTOPPP is composed of unincorporated Marin County, the Cities of Belvedere, Larkspur, Mill Valley, Novato, San Rafael, and Sausalito and the Towns of Corte Madera, Fairfax, Ross, San Anselmo, and Tiburon. The County's local stormwater program is responsible for implementing MCSTOPPP. The local stormwater program is administered by the Department of Public Works / County Flood Control Division staff in cooperation with the Community Development Agency, Environmental Health Services, and Parks and Open Space (Marin County, 2007b). Each MCSTOPPP member agency implements a local stormwater pollution prevention program and funds the countywide MCSTOPPP, which provide for the coordination and consistency of approaches between the local stormwater programs.

MCSTOPPP acts as a separate implementing entity to meet 2013 MS4 permit obligations on behalf of all the municipalities and the County. Under the 2013 MS4 permit, the participating municipalities must implement best management practices for operations and maintenance activities, implement stormwater pollution prevention plans at corporation yards, document the amounts of litter removed, and provide an adequate number of litter receptacles in commercial and other litter source areas. Permit requirements are implemented by the County and staff from municipalities. Permit requirements also include operations and maintenance best management practices that municipalities apply to their own operations, public education and staff training, water quality monitoring, stormwater control ordinances, construction site controls, postconstruction stormwater program, TMDL compliance tasks, and annual reporting (Marin County, 2020a). Marin County and the Town of Ross have adopted local stormwater runoff pollution prevention ordinances, as described below, which include BMPs that would apply to the project.

Marin Countywide Plan
The following goals and policies in the Marin Countywide Plan are relevant to the project (Marin County, 2007a).

Water Resources
Goal WR-1: Healthy Watersheds. Achieve and maintain proper ecological functioning of watersheds, including sediment transport, groundwater recharge and filtration, biological processes, and natural flood mitigation, while ensuring high-quality water.

Goal WR-2: Clean Water. Ensure that surface and groundwater supplies are sufficiently unpolluted to support local natural communities, the health of the human population, and the viability of agriculture and other commercial uses.

> ***Policy WR-2.3 Avoid Erosion and Sedimentation***. Minimize soil erosion and discharge of sediments into surface runoff, drainage systems, and water bodies. Continue to require grading plans that address avoidance of soil erosion and on-site sediment retention. Require developments to include on-site facilities for the retention of sediments, and, if necessary, require continued monitoring and maintenance of these facilities upon project completion.

> *Implementing Program: WR-2.b Integrate Bay Area Stormwater Management Agencies Association (BASMAA) Stormwater Quality Protection Guidelines into Permitting Requirements for All Development and Construction Activities*. All projects should integrate stormwater pollution prevention design features for water quality protection to the extent feasible, such as those included in the BASMAA Start-at-the-Source manual and the Tools Handbook.

The above-listed goals, policies, and implementing programs are implemented in the Marin County Code Chapter on Stormwater Pollution Prevention, discussed further below.

Marin County Code
In accordance with federal and state regulations, Marin County has adopted water quality standards applicable to areas within unincorporated Marin County.

Marin County Code Chapter 23.18, Stormwater Runoff Pollution Prevention
The intent of the chapter is to protect and enhance the water quality of Marin County's watercourses, water bodies and wetlands in a manner pursuant to and consistent with the Clean Water Act, the Porter-Cologne Water Quality Control Act (California Water Code Section 13000 et seq.), and the Phase II Small Municipal Separate Storm Sewer System (MS4) NPDES Permit, Water Quality Order No. 2013-0001-DWQ, General Permit No. CAS000004 (phase II stormwater permit) and subsequent revisions and amendments thereto.

The discharge of material other than stormwater to a county storm drain is prohibited. All discharges of material other than stormwater must be in compliance with a NPDES permit issued for the discharge. (Section 28.18.061) Any person engaged in activities which will or may result in pollutants entering a county storm drain shall undertake all practicable measures to cease such activities and/or eliminate or reduce such pollutants. Such activities include, but are not limited to, ownership, operation and/or use of parking lots, gasoline stations, industrial facilities, commercial facilities, construction activities, and stores. However, some discharges that could be generated during construction, such as uncontaminated pumped groundwater, diverted stream flows, and flows from riparian habitats and wetlands are exempt from this discharge prohibition provided any pollutants in the discharges are identified and appropriate control measures to minimize the impacts of such discharges are developed and implemented.

In particular, Section 28.18.093 of the County Code requires implementation of construction-phase best management practices designed to protect water quality as follows:

> Any person performing construction activities in the county shall implement appropriate BMPs to prevent the discharge of construction wastes, including soil or sediment, or contaminants from construction materials, tools and equipment from entering a county storm drain, watercourse, bay or ocean. In addition:
>
> 1. Construction-phase BMPs include erosion and sediment controls and pollution prevention practices. Erosion control BMPs may include, but are not limited to, scheduling and timing of grading (soil disturbing) activities,

timely revegetation of graded areas, the use of hydroseed and hydraulic mulches, and installation of erosion control blankets. Sediment control may include properly sized detention basins, dams, or filters to reduce entry of suspended sediment into the storm drain system and watercourses, and installation of construction entrances to prevent tracking of sediment onto adjacent streets. Pollution prevention practices may include designated washout areas or facilities, control of trash and recycled materials, covering of materials stored onsite, and proper location of and maintenance of temporary sanitary facilities. The combination of BMPs used, and their execution in the field, must be customized to the site using up-to-date standards and practices. The agency will provide references to current guidance manuals and BMP information on request.

2. Erosion and sediment control plan requirements.
   a. An erosion and sediment control plan (ESCP) shall be required for:
      i. Any project subject to a grading permit under Chapter 23.08, Excavating, Grading and Filling.
      ii. Any project subject to a building permit or other permit issued by the County that the agency determines has the potential for significant erosion and/or significant non-stormwater discharges of sediment and/or construction site waste.
   b. The ESCP shall comply with County Code Section 24.04.625 and shall include information required in the most recent version of the MCSTOPPP ESCP applicant package.

In addition, Section 23.18.095 of the County Code requires watercourse protection as follows:

> Every person owning, occupying, leasing, renting, or in control of the premises through which a watercourse passes shall: (A) keep and maintain that part of the watercourse within the property reasonably free of trash, debris, excessive vegetation, and other obstacles which would and/or could pollute or contaminate the flow of water through the watercourse; (B) maintain existing privately owned structures within or adjacent to a watercourse, so that such structures will not become a hazard to the use, function or physical integrity of the watercourse; and (C) not remove healthy native bank vegetation beyond that actually necessary for said maintenance, nor remove any vegetation in such a manner as to increase the vulnerability of the watercourse to erosion. No person shall commit or cause to be committed any of the following acts, unless a written permit has first been obtained from the agency:
>
> 1. Discharge into a watercourse;
> 2. Modify the natural flow of water in a watercourse;
> 3. Deposit in or remove any material from a watercourse, including its banks, except as required for necessary maintenance;

4. Construct, alter, enlarge, connect to, change or remove any structure in a watercourse; or
5. Place any loose or unconsolidated material within a watercourse or so close to the side so as to cause a probability of such material being carried away by storm waters.

Town of Ross General Plan

The following policies of the Ross General Plan related to hydrology and water quality are applicable to the project (Town of Ross, 2007).

Goal 1. An Abundance of Green and Healthy Natural Systems

1.1 Protection of Environmental Resources. Protect environmental resources, such as hillsides, ridgelines, creeks, drainage ways, trees and tree groves, threatened and endangered species habitat, riparian vegetation, cultural places, and other resources. These resources are unique in the planning area because of their scarcity, scientific value, aesthetic quality and cultural significance.

Goal 2. Sustainable Building and Community Practices.

2.2 Incorporation of Resource Conservation Measures. To the extent consistent with other design considerations, public and private projects should be designed to be efficient and innovative in their use of materials, site construction, and water irrigation standards for new landscaping to minimize resource consumption, including energy and water.

Goal 6. Protecting Creek Habitat and Reducing Flooding Hazards

6.2 Flood Control Improvements. The Town supports the construction of flood control improvements consistent with the natural environment, the design character of the Town of Ross and the safety and protection of persons and property.

6.3 Ross Valley Flood and Watershed Protection. The Town will work with other jurisdictions within the Ross Valley watershed to develop a comprehensive approach to flood protection and resource preservation strategies.

6.4 Runoff and Drainage. Stormwater runoff should be maintained in its natural path. Water should not be concentrated and flow onto adjacent property. Instead, runoff should be directed toward storm drains or, preferably to other areas where it can be retained, detained, and/or absorbed into the ground.

6.5 Permeable Surfaces. To the greatest extent possible, development should use permeable surfaces and other techniques to minimize runoff into underground drain systems and to allow water to percolate into the ground. Landscaped areas should be designed to provide potential runoff absorption and infiltration.

Town of Ross Municipal Code

The following policies of the Ross Municipal Code related to hydrology and water quality are applicable to the project (Town of Ross, 2020).

> **6.12.040 General--Storage and disposal.** It is unlawful for any person to keep, deposit, bury, burn or dispose of any solid waste, except as in this chapter is provided, in or upon any private property, public street, alley, sidewalk, gutter, park or upon the banks of or within any stream or creek in said town, or in or upon any of the waters thereof. Therefore, it is the intent of the town that every person residing or conducting business in this town shall dispose of solid waste only in the manner provided in this chapter. Nothing in this chapter shall prevent an owner and/or occupant of a residential or commercial premise from making occasional disposals at an authorized disposal site in addition to their regular weekly service, from utilizing a temporary debris box service, or from utilizing an employee or independent contractor to occasionally haul construction and/or demolition debris or for other occasional clean-up purposes consistent with Section 6.12.250. (Ord. 526 §1(part), 1994) (Town of Ross, 1994).

> **9.28.110 Refuse, trash and litter**. It is unlawful for any person to dump, deposit, or leave any bottles, broken glass, ashes, paper, boxes, cans, dirt, rubbish, waste, garbage, or refuse, or other trash. No such refuse or trash shall be placed in any waters in or contiguous to any park or recreation area, or left anywhere on the grounds thereof, but shall be placed in proper receptables provided for such purpose. Where receptacles are not so provided, all such refuse or trash shall be carried away from the park or recreation area by the person responsible for its presence, and properly disposed of elsewhere. (Ord. 266 §2 (part), 1967: prior code §4710) (Town of Ross, n.d.)

> **13.12.170 Pollution of water channels.** It is hereby declared to be a nuisance, and it is unlawful for any person to dump, put or place in, or on, or allow to run into, or on, any public reservoir, or the bank, border or margin, or into any water pipe, aqueduct, canal, stream, water, watercourse, or waterway within the town, any animal, vegetable, or mineral substance, or to do, perform or commit any act or thing which will pollute the purity and wholesomeness of any water or watercourse. (Ord. 496 §1(part), 1991) (Town of Ross, 1991).

> **13.16.010 Purpose**. The free and unobstructed flow of each and every creek, channel or watercourse in the town is essential to the proper drainage of the town and to the protection of life and property therein. Any weeds, trees, bushes, shrubs, brush, undergrowth, debris, or rubbish of any character or description which, at any time, interferes with the free and unobstructed flow of water in any creek, channel or watercourse constitutes a public nuisance and is subject to summary abatement, and/or abatement in accordance with Chapter 9.04. (Ord. 309 §2(part), 1970) (Town of Ross, 1970).

