Draft Environmental Assessment for the

LAGUNITAS CREEK WINTER HABITAT AND FLOODPLAIN ENHANCEMENT PROJECT

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March 2017

DRAFT

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ACRONYMS AND ABBREVIATIONS

Acronym	Definition
BAJ	Bar Apex Jam
BMP	best management practice
Cal/OSHA	California Occupational Safety and Health Administration
CDFW	California Department of Fish and Wildlife
CESA	California Endangered Species Act
cfs	cubic feet per second
Corps	U.S. Army Corps of Engineers
CSC	California species of special concern
CWA	Clean Water Act
dBA	A-weighted decibels
DPS	distinct population segment
EA	Environmental Assessment
ESU	Evolutionarily Significant Unit
FE	federally endangered
FESA	federal Endangered Species Act
FT	federally threatened
LDRJ	Log Debris Retention Jam
LWD	large woody debris
MM	Mitigation Measure
MMWD	Marin Municipal Water District
NEPA	National Environmental Policy Act
NOAA Fisheries	National Oceanic and Atmospheric Administration Fisheries division
NPS	National Park Service
OSHA	Occupational Safety and Health Administration
PRNS	Point Reyes National Seashore
RGP	Regional General Permit
RWQCB	Regional Water Quality Control Board
SC	species of concern
SE	state endangered
SPT	Samuel P. Taylor State Park
SR-	State Route
SWD	small woody debris
SWPPP	stormwater pollution prevention plan
SWRCB	State Water Resources Control Board
TMDL	Total Daily Maximum Load
USFWS	U.S. Fish and Wildlife Service

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CHAPTER 1
PURPOSE OF AND NEED FOR ACTION

1.1 INTRODUCTION

The Marin Municipal Water District (MMWD), in cooperation with the National Park Service (NPS), is proposing the Lagunitas Creek Winter Habitat and Floodplain Enhancement Project (proposed project). The proposed locations for habitat enhancement are within NPS lands in western Marin County administered by Point Reyes National Seashore (PRNS). The winter habitat restoration and floodplain enhancement proposed by the MMWD as part of ongoing watershed protection measures was developed in cooperation with the NPS, Marin County, the California Department of Fish and Wildlife, the San Francisco Regional Water Quality Control Board, the California State Water Resources Control Board (SWRCB), the U.S. Fish and Wildlife Service, and the National Oceanic and Atmospheric Administration Fisheries division.

As landowner, NPS has approval responsibility for the project and is the lead agency for National Environmental Policy Act (NEPA) compliance. MMWD has prepared this Environmental Assessment (EA) in conformance with NEPA and NPS Director's Order 12 to aid NPS in considering approval of the proposed MMWD project. The EA analysis considers a range of project alternatives and assesses the potential impacts that could result from the proposed habitat and floodplain enhancements. California Environmental Quality Act compliance was completed for this proposal by the California Department of Fish and Wildlife, which considered and approved the proposed project for funding as part of the 2015 and 2016 Fisheries Restoration Grant Programs. The record of California Environmental Quality Act compliance is included in this document as Appendix A. Additional funding has been secured through grants from SWRCB (Nonpoint Source Clean Water Act 319h Program) and the U.S. Fish and Wildlife Service (Coastal Program), as well as from MMWD.

1.2 PURPOSE

The purpose of the proposed project is to stabilize and improve Lagunitas Creek salmonid populations by increasing the winter habitat carrying capacity for coho salmon (*Oncorhynchus kisutch*) and steelhead trout (*O. mykiss*) in Lagunitas Creek. The project purpose is also to improve water quality. These projects would modify hydrology and enhance and restore existing floodplain and instream habitat at a number of locations in Lagunitas Creek. Based on the findings of a 2013 Lagunitas Creek winter habitat assessment and the 2011 Lagunitas Creek Stewardship Plan (Stewardship Plan), the proposed project must accomplish the following project objectives:

- Increase winter habitat and floodplain restoration.
- Reconnect the stream to its floodplain (improve floodplain connectivity).

- Enhance floodplain habitat (improve floodplain habitat complexity).
- Enhance instream habitat (improve rearing, shelter, frequency of woody debris, etc.).
- Avoid stranding juvenile salmonids.
- Avoid rapidly filling any channel with sediment.
- Avoid inadvertent increases in invasive predators (bass and bullfrogs).
- Prevent incidental degradation of water quality.
- Avoid creating stagnant water that could foster mosquitos,.
- Avoid loss of, or impacts to, habitat for California freshwater shrimp (*Syncaris pacifica*), a federally listed endangered species found in Lagunitas Creek.

A primary purpose of the project is to stabilize and improve Lagunitas Creek salmonid populations by increasing the winter habitat carrying capacity for coho salmon and steelhead trout. The project purpose is also to improve water quality, which will enhance three of the state-designated beneficial uses of Lagunitas Creek: fish migration and spawning; cold and warm freshwater habitats; and preservation of rare and endangered species. The mechanisms by which the project will benefit salmonids include the following:

- Increasing the available over-winter rearing habitat for juvenile salmonids
- Providing juvenile and adult salmonid flow refuge habitat both in the floodplain side channels and in the enhanced main channel/base-flow habitat of Lagunitas Creek
- Improving floodplain connectivity and reconnecting the base flow channel of Lagunitas Creek to existing floodplain channel
- Increasing and improving salmonid shelter habitat
- Increasing wood loading and frequency of woody debris structures for use by salmonids
- Sorting and storing sediment, in the main channel and out onto the floodplain
- Increasing patchiness of gravel–cobble and cobble–boulder complexes for use as salmonid spawning and juvenile winter rearing habitat

Ultimately, the project is expected to contribute to the recovery of coho salmon and steelhead within their respective Central California populations.

1.3 NEED AND BACKGROUND

Along the Central California coast, coho salmon are federally listed as an endangered species, and steelhead are federally listed as threatened under the federal Endangered Species Act

(ESA). Both populations have declined significantly in their respective ranges compared to historical numbers (Stillwater Sciences 2008; NOAA Fisheries 2012). California coho salmon have declined from about 350,000 adults, estimated in the 1940s, to less than 5,000 in current estimates. Lagunitas Creek historically supported ~4,000 adults, while the estimate for 2009 was an all-time low of 52 returning adults.

Central California coast steelhead trout have declined dramatically from 94,000 fish estimated in the 1960s to approximately 14,000 returning adults on average. Lagunitas Creek historically supported greater than 5,000 adults, whereas current estimates are as low as 300 returning adults (NOAA Fisheries 2016).

Lagunitas Creek still represents one of the largest and most stable populations of coho salmon in their southern extent and an important population of steelhead on the central coast (Stillwater Sciences 2008). Through a number of regulatory mandates and policy objectives, MMWD has recognized that its water supply operations impact salmonid habitat. In response, MMWD has taken responsibility for managing and maintaining aquatic resources in the Lagunitas Creek watershed for the benefit of the populations of coho salmon, steelhead trout, and California freshwater shrimp (a federally listed endangered species with habitat in Lagunitas Creek).

In 1953 Peters Dam was built across Lagunitas Creek to form Kent Lake. After its construction, Peters Dam became the upstream limit of anadromous[1] fish migration in the main channel of Lagunitas Creek (MMWD 2011a). In 1982, Peters Dam was raised by 45 feet in response to the severe drought California experienced in 1976 and 1977. The dam-raising was approved under the authority of SWRCB. Along with their decision to approve the dam-raising, SWRCB required that MMWD conduct studies to identify impacts of the additional diversion of water from Lagunitas Creek, including impacts on coho salmon and steelhead, both listed under the federal ESA. Studies to determine impacts to these listed fish species were conducted throughout the 1980s and early 1990s.

Based on the results of the studies and on water rights hearings held between 1990 and 1995, the SWRCB issued Order WR95-17 requiring MMWD to develop and implement a 10-year sediment and riparian management plan to mitigate impacts on the aquatic resources of Lagunitas Creek resulting from the additional water diversion. In response to the SWRCB order, MMWD developed the Lagunitas Creek Sediment and Riparian Management Plan in 1997.

MMWD implemented the Sediment and Riparian Management Plan and carried out the prescribed strategies and projects and additional habitat assessments over the course of the 10-year implementation time frame for the plan. In reaching the 10-year milestone of the Sediment and Riparian Management Plan, MMWD sought to continue its responsibilities for Lagunitas

[1] Anadromous fish are born in freshwater, spend most of their lives in the sea, and return to freshwater to spawn.

Creek into the future and developed the Lagunitas Creek Stewardship Plan (MMWD 2011b) as the planning document to address future actions to manage the habitat of Lagunitas Creek. The Stewardship Plan was based on the stipulations of the SWRCB's order, MMWD policy, requirements of California Fish and Game Code, conformance with the state and federal ESA, the Public Trust Doctrine,[2] and the state of knowledge about habitat needs for coho salmon and steelhead trout in Lagunitas Creek. This plan now serves as the principal planning document for MMWD's management of aquatic resources in Lagunitas Creek.

A key element of the Stewardship Plan is winter habitat enhancement, which grew out of a limiting factors analysis that had been conducted between 2006 and 2008 to determine which critical habitat or biological factors were limiting the size of the population of the anadromous fish species spawning in Lagunitas Creek. The analysis concluded that the amount of winter habitat available for use by juvenile salmon and steelhead was the primary limiting factor limiting the recovery (i.e., increase) of coho and steelhead populations in Lagunitas Creek (Stillwater Sciences 2008). In the Stewardship Plan, MMWD committed to conducting an assessment of the existing habitat and develop designs for the restoration and enhancement of winter habitat.

In 2013, MMWD completed a grant-funded assessment of winter habitat in Lagunitas Creek. The Lagunitas Creek Salmonid Winter Habitat Enhancement Assessment Report (Kamman 2013) identified the focal area for winter habitat enhancement in Lagunitas Creek as the Tocaloma reach and lower Olema Creek. The 2013 assessment culminated with the identification of specific sites for winter habitat enhancement work.

In 2014, SWRCB developed the Lagunitas Creek Watershed Fine Sediment Reduction and Habitat Enhancement Plan and an implementing Basin Plan Amendment, collectively referred to as the "Lagunitas Creek Sediment Total Daily Maximum Load (TMDL) Plan." The TMDL Plan identifies the maximum quantity of sediment per day that Lagunitas Creek can tolerate and remain within the established water quality standards and beneficial uses for fisheries, aquatic wildlife, aesthetics, and recreation. The goal of the TMDL Plan is to limit and control sedimentation in the creek; support and restore coho salmon, steelhead trout, and California freshwater shrimp populations; and protect and enhance the native fish, aquatic wildlife, aesthetics, and recreational values of Lagunitas Creek. It sets out four basic strategies to achieve these goals; two of which are related to the objectives of this project and are as follows: (1) reconnecting the stream channel to the floodplain to allow sediment to be trapped on the floodplain and (2) controlling sediment within the channel with large wood structures (SWRCB 2014).

[2] The principle that certain natural and cultural resources are preserved for public use, and that the government owns and must protect and maintain these resources for the public's use.

Since the publication of the TMDL Plan, MMWD and its partners have identified opportunities and constraints for enhancement, selected enhancement sites, and developed proposed site-specific designs for permitting and construction. These designs make up the current proposed project.

1.4 PROJECT AREA LOCATION

Lagunitas Creek is located in western Marin County, with a significant portion of the lower part of the creek flowing through NPS lands within the Golden Gate National Recreation Area and PRNS, as indicated in Figure 1. The creek stretches approximately 22 miles from its headwaters on Mount Tamalpais to its mouth at the southern tip of Tomales Bay. The proposed project includes a number of sites chosen for restoration on Lagunitas Creek, each within NPS land under the management of the PRNS. PRNS manages the north district of Golden Gate National Recreation Area, including Lagunitas Creek, the east shore of Tomales Bay, and the eastern lands of the Olema Valley, under a Regional Directive for Management.

1.5 RELATED LAWS/LEGISLATION AND OTHER PLANNING AND MANAGEMENT DOCUMENTS

The proposed project would comply with the following relevant regulations and policies.

National Park Service Organic Act

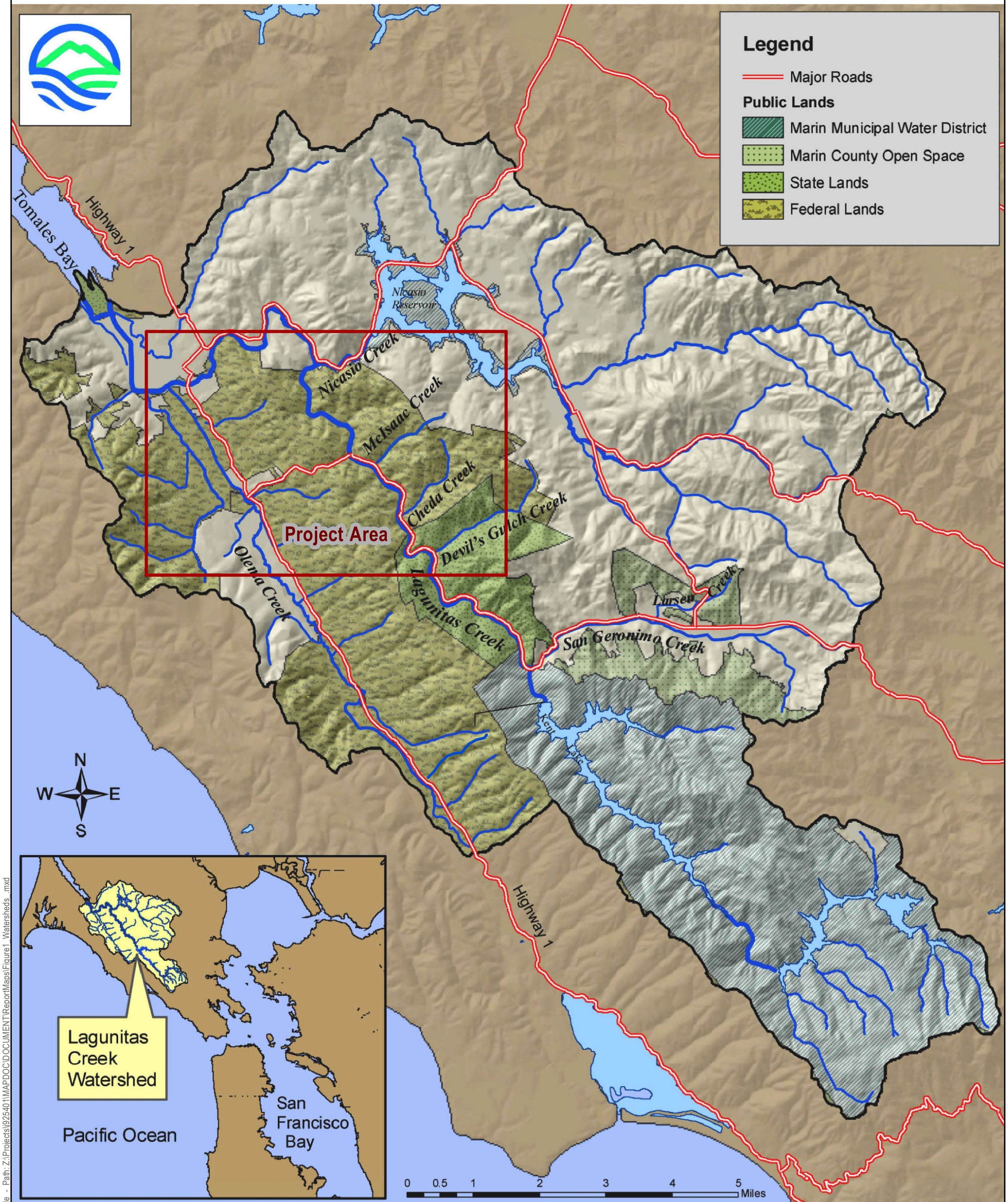
The NPS Organic Act directs NPS to manage units "to conserve the scenery and the natural and historic objects and the wildlife therein and to provide for the enjoyment of the same in such a manner as will leave them unimpaired for the enjoyment of future generations" (54 U.S.C. 100101(a)). Congress reiterated this mandate in the Redwood National Park Expansion Act of 1978 by stating that NPS must conduct its actions in a manner that will ensure no "derogation of the values and purposes for which these various areas have been established, except as may have been or shall be directly and specifically provided by Congress" (54 U.S.C. 100301). The Organic Act prohibits actions that permanently impair park resources unless a law directly and specifically allows for the acts. An action constitutes an impairment when its impacts "harm the integrity of park resources or values, including the opportunities that otherwise would be present for the enjoyment of those resources and values" (NPS 2006, Section 1.4.5).

Endangered Species Act

Section 9 of the federal ESA prohibits any take of a species that has been federally listed as threatened or endangered, except as permitted under the ESA. The definition of "take" is "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in such conduct," and has been interpreted to include habitat modification that interferes with a species' foraging, breeding, or shelter. All federal agencies are subject to the ESA. This EA describes the project's compliance approach specifically with regard to the following federally listed species:

- Coho salmon (*Oncorhynchus kisutch*)
- Steelhead trout (*O. mykiss*)
- California red-legged frog (*Rana draytonii*)
- California freshwater shrimp (*Syncaris pacifica*)
- Northern spotted owl (*Strix occidentalis caurina*)
- Marbled murrelet (*Brachyramphus marmoratus*)

In addition the purpose of the project is to stabilize and improve Lagunitas Creek salmonid populations by increasing the winter habitat carrying capacity for coho salmon and steelhead trout in Lagunitas Creek.



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SOURCE: Marin Municipal Water District, 2016

FIGURE 1
Regional Map

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National Park Service Management Policies 2006

The fundamental purpose of the national park system, established by the Organic Act and reaffirmed by the General Authorities Act, as amended, begins with a mandate to conserve park resources and values. This mandate is independent of the separate prohibition on impairment and applies with respect to all park resources and values. NPS managers must always seek ways to avoid, or to minimize to the greatest extent practicable, adverse impacts on park resources and values. Management policies are designed to protect the land for future generations. These policies establish a foundation of stewardship. The management policies must:

- Comply with current laws, regulations and executive orders;
- Prevent impairment of park resources and values;
- Ensure that conservation will be predominant when there is a conflict between the protection of resources and their use;
- Maintain NPS responsibility for making decisions and for exercising key authorities;
- Emphasize consultation and cooperation with local/state/tribal/federal entities;
- Support pursuit of the best contemporary business practices and sustainability;
- Encourage consistency across the system – "one national park system";
- Reflect NPS goals and a commitment to cooperative conservation and civic engagement;
- Employ a tone that leaves no room for misunderstanding the National Park Service's commitment to the public's appropriate use and enjoyment, including education and interpretation, of park resources, while preventing unacceptable impacts;
- Pass on to future generations natural, cultural, and physical resources that meet desired conditions better than they do today, along with improved opportunities for enjoyment (NPS 2006, p. 2).

However, the laws do give the NPS the management discretion to allow impacts to park resources and values when necessary and appropriate to fulfill the purposes of a park, so long as the impact does not constitute impairment of the affected resources and values (NPS 2006, Section 1.4.5).

The NPS Management Policies 2006 reference management of threatened and endangered plants and animals, stating:

> The NPS will survey for, protect, and strive to recover all species native to national park system units that are listed under the Endangered Species Act. The Service will fully meet its obligations under the NPS Organic Act and the Endangered Species Act to both proactively conserve listed species and prevent detrimental effects on these species. To meet these obligations, the Service will:
>
> - Cooperate with both the U.S. Fish and Wildlife Service and the NOAA Fisheries to ensure that NPS actions comply with both the written requirements and the spirit of the Endangered Species Act. This cooperation should include the full range of activities associated with the Endangered Species Act, including consultation, conferencing, informal discussions, and securing all necessary scientific and/or recovery permits (NPS 2006, Section 4.4.2.3).

The proposed project conforms to the management policies set by the NPS.

Golden Gate National Recreation Area Enabling Legislation

There are 10 sites included in this proposed project. Sites 1 and 2 are located outside NPS lands and are thus discussed in the cumulative table of this EA. Eight of the sites are on NPS lands. Of the eight project sites located on NPS lands, Site 9 is within PRNS lands and Sites 3, 4, 5, 6, 7, 8, and 10 are located on Golden Gate National Recreation Area lands that are managed by PRNS. As set forth in the 1972 legislation that created the Golden Gate National Recreation Area, the establishment of area and statement of purposes is as follows:

> In order to preserve for public use and enjoyment certain areas of Marin and San Francisco Counties, California, possessing outstanding natural, historic, scenic, and recreational values, and in order to provide for the maintenance of needed recreational open space necessary to urban environment and planning, the Golden Gate National Recreation Area (hereinafter referred to as the "recreation area") is hereby established. In the management of the recreation area, the Secretary of the Interior (hereinafter referred to as the "Secretary") shall utilize the resources in a manner which will provide for recreation and educational opportunities consistent with sound principles of land use planning and management. In carrying out provisions of this subchapter, the Secretary shall preserve the recreation area, as far as possible in its natural setting, and protect it from development and uses which would destroy the scenic beauty and natural character of the area (PL 92-589, Section 1).

Point Reyes National Seashore Enabling Legislation and General Management Plan

As set forth in the 1962 legislation that created PRNS, projection of the unique resources in the park is a primary purpose for its establishment:

> …to save and preserve, for the purposes of public recreation, benefit, and inspiration, a portion of the diminishing seashore of the United States that remains undeveloped (PL 87-657).

An amendment to the legislation passed in 1976 provides the NPS with specific management goals for PRNS:

> …the property … shall be administered …without impairment of its natural values, in a manner which provides for such recreational, educational, historic preservation, interpretation, and scientific research opportunities as are consistent with, based upon, and supportive of the maximum protection, restoration, and preservation of the natural environment within the area (PL 94-544).

The 1980 PRNS General Management Plan objectives that guide this project include the following:

- To identify, protect, and perpetuate the diversity of existing ecosystems which are found at Point Reyes National Seashore (NPS 1980, p. 1).
- To identify, protect, and preserve the significant historic and cultural resources of Point Reyes (NPS 1980, p. 2).
- To ensure that park development is the minimum necessary for efficient and essential management (NPS 1980, p. 3)

Executive Order 11988 and Director's Order 77-2 (Floodplain Management)

Executive Order 11988, "Floodplain Management" (May 28, 1980), was issued "to avoid to the extent possible the long and short term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct or indirect support of floodplain development wherever there is a practicable alternative." The goals of the project are in accordance with both the executive order and director's order to protect and preserve the natural resources and functions of floodplains and restore natural floodplain values previously affected by land use.

2011 Lagunitas Creek Stewardship Plan

The Stewardship Plan was developed by MMWD in June 2011 and addresses actions to be taken by MMWD in its ongoing efforts to manage the habitat of Lagunitas Creek for the benefit of the aquatic resource populations of coho salmon, steelhead trout, and California freshwater shrimp.

The Stewardship Plan has 10 distinct implementation elements: (1) ongoing mandatory requirements of SWRCB Order WR95-17, (2) winter habitat enhancement, (3) sediment reduction and management, (4) instream and riparian habitat enhancement, (5) biotechnical bank stabilization, (6) California freshwater shrimp habitat enhancement, (7) monitoring, (8) aquatic invasive species management, (9) programs and policies, and (10) collaboration and outreach. The Stewardship Plan is a planning document, intended to describe ongoing and guide future MMWD actions. It is intended to build on the collaborative approach that has developed over the years, in large part through the Lagunitas Creek Technical Advisory Committee. The plan was developed with other agencies and stakeholders through the Lagunitas Creek Technical Advisory Committee and incorporated comments received on a public review draft plan. As MMWD moves forward to implement specific actions in the plan, those actions undergo environmental review and permitting and are brought to the MMWD Board of Directors for approval. The time period for implementing the plan is the 10-year period of 2011 to 2020. NPS contributed to the development of the plan and is a collaborator as well as a participating entity on the Lagunitas Creek Technical Advisory Committee. The proposed project is in conformance with the 2011 Stewardship Plan.

Central California Coast Coho Salmon Recovery Plan

In 2012, the National Oceanic and Atmospheric Administration Fisheries division published the Central California Coast Coho Salmon Recovery Plan. The proposed project adheres to this Recovery Plan, which is based on the biological needs of the fish and provides the foundation for restoring the populations to healthy levels. The Recovery Plan summarized 27 habitats in Northern California and ranked conditions and threats for each life stage. The plan presented recommendations for Lagunitas Creek that have been included in the proposed project, including:

- Increasing large wood frequency throughout the watershed to improve conditions for adults and winter/summer rearing juveniles
- Developing floodplain enhancement and large woody debris projects in modified and incised channel areas of major tributaries
- Conduct rehabilitation activities that restore channels, floodplains, and meadows to extend the duration of the summer flow and provide refuge from high winter flows

Lagunitas Creek Sediment TMDL Plan

In June 2014, the San Francisco Bay Area Regional Water Quality Control Board adopted Resolution R2-2014-0027, which amended the regional Basin Plan, and adopted a TMDL for fine sediment in the Lagunitas Creek watershed and an implementation plan to achieve the TMDL and related habitat enhancement goals. The proposed project conforms to these set goals.

NPS uses this to identify and support its watershed management projects and programs for Lagunitas Creek. The goals of the Lagunitas Creek Sediment TMDL Plan are as follows:

- To restore an annual spawning run within the Lagunitas Creek watershed of 1,300 or more adult coho salmon, achieved for at least 12 consecutive years
- For native fish and aquatic wildlife species to be in good condition at the individual, population, and community levels
- To protect and enhance the aesthetic and recreational values of the creek and its tributaries

1.6 SCOPING AND PUBLIC INVOLVEMENT

Public scoping is the first step in the process of NEPA public review. Its objective is to engage agencies, organizations, and the public early in the EA development and request input on the proposed action, environmental issues that should be addressed in the EA, potential project alternatives, and sources of data that should be considered. Scoping allows agency and public concerns to be identified early and helps focus the analysis on important issues. Prior to public scoping, a scoping session was held internally with NPS staff representing a range of subject matter experts with expertise in environmental education and interpretation, natural and cultural resources, law enforcement, maintenance of park facilities, and park administration.

Originally, not all the sites covered in this document were included in the project because not all sites were completely funded. Public scoping was conducted for what was termed “Phase 1 projects” (Sites 3, 4, 5, 6, and 10 (Tocaloma)) from December 11, 2015, to January 11, 2016. However, 2016 funding was received for the remainder of the sites, originally termed “Phase 2” (Sites 7, 8, and 9), which prompted MMWD to combine all sites in the proposed project under this analysis. Because Phase 2 had not been included in the original scoping request, a second 30-day public scoping period was implemented with a closing date of August 3, 2016. For both scoping efforts a scoping notice was mailed to 349 addresses on the park mailing list, including all federal, state, and local representatives and relevant regulatory agencies. Comments were encouraged from the public through the NPS Planning, Environment and Public Comment (PEPC) website and hardcopy comments were accepted by U.S. mail or dropped off at the park office. During the original scoping period, comments were received from two representatives of environmental organizations and one individual. No additional comments were received during the second scoping period.

The following issues were raised during internal and public scoping and will be addressed within the scope of the EA:

- The EA should include the following information on Lagunitas Creek:
    - Current channel condition and the potential carrying capacity of the post-project channel

  - Flow expectations for the side channels: Would side channels be filled in higher than normal flows? Would channels be drained in summer?
  - Extent of the area to be restored to floodplain and target elevations and water depth across the future potential floodplain
- The EA should include the following information on the proposal project:
  - Location of staging areas and access routes for construction
  - Site plans for each site including extent of dredging, woody debris siting
  - Cut/fill ratios for grading: If there is to be excess cut, where materials would be disposed? Would stabilization and revegetation at the disposal site be needed?
  - Description of other projects with similar strategies that have been successful
  - Explanation why wood structures are not proposed for the side channels instead of the main channel where currents are greater
  - Explanation of how project design would react to storms and other natural events
  - Monitoring and adaptive management components to ensure project structures and channels would be rebuilt or replaced by another design if they were damaged by storms
  - Information on the Phase II sites
  - Effectiveness and success criteria
  - Adjacent land uses
  - Invasive plant species control methodology during construction and restoration
  - Would isolated pools or other safe areas for salmonids be created?
- The EA should provide information on the following resources:
  - The existing under-road cattle crossing at the Tocaloma site
  - Current habitat types in the project area
- The EA should consider the following alternative:
  - An alternative that would drive vertical logs into the stream bed which could then naturally collect large woody debris flowing downstream and thus reduce the need and cost to install the 30-35 foot long logs with root systems attached
- The EA should assess the potential project impacts and provide mitigation measures on the following issues:
  - Changes to current habitat types
  - Impacts to areas used as access routes

- Impacts of revegetation including source of revegetation materials
- Impacts from storms on the proposed wood structures
- Potential flood-inducing impacts of the proposed project on upstream and downstream private property and public resources, both during average wintertime flows, but also during high-water flow events
- Potential damage that could occur to private property or public structures if logs from the restoration structures should break loose
- Effects on the hydrologic regime of Lagunitas Creek
- Effects on sensitive biological resources within and adjacent to Lagunitas Creek, such as freshwater shrimp and red-legged frog
- Potential impacts to water quality including mitigation and monitoring
- Impacts to soils and mitigation measures for protection of disturbed soils
- Success criteria for revegetation of disturbed areas
- Compare impacts of a side channel versus dewatering during construction at the Tocaloma and McIsaac sites

1.7 IMPACT TOPICS TO BE CARRIED FORWARD FOR FURTHER ANALYSIS

Impact topics are the resources or values that could be affected, either beneficially or adversely, by implementing the proposed project. Impact topics that are given further analysis in EA Chapter 3, Environmental Consequences, are significant issues that play a key role in making a decision on the project. Other issues that arise from project implementation but that are not central to the proposal or of critical importance are addressed in Section 1.8 of this EA, Impact Topics Considered but Dismissed from Further Analysis.

NPS NEPA Guidance states that as a general rule, issues should be carried forward for detailed analysis if:

- The environmental impacts associated with the issue are central to the proposal or of critical importance.
- A detailed analysis of environmental impacts related to the issue is necessary to make a reasoned choice between alternatives.
- The environmental impacts associated with the issue are a big point of contention among the public or other agencies.
- There are potentially significant impacts to resources associated with the issue.

Based on input during public and internal scoping, the following issues will be carried forward for further analysis in Chapter 3, Environmental Consequences:

- Soils and Water Resources
- Special-Status Species
- Vegetation Resources
- Wildlife
- Cultural Resources
- Visitor Experience and Recreation Resources

1.8 IMPACT TOPICS CONSIDERED BUT DISMISSED FROM FURTHER ANALYSIS

The following impact topics were initially considered but were subsequently dismissed from analysis. In each case, it was determined that the impact topic did not warrant detailed analysis for the reasons outlined.

Soundscape. Although noise often has a negative connotation, one of the intrinsic values of national parks remains the potential for hearing "natural" noises such as crashing waves, running streams, or singing birds. A combination of noises that is intrinsic to a natural landscape is often characterized as a soundscape. Although the project area has a natural soundscape, occasional highway noise is audible at the project sites. Project construction would result in short-term, sporadic increases in noise levels surrounding the project area due to the creation of staging and access routes (movement of trucks and other machinery). There are no permanent residences next to the project sites; therefore, the nearest sensitive receptors to any of the construction areas would be recreational users in the park. Most of these users would likely be on the Cross Marin Trail. This trail would generally be open during construction; however, there may be temporary delays while machinery is moved across the trail during construction activities.

The vast majority of work would occur between August 1 and October 15. If replanting is necessary this work could extend later in the year. All work would be limited sunrise to sunset Monday through Sunday. Existing noise levels (approximately 29 A-weighted decibels (dBA)) could increase (up to 83 dBA) for short periods of time due to use of equipment needed to provide access and/or to place project proposed log structures within the creek. Because trail users are typically mobile, the duration of exposure to construction noise would be variable, and in any instance, intermittent and relatively brief (less than an hour).

Air Quality. Effects from the project would be temporarily adverse but limited over the short term due to the generation of pollutants from construction equipment during the brief deconstruction period. Operation of multiple pieces of heavy equipment would result in increased production of oxides of nitrogen (NO_x) and particulates for the duration of project activities. The Sacramento Metropolitan Air Quality Management District has produced a Roadway Construction Emissions Model (version 7.1.5.1) that was used to quantify construction emissions associated with off-road equipment and on-road worker vehicle emissions. Unmitigated construction-related (grubbing/land clearing) criteria pollutant exhaust emissions for the project are presented below.

Table 1
Average Daily Construction-Related Pollutant Emissions (pounds/day)

Scenario	ROG	NO_x	Exhaust PM_{10}[a]	Exhaust $PM_{2.5}$[a]
Unmitigated emissions	1.2	11.9	0.7	0.6
BAAQMD construction threshold	**54**	**54**	**82**	**54**

ROG = reactive organic gas; NO_x = oxides of nitrogen; PM_{10} = coarse particulate matter; $PM_{2.5}$ = fine particulate matter; BAAQMD = Bay Area Air Quality Management District.
Emissions include results modeled with the Sacramento Metropolitan Air Quality Management District Roadway Construction Emissions Model. Daily emissions are based on the grubbing/land clearing phase in the model, assuming that six workers, a backhoe, and a crane would be needed for a total duration of 15 days.
[a] The Bay Area Air Quality Management District's construction-related significance thresholds for PM_{10} and $PM_{2.5}$ apply to exhaust emissions only and not to fugitive dust (BAAQMD 2010).

As shown, maximum average daily emissions would be minimal and would not exceed the Bay Area Air Quality Management District daily significance thresholds during construction. The Bay Area Air Quality Management District develops regulations to improve public health, air quality, and the global climate based on the measures established under regional plans. Thus, the project would have a minimal impact in relation to construction emissions. In addition, the project would not result in long-term activities that would generate air pollutant emissions. As such, the project would have no impact in relation to operational emissions.

Park Operations and Management. Parks must consider the potential effects of proposed actions on overall park operations. Because this is a short-term construction project and will be managed and built by MMWD, this project would not significantly affect NPS operations and management. MMWD would be responsible for any damage to park facilities (including trails) that occurs as a result of construction activities. MMWD would also monitor proposed structures in the creek to guard against future damage to NPS facilities. MMWD would retain long-term responsibility for any maintenance (as needed) of the project structures following construction.

Adjacent Land Use. Lagunitas Creek is located in western Marin County (West Marin Planning Area), and the project area lies within the PRNS, as indicated on Figure 1. The West Marin Planning Area does not include any incorporated cities or towns (County of Marin 2007) and generally consists of open space and agricultural lands and small communities, including Bolinas, Dillon Beach, Inverness, Muir Beach, Nicasio, Point Reyes Station, Stinson Beach, and

Tomales, each of which has its own community plan. None of these communities are close to the project area. Although there are roadways near each of the project sites, surrounding land uses are primarily public open space. The nearest residences are the McIsaac Ranch, about 0.1 miles from the Tocaloma project site (Site 10), its associated upstream cottage, about 0.1 miles from Site 5, and the Zanardi Ranch, about 0.2 miles from Site 7.

Implementation of the proposed project would enhance Lagunitas Creek, and would not adversely change the existing surrounding environment or adjacent land uses. Temporary impacts to adjacent recreational facilities are discussed in Chapter 3.6, Visitor Experience and Recreation Resources. There is an existing under-road cattle crossing near the Tocaloma project site (Site 10), but this facility would not be impacted by project construction or operation. The construction and long-term operation of the proposed project would not affect adjacent land uses because impacts would be less than significant. There would be no potential long-range impacts to adjacent land uses from construction of the proposed project.

With respect to major flooding as a natural hazard to people or structures (e.g., roads), none of the proposed actions would have any measurable effects on flood-flow volumes being carried under 5-, 10- or 100-year flood flows because watershed-wide conditions dictate the volume and frequency of peak flows. Furthermore, one of the main design considerations in the proposed action was to avoid any increase in flood hazards to surrounding infrastructure. The project was designed so that there would be no increased flood hazards along adjacent roadways, trails, or facilities, and no increased bank instability below such infrastructure.

Although the project would not change peak flow volumes, it would result in minor, highly localized effects on water surface elevations, flow rates, and flow paths in the immediate vicinity of the proposed engineered log jams. These effects could occur in either direction (i.e., a local lowering of the flood flow or a local raising of the flood flow). For example, the Tocaloma Floodplain project would decrease the elevation of the high-flow channel by roughly 2–3 feet, whereas Sites 3–5 could locally increase the water surface elevation during peak flow periods. However, these changes are not at a magnitude that would be sufficient to adversely affect the built environment or present greater safety hazards for the public. Localized bed elevation increases along the entrenched portions of the main channel at Sites 3–5 would be a maximum of 6 feet. However, the change in flood surface elevation across all sites would be limited because such flows would be spread out over a much greater cross-sectional area. Furthermore, the influence of the project increases in bed elevation would not be felt very far upstream due to the longitudinal slope/profile of the creek.

Socioeconomic Resources. The proposed project would not contribute to the local economy and would have no impacts on socioeconomic resources, including gateway communities and employment.

Environmental Justice. Executive Order 12898 requires that all federal agencies evaluate the impact of proposed actions on minority or low-income communities. According to the U.S. Environmental Protection Agency's Office of Environmental Justice, environmental justice is the "fair treatment of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws. Fair treatment means that no group of people should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local, and tribal programs and policies." For environmental justice impacts to occur, significant environmental impacts attributable to a project must fall disproportionately upon environmental justice populations within the affected area. The proposed action would not have disproportionate health or environmental effects on minorities or low-income populations or communities as defined in the U.S. Environmental Protection Agency's Environmental Justice Guidance (1998). Any temporary closures of trails during construction would be equally applied to all visitors, regardless of race or socioeconomic standing. Any socioeconomic impacts would not disproportionately affect members of environmental justice populations.

Indian Trust Resources. The archaeological and cultural resource investigation and survey, which included correspondence with the Native American Heritage Commission, local Native American tribal representatives, and other interested parties, did not identify any tribal land uses or sacred sites in the project area (Salisbury and Roscoe 2015). A project area record search at the California Historical Resources Information System's Northwest Information Center in Rohnert Park, California, and a pedestrian field survey were also completed. Further cultural and historic resource issues are described in the Cultural Resources discussion in Chapter 3 of this EA.

Night Sky. NPS Management Policies 2006 direct NPS to "preserve, to the greatest extent possible, the natural lightscapes of parks, which are natural resources and values that exist in the absence of human-caused light." Recognizing the roles that light and dark periods and darkness play in natural resource processes and the evolution of species, NPS will protect natural darkness and other components of the natural lightscape in parks. Natural darkness or "night skies" can be impacted by artificial lighting. The proposed action would have no impacts to night skies, particularly because construction would occur only during daylight hours.

