

APPENDIX N

Biological Assessment/Essential Fish Habitat Assessment

**Corte Madera Creek
Flood Risk Management Project
Biological Assessment/ Essential Fish Habitat
Assessment**



U.S. Army Corps of Engineers
San Francisco District

Marin County Flood Control and
Water Conservation District

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ACRONYMS AND ABBREVIATIONS

%	percent
°F	degrees Fahrenheit
BA	biological assessment
CESA	California Endangered Species Act
CDFW	California Department of Fish and Wildlife
EFH	essential fish habitat
ESA	Endangered Species Act
District	Marin County Flood and Water Conservation District
FR	Federal Register
mL	milliliter
MSFCMA	Magnuson-Stevens Fishery Conservation and Management Act
NMFS	National Oceanic and Atmospheric Administration-National Marine Fisheries Service
RWQCB	Regional Water Quality Control Board
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service

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1 INTRODUCTION

The United States Army Corps of Engineers (USACE), in coordination with the non-federal sponsor, the Marin County Flood and Water Conservation District (District), proposes to construct the Corte Madera Creek Flood Risk Management Project (proposed action or project). The USACE has prepared this biological assessment (BA) and essential fish habitat (EFH) assessment to comply with the requirements of section 7 (50 C.F.R. 402.12) of the federal Endangered Species Act (ESA; 16 U.S.C. §§ 1531 *et seq.*) and EFH regulations (50 C.F.R. §§ 600.905-600.930) pursuant to the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA; 16 U.S.C. §§ 1801 *et seq.*). The proposed flood risk management project is located in the Corte Madera Creek watershed, also known as the Ross Valley watershed, in central-eastern Marin County, California.

This BA/EFH includes an analysis of the proposed project's impacts on ESA-protected salmonids and critical habitat managed by the National Oceanic and Atmospheric Administration-National Marine Fisheries Service (herein after, NMFS), including whether the project would jeopardize the continued existing of these species listed under the federal ESA or adversely affect critical habitat. This document also includes an analysis of the project impacts on EFH managed by the NMFS. The USACE has determined that the species managed by the United States Fish and Wildlife Service (USFWS) are not present in the action area and, therefore, the proposed action would have no effect on USFWS-managed species. United States Fish and Wildlife Service-managed species are not further discussed in this BA.

In addition, the non-federal sponsor may submit this BA/EFH and any federal incidental take statement issued for species protected under both the federal ESA and California Endangered Species Act to the California Department of Fish and Wildlife (CDFW) with a request for consistency determination, pursuant to Fish and Game Code § 2080.1.

1.1 Document Organization

This section provides an overview of the organization of this BA/EFH.

Section 1: Introduction. This section provides an overview of the purpose and organization of this document.

Section 2: Consultation History. This section summarizes the consultation history for the Corte Madera Creek Flood Risk Management Project.

Section 3: Action Area. This section provides a description of the action area.

Section 4: Corte Madera Creek Study Area. This section provides details of the study area within the action area. The discussion is centered on aspects of the study area that are relative to listed salmonids, critical habitat, and essential fish habitat.

Section 5: Proposed Action. This section details the proposed action, including the project description, construction activities and timing, habitat changes resulting from the proposed action, avoidance and minimization measures, and operations and maintenance activities.

Section 6: NMFS Managed Species and Critical Habitat. This section provides an overview of the consultation history with the NMFS, describes species may be affected by the proposed action, details the proposed action's impacts on NMFS-managed species and critical habitat, and cumulative impacts of the action and reasonably foreseeable non-federal actions on NMFS-managed species and critical

habitat. This section also provides the USACE's determination regarding if the proposed action will jeopardize the continued existence of NMFS-managed species or adversely affect critical habitat.

Section 7: Essential Fish Habitat. This section is the EFH assessment for the proposed action.

Section 8: List of Preparers and Reviewers.

Section 9: References.

2 CONSULTATION AND COORINDATION HISTORY

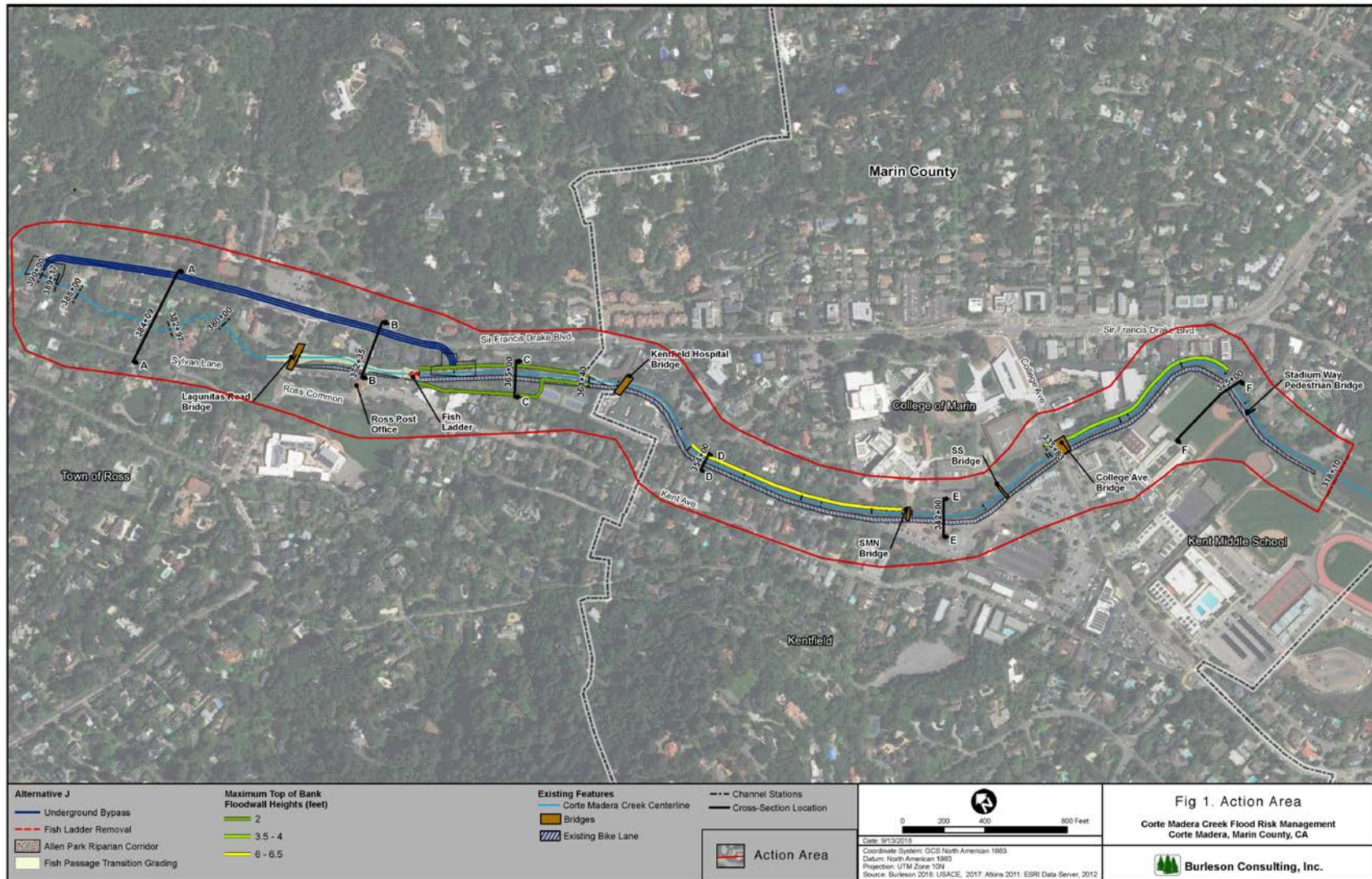
The Corte Madera Flood Risk Management Project has a long history, with the USACE and District making several attempts to complete the project's plan formulation and environmental compliance processes. Throughout the project planning efforts, the USACE and District have continued to engage resources agencies, including the NMFS, to ensure that agency concerns were addressed in the project planning. Specific coordination with the NMFS conducted during the current planning process is summarized below; this includes coordination in 2004, which was discussed in detail during the recent planning process.

- March 19, 2004: The NMFS sent a letter to the USACE (Appendix A) in which they express concern that the "...upper portion of the mile-long concrete channel and fish ladder present a significant barrier to upstream fish passage" and requests that the USACE work with NMFS, CDFW, and the District to address the situation.
- April 7, 2004: The USACE responds to NMFS's letter from March 29, 2004 (Appendix A) stating that completion of the project "...would include improved flow in the concrete channel, a replaced or eliminated "temporary" fish ladder and sediment basin." And that the USACE's next tasks include "design to improve fish passage in the constructed portion of the project and to replace or eliminate the fish ladder."
- October 12, 2016: The USACE held a conference call with NMFS to discuss coordination conducted in 2004. The NMFS cited USACE's letter from April 7, 2004, indicating that assessing fish passage was one of the next tasks, pending additional funds.
- March 29, 2016: The USACE and District held a resource agency workshop which was attended by the NMFS, United States Environmental Protection Agency (USEPA), San Francisco Bay Regional Water Quality Control Board (San Francisco RWQCB), and USFWS. The purpose of the meeting was to present the conceptual alternative plans for addressing flood risk along Corte Madera Creek and to discuss general concerns and conceptual mitigation, minimization, and avoidance measures.
- April 21, May 26, and July 14, 2016 (creek walks): On April 21 and May 26, the USACE, District, and resource agencies walked along Corte Madera Creek to discuss project features and habitat. Agency attendees included the NMFS, San Francisco Bay RWQCB, USFWS, CDFW, and USEPA. The resource agencies were concerned with improving ecological functions of the creek, particularly related to fish habitat and passage, and ensuring that net loss of riparian habitat does not occur. The USACE clarified that the 1944 authorization for this project is single-purpose flood risk management; however, all alternatives do address fish passage. Additionally, participating agencies wanted to ensure the project addresses climate change, including sea level rise. On July 14, 2016, the USACE, local sponsor, and above-mentioned resource agencies walked along Santa Rosa Creek to observe an example of a flood risk management project that incorporated environmental friendly features into the system.