3.9.5 Impact Assessment Methodology

Significance Criteria

Consistent with State CEQA Guidelines Appendix G (Environmental Checklist), the project would have a significant impact if it would:

a. Violate any water quality standards or waste discharge requirements or otherwise substantially degrade surface or ground water quality;
b. Substantially decrease groundwater supplies or interfere substantially with groundwater recharge such that the project may impede sustainable groundwater management of the basin;
c. Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river or through the addition of impervious surfaces, in a manner which would:
   i. result in substantial erosion or siltation on- or off-site;
   ii. substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or offsite;
   iii. create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff; or
   iv. impede or redirect flood flows;
d. In flood hazard, tsunami, or seiche zones, risk release of pollutants due to project inundation; or
e. Conflict with or obstruct implementation of a water quality control plan or sustainable groundwater management plan.

Given the nature of the project, impacts are analyzed in this section relative to the following additional threshold:

f. Expose people or property to flooding hazards

Approach to Impact Analysis

Overview

The following analysis discusses the potential impacts of the project related to changes in hydrology and water quality or other hydrology-related impacts in the project area. This section includes an analysis of potential short-term (construction) and long-term (operational) impacts of the project. Impact evaluations are assessed based on the existing conditions described earlier in this section. Mitigation measures are specified, as necessary, to reduce significant impacts.

Hydraulic Modeling

The floodplain analysis was completed based on the Ross Valley 1D/2D Unsteady-State Hydraulic Model (“Ross Valley Model” or “the model”) jointly developed and calibrated by USACE and Stetson Engineers Inc. in 2017 and used in the previous USACE led EIR/EIS process for the Corte Madera Creek Flood Risk Management Project (USACE 2018). The floodplain analysis is designed to analyze creek hydraulic and floodplain overland flow due to creek overtopping.

The Ross Valley Model was developed in USACE HEC-RAS v5.0 modeling software, by upgrading and merging two separate and previously developed models: the Lower Corte Madera Creek Model and the Upper Corte Madera Creek Model. The model was calibrated and verified by first calibrating to observed and recorded streamflow conditions from the December 15, 2016 bankfull event by adjusting the in-channel parameters that were used in setting up the model. The model was then calibrated to observed streamflows from the December 31, 2005 flood event by adjusting the floodplain parameters in the model. The model was also verified by comparing modelled results to actual flow conditions during the January 4, 1982 flood event. Calibration consisted of adjusting channel Manning's 'n', lateral weir flow coefficients, inline structure weir flow coefficients, or bridge/culvert modeling methods, all within reasonable ranges as specified in the HEC-RAS user's manual, until the model calculated WSEs matched the observed HWMs. The measured depths of sedimentation in the lower Unit 3 and Unit 2 concrete-lined channel were incorporated into the hydraulic modeling analysis as existing condition (USACE 2018).

Hydraulic models solve universally-accepted mathematical equations to simulate surface water movement across approximated topographic terrain. The solutions are approximations because a model cannot precisely quantify the spatially variable properties that exist in the real world. A reliable hydraulic model is one that can produce field-measured water levels and flow within an acceptable range of error. Error exists because information on the real-world system is always incomplete, and the field information that is available has associated errors (for example, measurement error). For all the three model calibration/verification events (i.e., December 15, 2016, December 31, 2005, and January 4, 1982), the differences between the model-simulated peak WSEs and the observed high water marks were well within the FEMA-required 0.5-foot range for most of the high water marks particularly at locations where high water marks were considered most reliable (see Appendix A of the U.S. Army Corps of Engineers Draft EIS/EIR (USACE, 2018)).

The following six scenarios were modeled:

1. Existing Condition Without Project
2. Existing Condition With Project
3. Future Condition Without Project
4. Future Condition With Project
5. Year 2100 Future Condition Without Project
6. Year 2100 Future Condition With Project

The existing condition without project reflects the current hydraulic conditions of Corte Madera Creek without construction of any planned or approved flood control projects. The existing condition with project reflects the existing condition model with all proposed project elements incorporated. The future condition without project reflects the hydraulic conditions of Corte Madera Creek with implementation of planned and/or approved projects listed in Table 3.9-5.

The future condition without project scenario also includes an intermediate level of sea level rise for 2067, as described below. Both the San Anselmo Flood Risk Reduction Project (projects 1, 3, and 7 in the table below) and Winship Bridge Project (project 8) are expected to be implemented concurrent with construction of the proposed project, as discussed further in Section 4.3 Cumulative Impacts. The remaining projects in Table 3.9-5 are anticipated to be implemented within 5 years. The future condition with project reflects the future condition model with all proposed project elements incorporated into the model. The approach to incorporating the project components into the model is described below. The Year 2100 future condition without project scenario includes all projects included in the future condition without project scenario and incorporates the CNRA predicted long-term sea level rise for year 2100. The future Year 2100 future condition with project scenario adds the proposed project elements to the Year 2100 future condition without project scenario.

Table 3.9-5 Projects Included in Future Condition Scenarios

No.	Project	Type	River/Creek	River Station (feet)
1	Sunnyside Nursery Site	New Detention Basin	Fairfax Creek	105+10
2	Azalea Avenue Bridge	Bridge Replacement	Fairfax Creek	22+30
3	Building Bridge #2	Bridge Removal	Corte Madera Creek	434+52
4	Madrone Avenue Bridge	Bridge Replacement	Corte Madera Creek	449+49
5	Nokomis Avenue Bridge	Bridge Replacement	Corte Madera Creek	454+77
6	Sycamore Avenue/Center Boulevard Bridge	Bridge Replacement	Corte Madera Creek	440+05
7	Bridge Avenue Bridge	Bridge Replacement	Corte Madera Creek	438+00
8	Winship Avenue Bridge	Bridge Replacement	Corte Madera Creek	405+38

Sources: (USACE, 2018)

The existing condition without project and future condition without project scenarios were based on the Ross Valley Model developed in 2017. The existing condition with project, future condition with project, and Year 2100 future condition with project scenarios are developed as a part of this EIR analysis, based on the Ross Valley Model, with several revisions made specifically to the project components. The revisions include channel geometry updates to reflect the proposed project analyzed in the EIR, selection of hydraulic roughness, and updates to the Manning's 'n' factor to reflect the Frederick Allen Park floodplain improvements. The following adjustments were made to the model to reflect the post-project conditions:

- Unit 4
  - Cross section geometries were adjusted to reflect the proposed Unit 4 design concept, between Corte Madera Creek Stations 37051 and 36970
- Unit 3

- Removal of the existing fish ladder inline structure and associated model cross sections
- Cross section geometry adjustments to the cross sections representing the Frederick Allen Park project component concept design
- Updated cross section Manning's "n" values along Frederick Allen Park project component to represent natural channel bottom and creek banks
- Floodwall added along the left and right bank of Allen Park. The top of floodwall elevations were adjusted to a height of 1 foot above the 25-year design event WSE
- Floodwall added on left bank adjacent to Granton Park, between Stations 35700 and 34500. The top of floodwall elevations were adjusted to a height of 1 foot above the 25-year design event WSE
- Floodwall added to the left bank downstream of the College Avenue Bridge, between Stations 33476 and 32500. The top of floodwall elevations were adjusted to a height of 1 foot above the 25-year design event WSE
- Short floodwall added on left overbank area upstream of College Avenue Bridge
- Manning's "n" roughness coefficients adjusted in concrete channel to reflect the approximate roughness associated with the proposed fish pools

- Unit 2
  - Cross section geometries were adjusted to reflect the proposed Unit 2 design at the mouth of the concrete channel, between Stations 32291 and 31810

The existing condition without project, existing condition with project, future condition without project, future condition with project, Year 2100 future condition without project, and Year 2100 future condition with project scenarios was modeled for the following three flood recurrence intervals:

1. 10-year
2. 25-year
3. 100-year

Sea Level Rise

Sea level rise projections developed for the future condition without project and future condition with project analysis are based on procedures prescribed by Engineering Regulation (ER) 1100-2-8162, Incorporating Sea Level Change in Civil Works Programs (USACE, 2013). The geographically closest and most suitable NOAA tide gage for establishing relative sea level change (SLC) trends for the project area is the San Francisco, CA, NOAA tide gage, Station ID: 9414290. The San Francisco tide gage has a 110-year period of record and has been referenced to NAVD88. The USACE Sea-Level Change Curve Calculator's intermediate sea level change of about 1 foot (from 1992, the last NTDE, to 2067) was used in modeling of the future without project and future with project conditions. With the mean higher-high water level of 6.65 feet at the San Francisco Gage, the estimated coastal water level in 2067 is 7.65 feet (USACE 2018). An additional sea level rise scenario is included in the impact analysis to evaluate future conditions in year 2100, with projected sea level rise based on the 2018 Update of the State of California Sea-Level Rise Guidance (CNRA 2018), under the high emission likely scenario. The estimated coastal water level at 2100 is 10.05 feet. Additional information on how sea level rise was incorporated into the future condition modeling can be found in Appendix A of the U.S. Army Corps of Engineers Draft EIS/EIR (USACE, 2018)).

Erosion and Sediment Deposition

Impacts to sediment transport and potential resulting sedimentation or erosion were analyzed by evaluating changes in velocity, channel material, and channel cross-sectional area. Increases in velocity when "with project" scenarios are compared to "without project" scenarios, could indicate an increase in sediment transport capability as well as increased potential for scour or erosion, while potential future decreases in velocities relative to current conditions could facilitate sediment deposition and decrease the potential for erosion and scour.

Channel materials vary in terms of susceptibility to erosion, with earthen material being much less resistant than concrete. For earthen streambanks and the streambed, clay dominated sediment or soils tends to be more cohesive and less erosive than sand dominated sediment, but these sensitivities to erosion are also influenced by local site conditions as well as the hydraulic forces during streamflow. For earthen stream surfaces, the presence of vegetation or erosion controls can provide some protection to lessen the risk or effect of erosion. Changes and transitions in channel cross-sectional areas can influence sediment transport in alluvial channels (non-bedrock channels built into sediment that the creek formerly deposited). For the same discharge volume, a larger cross-sectional area results in lower streamflow velocity and potentially a more depositional environment and conversely a smaller cross-sectional area with the same discharge rate results in higher streamflow velocity and potentially a more erosive environment. In a transition where the channel widens, velocities lessen, and the tendency is for that transition to be more depositional. However, sometimes local eddy effects can create localized sideboard scour at the streambanks immediately downstream of the transition to a wider channel. Conversely, in a transition to a narrower channel, velocities will typically increase and the reach downstream of the narrowing transition can be more erosive or incisional.