Relationship between Short-Term Uses of the Environment and Maintenance and Enhancement of Long-Term Productivity. The proposed action could have short-term adverse effects as described in Chapter 3. These possible impacts are limited and would be reduced by project design and associated mitigation. The project was designed to stabilize and improve Lagunitas Creek salmonid populations by increasing the winter habitat carrying capacity for coho salmon and steelhead trout in Lagunitas Creek, enhancing habitat and increasing long-term productivity.

Climate Change – Carbon Sequestration. Carbon sequestration potential—the ability of natural areas to act as a sink for carbon dioxide—is strongly tied to habitat type, with salt marshes, mangrove forests, and eelgrass meadows being considered the "highest sink" coastal ecosystems, because carbon is taken up by plants and stored long term in soils. Riparian soil does not have the same storage capacity as these other habitats. Therefore, the proposed action would be unlikely to have more than limited benefits on carbon sequestration.

Climate Change – Sea Level Rise. With rising sea levels, there will be more frequent and more serious flooding of low-lying coastal areas by extreme tides, storm surges, and wave effects. However, because the project sites are 50–85 feet above mean sea level the project would not be affected by sea level rise.

Wilderness. The project area is not located within designated wilderness and therefore wilderness will not be impacted.

CHAPTER 2
PROJECT DESCRIPTION

2.1 INTRODUCTION

The National Environmental Policy Act (NEPA) requires federal agencies to conduct a careful, complete, and analytical study of the impacts of proposals that have the potential to affect the environment, and consider alternatives to that proposal well before any decisions are made. Generally, development of a range of alternatives is required when preparing an environmental assessment (EA), as is a description of the no-action alternative (43 CFR 46.310). There is no minimum number of alternatives that must be developed when preparing an EA.

Furthermore, in instances where it is determined that there are "no unresolved conflicts about the proposed action with respect to alternative uses of available resources," the requirement to consider a range of alternatives, including the no-action alternative, does not apply (43 CFR 46.310(b)). In such circumstances, an EA need only evaluate the impacts of the proposed action. In this EA, the proposed alternative and a no-action alternative are analyzed.

The decision that will be made as a result of this analysis is focused solely on the actions described below. This chapter details eight restoration and enhancement sites as indicated on Figure 2.

2.2 ALTERNATIVE DEVELOPMENT PROCESS AND ALTERNATIVES CONSIDERED BUT DISMISSED FROM FURTHER EVALUATION

Alternatives for winter habitat and floodplain enhancement in Lagunitas Creek first began to be developed in 2009 when the assessment phase of the project defined the assessment study area. Initially, the study area was to be the main stem of Lagunitas Creek. Later, the study area was expanded to include the lower portion of Olema Creek, as recommended by NPS staff, where it was felt that enhancement opportunities existed. Other tributaries were not included within the assessment study area because private property in San Geronimo Creek would have restricted floodplain enhancement, limiting enhancement opportunities, and carried a high degree of liability concern. Devils Gulch and other smaller tributaries did not have any real floodplain opportunities. Thus, the assessment phase focused on mainstem Lagunitas Creek and lower Olema Creek.

In 2011, the Marin Municipal Water District (MMWD) began planning and design for Site 10 (the Tocaloma Floodplain site). Because of the location, size, and accessibility of the floodplain adjacent to the creek channel, this site had been singled out as an excellent opportunity for winter habitat/floodplain enhancement. The initial design concept was to develop a backwater area within the floodplain and three alternative backwater design concepts were considered:

- A large, backwater pond

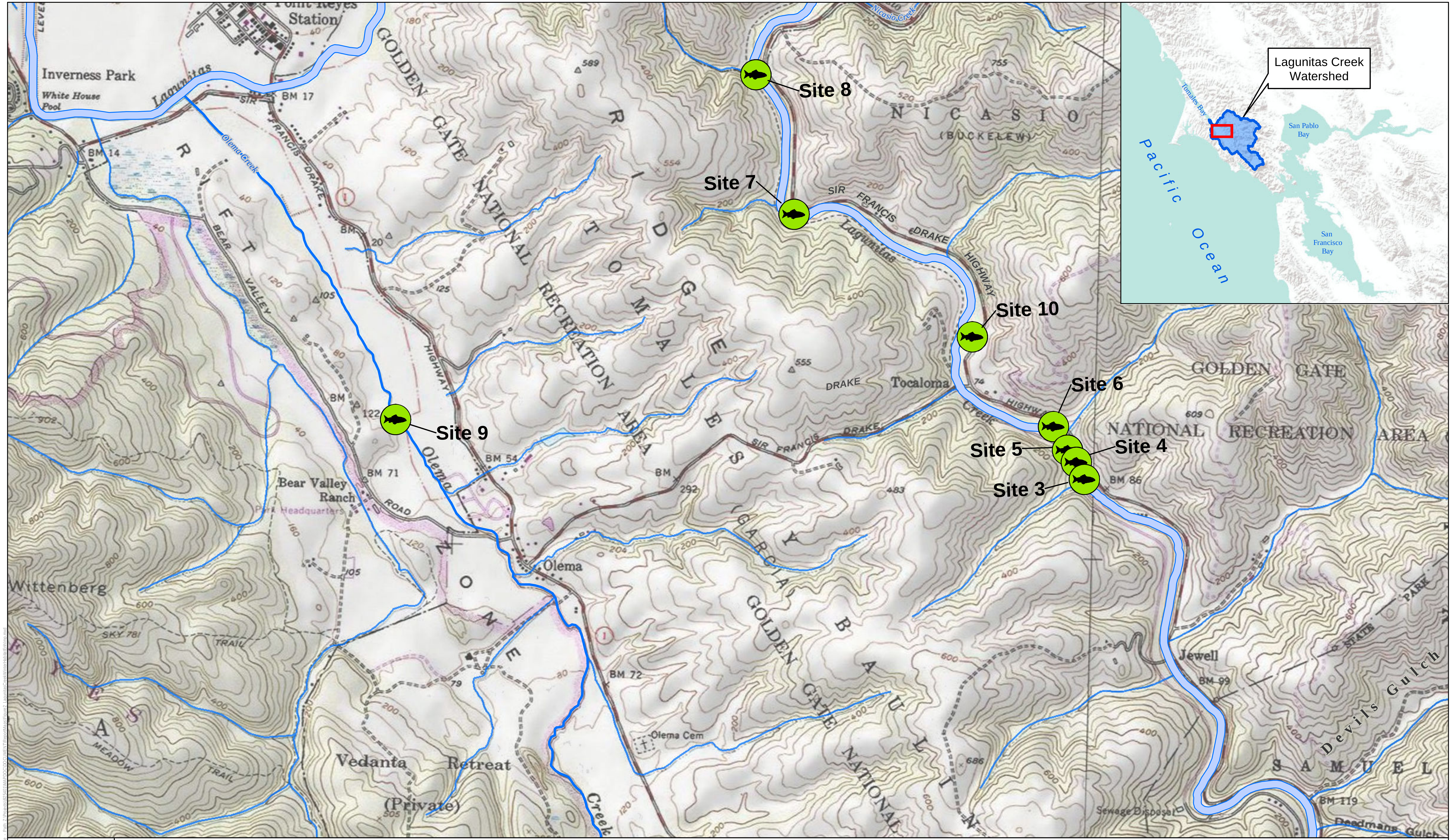
- A backwater pond with a central island within it
- Two backwater arms extending into the floodplain

However, after a review of these concepts by the California Department of Fish and Wildlife (CDFW), the State Water Resources Control Board (SWRCB), and the Lagunitas Creek Technical Advisory Committee, the backwater concept was set aside due to concerns associated with ponding that any backwater design would entail. The concerns were related to the potential for stranding fish, becoming breeding sites for bass or other non-native predatory warmwater fish, and increased water temperatures during the drier time of the year. Therefore, the flow-through, floodplain side channel concept that is the design presented here as part of the proposed project was developed.

In 2013, MMWD issued the Lagunitas Creek Salmonid Winter Habitat Enhancement Assessment Report (Kamman 2013) which evaluated existing winter habitat, habitat needs, and opportunities for enhancement to increase the winter habitat carrying capacity for coho salmon (*Oncorhynchus kisutch*) and steelhead trout (*O. mykiss*) in Lagunitas Creek. The winter habitat assessment was completed following an evaluation of hydrologic conditions, reconnaissance site visits, winter flooding field observations and measurements, numerical modeling of base flows and high-flow events, consideration of opportunities and constraints to enhance winter habitat, and identification of winter habitat enhancement approaches. During the assessment, it was determined that winter habitat and floodplain enhancement could best be achieved in the lowest reaches of Lagunitas Creek and in lower Olema Creek. There are floodplain areas in these reaches that could be reactivated. Further upstream, in mainstem Lagunitas Creek, it was found that the deep canyon which Lagunitas Creek flows through has very narrow and limited floodplain areas. Thus, the assessment eliminated mainstem Lagunitas Creek between Peters Dam and Swimming Hole Bridge (downstream of Devils Gulch) from further consideration and focused on the reaches from Swimming Hole Bridge down to Point Reyes Station, along with lower Olema Creek, for enhancement sites.

The proposed project design built upon the 2013 Winter Habitat Enhancement Assessment Report and consultation between MMWD and CDFW, the U.S. Fish and Wildlife Service (USFWS), SWRCB, the National Oceanic and Atmospheric Administration (NOAA) Fisheries division, and the Technical Advisory Committee. The consultation process considered and eliminated the following four alternative enhancement sites:

- Above Coast Guard Station, Point Reyes Station, Floodplain Enhancements
- North Marin Water District Well Site, High Flow Channel/Alcove Enhancements
- Nicasio Creek Confluence, Overbank Enhancements
- Samuel P. Taylor Park Reach, Further Augmentation of Existing Large Woody Debris Structures



SOURCE: Marin Municipal Water District, 2017

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FIGURE 2

Lagunitas Creek Winter Habitat Enhancement Implementation

Lagunitas Creek Winter Habitat and Floodplain Enhancement

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The first two sites, Above Coast Guard Station and North Marin Water District Well Site, were both eliminated because the habitat enhancement benefits were outweighed by the impacts and costs. Both sites have difficult access that would require significant impacts to get equipment to the site (essentially tracking equipment long distance where there is no road). Also, both would have required excessive bank and floodplain excavations with large areas of sediment disposal within riparian habitat (due in large part to how deeply incised the channel is through this reach of the creek). The Nicasio Creek Confluence site was eliminated because it was felt that the main channel and floodplain were already fairly complex and functioning such that there would not be as much benefit to be gained at this site as at other sites. Augmentation of existing woody debris structures through the Samuel P. Taylor Park reach was also eliminated from further consideration for this project because MMWD could pursue this as a separate, independent effort in the course of the district's work to continue installations of woody debris structures and provide maintenance of existing structures under the Lagunitas Creek Stewardship Plan.

Six other sites were retained and moved forward into the more detailed design stage:

- 449 Creek, High Flow Channel Enhancements (developed as Site 8)
- Zanardi Ranch, Floodplain Enhancements (developed as Site 7)
- Above Tocaloma, Floodplain Pond (developed as Site 6)
- McIsaac Creek, Floodplain Enhancements (developed as Sites 3–5)
- Below Big Bend, Channel Enhancement (developed as Sites 1 and 2)
- Olema Creek, Corridor Enhancements (developed as Site 9)

In most cases, the design concepts and features developed during the assessment stage were modified or refined. All of the sites were developed as channel and floodplain enhancements using large woody debris (engineered log jam) structures.

Three of these sites—449 Creek, Above Tocaloma, and McIsaac Creek—all were conceptually developed to include off-channel ponds within the associated floodplains. As with Site 10 (the Tocaloma Floodplain site), described previously, the concerns expressed about creating off-channel ponds led to those features being eliminated. The concepts were modified to reengage the mainstem channel with the floodplain as flow-through features.

Site 449 was identified as Site 8 and was relocated slightly upstream from the initial setting but was still focused on reengaging the same segment of floodplain. The Zanardi Ranch site was identified as Site 7 and was relocated slightly downstream where a longer area of floodplain could be reengaged. The Above Tocaloma site was refined and identified as Site 6 and the McIsaac Creek site was refined as Sites 3–5, all focused on reengaging the same segments of floodplain.

The Below Big Bend site was refined as Sites 1 and 2, focused on enhancing the same segment of mainstem channel, but also reengaging a segment of floodplain. Sites 1 and 2 are located on California State Parks land and are not under NPS authority and thus are not included as part of the project description for this EA. The Olema Creek sites, which were conceptually developed as three separate enhancement areas scattered along the creek corridor, were consolidated to a single segment of Olema Creek and defined as Site 9. Also, the initial concept for the Olema Creek sites included carving out floodplain alcoves adjacent to the main channel, but upon consideration of the dynamics of Olema Creek, the design was modified to focus on enhancing the existing channel because alcoves would prove to be less sustainable.

The alternatives analysis resulted in a proposed project with significantly less impacts than any of the alternatives considered. Impacts to stream channel and riparian habitat were significantly reduced by eliminating two alternative project sites, the Above Coast Guard Station and North Marin Water District Well Site, because both would have required excessive bank and floodplain excavations with large areas of sediment disposal within riparian habitat (in this deeply incised section of Lagunitas Creek). Additional construction-related impacts to riparian habitat were also reduced by eliminating these sites, which both have difficult access that would have required tracking equipment long distances adjacent to the creek.

Another alternative site that was eliminated—the Nicasio Creek Confluence site—further reduced stream and riparian habitat impacts because the site already functions well. The impacts of a project at this location outweighed the marginal benefits that might have been achieved in this particular part of the creek.

Project design alternatives were developed that provided environmental benefits and reduced or eliminated potential impacts:

- Off-channel ponds were eliminated, thus eliminating potential sites where invasive, predatory fish or wildlife could become established (e.g., bass or bullfrogs).
- Eliminating off-channel ponds also eliminated potential impacts to native fish and wildlife from degraded water quality conditions—areas of lower dissolved oxygen and/or higher temperatures—or areas of stagnant water were mosquitos could breed.
- Potential stranding of native fish was reduced or eliminated.

Finally, alternative construction approaches were developed and selected that reduce impacts:

- Impacts to native fish and wildlife occupying approximately 1,000 feet of Lagunitas Creek have been significantly reduced by the alternative construction method developed for the Log Debris Retention Jam (LDRJ) structures. Using the proposed temporary work platforms would allow the LDRJs to be installed in the flowing stream and would eliminate the need to dewater the creek at project Sites 4, 5, 7, and 8 (for the LDRJ at Site 8). This approach significantly reduces impacts to coho salmon, steelhead, and California freshwater shrimp.

2.3 DESCRIPTION OF PREFERRED ALTERNATIVE

There are seven specific locations on Lagunitas Creek and one on Olema Creek (as indicated in Figure 2) where MMWD proposes to restore and enhance natural hydrological processes and habitat within the creek: Sites 3–8 and Site 10 (which is also known as the Tocaloma Floodplain Site) are on Lagunitas Creek and Site 9 is on Olema Creek. The approximate center of the project area corresponds to the intersection of Sir Francis Drake Boulevard and Platform Bridge Road, east of the town of Olema. Sites 3–6 are located approximately 0.3 miles upstream, near the confluence of Lagunitas Creek with the tributary stream known as McIsaac Creek. Sites 7 and 8 are located approximately 1 and 1.5 miles downstream from the intersection, respectively, off Platform Bridge Road between Sir Francis Drake Boulevard and the Point Reyes–Petaluma Road. Site 10 (the Tocaloma Floodplain Site) is located approximately 700 feet downstream from this intersection, off Platform Bridge Road. Site 9 is the only site on Olema Creek, off Bear Valley Road and across from the Point Reyes National Seashore Headquarters.

The proposed winter habitat enhancement project would reconnect the base flow channel of Lagunitas Creek to existing floodplain channels, which can provide additional winter refuge and rearing habitat for juvenile coho salmon and steelhead trout. The proposed project would promote more frequently active high flows in side channels and across the larger floodplain to provide critical winter habitat for juvenile coho and steelhead. The proposed actions would also enhance habitat within the main base flow channel of Lagunitas Creek, at Sites 3–8, and Olema Creek, at Site 9, where large woody debris/engineered log jams would be installed. In addition, habitat enhancement features, such as log structures in the floodplain channels and the clearing of vegetation, would be implemented along the reconnected floodplain channels in order to provide habitat structure and improve flow within the floodplain. The goal is to address the primary limiting factor on salmonid populations—the need for more overwintering habitat for juvenile fish—in order to increase the creek's overall salmonid population.

At Sites 3–8, the primary method proposed for modifying creek hydrology would be the construction of large woody debris structures (engineered log jams) in the main stream channel designed to obstruct and backwater flows, raise creek water elevations, and deflect flows into existing adjacent floodplain channels on a more frequent basis than currently occurs under current winter flow conditions. At the Tocaloma Floodplain site (Site 10), an existing, remnant floodplain side channel would be excavated so that winter base flows could inundate the channel, making it available habitat for juvenile salmonids to occupy throughout much of the winter rearing period. In this location, large woody debris structures would be installed adjacent to

Lagunitas Creek and along the excavated side channel, allowing for the deepening and improved stability of that side channel as well as providing habitat for salmonids.

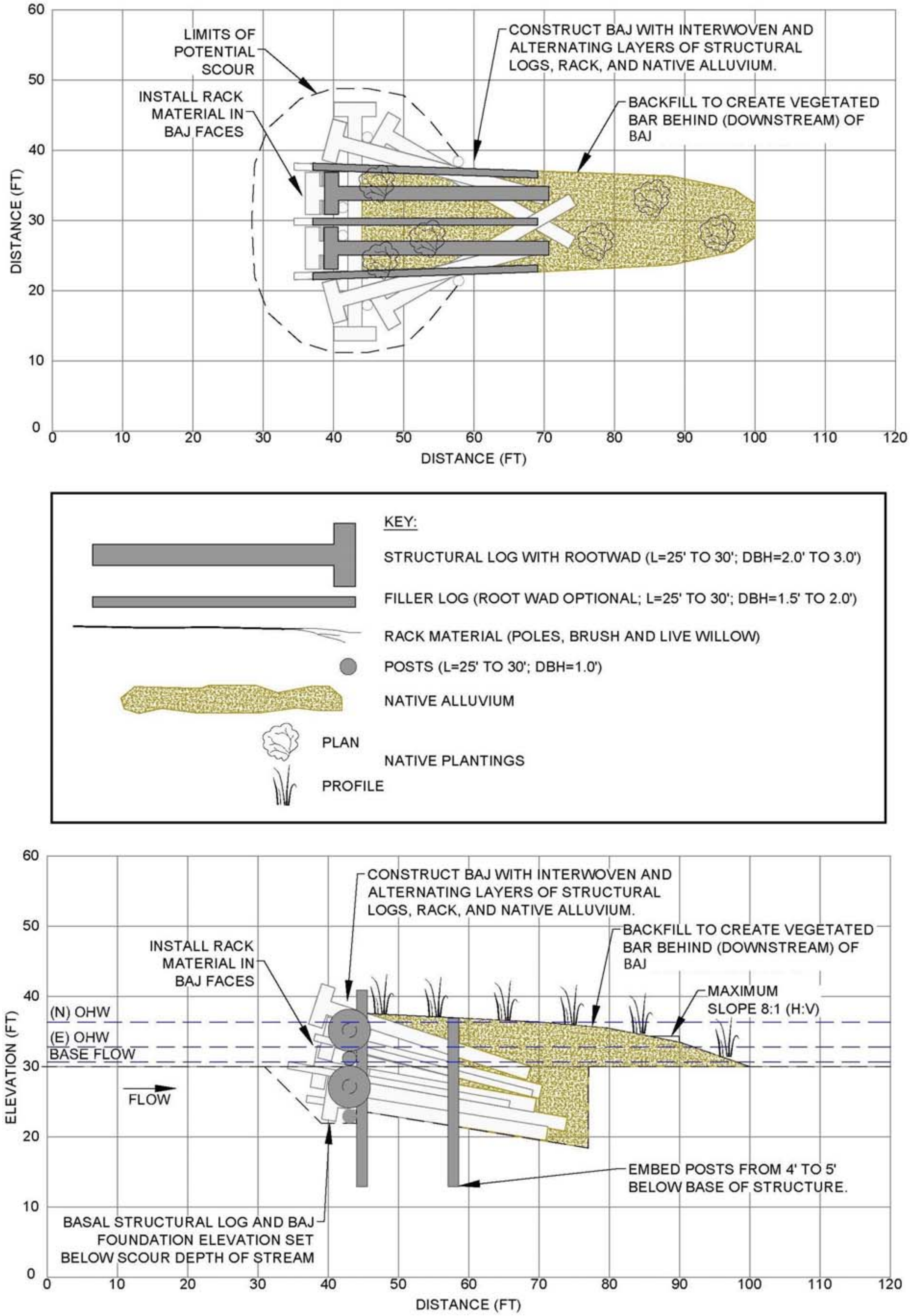
The design for Site 9 on Olema Creek uses a more passive "self-healing" approach, which incorporates construction of periodic log structures intended to (a) reduce knick-point[1] and incised channel migration and (b) capture and accumulate logs, debris, and sediment to fill a long stretch of incised channel, restoring a more natural channel morphology and connection to the adjacent floodplain, similar to what exists immediately downstream of the project reach. Instream structures would also reduce high flow velocities and provide instream cover. These same attributes apply to the engineered log jam projects on Lagunitas Creek.

A combination of three specific log structures would be used within the creek at different locations: a Bar Apex Jam (Figure 3), a Log Debris Retention Jam (Figure 4), and a Log Cross-Vane (Figure 4). Temporary Work Platforms (Figure 4) would be placed at Sites 4, 5, 7, and 8.

The eight project sites and habitat enhancement features are referred to as:

- **Site 3** – McIsaac Upstream Bar Apex Jam
- **Site 4** – McIsaac Upstream Log Debris Retention Jam 1
- **Site 5** – McIsaac Upstream Log Debris Retention Jam 2
- **Site 6** – McIsaac Downstream Bar Apex Jam
- **Site 7** – Fern Rock Log Debris Retention Jams
- **Site 8** – 449 Creek Log Debris Retention Jam and Bar Apex Jam
- **Site 9** – Olema Creek Log Cross-Vane and Log Debris Retention Jams
- **Site 10** – Tocaloma Floodplain Site, Floodplain Side-Channel Enhancement

1 A knick-point is part of a river or channel where there is a sharp change in channel slope, often caused by previous erosion.



SOURCE: Marin Municipal Water District, 2016

FIGURE 3

Bar Apex Jam Design Diagram

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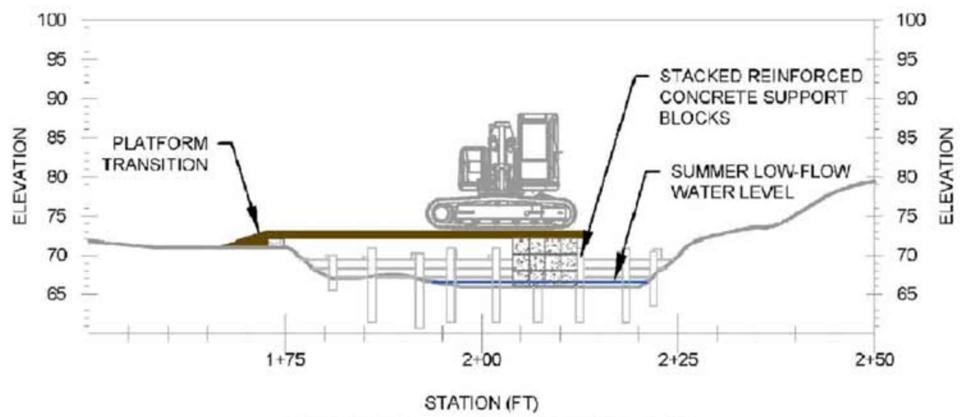

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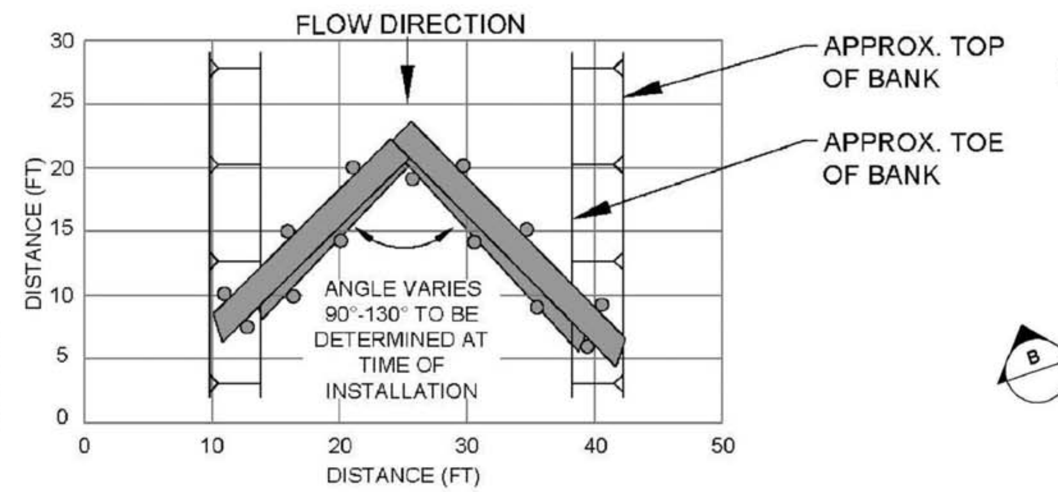
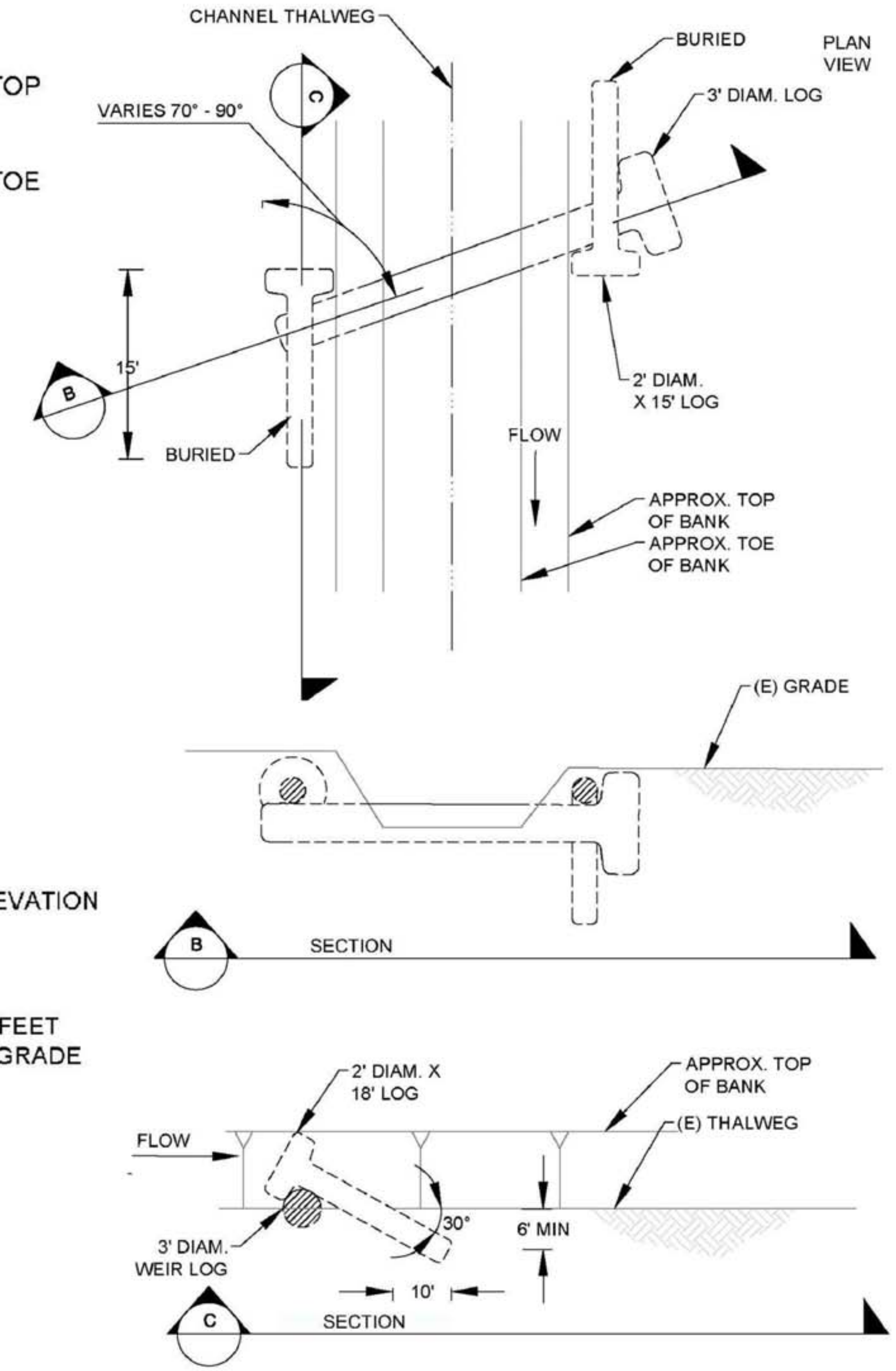
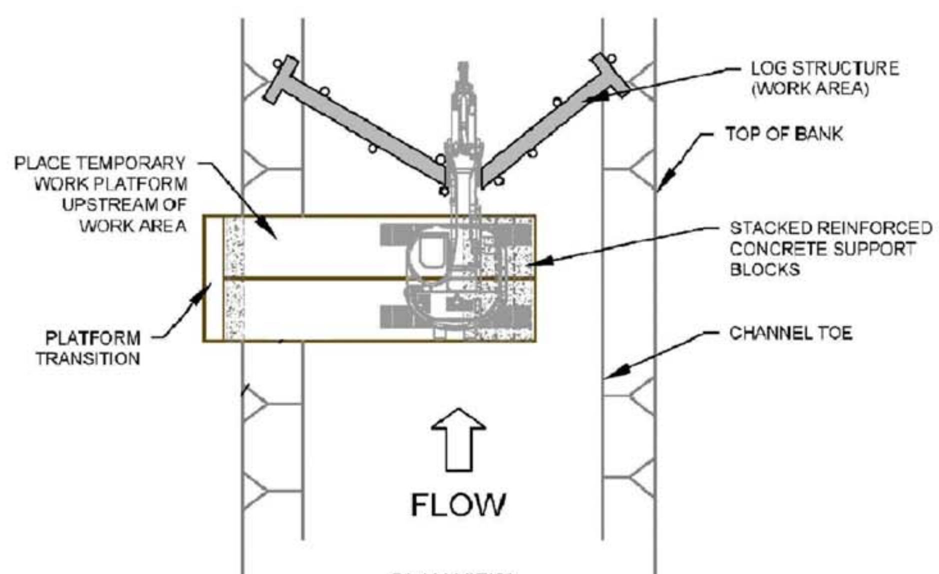


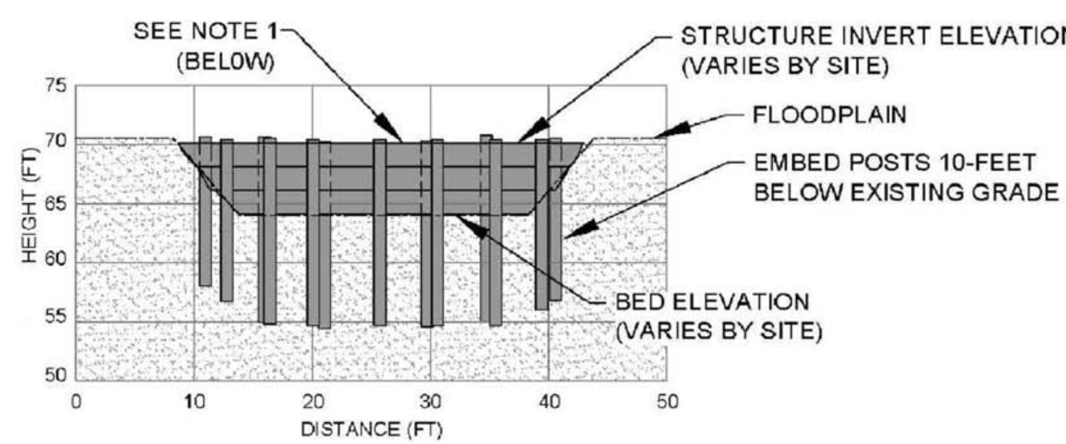
PLAN VIEW

QUANTITY ESTIMATES (TYP)	
STRUCTURAL LOGS	4
POSTS	12





PLAN VIEW



Typical Log Debris Retention Jam (LDRJ) (NTS)

KEY

STRUCTURAL LOG (L = 25-FT TO 30-FT; DBH = 2.0-FT TO 3.0-FT)

POSTS (SECTION VIEW) (MIN. DBH = 1.5-FT) (L = 10-FT TO 15-FT)

POSTS (PLAN VIEW) (MIN DBH = 1.5-FT)

Temporary Work Platform Schematic (NTS)

Typical Log Cross-Vane (NTS)

KEY

STRUCTURAL LOG WITH ROOTWAD (L=25' TO 30'; DBH=2.0' TO 3.0')

RACK MATERIAL (POLES, BRUSH AND LIVE WILLOW)

POSTS (MIN. DBH = 1.5')

DUDEK

SOURCE: Marin Municipal Water District, 2016

FIGURE 4

Log Debris Retention Jam/Log Cross-Vane/Temporary Work Platform Design Diagram

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The proposed woody debris/engineered log jam structures would consist of locally sourced natural materials, primarily logs with root systems attached. Vertical pinning logs would be driven into the streambed to secure the log structures. The design for the Bar Apex Jams (BAJs) at Sites 3, 6, and 8 call for these structures to be imbedded into the streambed, thus requiring excavation of the bed, after completing a clear-water[2] diversion around the site. In addition, rock, sand, and gravel from the existing streambed would be placed over the downstream portion of the structures and planted with locally sourced native riparian vegetation to stabilize the installed structures. The LDRJs at Sites 4, 5, 7, 8, and 9 would be installed by allowing equipment to reach both sides of the creek during the installation of the LDRJs. A plan for water handling during construction along with a detailed plan for the equipment platform to install the LDRJs has been established and is discussed in further detail below. This approach eliminates the need to dewater the creek during the installation of the LDRJs, which would be applicable to Sites 4, 5, 7, and 8. The upstream-most Log Debris Retention Jam and Log Cross-Vane at Site 9 would be partially imbedded in the channel and would therefore require clear-water diversions. All designs would be reviewed and approved by CDFW and SWRCB prior to construction.

The construction period would be August 1 into December; however, the vast majority of work would occur between August and October 15 and instream work will only be done during this August–October 15 period. All activities associated with the construction of the BAJ, LDRJ, and Log Cross-Vane facilities would be completed by October 15. The only work that could be conducted between October 15 and early December would be the replanting on the BAJs and work within the floodplain. Project construction would be implemented as specified in the Project Site Plans (Appendices B1 and B2). The entire project would be completed over two seasons, with Sites 3, 4, 5, 6, and 10 during the first season and Sites 7, 8, and 9 during the following season.

Staging areas may need to be temporarily fenced to provide security for refueling equipment, storage containers, and parked vehicles, as well as to keep people out of staging areas. Vegetation would be removed only as part of an effort to control invasive plants or to allow for construction access. If possible, vegetation would be cut back or cut low to allow resprouting. Upon completion of this project, all staging areas and access routes would be returned to their former condition. This work may include regrading and/or repaving of access routes and staging areas in order to restore the project site. Replanting would be sourced from the local genotype whenever possible.

During project construction visitors would be excluded from areas where heavy equipment is in use, but not excluded from using Cross Marin Trail. The segment of the trail at the project site would

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[2] Clear-water creek diversion consists of a system of structures and measures that divert water upstream of a project site, transport it around the work area, and discharge it downstream with minimal water quality degradation for either the project construction operations or the construction of the diversion.

generally not be closed for public use during construction, but some limited control of access may be needed, at certain times of the day causing short delays in access.

Construction elements for all sites would include mobilization and demobilization, materials delivery, clearing of vegetation, provision of an equipment access route, staging, and sediment and turbidity control. A detailed site clear-water creek diversion plan would be developed for all sites that require dewatering. Existing site conditions are depicted in project site photographs found in Appendix C. The site-specific construction activities are discussed below for each site.