- May 17, 2016: The USACE and District held a meeting with the NMFS and USEPA to discuss the proposed project's feasibility study. During this meeting, the NMFS and USEPA expressed their desire for a comprehensive climate change analysis, specifically related to sea level rise. Other desires included: minimization of riparian habitat loss in Unit 4, improving fish passage in Unit 3 with some renovation of resting pools, and restoration of natural fluvial and geomorphic processes.
- December 7, 2016: The USACE and District met with the NMFS, USEPA, San Francisco RWQCB, USFWS, and CDFW to discuss potential effects of the proposed action on listed fishes and how to mitigate for impacts related to fish passage. During this meeting, NMFS expressed concern that the existing trapezoidal channel has water velocities that are too high and uniform to allow juvenile salmonid life history strategies to effectively be successful in the channel. The NMFS recommended adding restoring resting pools in the lower portion of Unit 3, modifying the configuration and spacing of resting pools in the upper part of Unit 3, and addressing the Denil fish ladder. In addition, the USFWS and NMFS expressed concern regarding removal of riparian vegetation. The NMFS agreed to work with the USFWS such that riparian habitat protection and mitigation was included in the USFWS' Coordination Act Report.
- February 2, 2018: The NMFS sent a letter to USACE (Appendix A) stating that "Corte Madera Creek in Marin County is an important watershed for two species of anadromous salmonids listed under the federal Endangered Species Act of 1973. The watershed currently supports a population of threatened Central California Coast (CCC) steelhead (*Onchorynchus mykiss*) and several streams within the watershed are designated as critical habitat for CCC steelhead and endangered CCC Coho salmon (*Onchorynchus kisutch*)." The letter also stated that the creek is a migration corridor for Coho salmon and the lower reaches are designated essential fish habitat. The NMFS expressed concern that "Unit 3 is largely impassable to adult steelhead, and the NMFS October 2016 Multiple Species recovery Plan identifies the need for Marin County and the Corps to work together to improve fish passage in Corte Madera Creek." A specific concern was that the resting pools in Unit 3 are too shallow to provide adult fish protection from predators and that they only provide resting habitat during half the fish passage design flow range. The letter indicates NMFS support for Alternative F, which includes a proposed riparian park (Frederick S. Allen Park) and a natural stream bed downstream of Unit 4; but, also recommends improving fish passage in Unit 3, given that all spawning habitat is upstream of Unit 3.
- September 11, 2018: The USACE and District held conference call with NMFS, USEPA, and San Francisco Bay RWQCB to discuss migration in Unit 3. During the meetings the USACE and District agreed to pursue a Continuing Authorities Program 1135 project to investigate fish migration improvements related to improving fish resting pools in Unit 3, depending on availability of funds.
- September 21, 2018: An official species list was obtained from the California Species List Tools web page (Appendix B). The species list identified that Central California Coast steelhead (*Onchorynchus mykiss*) and Central California Coast Coho salmonid (*O. kisutch*) may be present in the action area, and that Corte Madera Creek is designated as critical habitat for both species of salmonids.

3 ACTION AREA

The action area is defined as “all areas to be directly or indirectly affected by the federal action and not merely the immediate area involved in the action” (50 C.F.R. § 402.02). The action area covers a portion of Corte Madera Creek and surrounding floodplain that extends from approximately 1,450 feet upstream of Lagunitas Road Bridge to 1,000 feet downstream of College Avenue. Also included within the action area are land parcels 073-161-26 and 073-273-39 and the right-of-way for Sir Francis Drake Boulevard between the parcels and Frederick S. Allen Park. The action area lies within a larger study area that identified Units 1, 2, 3, and 4. Unit 4 starts at the confluence of Ross and San Anselmo creeks where the stream becomes Corte Madera Creek, and continues downstream to the Denil fish ladder. Unit 3 extends from the fish ladder to College Avenue Bridge and Unit 2 extends from College Avenue Bridge to downstream of the action Area. Figure 1 provides a conservative estimate of the extent of the action area overlain on the proposed project.



4 CORTE MADERA CREEK STUDY AREA

The Corte Madera Creek Flood Risk Management Project is within 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 at Mount Tamalpais. Fifty percent of the basin lies below an elevation of 300 feet mean sea level and 90 percent lies below an elevation of 1,000 feet mean sea level.

The larger Corte Madera Creek Flood Control Project was originally authorized under the Flood Control Act of 1944 and reauthorized in 1962. It consisted of six units with a concrete-lined channel extending approximately 6.5 miles from the San Francisco Bay upstream into Fairfax. It was designed to carry all the flow from a standard project flood (approximately 7,500 cubic feet per second [cfs] or a 0.4 percent annual exceedance probability event). Flood control improvements were completed in Units 1, 2, and 3 in 1968, 1969, and 1971, respectively. The Unit 1 and Unit 2 improvements consisted of an earthen trapezoidal channel, extending 3 miles from the Kentfield to the San Francisco Bay. The upper 1,700 feet of Unit 2 were designed and constructed as a rectangular concrete-lined channel. Unit 3 extended the concrete-lined channel 3,500 feet upstream, terminating 600 feet downstream of Lagunitas Road Bridge in the Town of Ross. Unit 4 has not been constructed. The tidal portion of the creek extends several miles upstream from San Francisco Bay to the vicinity of the Kentfield Hospital Bridge in Unit 3.

The proposed action includes completing Unit 4 and modifying Unit 3 and a portion of Unit 2; Unit 1 would not be altered. The proposed project would occur along approximately 1.4 miles (7,490 linear feet) of Corte Madera Creek, from the Sir Francis Drake Boulevard Bridge at the beginning of Unit 4, to the end of the concrete channel in Unit 2. Specifically, the proposed action includes three units of the four-unit creek, including a portion of Unit 2 and all of Units 3 and 4. The four units are described below.

- **Unit 1.** Unit 1 extends approximately 2 miles from Bon Air Bridge to the creek's mouth at San Francisco Bay. Unit 1 is not included in the proposed action. All of Unit 1 is tidal and has an earthen channel.
- **Unit 2.** Unit 2 begins at the College Avenue Bridge and extends approximately 1.33 miles downstream to Bon Air Bridge. A portion of Unit 2 channel bottom is concrete lined, from the College Avenue Bridge to about 450 feet downstream of Stadium Avenue; the remaining portion is an earthen channel. All of Unit 2 is tidally influenced. Only the upper 0.33-mile concrete lined portion of Unit 2 is included in the proposed action.
- **Unit 3.** Unit 3 begins at the Denil fish ladder at the upstream end of the concrete channel and continues for approximately 0.67 mile to the College Avenue Bridge. The upper 1,900 feet of Unit 3 contains 28 small concrete pools placed in the center of the stream spaced about 64 feet apart. These pools were intended to serve as resting pools for salmonids; however, most of the pools fail to reduce flow velocity and provide inadequate cover. Approximately one-third of Unit 3 is tidal, up to the Kentfield Hospital. All of Unit 3 is concrete lined.
- **Unit 4.** Unit 4 starts at the confluence of Ross and San Anselmo creeks where the stream becomes Corte Madera Creek and extends approximately 0.4 mile before terminating at the Denil fish ladder. Unit 4 has a natural channel bottom.

Riverine (concrete lined-channel) habitat in this instance is defined as the USACE Flood Control Channel that extends from the fish ladder downstream to Kent Middle School for about 4,900 feet. The concrete lined portion of the channel has vertical walls and a 33-foot wide concrete streambed with a v-shaped thalweg in the center to concentrate low flows. The channel consists of long, straight sections, several subtle bends, and three tight curves. The upstream 1,900 feet of channel contains 28 pools, evenly spaced at 64 feet that were intended to function as resting pools for migrating steelhead trout and Coho salmon. Each pool is 4 feet long and 13 feet wide with a flat bottom 0.1 feet below the channel invert. Due to the channel invert, the sides of the pools are 1.3 feet below the channel bed (Love 2007). From Unit 3 to the downstream end of the proposed project, the concrete channels restrict establishment of riparian vegetation. Trees remain along the creek outside of the concrete walls, but are often relics of riparian woodland or landscaping trees installed as part of urban development. The riverine vegetation in Units 2 and 3 of the action area is sparse, often weedy and non-native, and provides little quality habitat or shade to the creek.

From the crossing of Sir Francis Drake Boulevard and Corte Madera Creek near the upstream end of Unit 4 downstream to the existing Denil fish ladder, Corte Madera Creek has vegetated banks with a gravel bed bordered by single family residences. Unit 4 has a more natural appearance than Units 2 and 3, characterized by riparian woodland and native material streambed. 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 with an average slope of 0.28 percent. Between the Ross Creek confluence and Lagunitas Road Bridge, the channel is deeply incised 12 to 15 feet below the banks and 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 to vertical where concrete retaining walls are built (PWA 2009b). The channel bed is characterized by 30- to 150-foot-long and 15- to 20-foot-wide lateral scour pool/riffle sequences with average depths ranging from 0.5 to 1.5 feet. Scour pools contain large woody debris, root wads, and substrate composed of small gravel, sand, and silt. The area has abundant shade (A.A. Rich and Associates 2000). The Lagunitas Road Bridge was replaced in 2010 with a higher soffit that has not changed the channel geomorphology.

From the confluence with Ross Creek downstream to a point just upstream of Lagunitas Road Bridge, the stream habitat is characterized by long (30–400 feet) and deep (1.5 feet average depth) lateral scour pool/riffle sequences. This area had more structure (e.g., large wood, root wads) than in downstream areas. This reach is deeply incised throughout with resident-built retaining walls along much of the area. Substrate in pool areas was primarily sand and silt (A.A. Rich 2000) with some gravel and cobble deposited around the Lagunitas Road Bridge (Town of Ross 2009a).

From about 80 feet upstream of the Lagunitas Road Bridge downstream to the existing wooden Denil fish ladder, riverine habitat is characterized by long (80–90 feet), shallow (1 foot average depth) alternating lateral scour pool/riffle sequences. These riffles were very narrow (3 to 8 feet wide) and shallow. Although shade in this area was abundant, the low stream flows, riprap, and wooden retaining walls resulted in fairly stagnant pool areas. Substrate in the pool areas consisted of sand, silt, and organic detritus. In the riffles, small gravel was the predominant substrate (A.A. Rich 2000).

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. The channel bed tapers from approximately 30 feet in width at the bridge to 15 feet 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/riffle sequences; riffles were 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 were extremely shallow. Substrate in the pool areas consists of sand, silt, and organic detritus; in the riffles, small gravel was the predominant substrate (A.A. Rich and Associates 2000).

Within Unit 4, a variety of homeowner-constructed bank stabilization structures occur on the right bank north of the Lagunitas Road Bridge and at various locations on the left bank south of the Lagunitas Road Bridge. These structures include sand and/or concrete bag retaining walls, plank and railroad tie walls, gabion walls, log walls, and concrete current deflectors. The creek continues to provide habitat elements for migratory waterfowl and fish. Lagunitas Road Bridge and the existing Denil fish ladder are located at the downstream end of Unit 4. This ladder and 4-foot-high timber bulkhead grade control structure were installed in 1971 (Fluvial Geomorphology Consulting 2006) to provide fish passage over the bulkhead which protects two sewer lines that cross below the creek just upstream of this location (Love 2007).

The Denil fish ladder, in its current condition, is the primary constriction to the high-water flows that cause extensive overbank flooding along Corte Madera Creek and barrier to fish passage. Bridge constrictions and poorly designed residential streambank stabilization structures have exacerbated flooding on this naturally flood-prone system (Stetson 2006).

Urban/developed habitat includes both landscape vegetation and non-permeable non-vegetated infrastructure that includes buildings, roads, trails, and other infrastructure. Urban/developed describes ornamental plants found in areas of development associated with the Town of Ross Post Office, Town of Ross Police Station, city parks, residential backyards, Kentfield Hospital, and College of Marin. Vegetation associated with landscaping include oleander (*Nerium oleander*), honeysuckle (*Lonicera sp.*), cork oak (*Quercus suber*), rush (*Juncus sp.*), iris (*Iris sp.*), Japanese maple (*Acer sp.*), wisteria (*Wisteria sinensis*), wild plum (*Prunus sp.*), ornamental rose (*Rosa sp.*), and Mexican fan palm (*Washingtonia robusta*). This vegetation is present sporadically along the top of the vertical concrete channel walls, providing some shade to the creek and may serve as limited aquatic food web support.