Impact Analysis Methods

For this impact analysis baseline conditions and potential impacts were based on conditions at the time the Notice of Preparation (NOP) was published (August 2020). Impacts were also evaluated for future conditions that reflect sea level rise of 1 foot and implementation of the projects in Table 3.9-5 as described above. The approach to use of both an existing condition and future condition analysis is consistent with CEQA Guidelines Section 15125(a)(1). The future condition baseline is provided because the use of the existing conditions baseline at the time of the NOP alone would be misleading in that it does not include information for upstream projects that have been planned or approved and would be constructed in the near future (see Table 3.9-5) and sea level rise, which has been raised as a concern in public comments. These future projects would affect the baseline hydraulic conditions of Corte Madera Creek at the time or shortly after the proposed project becomes operational because the planned or approved future projects are located upstream on Corte Madera Creek and will affect the hydrology of Corte Madera Creeks as the planned and approved upstream projects have been designed to provide flood risk reduction to communities upstream of the project area. Sea level rise will affect the limits of high tide within Corte Madera Creek in the project area, which changes the future hydrologic conditions of the creek within the project area.

The impact analysis for floodplain inundation due to creek overtopping considers both the changes in velocity and WSE at the 10-year, 25-year, and 100-year recurrence interval under the existing conditions, and future conditions when the planned and approved upstream flood control projects have been constructed. The future condition scenario also addresses sea level rise as noted above. Because sea level rise will result in changes to the future environmental conditions that affects the hydraulic conditions in Corte Madera Creek, sea level rise has been incorporated into the future condition assessment to support the evaluation of project impacts on that future condition. Additional information on sea level rise can be found on the preceding page and in Appendix A of the U.S. Army Corps of Engineers Draft EIS/EIR (USACE, 2018).

Given limitations in model precision as discussed under hydraulic modeling above, a threshold of 0.2 feet (2.4 inches) was used for determining whether there was a potentially significant increase or decrease in WSE in the impact discussion below. The 0.2-foot threshold is a reasonable level of precision for evaluating flooding impacts considering the standards for accuracy and precision associated with a hydraulic model like the one used to evaluate the proposed project. During the project design process, the hydraulic model will be refined and updated to improve the accuracy in predicting the change in WSE.

3.9.6 Impact Discussion

Impacts Avoided

Due to the nature of the project, potential impacts to the criteria described below would not occur; therefore, further impact discussion is not provided as described below:

1. **Criterion (b):** The project would not utilize groundwater or generate an increase in impervious surfaces. Much of the channel in the project area is concrete allowing for little to no infiltration. The project may provide a slight increase in groundwater infiltration; however, the effect would be nominal since flows would likely be conveyed through the concrete portion of the channel most of the year and soils would already be saturated during flood events when the floodplain was activated.

Impact Analyzed

Impact 3.9-1: The project could violate water quality standards or waste discharge requirements or otherwise substantially degrade surface or ground water quality; or result in discharge of pollutants into surface or ground waters or other alteration of surface or ground water quality (e.g., temperature, dissolved oxygen or turbidity).	Significance Determination
	Construction: Less than Significant with Mitigation
	Operation and Maintenance: Less than Significant with Mitigation

Construction

Unit 4 Channel Improvements and Fish Ladder Removal (Town of Ross)

The proposed work in Unit 4 extends from approximately 150 feet upstream of the Lagunitas Road Bridge to Unit 3 at Frederick Allen Park. The improvements include the removal of the existing fish ladder, grading within the channel and banks to increase hydraulic capacity and transition to the Allen Park improvements, and channel stabilization measures including planted rock, vegetated soil lifts, erosion control fabric, and engineered streambed material directly upstream of the removed fish ladder. Concrete will be installed at the transition to Unit 3. The improvements also include riprap and short cast-in-place concrete walls adjacent to existing concrete walls to reinforce those walls.

Removal of the fish ladder and grading the channel and banks would expose loose sediment and soils to precipitation, overland flows, and stream flows. The use of construction equipment in the channel has the potential for accidental release of petrochemicals and lubricants that could later spread following precipitation runoff or stream flows.

During construction, Unit 4 will be dewatered using a temporary diversion system to divert flows via pipe to the channel downstream of the work area (Appendix D). Channel stabilization measures including planted rock, vegetated soil lifts, erosion control fabric, engineered streambed material, concrete retaining walls, and a concrete apron where the fish ladder will be removed will be implemented to stabilize sediment and soils and help to prevent undesired erosion and sediment transport.

Compliance with the Construction General Permit, including preparation and implementation of the SWPPP and associated BMPs as well as inspection and reporting, would effectively reduce degradation of surface water quality to a less-than significant level. Adherence to these requirements would also effectively reduce potential impacts associated with spills or leaks of hazardous materials and stormwater quality during construction. Thus, construction of this element would not violate any water quality standards or waste discharge requirements or otherwise substantially degrade surface or ground water quality. The impact would be less than significant.

Unit 3 Frederick Allen Park

The Frederick Allen Park improvements include removing the existing concrete-lined flood control channel, constructing new retaining walls adjacent to the transition from Unit 4, 2-foot-tall concrete flood walls on top of both banks, and excavating and grading the channel, streambanks, and floodplain to widen the channel and create a natural floodplain. The improvements also include revegetating the area with riparian species and new landscaping (see planting plans in Appendix B), realigning Bike Route 20 within the park, and creating new pedestrian access to the creek. The floodwalls are anticipated to be cast-in-place free-standing walls.

Removal of the concrete channel and excavation, tree removal, and grading within the channel and existing park would expose loose sediment and soils to precipitation, overland flows, and stream flows. The use of construction equipment in the channel has the potential to cause an accidental release of hazard materials that could later spread following precipitation, runoff, or stream flows.

During construction, upper Unit 3 will be dewatered from the location of the existing fish ladder to the Kentfield Hospital Bridge (freshwater reach of Corte Madera Creek). Slope and channel stabilization measures including planted trees and shrubs, erosion control fabric, seeding, willow stakes, planted rock, retaining walls, concrete, and engineered streambed material will be installed to stabilize sediment and soils and help to prevent undesired erosion and sediment transport. Paving of the relocated Bike Route 20 multi-use pathway will also stabilize exposed soil in the project area.

Compliance with the Construction General Permit, including preparation and implementation of the SWPPP and associated BMPs as well as inspection and reporting, would effectively reduce the potential degradation of surface water quality to a less-than significant level. Adherence to these requirements would also effectively reduce potential impacts associated with spills or leaks of hazardous materials and stormwater quality during construction. Thus, construction of this element would not violate water quality standards or waste discharge requirements or otherwise substantially degrade surface or ground water quality. The impact would be less than significant.

Unit 3 Fish Pools, Granton Park Floodwall and Unit 2 Floodwall, and Stormwater Pump Station

The proposed work within the lower reach of Unit 3 and upper Unit 2 includes the construction or enhancement of up to 12 fish pools within the channel, constructing new 2- to 4-foot-tall floodwalls along the left bank that would either be attached to the existing floodwall or setback from the floodwall at the edge of District property, depending on USACE Section 408 authorization. The USACE may also require removal of trees within 15 feet of the existing floodwall and up to the limits of District property as part of the Section 408 authorization. The USACE has the authority to require removal of trees within 15 feet of the existing floodwall in the absence of the project. The project also includes a stormwater pump station at Laurel Avenue, adjacent to the channel's left bank. Construction of the floodwalls and pump station would temporarily expose loose soil; however, when completed, these structures would cover much of the exposed soil. Remaining disturbed areas would be revegetated to the extent allowed by the USACE. Construction or enhancement of fish pools would involve dewatering and bypass pumping to facilitate construction. Pools would be formed by removing existing concrete, excavating the pool, and installing new concrete to line the pool. Excavated concrete and sediment would be removed from the channel. Although the channel and banks are concrete through this reach, the use of construction equipment has the potential to cause accidental release of hazardous materials in and around the channel and may contaminate soils under the existing concrete channel exposed during pool, floodwall, and stormwater pump station construction.

As mentioned in the elements above, compliance with the Construction General Permit and implementations of the SWPPP and associated BMPs would reduce the potential degradation of surface water quality and potential impacts from construction-related spills or leaks. Therefore, construction of this element would not violate water quality standards or waste discharge requirements or otherwise substantially degrade surface or ground water quality. The impact would be less than significant.

Unit 2 Lower College of Marin Concrete Channel Removal
The ~~l~~Lower College of Marin Project ~~concrete channel removal~~ will involve ~~the~~ removal of portions of the concrete-lined flood control channel walls downstream ~~of~~ from Stadium Way to restore natural creek function and create tidal and wetland habitat. The removal of trees and concrete in this unit will expose sediment and dirt to runoff, stream flows, and tidal action. The use of equipment in the channel and accidental release of hazardous materials has the potential to contaminate soil and sediments that would later spread following precipitation, runoff, or stream and tidal flows.

Much of the exposed area will be revegetated with native vegetation; however, re-exposed channel sediments could be mobilized during tidal flows. The Unit 2 concrete channel removal project area is within the tidal influence of the San Francisco Bay. The Central San Francisco Bay is listed on the 303(d) list for mercury, PCBs, furan compounds, dioxin compounds, pesticides, and other contaminants. Sediments that would be excavated and exposed during construction could potentially be contaminated due to existing known contaminants in the San Francisco Bay, and the construction could result in transport of sediments and associated pollutants into San Francisco Bay. The transport of contaminated sediment to San Francisco Bay would be a significant impact. Soil testing was performed on samples from borings in the Lower College of Marin Project's concrete removal area (Geomorph Design Group, 2020). The soil samples were tested for heavy metals (CAM 17 metals), TPH (gas, diesel, and motor oil), semi-volatile organic compounds and PCBs. No hazardous materials were detected in the samples, and the soil contaminants are within the standard background levels for Marin County. ~~The implementation of **Mitigation Measure 3.9-1: Conduct Soil/Sediment Testing**, would ensure that soil and sediment exposed by the project is tested and any contaminated sediments are removed/immobilized.~~

As mentioned in the analysis of the other project elements construction above, compliance with the Construction General Permit and implementations of the SWPPP and associated BMPs would reduce the potential degradation of surface water quality and potential impacts from construction-related spills or leaks. Therefore, with the implementation of the SWPPP~~,~~ and associated BMPs~~, and Mitigation Measure 3.9-1, construction of~~ the ~~l~~Lower College of Marin concrete channel removal would not violate water quality standards or waste discharge requirements or otherwise substantially degrade surface or ground water quality. The impact would be less than significant ~~with the application of the prescribed mitigation measure~~.

Operation and Maintenance

Maintenance of the proposed project will include routine vegetation management, sediment and debris removal, and annual inspection and maintenance of the floodwalls and structures. Vegetation management would likely occur annually or on an as-needed basis and would not include ground-disturbing activities and would employ hand tools, thus minimizing risks of water quality impacts from spills or equipment leaks in the channel or erosion from disturbed soils. Debris and sediment would be removed from Corte Madera Creek as needed, and the frequency of debris and sediment removal and inspections would be similar to the existing maintenance of the concrete channel. The District's routine maintenance activities on Corte Madera Creek are addressed in the Marin County Flood Control Stream Maintenance Program, which was previously evaluated under CEQA and approved by the District in 2012. Maintenance of the proposed project would be consistent with the activities and impacts addressed in the previously authorized Marin County Flood Control Stream Maintenance Program. The impact discussion below focuses on operational impacts of the project.