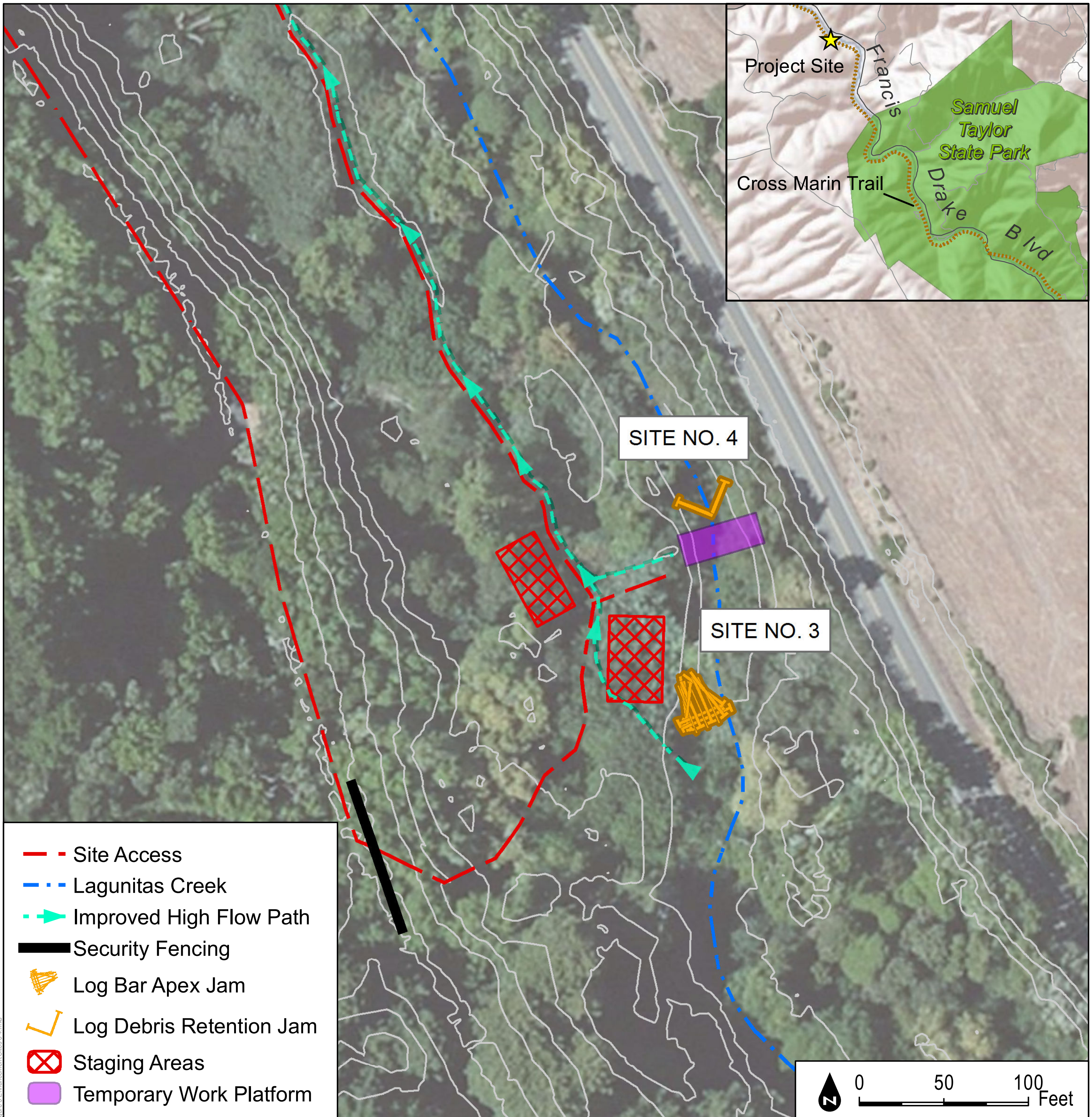
Project Site Descriptions

In some locations, cofferdams (constructed of sheet piling; sandbags or gravel bags secured with polyethylene plastic sheeting; water-filled bladders; interlocking sheet piling; and/or other material) would be constructed and keyed in at the creek channel immediately upstream and downstream of the work area. Lagunitas Creek water would flow by gravity from the upstream side of the cofferdam into an existing, naturally occurring high-flow side channel (or through flexible hose or PVC pipe) around the work area then back into the creek at an outfall located downstream. Following the clear-water creek diversion, any remaining water within the work area (i.e., water trapped in between the upstream and downstream cofferdams) would need to be dewatered with small pumps. The water pumped out of the work area would be discharged and dispersed onto the adjacent floodplain area, where it would soak into the soil and not be discharged back into the creek.

Specific water diversions would be finalized during construction based on site-specific conditions. The construction contractor would be required to dewater construction areas to provide for proper excavation and filling. Although diversion methods are left to the discretion of the contractor, the contractor would prepare a diversion plan to be approved by MMWD prior to beginning work. Diversions would employ best management practices (BMPs) and would be maintained in a manner that would not cause adverse disturbance to water quality and the environment.

Site 3 – McIsaac Upstream Bar Apex Jam

Winter habitat enhancement work at this site would include construction of a BAJ and high-flow channel improvements. The flow in the main channel of Lagunitas Creek at Site 3 (and Sites 6 and 8, described below) would require diversion during construction because the stream bed needs to be dry and excavated before the BAJ structures are constructed (see Figure 5). Lagunitas Creek flows year-round, with expected base flows estimated at 8 cubic feet per second (cfs) during the summer construction season. A significant consideration during construction would be minimizing impacts on creek water quality and aquatic habitat during construction which would disturb the channel bed and banks. Diverting water around construction areas would minimize impacts and maintain water quality. Clear-water creek diversion is described in more detail in Appendix B2 and Appendix D (Creek Diversion Memo).



PROJECT	DISTURBANCE AREAS (Square Feet)				
Site #	Access	Staging	Project Structures / Project Features	Total	Vegetation Type(s)
3	14,000	1,615	5,180	20,795	Riparian
4		1,260	1,050	2,310	Riparian

PROJECT	SOIL EXCAVATION QUANTITIES (Cubic Yards)			
Site #	Access	Staging	Project Structures / Project Features	Total
3	0	0	741	741
4	0	0	0	0

SOURCE: Marin Municipal Water District, 2017

FIGURE 5

Enhancement Sites 3 & 4

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The BAJ at Site 3 (and at Sites 6 and 8, described below) would be located in the mainstem channel of Lagunitas Creek, immediately downstream from the mouths of existing side channel entrance locations. The BAJ at Site 3 would reduce the channel conveyance area, obstruct flow, and raise backwater levels to more easily split and deflect high flows between the mainstem channel and floodplain side channel. Prior to dewatering, a fish barrier would be installed (<1/8-inch mesh screen) at locations upstream and downstream of work zone and cofferdam locations per CDFW fish screening criteria. After installation of fish barriers and prior to cofferdam installation, environmental clearances would be completed. Site 3 would be dewatered by installing cofferdams upstream and downstream of in-channel work area. The upstream cofferdam would be constructed to adequate height to allow backwatering of flow into a high-flow channel located on the floodplain adjacent to and parallel to the creek. Water would be diverted around the work zone in this high-flow bypass channel and discharged back to the creek downstream of the cofferdams and fish barriers. Measures to dissipate flow and minimize turbidity at the bypass outfall to the creek would be completed.

A temporary equipment crossing would be needed across the high-flow bypass channel to gain access to the construction area. Some excavation of the channel bed would be necessary to construct the BAJ structure. The BAJ structure can be installed in saturated soils, but some construction dewatering may be necessary. Jetting of stream gravel fill to fill all voids within the structure may be necessary, which would generate turbid water contained within the construction zone between cofferdams. Construction dewatering would be discharged via spray or flood methods onto adjacent floodplain in a manner that prohibits high-turbidity return flows from entering creek. Cofferdams, bypass channel crossing, and fish barriers would be removed after installation of log structures. Proper erosion control measures would be installed in disturbed areas above ordinary high water (per project stormwater pollution prevention plan at completion of construction.)

High-flow channel enhancement would entail clearing vegetation and loose wood from the pathways of the improved high-flow channels, along with some invasive plant species removal. During construction, some large wood and vegetation debris would be removed along the alignments of two targeted high-flow side channels, particularly at the upstream mouth of the channel, adjacent to the BAJ, to enhance the initial flow of water and energy up into and through the floodplain channel once construction is completed. The area of disturbance is described on Figure 5.

The access route and construction staging area for equipment and materials (i.e., primarily the logs to be used for construction of the BAJ, and -creek diversion materials) is shown on Figure 5 and in Appendix B2. Site access and staging will be shared for Sites 3 and 4. Equipment would access the site via a paved path—the Cross Marin Trail—traveling down an embankment and across the floodplain to the project site. Equipment and materials would be staged, set back from the creek.

During project construction visitors would be excluded from areas where heavy equipment is in use, but not excluded from using Cross Marin Trail. The segment of the trail at the project site would not be closed for public use during construction but some limited control of access may be needed, at certain times of the day causing short delays in access.

Site 4 – McIsaac Upstream Log Debris Retention Jam 1

Winter habitat enhancement work at this site would include construction of a log debris retention jam and high-flow channel improvements. The LDRJ is described below. The approach to activities within the floodplain would be similar as described previously for Site 3. The project site is shown on Figure 5 and further described in Appendix B2. This work would not require creek diversion or construction dewatering to install LDRJs but equipment access would be needed across the full channel width.

In order to gain construction access, a Temporary Work Platform would be constructed into the flowing creek per design details (see Figure 4). The platform includes establishing a temporary stable pier (likely constructed of large precast concrete block) in the creek to support a wood platform sufficient to support an excavator. The Temporary Work Platform would not span the full width of creek, but only extend approximately two-thirds of the creek width. An environmental monitor shall be present to provide clearances during the placement of any pier materials into the creek. The disturbance and resulting turbidity from the combined installation/removal of the Temporary Work Platform and log structure construction would be less than that associated with any clear-water diversion or dewatering efforts. The Temporary Work Platform, including concrete block pier, would be removed after installation of the log structure. Proper erosion control measures would be installed in disturbed areas above ordinary high water per the project stormwater pollution prevention plan at completion of construction.

LDRJs are designed to be a channel spanning array/line of logs driven vertically into the bed that act as a sieve to capture and retain woody debris and ultimately sediment. These structures have been termed “trashracks” and “flood fencing.” For this project, large wood cross-pieces (horizontal) would be pre-installed on the uprights to accelerate their performance. These structures would ultimately raise local channel bed grades and raise water elevations in the channel and along banks to direct backwater overbank flows into existing side channels. LDRJs are more passive than the BAJs and are selected for channel reaches that are narrower and more entrenched relative to the adjacent floodplain surface.

The LDRJ structure would be placed in the live, flowing stream channel. The structure would be constructed in two steps, one-half at a time, with half of the structure placed and secured in each step.

The access route and construction staging area for equipment and materials (i.e., primarily the logs to be used for construction of the LDRJ) are shown on Figure 5. Site access and staging will be shared for Sites 3 and 4. Equipment would access the site via a paved path—the Cross Marin Trail—traveling down an embankment and across the floodplain to the project site. Equipment and materials would be staged on the floodplain area, set back from the creek. The area of disturbance is described on Figure 5.

Site 5 – McIsaac Upstream Log Debris Retention Jam 2

Winter habitat enhancement work at this site would include construction of an LDRJ and high-flow channel improvements, including replanting where necessary within the floodplain. The LDRJ would be the same as the facility planned for Site 4, with slight variations to fit the site specific stream configuration at Site 5. The approach to work within the floodplain would be similar to that previously described for Site 4.

The access route and construction staging area for equipment and materials (i.e., primarily the logs to be used for construction of the LDRJ) are shown on Figure 6. Equipment would access the site via a paved path—the Cross Marin Trail—traveling down an embankment and across the floodplain to the project site. Equipment and materials would be staged on the floodplain area, set back from the creek. The area of disturbance is also described on Figure 6.

Site 6 – McIsaac Downstream Bar Apex Jam

Winter habitat enhancement work at this site would include construction of a BAJ and high-flow channel improvements. This work would require creek diversion and construction dewatering. These elements would be the same as the facility planned for Site 3, with slight variations to fit the site-specific stream configuration at Site 6 (see Figure 7 and Appendix B2).

The access route and construction staging area for equipment and materials (i.e., primarily the logs to be used for construction of the BAJ and the clear-water creek diversion materials), as well as the area of disturbance, are described on Figure 7. Equipment would access the site via a paved path—the Cross Marin Trail—traveling down an embankment and across the floodplain to the project site. Equipment and materials would be staged set back from the creek.

Site 7 – Fern Rock Log Debris Retention Jams

Winter habitat enhancement work at this site includes construction of four LDRJs and high-flow channel improvements. See Figure 8 and Appendix B2.

As described in Site 4, the project would include pre-installation of large wood cross-pieces (horizontal) to accelerate performance. The desired function of these structures is to ultimately raise local channel bed grades and raise water elevations in the channel and along banks to backwater overbank flows into existing side-channels. LDRJs are more passive than the BAJs and are selected in channel reaches that are narrower and more entrenched relative to the adjacent floodplain surface.

The four LDRJs at Site 7 would be installed in sequence, starting with the downstream-most structure, building one LDRJ at a time, moving upstream. This work would not require creek diversion or construction dewatering to install LDRJs but equipment access would be needed across the full channel width.

Access for Site 7 would be directly off Platform Bridge Road (see Figure 8). The staging area for equipment and materials would be set back from the creek and the site could also be accessed from this area. The area of disturbance is also described on Figure 8.

Site 8 – 449 Creek Log Debris Retention Jam and Bar Apex Jam

Winter habitat enhancement work at this site would include construction of an LDRJ, a BAJ, and high-flow channel improvements. See Figure 9 and Appendix B2. The upper LDRJ would be installed as described under Site 4 and the downstream BAJ would be installed as described under Site 3.

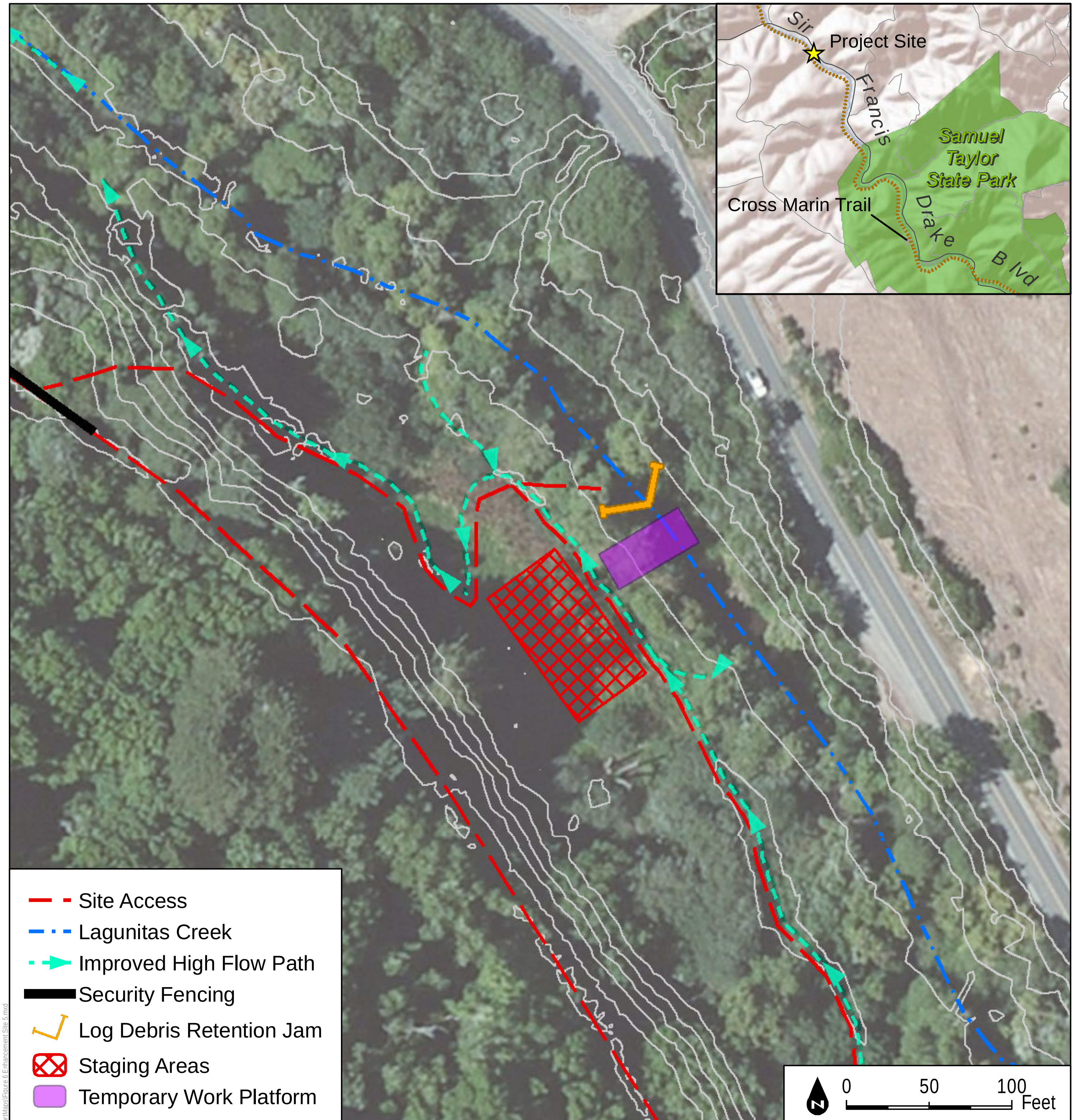
Access for Site 8 would be directly off Platform Bridge Road (see Figure 9). The staging area for equipment and materials would be set back from the creek and the site could also be accessed from this area. The area of disturbance is also described on Figure 9.

Site 9 – Olema Creek Log Cross-Vane and Log Debris Retention Jams

Winter habitat enhancement work at this site would include construction of a Log Cross-Vane as described below, and six creek LDRJs, as described for Sites 4, 5, 7, and 8. See Figure 10 and Appendix B2. This work would require creek diversion and construction dewatering for the Log Cross-Vane and first LDRJ and there would be site replanting where necessary; these elements would be as previously described for Sites 3, 6, and 8.

A single Log Cross-Vane would be installed at the upstream end of the Olema Creek reach to act as a bed grade control structure upstream of an existing knick-point. This structure is intended to provide a hardpoint to resist erosion. It would be used in combination with an LDRJ installed immediately downstream of the knick-point and as a grade control structure that would act as a hydraulic control, creating backwater conditions to reduce energy gradients, reduce erosion, and act to trap debris and sediment.

The creek channel needs to be dewatered in order to complete the installation of Log Cross-Vanes. Due to the proximity of the first LDRJ, the combined work area for these two structures will be dewatered. Prior to dewatering, fish barriers will be installed at locations upstream and downstream of the in-channel work zone per CDFW fish screening criteria. After installation of fish barriers and prior to cofferdam installation, environmental clearances will be completed.



PROJECT	DISTURBANCE AREAS (Square Feet)				
Site #	Access	Staging	Project Structures / Project Features	Total	Vegetation Type(s)
5		4,631	1,350	5,981	Riparian

PROJECT	SOIL EXCAVATION QUANTITIES (Cubic Yards)			
Site #	Access	Staging	Project Structures / Project Features	Total
5	0	0	0	0

SOURCE: Marin Municipal Water District, 2017

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FIGURE 6

Enhancement Site 5

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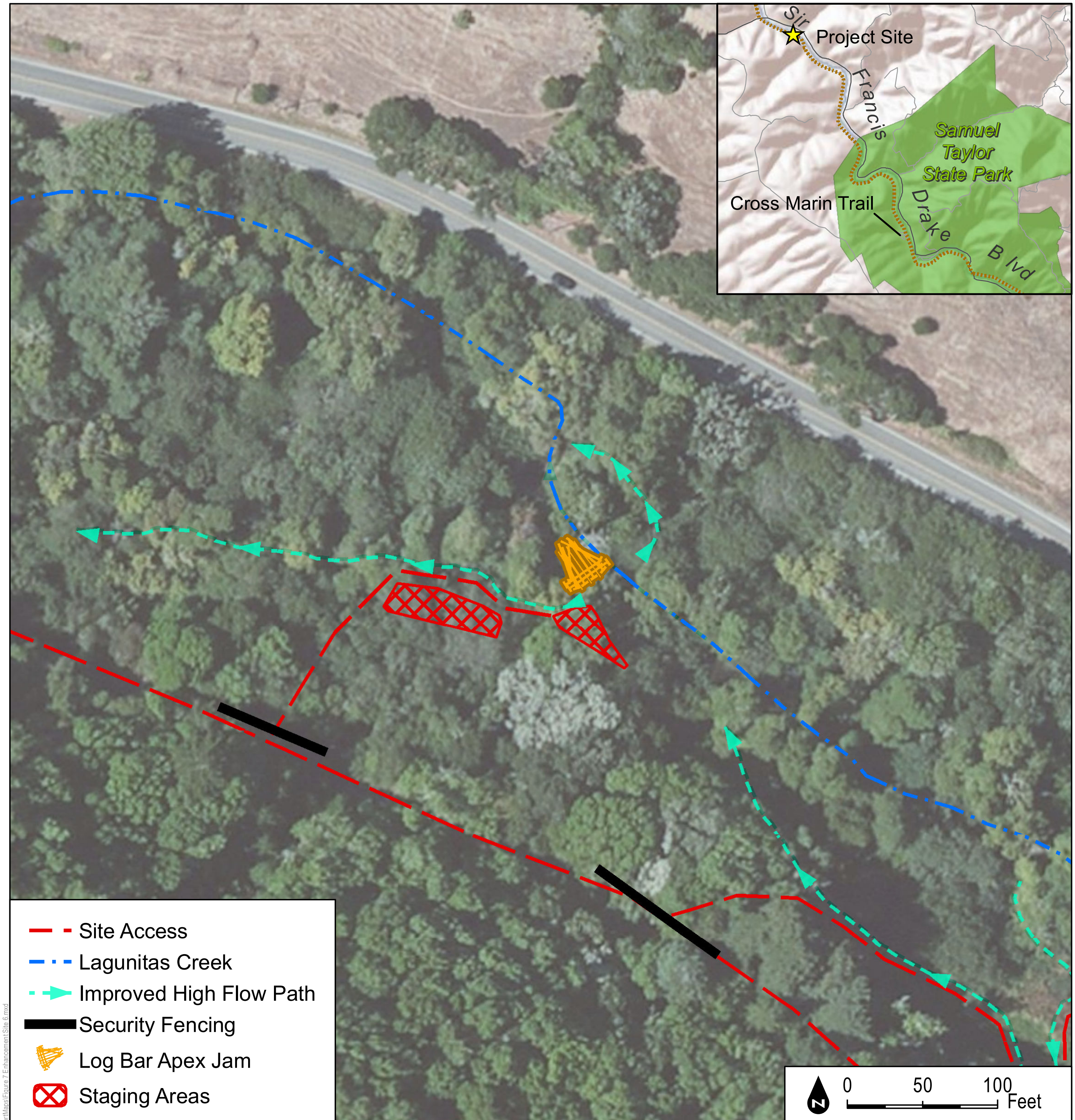

PROJECT	DISTURBANCE AREAS (Square Feet)				
Site #	Access	Staging	Project Structures / Project Features	Total	Vegetation Type(s)
6	2,400	2,217	5,480	10,097	Riparian

PROJECT	SOIL EXCAVATION QUANTITIES (Cubic Yards)			
Site #	Access	Staging	Project Structures / Project Features	Total
6	0	0	741	741

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SOURCE: Marin Municipal Water District, 2017

FIGURE 7

Enhancement Site 6

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PROJECT	DISTURBANCE AREAS (Square Feet)				
Site #	Access	Staging	Project Structures / Project Features	Total	Vegetation Type(s)
7	9,000	3,072	4,200	16,272	Riparian

PROJECT	SOIL EXCAVATION QUANTITIES (Cubic Yards)			
Site #	Access	Staging	Project Structures / Project Features	Total
7	0	0	0	0

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SOURCE: Marin Municipal Water District, 2017

FIGURE 8

Enhancement Site 7

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PROJECT	DISTURBANCE AREAS (Square Feet)				
Site #	Access	Staging	Project Structures / Project Features	Total	Vegetation Type(s)
8	3,000	2,000	4,730	9,730	Riparian

PROJECT	SOIL EXCAVATION QUANTITIES (Cubic Yards)			
Site #	Access	Staging	Project Structures / Project Features	Total
8	0	0	741	741

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SOURCE: Marin Municipal Water District, 2017

FIGURE 9

Enhancement Site 8

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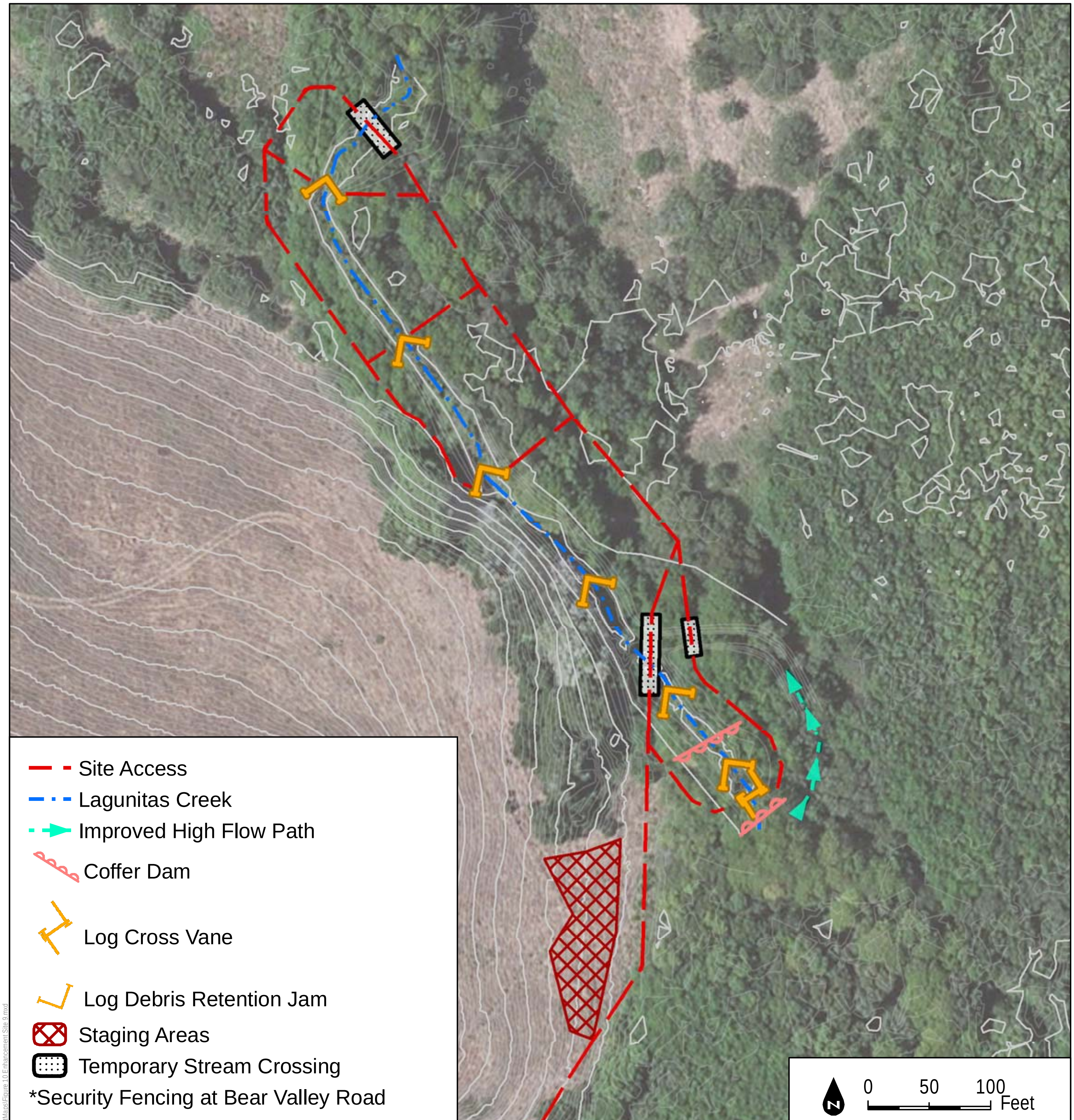

PROJECT	DISTURBANCE AREAS (Square Feet)				
Site #	Access	Staging	Project Structures / Project Features	Total	Vegetation Type(s)
9	18,000	6,300	5,480	29,780	Riparian

PROJECT	SOIL EXCAVATION QUANTITIES (Cubic Yards)			
Site #	Access	Staging	Project Structures / Project Features	Total
9	0	0	11	11

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SOURCE: Marin Municipal Water District, 2017

FIGURE 10

Enhancement Site 9

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The site will be dewatered by installing cofferdams upstream and downstream of the in-channel work area. The upstream cofferdam will be constructed to adequate height to allow backwatering of flow into a high-flow channel located on the floodplain adjacent and parallel to the creek. Water will be diverted around the work zone in this high-flow bypass channel and discharged back to the creek downstream of the cofferdams and fish barriers. Three Temporary Work Platforms (i.e., Stream Crossings) will be needed across the creek and the high-flow bypass channel to gain access to the construction area. An environmental monitor shall be present to provide clearances during the placement of any temporary stream crossing materials into the creek.

Jetting of stream gravel fill to fill all voids within the Log Cross-Vane structure may be necessary, which will generate turbid water contained within the construction zone between cofferdams. Construction dewatering will be discharged via spray or flood methods onto adjacent floodplain in a manner that prohibits high-turbidity return flows from entering creek.

For Site 9 on Olema Creek, the access route would be directly off Bear Valley Road. Staging for construction equipment and materials would be on site in a specified location just east of Olema Creek. Temporary crossings would be established across Olema Creek in two locations, to gain access to all of the LDRJ sites (see Figure 10). The area of disturbance is also described on Figure 10.

Site 10 – Tocaloma Floodplain Enhancement Site

Work at this site would grade and reopen a floodplain side channel, approximately 850 feet long, through the willow riparian and open, grassy floodplain adjacent to the dense willow/alder-dominated riparian corridor of Lagunitas Creek. Grading would be kept to a minimum to:

1. Connect the upstream end of the side channel to the base-flow channel of Lagunitas Creek
2. Retain existing low lying areas within the floodplain side channel alignment
3. Terminate before reconnecting with the creek at the downstream end, allowing flows within the side channel to complete the connection back to Lagunitas Creek

This would allow for this area to be inundated more frequently (during base high flows). Work at this site would not include any excavation into the main flow channel of Lagunitas Creek (no excavation of the bed or bank) but would leave a berm between the main channel and the excavated side channel that would be breached by high flows during subsequent storm events. Habitat features, consisting of large logs and rootballs, would be installed within the re-created side channel to serve two purposes: the structures would help deflect flows to ensure flows stay within the channel, allowing for the deepening and improved stability of the channel; and to provide instream forage, flow refuge, resting, and cover habitat for fish occupying the channel. The side channel slopes and bank would be stabilized by willow plantings and seeded with a native seed mix. The plantings would be transplants of willows harvested from within the alignment of the excavated floodplain channel, set aside, and then replanted after grading is complete. Excess soil from grading would be spread out on the upland slope along and below adjacent Platform Bridge Road, which is a previously disturbed road side slope, set back from the riparian corridor of Lagunitas Creek. These excess soils would be stabilized by grading at maximum 3:1 slopes and applying erosion control treatments: bio-degradable erosion control fabric, hydroseeding with a native seed mix, and fiber rolls.

The access route for this project site would be directly off Platform Bridge Road. Staging of construction equipment and materials (i.e., habitat enhancement logs, erosion control materials, and stock piling of vegetation to be used in revegetation) would be on site, within the riparian and upland portion of the site adjacent to Platform Bridge Road (see Figure 11 and Appendix B1).

The construction period would be August 1 into December; however, the grading elements of the project would occur between August and early November. Because this project does not entail any instream work and involves work only in the adjacent riparian floodplain, all grading work would be completed by November 15, with weather monitoring in effect between October 15 and November 15; no grading work would be conducted during a storm event within this period. Final erosion control and placement of habitat features may extend into late November and revegetation may be conducted into early December.

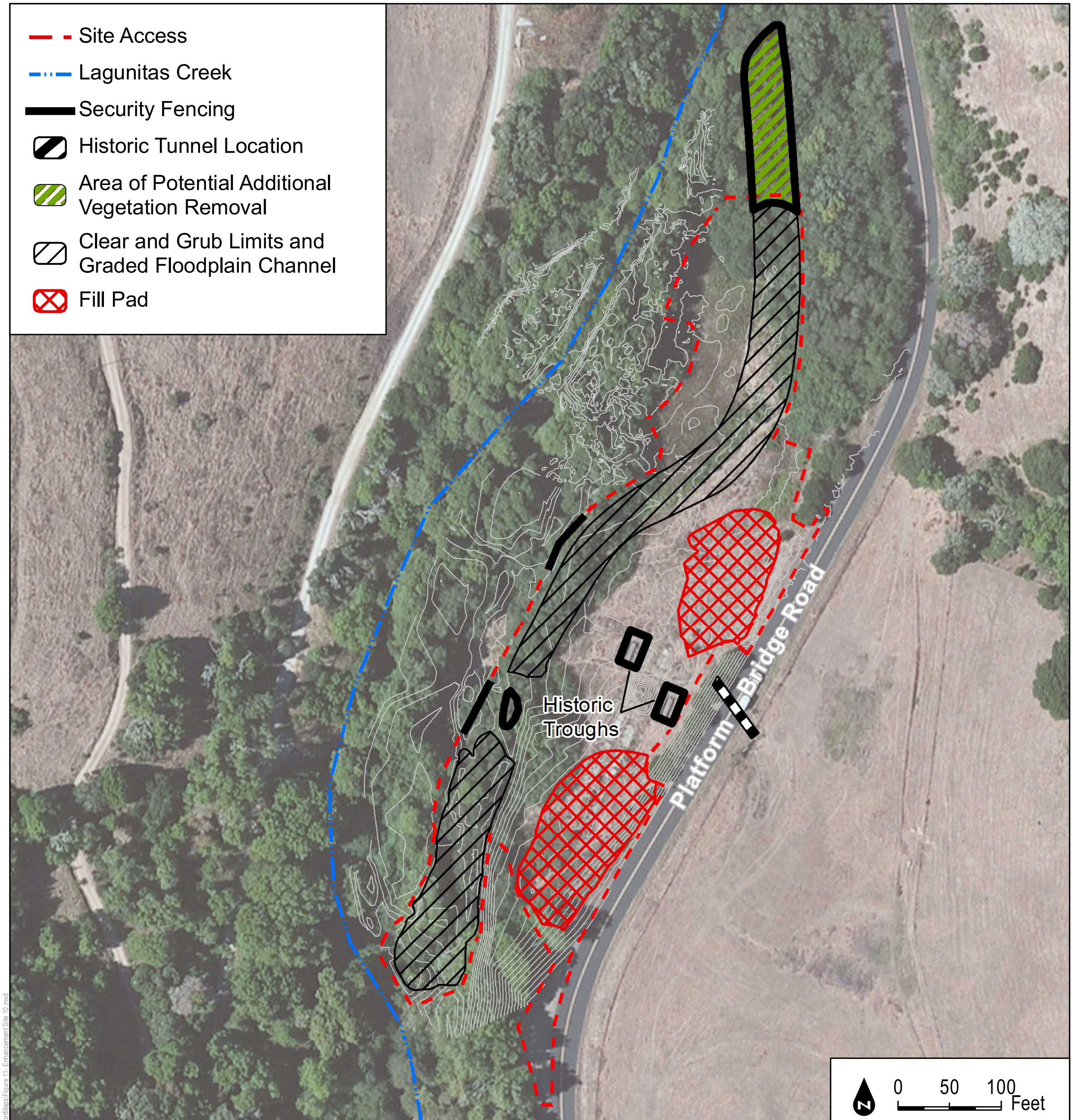
Staging and Access Summary

The access routes for the eight project sites have been identified and are shown on the associated figures above.

Staging areas may need to be temporarily fenced to provide security for refueling equipment, storage containers, and parked vehicles, as well as to keep people out of staging areas. All security fencing is shown on associated figures as well. Upon completion of this project, all staging areas and access routes would be reclaimed to their former condition.

Baseline Conditions and Effectiveness Monitoring Plan

The project would include a baseline conditions and effectiveness monitoring element in order to document and evaluate that the project objectives are met and how well the enhancement goals and targets are being achieved. The monitoring plan would include documenting baseline (pre-construction) conditions that can then be compared against post-construction conditions. The monitoring program would be conducted for at least 2 years following construction but would be expected to continue for 10 or more years. Implementation of a monitoring program is a requirement of the grant funding that has been approved for this project. The monitoring plan has been drafted for the SWRCB funding grant and will be finalized prior to project construction.



PROJECT	DISTURBANCE AREAS (Square Feet)				
Site #	Access	Staging	Project Structures / Project Features	Total	Vegetation Type(s)
10	40,000	32,500	54,000	126,500	Riparian

PROJECT	SOIL EXCAVATION QUANTITIES (Cubic Yards)			
Site #	Access	Staging	Project Structures / Project Features	Total
10	0	0	1,380	1,380

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SOURCE: Marin Municipal Water District, 2017

FIGURE 11

Enhancement Site 10 (Tocaloma)

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The plan incorporates the monitoring objectives of the CDFW Fisheries Restoration Grant Program funding.

The monitoring would be conducted under two phases, including pre-construction monitoring to document baseline conditions and post-construction monitoring to evaluate project effectiveness. Elements of the monitoring program would include the following:

- Photographic monitoring
- Flow monitoring
- Geomorphic monitoring
- Biological monitoring
- Water Quality monitoring
- Reporting

Monitoring work would be conducted to quantify the following:

- LWD Loading – increases in LWD loading in the creek channel, from both the installed LWD structures/engineered log jams and other LWD that collects at the structures
- Streambed Topography/Longitudinal Profile – changes in streambed elevations and slope resulting from the installed LWD structures
- Flow Modification – changes in water surface elevations resulting from the installed LWD structures, resulting in more frequent inundation of the floodplain

In addition, qualitative observations would record the following:

- Floodplain Morphology – notable changes in floodplain inundation, channel formation, and sediment accumulation

Biological monitoring would consist of the ongoing and extensive salmonid survey monitoring in Lagunitas Creek conducted by MMWD and others, which includes juvenile, spawner, and smolt surveys. Lagunitas Creek is an established life-cycle monitoring station in the Coastal Monitoring Plan; through these efforts, MMWD tracks the long-term status of coho salmon and steelhead trout in the watershed. The annual surveys occur throughout the year. Ongoing monitoring programs also include California freshwater shrimp (*Syncaris pacifica*) monitoring. In addition to the long-term biological monitoring, surveys at the project sites would also be conducted to detect and quantify coho salmon and steelhead trout use of the off-channel floodplain habitats and associated in-channel winter habitat enhancement structures in Lagunitas Creek during the winter period (December–March). The water quality monitoring would selectively monitor temperature and dissolved oxygen in the floodplain channels that are re-inundated at project sites, if water persists through the summer and early fall.

2.4 THE NO PROJECT ALTERNATIVE

Under this alternative, no action would be taken within the project area. Facilities would not be built to stabilize and improve Lagunitas Creek salmonid populations by increasing the winter habitat carrying capacity for coho salmon and steelhead trout in Lagunitas Creek. The Lagunitas Limiting Factors Analysis (Stillwater Sciences 2008) identified winter habitat as the limiting factor for both coho salmon and steelhead trout populations in the Lagunitas Creek watershed. Currently along Lagunitas Creek, most of the floodplain is not connected to the channel under normal, bank-full flows. The floodplain is only inundated under some of the higher winter storm flows. Under the No Project Alternative, this condition would continue to be a limiting factor for the salmonid populations.

Other identified winter habitat problems in Lagunitas Creek are a deep, confined channel with elevated velocities during storms and even at winter base flows; and reduced inundation of floodplain and side-channel habitat for salmonids. These conditions would not be improved under the No Project Alternative.