Sedimentation and Water Quality

Sediment yield from the upper watershed is high due to land use impacts. Natural landslides and earth flows in the upper watershed areas also periodically overwhelm the creeks with large volumes of fine-grained sediment (Stetson 2000).

For Corte Madera Creek, sediment is produced in the steeper, upper watershed areas, and transported to Units 2, 3, and 4. 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, R.R. 2000). Sediment deposition was also detected in the concrete-lined channel downstream of the Kentfield Hospital Bridge (Stetson 2015).

Sedimentation rates in Units 2 and 3 of Corte Madera Creek are high because of the combined influence of low channel slope in the concrete-lined channel and tide tidal influence does not reach into the Unit 4 or the upper portion of Unit 3. Sediment from Corte Madera Creek and San Francisco Bay is conveyed on incoming tides, adding to the sediment load.

Corte Madera Creek has a number of tributaries that flow from open space headwater areas through highly 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 (URS 2009; CCA 2002). The San Francisco Bay RWQCB 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 of Corte Madera Creek 2006). 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 (URS 2009). Erosion originating primarily from headwater areas and, to a lesser extent, creek banks in the towns, result in increased siltation in the creeks (Stetson 2000), which can be harmful to salmonids.

Both Corte Madera Creek and San Francisco Bay are identified by the Clean Water Act Section 303(d) List as impaired waterbodies. 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 in Corte Madera Creek. The San Francisco Bay RWQCB's 2005 Basin Plan amendment cites earlier data showing no detectable diazinon (less than 30 nanograms/liter) in water samples from Corte Madera Creek. The San Francisco Bay RWQCB (2007) approved a total maximum daily load in the Basin Plan for all urban creeks to address diazinon impairment. An attainment strategy to achieve the total maximum daily load has identified the sources of diazinon loading in the watershed and specified actions to address them (Marin County 2005a, 2007).

High coliform bacteria counts have been detected during the winter months in various segments of the creek (Marshall *et al.* 1994, as cited in A.A. Rich and Associates 2000). Friends of Corte Madera Creek (2006) found elevated levels of both *E. coli* and *Enterococcus* at several stations within Corte Madera Creek. In the summer of 2005, *Enterococcus* counts (most probable number /100 milliliter [mL]) ranged from 51 to 100 most probable number /100 mL throughout Corte Madera Creek downstream of Ross Town Hall. At the downstream end of the concrete channel, the *Enterococcus* count was 81 most probable number /100 mL. In summer of 2006, *Enterococcus* counts ranged from 29 to 92 most probable number /100 mL. At the downstream end of the concrete channel, the *Enterococcus* count was 29 most probable number /100 mL. Counts of *E. Coli* in Corte Madera Creek behind Ross Town Hall were elevated in winter months relative to summer months in 2004 (320 most probable number /100 mL winter versus 66 most probable number /100 mL summer) and 2005 (450 most probable number /100 mL winter versus 60 most probable number /100 mL summer). Although the results were highly variable, these counts periodically exceeded federal contact recreational criteria (saltwater concentrations of *Enterococcus* < 35 most probable number /100 mL, freshwater concentrations of *E. coli* < 126 most probable number/100 mL).

Water Temperature

High water temperatures have been attributed to urbanization of the watershed, specifically the reduction of shaded stream surface area, although less so within Unit 4, due to loss of riparian vegetation and increased channel width (Friends of Corte Madera Creek 2008a). Measured water temperatures in the study area are high beginning in late May and extending through September, ranging from 65 to 75 degrees Fahrenheit (°F) (A.A. Rich 2000), with higher temperatures being recorded within the concrete-lined sections of Corte Madera Creek. In 2008, temperatures at the Bridge Avenue Pool were measured between 62 and 70°F in June and August (Friends of Corte Madera Creek 2008a). Also, in 2008, temperatures in Ross Creek upstream of its confluence with Corte Madera Creek were recorded between 62 and 67°F during March and May (Friends of Corte Madera Creek 2008b). These temperatures are stressful for migrating salmonids, but thermal refugia may be available to fish due to either 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 (A.A. Rich 2000). Elevated water temperatures may also exacerbate existing problems with algae and aquatic plant growth (URS 2009).

Continuous water temperatures in Corte Madera Creek near the Ross Creek confluence at two different locations were collected in 2013 by the Friends of Corte Madera Creek: one at about 80 feet upstream of the Ross Creek confluence and the other at about 300 feet downstream of the Ross Creek confluence. The collected water temperatures at the downstream location were generally about 3 - 6°F cooler than the upstream location in the summer months (June-September), suggesting there was a cooling effect between the two locations. The cooling effect would not result from Ross Creek surface inflow because there was no flow at the downstream end of Ross Creek in the summertime of 2013. The cooling effect may have resulted from Ross Creek subsurface inflow (Stetson 2014) from the Ross Valley groundwater basin (San Francisco Bay RWQCB 2007).

Riparian Habitat

A visual habitat survey of the action area defined habitats as: riverine (concrete-lined channel), riverine (earthen-lined channel), riparian woodland, coastal brackish marsh, eucalyptus woodland and urban/developed (including ornamental landscaping) (Atkins 2011). The creek channel, within and upstream of Unit 4, has considerable vegetation, primarily on the natural banks. This vegetation provides 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); however, banks in Unit 4 are actively eroding along approximately 7,200 linear feet of bank. Royston (1977) estimated that roughly 20 percent of the total length of bank would be subject to one foot of erosion per year.

The riparian habitat in Unit 4 upstream of the existing Denil fish ladder is riparian woodland. This habitat includes the earthen streambed channel of Corte Madera Creek. No riparian woodland habitat exists in the action area downstream of the fish ladder in Units 2 and 3. Overall, canopy cover within the riparian woodland (Unit 4) ranges from 10 to 100 percent (Town of Ross 2009a). However, the riparian woodland in Unit 4 is somewhat fragmented by encroaching urbanization including houses, streets, bridges, and landscaping vegetation. Dominant species in the overstory include box elder (*Acer negundo* ssp. *californicum*), silver wattle (*Acacia dealbata*), big leaf maple (*Acer macrophyllum*), willow (*Salix* sp.), blue gum (*Eucalyptus* sp.), redwood (*Sequoia sempervirens*), western juniper (*Juniperus occidentalis* var. *occidentalis*), and white alder (*Alnus rhombifolia*). Species observed in the understory include Himalayan blackberry (*Rubus discolor*), periwinkle (*Vinca major*), English ivy (*Hedera helix*), Bermuda buttercup (*Oxalis pes-caprae*), miner's lettuce (*Claytonia perfoliata*), cut-leaf geranium (*Geranium dissectum*), white-flowered onion (*Allium triquetrum*), giant reed (*Arundo donax*), scotch broom (*Cytisus scoparius*), bedstraw (*Galium* sp.), prickly lettuce (*Lactuca serriola*), common horsetail (*Equisetum arvense*), field mustard (*Brassica rapa*), poison oak (*Toxicodendron diversilobum*), California man-root (*Marah fabaceus*), and cheeseweed (*Malva parviflora*).

Wetlands

A review of the National Wetland Inventory data for the study area identified several types of wetland features (e.g., emergent freshwater wetland, estuarine and marine wetland) located within the study area (portions of Unit 2) but outside of the action area (USFWS 2009). Reconnaissance level surveys conducted in April 2010 (USACE 2010) and again in November of 2017 by the USACE and District support the likely absence of wetland features within the action area because no potential jurisdictional wetlands were observed.

A formal jurisdiction determination of waters of the U.S. was performed for the Lagunitas Road Bridge Replacement Project in 2007 (Town of Ross 2009a). This determination included portions of Corte Madera Creek extending from approximately 17 linear feet upstream of the Lagunitas Road Bridge and 224 linear feet downstream, covering approximately 0.212 acre (9,228 square feet) of jurisdictional non-

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wetland waters of the U.S. (Town of Ross 2009a). With the exception of this small area near the Lagunitas Road Bridge, the rest of the action area has not been subject to a formal jurisdictional determination for waters of the U.S.; however, all of Corte Madera Creek within the action area is considered to be waters of the U.S. in this analysis.

Existing Salmonid Upstream Passage

Michael Love and Associates in association with Jeff Anderson and Associates conducted a steelhead passage assessment for Corte Madera Creek in 2007. The specific objectives of this project were to assess current upstream passage conditions and develop feasible alternatives for providing suitable passage for returning adult steelhead within the existing concrete channel. An overview of this study relevant to the proposed action is presented below. Detailed information of the study is available in the final report, which is incorporated by reference into this biological assessment (Love 2007). The following section summarizes this report's relevance to the action area.

Observations of water velocities within the existing resting pools suggested these pools are too small to sufficiently reduce water velocities at most upstream migration flows, but larger pools could potentially provide suitable resting areas. Existing fish passage conditions were assessed using a combination of a field monitoring program and numerical model estimates. These field observations were used to calibrate a two-dimensional (2-D) hydrodynamic model of the project reach that was used to estimate water velocities and depths encountered by steelhead at typical migration flows. These results were used in a fish routing and energetics model to estimate the proportion of the steelhead population able to ascend the concrete flood control channel over a range of stream flows and tidal conditions.

A design flow of 5,400 cubic feet per second (cfs) for Unit 3 was used to evaluate its impact on water surface elevations. In drainages such as Corte Madera Creek, a common high fish passage flow for salmon and steelhead is the 10 percent exceedance flow (177 cfs) during the period of migration, December through March. The low passage design flow at 50 percent exceedance is 14 cfs at Ross Creek, a tributary to Corte Madera Creek.

Steelhead Depth and Velocity Criteria: The CDFW and the NMFS have guidelines for upstream passage of adult steelhead through culverts, but not for flood control channels (Love 2007). These guidelines recommend a minimum water depth of 1.0 foot and a maximum average cross-sectional water velocity of less than 2 cfs for culverts exceeding 300 feet in length. Preliminary hydraulic analysis of Unit 3 found that these depth and velocity criteria are never mutually satisfied throughout the entire channel reach. Yet, on numerous occasions individual steelhead have been observed swimming through the entire Unit 3 channel. To provide a more accurate assessment of fish passage conditions in Unit 3, a fish routing, locomotion, and energetics model was developed. Factors considered were flow velocities, water depth, swimming speeds, time to fatigue and rest, and body size.

The average length of 24.5 inches was used for the Corte Madera Creek adult steelhead body length (BL). Because different size steelhead have different swimming strength and endurance, models of steelhead swim speed are expressed as body length per second (body length [24.5 inches] per second). A water velocity of 1 body length per second was selected as the maximum suitable velocity for allowing an adult steelhead to rest and recover from fatigue.

Assuming the largest steelhead in the Corte Madera population is 32 inches in length and has a body depth of 0.6 feet, a minimum required water depth of 0.6 feet was used for fish routing purposes in the model. For evaluating the existing resting pools in Unit 3, it was assumed that a resting pool must be an area of at least 2 feet long by 2 feet wide, with water velocities less than 2 BLs, and a water depth of at least 0.6 feet to be considered effective as a rest area for steelhead.

Assessment of Existing Pools in Unit 3: Using the resting pool criteria above, evaluation of the existing pools found they provide resting habitat at the analyzed flows of 14 cfs, 23 cfs, and 40 cfs, and to a lesser extent at 77 cfs. At 113 cfs and 177 cfs, only a select few of the existing pools provided suitable resting habitat, resulting in excessively long sections of channel with no areas for fish to rest. Given the distances involved, these water velocities are extremely challenging to a migrating adult steelhead and result in fatigue relatively quickly (Love 2007).