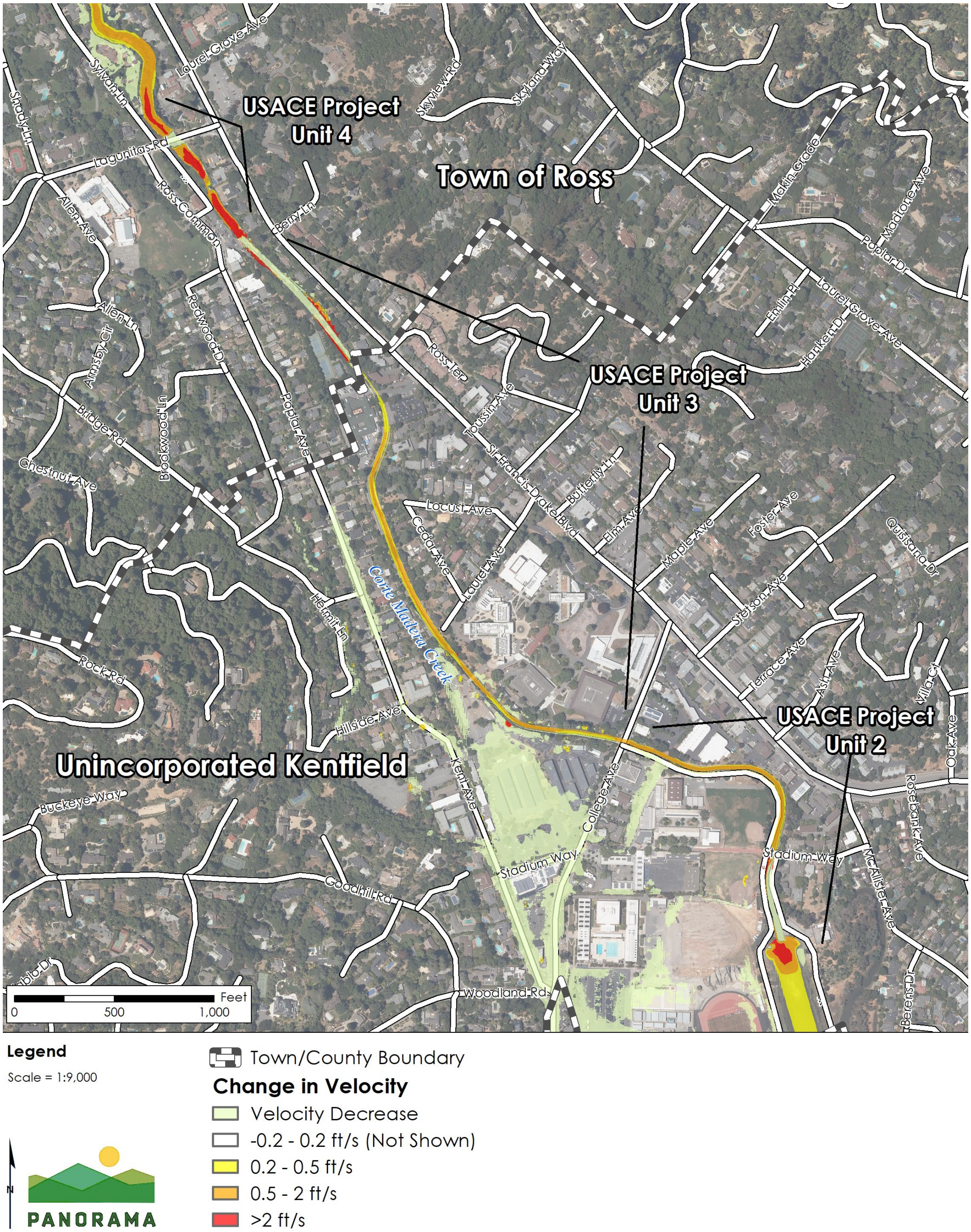
Unit 4

The project change in flow velocity under existing conditions is shown in Attachment E. As shown in Figure 3.9-4 through Figure 3.9-6, the project would increase flow velocities in the channel through most of Unit 4, while decreasing velocities around Lagunitas Road Bridge. Since velocity increases of 2 to 4 feet/second (increase of 20 to 50 percent) would occur throughout much of this unit compared to the no project conditions, the project designs include multiple elements to reduce erosion potential. The area of the removed Denil fish ladder at the transition between Unit 4 and Unit 3 will be stabilized with a concrete apron to prevent erosion and protect the buried Ross Valley Sanitary District pipeline. Segment of the new channel upstream of the removed fish ladder would be widened and provide a smooth grade transition that would support long term channel stability and reduce erosion potential. Site-specific creek-bank toe protection and bank stabilization will be installed in areas determined to be at increased risk of erosion or scour. Creek-toe protection may include a new buried rock keyway, bioengineered stabilization using willows and other native planting, and reinforced concrete wall. Additional as-needed channel stabilization and reinforcement would include installation of erosion-control fabric and engineered streambed material. The improvements would provide long-term streambank stabilization and erosion control in Unit 4. The project would not contribute to violation of water quality standards or result in increased discharge of pollutants during the operational period because long-term sediment control is incorporated into the project design. The impact would be less than significant.

Unit 3 Frederick Allen Park

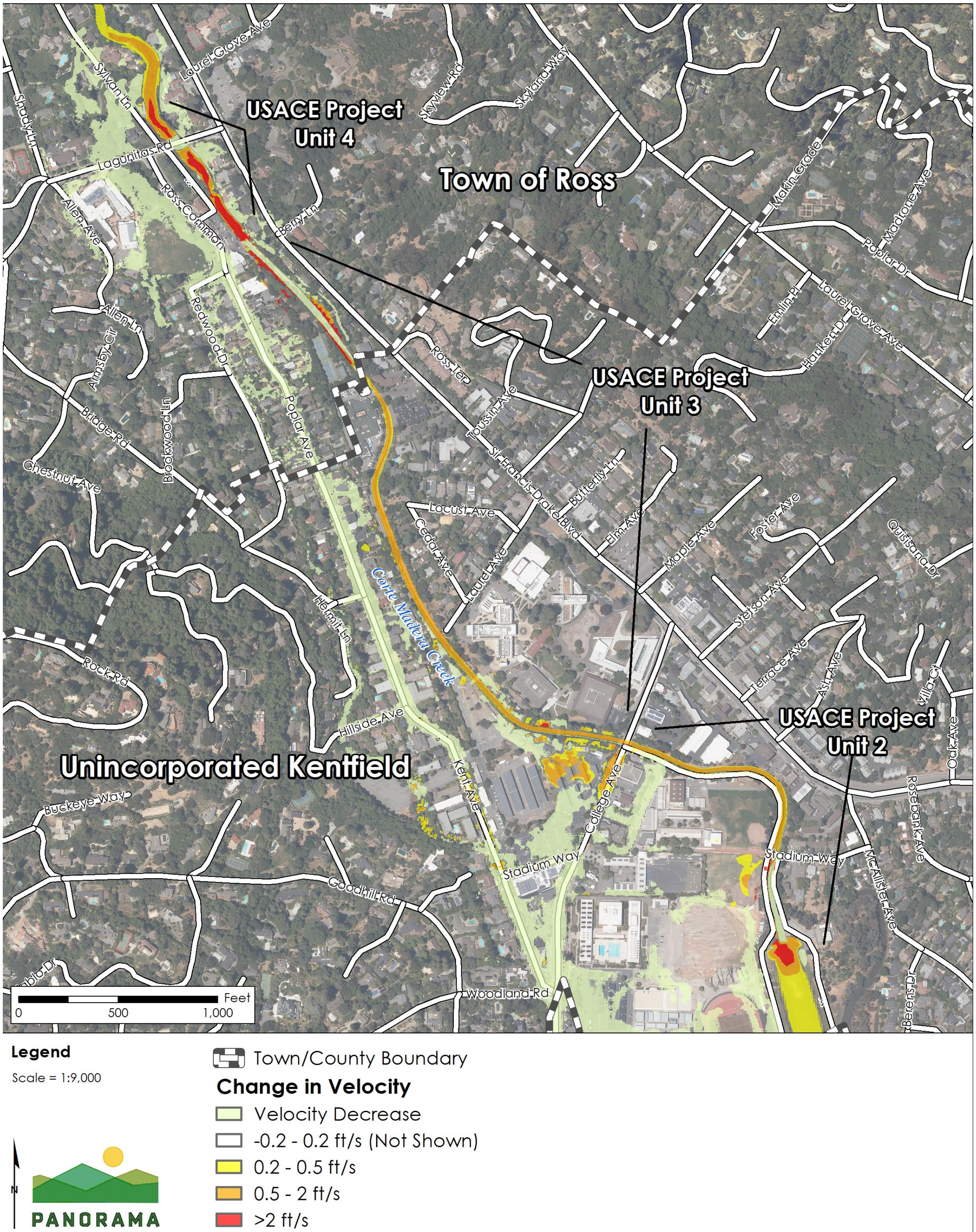
The project design in Frederick Allen Park includes retaining walls and a paved multi-use path to provide permanent soil stabilization within the area. Vegetation would be planted in proximity to the creek and would provide shade for the creek. The increased riparian vegetation and shading of the creek would have a beneficial impact on water quality because the vegetation would provide nutrient retention benefits and the temperature in the natural shaded channel would be less than the existing concrete-lined channel. A split-rail fence would be installed near the multi-use path to prevent encroachment into the habitat areas during the vegetation establishment period. A new access to the creek would be provided from the low point in the multi-use path. The new creek access would allow for pedestrian access only and signs would be placed to educate the public about the habitat and creek and discourage littering and off trail access into habitat areas. The public educational signage and placement of trash receptacles would reduce the risk of water quality impacts from erosion and trash to a less--than-significant level. The removal of the concrete channel, grading of the floodplain and streambanks, and removal of trees in the Frederick Allen Park area will expose soils to overland flows and flood flows, increasing the risk of erosion in the newly disturbed areas. The potential for erosion due to changes in flood elevations and velocities is discussed in further detail in Impact 3.9-2 below, however widening the channel cross-sectional form and constructing instream benches at Frederick Allen Park is anticipated to decrease relative water velocities on vegetated or unarmored slopes, thereby decreasing the risk of erosion to a less-than-significant level. However, soil and sediment erosion could potentially increase turbidity or transportation of pollutants if eroded soils are contaminated. The potential increase in turbidity or transportation of pollutants from soils that could be contaminated is considered a significant impact to downstream water quality. Implementation of Mitigation Measure 3.9-1 would ensure that soil and sediment exposed by the project is tested and any contaminated sediments are removed/immobilized during construction. Therefore, with the implementation of Mitigation Measures 3.9-1 the Frederick Allen Park modifications would not violate water quality standards or waste discharge requirements or otherwise substantially degrade surface or ground water quality. The impact would be less than significant with mitigation.