The hydrology of Lagunitas Creek would not be modified and enhanced. Existing floodplain and instream habitat would not be restored at a number of locations in Lagunitas Creek.

No regulatory consultation would be required under this alternative. The No Project Alternative would not achieve any project objectives.

2.5 CUMULATIVE IMPACTS

The Council on Environmental Quality's regulations to implement NEPA require the assessment of cumulative impacts in the decision-making process for federal projects. Cumulative impacts are defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions" (40 CFR 1508.7). Cumulative impacts are considered in each of the resource sections of Chapter 3.

Cumulative impacts were determined by combining the impacts of the alternative being considered with other past, present, and reasonably foreseeable future actions. It was therefore necessary to identify other ongoing or reasonably foreseeable future projects in the applicable surrounding region.

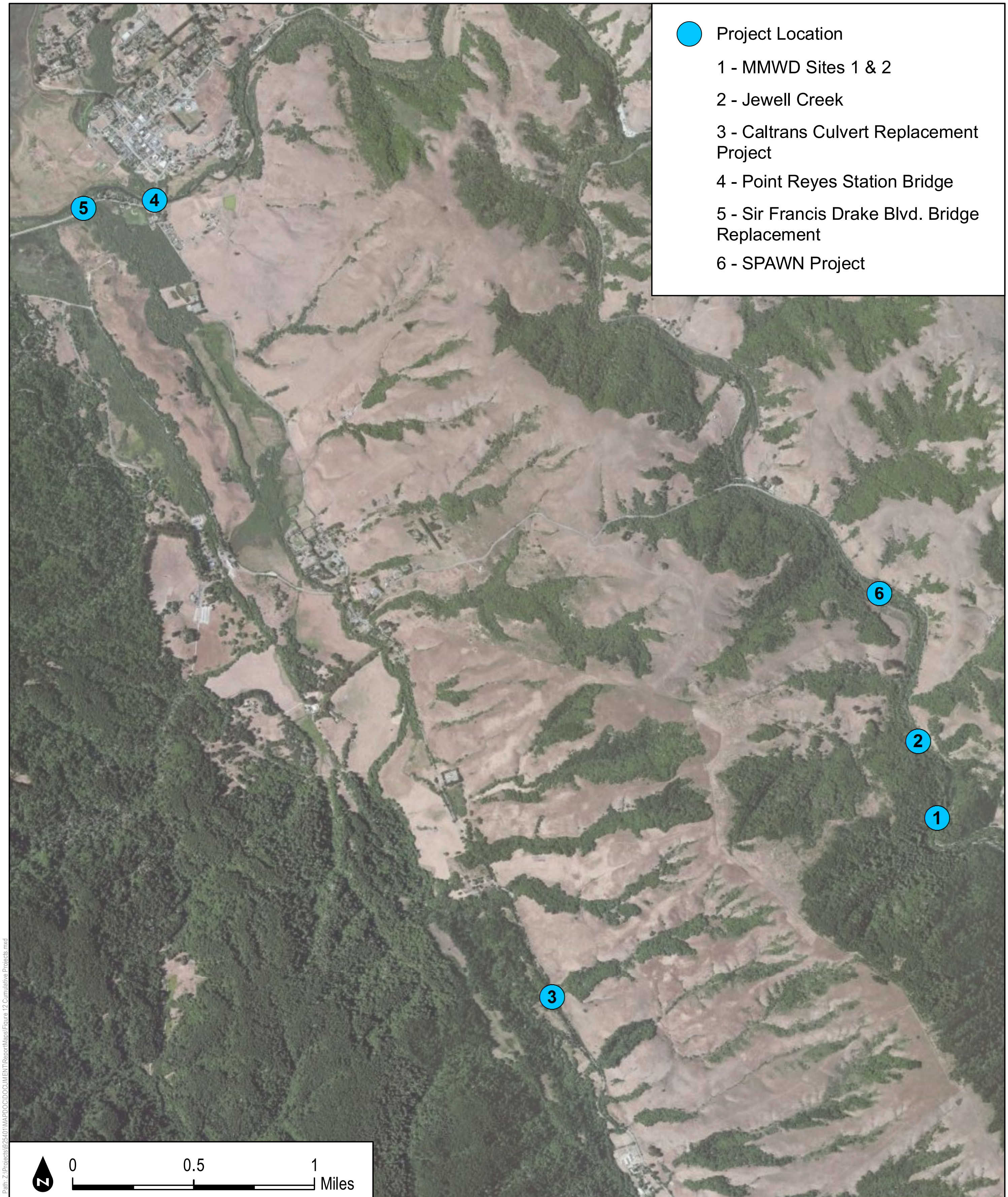
Actions identified by NPS that have the potential to have a cumulative impact in conjunction with the project are described in Table 2 and shown on Figure 12.

Table 2
Cumulative Impacts Project List

Title	Location	Project Description
1) Sites 1 & 2	Sites 1 and 2 are located approximately 2 miles upstream from the community of Jewell and Samuel P. Taylor State Park.	Sites 1 and 2 are California State Park Lands, within Samuel P. Taylor State Park. These sites are part of the Lagunitas Creek salmonid winter habitat enhancement plan for Phase 2 of the project. The purpose of the project is to stabilize and improve the Lagunitas Creek salmonid populations by increasing the winter habitat carrying capacity for coho salmon and steelhead trout in Lagunitas Creek.
2) Jewell Creek	The project site is located approx. three miles east of the town of Olema and approx. 4 miles north of Kent Lake in unincorporated Marin County. This site is north of Samuel P. Taylor State Park within Golden Gate National Recreation Area and is owned and operated by the NPS. The culvert was installed and is operated by MMWD.	This project was recently completed. The objective was to reduce potential erosion and annual persistent sediment loading into Lagunitas Creek, improve fish passages, and provide winter refuge habitat for salmonids at the confluence of Jewell and Lagunitas Creek. In order to do this, the project involved replacement of an existing round culvert with a bottomless arch culvert and replace a secondary drainage culvert at the confluence of Jewell and Lagunitas Creeks.
3) Caltrans Culvert Replacement Project	Located at Post Mile 24.7, which is approx. 1.8 miles south of the town of Olema, on State Route 1.	The project involves the removal of the two undersized and damaged 24-inch-diameter culverts beneath State Route 1 that currently convey intermittent flows and also the construction of a cast-in-place or precast, reinforced concrete, bottomless culvert.
4) Point Reyes Station Bridge	The bridge serves as a connection between Point Reyes Station and the unincorporated town of Olema to the south of State Route 1 (Highway 1) in Marin County, California.	A bridge that has been in place for 80+ years and leads to Point Reyes Station will be demolished and replaced in order to necessitate a new bridge across Lagunitas Creek. Caltrans has determined that the steel bridge is deteriorating and to be updated to meet current seismic and safety standards for all users of the bridge.
5) Sir Francis Drake Blvd. Bridge Replacement	Sir Francis Drake Boulevard Bridge is located just west of Highway 1 and is a narrow two-lane roadway that provides access between the community of Inverness as well as Point Reyes Station and the Point Reyes National Seashore.	The County of Marin is seeking to replace bridges that are no longer functional and/or structurally inadequate. Sir Francis Drake Boulevard (over Olema Creek) is a bridge that needs replacement while at the same time assuring that the riparian habitat is protected, not impacting adjacent Point Reyes National Seashore and minimizing disturbance during construction will need to be implemented into an environmental review. This bridge is the access point to Cross Marin Trail and MMWD Enhancement Project Sites 1 & 2.
6) SPAWN Project	The project site closest to the MMWD project is located in Tocaloma on Lagunitas Creek approx. 6.4 miles from the Highway 1 bridge in Point Reyes Station. The downstream limit of the project is the Turtle Island Network/Salmon Protection and Watershed Network (SPAWN) office and extends upstream approx. 4,500 feet to the border of Samuel P. Taylor State Park. This	The Lagunitas Creek Floodplain and Riparian Enhancement Project is being developed in order to support improvements to riparian ecosystem function and habitat for coho salmon in a portion of Lagunitas Creek in Tocaloma, California. Goals of the project include: enhancing winter habitat for the rearing life stage of coho salmon, enhancing habitat for the spawning life stage of coho salmon, and protecting and enhancing the habitat for other species such as California freshwater shrimp, northern spotted owl (*Strix occidentalis caurina*), California

Table 2
Cumulative Impacts Project List

Title	Location	Project Description
	downstream portion is further away from the MMWD project sites.	red-legged frog (*Rana draytonii*), and western pond turtle (*Actinemys marmorata*).
Japanese Knotweed Eradication	NPS is developing an effort to control and eradicate this species on NPS lands within the Lagunitas Creek watershed.	Project is in development. MMWD construction methodology will support this effort by removing or capping plants if they are found within construction sites so as not to exacerbate the problems related to this invasive species.



SOURCE: Marin Municipal Water District (MMWD), 2017; Dudek, 2017

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FIGURE 12

Cumulative Projects

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2.6 MITIGATION AND MONITORING

The following mitigation measures (MMs) (which include monitoring requirements) are designed to reduce potential project impacts to less than significant levels.

MM HYD-1a Stormwater and Erosion Control BMPs. Marin Municipal Water District (MMWD) or its contractor(s) shall implement erosion-control measures consistent with the most recent versions of the California Stormwater Quality Association guidance and/or handbook with respect to stormwater construction best management practices (BMPs). MMWD shall prepare and ensure implementation of a stormwater pollution prevention plan. Also see page C-3 of project plans (Appendix B2). The plan shall be approved by MMWD in consultation with the National Park Service (NPS) and Regional Water Quality Control Board (RWQCB) prior to beginning work. Stormwater and erosion control measures shall include, but not be limited to, the following:

- Construction activities shall be scheduled in August–October when flows are at a minimum (around 6–8 cubic feet per second (cfs)) to minimize effects to the stream channel and banks. To the extent feasible, grading activities shall be limited to the immediate area required for construction.
- Temporary erosion control measures shall be employed for disturbed areas (no disturbed surfaces shall be left without erosion control measures in place):
  - Fiber rolls shall be placed along the perimeter of the site to reduce runoff flow velocities and prevent sediment from leaving the site or entering Lagunitas Creek or the secondary drainage.
  - Silt fences shall be placed downgradient of disturbed areas to slow runoff and retain sediment.
  - Fill pads, staging areas, and other temporarily disturbed areas shall be stabilized with a combination of methods including erosion control blankets, overlapping, staked-in fiber rolls, and/or native seed.
- Revegetation of disturbed soil areas shall be facilitated by salvaging and storing existing topsoil and reusing it in restoration efforts in accordance with NPS policies and guidance. Topsoil storage shall be for as short a time as possible to prevent loss of seed and root viability, loss of organic matter, and degradation of the soil microbial community. Salvaged topsoil shall not be piled taller than 2 feet high and 3 feet wide, and piles shall be windrowed to retain viability of the microorganisms.

- Where plantings or seeding are required, NPS-approved native plant material must be obtained and used in accordance with NPS policies and guidance.
- Management techniques shall be implemented to foster rapid development of target native plant communities and to eliminate invasion by exotic or other undesirable species.
- As necessary (i.e., during storms that may occur within the construction window), surface runoff, including ponded water, shall be diverted away from areas undergoing grading, construction, excavation, vegetation removal, and/or any other activity that may result in a discharge to Lagunitas Creek. Normal flow pathways shall be restored upon completion of work at that location. Following construction, sites will be monitored following first flush of flows.
- Temporary sediment traps, filter fabric fences, inlet protectors, vegetative filters and buffers, or settling basins shall be used to detain runoff water long enough for sediment particles to settle out.
- Construction materials, including topsoil and chemicals, shall be stored, covered, and isolated so as to prevent runoff losses and potential surface water contamination.

MM HYD-1b Spill Prevention and Countermeasure Plan. MMWD and/or its contractor(s) shall implement BMPs that will minimize the potential adverse effect of the project to groundwater and soils from equipment and vehicle use of fuels, oils, and/or lubricants. A spill prevention and countermeasure plan shall be developed that shall identify proper storage, collection, and disposal measures for potential pollutants (such as fuel containers, spent equipment, construction debris, trash, etc.) on site. The plan shall also establish procedures to follow in the event of an accidental spill, including emergency containment, agency notification, cleanup, and disposal requirements. The plan shall be approved by MMWD in consultation with NPS and RWQCB prior to beginning work. The BMPs shall include, but not necessarily be limited to, the following:

- Areas where heavy equipment may operate in the channel bed shall be strictly limited to only the most essential areas.
- Fuel and vehicle maintenance areas shall be established (at least 10 feet) away from all drainage courses and these areas shall be designed to control runoff.
  - Manufacturer's recommendations on use, storage, and disposal of chemical products used in construction shall be followed.

  - All heavy equipment shall be required to carry emergency spill containment materials.
  - Overtopping construction equipment fuel tanks shall be avoided.
- Secondary containment shall be provided for any hazardous materials temporarily stored in designated staging areas.
- Clear-water creek diversion pumps shall be refueled in areas well away from the stream channel and fuel-absorbent mats shall be placed under the pump while refueling.
- During routine maintenance of construction equipment, grease and oils shall be properly contained and removed.
- Regular inspections of construction equipment and materials storage areas for leaks shall be performed and records shall be maintained documenting compliance with guidelines for the storage, handling, and disposal of hazardous materials, where applicable.
- Discarded containers of fuels shall be properly disposed of in accordance with state and federal laws.

MM HYD-1c **Clear-Water Creek Diversions and Construction Dewatering.** The construction contractor shall prepare a Dewatering Plan to be approved by MMWD in consultation with NPS, RWQCB, and CDFW prior to beginning work. The dewatering plan shall review all clear-water creek diversion and construction dewatering considerations and best management practices described in the Basis of Design Report completed by Kamman (2014) and/or any more recent design report completed to date. Examples of required BMPs include the following:

- Where dewatering pumps are required (clear-water gravity diversion shall be the preferred method), intakes shall be screened with less than 5-millimeter mesh screen to prevent other aquatic organisms from entering the pump. In addition, a filtration/settling system shall be included to reduce downstream turbidity (i.e., filter fabric, turbidity curtain). The selection of an appropriate system shall be based on the actual rate of discharge at time of construction.
- Cofferdams shall be constructed of sandbags or gravel bags secured with polyethylene plastic sheeting; water-filled bladders; interlocking sheet piling; and/or other material. Gravel bags should be filled with clean river run gravels. Cofferdams shall be covered with visqueen to minimize water infiltration. During construction, inspection shall occur daily during the work week. Any gaps, holes, or scour shall be immediately repaired.

- Water pumped from typical excavation areas is likely to contain suspended sediments or other materials and may not be discharged directly to surface waters. Sediment controls shall be provided to remove sediments generated during the dewatering activities.
- Water outfalls shall be contained within folded and secured filter fabric sediment traps to minimize turbidity to outfall areas.
- Cofferdams constructed of sandbags or gravel bags secured with polyethylene plastic sheeting; water-filled bladders; interlocking sheet piling; and/or other material will be constructed and keyed in at the creek channel upstream of the work area. Water shall be pumped from the upstream side of the cofferdam through one or more flexible hoses or PVC pipes that will run along the top of bank to a creek outfall below the work area. Diversion pipe outlets shall be directed to instream structures to prevent streambed erosion.
- Pumped water shall be discharged in conformance with all applicable laws and permit requirements and the channel and banks will be returned to pre-project condition in those areas affected by dewatering structures/activities.

MM HYD-2 **Monitoring and Adaptive Management Plan.** A comprehensive Geomorphological Monitoring and Adaptive Management Plan (plan) shall be developed prior to implementation of the project, and shall be approved by MMWD in consultation with NPS, RWQCB, and the California Department of Fish and Wildlife prior to beginning work. At a minimum, the plan shall incorporate the following elements:

- Pre- and post-project photo monitoring from established photo points shall be performed, as well as photographs being taken during construction. Post-construction photographic monitoring would be expected to be completed during the early fall of 2017 and 2018.
- Pre- and post-construction stream flow monitoring shall occur, specifically at the structural features constructed and in the floodplain channel designed to be re-inundated. Monitoring shall include site inspections at various flow stages and shall use photographs, video, and flow stage gages (i.e., data loggers). Monitoring stations shall be established at the inlet and outlet of floodplain channels that have been designed to be re-inundated, and MMWD shall document when the floodplain channel features become active and/or disconnected from the base flow channel.
- Water surface elevation at stage gages shall be measured under a variety of flow conditions during two winters post-construction, during moderate storm periods

when stream flows in Lagunitas Creek are ranging between 100 and 500 cfs, as determined by the existing U.S. Geological Society stream gage located upstream of the project area, in Samuel P. Taylor State Park. Surveys would be expected to be completed during the winters of 2017/2018 and 2018/2019.

- Elevation of the streambed across the stream channel shall be measured by cross-section surveys at each large woody debris (LWD) structure and along the stream by longitudinal surveys through the segment of the stream channel for each of the LWD sites. These surveys shall be completed immediately following the construction of the LWD structures at each site. Photographs of the as-built streambed conditions shall be recorded from the photographic monitoring stations. Surveys would be expected to be completed during the early fall of 2017 and 2018.
- Post-construction geomorphic monitoring shall be completed at key locations throughout the project sites (structures, high-flow channel inlets/outlets, and reactivated channels). Monitoring shall include site inspections during and after high flow events and shall include photographs and field measurements to quantify notable geomorphic changes from as-built conditions, especially erosion and sediment/wood aggradation. The structural integrity of the instream wood structures shall also be evaluated as part of this monitoring component.
- MMWD shall selectively monitor temperature and dissolved oxygen in the floodplain channels that are re-inundated at the project sites, if water persists through the summer and early fall. Surveys would be expected to be completed between the late spring and early fall of 2017 and 2018.

The monitoring activities proposed above shall be used to evaluate project progress towards meeting the goals and objectives. As part of plan development, thresholds or criteria for success shall be developed as well as conditions that trigger a management action. Not meeting the specified thresholds would initiate a management response, and the plan would describe a range of potential adaptive management actions. The plan should outline possible response pathways if project monitoring determines that a trigger has been activated, such as the following:

1. Determine whether more data is required and continue (or modify) monitoring
2. Identify and implement a remedial action
3. Modify project goals and objectives (this option would only be considered as a last resort and upon careful consideration)

There may be multiple management action options when a particular trigger or threshold is activated, depending on a variety of factors such as how far the project is from achieving a specific goal, whether the situation is an imminent threat to the surrounding ecosystem services/functions or site stability, etc. The process should be designed to be flexible to allow for a wide range of management actions. However, the plan should also impose a structured approach as management actions must derive from monitoring results.

For the first 5 years after construction, an annual monitoring report shall be generated to document project site conditions and effectiveness. A post-construction monitoring and adaptive management report shall also be prepared and submitted as part of the final project reporting.

MM BIO-1 **Monitor during and after Construction.** An approved biological monitor will be present during construction as required by project minimization measures for the protection of all species (e.g., measures provided by the U.S. Fish and Wildlife Service (USFWS)/National Oceanic and Atmospheric Administration (NOAA) Fisheries, U.S. Army Corps of Engineers, California Department of Fish and Wildlife (CDFW), and Regional Water Quality Control Board (RWQCB) permit conditions). Post-construction effectiveness monitoring will be implemented, as described in the project description. An effectiveness monitoring plan will be finalized, for State Water Resources Control Board (SWRCB) and CDFW approval, and implemented for a minimum of 2 years after construction. Elements of the effectiveness monitoring program will include photographic monitoring, flow monitoring, geomorphic monitoring, biological monitoring, water quality monitoring, and reporting.

Implementation Procedure	Monitoring and Reporting Actions	Monitoring Responsibility	Monitoring Schedule
1. Marin Municipal Water District (MMWD) coordinates with NPS, CDFW, NOAA Fisheries, and USFWS and assigns a qualified biological monitor to provide construction monitoring throughout the length of the project.	1. MMWD formalizes assignment	1. Qualified biologist, MMWD	1. During construction
2. MMWD finalizes the baseline conditions and effectiveness monitoring plan, in coordination with SWRCB, CDFW, and NPS	2. MMWD formalizes assignment	2. Qualified biologist and hydrogeomorphologist, MMWD	2. Annual monitoring reports

MM BIO-2 MMWD shall consult with NOAA Fisheries under Section 7 of the federal Endangered Species Act and CDFW under Section 1600 of the California Endangered Species Act to provide preservation and avoidance measures commensurate with the CDFW standards for the affected species. Prior to and during the initiation of construction activities, a qualified CDFW biologist and other approved fisheries biologists shall be present during installation of the clear-water creek diversions. The biologists shall implement NOAA Fisheries-approved procedures to ensure that no fish species are harmed by project-related activities. At a minimum, the procedures may include relocation of fish from the disturbance area and temporary placement of barriers to prevent fish from entering the disturbance zone. Any required relocation is directed by CDFW using their protocol. Other measures may be implemented upon their approval by the regulatory agencies. Any fish captured shall be relocated to suitable habitat downstream or upstream of the project site, where they would not be affected by construction activities. If necessary, the capture and relocation of coho salmon and coastal steelhead associated with work site clear-water creek diversions would require an Incidental Take Permit under Section 2081 of the California Fish and Game Code, to be issued by the CDFW.

MM BIO-3 MMWD shall informally consult with USFWS under Section 7 of the federal Endangered Species Act and CDFW for the California Endangered Species Act to provide preservation and avoidance measures commensurate with the USFWS and/or CDFW standards for the California freshwater shrimp. Prior to the initiation of construction activities, an approved freshwater shrimp expert (anticipated to be Larry Serpa) shall conduct detailed shrimp sampling in the vicinity (upstream and downstream) of the instream large woody debris (LWD) structure enhancement sites to remove as many shrimp as possible prior to construction activities.

Prior to installing the clear-water creek diversion and bypass flow dissipaters and flow deflection and turbidity containment structures, and Temporary Work Platforms, the areas proposed for these structures would also be surveyed by an approved freshwater shrimp expert (probably Larry Serpa) to locate and remove any shrimp that could be impacted by installation of any of these structures. The approved expert (e.g., Larry Serpa) and a qualified CDFW biologist shall also be present during creek diversions to sample, capture, and relocate any and all shrimp that are present within the section to be dewatered. Because shrimp breed in September, shrimp capture and relocation efforts should occur in August (prior to the breeding season) to minimize impacts to this species. Any required relocation is directed by CDFW using their protocol. Repeated sampling would be required as water levels decline within the area to be dewatered to increase the probability that all shrimp are removed from the site. The biologists shall implement USFWS-approved procedures to ensure that no freshwater shrimp are harmed by project-related activities. However, sampling would be discontinued at any given section of stream habitat prior to causing any significant habitat damage.

Survey/Sampling Procedures

The following survey/sampling methods would be employed during pre-construction surveys conducted at enhancement sites.

Pre-Construction Survey Requirements

Surveys shall be conducted within 2 weeks of construction at each enhancement location. The purpose of the pre-construction survey is to:

1. Determine the relative abundance and distribution of freshwater shrimp in the vicinity of the instream enhancement sites.
   - Areas to be surveyed at each site are based on habitat typing data collected in February 2016 (Appendix E, Lagunitas Creek Winter Habitat Sites 3–9 Habitat Typing Units).
   - Survey areas at each site would include all areas potentially affected by installation of the LWD structures and associated temporary work structures (e.g., clear-water creek diversions, flow deflection and turbidity containment structures, and bypass flow dissipaters).
   - In general, the habitat where the LWD structure and temporary work structures are to be installed and one habitat unit upstream and downstream of these locations would be surveyed.
2. Capture and relocate as many shrimp as possible from within seven of the eight enhancement sites (Sites 3–9). No work within the channel of Lagunitas Creek would be conducted at Site 10 (Tocaloma Floodplain Site) so no shrimp disturbance would occur. Because the instream areas that would be affected by installation of wood structures (i.e., Log Cross-Vanes, Bar Apex Jams (BAJs), and Log Debris Retention Jams (LDRJs)) and associated work structures vary from site to site, survey areas also vary between sites. Based on the location of each LWD structure and associated work structures and the results of habitat typing, survey areas for each site are provided below:
   - At Site 3, construction of the BAJ would require a clear-water creek diversion with installation of cofferdams upstream and downstream of the

structure location and a bypass flow dissipater downstream of the cofferdams. Approximately 100 feet of stream would be dewatered at this site, which would affect two habitat units (Riffle 3A where the structure is to be installed and Run 3B located immediately upstream). Although suitable shrimp habitat may not be present in these two units, potentially suitable areas in the habitats shall be surveyed since the dewatered area would encompass all or a portion of these two units. Additionally, the area in the vicinity of the downstream end of the high-flow bypass channel where the energy dissipater would be installed (upstream end of Pool 3A) would be surveyed as part of Site 4 if appropriate shrimp habitat was present.

- At Site 4, construction of the LDRJ would also require installation of a Temporary Work Platform that would be constructed in the flowing creek. The platform would include establishing a temporary stable pier (likely constructed of large precast concrete block) in the creek to support a wood platform sufficient to support an excavator. The temporary platform would not span the full width of creek, but only extend approximately 2/3 of the creek width. Even though construction of the LDRJ would be accomplished from the Temporary Work Platform, installation of the platform from the stream bank on the west side of the creek could affect shrimp located along the bank or within the channel itself (among small debris or in weed beds) in one habitat unit (Pool 4A, where the LDRJ and associated Temporary Work Platform are to be installed). Surveys would be conducted in Pool 4A along the west bank of the creek and potentially within the channel within and adjacent to the location of the Temporary Work Platform.
- At Site 5, construction of the LDRJ would require installation of a Temporary Work Platform that would be constructed in the flowing creek. The platform would include establishing a temporary stable pier (likely constructed of large precast concrete block) in the creek to support a wood platform sufficient to support an excavator. The Temporary Work Platform would not span the full width of creek, but only extend approximately 2/3 of the creek width. Even though construction of the LDRJ would be accomplished from the Temporary Work Platform, installation of the platform would occur from the stream bank on the west side of the creek. The Temporary Work Platform would be located immediately upstream of the LDRJ in Riffle/Run Complex 5B. Suitable shrimp habitat is likely not present in this riffle/run complex due to the shallow water and fast current. As a result, shrimp surveys would likely

not be required for this site. However, if suitable shrimp habitat was found to be present, surveys would be performed.

- At Site 6, construction of the BAJ would require a clear-water creek diversion with installation of cofferdams upstream and downstream of the structure location and bypass flow dissipaters downstream of the cofferdams. Approximately 100 feet of stream would be dewatered at this site, which would directly affect two habitat units (Pool 6F, where the structure is to be installed, and Riffle 6E, located immediately downstream of Pool 6F). Although suitable shrimp habitat may not be present in Riffle 6E, potentially suitable areas in both habitats shall be surveyed since the dewatered area would encompass all or a portion of the two units. Additionally, the area in the vicinity of the downstream end of the high-flow bypass channel where the energy dissipater would be installed (Pool 6C) would also be surveyed if appropriate shrimp habitat is present.
- At Site 7, construction of the four LDRJs would require installation of a Temporary Work Platform at each location that would be constructed in the flowing creek. Each platform would include establishing a temporary stable pier (likely constructed of large precast concrete block) in the creek to support a wood platform sufficient to support an excavator. The Temporary Work Platforms would not span the full width of creek, but only extend approximately 2/3 of the creek width. Even though construction of the LDRJs would be accomplished from the Temporary Work Platforms, installation of the platforms from the streambank on the north side of the creek could affect shrimp at some locations if suitable habitat was present along the bank or within the channel itself (among small debris or in weed beds). Suitable shrimp habitat is present at two of the LDRJ locations (LDRJ1 and LDRJ2), which are located in pool habitat, but is likely not present at LDRJ3 and LDRJ4, which are located in run habitat characterized by relatively shallow water depths and high water velocities. As a result, surveys would need to be conducted at the LDRJ1 and LDRJ2 sites, but may not be required at the LDRJ3 and LDRJ4 sites. However, if suitable shrimp habitat is found to be present at the LDRJ3 and LDRJ4 sites, surveys would be performed.
- At Site 8, winter habitat enhancement activities include installation of a BAJ, LDRJ, and high-flow channel improvements. Construction of the BAJ would require a clear-water creek diversion with installation of cofferdams upstream and downstream of the structure location and bypass flow directed into an enhanced high-flow path (floodplain side channel would be temporarily

deepened as needed) along the right bank, looking downstream). Approximately 100 feet of stream would be dewatered at this site.

Similar to Sites 4 and 7, installation of the LDRJ would use a Temporary Work Platform that would be constructed in the flowing creek. The platform includes establishing a temporary stable pier (likely constructed of large precast concrete block) in the creek to support a wood platform sufficient to support an excavator. The Temporary Work Platform would not span the full width of creek, but only extend approximately two-thirds of the creek width. The Temporary Work Platforms will be installed from the north bank of the creek.

Suitable shrimp habitat is likely present within the dewatered reach at the BAJ site and surveys would be performed in all suitable habitat throughout the entire reach to be dewatered. At the LDRJ site, shrimp surveys would be conducted along the bank and potentially within the creek channel in the vicinity of the Temporary Work Platform.

- At Site 9, winter habitat enhancement activities include installation of a Log Cross-Vane and six LDRJs. Construction of the Log Cross-Vane and associated LDRJ1 would require a clear-water creek diversion with installation of cofferdams upstream and downstream of these structures. Bypass flow would be directed through a pipe into the adjacent historic channel. Approximately 75 feet of stream would be dewatered at this location. Construction of the remaining downstream LDRJs would be accomplished from one or both banks adjacent to each site. Due to the relatively narrow stream channel throughout Site 9, installation of the LDRJs should not affect streambanks but would impact the channel itself from bank to bank. As a result, LDRJs constructed in locations where suitable shrimp habitat was present would be surveyed. LDRJ2 and the temporary stream crossing platform immediately downstream of LDRJ2 are located in a pool and surveys would be required along both banks and potentially within the channel. LDRJ3, LDRJ4, LDRJ5, and LDRJ6 are all located in pool habitats and surveys would be required along both banks and potentially within the channel at all four sites.

Pre-construction surveys would be conducted in July and/or August (prior to breeding) approximately 2 weeks prior to the scheduled construction period at each site. The primary purpose of these pre-construction surveys is (1) to determine the distribution and relative abundance of shrimp within the reach and in the immediate vicinity of the nine instream enhancement sites, Sites 3–9 (i.e., repeat surveys conducted in 2015 and 2016 within the enhancement reach), and (2) to capture and relocate (to other nearby suitable pools that would not be affected by enhancement activities) as many shrimp as possible within and immediately adjacent to each of the stream areas affected by construction of the LWD structures. Areas to be included in the pre-construction surveys at each enhancement site are delineated under item 2 above.

The following survey methods were extracted from Serpa (2013, 2015). Sampling would be conducted using a 15-inch-diameter insect net. The long bag of this aerial net reduces the amount of force that shrimp are subjected to within the net during the sampling process. Use of this net also ensures that shrimp cannot leave the net once captured, which can happen with dip nets. During sampling, the net is submerged and used to vigorously disturb vegetation along the edges of pools and other calm water areas to dislodge attached shrimp. Immediately after disturbing the vegetation, the net is moved back through the agitated area to collect any shrimp that moved out into open water when they were dislodged by the passage of the net. This procedure covers a much larger habitat area than the push-pull process initially used by Li (1981), since the net can be moved repeatedly through the entire habitat and adjacent water column. Each area would be sampled and resampled until no additional shrimp are captured in three consecutive net sweep events. However, sampling would be discontinued at any given section of stream habitat prior to causing any significant habitat damage.

Following each of the sampling events described above, the contents of the net bag would be emptied into a plastic pan located at a level location along the side of the habitat. The pan would be placed on a plastic sheet (approximately 2 feet by 3 feet) and partially filled with creek water. The sheet is provided to capture any shrimp that might flip out of the pan so they can be safely returned to the plastic pan. After the net bag sample is placed into the pan, detritus, leaves, and other materials would be carefully removed and placed on top of the net bag. The remaining contents would be inspected for any shrimp present and the debris on top of the net would then be examined several times before the remaining contents of the pan and the net are placed back into the stream. Shrimp would then be moved from the pan to a covered plastic container partially filled with creek water using a small aquarium net. All captured shrimp would be counted and identified as a male, female, or juvenile. Captured shrimp would be quickly relocated to appropriate habitat upstream of Site 3 or downstream of Site 6 to ensure that relocated shrimp would not be affected by construction activities at the enhancement sites.

Follow-Up Pre-Construction Surveys (Within 48-Hours of Scheduled Construction)

The follow-up pre-construction surveys would be conducted immediately prior (within 48 hours) to scheduled construction, by an approved expert (Larry Serpa). The primary purpose of these surveys is to capture and relocate any remaining shrimp within the affected stream reaches immediately prior to construction. All shrimp captured during this second sampling effort would be processed and relocated to other suitable pools in the general area in the same manner as that described above for the initial pre-construction surveys.

The follow-up capture and relocation surveys at sites where the BAJ installation sites would be dewatered prior to construction, would occur in two phases, to be conducted by the approved expert (Larry Serpa) and a qualified CDFW biologist, using CDFW protocol. Phase 1 surveys would be conducted within the general location where the clear-water creek diversion and bypass flow dissipaters would be installed within 48-hours of installation to remove as many shrimp as possible from these locations. Following installation of the cofferdams and prior to initiation of creek diversion and dewatering procedures, extensive surveys would be conducted within the enclosed stream reach to capture and relocate as many shrimp as possible. Additional, surveys would then be conducted during the diversion and dewatering process to continue to remove any shrimp that were missed during the previous survey effort. To avoid potential entrainment issues during dewatering, a velocity diffuser would be used at the point where water is pumped out of the isolated stream section.

Follow-up capture and relocation surveys at sites where only half the LDRJ installation would be isolated at a time but not dewatered prior to construction would occur in one phase. Surveys would be conducted in the general locations where the K-rail (or other similar material), turbidity curtain, and LDRJ would be installed, within 48 hours of installation to remove as many shrimp as possible from these locations.

Once all the shrimp have been removed and relocated from each enhancement site, construction can be initiated.

Implementation Procedure	Monitoring and Reporting Actions	Monitoring Responsibility	Monitoring Schedule
1. MMWD/contractor prepares freshwater shrimp sampling and relocation plan.	1. MMWD incorporates measures in construction specifications	1. MMWD/contractor	1. Prior to construction

Implementation Procedure	Monitoring and Reporting Actions	Monitoring Responsibility	Monitoring Schedule
2. MMWD assigns an approved expert to conduct pre-construction surveys for freshwater shrimp.	2. MMWD formalizes assignment	2. Approved expert and MMWD	2. Prior to construction
3. Conduct surveys to determine distribution and general abundance of shrimp in the vicinity of Sites 3–9 and to capture and relocate as many shrimp as possible at these locations.	3. MMWD formalizes assignment	3. Approved expert and MMWD	3. Within 1 week prior to scheduled construction at instream enhancement Sites 3–9
4. Conduct surveys to capture and relocate any remaining shrimp at Sites 3–9, as needed.	4. MMWD formalizes assignment	4. Approved expert, qualified CDFW biologist, and MMWD	4. Within 48 hours prior to scheduled construction at instream enhancement Sites 3–9
5. Conduct surveys to capture and relocate any remaining shrimp at Sites 3–9, as needed, during dewatering operations.	5. MMWD formalizes assignment	5. Approved expert, qualified CDFW biologist, and MMWD	5. During creek diversion at Sites 3–9, as needed

MM BIO-4 Implement the following measures specified in the California Red-Legged Frog Programmatic Biological Opinion (USFWS 1999):

1. At least 15 days prior to the onset of activities, the applicant or project proponent shall submit the name(s) and credentials of biologists who would conduct activities specified in the following measures. No project activities shall begin until proponents have received written approval from the U.S. Fish and Wildlife Service (USFWS, Service) confirming that the biologist(s) is qualified to conduct the work.
2. A Service-approved biologist shall survey the work site two weeks before the onset of activities. MMWD will consult with NPS at this time as well. If California red-legged frogs, tadpoles, or eggs are found, the approved biologist shall contact the Service to determine if moving any of these life-stages is appropriate. In making this determination, the Service shall consider if an appropriate relocation site exists. If the Service approves moving animals, the approved biologist shall be allowed sufficient time to move California red-legged frogs from the work site before work activities begin. Only Service-approved biologists shall participate in activities associated with the capture, handling, and monitoring of California red-legged frogs.

3. Before any construction activities begin on a project, a Service-approved biologist shall conduct a training session for all construction personnel. At a minimum, the training shall include a description of the California red-legged frog and its habitat. Training will stress the importance of the California red-legged frog and its habitat, the general measures that are being implemented to conserve the California red-legged frog as they relate to the project, and the boundaries within which the project may be accomplished. Brochures, books, and briefings may be used in the training session provided that a qualified person is on hand to answer any questions.
4. A Service-approved biologist shall be present at the work site until such time as all removal of California red-legged frogs, instruction of workers, and habitat disturbance activities have been completed. After this time, the contractor or permittee shall designate a person to monitor on-site compliance with all minimization measures. The Service-approved biologist shall ensure that this individual receives training outlined above in measure3 and in the identification of California red-legged frogs. The monitor and the Service approved biologist shall have the authority to halt any action that might result in impacts that exceed the levels anticipated by the NPS and Service during review of the action. If work is stopped, the NPS and Service shall be notified immediately by the Service-approved biologist or on-site biological monitor.
5. During project activities, all trash that may attract predators shall be properly contained, removed from the work site and disposed of regularly. Following construction, all trash and construction debris shall be removed from work areas.
6. All fueling and maintenance of vehicles and other equipment and staging areas shall occur at least 20 meters from any riparian habitat or water body. The NPS and MMWD shall ensure contamination of habitat does not occur during such operations. Prior to the onset of work, the NPS shall ensure that the permittee has prepared a plan to allow a prompt and effective response to any accidentals pills. All workers shall be informed of the importance of preventing spills and of the appropriate measures to take should a spill occur.
7. A Service-approved biologist shall ensure that the spread or introduction of invasive exotic plant species shall be avoided to the maximum extent possible. When practicable, invasive exotic plants in the project areas shall be removed.
8. Project sites shall be revegetated with an appropriate assemblage of native riparian wetland and upland vegetation suitable for the area. A species list and restoration and monitoring plan shall be included with the project proposal for review and approval by NPS. Such a plan must include, but not be limited to,

location of the restoration, species to be used, restoration techniques, time of year the work will be done, identifiable success criteria for completion, and remedial actions if the success criteria are not achieved.