Steelhead Passage Efficiency Relative to Flow and Tidal Conditions: Results from Fish_REALMS for existing conditions found tidal conditions in Unit 3 are as important a factor for influencing fish passage as flow magnitude. The lower 900 feet of the modeled reach does not contain resting pools and at mean lower low water tidal condition, this section of channel is not tidally backwatered. The result is an excessively long reach with relatively swift water velocities and no resting opportunities. Therefore, nearly the entire population of Corte Madera Creek steelhead are unable to ascend Unit 3 at any of the assessed fish passage flows during low tide (Table 1).

Table 1: Estimated Proportion of Steelhead Population Capable of Ascending Unit 3 of Corte Madera Creek at Various Flow and Tidal Conditions						
Tide	Percent Successful Upstream Passage					
	14 cfs	23 cfs	40 cfs	77 cfs	113 cfs	117 cfs
MLLW	7	2	2	2	2	1
MTL	98	85	51	13	7	1
MHHW	99	92	97	73	54	4
MLLW = mean lower low water MTL = mean tide level MHHW = mean higher high water						

Photos Showing Existing Features of the Project Area

Photos 1 and 2 show the Denil fish ladder, which is currently non-functional and acts as a fish passage barrier. Note the abrupt change in the aesthetic quality at the fish ladder as the stream bed changes from a native streambed substrate to a concrete lined channel.



Photo 1. Denil Fish Ladder from the Right Bank (taken November 2017)



Photo 2. Below Denil Fish Ladder Looking Upstream

Photo 3 shows the concrete channel downstream from the fish ladder. The concrete channel is 33 feet wide with vertical walls and a v-shaped channel bottom. The channel consists of long straight sections, several subtle bends, and three tight curves. A constructed resting pool, 4 feet long and 13 feet wide is visible in the channel bottom of Photo 3.



Photo 3. Concrete Channel Downstream of the Fish Ladder taken from the Right Bank

5 PROPOSED ACTION

The purpose of the proposed action is to improve current channel capacity to convey flood flows of 5,400 cubic feet per second (i.e., 4 percent annual exceedance probability) through Units 2, 3, and 4 in Corte Madera Creek. The proposed action was developed in consideration of improving fish passage for threatened and endangered fish species Corte Madera Creek. The underground bypass culvert would be constructed underneath Sir Francis Drake Boulevard to convey flow from the upstream portion of Unit 4 downstream to the Allen Park Riparian Corridor in Unit 3. Floodwalls would be constructed at College of Marin, Kent Middle School, downstream of the Allen Park Riparian Corridor near the Granton Park neighborhood, and adjacent to College Avenue. The proposed action would not require any parcel acquisition; however, permanent easements would total 3.44 acres and temporary easements would affect 3.87 acres. Details of the project components are discussed below.

Details regarding the project features, including construction, are discussed in the following subsections and shown in Figures 3-5a through 3-5f in Chapter 4 of the draft EIS/EIR. The project feature discussions include a summary of the habitat changes resulting from construction of the respective features. Details of habitat changes resulting from construction of the project are provided in Section 5.5. Avoidance and minimization measures are also proposed to avoid or minimize the potential effects of the proposed action on natural resources; these measures would be utilized for all aspects of project construction, as necessary. Section 5.8 summarizes the avoidance and minimization measures that would be implemented to protect natural resources from construction impacts.

5.1 Unit 4 Bypass Culverts at Sir Francisco Drake Boulevard

The proposed action includes an underground bypass with two parallel culverts that would convey flow underneath Sir Francis Drake Boulevard (Figures 3-5b and 3-5c of the draft EIS/EIR in Chapter 3). The culvert bypass would begin on the left bank approximately 1,465 feet upstream of Lagunitas Road Bridge and the majority of the proposed alignment would run under Sir Francis Drake Boulevard. Each culvert would be 12-feet wide by 7-feet high and length of approximately 2,200 feet. The bypass would exit and re-enter the creek at properties that are owned by the District. The downstream termination point of the underground bypass would connect with the Allen Park Riparian Corridor. Construction activities would include trenching portions of Sir Francis Drake Boulevard up to 20 feet deep by 30 feet wide for installation of prefabricated box culverts. Construction of the bypass would require relocation of underground utilities that exist underneath Sir Francis Drake Boulevard. The excavation schedule would be established during preconstruction engineering and design phase. Although site preparation work would still be necessary, the proposed action would require minimal riparian vegetation removal (approximately 0.43 acre) because the majority of work would occur along an existing roadway where there is minimal ecology value. Construction of the bypass would leave the existing riparian woodland vegetation in Unit 4 intact, thereby protecting sensitive habitat and maintaining the existing shade and cover. Once complete, fish screens or grating would be installed on the bypass to prevent fish from passing through the culverts. Rather than passing through the culvert, fish would migrate around the culvert through the Allen Park Riparian Corridor. In the long term, an increased potential for channel stabilization in Unit 4 would exist by reducing flood flow frequency and stream power within the channel.

5.2 Fish Ladder Removal and New Transition (Unit 4)

The 950-foot Denil fish ladder in Unit 4 downstream from the Lagunitas Road Bridge, would be removed and replaced with a smooth transition (Figure 3-5c of the draft EIS/EIR in Chapter 3). The Denil fish ladder was intended to be a temporary structure at the upstream end of the Corte Madera Creek Flood Control Project in Unit 3 until it could be extended into Unit 4; however, a lawsuit prevented the construction in Unit 4. The Denil fish ladder would be replaced with a combination of natural bed material and biotechnical bank stabilization or stone protection treatments to eliminate the hydraulic jump and create a smooth transition that would also improve fish passage.

As a result of removing the fish ladder, channel modifications would be necessary to accommodate the change in flow dynamics. This would also create the need to modify and lower the channel floor elevations to allow for a smooth transition and geomorphological sustainable channel bed. The channel bed modification would extend from the fish ladder to approximately 110 feet upstream of Lagunitas Bridge. A portion of the natural channel in Unit 4, extending a length of approximately 115 feet within the reach between Lagunitas Road Bridge and the fish ladder, would be widened to increase hydraulic conveyance capacity. The concrete streambed downstream of the existing fish ladder (starting at its upstream limit at the beginning of Unit 3) would be demolished and removed for approximately 950 feet. Once the fish ladder is removed, the channel would be regarded to create a smooth grade transition between Units 3 and Unit 4 using a combination of natural bed material and biotechnical bank treatments to meet fish passage criteria. The biotechnical bank treatments would provide an armored transition between earthen streambank and vertical concrete channel wall. The footprint of this action is mostly within the channel although a small area of streambank could be modified. The potential exists to provide a high-flow refuge habitat.

Avoidance and minimization measures would include streamflow diversion if channel flow is present and temporary relocation of aquatic species, if present, during removal and reconstruction of the streambed. In-channel work could increase turbidity and suspended solids within the channel from diversion of the channel and post construction, but would be localized (not extend below Unit 2) and of short duration (less than one month). Long-term benefits that would be realized post-construction include improved fish passage and quality of fish habitat. Fish ladder removal would result in minimal vegetation disturbance and leave sensitive riparian woodland habitat in Unit 4 intact, thereby preserving shade to Corte Madera Creek.

5.3 Allen Park Corridor (Unit 3)

The proposed action includes the creation of Allen Park Riparian Corridor, constructed at Frederick S. Allen Park, is located in Unit 3. It would extend approximately 900 feet downstream from the Denil fish ladder and encompass approximately 2 acres. The riparian corridor would include a widened, natural substrate channel that allows higher flows to spread over a larger area and include floodwalls (top-of-bank or setback) on both banks to a maximum height of 2 feet (Figure 3-5c of the draft EIS/EIR in Chapter 3). At the upstream end of the left bank, the channel could not be widened due to limited real estate. As such, a floodwall is proposed at this location and would be constructed at the left limit of the existing concrete channel.

Construction of Allen Park Riparian Corridor would require relocation of the sewer line that crosses underneath the fish ladder and extends along the left bank of Corte Madera Creek on the landward side of the concrete wall. The pipe was likely built concurrently with the flood control channel. If realignment is necessary, the new line would be constructed before the current line is demolished. A temporary bypass line could be required during part of the construction. The length of demolished line would be

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approximately 1,115 feet and the added line would be approximately 1,031 feet. The new line would include a new inverted syphon beneath the creek that connects with the line from Sir Francis Drake Boulevard and a second inverted syphon to re-connect with the existing trunk line downstream near College of Marin. The current line is within an existing right-of-way and the new location would be located on public property.

Allen Park is a wooded upland area comprised of both native and ornamental species. Tree removal and regrading would occur to create a floodplain with revegetation including native riparian woodland habitat. Section 5.5 of this document details the changes to riparian habitat as a result of construction and long-term implementation of the proposed action, including a request for a vegetation variance along the floodwalls. Approximately 950 feet ($\pm$ 50 feet) of concrete channel would be removed, which would include removing 14 of the inadequately designed fish resting pools. The channel would be redesigned to include new resting pools, cover, and diverse aquatic habitat. Construction of the park would disturb the Allen Park footprint adjacent to the existing concrete channel; however, implementing AMMs would prevent or minimize sediment reaching the stream, as well as direct impacts to aquatic species.

In the long-term, the riparian corridor would be expected to improve aquatic and riparian steelhead habitat for both upstream migrating adults and downstream migrating and rearing juveniles. Long-term, temporary impacts would exist until regrowth of the riparian canopy occurs; however, fairly rapid revegetation of the area coupled with erosion control measures would protect the floodplain and minimize sediment delivery to the channel while vegetation is establishing. The number of trees to be removed would be determined during preconstruction engineering design; however, following construction, approximately 2.08 acres of riparian habitat would be established within and adjacent to the Allen Park Riparian Corridor. In addition, construction of the Allen Park Riparian Corridor would convert approximately 4.66 acres of urban and developed land to habitat features and remove approximately 2.27 acres of concrete lined channel. The project team would work closely with the Town of Ross on the design of the riparian habitat in that area.

5.4 Floodwalls (Units 2, 3, and 4)

Approximately 3,810 linear feet of top-of-bank floodwall would be constructed as part of the proposed projects (Figures 3-5b through 3-5f on the draft EIS/EIR in Chapter 3). The floodwalls would be constructed in Units 2 and 3. Those portions of the proposed action that include floodwalls, the majority of the floodwall structure would be constructed using reinforced concrete. Floodwall thickness would be expected to vary from 12 to 24 inches, depending on the floodwall height, location, geotechnical data, and other design parameters and requirements that would be determined during the detailed project design phase. Any floodwalls that interfere with runoff or subsurface flow into the creek would be identified and improvements would be made depending on the size, type, and depth of the drainage structure without impacting the intended operational purpose and integrity of both the floodwall and the drainage structure. Features such as pump stations and flap gates to convey flow behind the walls both during normal operation and in flood events, including to convey any flow changes from the proposed action, would be defined during preconstruction engineering and design as a part of the interior drainage evaluation. All floodwalls and retaining walls would meet requirements of USACE Engineer Technical Letter 1110-2-583 (USACE 2014) that requires a minimum of 15 feet vegetation-free zone along each face of the structure; however, the District will request a vegetation variance, as discussed in Section 5.5. Grass is allowed within this vegetation-free zone and variances can be obtained if the maximum area within the existing real estate interest is less than 15 feet. This variance may be

required in several project areas where real estate is not available. Closure structures would be needed where floodwalls connect to bridge crossings and cross roadways or bike paths. If the elevation of the roadway is higher than the top of the floodwall design, the floodwall would connect into the roadway abutment without a closure structure because the roadway would function as a closure structure with a continuous line of protection. Floodwalls in Unit 4 above the Lagunitas Road Bridge would require an access road for maintenance and flood fighting. Following construction of the floodwalls, grass will be planted in the 15 feet clear area on both sides of floodwalls to prevent post-construction erosion and sedimentation. A maintenance road would be constructed to allow small vehicles to monitor the creek behind homes through Sylvan Lane properties.