Figure 3.9-4 Project Changes in Velocity from Future Conditions, 10-Year Flood Event



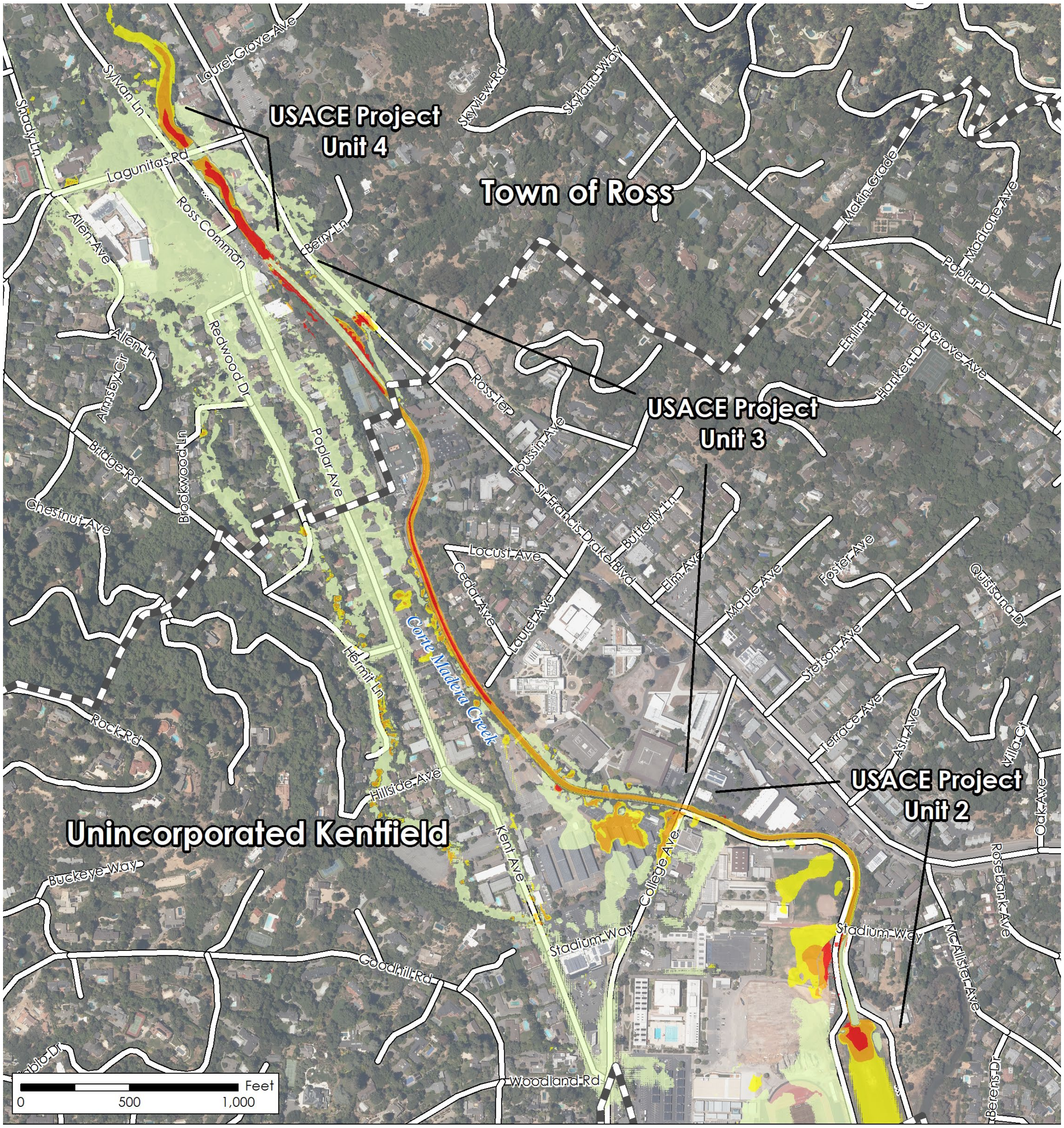
Sources: (US Geological Survey, 2013; U.S. Geological Survey, 2016; Tele Atlas North America, Inc., 2020; Bay Area Open Space Council, 2011; GHD, 2020)

Figure 3.9-5 Project Changes in Velocity from Future Conditions, 25-Year Flood Event



Sources: (US Geological Survey, 2013; U.S. Geological Survey, 2016; Tele Atlas North America, Inc., 2020; Bay Area Open Space Council, 2011; GHD, 2020)

Figure 3.9-6 Project Changes in Velocity from Future Conditions, 100-Year Event



Legend

Scale = 1:9,000

Town/County Boundary

Change in Velocity

- Velocity Decrease
- -0.2 - 0.2 ft/s (Not Shown)
- 0.2 - 0.5 ft/s
- 0.5 - 2 ft/s
- >2 ft/s

Sources: (US Geological Survey, 2013; U.S. Geological Survey, 2016; Tele Atlas North America, Inc., 2020; Bay Area Open Space Council, 2011; GHD, 2020)

Unit 3 Fish Pools, Granton Park Floodwall and Stormwater Pump Station, and Unit 2 College of Marin Floodwall

The Unit 3 fish pools would be lined with concrete to provide the structural integrity needed for the fish pools and the concrete channel and seal the pool from groundwater. The concrete-lined fish pools would not create an increased risk of sedimentation and would have no long-term impact on water quality. The floodwalls in Units 3 and 2 will be concrete and would not be at risk of erosion. The floodwalls in Units 3 and 2 may require permanent tree removal to comply with USACE Section 408 requirements. USACE has the authority to require removal of trees within 15 feet of the existing floodwall. If USACE requires tree removal, the roots and stump of the tree would remain in place and the tree removal would not create a significant source of erosion or other impacts on water quality. The pump station would be stabilized with concrete and gravel and would not cause a significant water quality impact. The impact on water quality would be less than significant.

Unit 2 Lower College of Marin Concrete Channel Removal ~~Corte Madera Creek (Phase 2)~~

The Unit 2 lower College of Marin concrete channel removal and restoration is being designed to be a natural, self-maintaining creek ecosystem, resilient to sea-level rise and climate change. Minimal routine maintenance is anticipated. In the event unforeseen maintenance is required, such as to address storm flow debris, washed up boats, or other man-made debris in the area that affects the natural function of the habitat, the District would conduct maintenance activities consistent with the existing District maintenance program.

Following concrete removal, much of the exposed area will be revegetated with native vegetation. However re-exposed channel sediments along the lower banks and streambed could be mobilized during ~~tidal flows or~~ flood events and tidal conditions, possibly building up fine sediment deposition in the reach that could be mobilized during daily tidal cycles, potentially increasing turbidity and transporting associated pollutants into San Francisco Bay. As discussed above, soil sampling in the Lower College of Marin area concluded that the soils are not hazardous, and the proposed project would not expose contaminated soil and sediment. ~~Implementation of Mitigation Measure 3.9-1 would ensure that soil and sediment exposed by the project is tested and any contaminated sediments are removed/immobilized during construction.~~ In addition, site-specific bank protection will be installed in areas determined to be at increased risk of erosion or scour and creation and enhancement of vegetated tidal habitat would minimize the risk of erosion and increased turbidity to a less than significant level. Therefore, ~~with the implementation of Mitigation Measures 3.9-1,~~ operation and maintenance in this element would not violate any water quality standards or waste discharge requirements or otherwise substantially degrade surface or ground water quality. The impact would be less than significant ~~with mitigation~~.

Mitigation: Implement Mitigation Measure 3.9-1.

Mitigation Measure 3.9-1: Conduct Soil/Sediment Testing. Excavated and exposed soil and sediment at risk of erosion or mobilization will be tested for contaminants of potential concern (COPCs) for concentrations above SFBRWQCB's Environmental

Screening Levels (ESLs) for shallow soils, where groundwater is not a drinking water source, for commercial land use. Additional sampling results shall be compared to the Total Threshold Limit Concentrations (TTLCs) specified in California Code of Regulations (CCR) Title 22 Chapter 11 for hazardous waste identification. Soils will be tested prior to initiation of excavation activities to determine appropriate treatment, storage, and suitability for on-site onsite reuse, landfill disposal, or hazardous waste disposal.

Significance after Mitigation: Mitigation Measures 3.9-1 would reduce the potential impact on water quality to less than significant by requiring testing of soils and sediment at risk of erosion or mobilization and removal or immobilization of any soils found to be over applicable water quality standards.

Impact 3.9-2: The project would not substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river or through the addition of impervious surfaces, in a manner which would: i. result in substantial erosion or siltation on- or off-site; ii. substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or offsite; iii. create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff; or iv. impede or redirect flood flows.	Significance Determination Construction: Less than Significant Operation and Maintenance: Less than Significant

Construction

Erosion and Siltation (i)

In-channel construction would occur during the dry season when creek flows would be lowest. During construction, remaining surface flows would be diverted around areas of active construction, minimizing potential erosion during construction activities.

Immediately following construction dry-season flows would come in contact with the recently graded bed and constructed earthen streambanks in Unit 4 and Frederick Allen Park. However, channel stabilization measures implemented during construction including planted rock, vegetated soil lifts, erosion-control fabric, and engineered streambed material in these units would decrease the risk of erosion immediately following construction to a less than significant level.

The enlarged fish pools in the concrete-lined flood control channel in Unit 3 will be lined with concrete to prevent groundwater infiltration. The fish pools and existing concrete channel would not be subject to erosion or siltation during or immediately following construction because no sediment would be exposed to erosion or siltation.

During construction, Unit 2 will be dewatered using a temporary berm and sheet wall with upstream flows diverted around the work area. Immediately following construction, recently exposed soil and sediment in a portion of the channel will be exposed to dry season flows and tidal influence. Newly exposed earthen banks will be revegetated while, the streambed and intertidal mudflats will remain unvegetated. Given the channel slope, increased cross-sectional channel width, and low elevation relative to sea level, fluvial processes in Unit 2 are anticipated to be depositional as tidal action becomes the primary geomorphic process, similar to existing conditions. The impact would be less than significant.

Runoff and Flood Flows (ii), (iii), (iv)
In-channel construction would occur during the dry season when creek flows would be lowest. Therefore, construction of the project would not result in substantial changes in runoff. Temporary dewatering and diversion activities would be finished prior to wet season flows and would not impede or redirect flood flows. Therefore, construction of the project would not substantially alter the existing drainage pattern of the area in a manner that would result in substantial water quality or hydrological impacts. The impact would be less than significant.

Operation and Maintenance
Erosion or Siltation (i)
The project would alter flow velocities along much of the channel during high flow events as shown in Figure 3.9-4 through Figure 3.9-6. Increased flow velocities could potentially increase erosion in creek sections lacking streambank or bed protection or where existing channel protection is removed. As such, project designs include toe protection and scour protection in areas identified as potentially at risk of erosion.

As mentioned in Impact 3.9-1, the project would increase flow velocities in the channel through most of Unit 4, while decreasing velocities around Lagunitas Road Bridge. Since velocity increases of 2 to 4 feet/second (increase of 20 to 50 percent) throughout much of this unit, project designs include multiple elements to increase bank and bed stability and reduce erosion potential due to increases in streamflow velocity.

In the Frederick Allen Park portion of Unit 3, velocity decreases of 3 to 8 feet/second (increase of 20 to 50 percent) would occur due to the much wider channel cross section and increased roughness. Given the change from concrete to earthen channel here, this decrease in flow velocity is anticipated to be proportionate to the reduced channel sheer strength and neutral in respect to sediment transport conditions within the Frederick Allen Park portion of Unit 3.

In the downstream portion of Unit 3, flow velocities would generally increase slightly by 0 to 2 feet/second (increase of 0 to 20 percent). Since this portion of Unit 3 is a concrete channel, these increases would not increase the potential for erosion, and sediment deposition rates would be unaffected or decrease as compared to existing conditions in this portion of the creek. Similarly, the upstream portion of Unit 2, which is also a concrete channel, would experience slight increases in velocity (0.5 to 0.75 feet/second, equivalent increase of 5 to 10 percent) with little change in erosion or siltation potential.