9. Stream contours shall be returned to their original condition at the end of project activities, or to fit pre-determined project designs, unless consultation with the Service has determined that it is not beneficial to the species or feasible.

10. The number of access routes, number and size of staging areas, and the total area of the activity shall be limited to the minimum necessary to achieve the project goal. Routes and boundaries shall be clearly demarcated within riparian floodplain areas. Where impacts occur in these staging areas and access routes, restoration shall occur as identified in measures 8 and 9 above.

11. Work activities shall be completed between July and early December. Should the proponent or applicant demonstrate a need to conduct activities outside this period, the NPS may authorize such activities after obtaining the Service's approval.

12. To control erosion during and after project implementation, the applicant shall implement best management practices, as identified by the appropriate Regional Water Quality Control Board.

13. If a work site is to be temporarily dewatered by pumping, intakes shall be completely screened with wire mesh not larger than five millimeters (mm) to prevent California red-legged frogs from entering the pump system. Pumped water shall be discharged and dispersed onto adjacent riparian floodplain areas and not directly back into Lagunitas Creek. Following completion of construction activities, any barriers to flow shall be removed in a manner that would allow flow to resume with the least disturbance to the substrate.

14. A Service-approved biologist shall permanently remove from within the project area any individuals of exotic species, such as bullfrogs, crayfish, and centrarchid fishes to the maximum extent possible. The permittee shall have the responsibility to ensure that their activities are in compliance with the California Fish and Game Code.

Implementation Procedure	Monitoring and Reporting Actions	Monitoring Responsibility	Monitoring Schedule
1. Implement measures from the USFWS California Red-Legged Frog Biological Opinion. Consult with NPS.	1. MMWD incorporates measures in construction specifications	1. MMWD/contractor	1. Prior to and during construction

MM BIO-5 Prior to construction, the sites shall be surveyed for western pond turtles by a qualified biologist. If turtles are found, there shall be no further disturbance at the project site until CDFW and NPS have been consulted. Additional provisions resulting from the consultation could be required to protect turtles and are likely to include a list of the exclusion measures that will be used at the work site to prevent the take of or injury to pond turtles that could occur on site.

Implementation Procedure	Monitoring and Reporting Actions	Monitoring Responsibility	Monitoring Schedule
1. MMWD assigns qualified biologist to conduct a preconstruction survey for western pond turtles.	1. MMWD formalizes assignment	1. Qualified biologist, MMWD	1. Prior to construction
2. MMWD shall contact CDFW prior to conducting surveys.	2. MMWD contacts CDFW in advance of conducting surveys	2. MMWD, NPS, and qualified biologist	1. Prior to construction
3. If western pond turtles are present, MMWD consults with CDFW.	3. Daily inspections during construction period	3. MMWD, NPS, and qualified biologist	3. During construction

MM BIO-6 Work will normally be scheduled for August 1 through February 1 to avoid disturbance to nesting birds in conformance with the Migratory Bird Treaty Act. All survey results must be transmitted to the NPS wildlife biologist MMWD will coordinate with NPS both prior to conducting the preconstruction bird and raptor surveys, and after conducting the surveys to submit the survey reports to NPS for approval.

Implementation Procedure	Monitoring and Reporting Actions	Monitoring Responsibility	Monitoring Schedule
1. MMWD coordinates with NPS and assigns a qualified biologist to conduct pre-construction surveys for nesting birds and raptors.	1. MMWD formalizes assignment	1. NPS qualified biologist, MMWD	1. Prior to construction
2. If active nests are present, consult with NPS and CDFW and restrict construction within 500 feet of nests.	2. MMWD consults with NPS and CDFW and assigns qualified biologist to conduct periodic surveys during nesting season	2. MMWD, NPS, and qualified biologist	2. During nesting season
3. MMWD submits the survey reports to NPS for approval.	3. Obtain approval from NPS	3. MMWD	3. Prior to construction

MM BIO-7 Prior to construction, the sites shall be surveyed for bats by a qualified biologist. If bats are found, there shall be no further disturbance at the project site until NPS, CDFW, and USFWS have been consulted. Additional provisions resulting from the consultation could be required to protect roosting bats or bat maternity sites.

Implementation Procedure	Monitoring and Reporting Actions	Monitoring Responsibility	Monitoring Schedule
1. MMWD assigns qualified biologist to conduct a preconstruction survey for bats and bat roosting areas.	1. MMWD formalizes assignment	1. Qualified biologist, MMWD	1. Prior to construction
2. MMWD shall contact NPS prior to conducting surveys.	2. MMWD contacts NPS in advance of conducting surveys	2. MMWD, NPS, and qualified biologist	1. Prior to construction
3. If bats are present, MMWD consults with NPS, CDFW, and USFWS.	3. Periodic inspections during breeding season	3. MMWD, NPS, and qualified biologist	3. During breeding season

MM BIO-8 MMWD shall describe required replanting which would be implemented as soon as construction is complete. This description shall include, but not be limited to, replanting of vegetation removed prior to or during construction, and management and monitoring of the habitat to ensure success for any species that cannot be avoided. Replanting shall be conducted using NPS standard operating procedures, such as preparation of soil conditions, use of NPS approved native plants, plant protection, irrigation or watering if necessary, and control of aggressive non-native species. MMWD shall submit the pre-construction survey for all special-status species to NPS for review and approval as part of the Special Use Permit approval. MMWD would use local plant materials for revegetation of the disturbed areas. To the greatest extent possible the plant materials would consist of cuttings from the project sites. If sufficient on-site plant material is not obtained, a secondary source may include local cuttings and/or collections from the local watershed or from adjacent watersheds. Replanting shall take into account that use of container plants that meet this source criteria may add additional time to the revegetation process in that the materials need to be collected and provided to a contractor in of advance the expected planting date. This would ensure that the seeds can be collected during the appropriate season and the container plants would be of an appropriate size for out-planting. Using local cuttings can reduce the length of this phase.

Implementation Procedure	Monitoring and Reporting Actions	Monitoring Responsibility	Monitoring Schedule
1. MMWD prepares replanting plan.	1. MMWD	1. MMWD	1. Prior to or during construction

Implementation Procedure	Monitoring and Reporting Actions	Monitoring Responsibility	Monitoring Schedule
2. MMWD coordinates with NPS and implements replanting.	2. MMWD	2. MMWD, NPS, and qualified biologist	2. Post-construction

MM BIO-9 The following steps shall be taken to ensure that project construction does not spread or exacerbate the growth of Japanese knotweed in the Lagunitas Creek watershed:

- A springtime pre-construction survey of all project areas (staging, access, and treatment sites) shall be conducted by a qualified biologist to search for Japanese knotweed throughout all areas of each project site, including access routes, staging areas, and at project structure locations.
- If Japanese knotweed is observed, it shall be marked with a 20-foot buffer in the field with flagging, stakes, or other appropriate markers to designate its location and extent; GPS points or polygons will be collected at all Japanese knotweed patches. Mapped observations will be provided to NPS.
- Construction activities shall be planned and laid out to avoid any existing Japanese knotweed as much as possible, with the goal of avoiding all existing patches, if possible; this may include aligning access routes to avoid it and/or locating and laying out staging areas to avoid it.
- Any patches of Japanese knotweed that cannot be avoided shall either be removed or capped. Removal equipment will arrive at the site clean. Removal shall address all plant parts, both above- and belowground; the material shall be taken off site for appropriate disposal (incineration or other appropriate disposal method) outside the watershed. Capping shall fully cover the patch with local, native soil. Any excavations from plant removal will be backfilled with local, native soil.
- Prior to any Japanese knotweed removal, MMWD shall coordinate with NPS regarding removal methodology, inspection of equipment, and construction schedule to allow NPS or MMWD personnel to observe and monitor the knotweed removal.

Following construction, MMWD shall coordinate post-construction monitoring with NPS and conduct surveys for Japanese knotweed as an element of the project's effectiveness monitoring plan (see Section 2.3). GPS points and other data on Japanese knotweed shall be provided to NPS. MMWD shall continue to coordinate and collaborate with NPS on NPS's Japanese knotweed eradication efforts on NPS lands within the Lagunitas Creek watershed (see Section 2.5).

Implementation Procedure	Monitoring and Reporting Actions	Monitoring Responsibility	Monitoring Schedule
1. MMWD coordinates with NPS and assigns a qualified biologist to conduct spring surveys for Japanese knotweed	1. MMWD formalizes assignment	1. NPS approved biologist, MMWD	1. Spring prior to construction
2. If Japanese knotweed is observed, it shall be marked in the field for avoidance. Any patches that cannot be avoided shall either be removed or capped.	2. MMWD consults with NPS and assigns qualified biologist to observe	2. MMWD, NPS, and qualified biologist	2. During construction
3. Monitoring shall be included in project effectiveness monitoring plan.	3. As described in Section2.3	3. MMWD	3. Post construction

MM BIO-10 **Construct during the Fall**. The total construction period is anticipated to occur from July through December; however, in-channel work will be restricted to the August through October period when stream flow is minimal (~8 cubic feet per second (cfs)) to minimize impacts to water quality and/or aquatic habitat. In-channel construction activities are anticipated to last up to 75 days (from August 1 through October 15), and up to 60 days for finished grading and revegetation. Work in the Tocaloma Floodplain and in the other floodplain areas will likely extend into November, with replanting activities occurring from November into December.

Implementation Procedure	Monitoring and Reporting Actions	Monitoring Responsibility	Monitoring Schedule
1. MMWD will execute project construction during the summer–early fall period under low-flow conditions.	1. MMWD ensures construction only in the summer–early fall period when stream flows are minimal (8 cfs)	1. MMWD/contractor	1. Prior to construction

MM CUL-1 If a significant cultural resource (historical resource) is identified at a project location, adverse change to the identified cultural resource(s) shall be avoided. If cultural resources cannot be completely avoided through project redesign, specific protection measures shall be developed and enacted. These measures can include site boundary delineation with fencing or flagging to prevent accidental disturbance of cultural resources during construction or on-site construction monitoring by cultural resource professionals during construction to assure that cultural resources are not disturbed.

MM CUL-2 The contractor shall report any previously unknown historic or archaeological resources discovered at a project location to the U.S. Army Corps of Engineers (Corps) as required in the Regional General Permit. In the event of any discovery during construction of human remains, archaeological deposits, or any other type of cultural resource, the Contractor shall notify the National Park Service and Corps archaeological staff within 24 hours. Construction work shall be suspended immediately and shall not resume until both agencies re-authorize project construction. If it becomes impossible to implement the project at a work site without disturbing cultural resources, then activity at that work site shall be discontinued.

2.7 PERMIT REQUIREMENTS AND CONSULTATIONS

The Fisheries Restoration Grant Program operates a Regional General Permit issued by the Corps. Compliance for this project regarding Clean Water Act requirements is met by conformity with RGP12 (file numbers 2003-27922N and 2003-279220, which were issued in 2010 and 2016 respectively by the Corps San Francisco District) and covers action items implemented within the regulatory boundaries of the San Francisco District. As part of this compliance, MMWD shall submit annual reports to the 401 Program Managers of SWRCB and the Bay Area RWQCB documenting work undertaken during the preceding year.

MMWD shall obtain project clearance under CDFW's lake and streambed alteration agreement process (California Fish and Game Code, Section 1600 et seq.) This program is an integral part of stream restoration planning and implementation. An agreement is required to designate specific measures to minimize disturbance to the stream environment. MMWD has already obtained Section 1600 Streambed Alteration Agreement No. 1600-2016-0110-R3 for Sites 3–6 and 10 and will apply for Sites 7–9.

MMWD shall obtain project approval and permitting from NPS prior to implementation of the project on NPS lands. As landowner, NPS has approval responsibility for the project and is the lead agency for NEPA compliance. MMWD has prepared this Environmental Assessment (EA) in conformance with NEPA and NPS Director's Order 12 to aid NPS in considering approval of the proposed MMWD project. The EA analysis considers a range of project alternatives and assesses the potential impacts that could result from the proposed habitat and floodplain enhancements. California Environmental Quality Act compliance was completed for this proposal by CDFW, which considered and approved the proposed project for funding as part of the 2015 and 2016 Fisheries Restoration Grant Programs. The record of California

Environmental Quality Act compliance is included in this document as Appendix A. Additional funding has been secured through grants from SWRCB (Nonpoint Source Clean Water Act 319h Program) and USFWS (Coastal Program), as well as from MMWD.

As described in Section 2.6 under **MM BIO-2** and **MM BIO-3**, MMWD shall consult with NOAA Fisheries and USFWS under Section 7 of the federal Endangered Species Act and CDFW under Section 1600 of the California Fish and Game Code to provide preservation and avoidance measures commensurate with the protection standards for affected species.

CHAPTER 3
ENVIRONMENTAL CONSEQUENCES

The environmental consequences analysis is this chapter addresses significant issues that play a key role in making a decision on the project. Other issues that may arise from project implementation but that are not central to the proposal or of critical importance were addressed in Section 1.8, Impact Topics Considered but Dismissed from Further Analysis, of this Environmental Assessment (EA). The following issues are addressed in this chapter:

- Soils and Water Resources
- Special-Status Species
- Vegetation Resources
- Wildlife
- Cultural Resources
- Visitor Experience and Recreation Resources

General Methodology

For the purposes of this document, potential impacts are generally described in terms of the nature of the impact (Are the effects beneficial or adverse?), duration (Are the effects restricted to the implementation period? Are they short term? Are they long term?), intensity (Are there no effects or would effects be negligible, minor, moderate, major?), type of impact (Are the effects direct, indirect, and/or cumulative?), and context (Are the effects localized to the project area, park, or region?).

- **Context of Impacts:** Context describes the geographic setting within which an impact is analyzed. A localized impact is one that occurs within or in the immediate vicinity of the project reaches (i.e., areas limited to Sites 3–6 or the Tocaloma Floodplain). A watershed-wide impact would apply to those impacts that could be felt throughout the Lagunitas Creek corridor. A regional impact is one that takes place on a scale larger than Lagunitas Creek corridor—such as one that would be felt at the County-wide scale or Tomales Bay and the Pacific Ocean.
- **Nature of Impacts:** The nature of the impact is considered beneficial if it stops or reverses the adverse effects of human activities on flow regimes, channel morphology, and/or soil and sediment budgets. The nature of the impact is considered adverse if it continues or worsens the historical adverse impacts of humans on natural physical processes, or if the project introduces new stresses in the system.

- **Intensity of Impacts:** The intensity of impacts describes the degree to which the project or project-related activities would affect a given resource.
- **Duration of Impacts:** Duration describes the length of time that an impact would affect a given resource; this is an important concept with regard to natural physical processes. Many impacts can occur over multiple timeframes or duration periods, or can occur over brief, discrete period (episodically). Duration of project impacts are described as construction-phase impacts (restricted to the restoration actions and/or implementation of post-project erosion control); short-term impacts (restricted to the first two large bankfull or flood flows following project installation); or long-term impacts (impacts that would occur over the course of several years or decades).
- **Type of Impacts:** Type describes the type of relationship between the proposed actions and the impact. Type is generally described as direct (actions would directly effect this change); indirect (actions would not effect this change, but would enable change to occur, or change would occur later in time, or farther in distance than the actions); and/or cumulative (actions would have an additive effect with the actions of other past, ongoing, or reasonably foreseeable future projects).

Council on Environmental Quality regulations implementing the National Environmental Policy Act defines a cumulative impact as "…the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time" (40 CFR 1508.7). In other words, cumulative impacts are the impacts of actions independent of those in this proposal. In the case of the proposed project, the existing condition is a result of cumulative conditions in the watershed, so analysis of the project alone is also an analysis of the project along with past projects.

3.1 SOILS AND WATER RESOURCES

3.1.1 Introduction

This section describes existing setting with respect to water resources and soils, with a particular focus on watershed hydrology, flow regimes, sediment budgets, and water quality as it relates to the project reaches along Lagunitas Creek. In addition, this section describes the applicable laws, regulations, and policies and evaluates the short-term and long-term impacts of the project related to watershed hydrology and soils.

3.1.2 Regulatory Framework

The Clean Water Act (CWA) (33 U.S.C. 1251 et seq.), as amended by the Water Quality Act of 1987, is the major federal legislation governing water quality. The objective of the CWA is "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters." Numerous agencies have responsibilities for administration and enforcement of the CWA. At the federal level this includes the U.S. Environmental Protection Agency, the U.S. Army Corps of Engineers (Corps), the Bureau of Reclamation, and the major federal land management agencies such as the National Park Service (NPS), U.S. Forest Service, and the Bureau of Land Management. At the state level, with the exception of tribal lands, the California EPA and its sub-agencies, including the State Water Resources Control Board (SWRCB), have been delegated primary responsibility for administering and enforcing the CWA in California. Important sections of the act are described below.

CWA Section 303 (Impaired Waters and TMDLs)

Under Section 303(d) of the CWA, the State of California is required to develop a list of impaired water bodies that do not meet water quality standards and objectives. California is required to establish Total Maximum Daily Loads (TMDLs) for each pollutant/stressor. A TMDL defines how much of a specific pollutant/stressor a given water body can tolerate and still meet relevant water quality standards.

Lagunitas Creek is listed pursuant to federal CWA Section 303(d) requirements as an impaired waterbody due to increases in the amount of fine sediment (primarily sand) that is being deposited in the streambed. Lagunitas Creek is not meeting narrative water quality objectives for sediment, settleable material, and population and community ecology due to elevated rates of erosion and sedimentation in the Lagunitas Creek watershed. Under CWA Section 303(d), SWRCB is required and authorized to establish a TMDL for those pollutants identified as causing impairment of waters on the Section 303(d) list. Additionally, under California Water Code Section 13242, SWRCB is authorized to develop an implementation program for achieving water quality objectives.

In June 2014, the San Francisco Bay Regional Water Quality Control Board (RWQCB) adopted Resolution R2-2014-0027 amending its Basin Plan. The Basin Plan amendment establishes (1) a sediment TMDL for Lagunitas Creek, upstream of Devil's Gulch the TMDL at 120% of natural background (7,400 metric tons per year), and upstream of Olema Creek at 110% of natural background (11,800 metric tons per year); (2) numeric targets for streambed mobility and redd scour; (3) load allocations for all significant sediment sources; and (4) an implementation plan to achieve the TMDL and related habitat enhancement goals.

The proposed project is one of many actions already implemented or being planned to achieve fine sediment reduction, water quality improvement, and habitat enhancement goals within Lagunitas Creek.

CWA Section 401 (Water Quality Certification)

CWA Section 401 requires an applicant for any federal permit that proposes an activity which may result in a discharge to waters of the United States, to obtain certification from the state that the discharge will comply with other provisions of the act. Water Quality Certification or a waiver from the RWQCB is required before a Section 404 permit becomes valid. The RWQCB also reviews projects for consistency with Waste Discharge Requirements under the state land disposal regulations.

CWA Section 402 (National Pollutant Discharge Elimination System Program)

CWA Section 402 establishes the National Pollutant Discharge Elimination System, a permitting system for the discharge of any pollutant (except for dredged or fill material which is governed under CWA Section 404) into waters of the United States. This permit program is administered by the SWRCB and the nine RWQCBs, which have several programs that implement individual and general permits related to construction activities, stormwater runoff quality, and various kinds of non-stormwater discharges.

For stormwater discharges associated with construction activity in the State of California, the SWRCB has adopted the General Permit for Storm Water Discharges Associated with Construction and Land Disturbance Activities (Construction General Permit) to avoid and minimize water quality impacts attributable to such activities (SWRCB 2010). The Construction General Permit applies to all projects in which construction activity disturbs 1 acre or more of soil. Construction activity subject to this permit includes clearing, grading, and disturbances to the ground, such as stockpiling and excavation. The Construction General Permit requires the development and implementation of a stormwater pollution prevention plan (SWPPP), which would include and specify water quality best management practices (BMPs) designed to prevent pollutants from contacting stormwater and keep all products of erosion from moving off site into receiving waters. Routine inspection of all BMPs is required under the provisions of the

Construction General Permit, and the SWPPP must be prepared and implemented by qualified individuals as defined by the SWRCB.

CWA Section 404 (Discharge of Dredged or Fill Material)

CWA Section 404 establishes a permit program for the discharge of dredged or fill material into waters of the United States. This permit program is jointly administered by the Corps and the U.S. Environmental Protection Agency.

As described in the California Environmental Quality Act compliance document for this project (Appendix A2), the Fisheries Restoration Grant Program operates under a Regional General Permit (RGP) issued by the Corps. RGP12 (file numbers 2003-27922N and 2003-279220) was issued in 2016 by the Corps San Francisco District. The RGP allows the California Department of Fish and Wildlife (CDFW), grantees, and other individuals and groups to conduct fishery habitat restoration activities using methods described in the California Salmonid Stream Habitat Restoration Manual, 4th edition, that have been evaluated by CDFW biologists.

Federal Anti-Degradation Policy

The federal anti-degradation policy is designed to protect water quality and water resources. The policy directs states to adopt a statewide policy that includes the following primary provisions: (1) existing instream uses and the water quality necessary to protect those uses shall be maintained and protected; (2) where existing water quality is better than necessary to support fishing and swimming conditions, that quality shall be maintained and protected unless the state finds that allowing lower water quality is necessary for important local economic or social development; and (3) where high-quality waters constitute an outstanding national resource, such as waters of national and state parks, wildlife refuges, and waters of exceptional recreational or ecological significance, that water quality shall be maintained and protected.

SWRCB Order WR95-17

SWRCB regulates the diversions of water from the Lagunitas Creek basin by the Marin Municipal Water District (MMWD), which supplies water for over 190,000 people, including commercial users, in southern and central Marin County. In response to a severe 2-year drought in 1976–1977, MMWD sought to increase its water storage capacity by raising Peters Dam and enlarging Kent Lake. The SWRCB, in its “Decision 1582,” approved the enlargement of Kent Lake, established instream flow standards, and directed MMWD to conduct studies on fisheries protection measures. The primary issues of concern were the impacts to anadromous salmonids (i.e., coho salmon (*Oncorhynchus kisutch*) and steelhead trout (*O. mykiss*)) and to California freshwater shrimp (*Syncaris pacifica*). The SWRCB indicated that final mitigation measures would be decided upon following the completion of the studies. Throughout the 1980s and early

1990s, MMWD conducted studies on the fisheries and hydro-geomorphology of Lagunitas Creek. Additional studies were conducted by CDFW.

These studies culminated in SWRCB issuing Order WR95-17 in 1995, in which the SWRCB ordered MMWD to develop and implement a 10-year sediment management plan, a riparian management plan, and a fishery resources monitoring workplan. The order was intended as mitigation to address the impacts of MMWD creek diversions at Kent Lake on Lagunitas Creek. The Lagunitas Creek Sediment and Riparian Management Plan was completed in 1997. MMWD successfully completed the activities defined in the 10-year Lagunitas Creek Sediment and Riparian Management Plan, continues to meet the ongoing requirements of Water Right Order 95-17, and continues to implement various elements of the Sediment and Riparian Management Plan. MMWD developed a new plan, the Lagunitas Creek Stewardship Plan (MMWD 2011), describing its management goals, activities to date, monitoring efforts, and a list and schedule of planned activities related to habitat enhancement and sediment management along Lagunitas Creek.

Floodplain Management

Executive Order 11988, Floodplain Management (May 28, 1980), was issued "to avoid to the extent possible the long and short term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct or indirect support of floodplain development wherever there is a practicable alternative." The goals of the project are in accordance with both the executive order and director's order to protect and preserve the natural resources and functions of floodplains and restore natural floodplain values previously affected by land use.

3.1.3 Affected Environment

The physical form, sediment composition, and biota within the project reaches along Lagunitas and Olema Creeks are influenced by numerous factors within the contributing watershed. Such watershed factors include (1) its size, shape, and topography; (2) its underlying geology (including structural features and faults); (3) the timing, magnitude, and duration of flow; (4) the type and distribution of soils, land cover, and vegetation; and (5) anthropogenic (human-caused) influences. Populations of coho salmon and steelhead trout rely on favorable conditions within the watershed to successfully complete their life-cycle, particularly with respect to water quality (e.g., turbidity and temperature), the distribution and abundance of shading and/or refuge areas (i.e., vegetation and woody debris), and the relative abundance and distribution of fine versus coarse sediment that form both the active channel and floodplain. Historic logging, agriculture, livestock grazing, urbanization, road construction, dam construction (i.e., flow regulation), and stream alteration over the last 150 years have altered the natural hydrologic regime, resulting in adverse effects on water and habitat quality. As a result, coho salmon and steelhead trout populations face significant stresses and limitations, particularly with respect to winter habitat (Stillwater Sciences 2008).

There has been substantial study around the hydrologic processes that influence sedimentation and riparian habitat within the Lagunitas Creek watershed, driven primarily by protections to coho and steelhead under the Endangered Species Act, the listing of Lagunitas Creek as an impaired water body under CWA Section 303(d) for sediment, and SWRCB Order WR95-17. The following description of watershed characteristics and processes are derived from several studies of the Lagunitas Creek watershed, most recently conducted by Stillwater Sciences (2008, 2010), Cover (2012), and Kamman Hydrology & Engineering Inc. ((Kamman) 2013, 2014).

Watershed Geography

Lagunitas and Olema Creeks drain much of west-central Marin County and are the largest watershed in the County, encompassing a 109-square-mile drainage area at its confluence with the southern end of Tomales Bay (Kamman 2014). Lagunitas Creek originates on Mount Tamalpais and has a total length of about 22 miles, which can be divided into two main sections. The upper 8 miles of the creek is impounded by four reservoirs operated by MMWD, the fourth and largest of which is Kent Lake. Formed by Peters Dam, which was built in 1954 and raised in 1982, Kent Lake holds approximately 32,900 acre-feet of water. The three smaller reservoirs above Kent Lake near the headwaters consist of Lake Lagunitas (dam built in 1872), Bon Tempe Lake (dam built in 1948), and Alpine Lake (dam built in 1918). Downstream of Kent Lake, Lagunitas Creek flows another 12 miles where it is joined by several "unregulated" (i.e., undammed/free-flowing) tributaries including San Geronimo Creek, Irving Creek, Barnabe Creek, Deadman's Gulch, Devil's Gulch, Cheda Creek, McIsaac Creek, and Olema Creek. The Olema Creek watershed is a 14.5-square mile sub-basin (about 14% of the whole watershed), with Olema Creek flowing in nearly a straight line through the rift valley of the San Andreas Fault. The other major tributary is Nicasio Creek, which is impounded by MMWD's Nicasio Reservoir (formed by Seeger Dam, built in 1960) (MMWD 2011). Lagunitas Creek and Olema Creek meet in the estuary, at the newly restored Giacomini Wetlands, where a vast area of former dairy pasture was reopened to tidal action in 2008, restoring vital estuary habitat (Kamman 2014).

As part of an effort to establish a sediment budget for Lagunitas Creek, Stillwater Sciences (2010) established geomorphic landscape units within the Lagunitas Creek watershed above the confluence of Olema Creek by compiling geographic data on geology, land cover, and hillslope gradient for each of the sub-watersheds contributing to flow in the creek. The study focused on sediment sources in the unregulated portions of the watershed (64.4 square kilometers (24.9 square miles)), which consist of San Geronimo Creek, Woodacre Creek, Devil's Gulch, Cheda Creek, and other small tributaries that are not dammed, including McIsaac Creek. The land cover, geology, and slope gradients for the Lagunitas Creek watershed above the confluence of Olema Creek are provided in Table 3. The geologic units underlying the watershed primarily consist of Franciscan Mélange, with Quaternary alluvium being the smallest component, limited to creek beds. The land cover is dominated by mixed forest (>50% canopy) and mixed shrub

(<50% canopy) lands, with agricultural/herbaceous land covers dominating the Nicasio Creek portion of the watershed. Slope gradients in the watershed are steep, exceeding 30% in most areas, with gentle gradients of less than 5% composing less than 9% of the sub-watersheds. The elongated shape of the watershed is a product of the structural trend of the geology, which is heavily influenced by the northwest-trending San Andreas Fault Zone. Bedrock geology is an important control on the longitudinal profile of Lagunitas Creek, whereby resistant layers represent barriers to further incision and migration of headcuts.

Olema Creek has a much lower-gradient creek channel than Lagunitas Creek and is contained within the San Andreas Rift Zone (Kamman 2013). In the early 1920s, Olema Creek between the Town of Olema and its confluence with Lagunitas Creek was straightened into the 3-kilometer-long (1.9-mile-long) Olema Canal, which drained the surrounding land for agricultural production. Olema Creek is currently reclaiming its historic configuration in an interesting example of restoration through a change in management, which in this case consists of no longer maintaining the straightened channel (MMWD 2011).

Table 3
Land Cover, Geology, and Slope of Lagunitas Creek Sub-Watersheds

	Upper Lagunitas Creek (upstream of Peters Dam)	Unregulated Nicasio Creek (upstream of Seeger Dam)	Middle and Lower Lagunitas Creek (above confluence with Olema Creek)	Whole Watershed
Area	55.7 km^2	93.2 km^2	64.4 km^2	213.2 km^2
Coverage of Geologic Terrains (% of area)				
Quaternary Alluvium	6%	5%	4%	5%
Franciscan Mélange	57%	70%	56%	63%
Nicasio Reservoir	24%	4%	24%	16%
San Bruno Mountain	8%	16%	16%	14%
Land Cover/Vegetation (% of area)				
Agricultural/Herbaceous	8%	56%	32%	36%
Mixed Shrub	35%	9%	13%	17%
Mixed Forest	51%	32%	53%	43%
Urban/Barren	7%	4%	2%	4%
Slope Gradient Categories (% of area)				
0%–5%	6%	9%	4%	7%
5%–30%	28%	38%	35%	35%
>30%	66%	53%	61%	59%

Source: Stillwater Sciences 2010, Tables 3-3 through 3-6.

Watershed Conditions and History

Historic land use changes and management practices are believed to have had large impacts on stream channel conditions in the Lagunitas Creek watershed as a result of changes in the supply and transport of sediment (Cover 2012). Recent watershed history includes a typical pattern of Euro-American settlement: crop production, ranching, and logging for paper production dominated the period from 1850–1918. Thereafter there was a switch from row crops to grazing and the beginnings of flow regulation (1919–1945), limited population increases and the beginnings of significant flow regulation (1945–1982, including the initial Peters Dam and Seeger Dam), and the current period since 1983 that is characterized by continued development in the San Geronimo Creek watershed and increased concerns for environmental quality. Rates of hillslope sediment delivery are likely to have increased dramatically during the initial settlement period in response to activities associated with livestock raising, the introduction of non-native grasses, and intensive logging. Rates of sediment production are thought to have progressively reduced during subsequent periods in response to flow regulation, with sediment production switching to channel sources (Stillwater Sciences 2010). The impacts of development are recorded by several studies that document variable rates of sedimentation into Tomales Bay, studies of sediment yields from neighboring areas, and by channel monitoring activities in the watershed since 1979. The channel monitoring studies recognized the mobility of bed sediments in both Lagunitas and San Geronimo Creeks, and the predominance of supply of finer gravels and sand delivered from San Geronimo Creek, with potential impacts on aquatic habitats (Stillwater Sciences 2010).

The two largest flood flows in the last century occurred in 1925 and 1982. Using evidence from available river gaging stations in Marin County supplemented with historical narratives from the Muir Woods National Monument suggested that the January 4, 1982, event may have been the largest flow event in the County since an event on February 11, 1925 (Stillwater Sciences 2010). Flows of such magnitude are sufficient to completely rework the floodplain and result in significant shifts in the location, slope, and geometry of the active channel. Landscape changes resulting from geomorphic processes can take many decades if not centuries to complete, and it is important to acknowledge that the conditions of the creek over the course of several years may only reflect a small part of a longer-term geomorphic process. For example, the morphology of the middle and lower portions of Lagunitas Creek is likely to still be in the process of adjusting to the changes in sediment source areas and the altered flow regime imposed by dams and other human disturbances with the watershed.

On Olema Creek, the corridor and valley downstream of Bear Valley Road was pastureland, largely denuded of woody riparian vegetation and hosting a deeply incised creek channel prior to the NPS acquisition of Point Reyes National Seashore lands in 1963. Prior to that time, owners would clear the creek of vegetation and debris to maximize conveyance of high flows, while also filling in the banks of the creek to maximize pastureland, resulting in a deeply incised channel. Over time, especially after the 1982 storms and landslides, and in the 1990s when cattle grazing ceased, the channel has taken on a more natural form and function and is experiencing aggradation (Kamman 2013).

Magnitude, Frequency and Duration of Wet-Season Flows

Long-term peak and daily flow records are available from four flow gages within the watershed: (1) MMWD's gage on San Geronimo Creek at the Lagunitas Bridge crossing; (2) the U.S. Geological Survey gage within Samuel P. Taylor State Park (SPT); (3) a second U.S. Geological Survey gage located at Gallagher Ranch near Point Reyes Station; and (4) the NPS gage on Olema Creek at the Bear Valley Road Crossing. The stream gage records at SPT are likely to be the most representative of flow conditions encountered along all project sites, except Site 9, which is best represented by the NPS gage on Olema Creek at the Bear Valley Road Crossing.

Between Water Years 1996 and 2009, winter stream flows at the U.S. Geological Survey gage in SPT peaked at a median of about 1,800 cubic feet per second (cfs) during the height of the most severe storm event in each year (MMWD 2011). In the 1996–2009 period, the most severe flow events occurred in 1998 and 2006, when flows at the SPT gage peaked at around 6,000 cfs and 10,000 cfs, respectively. Figure 13 shows the peak instantaneous flow by water year at the SPT gage. Winter flows in Lagunitas Creek are most profoundly influenced by San Geronimo Creek, Kent Lake spills, and Nicasio Reservoir spills (MMWD 2011). Summer flows at the SPT have been maintained at 8 cfs since SWRCB Order WR95-17 in 1995. San Geronimo Creek contributes very little flow during the summer, so the 8 cfs base flow has been maintained almost entirely by Kent Lake releases (MMWD 2011). The estimated Olema Creek winter base flow can be 5–10 cfs and summer base flow ranges from 0.1 to 1.0 cfs (Kamman 2014).

Kamman (2013) analyzed the frequency and characteristics of flow within Lagunitas Creek and Olema Creek during wet, normal, and dry water years, and compared it to what would occur if the watershed were unaffected by dams. Kamman made two primary findings based on this comparison (Kamman 2013):

- Summer base flows are maintained at significantly higher levels under the WR95-17 flow regime than would have occurred naturally. This provides a substantial increase in wetted rearing depth and area during the summer and in some cases could perennially inundate backwater and/or alcove features connected to the main stem and constructed to enhance winter habitat conditions.
- The magnitude and duration of the majority of peak flows has been reduced under the WR95-17 flow regime. As a result, the extent and duration of overbank flows (and channel–floodplain connectivity) are reduced under the WR95-17 flow regime.
- Olema Creek is unregulated by dams but is thought to have been profoundly affected by the storms of 1982 and removal of cattle grazing in the Olema Creek project reach during the 1990s, which has led to frequent channel avulsion and overbank flows.

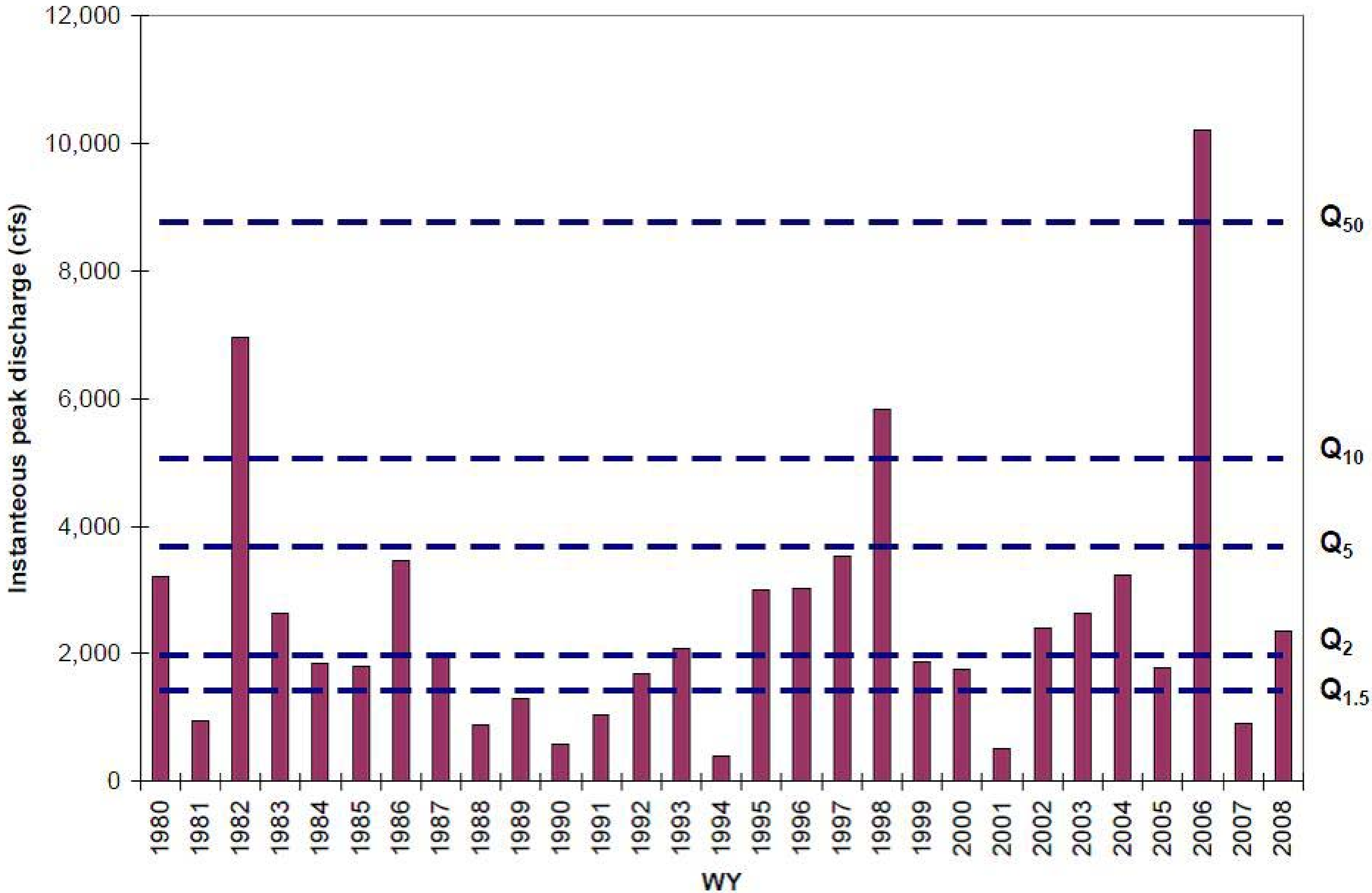

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Figure 13
Annual Maximum Discharge for Lagunitas Creek at Samuel P. Taylor State Park

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Bank-full flows—the return period for a typical bank-full flow event in the San Francisco Bay Area is 1.5 to 2 years—flows range from approximately 1,370 to 1,850 cfs at the SPT gage and approximately 2,300 to 3,575 cfs at the Point Reyes Station gage. Analysis of peak flows within the watershed suggests that under current regulated conditions (i.e., dams), there is an approximately 50% reduction in peak flows for any given recurrence interval when compared to natural, unaltered watershed conditions (Kamman 2013). Similarly, the main stem of Lagunitas Creek below the dams has seen a reduction in the magnitude and frequency of high flows (i.e., >30 cfs) and an increase in the magnitude and frequency of low flows (i.e., <30 cfs) relative to unimpaired (i.e., pre-dam) conditions (Kamman 2013).