Construction of the College of Marin floodwalls and Granton Park in Units 2 and 3, respectively (discussed below), would not alter existing habitat or have direct or indirect impacts to salmonids because the top-of-bank floodwalls would be built on top of the 33-foot wide concrete channel. Vegetation clearance would occur on the landward side of the floodwalls, but this vegetation is ornamental and provides little if any benefit to the channel in terms of shade, cover, and nutrients.

Granton Park Floodwall (Unit 3)

A floodwall would be constructed along the left bank of the creek near the Granton Park neighborhood and extend approximately 1,050 feet terminating at the Science, Math, and Nursing (SMN) Bridge on the western boundary of the College of Marin campus. The height of the Granton Park floodwall would vary. At its upstream end, the wall would be about 2 feet high and gradually increase to a height of about 6 feet downstream. The new floodwall would be installed as a separate wall offset from the existing concrete wall. Additional interior drainage improvements for the creek outlets such as flap gates and pump station would likely be needed, and will be considered during preconstruction engineering and design.

College of Marin Floodwall (Unit 2)

The proposed action also includes a 75-foot long, top-of-bank floodwall upstream of College Avenue Bridge angled to funnel flow under the bridge, and a longer floodwall downstream of College Avenue Bridge extending approximately 950 feet. The College Avenue floodwalls would be constructed along the left bank and at the upstream limit have a maximum height of 4 feet and gradually taper down to a height of 2 feet downstream at its terminus.

Habitat Changes Resulting from the Proposed Action

Existing habitat in the immediate vicinity of the project area was mapped using GIS and delineated in to different habitat types, from urban and developed to natural habitats. The project features were overlain on the existing habitat and the resulting changes to habitat were recorded. Table 2 provides a summary of the existing habitat types, habitat types that would be present following construction of the proposed action, and the changes in habitat. Table 3 further divides the habitat changes for the various project components. As shown, the proposed project would result in a gain of approximately 1.35 acres of riparian woodland and 0.22 acre of riparian herbaceous habitats. Of this, approximately 1.36 acres would be established within the Allen Park Riparian Corridor. In addition, construction of the Allen Park Riparian Corridor would convert approximately 0.78 acre of urban and developed land to natural habitat features and remove approximately 0.58 acre of concrete lined channel.

Per USACE design policy for vegetation near levees, dams and floodwalls (Engineering Technical Letter 1110-2-583), the District will request a vegetation variance along the floodwalls. The USACE's vegetation policy guidance letters (October 2017) indicates that vegetation variances may be granted in cases

where the flood safety risks of the vegetation do not outweigh the benefits of allowing non-policy compliant vegetation. A risk analysis will be performed for Corte Madera Creek prior to the pre-construction, engineering, and design phase of the project. This will determine to what extent riparian vegetation could be restored at Allen Park Riparian Corridor. However, on the right bank, the floodwall along the upper two-thirds of the park is far enough away from the channel that shading riparian habitat along the creek will be allowed to reestablish.

Table 2. Summary of Habitat Changes Resulting from the Proposed Action

Affected Habitat	Existing Habitat in Project Footprint	Future Habitat in Project Footprint	Habitat Change
Riparian Woodland	0.43	1.79	+1.35
Riparian Herbaceous	0	0.22	+0.22
Riverine (concrete)	1.2	0.46	-0.74
Urban / Developed	3.17	1.84	-1.33

Table 3. Potential Habitat Changes Resulting from the Proposed Action

Construction Activity	Affected Habitat	Habitat in Existing Project Footprint	Habitat in Future Project Footprint	Habitat Change
Top of Bank Floodwalls	Riparian Herbaceous	0	0.12	+0.12
	Riverine (Concrete)	0.53	0.43	-0.10
	Urban / Developed	2.27	1.75	-0.52
Allen Park Riparian Corridor	Riparian Woodland	0	1.26	+1.26
	Riparian Herbaceous	0	0.10	+0.10
	Riverine (Concrete)	0.58	0	-0.58
	Urban / Developed	0.78	0	-0.78
Fish Transition Grading	Riparian Woodland	0.43	0.53	+0.10
	Riverine (Concrete)	0.09	0.03	-0.06
	Urban / Developed	0.12	0.09	-0.03

5.6 Project Construction Schedule and Phasing

Construction of the project would begin in early 2020 and the project would be completed within 3 years. The construction window within Corte Madera Creek is between June 15 and October 15 in accordance with requirements to protect federally threatened steelhead trout (*Oncorhynchus mykiss*) and Coho salmon (*Oncorhynchus kisutch*). In-stream construction would be limited by a 120-day window although out of channel construction would not be subject to these constraints. The project would be conducted in four phases, as presented in Table 4.

Table 4. Construction Duration (days) for Each Phase of the Proposed Action			
Construction Phase	Unit	Description	Construction Period (days)
Phase 1	Unit 3	Allen Park Riparian Corridor	95
Phase 2	Unit 2	Unit 2 – From downstream end of the concrete-lined channel to College Avenue Bridge	70
Phase 3	Unit 3	Unit 3 - From College Avenue Bridge to upstream end of concrete lined section (the fish ladder)	70
Phase 4	Unit 4	Unit 4 – From the fish ladder to the upstream end of project	300

Project construction would be completed by tasks. Anticipated tasks are presented in Table 5. Construction would start at Allen Park, and then construct most downstream floodwalls working upstream. The bypass construction would be the final phase.

Table 5. Construction Tasks in Each Phase of the Proposed Action	
Task ID	Task Description
Phase 1 (Unit 3)	
1.1	Prepare site (grade changes, clearing and grubbing, tree removal)
1.2	Construct Allen Park Riparian Corridor
1.3	Remove existing Denil fish ladder and replace with a smooth transition between Units 3 and 4
Phase 2 (Unit 2)	
2.1	Prepare site (grade changes, clearing and grubbing, tree removal)
2.2	Construct floodwalls (top of bank or setback)
Phase 3 (Unit 3)	
3.1	Prepare site (grade changes, clearing and grubbing, tree removal)
3.2	Construct floodwalls (top of bank or setback)
Phase 4 (Unit 4)	
4.1	Prepare site (grade changes, clearing and grubbing, tree removal)
4.2	Install two parallel underground bypass culverts under Sir Francis Drake Boulevard

5.7 Equipment Required to Construct the Project

Heavy equipment required to construct the proposed project are listed below. Table 6 provides the equipment required for each construction task.

- | | |
|--------------------------------|---|
| 1. Articulated Haulers | 12. Trencher Machines |
| 2. Dump Trucks | 13. Truck Concrete Pumps |
| 3. Wheeled Excavator | 14. Concrete Pumps |
| 4. Walking Excavators | 15. Pile Driver (Hammer/Vibratory) |
| 5. Compact Excavators | 16. Truck Mounted Crane |
| 6. Electric Crawler Excavators | 17. Mobile Crane |
| 7. Back Hoe Loader | 18. Heavy Concrete Cutters |
| 8. Long Arm Backhoe Loader | 19. Multi-Processor Concrete |
| 9. Soil Compactor | 20. Cutter/crusher |
| 10. Manual Soil Compactors | 21. Mountable tree, shrub and stump remover |
| 11. Tracked Carriers | 22. Asphalt Drum Compactor |

Table 6: Construction Activities and Equipment Required for Each Task		
Task ID	Construction Activities	Construction Equipment (see list above)
Phase 1 (Unit 3)		
1.1	Prepare site (grade changes, clearing and grubbing, tree removal)	3, 5, 6, 9, 10, 11, and 21
1.2	Construct Allen Park Riparian Corridor	1, 2, 3, 4, 5, 7, 8, 10, 13, and 21
1.3	Remove existing Denil fish ladder and replace with a smooth transition between Units 3 and 4	3, 5, 6, 7, 9, 10, 11, 13, and 14
Phase 2 (Unit 2)		
2.1	Prepare site (grade changes, clearing and grubbing, tree removal)	3, 5, 6, 9, 10, 11, and 21
2.2	Construct floodwalls (top of bank or setback)	1, 2, 3, 4, 5, 6, 7, 8, 10, 11, 13, 14, 15, and 18
Phase 3 (Unit 3)		
3.1	Prepare site (grade changes, clearing and grubbing, tree removal)	3, 5, 6, 9, 10, 11, and 21
3.2	Construct floodwalls (top of bank or setback)	1, 2, 3, 4, 5, 6, 7, 8, 10, 11, 13, 14, 15, and 18
Phase 4 (Unit 4)		
4.1	Prepare site (grade changes, clearing and grubbing, tree removal)	3, 5, 6, 9, 10, 11, and 21
4.2	Install two parallel underground bypass culverts under Sir Francis Drake Boulevard	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 13, 14, 15, and 18

5.8 Avoidance and Minimization Measures to Protect Natural Resources

Several avoidance and minimization measures (AMMs) are included in the propose project to avoid and minimize potential impacts to natural resources in the action area. Many of these measures are not specific to the protection of salmonids; however, they ensure that the biological and physical resources in the action area will be protected, thereby protecting salmonid habitat. For example, implementing turbidity management, hazardous spill, and stormwater runoff plans will prevent sedimentation and toxic substances from entering the creek during construction. Working during the dry season (June 15 through October 15), which is outside of the salmonid migratory period, could reduce the potential for direct impacts on listed salmonids and their critical habitat, as well as sedimentation and elevated turbidity in the creek. Avoidance and minimization measures included in the proposed action which have the potential to avoid and minimize impacts to natural resources are listed below.

AMM-1: Seasonal Restrictions. Implement wet-season restrictions on construction for wildlife protection. Construction activities in or adjacent to the channel of Corte Madera Creek shall be conducted during the dry season (June 15 through October 15).