In Unit 2 downstream of Stadium Way, streamflow velocity would decrease resulting from the expanded cross-sectional area of the channel, while improved flood containment would increase streamflow volume, by keeping flows that previously would have gone overbank now in the channel, resulting in greater instream flows. This increase in streamflow volume translates in the hydraulic model as an increase in flow velocity at the transition from the existing concrete channel to an earthen channel, as shown on Figure 3.9-4 through Figure 3.9-6. However, since tidal processes are the primary hydrological driver in this reach, actual flow dynamics in the lower portion of Unit 2 are anticipated to be comparable to existing conditions. In addition, the proposed project design gradually expands the channel cross-sectional from 32 feet to 180 feet (approximate) over a distance of 625 linear feet (approximate) as compared to existing conditions where the channel expands from 32 feet to 180 feet over 85 linear feet (approximate). This elongated, more gradual increase in channel width would lower the potential for eddying and subsequent bank erosion at the point of expansion. Considering the tidal flow regime, low gradient channel slope, and increased channel cross-sectional area, the erosion or siltation potential in the lower portion of Unit 2 is anticipated to be comparable to existing conditions during project operation. The impact on erosion and siltation would be beneficial and less than significant.

Surface Runoff and Stormwater Drainage (ii) and (iii)

The project involves removal of concrete in Frederick Allen Park and at lower College of Marin in Unit 2. The removal of impervious surfaces and replacement with riparian and marsh habitat would reduce surface runoff and have a beneficial effect by reducing runoff. The project includes installation of a stormwater pump station that would have a beneficial effect on the stormwater drainage system. The project would not generate substantial additional sources of polluted run-off as discussed in Impact 3.9-1 above. The impact would be beneficial and less than significant.

Impede or Redirect Flood Flows (iv)

The project involves modification to the USACE constructed concrete-lined flood control channel and installation of a stormwater pump station and floodwalls to redirect flood flows into Corte Madera Creek and reduce flooding in residential areas. The changes in WSE in the areas surrounding the project are shown in Figure 3.9-7 through Figure 3.9-9. In general, the project will decrease flooding in portions of Ross and Kentfield, while leading to slight increases in flood elevations in small areas around the College of Marin, specifically the College of Marin parking lot. Flood inundation would not occur in any areas not already inundated during the 100-year event.

The Frederick Allen Park project component would also increase the conveyance capacity of the channel by removing the current channel constriction at the Denil fish ladder. Thus, while the project would redirect flood flows from residential areas to Corte Madera Creek, the impact from redirection of flood flows from residential areas to the creek channel would be beneficial and the impact would be less than significant.

Mitigation: None required.

Impact 3.9-3: The project would not risk release of pollutants as a result of project inundation due to tsunami	Significance Determination
	Construction: Less than Significant
	Operation and Maintenance: Less than Significant

Construction

The Unit 2 concrete channel removal area is in a designated tsunami inundation area, as shown on Figure 3.9-3. Construction activities would occur within the tsunami inundation area during concrete removal, channel grading, and habitat enhancement activities. In-channel construction would occur over a six-week period from September 1 to October 15. However, it is extremely unlikely that a tsunami would affect the project area during the six-week construction period for several reasons. Tsunamis rarely affect California with only 76 recorded events over a 200-year period (1812-2012) with a wave height exceeding 1 meter (CDOC 2021). Tsunamis cannot originate from San Francisco Bay as regional faults are transform (horizontal) faults that do not cause the displacement necessary to result in a tsunami. The effects of tsunamis originating in the Pacific Ocean are significantly dampened by regional topography, specifically the 1-mile-wide constriction at the Golden Gate, the Tiburon Peninsula, and Angel Island. In addition, the project does not increase the potential to cause a tsunami nor increase the wave amplitude if one occurred. Therefore, the risk release of pollutants as a result of project inundation due to tsunami would be less than significant.

Operation and Maintenance

Unit 2 is subject to daily tidal inundated by the San Francisco Bay. The project has been designed to address inundation from tides, sea level rise, and flooding due to large rain events. None of the project elements will introduce pollutants to the area that could be mobilized during operation as a result of inundation due to a tsunami. Potential impacts due to tsunami would be less than significant.

Mitigation: None required.

Impact 3.9-4: The project would not conflict with or obstruct implementation of a water quality control plan or sustainable groundwater management plan.	Significance Determination
	Construction: Less than Significant
	Operation and Maintenance: Less than Significant

Water Quality Control Plan

The San Francisco Bay Plan lists multiple beneficial uses for Corte Madera Creek, the Ross Valley Groundwater Basin, and the Central San Francisco Bay (Table 3.9-4). As described above, the project would not significantly affect groundwater and would therefore not affect the groundwater basin's beneficial uses. The removal of the concrete flood control channel and creation of a channel with natural substrate and riparian vegetation in Frederick Allen Park, removal of the Denil fish ladder, construction of larger fish resting pools, and creation of saltwater marsh in Unit 2 would have a beneficial effect for uses relating to noncontact recreation, fish migration and habitat, and preservation of rare and endangered species. The project would not significantly affect uses related to water contact recreation, navigation, industrial service or process supply, or shellfish harvesting as compared to existing conditions. Table 3.9-6 below, contains additional detail on project impacts on beneficial uses. The impact would be less than significant.

Sustainable Groundwater Management Plan

The SGMA Basin Prioritization process designated the Ross Valley Groundwater Basin as a very low priority, therefore the project is not in an area subject to a sustainable groundwater management plan (DWR, 2019). The project would have no impact on implementation of a sustainable groundwater management plan.

Mitigation: None required.

Table 3.9-6 Project Impacts on Beneficial Uses

Beneficial Use	Waterbody	Project Impacts
Agricultural Supply	Ross Valley Groundwater Basin	**No impact.**
Municipal and Domestic Supply	Ross Valley Groundwater Basin	**No impact.**
Industrial Service Supply	SF Bay – Central, Ross Valley Groundwater Basin (Potential)	**No impact.**
Industrial Process Supply	SF Bay – Central, Ross Valley Groundwater Basin (Potential)	**No impact.**
Commercial and Sport Fishing	Corte Madera Creek, SF Bay – Central	**Beneficial.** The project improves instream migration and habitat for steelhead.
Shellfish Harvesting	SF Bay – Central	**No impact.**
Cold Freshwater Habitat	Corte Madera Creek	**Beneficial.** The project improves upstream and downstream migration and creates new rearing habitat suitable for salmonids.
Estuarine Habitat	SF Bay – Central	**Beneficial.** The Project creates 0.6 acre of new salt marsh habitat.
Fish Migration	Corte Madera Creek, SF Bay – Central	**Beneficial.** Removing the defunct fish ladder, reducing the channel slope, adding and enhancing fish pools, and removing the concrete in portions of Unit 2 and 3 improve upstream and downstream migration and rearing habitat for salmonids.
Preservation of Rare and Endangered Species	Corte Madera Creek, SF Bay – Central	**Beneficial.** The project improves instream habitat and migration for listed salmonids. Creation of salt marsh habitat in Unit 2 increases suitable habitat for California Ridgway's rail and salt marsh harvest mouse.

Beneficial Use	Waterbody	Project Impacts
Fish Spawning	Corte Madera Creek, SF Bay – Central	**No impact.** The project area lacks spawning habitat.
Warm Freshwater Habitat	Corte Madera Creek	**Beneficial.** The project improves bank stability and decreases erosion potential in Unit 4 and creates higher value riparian habitat within Frederick Allen Park.
Wildlife Habitat	Corte Madera Creek, SF Bay – Central	**Beneficial.** The project creates 0.6 acre of new tidal and wetland habitats and 0.8 acre of new riparian and upland transitional habitats in Unit 2 and creates higher value riparian habitat within Frederick Allen Park.
Water Contact Recreation	Corte Madera Creek, SF Bay – Central	**No impact.**
Noncontact Water Recreation	Corte Madera Creek, SF Bay – Central	**Beneficial.** Noncontact forms of water recreation (walking, sightseeing, wildlife watching and aesthetic enjoyment) are improved by replacing concrete portions of the channel and increasing riparian and wetland habitats within Fredrick Allen Park and in portions of Unit 2.
Navigation	Corte Madera Creek, SF Bay – Central	**No impact.**

Sources: (SFBRWQCB, 2017)

Impact 3.9-5: The project would not expose people or property to flooding hazards	Significance Determination
	Construction: Less than Significant
	Operation and Maintenance: Less than Significant

Construction

In-channel construction would occur during the dry season when anticipated creek flows would be lowest. In addition, a diversion and dewatering system would be implemented to facilitate construction within the channel. Therefore, construction of the project would not result in the exposure of people or property to water related hazards. The impact would be less than significant.

Operation and Maintenance

Overview

The project will reduce flooding within the Town of Ross and in unincorporated Kentfield. The effectiveness of the project in reducing flood hazards was evaluated through hydraulic modeling under the 10-year (10 percent probability in any given year), 25-year (4 percent probability in any given year), and 100-year (1 percent probability in any given year) flood recurrence intervals. The existing floodway and 100-year flood zone are shown in Figure 3.9-3.

The project impacts are shown graphically as the change in WSE or flood depth that would result from the project during the 10-, 25-, and 100-year flood events. The project impacts on existing flood conditions are presented in Appendix E. The project impacts on future conditions are presented in Figure 3.9-7 through Figure 3.9-9. The model-predicted flood inundation depths are shown for the 10-year, 25-year, and 100-year events for the existing condition without project, existing condition with project, future condition without project, and future condition with project scenarios in Appendix E. Areas shown in the figures as "Flows Confined to Channel" are areas that are predicted to no longer have flood inundation from creek overtopping after the project is completed. Areas shown in the figures with "Flooding Reduced" are areas with significantly reduced flood inundation (greater than 0.2 foot) from creek overtopping after the project is completed. The impacts are described below by condition and area.

Project Impact on Existing Condition and Future Condition

Town of Ross (Unit 4 and Frederick Allen Park)

In Ross, flooding due to creek overtopping would be reduced throughout most of the existing flood inundation areas under the 10--year, 25-year, and 100-year flood scenarios for both existing and future conditions. Substantial reduction in flood elevation would occur along portions of Sylvan Lane, Lagunitas Road, Allen Avenue, Ross Common, Poplar Avenue, and Redwood Drive. The greatest improvements in flooding would be seen under the 10-year and 25-year flood scenarios under both existing and future conditions. In Frederick Allen Park, the graded/lowered areas would see increased flood inundation as those areas would be a part of the widened natural creek corridor for flow conveyance. Section 3.8 Hazards addresses the potential flood hazard within Frederick Allen Park.