Sediment Supply Sources and Mobilization

Stillwater Sciences (2010) conducted a study to evaluate the sediment budget within the unregulated portions of the watershed. The source areas and origin of sediment within the watershed are an important control on both turbidity (suspended sediment) and stream morphology (bedload sediment), and can provide valuable information for watershed management actions. Table 4 provides a summary of the natural and human-influenced sources of sediment that are typically found in coastal California watersheds. The sediment source mechanisms within the Lagunitas Creek watershed consist of the following, as shown on Figure 14 (Stillwater Sciences 2010):

- Hillslope slides and gullies (7,952 metric tons per year)
- Tributary bank erosion (5,349 metric tons per year)
- Mainstem incision (4,808 metric tons per year)
- Tributary incision (3,193 metric tons per year)
- Connected road and trail sediment (2,035 metric tons per year)
- Mainstem bank erosion (477 metric tons per year)
- Soil creep (276 metric tons per year)

The sediment sinks consist of the following, also shown on Figure 14 (Stillwater Sciences 2010):

- Colluvial storage (−2,624 metric tons per year)
- Mainstem aggradation (−1,329 metric tons per year)

Overall, the sediment budget for Lagunitas Creek watershed consists of nearly 57% sediment production from channel sources (10% intercepted by channel aggradation) and 34% from hillslope slides, gullies, and soil creep, of which one-third is estimated to go into colluvial storage. The results appear consistent with the highly regulated flow and sediment regimes, and urban expansion within the San Geronimo watershed. Sub-watershed sediment production is generally proportional to the contributing area but is higher in San Geronimo Creek, so this watershed produces 47% of the total sediment from only 38% of the drainage area. Notable sources in the San Geronimo watershed include erosion from a relatively dense network of roads and trails, contributions from agriculture on steep terrain, and tributary bank erosion in headwater channels and second-order channels draining urban areas. Fine sediment production rates are also highest in the San Geronimo watershed.

By comparison to theoretical and cosmogenic studies of long-term rates of sediment production from neighboring watersheds, present-day human activities in the Lagunitas Creek watershed have cumulatively increased sediment yields somewhere from double to an order of magnitude over such background rates (Kamman 2013).

Table 4
Summary of Sediment Production and Storage Processes in the California Coast Range

Category	Sub-Category	Geomorphic Process
Sediment production (natural processes)	Hillslope and mass wasting processes	Creep and biogenic transport
		Shallow landsliding
		Deep-seated landsliding
	Hillslope overland flow erosion	Sheetwash and rill erosion
	Channel production processes	Channel head advance and knick-point migration
		Gully and channel incision
		Bank erosion
Sediment production (human disturbances)	Road-related	Cut and fill failures
		Surface erosion
		Stream crossings fill failures
		Inboard ditch incision and slope destabilization
		Gully formation due to runoff associated with inboard ditch relief
		Accelerated runoff and channel destabilization
	Agriculture and rangeland	Surface wash rilling and gullying
		Accelerated runoff and channel destabilization
		Shallow landsliding resulting from vegetation removal
		Channel erosion and destabilization from riparian vegetation removal
	Urban	Fine sediment release following construction
		Fine sediment flushing resulting from connection of drainage network
		Channel erosion resulting from post-construction low sediment and accelerated runoff
	Channel management	Channel erosion and destabilization through straightening and relocation
		Channel erosion and destabilization through LWD removal
		Forced storage resulting from dams and grade control measures

Table 4
Summary of Sediment Production and Storage Processes in the California Coast Range

Category	Sub-Category	Geomorphic Process
Channel sediment routing and storage dynamics		Sediment transport
		In-channel/overbank sediment storage

Source: Stillwater Sciences 2011, Table 3-1.

Sediment loads through SPT (average 4,272 metric tons per year) vary from almost 0 to more than 30,000 tons during Water Year 2006, when large flows occurred from Kent Lake spilling and from San Geronimo Creek (see Figure 15). In both cases, the highest annual sediment load is approximately double the second highest load. Annual loads through the Point Reyes Station gage are less variable by year and, from an average of 17,224 metric tons per year, have exceeded 50,000 tons on three occasions (Water Years 1995, 1998, and 2006), achieving over 60,000 tons in 1998 (Stillwater Sciences 2010). Considering that many of these flows presumably emanate from Nicasio Reservoir spilling, this emphasizes the ability of the lower Lagunitas Creek to transport sediment more regularly and may explain the accentuated channel erosion tendency seen in the regulated section of Nicasio Creek and downstream.

Sediment dynamics are largely driven by episodic events, such as floods, that tend to overwhelm incremental, longer-term improvements in sediment delivery to the creek.

Lagunitas Creek Channel Morphology

Kamman (2013) identifies two distinct geomorphic channel types or channel geometries at different locations through the project site. One type of channel is the “box channel” geometry that exhibits a single threaded, narrow, steep-sided entrenched (incised) box-channel shape. As a result, box channel reaches appear to be somewhat vertically disconnected from adjacent floodplain surfaces. The second channel types are shallower, wider, and multi-threaded channels with abundant in-channel features such as log-jams and longitudinal gravel bars, and are generally better connected to the adjacent floodplain. Kamman (2013) focuses on two primary elements that limit winter habitat needed for the recovery of salmonids: (1) an above-average percentage of channel geometries display a high ratio of depth to wetted perimeter, resulting in elevated velocity conditions in a disproportionate amount of mainstem channel, even during winter base flow conditions; and (2) the reduced frequency, duration, and magnitude of regular winter high flows has reduced the amount of inundated floodplain and side channel areas available for high flow refugia.

Channel incision causes habitat simplification, which herein is defined as the progressive lowering over time of the streambed elevation as a result of net erosion. San Geronimo and Lagunitas Creeks and alluvial reaches of their tributaries have incised substantially during the historical period. Channel incision obliterates the basic physical habitat structure of the channel, expressed by a substantial reduction in the frequency and area of gravel bars, riffles, and side channels. If a channel incises substantially, it will become disconnected from its surrounding floodplain, which further increases the rates of incision, streambed mobility, and scour depth. Another effect of incision has been a significant reduction in LWD input to Lagunitas Creek and its tributaries, which also greatly diminishes the capacity for these creeks to store, sort, and meter sediment.

The floodplain also displays some broad off-channel shallow depressions along the base of the western valley wall. The Tocaloma reach floodplain consists of a large floodplain area along the left bank within valley confines. There is a well-developed high flow channel network across the floodplain surface. A couple of tributary drainages flow onto the floodplain surface at the edge of the valley, but these are distant from the channel. Along Lagunitas Creek, most of the floodplain is inundated only during relatively high winter storm flows. Monitoring done by Kamman (2013) found that floodplain inundation occurs at flow ranges between the annual and 2-year flood recurrence intervals.

Olema Creek Channel Morphology

Olema Creek channel has been artificially straightened and confined and has responded historically by incising to a point of disconnecting the channel and adjacent floodplain at a natural frequency and duration. With removal of the land use and management practices that converted the creek to drainage ditch, the creek corridor appears to be evolving back to a more natural state—the creekbed is aggrading and the riparian corridor and associated wetlands are expanding (Kamman 2013).

3.1.4 Methodology

Particular consideration was given to actions with potential to affect the soils, natural hydrology, aquatic habitat features, and surface water quality of Lagunitas and Olema Creeks. The following primary aspects of water resources were assessed when considering potential impacts:

- Natural processes such as erosion, deposition, and maintenance of natural channel patterns.
- Water quality conditions necessary to support aquatic life within the creek systems
- Aquatic habitat attributes that support or provide habitat within the creek systems.

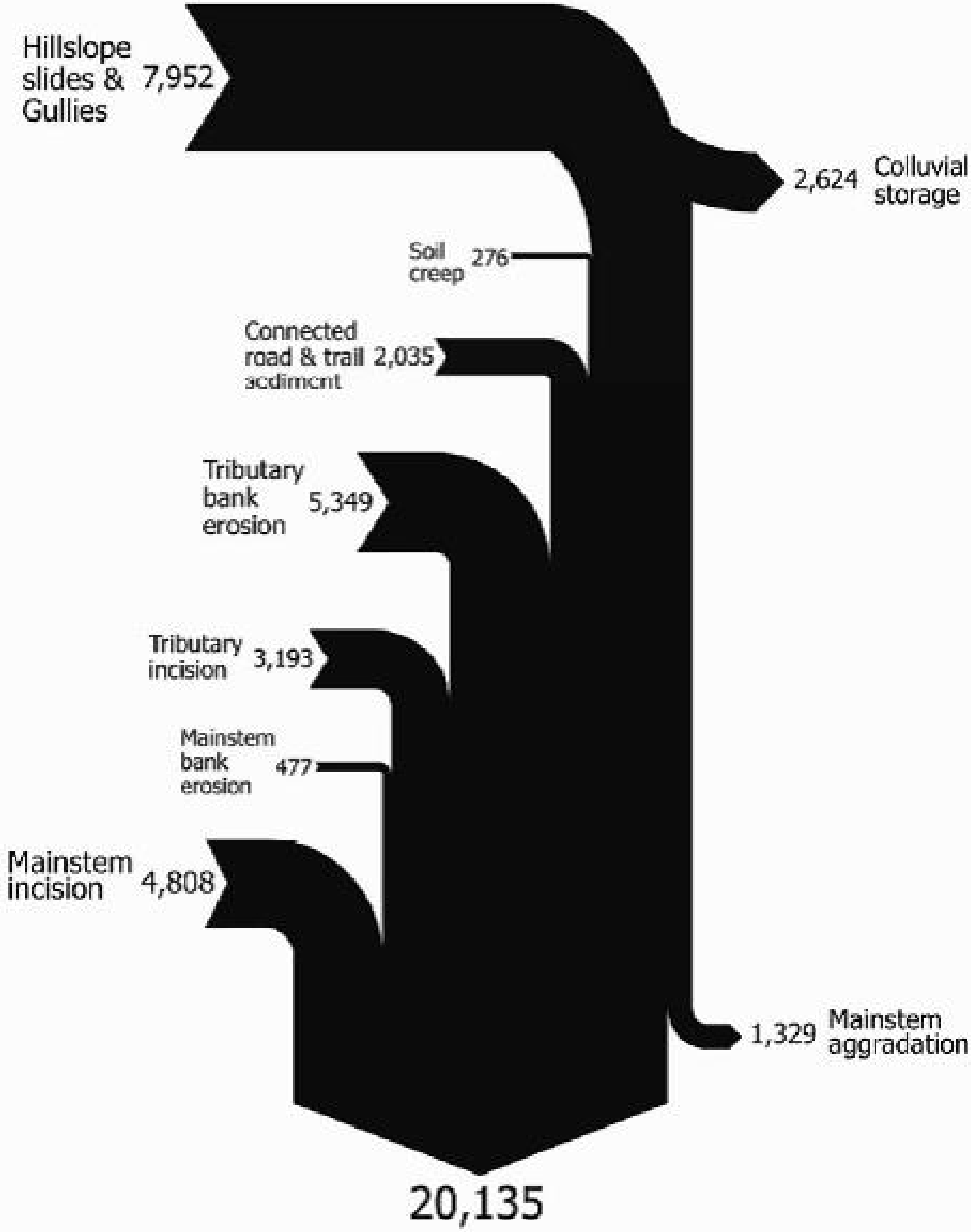

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Figure 14

Schematic Description of Sediment Source Mechanisms in the Lagunitas Creek Watershed (metric tons/year)

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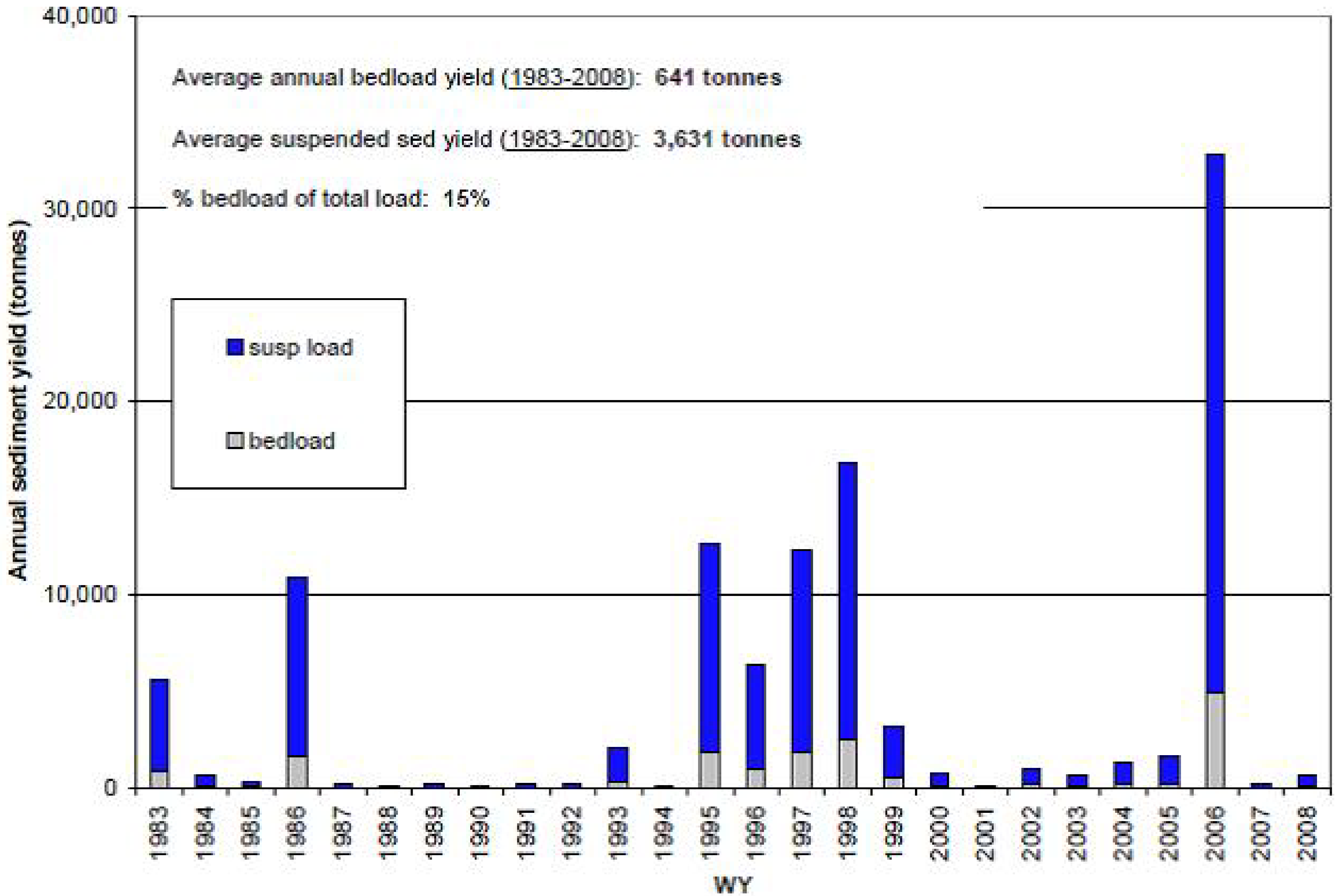

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Figure 15
Annual Total Sediment Yield for Lagunitas Creek at Samuel P. Taylor State Park

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3.1.5 Impact Analysis – Proposed Project

The discussion below first focuses on beneficial effects, then adverse effects, and finally cumulative effects.

Beneficial Effects

Hydrological Processes

The project would have a beneficial effect on hydrologic processes. The primary proposed method for modifying creek hydrology at each of the project sites is the construction of engineered log jams in the main stream channel designed to raise creek water elevations (e.g., Bar Apex Jams (BAJs) and Log Debris Retention Jams (LDRJs)), prevent upstream migration of knick-points (Log Cross-Vanes), deflect flows into existing adjacent floodplain channels on a more frequent and prolonged basis than would otherwise occur under existing conditions (BAJs and LDRJs), and encourage channel migration (Diversion Vanes). Along these reaches, the project would reduce the channel slope and spread flows across the valley floor, thus reducing the average depth of water and spreading flow over a wider area. This in turn would reduce shear stress on the stream bed, and reduce streambed mobility and further incision. These features also serve to sort, meter, and store fine sediment, thereby substantially enhancing the diversity of streambed substrate patches. Proposed actions at the Tocaloma Floodplain site are limited to the high-flow channel, and are primarily intended to further enhance the quality of a floodplain system by the lowering of the high-flow channel in a manner that makes it a flow path on a more frequent basis, and placing logs and rootwads within the high-flow channel to further enhance the quality of the habitat. The intent of all project sites is to spread out high winter flows and increase the diversity of the creek corridor in a manner that (1) reduces the erosive power of the creek (because it is currently confined to a single thread most of the time) and (2) encourages the formation of beneficial habitat features, including pools, woody debris, and refuge areas.

As the proposed project seeks to restore natural processes and locally halt or reverse the adverse effects that channel incision (i.e., the occurrence of "box channel" geometry) has had on the Lagunitas and Olema Creek corridors, the project would have a beneficial impact that would be localized and long term in nature. The beneficial impacts would be most noticeable during average and bank-full winter flow conditions, during which average velocities would be reduced because the channel would be less entrenched. Though the project would not affect the overall flow volumes in the creek, the BAJs and LDRJs are likely to result in a more complex channel form, such that during summer low-flow conditions, additional pools may be present, especially around woody debris, in reaches where deflector vanes are installed, and upstream of LDRJs. In some areas on either side and a short distance downstream of the BAJs, localized scour pools could form. Scour pools around woody debris is a natural occurrence that is localized in nature and would be counterbalanced by depositional features elsewhere within the floodplain. Effects on hydrologic processes are considered beneficial, but less than significant.

Water Quality

The proposed LDRJs (Sites 4, 5, 7, and 8) would be designed to promote the accumulation of woody debris and the subsequent buildup of sediment behind the structures. The creation or encouragement of depositional (i.e., aggradational) environments within the creek corridor is desirable from a water quality standpoint because it traps bedload sediment and maintains a stable elevation and thus discourages the continued formation of box channel geometries through channel incision. The main difference between LDRJs (Sites 4, 5, 7, 8, and 9) and BAJs (Sites 3, 6, and 8) is that the LDRJs are primarily intended as sediment-trapping grade-control structures, whereas BAJs are primarily intended to create complex flow conditions and the splitting of flow into multiple channels. The Log Cross-Vane proposed at Site 9 would act as a bed grade control structure to stabilize an eroding knick-point (head cut) in the channel by creating a hydraulic control and hardpoint to resist further erosion.

By designing structures that would ultimately elevate the bottom depth of the channel, the project promotes the flow of water, during winter flows especially, along multiple paths through the floodplain and increases the complexity of the creek channel. This effect provides additional areas, within the floodplain, for sediment to be sorted, metered, and stored. Another intent of engineered log jams such as diversion vanes is to address channel reaches that are unnaturally straight by encouraging a meandering channel and discouraging upstream migration of knick-points. In the context of the total sediment budget of Lagunitas Creek watershed, the beneficial effect would be limited; however, in the localized context of the project reaches, the beneficial effect would be more pronounced. With regard to sediment loads within the creek, the effect is likely to be short term, because the retention capacity of the LDRJs may be reached in wet years following their installation. Kamman (2013) modeled the potential volume and timing of sediment buildup behind the LDRJs and found the timing of such buildup to be highly uncertain, because it would take a significant high-flow event to carry appreciable volumes of bedload sediment. It is estimated that between 415 and 825 tons of sediment would be trapped behind each LDRJ in the stream reach through Sites 3–6, and that it would take 2 to 3 years, on average, to attain the sediment storage capacity. However, a significant flow event could fill up both LDRJs in 1 year, or it may be several years before even just the upstream LDRJ is filled. In either case, the sediment-trapping effect of the LDRJs would cease once they are fully backfilled with woody debris and sediment (Kamman 2014).

More important of an effect than providing additional opportunities for localized deposition and storage of sediment (of all sizes), however, is that the project serves to prevent future incision occurring within the project reaches. One of the main findings of the hydrologic studies of the watershed is that human influences of the watershed (including damming and land-use changes) has caused an increase in the proportion of sediment being generated from instream sources, particularly mainstem incision. Kamman (2014) found that all project sites on Lagunitas Creek display an incised character, but at least in the recent past have been in a state of dynamic equilibrium with the hydrologic and sediment yield/transport processes. The engineered log jams, especially LDRJs, help control the longitudinal profile of the stream by preventing further incision in the localized upstream area of influence. On a broader level applicable to all sites, the successful widening and diversification of flow paths available for high winter flows would result in a long-term localized beneficial effect with regard to the undesirable effects of sedimentation. For stream reaches that are overly straightened, meander paths created by cross-vanes can help increase channel complexity and restore beneficial natural processes such as localized scour and deposition.

It should also be noted that projects have been designed in an effort to avoid perennial ponding by surface and groundwater in order to avoid introduction of undesired invasive species and create poor water quality conditions (e.g., high temperatures and low dissolved oxygen). Water quality effects are considered beneficial, but less than significant.

Adverse Effects

The scope of adverse effects with respect to natural physical processes and soils is fairly limited, because one of the primary goals of the project is to restore such processes. The potential adverse effects are primarily limited to the hydrologic and water quality effects of construction-related disturbances required for engineered log structure installations and floodplain enhancements. Such impacts are generally brief or short term in nature, and are largely addressed by the erosion control provisions found in project plans. Measurable adverse effects in the long term would be limited to circumstances where the proposed project might not function as intended or might create undesirable conditions.

Flood Hazards

The project will not create a flood hazard. With respect to major flooding as a natural hazard to people or structures (e.g., roads), none of the proposed actions would have any measurable effects on flood-flow volumes being carried under 5-, 10- or 100-year flood flows because watershed-wide conditions dictate the volume and frequency of peak flows (Kamman 2013). Furthermore, one of the main design considerations in the proposed action was to avoid any increase in flood hazards to surrounding infrastructure. The project was designed so that there would be no increased flood hazards along adjacent roadways, trails or facilities, or private properties or any increased bank instability below such infrastructure.

Although the project would not change peak flow volumes, it would result in highly localized effects on water surface elevations, flow rates, and flow paths in the immediate vicinity of the proposed engineered log jams. These effects could occur in either direction (i.e., a local lowering of the flood flow or a local raising of the flood flow). For example, the Tocaloma Floodplain project would decrease the elevation of the high-flow channel by roughly 2–3 feet, whereas Sites 3–5 could locally increase the water surface elevation during peak flow periods. However, these changes are not at a magnitude that would be sufficient to adversely affect the built environment or present greater safety hazards for the public. Localized bed elevation increases along the entrenched portions of the main channel at Sites 3–5 would be a maximum of 6 feet. However, the change in flood surface elevation across all sites would limited because such flows would be spread out over a much greater cross-sectional area. Furthermore, the influence of the project increases in bed elevation would not be felt very far upstream due to the longitudinal slope/profile of the creek. When creek flows impinge on an immovable object (i.e., the BAJs, LDRJs, and deflector vanes), there is a rapid hydraulic transformation of the velocity head component into elevation head, resulting in a rise in water level in front of the obstruction (i.e., a piling up of water).

Kamman (2014) performed hydraulic analyses using HEC-RAS models[1] and the Bernoulli equation[2] to compare existing flood flows with the design flows and water surface elevations after implementation of the project. The local increases in water surface elevations are enough, but not more than necessary, to reach the target high-flow inlet elevations for the secondary channels. Effects on flooding hazards would be less than significant.

Short-Term Impacts Related to Site Access and Staging Areas

Minor improvements may be needed to make access suitable for transport or travel of heavy equipment and trucks. For example, staging areas would be established at the Tocaloma Floodplain site, the floodplain area between Sites 4 and 5, and at Sites 7, 8, and 9. Staging areas and access routes at all other sites would be established in a manner that minimizes unnecessary disturbances to the Lagunitas and Olema Creek corridors. Staging areas may need to be temporarily fenced to provide security for refueling equipment, storage containers, and parked vehicles, as well as to keep people out of staging areas. In most cases, access routes to the low-flow channel coincide with the areas proposed to be cleared of vegetation and woody material along the secondary-flow channels. For example, the staging area proposed to serve construction at Sites 3–6 would coincide with the western flow channel but would involve some incremental

[1] HEC-RAS models are used to perform one-dimensional steady flow, one- and two-dimensional unsteady flow calculations, sediment transport/mobile bed computations, and water temperature/water quality modeling.

[2] The Bernoulli Equation is a statement of the conservation of energy principle appropriate for flowing fluids. The qualitative behavior is usually labeled with the term "Bernoulli effect" – the lowering of fluid pressure in regions where the flow velocity is increased.

disturbance and compaction within the floodplain. The staging area to serve the Tocaloma Floodplain site is located on a previously disturbed area on the margin of Platform Bridge Road. Where work generates excess soils, the approach would be to place excess soils in a location chosen to (a) be outside the high-flow paths of Lagunitas Creek, (b) minimize changes in topography, and (c) consolidate the impact to one area.

Disturbances due to installation of the project would be of limited duration, would be limited to the areas necessary to complete the work, and would occur during the dry season, and disturbed areas would be restored when construction activities are complete. Environmentally sensitive areas would be marked (i.e., flagged or cordoned off) and protected from disturbance by construction equipment. As described in **Mitigation Measure (MM) HYD-1a** (see Section 2.6, Mitigation and Monitoring, for text of mitigation measures), erosion control and site stabilization methods (e.g., erosion control blankets, reseeding with native material, fiber rolls) would be implemented as needed to minimize the short-term and long-term effects of construction disturbances. Residual impacts remaining after implementation of erosion controls (e.g., loose areas of soil), if any, would be short term, would cease after the first flushing flows of the rainy season, and would be less than significant.

Construction-Related Hazardous Materials Leaks or Spills

Construction activities would involve use of heavy machinery and mechanical equipment (e.g., dewatering pumps) with the potential for spills or leaks of hazardous substances (e.g., fuel, gasoline, oil, and/or lubricating grease), if improperly managed. Due to the nature of the construction activities, only small quantities of these materials would be required in any one work area at any one time, and normal operating conditions would not generate such pollutants. Per **MM HYD-1b**, proper measures would be put in place to ensure that construction materials and equipment are properly managed, and to establish contingency and response plans in case an accident occurs. All refueling of powered equipment will occur in areas with secondary containment features (e.g., drip pans or fuel-absorbent mats). With implementation of **MM HYD-1b**, adverse effects of the project with respect to hazardous materials leaks or spills will be made highly unlikely, would be limited to the construction phase, and would be less than significant.

Short-Term Impacts Related to Instream Construction Methods

Flow in Lagunitas Creek is perennial, with expected base flows estimated between 6.0 and 8.0 cfs during the summer construction season, depending on water year type. Summer base flows in Olema Creek are limited, but were determined to be 5 cfs for the purpose of designing construction dewatering methods. Instream construction would have the potential to cause limited and short-term increases in turbidity within and downstream of work areas, if improperly performed.

Because construction activities within the Tocaloma Floodplain would be limited to the high-flow channel and would occur during the dry season, instream construction is not required; therefore, this potential adverse effect is limited to Sites 3–9.

Project construction activities will clear creek diversions consisting of channel-spanning cofferdams, partial channel isolation, and creek diversion around work areas, in conjunction with turbidity curtains. These methods have been selected according to the specific geometry of each site and the type of engineered log jams proposed, and are described in Chapter 2, Project Description, and Appendix D. The exact method of diversion chosen will depend on the conditions and flow within the creek during construction activities, but would consist of either gravity flow through side channels, or through a flexible hose or PVC pipe. Diverting water around construction areas in secondary side channels would be the preferred approach to minimizing impacts. Prior to any construction work and after the necessary environmental clearances to address potential aquatic organisms (i.e., fish capture and relocation activities; see Chapter 2), clear-water creek diversions would be constructed upstream of project reaches and water diverted around the construction area until the project work is completed and the reach is fully winterized. Gravity diversion systems would be designed where possible, but electric pumps (equipped with gravity flow intake) may be needed to extract water and divert it through a fire hose or PVC pipe to a discharge point downstream of all work areas. In either case, a cofferdam would be installed upstream and downstream of the work area to isolate it. Cofferdams would be constructed of sheet piling; sandbags, gravel bags, or similar secured with visqueen; and/or water-filled bladders.

The LDRJs at Sites 4, 5, 7, and 8 would be constructed incrementally in two steps, using K-rails to direct base flow around the work area and turbidity curtains to contain sediment generated by excavation activities in the work area. The first half of the LDRJ would be constructed with creek flow diverted around the active work area, and the second half would be constructed in the same manner. This will not dewater the creek but instead divert flows so that the structure is placed in calmer water, thus minimizing turbidity.

The proposed methods of creek diversion and dewatering are appropriate to ensure that the intensity of potential construction-phase effects of the project on turbidity within Lagunitas Creek would be minimized. A detailed dewatering plan will be developed for all sites that require dewatering. Given that the creek is impaired under CWA Section 303(d) for turbidity, instream construction must proceed in a manner that reduces the mobilization of sediment and corresponding increases in turbidity to the maximum extent practicable. Therefore, implementation of **MM HYD-1c** would ensure that instream construction proceeds with all the precautionary measures necessary to limit the intensity of impacts on water quality and that these impacts would be less than significant.

Long Term Impacts Associated with Unanticipated Effects or Failure to Meet General Design Criteria

Kamman and Balance Hydrologics Inc. have designed Sites 3–10 to meet several important design criteria (as described in Section 1.2). The designs are based on decades of studies around the hydrology and geomorphology of the watershed and creek corridor, as well as on sophisticated modeling techniques meant to estimate the outcome of proposed designs. However, as a natural and highly dynamic system, it should be recognized that the project could have unintended consequences or otherwise fail to meet stated design objectives over the short term and/or long term. Such conditions could include (a) isolated pools of standing water during low-flow periods, (b) accelerated erosion of side banks, or (c) unintended scour and/or localized slope instabilities. The nature, occurrence, and location of such effects cannot be predicted because of the dynamic quality of stream systems. As such, implementation of a long-term Monitoring and Adaptive Management Plan (**MM HYD-2**) is essential in ensuring that the long-term effects of the project meet stated goals and objectives. Implementation of **MM HYD-2** would ensure that if any of the project's design criteria or objectives is not being met, it will trigger a decision to take action, which may include heightened monitoring, sediment removal, wood removal or addition, or any combination of these actions; thus, these potential impacts would be less than significant.

Cumulative Effects

There are a number of existing management plans and programs that address watershed resource issues, particularly water quality and aquatic and fisheries resource issues, for the Lagunitas Creek watershed. Some of these existing plans and programs are specific to Lagunitas Creek while others are more regional. For current and future projects, the cumulative analysis assumes the geographic area of analysis to be the Lagunitas Creek watershed, and identifies projects and actions currently taking place or that are anticipated to take place in accordance with the Lagunitas Creek Stewardship Plan. Specific projects are identified in Chapter 2, Table 2. At this time it does not appear that any of the named cumulative projects are scheduled in such a way as to have significant cumulative impacts combined with the proposed project. In addition, the mitigation measures proposed for this project in combination with similar (primarily construction) mitigation included in other projects will avoid cumulative adverse impacts.

Implementation of the Lagunitas Creek Stewardship Plan is anticipated to cover a 10-year period from 2011 to 2020. Many of the projects identified are dependent on securing funding, environmental review, permits, and other factors, and thus have either already been implemented partially or may be implemented in the future beyond the period identified. Categories of actions identified in the plan include the following:

- Ongoing mandatory requirements of SWRCB Order WR95-17

- Winter habitat enhancement
- Sediment reduction and management
- Instream and riparian habitat enhancement
- Biotechnical bank stabilization
- California freshwater shrimp habitat enhancement
- Monitoring
- Aquatic invasive species management
- Programs and policies
- Collaboration and outreach

The cumulative effect would be a more natural, dynamic balance of sediment supply and transport capacity. This would be a long-term direct and indirect (but not significant) local and regional benefit.

Conclusion

The project's effects on natural physical processes and soils are primarily localized and beneficial in the long term, because it implements strategies to control long-term channel incision, to direct flows into multiple channels, and to reintroduce natural elements through strategic placement of large woody debris (LWD). The potential for adverse effects to water quality is primarily limited to short-term effects during and immediately following construction/ installation activities in the local area and immediately downstream. Implementation of **MM HYD-1a** through **MM HYD-1c** addresses short-term construction-related effects on water quality, whereas implementation of **MM HYD-2** addresses evaluating whether the project is having the intended effects. **MM HYD-2** implements a long-term Monitoring and Adaptive Management Plan to identify whether project goals, objectives, and/or design criteria are being met and sets out procedures and triggers for corrective actions. On a cumulative scale, the project is one of many actions being implemented throughout the watershed to improve water quality and habitat within Lagunitas Creek.

3.1.6 Impact Analysis – No Action Alternative

Under this alternative no direct action would occur as a result of the project and the beneficial impacts described below would not occur:

- There would be no restoration of natural processes that could locally halt or reverse the adverse effects that channel incision (i.e., the occurrence of "box channel" geometry) has had on the Lagunitas Creek corridor. Incision on these sites would continue to occur.

- During average and bank-full winter flow conditions, average velocities would not be reduced because the channel would not be less entrenched. Current high velocities would continue to entrench creek channels.
- The bottom depth of the channel at Sites 3–6 would not be elevated; therefore, the increased flow of water, during winter flows especially, along multiple paths would not increase the complexity of the creek channel. Additional areas for sediment to be sorted, metered, and stored would not be created.
- Future incision within the project reaches would not be prevented. The widening and diversification of flow paths available for high winter flows under the proposed project would not result in a long-term localized beneficial effect with regard to the undesirable effects of sedimentation. Incision and the undesirable effects of sedimentation would continue to occur.
- Efforts to prevent perennial ponding by surface water and groundwater that promotes the introduction of undesired invasive species and creates poor water quality conditions (e.g., high temperatures and low dissolved oxygen) would not be realized. Perennial ponding would continue to occur, supporting invasive species and poor water quality.

The adverse impacts described in this section would not occur. However, the scope of adverse effects with respect to water resources and soils is fairly limited, because one of the primary goals of the project is to restore such processes. Construction-related disturbances required for engineered log structure installations and floodplain enhancements would be avoided under the No Action Alternative. Short-term disturbances due to installation of the project would not occur. Although cumulative impacts are not expected to occur due to installation of the proposed project, under the No Action Alternative there would be no activity to add to cumulative actions in the project area.

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3.2 SPECIAL-STATUS SPECIES

3.2.1 Introduction

The proposed project is intended to stabilize and improve Lagunitas Creek salmonid populations by increasing the winter habitat carrying capacity for juvenile steelhead and coho salmon in Lagunitas Creek. However, implementation of the proposed project could affect special-status species directly or through habitat modifications. A list of special-status species that have the potential to occur in the vicinity of the project sites (see Appendix G) was compiled based on data contained in the California Natural Diversity Database (CDFW 2017); the U.S. Fish and Wildlife (USFWS) list of federal endangered and threatened species that occur in or may be affected by the proposed project (USFWS 2017); and the California Native Plant Society Inventory of Rare and Endangered Plants (CNPS 2017).

Species listed per the federal Endangered Species Act (FESA) and the California Endangered Species Act (CESA) and their habitat that are known to occur or potentially occur in Lagunitas Creek or in the general vicinity and could be affected by the project include Central California coast coho salmon (*Oncorhynchus kisutch*, federally endangered (FE), state endangered (SE)), Central California coast steelhead trout (*O. mykiss*, federally threatened (FT)), California red-legged frog (*Rana draytonii*, FT), California freshwater shrimp (*Syncaris pacifica*, FE, SE), northern spotted owl (*Strix occidentalis caurina*, FT, species of concern (SC)), and marbled murrelet (*Brachyramphus marmoratus*, FT). No special-status plants were observed during the botanical surveys (HSU CRF May 2015, HSU CRF December 2015, Williams 2015, and HSU CRF 2016, all included in Appendix F to this EA).

Additionally, several other special-status species are also known to occur in Lagunitas Creek or the general region, including the Tomales roach (*Lavinia symmetricus* ssp., California species of special concern (CSC)), western pond turtle (*Actinemys marmorata*, CSC) (currently under review for potential listing), foothill yellow-legged frog (*Rana boylii*, CSC), pallid bat (*Antrozous pallidus*, CSC), and Townsend's big-eared bat (*Corynorhinus townsendii*, CSC).

Designated critical habitat is also present in the general region for several species, including Central California coast coho salmon and Central California coast steelhead trout within Lagunitas Creek and tributaries (including Olema Creek); marbled murrelet, approximately 0.7 miles southeast of the project area; California red-legged frog, approximately 0.65 miles west of the project area; and northern spotted owl, approximately 3.0 miles southeast of the project area (USFWS 2017).

3.2.2 Regulatory Framework

Federal Endangered Species Act of 1973

FESA (PL 93-205, 87 Stat. 884, 16 U.S.C. 1531 et seq.) protects threatened and endangered species from unauthorized take and directs federal agencies to ensure that their actions do not jeopardize the continued existence of listed species. Section 7 of the act defines federal agency responsibilities for consultation with USFWS, or the National Oceanic and Atmospheric Administration (NOAA) Fisheries division for fish and marine mammal species. Consultation requires preparation of a Biological Assessment to identify any threatened or endangered species that is likely to be affected by the proposed action.