AMM-2: Salmonid Monitoring. If Coho salmon are observed in the project area during winter months or during preconstruction fish capture and relocation activities, all project activities shall cease and CDFW and NMFS shall immediately be notified. If steelhead are determined or presumed to be present in the project site, then the following avoidance and minimization measures shall be implemented:

- To minimize turbidity and stress to salmonids, personnel shall avoid walking through stream pools and the thalweg of the channel, and shall instead walk across riffles or outside of the stream bed to access a project site.
- No equipment is to be operated from within the active stream channel unless the stream has been dewatered and fish have been relocated by a qualified and permitted biologist.
- A fisheries biologist with appropriate licenses and equipment (buckets, aerators, etc.) must be on-site to catch and move fish downstream as dewatering proceeds. Captured fish shall be handled with extreme care and kept in water to the maximum extent possible during relocation activities. All captured fish shall be kept in cool shaded, aerated water protected from excessive noise, jostling, or overcrowding any time they are not in the stream and fish shall not be removed from this water except when released. To avoid predation, the biologist shall have at least two containers and segregate young-of-year fish from larger age-classes and other potential aquatic predators. Captured salmonids will be relocated, as soon as possible, to a suitable instream location in which habitat condition are present to allow for adequate survival of transported fish and fish already present. Cofferdams used to divert water shall be constructed with clean river gravel or sand bags and sealed with sheet plastic.
- If any salmonids are found dead or injured, the biologist shall contact NMFS. The purpose of contacting the NMFS is to review the activities resulting in take and to determine if additional protective measures are required. All salmonid mortalities shall be retained, placed in an appropriately-sized sealable plastic bag, labeled with the date and location of collection, fork length measured, and frozen as soon as possible. Frozen samples shall be retained by the biologist until specific instructions are provided by NMFS. The biologist may not transfer biological samples to anyone other than the NMFS without obtaining prior written approval. Any such transfer will be subject to such conditions as NMFS deems appropriate.

- Intakes and outlets shall be designed to minimize turbidity and the potential to wash contaminants into the stream.
- If a work site is to be temporarily dewatered by pumping, intakes shall be completely screened with wire mesh not larger than 5 millimeters to prevent amphibians from entering the pump system. On salmonid streams, the intake pipe shall be fitted with fish screens meeting CDFW and NMFS' criteria to prevent entrainment or impingement of small fish.
- A filtration/settling system must be included to reduce downstream turbidity (i.e. filter fabric, turbidity curtain). The selection of an appropriate system is based on the rate of discharge. If feasible, water that is pumped into a pipe shall discharge onto the top of bank into a densely vegetated area, which may require extra hose length.
- Once the project work is complete, water shall be slowly released back into the work area to prevent erosion and increased turbidity.
- The channel and soil surface shall be restored after the work is complete. Any material added to the channel or basin to provide support for the work approved under this provision shall be removed unless required for erosion control or habitat enhancement and/or restoration.
- For minor actions where the disturbance to construct cofferdams to isolate the work site would be greater than that which would occur in completing the proposed action, measures will be put in place immediately downstream of the work site to capture suspended sediment. This may include installation of silt catchment fences across the drainage or placement of a straw wattle or filter berm of clean river gravel. Silt fences and other non-native materials will be removed from the stream following completion of the activity. Gravel berms may be left in place after breaching, provided they do not impede the stream flow.

AMM-2: Minimize In-water Construction. In-water construction activities will be minimized to the extent practical. In instances where in-water construction activities occur, activities would be limited to the dry season (June 15 through October 15).

AMM-3: Minimize Disturbance to Existing Vegetation. Disturbance to existing vegetation shall be limited to the project area. Existing ingress and egress points shall be used, and staging and material storage areas shall be confined to the paved areas as much as possible.

AMM-4: Minimize the Project Footprint. The amount of disturbance within the project area shall be reduced to the absolute minimum necessary to accomplish the proposed project. Topsoil from the creek banks shall be removed, stockpiled, covered, and encircled with silt fencing to prevent loss or movement of the soil into Corte Madera Creek. All disturbed soils shall undergo erosion control treatment prior to the rainy season and after construction is terminated. Treatment typically includes temporary seeding with native species and sterile straw mulch. All topsoil shall be replaced in a manner as close as possible to pre-disturbance conditions.

AMM-5: Site Restoration. Exposed soil will be stabilized to prevent erosion and revegetated with native vegetation as soon as feasible after construction is complete. Revegetation will occur at a ratio of at least 1.5:1 to account for initial mortality of plantings. Revegetation will occur with native species appropriate for site conditions. If soil moisture is deficient, new vegetation will be supplied with supplemental water until vegetation is firmly established. Erosion control fabric, hydromulch, or other mechanisms will be applied as appropriate to provide protection to seeds, hold them in place, and help retain moisture. Revegetation shall be regularly monitored for survival for at least five years or until adequate ground cover and survival is achieved. In addition, grass will be planted in the 15 feet clear

area on both sides of floodwalls to prevent post-construction erosion and sedimentation. Monitoring for colonization of invasive species will occur, and eradicated if established.

AMM-6: Signing to Protect the Natural Habitat. Interpretive signs prohibiting access to areas that are closed to the public, and indicating the importance of protection of sensitive biological resources, will be placed in key locations, such as along trails near sensitive habitats. A qualified biologist shall determine the appropriate buffer size, in consultation with CDFW, and delineate the buffer using Environmentally Sensitive Area fencing, pin flags, and yellow caution-tape. The project area shall be delineated with high-visibility temporary orange-colored fence at least 4 feet in height, flagging, or other barriers.

AMM-7: Project Site Maintenance. The project areas will be maintained trash-free, and food refuse will be contained in secure bins and removed daily.

AMM-8: Vehicle Staging, Fueling, and Use. Vehicle staging, cleaning, maintenance, refueling, and fuel storage will be located 150 feet or more from Corte Madera Creek. All fueling shall be equipped with secondary containment and avoid a direct connection to underlying soil, surface water, and storm drains.

No equipment will enter live water except for aquatic equipment or amphibious equipment designed specifically for aquatic or amphibious use. All vehicles operated within 150 feet of any body of water will be inspected daily for leaks and, if necessary, repaired before leaving the staging area. Inspections will be documented in a record that is available for review on request.

AMM-9: Maintenance and Cleaning of Equipment and Vehicles. Equipment will be cleaned of any sediment or vegetation before transfer and use between sites to prevent spreading pathogens or exotic/invasive species. Further, all equipment will be maintained free of petroleum leaks and kept clean. Vehicle and equipment washing will occur on-site as needed. No runoff from vehicle or equipment washing will be permitted to enter waters of the state without adequate treatment.

AMM-10: Hazardous Materials Management/Fuel Spill Containment Plan. A hazardous materials management and fuel spill containment plan will be developed prior to construction and given to all contractors and biological monitors working on the project. This plan will ensure that hazardous material, including petroleum products, do not enter Corte Madera Creek should a spill occur. The plan will require:

- Equipment and materials for cleanup of spill be available on site and that spills and leaks will be cleaned up immediately and disposed of properly. Authorities will be notified of spills as required by 40 CFR 110.
- Prior to entering the work site, all field personnel shall be appropriately trained in spill prevention, hazardous material control, and clean-up of accidental spills.
- Field personnel shall implement measures to ensure that hazardous materials are properly handled and the quality of water resources is protected by all reasonable means. Preventative measures will be implemented, such as vehicle and equipment staging, cleaning, maintenance, and refueling; and contaminant (including fuel) management and storage.

AMM-11: Turbidity Management Plan. Implement a water quality and turbidity management plan; plan will include stormwater management. This plan will provide measures to protect water quality in Corte Madera Creek during construction. It may include methods such as using Use coffer dams and/or silt curtains to the extent feasible during construction.

AMM-12: Prepare Stormwater Pollution Prevention Plan. Erosion will be controlled based on the Storm Water Pollution Prevention to be prepared for the project. The plan would outline measures to prevent debris, construction-related material or wastes, and other organic or earthen products from entering the creek during construction. Further, implementing the Stormwater Pollution Prevention Plan measures will minimize soil erosion and related sedimentation.

AMM-13: Grading and Erosion Control Plan. A grading and erosion control plan would be prepared by a California Registered Civil Engineer. The grading and erosion control plan shall be submitted to Marin County before issuance of grading permits for all new development on the project site and all supporting elements. The plan shall be consistent with the state's National Pollution Discharge Elimination System permit requirements and shall include the site-specific grading associated with development for all project phases.

5.9 Operation and Maintenance Activities

Once constructed there would be on going operation and maintenance activities associated with the project. An operation and maintenance manual would be developed in cooperation with the District describing the frequency, extent, and types of inspection and operation needed. Most maintenance activities would occur during the dry season from April 15 to October 15. These would include five types of maintenance activities:

- Vegetation management
- Sediment and debris removal
- Erosion control
- Maintenance and repair of all components of the Project including: floodwall, levee, drainage structures, channel lining and all channel erosion protection features.
- Regular annual inspection.

Vegetation Management

Vegetation management activities will be employed to achieve three main goals:

- Maintain channel flow capacity
- Reduce fire fuels
- Restore creek habitat by removing invasive nonnative plants and revegetating with native plants

Vegetation management activities do not include ground-disturbing activities. These activities employ vegetation control methods such as cutting and removing vegetation above the ground by hand or with loppers, hand saws, chainsaws, pole saws, weed eaters, and other hand tools. Removal of non-native vegetation, tree removal and thinning employ a mix of tools including chainsaws, loppers, hand saws, pole saws, hedge trimmers, and other hand tools.

Sediment and Debris Removal

Equipment types, equipment locations, crew sizes, and staging areas could vary depending on the need of each site. Equipment includes long-reach excavators, backhoes, haulers, and front loaders. Excavated sediment would be placed directly into dump trucks, or placed in or pushed to staging areas, then lifted into dump trucks.

Erosion Control

Erosion control is typically accomplished by armoring the critical areas (bends and steep banks) along the channel with riprap and by means of other biotechnical methods. Equipment typically used for erosion control work can include excavators, haulers, front loaders, and bulldozers.

Maintenance and Repair of Flood Control Structures

Flood control structures are defined to include all structures built or maintained by the District, including, but not limited to floodwalls, levees, closure gates, weirs, diversion structures, trash racks, stream gage structures, grade control structures, energy dissipaters, utility line crossings, culverts, outfalls, storm drain or pump station inlet/outlet structures, and similar structures.

Regular Annual Inspection

Annual routine inspection would be performed to make sure the proposed project is capable of performing as intended. The government may perform inspections every 5 years depending on the availability of funds. Any deficiencies discovered during inspection would be the responsibility of Marin County.

6 NMFS-MANAGED SPECIES AND CRITICAL HABITAT

On September 21, 2018, the NMFS provided an official species list for the Corte Madera Flood Risk Management Project (Appendix B) from the California Species List Tools web page. The species list identified one threatened and one endangered species that may be present in the action area, as well as critical habitat that is present in the action area. In addition, in a February 2, 2018, letter from NMFS to the USACE (Appendix A), NMFS determined that Corte Madera Creek supports both Central California Coast steelhead (*Onchorynchus mykiss*) and Central California Coast Coho salmonid (*O. kisutch*), and is designated critical habitat for both salmonids. The salmonids and critical habitat that may be affected by the proposed action are discussed below.

This section is followed by an analysis of the potential effects of the proposed action on both salmonids. Impacts to steelhead and Coho are analyzed together because they are expected to be similar since both species have similar life histories.

6.1 Central California Coast Steelhead and Critical Habitat

The Central California Coast steelhead (*Oncorhynchus mykiss*) was listed as threatened on January 6, 2006, 71(3) FR:834-862 and critical habitat was designated on May 5, 1999, 64(86) FR:24049-24062. The Central California Coast steelhead population is a distinct population segment that includes all naturally spawned populations of steelhead in coastal streams and rivers from the Russian River to Aptos Creek (inclusive) and their tributaries; also included are the drainages of San Francisco, Suisun, and San Pablo bays. A detailed account of the taxonomy, ecology, and biology of this species is provided in the Biological Opinion for Long-term Management Strategy for the Placement of Dredged Material in the San Francisco Region (NMFS 2015). Supplemental or updated information is provided in the USFWS's 5-year review of the listing of Central California Coast steelhead (NMFS 2016), both of which are hereby incorporated by reference.