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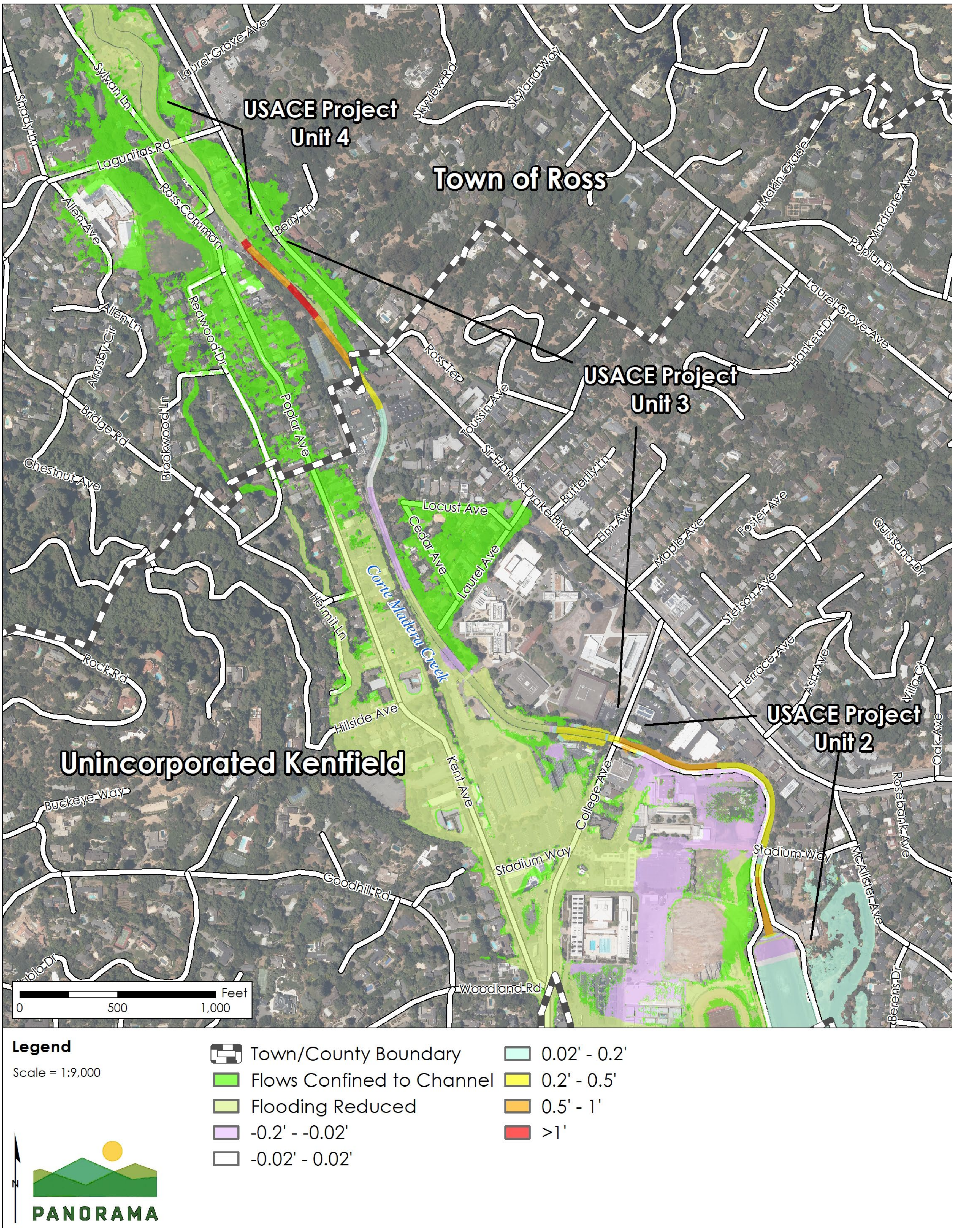
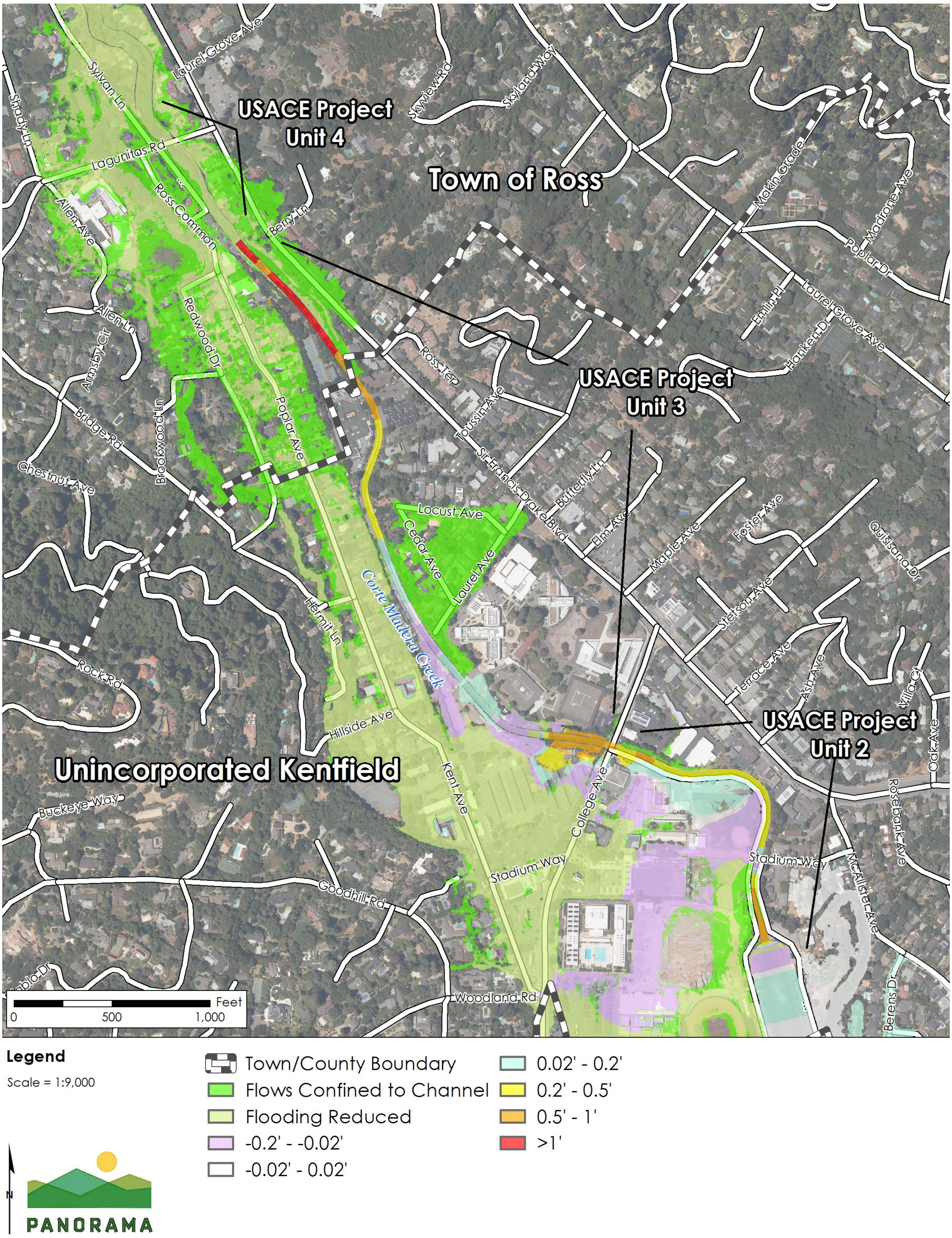
Figure 3.9-7 Project Changes in Water Surface Elevation from Future Conditions, 10-Year Flood Event



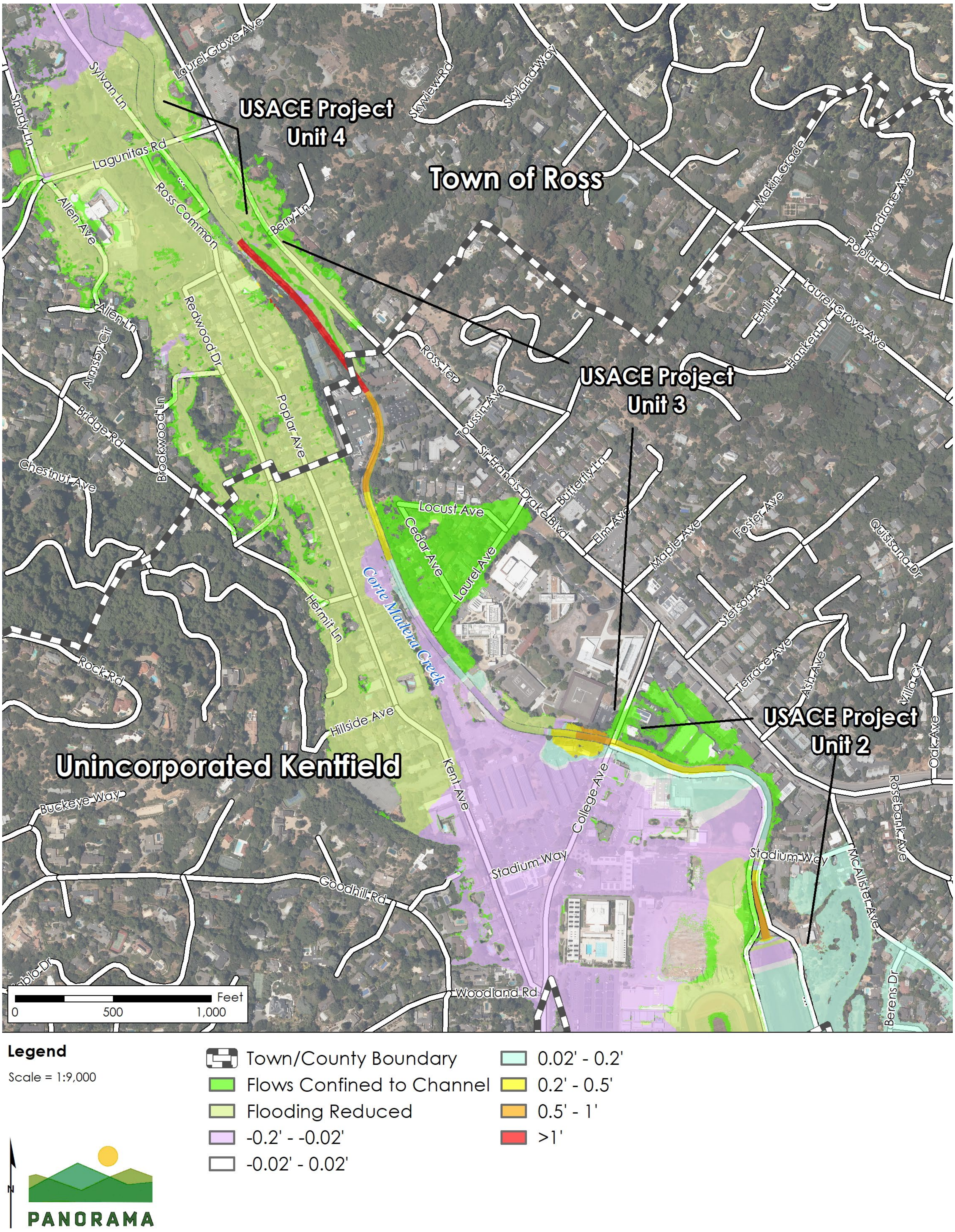
Sources: (US Geological Survey, 2013; U.S. Geological Survey, 2016; Tele Atlas North America, Inc., 2020; Bay Area Open Space Council, 2011; GHD, 2020)

Figure 3.9-8 Project Changes in Water Surface Elevation from Future Conditions, 25-Year Flood Event



Sources: (US Geological Survey, 2013; U.S. Geological Survey, 2016; Tele Atlas North America, Inc., 2020; Bay Area Open Space Council, 2011; GHD, 2020)

Figure 3.9-9 Project Changes in Water Surface Elevation from Future Conditions, 100-Year Flood Event



Sources: (US Geological Survey, 2013; U.S. Geological Survey, 2016; Tele Atlas North America, Inc., 2020; Bay Area Open Space Council, 2011; GHD, 2020)

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Increased flood inundation due to creek overtopping would not occur in the vicinity of Unit 4 in any commercial or residential areas. Operation and maintenance of the project would result in a net reduction of flooded residential and commercial areas and reduced water depth during flooding, thereby reducing the exposure of people and property to water-related hazards. The impact would be beneficial and less than significant.