Migratory Bird Treaty Act

Migratory birds are protected by USFWS under the provisions of the Migratory Bird Treaty Act of 1916 as amended (16 U.S.C. Chapter 7, 703–712), which governs the taking, killing, possession, transportation, and importation of migratory birds, their eggs, parts, and nests. The take of all migratory birds is governed by the Migratory Bird Treaty Act's regulation of taking migratory birds for educational, scientific, and recreational purposes and requiring harvest to be limited to levels that prevent over-utilization. Executive Order 13186 (signed January 10, 2001) directs each federal agency taking actions that would have or would likely have a negative impact on migratory bird populations to work with USFWS to develop a Memorandum of Understanding to promote the conservation of migratory bird populations. Protocols developed under the Memorandum of Understanding must include the following agency responsibilities:

- Avoid and minimize, to the extent practicable, adverse impacts on migratory bird resources when conducting agency actions.
- Restore and enhance habitat of migratory birds, as practicable.
- Prevent or abate the pollution or detrimental alteration of the environment for the benefit of migratory birds, as practicable.

The executive order is designed to assist federal agencies in their efforts to comply with the Migratory Bird Treaty Act; it does not constitute any legal authorization to take migratory birds. "Take," under the Migratory Bird Treaty Act, is defined as the action of, or an attempt to, pursue, hunt, shoot, capture, collect, or kill (50 CFR 10.12). The definition includes "intentional" take (take that is the purpose of the activity in question) and "unintentional" take (take that results from, but is not the purpose of, the activity in question).

Bald and Golden Eagle Protection Act

The Bald and Golden Eagle Protection Act prohibits the taking or possession of and commerce in bald eagles (*Haliaeetus leucocephalus*) and golden eagles (*Aquila chrysaetos*), with limited exceptions. Under the act, it is a violation to "take, possess, sell, purchase, barter, offer to sell, transport, export or import, at any time or in any manner, any bald eagle commonly known as the American eagle, or golden eagle, alive or dead, or any part, nest, or egg, thereof." "Take" is defined to include pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest, and disturb. "Disturb" is further defined as "to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available (1) injury to an eagle, (2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or (3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior" (50 CFR 22.3).

Recent revisions to the Bald and Golden Eagle Protection Act authorize take of bald eagles and golden eagles under the following conditions: where (1) the take is compatible with the preservation of the bald eagle and golden eagle; (2) the take is necessary to protect an interest in a particular locality; (3) the take is associated with but not the purpose of an otherwise lawful activity; (4) for individual instances of take, the take cannot be avoided; or (5) for programmatic take, the take is unavoidable even though advanced conservation practices are being implemented (50 CFR 22.26).

The Magnuson-Stevens Fishery Conservation and Management Act

The Magnuson-Stevens Fishery Conservation and Management Act requires all federal agencies to consult with NOAA Fisheries on all cumulative and synergistic actions or proposed actions that may adversely affect Essential Fish Habitat. The assessment of cumulative effects on Essential Fish Habitat is consolidated with the assessment of cumulative effects under FESA. "Essential Fish Habitat" is the aquatic habitat (water and substrate) necessary for fish to spawn, breed, feed, or grow to maturity that would allow a level of production needed to support a long-term, sustainable commercial fishery and contribute to a healthy ecosystem. Species covered under the Magnuson-Stevens Fishery Conservation and Management Act include coho salmon, steelhead trout, Chinook salmon (*Oncorhynchus tshawytscha*), and chum salmon (*O. keta*).

Executive Order No. 13112: Invasive Species

This executive order prevents the introduction of invasive species and directs federal agencies to not authorize, fund, or carry out actions that it believes are likely to cause or promote the introduction or spread of invasive species.

State

California Endangered Species Act

California Fish and Game Code (Section 2050 et seq.) prohibits the taking of species listed as threatened or endangered under CESA, or candidates for listing, except as authorized by state law. Section 2081 of CESA states that take of an endangered, threatened, or candidate species may be authorized by CDFW if the impacts of the take are incidental to an otherwise lawful activity, are "minimized and fully mitigated," and do not "jeopardize the continued existence of [the] species." Any mitigation measures imposed under CESA must be measures "roughly proportional in extent to the impact of the authorized taking on the species."

SWRCB Order WR95-17

The order establishes minimum flows that MMWD must maintain for instream flow and upstream migration flows, and also establishes temperature thresholds for Lagunitas Creek at different times of year that MMWD must maintain for the benefit of anadromous fish species. MMWD must implement these actions and remain in compliance with the order.

Local

2011 Lagunitas Creek Stewardship Plan

The Lagunitas Creek Stewardship Plan was developed by MMWD in June 2011 and addresses actions to be taken by MMWD to manage the habitat of Lagunitas Creek for the benefit of the aquatic resource populations of coho salmon, steelhead trout, and California freshwater shrimp. The Stewardship Plan is a planning document, intended to describe ongoing and guide future actions.

Lagunitas Creek Sediment TMDL Plan

In June 2014, the San Francisco Bay Area RWQCB adopted Resolution R2-2014-0027, which amended the regional basin plan and adopted a TMDL for fine sediment in the Lagunitas Creek watershed and an implementation plan to achieve the TMDL and related habitat enhancement goals. The goals of the Lagunitas Creek Sediment Reduction and Habitat Enhancement Plan (Lagunitas Creek Sediment TMDL Plan) are as follows:

- To restore an annual spawning run within the Lagunitas Creek watershed of 1,300 or more adult coho salmon, achieved for at least 12 consecutive years.
- For native fish and aquatic wildlife species to be in good condition at the individual, population, and community levels.
- To protect and enhance the aesthetic and recreational values of the creek and its tributaries.

3.2.3 Affected Environment

3.2.3.1 Listed Species

The 109-square-mile Lagunitas Creek watershed provides 52 miles of accessible habitat to salmonids, which is about 50% of the habitat that was historically available to salmonids in this creek.

Lagunitas Creek originates on the north slope of Mount Tamalpais and flows in a northwesterly direction for 40 kilometers (25 miles) to Tomales Bay (see Figure 1, Regional Map). The lower 19 kilometers (12 miles) is accessible to anadromous salmonids. San Geronimo Creek, Devil's Gulch, Nicasio Creek, and Olema Creek are the major tributaries to Lagunitas Creek. Devil's Gulch, which flows through NPS and California State Parks land before entering Lagunitas Creek, is the smallest of these tributaries, but it has perennial surface flows in addition to salmonid habitat characteristics, making it an important coho salmon spawning stream. Lagunitas Creek is designated as critical habitat for Central California coast steelhead trout and Central California coast coho salmon. Like most streams of coastal California, and much of the Pacific coast of North America, Lagunitas Creek in Marin County, California, has experienced large declines in populations of salmonid fishes in the nineteenth and twentieth centuries (Brown et al. 1994). Declines in endangered coho salmon and threatened steelhead trout populations correspond with the large-scale expansion of human land use in the Lagunitas Creek watershed, including logging, agriculture, livestock grazing, urbanization, dam construction, and stream alteration. Lagunitas Creek was listed on the 303(d) list of impaired water bodies of the San Francisco Bay RWQCB because of concerns that sediment was negatively affecting habitat for salmonids (SWRCB 2012). Water bodies on the 303(d) list require the development of a TMDL, which is an action plan to improve water quality and habitat.

Before developing a TMDL, it is necessary to have a strong, quantitative understanding of the effects of sediment on beneficial uses (i.e., coldwater habitat, spawning habitat, migration habitat). Historic land use changes and management practices are believed to have had large impacts on stream channel conditions in the Lagunitas Creek watershed as a result of changes in the supply and transport of sediment. For example, large portions of the channel network located in aggradation environments have undergone channel incision, transforming complex, multi-channel fluvial ecosystems into simple, single-thread channels that are disconnected from their historic floodplains. This pervasive process of incision is likely a result of a combination of factors including reductions in wood loading to channels, direct modification of channels including the removal of wood, changes in watershed hydrology associated with timber harvest and agriculture, and ubiquitous changes in grassland composition and soil compaction from grazing and agriculture.

Currently, sediment input is believed to be elevated by a factor of 2–10 times over natural levels across much of the watershed (Stillwater Sciences 2010), although dams block a large amount of coarse sediment from entering the mainstem of Lagunitas Creek. Despite the reduced supply of sediment below the dams, the delivery of large amounts of fine sediment from tributaries combined with a lack of flushing flows appear to be important controls on bed conditions in Lagunitas Creek, which have fined in recent years (Hecht et al. 2008).

Most gravel-bed streams have beds that are organized into distinct textural patches of sorted particles. The overall range and number of patches in a given reach of stream have been observed to be relatively constant through time, but some patches can migrate, disappear, or expand or contract in size, while other patches appear to be stable (Dietrich et al. 2005). Patches have also been observed to form in flume studies (Dietrich et al. 1989; Lisle et al. 1993). As the supply of bed material was gradually decreased during these flume studies, inactive coarse patches expanded in size, zones of active transport narrowed, and freely moving bed load sheets disappeared, suggesting that patch dynamics may be a primary response to altered sediment supply (Dietrich et al. 2005; Nelson et al. 2009). Thus, in addition to considering the effects of sediment supply on overall changes in streambed grain size or bed mobility, attention to the number, size, and texture of patches may yield additional information about channel responses.

Salmonids

Four species of salmonids are found in the Lagunitas Creek watershed: coho salmon, steelhead trout, Chinook salmon, and chum salmon. Coho salmon and steelhead trout are known to occur and spawn in Lagunitas Creek. Chinook salmon and chum salmon are sporadic visitors to Lagunitas Creek, and occasional spawning has been documented for both species.

Central California Coast Steelhead

On January 5, 2006, NOAA Fisheries issued final listing determinations for 10 distinct population segments (DPSs) of steelhead, including Central California coast steelhead (71 FR 834). Also in 2006, NOAA Fisheries applied the joint USFWS–NOAA Fisheries DPS policy (61 FR 4722) rather than the agency's Evolutionarily Significant Unit (ESU) policy for the delineation of West Coast steelhead DPSs under FESA. Only ocean-run steelhead trout, not resident rainbow trout, are protected under FESA. The Central California coast steelhead DPS includes all naturally spawned populations of steelhead (and their progeny) in California streams from the Russian River (inclusive) to Aptos Creek (inclusive), and the drainages of San Francisco, San Pablo, and Suisun Bays eastward to Chipps Island at the confluence of the Sacramento and San Joaquin Rivers; excluding the Sacramento–San Joaquin River Basin. Artificially propagated stocks from the Don Clausen Fish Hatchery and the Kingfisher Flat Hatchery/Scott Creek are also included (71 FR 834).

Steelhead generally spend 1 to 3 years in freshwater and 1 or 2 years in the ocean before returning to spawn, although the most common life history pattern is to spend 2 years in freshwater and 1 year in the ocean (Shapovalov and Taft 1954). Unlike coho, steelhead can return to the ocean after spawning and spawn multiple times. This flexibility means that steelhead do not show strong year class patterns in their spawning runs. Steelhead begin migrating up coastal and inland streams from November through early May to spawn in freshwater streams. In Lagunitas Creek, steelhead are generally first observed in late December or early January and continue spawning through April or even into May (MMWD 2015a). Juvenile steelhead spend up to 3 years rearing in freshwater, and then migrate to the ocean, where they feed and mature for another 3 years before returning to their natal streams to breed (MMWD 2015b).

Critical Habitat

In 2000, critical habitat was designated for steelhead along the California coast. In 2002 these designations were withdrawn due to a NOAA Fisheries decree and were not reinstated until a final ruling was issued in August 2005 (70 FR 52488–52627). The specific areas designated in the rule text include approximately 8,935 net miles (14,269 kilometers) of riverine habitat and 470 square miles (1,212 square kilometers) of estuarine habitat (primarily in San Francisco–San Pablo–Suisun Bays) in California.

Recovery Plan

NOAA Fisheries released the Coastal Multispecies Public Draft Recovery Plan for California Coastal Chinook Salmon, Northern California Steelhead and Central California Coast Steelhead in October 2015. The public comment period closed January 18, 2016. The final recovery plan was issued in October 2016.

Occurrence within the Project Area

Central California coast steelhead are known to spawn and rear in Lagunitas Creek, and spawning has been documented within the reach proposed for enhancement activities. Spawning has been documented within the Devil’s Gulch to Tocaloma reach as well as the reach immediately downstream between Tocaloma and Nicasio Creek. In 2014–2015, redds were documented within Lagunitas Creek (Figures 16 and 17, Salmonid Redds in Relation to Winter Habitat Enhancement Sites) and along Olema Creek (Figure 18, Salmonid Redds in Relation to Winter Habitat Enhancement Sites). Rearing habitat for juvenile steelhead is also present within the reach proposed for enhancement activities and juveniles have been documented within this area every year since 1999 (MMWD 2015b). In addition, steelhead spawn and rear in Olema Creek within the reach proposed for Site 9 (Carlisle et al. 2011 and 2013). The spawning season for steelhead is from December through April.

Central California Coast Coho Salmon

The State of California listed coho salmon south of San Francisco Bay as a state endangered species in 1995. NOAA Fisheries listed the Central California coast coho salmon ESU as federally threatened on October 31, 1996 (61 FR 56138). On August 30, 2002, the California Fish and Game Commission found that coho salmon warranted listing as an endangered species under CESA from San Francisco Bay north to Punta Gorda (the remainder of the Central California coast coho salmon ESU). In response to severe population declines between 1996 and 2004, NOAA Fisheries relisted CCC coho salmon and changed its status from threatened to endangered (i.e., in danger of extinction throughout all or a significant portion of its range) on June 28, 2005 (70 FR 37160). At the time it was reclassified as endangered in 2005, the ESU was defined to include all naturally spawning populations of coho salmon found in coastal watersheds from Punta Gorda in Northern California southward to and including the San Lorenzo River in Central California, as well as four artificially propagated stocks of coho salmon. In 2011, the NOAA Fisheries extended the range of coho salmon south to include Soquel and Aptos Creeks (77 FR 19552).

Coho salmon are anadromous fish, rearing at least partially in freshwater, migrating to the ocean as smolts, spending their adult life in the ocean, and then migrating back into freshwater streams to spawn. Most coho salmon from California streams spend approximately 18 months in freshwater (including incubation) and 18 months in the ocean, returning to spawn in their natal stream in their third year, after which they die (Shapovalov and Taft 1954; Moyle 2002). They can be grouped into year classes of 3-year increments. For example, spawning fish in 2014–15 are the progeny of spawners in 2011–12 and are considered to be in the same year class. Spawning years with relatively poor reproductive success can result in poor spawning runs 3 years later. Although the majority of coho return as 3-year-old fish, some males, called jacks, spend less than a year in the ocean before becoming sexually mature and returning to their natal stream to spawn at 2 years of age (Sandercock 1991). Spawning coho begin to arrive near the mouth of Lagunitas Creek in late summer and fall to begin acclimation to freshwater before migrating upstream (Bratovich and Kelley 1988). The spawning period is generally from mid-November to mid-January but adult coho have been observed from late October to late February (MMWD 2015a). Monitoring in Lagunitas Creek since 2006 indicates that emigration of coho and Chinook salmon smolts generally occurs between March and early June (MMWD 2015c).

<u>Critical Habitat</u>

On May 5, 1999, NOAA Fisheries designated critical habitat for two ESUs of coho salmon pursuant to FESA. Critical habitat for the Central California coast ESU, which includes Lagunitas Creek and tributaries, encompasses accessible reaches of all rivers (including estuarine areas and tributaries) between Punta Gorda and the San Lorenzo River (inclusive) in California, including two streams entering San Francisco Bay: Arroyo Corte Madera Del Presidio and Corte Madera Creek.

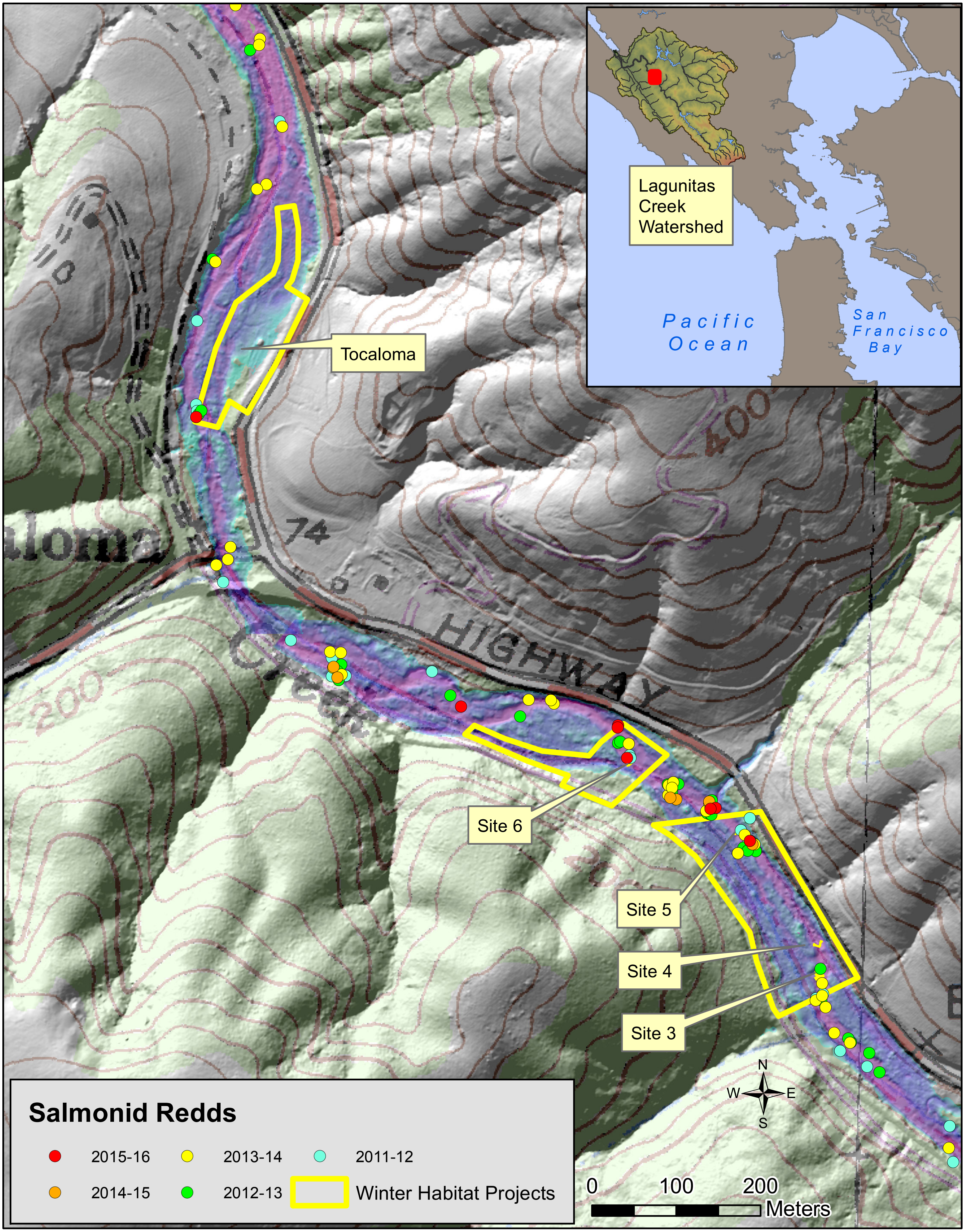

Figure 16 Salmonid redds in relation to winter habitat enhancement sites.

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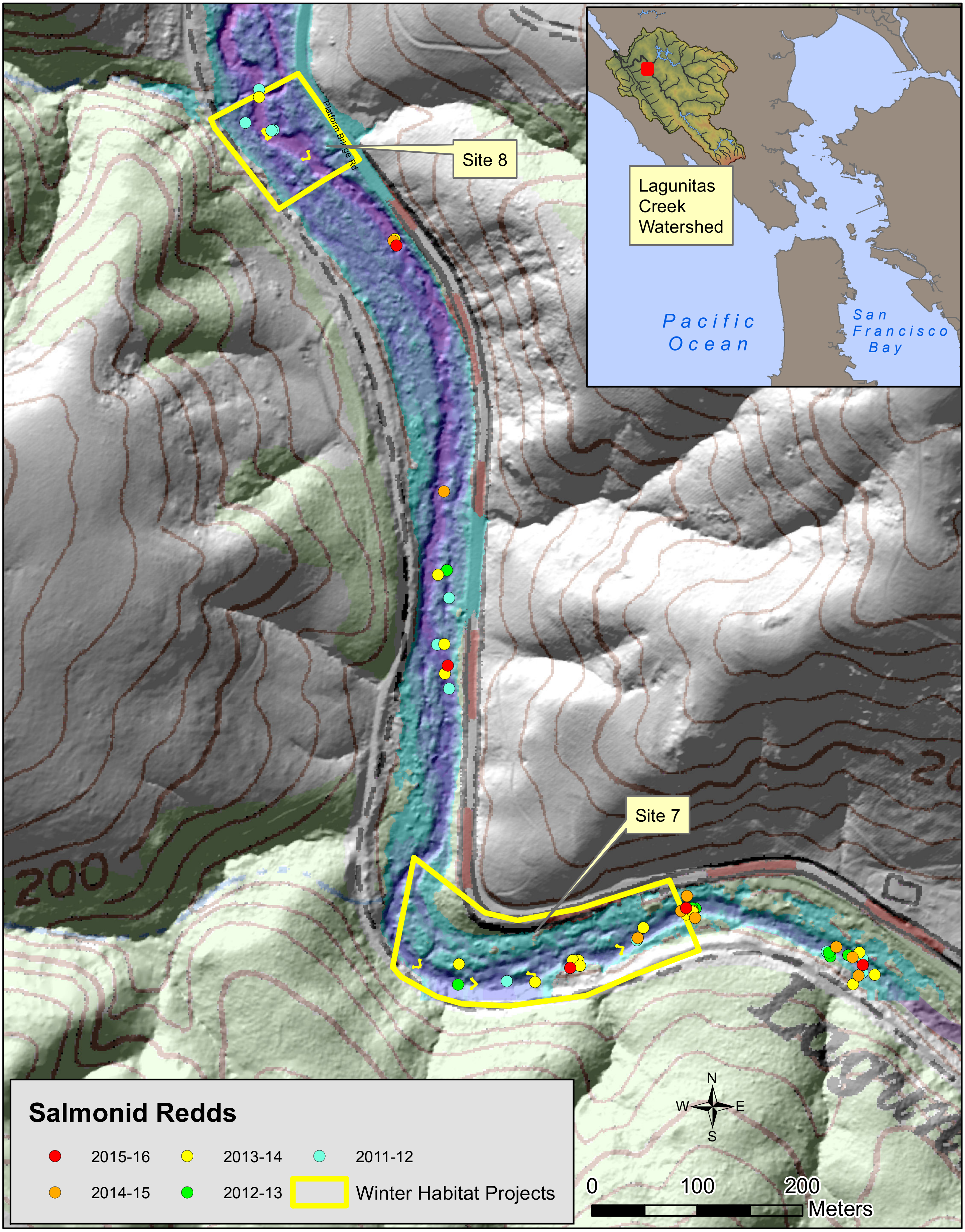

Figure 17 Salmonid redds in relation to winter habitat enhancement sites.

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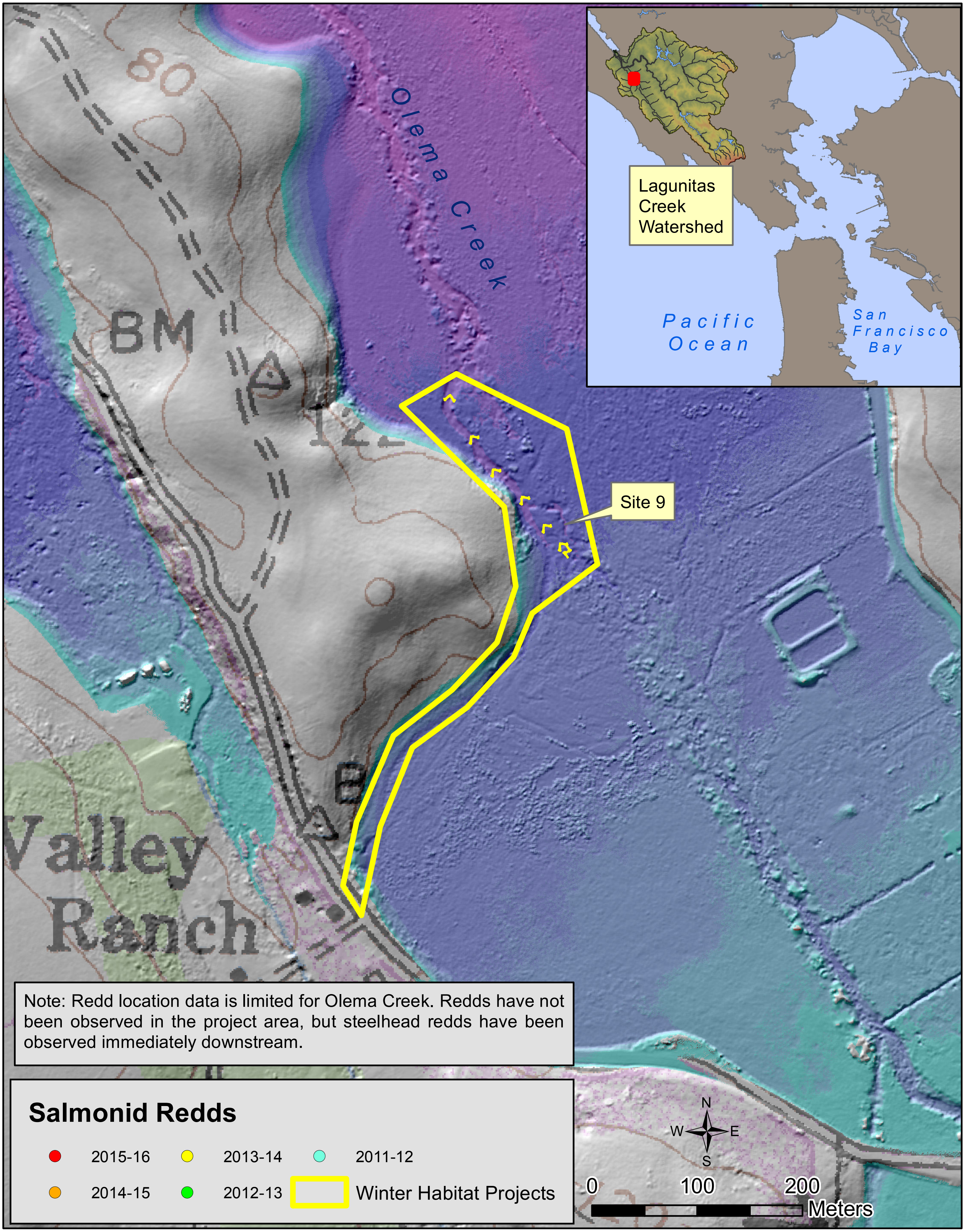

Figure 18 Salmonid redds in relation to winter habitat enhancement sites.

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Recovery Plan

In 2004, the state developed and finalized a recovery strategy for the California ESUs (CDFG 2004) of coho salmon, and in 2012, NOAA Fisheries issued a final recovery plan for the Central California coast coho salmon ESU (NOAA Fisheries 2012).

Occurrence within the Project Area

Coho salmon are known to spawn and rear in Lagunitas Creek and spawning has been documented within the reach proposed for enhancement activities. Spawning has been documented within the Tocaloma to Devil's Gulch reach as well as the reaches immediately downstream, between Nicasio Creek and Tocaloma, and upstream between Devil's Gulch and Peter's Dam (MMWD 2015a). In 2014–2015, redds were documented within Lagunitas Creek (Figures 16 and 17) and along Olema Creek (Figure 18). Rearing habitat for juvenile coho is also present within the reach proposed for enhancement activities, and juveniles have been documented within this area every year since 1999 (MMWD 2015b). In addition, coho spawn and rear in Olema Creek, within the reach proposed for Site 9 (Carlisle et al. 2011, 2013). The spawning season for coho salmon is from October through January.

Minimization Measure

As stated in the NOAA Biological Opinion (NOAA 2016), measures to minimize injury and mortality of salmonids during fish relocation and dewatering activities are excerpted from Flosi et al. (2010) and are shown below:

- If feasible, plan to perform initial fish relocation efforts several days prior to the start of construction. This provides the fisheries biologist an opportunity to return to the work area and perform additional electrofishing passes immediately prior to construction. In many instances, additional fish will be captured that eluded the previous day's efforts.
- Prior to dewatering a construction site, fish and amphibian species should be captured and relocated to avoid direct mortality and minimize take. This is especially important if listed species are present within the project site.
- Fish relocation activities must be performed only by qualified fisheries biologists, with a current CDFW collectors permit, and experience with fish capture and handling.
- Electrofishing should only be conducted by properly trained personnel following CDFW and NOAA Fisheries guidelines.
- In regions of California with high summer air temperatures, perform relocation activities during morning periods.

- Periodically measure air and water temperatures. Cease activities when instream water temperature exceeds 18°C.
- Exclude fish from reentering the work area by blocking the stream channel above and below the work area with fine-meshed net or screen. Mesh should be no greater than 1/8-inch diameter. Completely secure the bottom edge of net or screen to the channel bed to prevent fish from reentering the work area. Place exclusion screening in areas of low water velocity to minimize fish impingement. Screens should be regularly checked and cleaned of debris to permit free flow of water.
- Prior to capturing fish, determine the most appropriate release location(s). Choose release sites with the following characteristics if possible:
    - Similar water temperature as capture location
    - Adequate dissolved oxygen
    - Ample habitat for captured fish
    - Low likelihood of fish reentering work site or becoming impinged on exclusion net or screen.
- Determine the most efficient means for capturing fish. Complex stream habitat generally requires the use of electrofishing equipment, whereas in outlet pools, fish may be concentrated by pumping water out of the pool and then seining or dip netting fish.
- Minimize handling of salmonids. However, when handling is necessary, always wet hands or nets prior to touching fish.
- Temporarily hold fish in cool, shaded, aerated water in a container with a lid. Provide aeration with a battery-powered external aeration device. Protect fish from jostling and noise and do not remove fish from this container until time of release.
- Place a thermometer in holding containers and, if necessary, periodically conduct partial water changes to maintain a stable water temperature. If water temperature reaches or exceeds 18°C, fish should be released and rescue operations ceased.
- Avoid overcrowding in containers. Have at least two containers and segregate young-of year (YOY) fish from larger age-classes to avoid predation. Place larger amphibians, such as Pacific giant salamanders, in container with larger fish. If fish are abundant, periodically cease capture, and release fish at predetermined locations.
- Visually identify species and estimate year-class of fish at time of release. Count and record the number of fish captured. Avoid anesthetizing or measuring fish.
- Submit reports of fish relocation activities to CDFW and NOAA Fisheries in a timely fashion.

- If mortality during relocation exceeds 3%, stop efforts and immediately contact the appropriate agencies.

Invertebrates

California Freshwater Shrimp

The California freshwater shrimp was listed as endangered by the California Fish and Game Commission in 1980 and was listed by USFWS as endangered on October 30, 1988 (55 FR 43884). The California freshwater shrimp is endemic to perennial lowland streams in Sonoma, Marin, and Napa Counties, most of which have a gentle gradient of less than 1% (Serpa 1991). Currently, there are a total of 21 streams in these three counties that are known to support California freshwater shrimp. Lagunitas Creek has one of the largest populations of California freshwater shrimp, and it is the only stream containing freshwater shrimp that flows through protected lands.

California freshwater shrimp occur primarily along the edges of stream pools, in areas away from the main current, where there are undercut banks and exposed riparian tree roots and adventitious roots that develop on the submerged portions of some herbaceous plants and shrubs that hang into the water (Eng 1981). Additionally, freshwater shrimp preferentially select portions of the pools that are from 1 to 4 feet deep. During the summer dry season they can survive as long as some water remains in the pool, even if surface flow between pools has ceased (Serpa 1991). California freshwater shrimp breed in September, when stream conditions are still relatively calm. Juveniles are released as miniature adults in late spring (Eng 1981), after stream flows diminish. During the winter, habitat includes shallow margins of stream pools containing undercut banks and exposed living fine-root material that provide shelter and refuge from high water velocities associated with winter storm events.

Critical Habitat

Critical habitat has not been designated for the California freshwater shrimp.

Recovery Plan

The California freshwater shrimp recovery plan was published by USFWS in 1998. The objectives of the recovery plan are to (1) recover and delist the California freshwater shrimp when numbers increase sufficiently and suitable habitat is secured and managed with 17 watersheds harboring shrimp and (2) enhance habitat conditions for native aquatic organisms that currently co-exist or have occurred historically with the California freshwater shrimp.

Occurrence within the Project Area

The California freshwater shrimp has been frequently documented in Lagunitas Creek (Serpa 2013) and specifically within the reach proposed for Phase I (Sites 3–6 and 10) enhancement activities (Serpa 2015). The Lagunitas Creek reaches for the proposed Phase 2 activities (Sites 7 and 8) provide fair to unsuitable habitat conditions for California freshwater shrimp, and the reach of Olema Creek for Site 9 appears to have poor to fair quality habitat (Serpa, pers. comm. 2016).

Amphibians

California Red-Legged Frog

The California red-legged frog was federally listed as a threatened species throughout its range in California by USFWS on May 23, 1996 (75 FR 12816). The historic range of the California red-legged frog extended along the coast from Marin County, California, and inland from Shasta County, California, southward to northwestern Baja California, Mexico (Jennings and Hayes 1994; USFWS 2002). This area includes the Coast Ranges and the west slope of the Sierra Nevada at elevations below 1,525 meters (5,000 feet). The frog's current range is greatly reduced, with most remaining populations occurring along the coast from Marin County to Ventura County as well as in isolated locations in the foothill region of the western slopes of the Sierra Nevada. The subspecies has experienced a 70% reduction in its range in California due to habitat alteration, excessive harvest, and introduction of non-native predators, especially bullfrogs and introduced fish species.

Adult California red-legged frogs prefer dense shrubby or emergent riparian vegetation near deep (≥0.7 meters (2.3 feet)), still or slow-moving water, especially where dense stands of overhanging willow and an intermixed fringe of cattail occur (Hayes and Jennings 1988). This subspecies breeds from November through April (Jennings and Hayes 1994). Upland areas provide important sheltering habitat during winter when California red-legged frogs are known to aestivate in burrows and leaf litter.

Critical Habitat

Final critical habitat designation for California red-legged frog occurred on March 17, 2010 (75 FR 12816–12959). In total, the final designation of critical habitat for California red-legged frog resulted in approximately 1,636,609 acres (662,312 hectares) of critical habitat designated in 27 California counties.

Based on the locations of designated critical habitat units in Marin County, the proposed project does not occur within or adjacent to critical habitat for California red-legged frog. However, Critical Habitat Unit MRN-3 occurs approximately 1 mile to the west of the project site, and MRN-2 occurs about 6 miles to the north of the project site.

Recovery Plan

The recovery plan for the California red-legged frog was published by USFWS on May 28, 2002, defining actions needed to recover the species to sufficient numbers throughout all or part of their range with the goal of delisting. Recovery objectives in the recovery plan include (1) protecting existing populations by reducing threats, (2) restoring and creating habitat that will be protected and managed in perpetuity, (3) surveying and monitoring populations and conducting research on the biology of and threats to the species, and (4) reestablishing populations of the species within its historic range.

Occurrence within the Project Area

The California red-legged frog occurs within the general region, and has been documented on upper Lagunitas Creek and in a stock pond along McIsaac Creek (ESA 2009), a right-bank tributary to Lagunitas Creek located just downstream of Site 5. Site 9 includes marginal habitat and thus occurrence at this site is not likely. Additionally, a group of a few adult/subadult California red-legged frogs were observed in the floodplain along Lagunitas Creek in the vicinity of Site 8 during the summer of 2015 (Ettlinger, pers. comm. 2016). There are no additional recent sightings of California red-legged frog in Lagunitas Creek downstream of the Shafter Bridge area, although subadult California red-legged frogs have been observed in this area in the past. In general, habitat present within the Devil's Gulch to Tocaloma reach of Lagunitas Creek (as well as most of Lagunitas Creek) provides relatively poor habitat for California red-legged frog breeding and larval development, due primarily to high flows during the winter when this species breeds. Additionally, the fairly dense forest canopy, cool water temperatures, and lack of adjacent upland grassland habitat along Lagunitas Creek further restricts the likelihood of encountering this species (ESA 2009).

Birds

Northern Spotted Owl

The northern spotted owl was listed as federally threatened in 1990 (55 FR 26114–26194), and declared state threatened on August 25, 2016, pursuant to Sections 2075 and 2075.5 of the California Fish and Game Code.

Northern spotted owls generally inhabit older forested habitats that contain the structural characteristics required for nesting, roosting, and foraging. Specifically, northern spotted owls require a multi-layered, multi-species canopy with moderate to high canopy closure. The stands typically contain a high incidence of trees with large cavities and other types of deformities; large snags (standing dead trees); an abundance of large, dead wood on the ground; and open space within and below the upper canopy for spotted owls to fly. Recent landscape-level analyses suggest that in some parts of the subspecies' range a mosaic of older forest habitat interspersed with other vegetation types may benefit northern spotted owls more than large, homogeneous expanses of older forests. In redwood forests along the coast range of California, northern spotted owls may be found in younger forest stands that have the structural characteristics of older forests.

Critical Habitat

Critical habitat for northern spotted owl, as designated in 1992 and revised in 2012 (57 FR 1796–1838, effective on February 14, 1992, and as revised at 77 FR 71875–72068, effective on January 3, 2013), includes approximately 9,577,969 acres (3,876,064 hectares) of critical habitat in the States of Washington, Oregon, and California.

Based on the locations of designated critical habitat units in Marin County, the project does not occur within or adjacent to critical habitat for northern spotted owl. However, Critical Habitat Subunit RDC-5 occurs approximately 3.5 miles to the southeast of the project area.

Recovery Plan

The current recovery plan for the northern spotted owl was published by USFWS on June 28, 2011, defining actions needed to recover the species to sufficient numbers throughout all or part of their range with the goal of delisting. The four basic steps in the recovery strategy of the recovery plan include (1) completion of a rangewide habitat modeling tool, (2) habitat conservation and active forest restoration, (3) barred owl management, and (4) research and monitoring.

Occurrence within the Project Area

This species is known to occur within NPS, California State Parks, Marin County Open Space District, and MMWD lands. Based on surveys conducted by Point Blue Conservation Science since 1997, approximately 30 known breeding sites have been identified on or adjacent to Marin County Open Space District and MMWD lands. Additional surveys have been conducted from 2010 through 2016 by the NPS, which have identified additional northern spotted owl nesting sites in the general project region (NPS and Point Blue n.d.).