Critical habitat was designated in September 2005 for this species that includes the action area (NMFS 2005). The primary constituent elements of critical habitat for this species are freshwater spawning, rearing, and migration areas; estuarine areas free of obstructions and of sufficient quality to support adult and juvenile rearing; and nearshore and offshore marine areas.

This evolutionarily significant unit (ESU) includes fish within Corte Madera Creek. The remaining portions of this section provide a discussion of the Central California Coast steelhead habitat and biology, as it pertains to the action area, as well as a discussion of the status of the species in the action area. This evolutionarily significant unit (ESU) includes fish within Corte Madera Creek.

Habitat and Biology in the Action Area

Corte Madera Creek is a migratory corridor for steelhead and steelhead spawn in the upper watershed. Adults migrate upstream to spawning areas in the upper watershed, upstream of the action area, from December through March. Migration of steelhead occurs in pulses, coinciding with storm events, resulting in temporary highwater flows (freshet conditions). Studies suggest that these freshet conditions are required to initiate both movement into a lagoon or bay, and upstream into the creeks.

Adult steelhead migrate upstream into Corte Madera Creek December through March and spawn in the upper watershed during early spring. Migration of steelhead occurs in pulses, coinciding with storm events, resulting in temporary highwater flows (freshet conditions). Studies suggest that these freshet conditions are required to initiate both movement into a lagoon or bay and upstream into the creeks. After spawning over clean gravels in the headwaters of Corte Madera Creek, adult steelhead may

survive the spawning activity and outmigrate back to the ocean to spawn again in following years. The young steelhead that emerge from the gravels typically spend 1 or 2 years rearing in the freshwater stream before outmigrating to the ocean as smolts about 6-7 inches in length from March into June. They then rear for 2 to 3 years in the ocean before returning to their natal stream to reproduce. Unobstructed upstream passage for adults (and downstream for smolts) plus suitably cold summer/fall rearing temperatures (55 to 60°F optimal) for the juvenile fish are limiting factors for salmonids in Corte Madera Creek (A.A. Rich 2002).

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CCC Steelhead Critical Habitat in the Action Area

Corte Madera Creek and its tributaries are designated by NMFS as critical habitat for Central California Coast steelhead. The lateral extent of critical habitat includes the stream channels within the designated stream reaches, and includes a lateral extent as defined by the ordinary high-water line (USACE 1986). This critical habitat designation would be applicable to any in-water portion of the action area. Primary constituent elements in the action area include migration corridors.

CCC Steelhead Status in the Action Area

Corte Madera Creek supports a small population due to upstream migration impediments. It is estimated that only 10 percent of adults attempting the passage make it to unit 4 (Love 2007). Past summer surveys have shown a very small resident population of steelhead in Corte Madera Creek.

6.2 Central California Coast Coho Salmon and Critical Habitat

The Central California Coast Coho salmon (*Oncorhynchus kisutch*) was listed as endangered on October 31, 1996, 61 (212) FR:56138-56149. This species is also designated as endangered by the State of California. A detailed account of the taxonomy, ecology, and biology of this species is provided in the Appendix A of the Pacific Coast Salmon Fishery Management Plan's description of the Central California Coast Coho salmon (PFMC 2014). Supplemental or updated information is provided in the USFWS's 5-year review of the listing of Central California Coast Coho salmon (NMFS 2016), both of which are hereby incorporated by reference. The remaining portions of this section provide a discussion of the Central California Coast Coho salmon habitat and biology, as it pertains to the action area, as well as a discussion of the status of the in the action area.

Habitat and Biology in the Action Area

Corte Madera Creek and its tributaries are designated as critical habitat for this population of Coho salmon. Historically present in Corte Madera Creek, they have rarely been observed since 1984 (Leidy 1984; Leidy 2005). Juvenile Coho salmon were not found in the Corte Madera Creek watershed survey conducted in 2000 (A.A. Rich 2000).

Adult Coho salmon typically enter small coastal watersheds such as Corte Madera Creek about a month earlier than steelhead, ascending the stream with the first rains in mid-November. The adult Coho salmon are smaller than Chinook salmon and are approximately the size of steelhead. The passage, spawning, and rearing needs of Coho salmon are very similar to steelhead, so focusing on achieving the habitat needs of steelhead would also benefit Coho salmon. Adult Coho salmon would migrate up Corte Madera Creek from mid-November through mid-January, then spawn into February or early March. As typical of Pacific salmon, the Coho die after this single spawning episode. After rearing in the freshwater creek for usually 1 year, the juvenile Coho salmon outmigrate during spring high flows in April and May. They then spend 16 to 18 months at sea before returning as adults to spawn in their natal creek (Moyle 2002).

Juvenile Coho salmon prefer deeper pools (> 1 meter) with overhead cover and habitat created by large woody debris in the stream channel. The juveniles do best in summer waters of 54 to 57°F and do not persist in waters of 72 to 77°F (Moyle 2002).

CCC Coho Salmon Critical Habitat in the Action Area

Corte Madera Creek and its tributaries are designated by NMFS as critical habitat for Central California Coast Coho salmon. The primary constituent elements of critical habitat for this species are freshwater spawning, rearing, and migration areas; estuarine areas free of obstructions and of sufficient quality to support adult and juvenile rearing; and nearshore and offshore marine areas although the species is considered extirpated from this habitat. The lateral extent of the critical habitat includes the stream channels within the designated stream reaches, and includes a lateral extent as defined by the ordinary high-water line (USACE 1986). This critical habitat designation would be applicable to any in-water portion of the proposed project.

CCC Coho Salmon Status in the Action Area

Although historically present in the Corte Madera Creek watershed, this species is assumed to be extirpated from the creek and has not been observed in the creek since 1981 (Leidy 2007). However, in its February 2018 letter to the USACE, NMFS indicated that the Corte Madera Creek is a migration corridor for listed CCC Coho salmon and remains critical habitat.

6.3 Effects of the Action on CCC Steelhead and CCC Coho Salmon

In-channel construction would take place during the dry season, between June 15 and October 15 (AMM-1: Seasonal Restrictions), when adults and most juveniles are unlikely to be present and would avoid interfering with adult spawning migrations or the outmigration of smolts. Limiting the construction to the dry season, when salmonids are not likely to be present in the creek, would minimize the risk of individual steelhead being killed, injured, or displaced. This is particularly true for summer construction work downstream of the existing fish ladder where the concrete-lined channel offers little or no shelter for juvenile salmonids and water temperature becomes too warm to sustain salmonids. Although construction is proposed when salmonids are not expected to be present in the project area, during in-channel construction, fish biologists will conduct salmonid monitoring in accordance with AMM-2: Salmonid Monitoring. Salmonid monitoring may require fish capture and removal. This activity is necessary, but is considered take under the Endangered Species Act, because handling listed salmonids is a form of harassment and mortality can occur from electrofishing.

Prior to construction, best management practices to protect water quality would be developed and included in various plans (i.e., AMM-8: Turbidity Monitoring Plan, AMM-12: Prepare Stormwater

Pollution Prevention Plan, AMM-13: Grading and Erosion Control Plan, and AMM-10: Hazardous Materials Management/Fuel Spill Containment Plan). Best management practices would include methods to prevent constituents of concern, construction debris, and sediment from unintentionally entering the creek. The plans would also identify measures that would be taken to protect creek waters from petroleum product spills. However, unintentional introduction of sediment into the water from erosion or runoff and increased turbidity caused by construction activities could affect salmonids feeding rates and growth, increase mortality, cause behavioral avoidance, should they be present in the creek and evade capture. The unintended introduction of petrochemicals associated with construction equipment (ex: refueling events, equipment servicing, and rupture of hydraulic lines from non-mobile construction equipment) could injure or kill salmonids and their macroinvertebrate prey populations. Temporary impacts could include loss of habitat, food sources, and cover during construction.

Following construction, permanent modifications to the creek are designed to benefit salmonids. Adult migration in the creek is currently a problem as a result of high water velocities through the concrete channel and the fish ladder, which is an impediment to upstream migration. Construction of the project is expected to eliminate some of these problems. Replacing an ineffective fish ladder with a smooth transition to facilitate fish passage will improve upstream salmonid migration through the approximate 909 feet of regraded stream channel. The smooth transition would be designed in consultation with NMFS to ensure features, such as sufficient resting pools, support fish passage. The Allen Park Riparian Corridor would provide refuge for both adults and juveniles during high water flows because salmonids would be able to use flooded areas outside of the high flow channel. Finally, culverts would be installed with screens to prevent fish entrapment, which would also be designed in accordance with NMFS Fish Screening Criteria for Anadromous Salmonids (NMFS 1997).

As discussed, approximately 0.43 acre of riparian woodland would be removed during removal and re-grading of the fish ladder. The project would self-mitigate for this loss by replacing riparian habitat along the fish ladder and constructing the Allen Park Riparian Corridor. Once complete, approximately 1.57 acres of riparian habitat would be established in these areas. Riparian habitat would be replaced at a ratio of 3.65:1. Floodwalls would be constructed in areas downstream of the fish ladder and Allen Park Riparian Corridor. These areas currently do not have sufficient riparian habitat that provides shade, and riparian habitat would likely not be established as a result of the highly urbanized surrounding landscape.

As discussed, the District will request a vegetation variance along the floodwalls, which will determine the extent of riparian vegetation that could be restored at Allen Park Riparian Corridor. However, on the right bank, the floodwall along the upper two-thirds of the park is far enough away from the channel that shading riparian habitat along the creek will be allowed to reestablish. The floodwall along the left bank is closer to the creek and a variance would likely be required for shading riparian habitat to establish.

Adult steelhead migrate December through March, and Coho enter about a month earlier, after the first rains in November. Juveniles typically outmigrate in the spring. As mentioned, construction activities would not occur during these times. However, prior to establishment of shading riparian habitat along the removed fish ladder, water temperatures may be affected. Areas downstream of the fish ladder have minimal shading riparian habitat. Once the project is complete and riparian habitat reestablishes along the removed fish ladder and the Allen Park Riparian Corridor, shading riparian habitat may result in a cooling effect in these areas. 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 proposed action has primarily surface water components, information on groundwater hydrology has been

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included in this document as necessary to determine its relationship to surface water in the creek. By removing portions of the concrete channel more groundwater discharge into the creek would be expected. During the summer this increase of groundwater discharge would increase baseflow and cool surface water temperatures.

6.4 Effects of the Action on CCC Steelhead and CCC Coho Salmon Critical Habitat

The only primary constituent element in the action area is migration corridor. Construction of the proposed action would occur during the dry season, when salmonids are not likely to be migrating to or from spawning grounds. Floodwalls would be installed in the lower portions of the channel, in Units 2 and 3; however, these floodwalls would not result in alterations to the channel or the migratory corridor. Upstream areas of the channel, from the Denil fish ladder to the end of the proposed Allen Park Riparian Corridor, would ultimately improve salmonid migratory habitat, as the ladder is currently an impediment to fish passage. Additionally, shading riparian habitat would be established along the removed fish ladder and in the Allen Park Riparian Corridor downstream of the ladder.