Unit 3 (Unincorporated Kentfield)
In unincorporated Kentfield, flooding due to creek overtopping would be reduced throughout much of the existing flood inundation areas under the 10-year, 25-year, and 100-year flood scenarios for both existing and future conditions. Substantial reductions in flooding would occur in the Granton Park neighborhood along Cedar Avenue, Locust Avenue, and Laurel Avenue. The new pump station and floodwall will address the creek overtopping issue, and the creek backwater issue to the area's storm drain collection system. Note that localized overland flow may still occur when stormwater runoff in the area exceeds the storm drain pipeline capacity at Cedar Avenue and Laurel Avenue. Reduced flooding would also occur in residential and commercial areas west of Corte Madera Creek. Under the 25-year and 100-year flood scenarios for both existing and future conditions there would be WSE increases of 2 to 6 inches in small areas adjacent to the channel around the College of Marin, the Union Bank parking lot, and A.E. Kent Middle School. These impacts would be limited to parking lots, playgrounds, and elevated trailers. Localized flooding in these areas appears correlated to existing channel structures and existing hydraulic constraints at the College Avenue bridge crossing, and improved flow conveyance in Unit 4 as a result of the Denil fish ladder removal. Additional inundation due to creek overtopping would not occur in any new areas that are not already inundated during the 100-year event. Therefore, operation and maintenance of the project would result in a net reduction of flood areas thereby reducing the exposure of people and property to water related hazards. The impact would be beneficial and less than significant.

Unit 2 and Lower Corte Madera Creek
In Unit 2 and Lower Corte Madera Creek, flooding would be reduced throughout much of the existing flood inundation areas under the 10-year, 25-year, and 100-year flood scenarios for both existing and future conditions. The floodwall is proposed mainly to address potential additional creek overtopping as a result of the project, and its potential flood inundation impacts to the commercial area bounded by College Avenue, Sir Francis Drake Boulevard, and the creek. Additional inundation would not occur in any new areas that are not already inundated during the 100-year event. Increases in WSE of approximately 1 inch and less than 0.2 foot (2.4 inches) are predicted in areas downstream of College Avenue. Change in WSE less than 0.2 foot is less than the model precision and is within the range of model uncertainty as discussed in Section 3.9.5. Because the change in WSE is less than the precision of the current model, the impact is less than significant.

With the proposed project elements, including the floodwall to address potential creek overtopping to the left bank at the downstream of College Avenue, operation and maintenance of the project would result in a net reduction in flooding in the vicinity of Unit 2 and any projected increase in flooding is within the model uncertainty and less than significant. The project would therefore reduce the exposure of people and property to water-related hazards and would not significantly increase flooding hazards. The impact would be beneficial and less than significant.

Summary of Project Benefits

The hydraulic modeling for both existing and future condition with project scenarios show either a reduction of flooding or no significant increase in flooding in areas adjacent to Corte Madera Creek in the Town of Ross or Kentfield, except in isolated, non-sensitive use areas (i.e., parking lots near College Avenue). The number of parcels ~~by area~~ in Ross Valley that would benefit from decreased flooding during a 25-year flood event under existing conditions are summarized in Table 3.9-7 below. The parcels that would benefit from reduced flooding during the 25-year flood event are shown in Figure 3.9-10.

Table 3.9-7 Summary of Project Flood Reduction Benefits, Existing Condition Scenario, 25-Year Event

Jurisdiction/Land Use	Number of ~~Structures~~ Parcels with Reduced Flooding				
	Area No Longer Inundated After Project	1 to 4.5 feet reduction in water surface	0.5 to 1 foot reduction in water surface	0.2 to 0.5 foot reduction in water surface	Total
Kentfield					
Commercial	4			5	9
Institutional	18		3	11	32
Residential	37	19	47	33	136
Kentfield Total	*59*	*19*	*50*	*49*	*177*
Larkspur					
Commercial				1	1
Institutional			2	3	5
Residential				11	11
Larkspur Total			*2*	*15*	*17*
Town of Ross					
Commercial	1	2	8		11
Institutional	3	17	3		23
Residential	2	48	35	14	99
Ross Subtotal	*6*	*67*	*46*	*14*	*133*
Total All Areas	**65**	**86**	**98**	**78**	**327**

[e] The reduction in flooding reflects changes in WSE based on model predictions for the existing hydrologic conditions. Reduction in flooding of less than 0.2 foot is below the model precision and is interpreted as no change in flood elevation.

Sea Level Rise Impacts

As discussed in Section 3.9.5, the future condition without project and future condition with project modeling includes an intermediate level of sea level rise of 1.0 foot. With an intermediate level of sea level rise, the project has broad benefits from reduced flooding in the Town of Ross and Kentfield areas. As presented in Table 3.9-3, there are multiple models of sea level rise and the high estimate of sea level rise exceeds the intermediate sea level rise estimate incorporated in the hydraulic modeling. Additional modeling was conducted to evaluate project impacts with current projections for sea level rise in year 2100 (CNRA 2018). The Year 2100 future condition model which includes a greater level of sea level rise shows that the project would still provide benefits by reducing flood inundation in areas within Ross Valley; however, additional areas would be subject to tidal inundation and the benefits would be less in areas that are subject to tidal inundation/flooding.

The purpose of the project is to reduce flooding on Corte Madera Creek and the project is not intended to address flooding from sea level rise. While the project does not address sea level rise impacts, the project will not exacerbate flooding impacts when sea level rise is considered and would have flood reduction benefits in areas not subject to tidal flooding, including the Town of Ross, as demonstrated by the future condition with project and Year 2100 future condition with project modeling. Separate from this project, the County has conducted a vulnerability assessment for sea level rise (Marin County Department of Public Works, 2017). Since completing the vulnerability assessment, BayWAVE has led efforts to develop a countywide collaboration for adaption, the County has evaluated a nature-based adaptation framework, and developed adaptation land use planning guidance. The County also participates in several regional efforts to plan for climate change resilience and adaptation. The Town of Corte Madera recently developed a Climate Action Plan that addresses sea level rise along the waterfront including wetlands south of Corte Madera Creek. The project supplements and will not conflict with or impact on-going planning efforts to address sea level rise effects.

Mitigation: None required.

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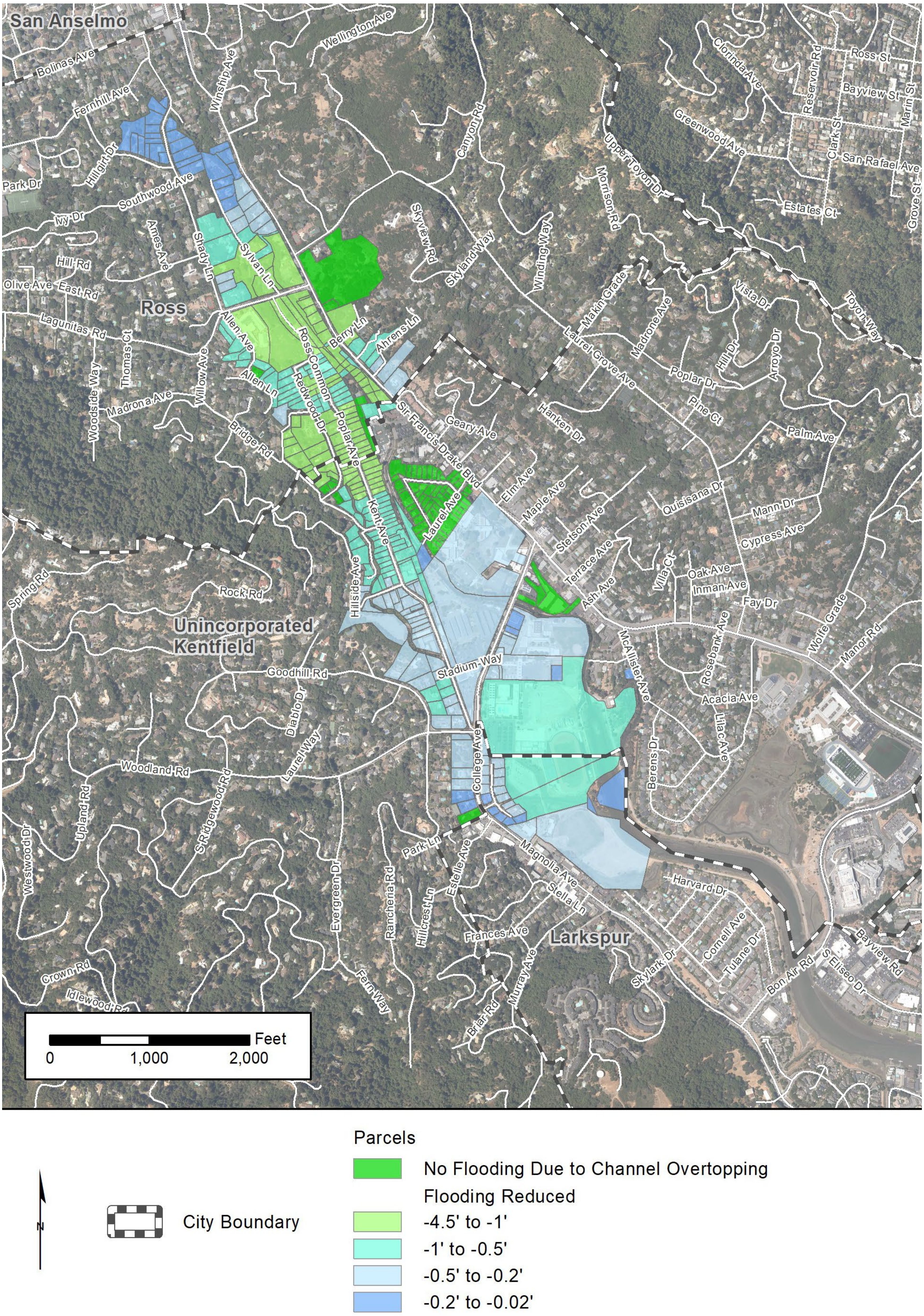
Figure 3.9-10 Reduction in Water Surface Elevation by Parcel, Existing Condition 25-Year Flood Event



Sources: (US Geological Survey, 2013; U.S. Geological Survey, 2016; Tele Atlas North America, Inc., 2020; Bay Area Open Space Council, 2011; GHD, 2020)

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