6.5 Cumulative Effects on CCC Steelhead and CCC Coho Salmon and Salmonid Critical Habitat

Cumulative effects include analyzing the potential effects of the proposed action along with the effects the reasonably foreseeable future non-federal projects in and around the action area. Non-federal projects that have the potential to result in cumulative effects to listed salmonids and salmonid critical habitat are presented in Table 7. Foreseeable projects in the action area that are most likely to have cumulative effects on salmonids include a bridge replacement upstream of the action area, redesign of an ephemeral drainage at Marin Day School, and rehabilitation of Sir Francis Drake Boulevard.

The bridge replacements would likely not result in measurable impacts to water quality whereas fish passage would either be improved or not affect salmonids at all. Bridge replacements would cause temporary disturbance to the stream and likely require dewatering of the channel and potentially relocating steelhead, if they are present. This would result in a temporary impact and unlikely to have a cumulative impact. Repaving Sir Francis Drake Boulevard could contribute to cumulative impact for the proposed action if the repaving is not completed in conjunction with construction of the bypass. However, similar to the proposed action, all in-water construction that could directly affect listed salmonids would occur during the dry season (between June 15 and October 15), thereby minimizing direct impacts on listed salmonids.

Table 7: Reasonably Foreseeable Cumulative Projects			
Project or Program Name	Description of Project or Program	Environmental Review Status	Construction Dates
Ross Valley Flood Protection and Watershed Program (Marin County)	The Ross Valley Watershed Flood Risk Reduction Program is a regional effort led by the Flood Control District in partnership with the City of Larkspur, Town of Ross, Town of San Anselmo, Town of Fairfax, and Town of Corte Madera. The program would meet the overall	Undergoing Environmental Review	Phase One (2017-2027) Phase Two (2028-2050)

Table 7: Reasonably Foreseeable Cumulative Projects			
Project or Program Name	Description of Project or Program	Environmental Review Status	Construction Dates
	objective of substantially reducing the frequency and severity of flooding throughout the Ross Valley Watershed in an economically viable manner while providing multiple benefits and minimizing environmental impacts. Phase One would include use of flood diversion and storage (FDS) basins, bridge replacements and selected elements in the creeks to increase capacity. Phase Two elements of the Program would implement additional creek improvements, bridge replacements, additional FDS basins, low impact development, flood preparation and education, and creek maintenance, after implementation of Phase One.		
Ross Valley Flood Protection and Watershed Program's Bridge Replacement Projects (San Anselmo, Fairfax, Ross)	Several bridges in the same region of the Ross Valley as the proposed project (i.e., on San Anselmo Creek or other tributaries in the Corte Madera Creek watershed) are planned for removal and replacement in such a way as to move their foundations out of the creek channels. The bridge replacements would include Azalea Avenue, Madrone Avenue, Nokomis Avenue, Sycamore Avenue/Center Boulevard, and Winship Avenue bridges.	Undergoing Environmental Review	Within the next 5 years; some could occur contemporaneously with the action area
Marin County Day School Improvements, Lake or Streambed Alteration Agreement No. 1600-2015-0385-R3 (Corte Madera)	This project involves modification to an existing ephemeral stream that flows through campus. Phase 1 work was implemented along the downstream portion of the stream according to Streambed Alteration Agreement 1600-2008-0167- R3. This project (Phase 2) continues the creek modification from the upstream terminus of the previous project. Approximately 400 linear feet of stream channel will be modified. The intent of the channel design is to create a geomorphically stable naturalized and enhanced creek channel.	Planned	Uncertain
Marin County Day School Improvements (Corte Madera)	Marin County Day School, proposes building renovations, demolitions, and new construction of the existing campus and completion of a creek restoration program. The improvements would provide updated and more modern accommodations for students and more classrooms in order to reduce class sizes for more personalized instruction. No enrollment increases are proposed as part of this project.	Planned	Uncertain

6.6 Conclusion

Construction of the project has the potential to take listed salmonids should they be present in the creek during the dry period (June 15 and October 15). The proposed action would directly affect a total of 0.43 acre of riparian habitat; however, this habitat would be replaced at a ratio of 3.65:1, thereby increasing shading riparian habitat in the upper portions of the creek, compared to existing conditions. Removal of the fish ladder will improve the ability of salmonids to migrate upstream to spawning grounds.

Overall, construction of the proposed action may affect, and is likely to adversely affect, threatened CCC steelhead and endangered CCC Coho salmon. Once the project is complete and riparian habitat reestablishes in the upstream areas, the project would have a beneficial effect on CCC steelhead and CCC Coho salmon, compared to the existing conditions of the channel.

In conclusion, the project would not jeopardize the continued existing of either salmonid species, nor would it adversely affect critical habitat. This conclusion is based on the following:

- Removal of the Denil fish ladder at the head of the concrete-lined channel and grading this area to make it suitable for anadromous fish upstream passage will allow more adult anadromous salmonids to reach spawning and rearing habitat in the upper watershed.
- Removing the concrete-lined channel and widening the creek channel at Frederick S. Allen Park to create a vegetated riparian floodplain would provide sheltered and shaded rest area for anadromous fish, both adults and outmigrating smolts as they migrate through this areas, thereby increasing fish survival. Removing the concrete channel bed would allow cooler groundwater to enter the channel and may provide both cooler water temperature and higher baseflow.
- Increasing riparian habitat in the upper portion of the project area by approximately 1.45 acres.
- A floodwater bypass culvert would be buried beneath Sir Francis Drake Blvd to reduce flooding rather than the option of extending concrete floodwalls upstream of the Lagunitas Road Bridge and removing riparian trees providing shade to the channel. The latter approach to reduce flooding would result in a significant reduction in undercut streambank habitat and in riparian shading of the channel. The riparian shading is critical to keep water temperatures from becoming too warm to support juvenile salmonids.
- The instream construction of the proposed project would occur between June 15 and October 1 when the Corte Madera Creek channel below Lagunitas Road Bridge would be dry or have intermittent pooling. Should there be watered areas in the instream construction zone, any fish in these waters would be captured by a fisheries biologist and relocated to the natural channel upstream of the Lagunitas Road Bridge.
- Pumps used during dewatering of Corte Madera Creek prior to construction would be screened to prevent accidental entrainment of juvenile salmonids.
- Disturbance of the creek channel and stream banks would occur during the dry season and the areas stabilized prior to the fall/winter rains.

7 ESSENTIAL FISH HABITAT

This section provides an analysis of the proposed action on essential fish habitat in the action area. The Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) protects the Essential Fish Habitat (EFH) of species fished for fishery purposes. EFH is defined as “...those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity...” (16 U.S.C. 1802(10)). The action area is located within coastal waters identified as EFH for various life stages of fishes managed under the Pacific Coast Salmon Fisheries Management Plan (PFMC 2014). The Pacific Coast Salmon Fisheries Management Plan (PFNC 2016) consists of EFH for Coho, Chinook, and Puget Sound pink salmon. Pacific salmon EFH is defined as “...waters and substrate necessary for salmon product needed to support a long-term sustainable salmon fishery and salmon contributions to a healthy ecosystem.” This EFH includes “...streams, lakes, ponds, wetlands, and other currently viable water bodies and most of the habitat historically accessible to salmon in Washington, Oregon, Idaho, and California. In estuarine and marine areas, salmon EFH extends from the nearshore and tidal submerged environments with state territorial waters out to the full extent of the exclusive economic zone...”

7.1 Fish Species of Concern

In the project area, salmonid fish species included in the Pacific Coast Salmon FMP are limited to the Central California Coast Coho salmon (*Oncorhynchus kisutch*), a species with commercial value and that has state and federal status as endangered south of Punta Gorda in northern California. Although believed to extirpated from Corte Madera Creek since the 1980s, the creek is designated as critical habitat for the Coho salmon. A description of the timing of the Coho salmon spawning migration, juvenile rearing, and the emigration of smolts can be found in Section 6.2 of this document.

7.2 Effects of the Proposed Action on Essential Fish Habitat

This assessment of project effects to the Coho salmon evaluates the possible adverse impact to the species’ EFH as defined in the Pacific Coast Salmon Plan Amendment 18 (NMFS 2014). There are five Habitat Areas of Particular Concern (HAPC) listed in Amendment 18 that are evaluated in the following subsections for potential adverse impacts to Coho salmon resulting from the project.

Complex Channels and Floodplain Habitats. The portion of Corte Madera Creek present in the action area is a single channel at the lower end of the creek beginning 18,131 feet upstream of the mouth of the creek, and ending just prior to it emptying into tidal waters into San Francisco Bay. Corte Madera Creek in the lowermost portion of the project area is a 33-foot wide concrete-lined channel that extends 5,172 feet upstream to the Denil fish ladder that is in disrepair and a fish passage barrier. Above the fish ladder, the channel is deeply incised with residences on the left bank and Frederic Allen Park and Ross Commons on the right bank up to Lagunitas Road Bridge. Here and continuing above the Bridge to the bypass outflow, the channel is lined intermittently with many homemade floodwalls.

An assessment of the ability of adult steelhead to migrate up the concreted-line creek channel and ascend the existing fish ladder was conducted by Michael Love and Associates with Jeff Anderson and Associates (Love 2007). The study found that the passage of adult steelhead (this also applies to Coho salmon) can occur only within a narrow range of flow and tidal conditions which greatly impedes the ability of anadromous salmonids to reach the natural stream channel above the Lagunitas Road Bridge.

Overall, proposed action would benefit Coho salmon EFH because:

- Removing the existing fish ladder and grading this section of the creek channel such that a fish ladder is not required.
- Increasing channel complexity by creating a riparian floodplain adjacent to the creek at Allen Park Riparian Corridor just below the existing fish ladder.

Thermal Refugia. Corte Madera Creek provides thermal refugia to adult and juvenile Coho salmon in the heavily shaded reach of the proposed project area upstream of the Lagunitas Road Bridge. Extensive riparian canopy and natural stream banks and channel keep the waters of Corte Madera Creek cooler than occurs downstream in the channelized portion of the creek.

- The proposed action benefits Coho salmon thermal refugia by:
- Allowing easier access to the shaded natural creek channel above the Lagunitas Road Bridge by removing the need for a fish ladder;
- Creating a riparian vegetation shaded resting area for ascending adult salmon in Allen Park Riparian Corridor and in Unit 2 near the College of Marin.

Spawning Habitat. There is no spawning habitat within the action area; therefore, proposed action would not affect spawning EFH. However, by removing the need for a fish ladder and making it easier for adult Coho salmon to reach upstream spawning habitat, the proposed action indirectly benefits Coho salmon spawners.

Estuaries. The proposed action ends where the creek flows into the estuary waters of San Francisco Bay, it would not affect Coho salmon EFH in the estuary.

Marine and Estuarine Submerged Aquatic Vegetation. The proposed action would not alter submerged aquatic vegetation habitat in the estuary and would not affect estuarine aquatic vegetation EFH.

7.3 Conclusions

The proposed action would not substantially affect essential habitats of Coho salmon associated with Corte Madera Creek. The proposed action would benefit essential habitat for Coho salmon by:

- Improving the migration corridor for adult salmon allowing them easier access to upstream spawning habitat.
- Creating a riparian vegetated flood plain above the fully concrete-lined channel to provide a temporary refuge for ascending adult salmon and outmigrating smolts, and.

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