The project sites are located in known northern spotted owl nesting habitat and several documented nesting sites occur within 0.25 miles (0.4 kilometers) of several project sites. The northern spotted owl could potentially nest and roost in trees as well as using habitats or foraging within the project sites or in adjacent areas if present. The species could also be adversely affected if active nesting, roosting, or foraging sites (including trees) were to be disturbed by tree removal or trimming or exposure to a substantial increase in noise or human presence during project activities.

Nesting has not been documented in the vicinity of the proposed stream enhancement sites; however, according to recent surveys conducted by NPS, two nesting sites occur within 0.25 miles of several enhancement sites. Additionally, a resident single male was detected in the vicinity of winter habitat project Site 1 and the Jewell Creek Fish Passage project site, along the Cross-Marin Trail on two nights in 2015 by Point Blue Conservation Science (Cormier 2015), and when combined with 2014 detections, meets Resident Single status. Additional nesting locations have been identified by the NPS at Platform Bridge, Zanardi Creek, McIsaac Creek, Cheda Creek, and Bike Path locations. Two of the nesting sites (Bike Path and Platform Bridge) are located within 0.25 miles of Sites 3–6 and Site 7, respectively. A known nest site is also located in the vicinity of Lagunitas Creek; however, in 2014, surveys did not document nesting at that site, and nesting sites have not been observed along Lagunitas Creek during any of the surveys conducted since 1997.

Northern spotted owl surveys (by Point Blue Conservation Science and likely the NPS) are anticipated to continue on an annual basis at locations around the project sites.

Because project construction will occur in the fall (after August 1), outside the nesting season, and will not directly or indirectly impact any northern spotted owl nesting habitat (work will be conducted in riparian habitat and will not affect any potential nesting trees), impacts to this species are not anticipated. No further discussion of this species is included in this EA.

Marbled Murrelet

The marbled murrelet DPS in California, Oregon, and Washington was listed as federally threatened in 1992 (57 FR 45328).

Marbled murrelets spend the majority of their lives on the ocean, but come inland to nest. This species feeds near shore and nests inland along the coast from Eureka to the Oregon border and from Half Moon Bay to Santa Cruz. They generally nest in old-growth forests, characterized by large trees, multiple canopy layers, and moderate to high canopy closure. In California, nests are typically found in coastal redwood and Douglas-fir forests. These forests are located close enough to the marine environment for the birds to fly to and from nest sites.

<u>Critical Habitat</u>

Critical habitat for the marbled murrelet, as designated in 1996 and revised in 2011 (61 FR 26256, effective on June 24, 1996, and as revised at 76 FR 61559, effective on November 4, 2011), includes approximately 3,698,100 acres (1,497,000 hectares) in the States of Washington, Oregon, and California.

Three designated critical habitat units are present in Marin County. The nearest critical habitat unit (CA-09-B) occurs in the vicinity of Samuel P. Taylor State Park, approximately 1.1 miles (1.8 kilometers) south-southeast of the project area. A second critical habitat unit (three separate areas) is present along the southern portion of Tomales Bay, located approximately 4 to 7 miles northwest of the project area.

Recovery Plan

The current recovery plan for marbled murrelet was published by USFWS on September 24, 1997, defining actions needed to recover the species to sufficient numbers throughout all or part of their range with the goal of delisting. The recovery plan has three objectives: (1) stabilize and then increase population size, changing the current downward trend to an upward (improving) trend throughout the listed range; (2) provide conditions in the future that allow for a reasonable likelihood of continued existence of viable populations; and (3) gather the necessary information to develop specific delisting criteria. The five steps to achieve these objectives include (1) increase the productivity of the population, as reflected by total population size, the juvenile-to-adult ratio, and other measures of nesting success; (2) minimize or eliminate threats to survivorship; (3) identify and conduct the research and monitoring necessary to determine specific delisting criteria; (4) encourage cooperative research; and (5) coordinate monitoring and research efforts.

Occurrence within the Project Area

Two recent protocol-level surveys conducted for marbled murrelet in suitable habitat along the reach of Lagunitas Creek from Peter's Dam downstream to Tocaloma detected no marbled murrelets (Avocet Research Associates 2012, 2013). There are no historical records of murrelets nesting in Marin County. Based on the survey results and historic record, the surveyors concluded that Lagunitas Creek does not support occupied habitat within the survey reach. Additionally, according to Jules Evans of Avocet Research Associates (Evans, pers. comm. 2016), appropriate habitat characteristics for marbled murrelet are not present along Lagunitas Creek downstream from Tocaloma and along Olema Creek. Marbled murrelet are presumed to be absent from the Lagunitas Creek watershed; therefore, the project would not have any impacts on marbled murrelet.

Based on this information, the marbled murrelet is not expected to be present along the creek or in the vicinity of the enhancement sites. No further discussion of this species is included in this EA.

3.2.3.2 Species of Special Concern

Tomales Roach

This species only occurs in tributaries to Tomales Bay, including Lagunitas and Walker Creeks and their tributaries.

Occurrence within the Project Area

The Tomales roach is known to occur in Lagunitas Creek and its tributaries, including Olema Creek. Habitat for the Tomales roach is present within the reach proposed for enhancement activities and schools of roach have been documented annually within the area since 1999 (MMWD 2015b). Based on distributional information, presence of suitable habitat, and the documented occurrence of this species in Lagunitas Creek, the potential for occurrence in the project area is high.

Western Pond Turtle

The western pond turtle occurs from the west coast of North America from southern Washington to northern Baja California. This species requires aquatic habitats with suitable basking sites and suitable upland habitat for egg-laying. Nest sites most often characterized as having gentle slopes (<15%) with little vegetation or sandy banks.

Occurrence within the Project Area

Western pond turtles have been documented in MMWD reservoirs, including Lake Lagunitas and Alpine Lake (GANDA 2003), and in Nicasio Reservoir and Nicasio Creek upstream of the reservoir (Andrew, pers. comm. 2017). There are a number of documented occurrences of western pond turtle within about 2.5 miles (4 kilometers) northwest of the project area in the Olema Creek area, and a few additional sightings to the southeast of the project area (Fidenci 1999 and 2003; GANDA 2003). This species is known to occur within the Lagunitas Creek watershed and has been documented in Lagunitas Creek (although not in the reach from Nicasio Creek upstream to Kent Lake) during most of the smolt trapping surveys conducted by MMWD since 2006 (Ettlinger, pers. comm. 2017). Based on these occurrence records and presence of suitable habitat on Lagunitas Creek within the project area, the potential for occurrence at the enhancement sites is quite possible but not guaranteed.

Foothill Yellow-Legged Frog

This species frequents rocky streams and rivers with rocky substrate and open, sunny banks, in forests, chaparral, and woodlands. Foothill yellow-legged frogs use or are associated with a variety of aquatic habitat types, including pools, riffles, runs, cascade pools, and step-pools, depending on life stage and time of year.

The foothill yellow-legged frog is generally found in small to fairly large streams that are characterized by the presence of cobble and boulder-sized substrate. Foothill yellow-legged frogs use the shallower portions of stream channels where velocities are low, such as at pool tail-outs, backwater habitat, and edgewater areas. They are sometimes found in isolated pools, vegetated backwaters, and spring-fed pools. Occurrence and distribution relative to canopy or shade may be somewhat tied to life stage, but streams that afford good exposed basking sites appear to be broadly used.

Occurrence within the Project Area

This species is known to occur in the general region and was documented on Devil's Gulch and Lagunitas Creek below Peters Dam in 1956 (CDFW 2017). This species could potentially occur within the overall project area; however, the dense forests and heavily shaded Lagunitas Creek corridor within the project area provides limited suitable habitat for this species (Seltenrich and Pool 2002). As a result, potential for occurrence within the project area is low. Because this species is not anticipated to occur within the enhancement reaches, no further discussion of the foothill yellow-legged frog is included in this EA.

Pallid Bat

This species occurs in deserts, grasslands, shrublands, woodlands, and forests. It is most common in open, dry habitats with rocky areas for roosting. Roosts must protect bats from high temperatures. Pallid bats are very sensitive to disturbance of roosting sites.

Occurrence within the Project Area

The project area and surrounding forests provide suitable roosting habitat for this species. This species has been documented along Olema Creek (near Olema) and along Lagunitas Creek near Tocaloma (CDFW 2017). Based on these occurrence records and presence of suitable habitat, the potential for occurrence in the project area is possible, but not highly likely.

Townsend's big-eared bat

The Townsend's big-eared bat is found throughout most of California, and is known to occur in deserts, coastal redwood forests, and forests and woodlands in the Coast Ranges and Sierra Nevada. However, they tend to be concentrated in areas with caves and cave-like roosting habitat, such as mines, buildings, bridges, and basal hollows in big old-growth trees.

Occurrence within the Project Area

The project area and surrounding forests provide suitable roosting habitat for this species. This species has been documented in the vicinity of both Olema and Tocaloma (CDFW 2017). Townsend's big-eared bats could use trees with suitable cavities, crevices, exfoliating bark, and/or bark fissures on and near the enhancement sites for roosting. Based on the presence of suitable habitat, the potential for occurrence in the project area is possible.

3.2.3.3 Site Descriptions and Species Evaluations

In the vicinity of Sites 3–8, Lagunitas Creek consists of a single-thread channel corridor with broad floodplain on the left (west) bank and some high/secondary channel development across the floodplain. Site 9 is located on Olema Creek, which consists of a single-thread channel corridor with a variable-width floodplain. Descriptions of stream enhancement sites are based primarily on the February 2017 updated habitat data. Descriptions of each of the stream enhancement sites also includes descriptions of habitat units upstream (approximately 50+ feet) and downstream (approximately 100+ feet) of the structure locations that could be affected by installation and functioning of the instream structures.

Site 3: McIsaac Upstream Bar Apex Jam

The BAJ at Site 3 will be installed toward the left channel bank (looking downstream) in a riffle located immediately downstream of an entrance to a high-flow channel (eastern high-flow channel) located on the left bank (see Figure 5). Improvements will also be made to the high-flow channel, including clearing vegetation and rack material from along the high-flow pathways of the improved high-flow channels, along with some invasive plant species removal and revegetation with native riparian plants. The riffle is approximately 33 feet in length with a mean width of 20 feet, a mean water depth of 1.0 feet, and a maximum water depth of 2.3 feet. Gravel was the dominant substrate with sand/silt/clay as subdominant. Terrestrial vegetation and small woody debris (SWD) provide about 80% of the available shelter for fish with the remaining cover provided by large woody debris (LWD). Both banks are composed primarily of sand, silt, and clay.

Installation of the BAJ will require a clear-water creek diversion because flow in Lagunitas Creek is perennial, with expected base flows estimated at 8 cfs during the summer construction season. Cofferdams will be constructed of (1) sheet piling, (2) sandbags or gravel bags secured with polyethylene plastic sheeting, and/or (3) water-filled bladders, and will be constructed and keyed in at the creek channel immediately upstream and downstream of the work area. Lagunitas Creek water would flow by gravity from the upstream side of the cofferdam into an existing, naturally occurring high-flow side channel located along the left bank (looking downstream), or through flexible hose or PVC pipe around the work area then back into the creek at an outfall located downstream. The BAJ would ultimately raise local channel bed grades and raise water elevations in the channel and along banks to backwater overbank flows into existing side-channels.

Because the BAJ would be installed in a riffle and a portion of a run, it is unlikely that suitable shrimp habitat is present and surveys would likely not be required. However, surveys would be conducted in one or both of these habitats if suitable shrimp habitat is present. Shrimp surveys have not been conducted in this area historically and as a result, shrimp presence has not been documented.

Upstream

Habitat immediately upstream of the Site 3 riffle consists of a run 66 feet in length, with a mean width of 15 feet, a mean water depth of 1.6 feet, and a maximum water depth of 2.4 feet. Gravel was the dominant substrate, with small cobble as subdominant. Terrestrial vegetation and SWD provides about 65% of the available shelter for fish with the remaining cover provided by root masses, undercut banks, bubble curtains, and LWD. The right bank is composed primarily of sand/silt/clay and the left bank is composed primarily of cobble and gravel. At the time of the stream assessment (late fall), water velocities in this unit were relatively high.

Downstream

Stream habitat immediately downstream of the Site 3 riffle consists of a pool 62 feet in length, with a mean width of 25 feet, a mean water depth of 3.4 feet, and a maximum water depth of 4.4 feet. The pool tail crest was composed primarily of silt and clay, with a water depth of 1.5 feet. The dominant substrate was silt/clay/sand, with gravel as subdominant. LWD and SWD present in a debris jam at the upper end of the pool provide about 80% of the available shelter for fish, with the remaining cover provided by terrestrial vegetation, root masses, and undercut banks. Both banks are composed primarily of cobble and gravel. The BAJ at Site 3 would be installed immediately upstream of the existing debris jam, leaving the jam intact.

Site 4: McIsaac Upstream Log Debris Retention Jam 1

The LDRJ at Site 4 (located approximately 100 feet downstream of the Site 3 BAJ) will be installed across the channel about 40 feet downstream from the head of a long pool (Unit 4A) (see Figure 5). Improvements would also be made to the high-flow channel located along the left bank just upstream of the structure. The structure will be positioned immediately downstream of another left bank (looking downstream) entrance to the same high-flow channel (eastern high-flow channel) accessed at Site 3 (Figure 5). The pool is approximately 433 feet in length, with a mean width of 34 feet, a mean water depth of 2.8 feet, and a maximum water depth of 3.6 feet. The pool tail crest was composed primarily of sand with a water depth of 1.0 feet. Gravel was the dominant substrate type with silt/clay/sand as subdominant. Terrestrial vegetation and undercut banks provide about 80% of the available shelter for fish, with the remaining cover provided by root masses, LWD, and SWD. Both banks are composed primarily of sand/silt/clay substrates.

Installation of the LDRJ at Site 4 would use a Temporary Work Platform that would be constructed into the flowing creek. The platform includes establishing a temporary stable pier (likely constructed of large precast concrete block) in the creek to support a wood platform sufficient to support an excavator. The Temporary Work Platform would be installed from the southwest bank of the creek, and would not span the full width of creek, but only extend approximately two-thirds of the creek width. The LDRJ would ultimately raise local channel bed grades and raise water elevations in the channel and along banks to backwater overbank flows into existing side-channels.

In 2015, shrimp surveys were conducted by Larry Serpa in 6 pools within the Site 4 reach for a combined stream length of 802 feet. A total of 383 shrimp were collected during the surveys, with an average of 2.1 shrimp per foot of pool stream length.

Even though construction of the LDRJ would be accomplished from the Temporary Work Platform, installation of the platform from the streambank on the west side of the creek could affect shrimp located along the bank or within the channel itself (amid small debris or in weed beds) in one habitat unit (Pool 4A, where the LDRJ and associated Temporary Work Platform are to be installed). Surveys would be conducted in Pool 4A along the west bank of the creek and potentially in the channel within and adjacent to the location of the Temporary Work Platform.

Upstream

Habitat immediately upstream of the Site 4 pool consists of another pool, described as the downstream pool under Site 3: McIsaac Upstream Bar Apex Jam.

Downstream

The Site 4 pool is very long and the LDRJ is being installed near the head of the pool; therefore, it is unlikely that downstream effects will extend beyond this pool.

Site 5: McIsaac Upstream Log Debris Retention Jam 2

The LDRJ at Site 5 will be installed across the channel in a riffle/run complex (see Figure 6). Improvements would also be made to the high-flow channel located along the left bank upstream of the structure. The riffle/run is approximately 75 feet in length with a mean width of 25 feet, a mean water depth of 0.9 feet, and a maximum water depth of 1.3 feet. Gravel was the dominant substrate, with silt/clay/sand as subdominant. Terrestrial vegetation and undercut banks provide 100% of the available shelter for fish. Both banks are composed primarily of sand/silt/clay substrates.

Similar to Site 4, installation of the LDRJ at Site 5 would use a Temporary Work Platform that would be constructed into the flowing creek. The platform would include establishing a temporary stable pier (likely constructed of large precast concrete block) in the creek to support a wood platform sufficient to support an excavator. The Temporary Work Platform would be installed from the southwest bank of the creek and would not span the full width of creek, but only extend approximately two-thirds of the creek width. The LDRJ would ultimately raise local channel bed grades and raise water elevations in the channel and along banks to backwater overbank flows into existing side-channels.

In 2015, shrimp surveys were conducted by Larry Serpa in 6 pools in the Sites 5 and 6 reach (above Zanardi) for a combined stream length of 630 feet. A total of 183 shrimp were collected during the surveys, with an average of 3.4 shrimp per foot of pool stream length. However, the LDRJ would be installed in a riffle/run complex (5B) where appropriate shrimp habitat is likely not present.

Even though construction of the LDRJ would be accomplished from the Temporary Work Platform, installation of the platform would occur from the streambank on the west side of the creek. Because the LDRJ would be installed in a riffle/run complex characterized by shallow water with a swift current, it is unlikely that suitable shrimp habitat is present along the bank or within the channel itself (amid small debris or in weed beds) in the vicinity of the Temporary Work Platform. As a result, shrimp surveys would likely not be required for this site. However, if suitable shrimp habitat is found to be present, surveys would be performed.

Upstream

Habitat immediately upstream of the Site 5 riffle/run complex consists of a glide approximately 98 feet in length with a mean width of 24 feet, a mean water depth of 1.1 feet, and a maximum water depth of 2.1 feet. Silt, clay, and sand was the dominant substrate, with gravel as subdominant. Terrestrial vegetation and undercut banks provide about 75% of the available shelter for fish, with the remaining cover provided by root masses and aquatic vegetation. Both banks are composed primarily of sand/silt/clay substrates.

Downstream

Stream habitat immediately downstream of the Site 5 riffle/run complex consists of a run approximately 151 feet in length with a mean width of 30 feet, a mean water depth of 1.6 feet, and a maximum water depth of 2.4 feet. The dominant substrate was silt/clay/sand, with gravel as subdominant. Undercut banks provide about 70% of the available shelter for fish. with the remaining cover provided by terrestrial vegetation, root masses, and SWD. Both banks are composed primarily of sand/silt/clay substrates.

Site 6: McIsaac Downstream Bar Apex Jam

The BAJ at Site 6 will be installed toward the left side of the channel at the lower end of a pool located immediately downstream of the entrance to a high-flow channel (downstream high-flow channel) located on the left bank (looking downstream) (see Figure 7). Improvements would also be made to the high-flow channel located upstream of the structure. The pool is approximately 102 feet in length, with a mean width of 21 feet, a mean water depth of 2.9 feet, and a maximum water depth of 3.9 feet. The pool tail crest was composed primarily of sand, with a water depth of 1.1 feet. Gravel was the dominant substrate, with sand/silt/clay as subdominant. Terrestrial vegetation and root masses provide about 70% of the available shelter for fish, with the remaining cover provided by LWD, SWD, and undercut banks. The right bank was composed primarily of sand/silt/clay substrates.

Similar to Site 3, installation of the BAJ at Site 6 would require a clear-water creek diversion and installation of cofferdams upstream and downstream of the structure location and bypass flow dissipaters downstream of the cofferdams because flow in Lagunitas Creek is perennial, with expected base flows estimated at 8 cfs during the summer construction season. The upstream and downstream cofferdams would be constructed of similar materials to those described for Site 3, and would be constructed and keyed in at the creek channel upstream of the work area. The total length of stream to be dewatered is approximately 100 feet. Bypass flows would occur through a natural floodplain swale located along the right bank (looking downstream) immediately upstream of the BAJ. Dewatering systems would be refined during construction based on site-specific conditions. The BAJ would ultimately raise local channel bed grades and raise water elevations in the channel and along banks to backwater overbank flows into existing side-channels.

In 2015, shrimp surveys were conducted by Larry Serpa in six pools in the Sites 5 and 6 reach (above Zanardi) for a combined stream length of 630 feet. A total of 183 shrimp were collected during the surveys, with an average of 3.4 shrimp per foot of pool stream length.

Because the BAJ will be installed at the downstream end of a pool (6F), suitable shrimp habitat is likely present and surveys would be required. Additionally, a riffle (6E) is located immediately downstream of the installation location and would also be dewatered. Even though suitable habitat is likely not present in the riffle, potentially suitable habitat in both units would be surveyed because the dewatered area would encompass all or a portion of the two units. Additionally, the area in the vicinity of the downstream end of the high-flow bypass channel where the energy dissipater would be installed (Pool 6C) would also be surveyed if appropriate shrimp habitat is present.

Upstream

Stream habitat immediately upstream of the Site 6 pool consists of a run/glide complex approximately 72 feet in length, with a mean width of 27 feet, a mean water depth of 0.9 feet, and a maximum water depth of 1.1 feet. The dominant substrate consisted of gravel, with silt/clay/sand as subdominant. Root masses and terrestrial vegetation provide about 85% of the available shelter for fish, with the remaining cover provided by undercut banks. Both banks are composed primarily of sand/silt/clay substrates.

Downstream

Several short habitat units occur downstream of the Site 6 pool that could potentially be affected by installation and functioning of the BAJ and are included below.

Habitat immediately downstream of the Site 6 pool consists of a riffle approximately 26 feet in length, with a mean width of 17 feet, a mean water depth of 1.0 feet, and a maximum water depth of 1.3 feet. Bedrock was the dominant substrate, with silt/clay/sand as subdominant. Terrestrial vegetation and bedrock ledges provide about 100% of the available shelter for fish. Both banks are composed primarily of sand/silt/clay substrates.

Stream habitat immediately downstream of the Site 6 riffle consists of a run approximately 36 feet in length, with a mean width of about 26 feet, a mean water depth of 2.1 feet, and a maximum water depth of 3.0 feet. The dominant substrate was silt/clay/sand, with gravel as subdominant. Terrestrial vegetation and root masses provide about 90% of the available shelter for fish, with the remaining cover provided by SWD and undercut banks. Both banks are composed primarily of sand/silt/clay substrates.

Habitat immediately downstream of the Site 6 run consists of a pool approximately 43 feet in length, with a mean width of 21 feet, a mean water depth of 2.4 feet, and a maximum water depth of 3.7 feet. Silt, clay, and sand were the dominant substrate type, with gravel as subdominant. Root masses and terrestrial vegetation provide about 90% of the available shelter for fish, with the remaining cover provided by SWD and undercut banks. The right bank is composed of sand/silt/clay substrates and the left bank consists of cobble and gravel.

Site 7: Fern Rock Log Debris Retention Jams

Four LDRJs will be installed at Site 7 and improvements would also be made to the high-flow channel located along the right bank (looking downstream) downstream and adjacent to the structures (see Figure 8). The four LDRJs would be installed in sequence, starting with the downstream-most structure, building one LDRJ at a time, moving upstream. This will minimize equipment driving back and forth through the floodplain side-channel to access LDRJ sites. The two upstream LDRJs (1 and 2) would be constructed in pool habitat and the two downstream LDRJs (3 and 4) would be installed in run habitat.

Installation of the four LDRJs would use a Temporary Work Platform that would be constructed into the flowing creek. The platform would include establishing a temporary stable pier (likely constructed of large precast concrete block) in the creek to support a wood platform sufficient to support an excavator. The Temporary Work Platform would not span the full width of creek, but only extend approximately two-thirds of the creek width. The Temporary Work Platforms would be installed from the north bank of the creek.

In 2016, shrimp surveys were conducted by Larry Serpa in the Site 7 reach and a total of 39 shrimp were collected.

Even though construction of the LDRJs would be accomplished from the Temporary Work Platforms, installation of the platforms from the streambank on the north side of the creek could affect shrimp at some locations if suitable habitat was present along the bank or within the channel itself (amid small debris or in weed beds). Suitable shrimp habitat is present at two of the LDRJ locations (LDRJ1 and LDRJ2), which are located in pool habitat, but is likely not present at LDRJ3 and LDRJ4, which are located in run habitat with relatively shallow water depths and high water velocities. As a result, surveys would need to be conducted at the LDRJ1 and LDRJ2 sites, but would not be required at the LDRJ3 and LDRJ4 sites. However, if suitable shrimp habitat were found to be present at the LDRJ3 and LDRJ4 sites, surveys would be performed.

The LDRJs would ultimately raise local channel bed grades and raise water elevations in the channel and along banks to backwater overbank flows into existing side-channels. Stream habitat data for each of the four LDRJ locations are provided below.

LDRJ 1 (the most upstream structure) will be installed in a pool 181 feet in length, with a mean width of 33 feet, a mean water depth of 1.8 feet, and a maximum water depth of 4.5 feet. The dominant substrate consisted of silt/clay/sand, with gravel as subdominant. Terrestrial vegetation and root masses provide about 80% of the available shelter for fish, with the remaining cover provided by SWD. Both banks are composed primarily of sand/silt/clay substrates.

Upstream

Stream habitat immediately upstream of the LDRJ 1 pool consists of a run; however, habitat data is not available.

Downstream

Habitat immediately downstream of the pool consists of a pool 183 feet in length, with a mean width of 30 feet, a mean water depth of 2.0 feet, and a maximum water depth of 4.5 feet. The dominant substrate consisted of silt/clay/sand, with gravel as subdominant. Root masses and terrestrial vegetation provide about 75% of the available shelter for fish, with the remaining cover provided by LWD and undercut banks. The right bank was composed primarily of sand/silt/clay substrates and the left bank consisted of cobble and gravel.

LDRJ 2 will be installed in a pool 183 feet in length, with a mean width of 30 feet, a mean water depth of 2.0 feet, and a maximum water depth of 4.5 feet. The dominant substrate consisted of silt/clay/sand, with gravel as subdominant. Root masses and terrestrial vegetation provide about 75% of the available shelter for fish, with the remaining cover provided by LWD and undercut banks. The right bank was composed primarily of sand/silt/clay substrates and the left bank consisted of cobble and gravel.

Upstream

Stream habitat immediately upstream of the LDRJ 2 pool consists of a pool 181 feet in length, with a mean width of 33 feet, a mean water depth of 1.8 feet, and a maximum water depth of 4.5 feet. The dominant substrate consisted of silt/clay/sand, with gravel as subdominant. Terrestrial vegetation and root masses provide about 80% of the available shelter for fish, with the remaining cover provided by SWD. Both banks are composed primarily of sand/silt/clay substrates.

Downstream

Stream habitat immediately downstream of the LDRJ 2 pool consists of a pool 171 feet in length, with a mean width of 26 feet, a mean water depth of 1.5 feet, and a maximum water depth of 3.8 feet. The dominant substrate consisted of silt/clay/sand, with gravel as subdominant. Terrestrial vegetation provides about 80% of the available shelter for fish, with the remaining cover provided by undercut banks, LWD, and SWD. Both banks are composed primarily of sand/silt/clay substrates.

LDRJ 3 will be installed in a run 108 feet in length, with a mean width of 22 feet, a mean water depth of 1.2 feet, and a maximum water depth of 1.9 feet. The dominant substrate consisted of silt/clay/sand, with gravel as subdominant. SWD provides about 80% of the available shelter for fish, with the remaining cover provided by terrestrial vegetation. Both banks are composed primarily of sand/silt/clay substrates.

Upstream

Stream habitat immediately upstream of the LDRJ 3 run consists of a pool 171 feet in length, with a mean width of 26 feet, a mean water depth of 1.5 feet, and a maximum water depth of 3.8 feet. The dominant substrate consisted of silt/clay/sand, with gravel as subdominant. Terrestrial vegetation provides about 80% of the available shelter for fish, with the remaining cover provided by undercut banks, LWD, and SWD. Both banks are composed primarily of sand/silt/clay substrates.

Downstream

Habitat immediately downstream of the LDRJ 3 run consists of a pool 90 feet in length, with a mean width of 27 feet, a mean water depth of 1.7 feet, and a maximum water depth of 3.5 feet. The dominant substrate consisted of silt/clay/sand, with gravel as subdominant. Root masses and SWD provide about 95% of the available shelter for fish, with the remaining cover provided by terrestrial vegetation. Both banks are composed primarily of sand/silt/clay substrates.

LDRJ 4 (the most downstream structure) will be installed in a run 404 feet in length, with a mean width of about 21 feet. Additional habitat data is not available.

Upstream

Stream habitat immediately upstream of the LDRJ 4 run consists of a pool 111 feet in length, with a mean width of 21 feet, a mean water depth of 1.9 feet, and a maximum water depth of 2.8 feet. The dominant substrate consisted of silt/clay/sand, with gravel as subdominant. SWD and undercut banks provide about 85% of the available shelter for fish, with the remaining cover provided by terrestrial vegetation and LWD. Both banks are composed primarily of sand/silt/clay substrates.

Downstream

Habitat immediately downstream of the LDRJ 4 run consists of a pool 128 feet in length, with a mean width of 21 feet, a mean water depth of 2.1 feet, and a maximum water depth of 4.8 feet. The dominant substrate consisted of silt/clay/sand, with gravel as subdominant. Root masses and terrestrial vegetation provide about 80% of the available shelter for fish, with the remaining cover provided by boulders and SWD. Both banks are composed primarily of sand/silt/clay substrates.

Because streamflow will be diverted into a high-flow channel at several locations upstream and downstream of the LDRJ 1 installation site and will return to the creek at a pool downstream of the LDRJ 4 installation site (described above), the following pool description is also included. The habitat consists of a pool 149 feet in length, with a mean width of 22 feet, a mean water depth of 1.9 feet, and a maximum water depth of 4.3 feet. The dominant substrate consisted of silt/clay/sand, with gravel as subdominant. Terrestrial vegetation and SWD provide about 70% of the available shelter for fish, with the remaining cover provided by bedrock ledges, boulders, and root masses. Both banks are composed primarily of sand/silt/clay substrates.

Site 8: 449 Creek Log Debris Retention Jam and Bar Apex Jam

At Site 8, winter habitat enhancement activities include installation of a BAJ, LDRJ, and high-flow channel improvements (see Figure 9). The BAJ would be installed in pool habitat and would require a clear-water diversion since flow in Lagunitas Creek is perennial with expected base flows estimated at 8 cfs during the summer construction season. Installation of cofferdams (as described for Sites 3 and 6) would be required upstream and downstream of the work area for the BAJ, and creek flow would be diverted into the adjacent floodplain side channel (along the right bank, looking downstream). Approximately 150 feet of stream would be dewatered at this site. The LDRJ would also be installed in a pool 415 feet in length, with a mean width of 25 feet, a mean water depth of 1.9 feet, and a maximum water depth of 5.1 feet. Sand, silt, and clay were the dominant substrate, with gravel as subdominant. SWD and terrestrial vegetation provide about 80% of the available shelter for fish, with the remaining cover provided by LWD and root masses. Both banks are composed primarily of sand/silt/clay substrates.

Similar to Sites 4 and 7, installation of the LDRJ would use a Temporary Work Platform that would be constructed in the flowing creek. The platform includes establishing a temporary stable pier (likely constructed of large precast concrete block) in the creek to support a wood platform sufficient to support an excavator. The Temporary Work Platform would not span the full width of creek, but only extend approximately two-thirds of the creek width. The Temporary Work Platforms would be installed from the north bank of the creek.

In 2016, shrimp surveys were conducted by Larry Serpa at Site 8 and a total of 29 shrimp were collected.

Suitable shrimp habitat is likely present within the dewatered reach at the BAJ site and surveys would be performed in all suitable habitat throughout the entire reach to be dewatered. At the LDRJ site, shrimp surveys would be conducted along the bank and potentially within the creek channel in the vicinity of the Temporary Work Platform.

The LDRJ and BAJ would ultimately raise local channel bed grades and raise water elevations in the channel and along banks to backwater overbank flows into existing side-channels.

Upstream

Stream habitat immediately upstream of the Site 8 LDRJ pool consists of a glide 73 feet in length with a mean width of 29 feet, a mean water depth of 1.2 feet, and a maximum water depth of 1.6 feet. The dominant substrate consisted of silt/clay/sand, with small cobble as subdominant. Terrestrial vegetation and SWD provides about 80% of the available shelter for fish, with the remaining cover provided by LWD and root masses. Both banks are composed primarily of sand/silt/clay substrates.

Downstream

Habitat immediately downstream of the Site 8 LDRJ pool consists of another pool, which is described below for installation of the BAJ.

The BAJ will be installed in a pool 118 feet in length, with a mean width of 25 feet, a mean water depth of 2.2 feet, and a maximum water depth of 4.3 feet. Sand, silt, and clay was the dominant substrate, with gravel as subdominant. Terrestrial vegetation and SWD provide about 80% of the available shelter for fish, with the remaining cover provided by LWD, and root masses. The right bank was composed primarily of cobble and gravel substrates and the left bank consisted of sand/silt/clay substrates.

Upstream

Stream habitat immediately upstream of the Site 8 BAJ pool is described above for installation of the LDRJ.

Downstream

Habitat immediately downstream of the Site 8 BAJ pool consists of a riffle 38 feet in length, with a mean width of 20 feet, a mean water depth of 0.5 feet, and a maximum water depth of 1.2 feet. Gravel was the dominant substrate, with small cobble as subdominant. Terrestrial vegetation provides about 90% of the available shelter for fish, with the remaining cover provided by SWD. The right bank is composed primarily of sand/silt/clay substrates and the left bank consisted of cobble and gravel substrates.

Since streamflow will be diverted into a high-flow channel just upstream of the LDRJ installation site and will return to the creek at a pool just downstream of the riffle (described above), the following pool description is also included. Habitat immediately downstream of the riffle consists of a pool 181 feet in length, with a mean width of 20 feet, a mean water depth of 1.8 feet, and a maximum water depth of 5.5 feet. Sand, silt, and clay was the dominant substrate, with gravel as subdominant. SWD and LWD provide about 60% of the available shelter for fish, with the remaining cover provided by terrestrial vegetation and root masses. The right bank is composed primarily of cobble and gravel substrates and the left bank consisted of sand, silt, and clay.

Site 9: Olema Creek Log Cross-Vane and LDRJs

Winter habitat enhancement at Site 9 includes the installation of a Log Cross-Vane and six LDRJs (as described for Sites 4, 5, 7 and 8) (see Figure 10). A single Log Cross-Vane would be installed at the upstream end of the Olema Creek reach to act as a bed grade control structure upstream of an existing knick-point. This structure is intended to provide a hardpoint to resist erosion. It would be used in combination with a LDRJ installed immediately downstream of the knick-point and as a grade-control structure that would act as a hydraulic control, creating backwater conditions to reduce energy gradients, reduce erosion, and act to trap debris and sediment. Construction of the Log Cross-Vane and associated LDRJ1 would require a clear-water creek diversion with installation of cofferdams (as described previously for Sites 3 and 6) upstream and downstream of these structures. Bypass flow would be directed through a pipe into the adjacent historic channel, located along the right bank, looking downstream. Approximately 75 feet of stream would be dewatered at this location. The remaining LDRJs would be installed downstream in strategic locations as additional hydraulic controls. Construction of the remaining downstream LDRJs would be accomplished from one or both banks adjacent to each site. Due to the relatively narrow stream channel throughout Site 9, installation of the LDRJs should not affect streambanks but would impact the channel itself from bank to bank.

In 2016, shrimp surveys were conducted by Larry Serpa in the Site 9 reach and a total of 19 shrimp were collected (all but one of them occurred in the most downstream pool).

LDRJs constructed in locations where suitable shrimp habitat is present would be surveyed. LDRJ2 and the temporary stream crossing platform immediately downstream of LDRJ2 are located in a pool and surveys would be required along both banks and potentially within the channel. LDRJ3, LDRJ4, LDRJ5, and LDRJ6 are all located in pool habitats and surveys would be required along both banks and potentially within the channel at all four sites. The LDRJs would ultimately raise local channel bed grades and raise water elevations in the channel and along banks to backwater overbank flows into a historic channel and into parts of the floodplain.

The Log Cross-Vane will be installed in a pool upstream of an existing knick-point. The is pool is 275 feet in length with a mean width of 10 feet, a mean water depth of 1.4 feet, and a maximum water depth of 1.8 feet. The dominant substrate was silt/clay/sand. Terrestrial vegetation provides about 60% of the available shelter for fish, with the remaining cover provided by undercut banks, root masses, SWD, and aquatic vegetation. Both banks are composed primarily of sand/silt/clay substrates.

Upstream

Stream habitat data upstream of the Log Cross-Vane pool is not available.

Downstream

Habitat immediately downstream of the Log Cross-Vane pool is provided below under the description of habitat at LDRJ 1.

Stream habitat data for each of the six LDRJ locations are provided below.

LDRJ 1 (the most upstream structure) would be installed in a run 126 feet in length with a mean width of 7 feet, a mean water depth of 0.5 feet, and a maximum water depth of 0.9 feet. The dominant substrate was silt/clay/sand. Terrestrial and aquatic vegetation provide 100% of the available shelter for fish. Both banks are composed primarily of sand/silt/clay substrates.

Upstream

Stream habitat immediately upstream of the run at LDRJ 1 is described above for the installation of the Log Cross-Vane.

Downstream

Habitat immediately downstream of the run at LDRJ 1 is provided below for the installation of LDRJ 2.

LDRJ 2 will be installed at the downstream end of a pool 67 feet in length, with a mean width of 12 feet, a mean water depth of 2.8 feet, and a maximum water depth of 4.9 feet. The dominant substrate was silt/clay/sand. Root masses, SWD, and LWD provide about 80% of the available shelter for fish, with the remaining cover provided by undercut banks and terrestrial vegetation. Both banks are composed primarily of sand/silt/clay substrates.

Upstream

Stream habitat immediately upstream of the pool at LDRJ 2 is provided above for the installation of LDRJ 1.

Downstream

Habitat immediately downstream of the of the pool at LDRJ 2 consists of a short riffle 24 feet in length, with a mean width of 5 feet, a mean water depth of 0.4 feet, and a maximum water depth of 0.4 feet. The dominant substrate was silt/clay/sand. Shelter for fish was not present in this habitat. Both banks are composed primarily of sand/silt/clay substrates.

LDRJ 3 would be installed in a pool 95 feet in length, with a mean width of 11 feet, a mean water depth of 1.2 feet, and a maximum water depth of 2.4 feet. The dominant substrate was silt/clay/sand. Root masses, SWD, and LWD provide about 80% of the available shelter for fish, with the remaining cover provided by undercut banks and terrestrial vegetation. Both banks are composed primarily of sand/silt/clay substrates.

Upstream

Stream habitat immediately upstream of the pool at LDRJ 3 consists of another pool 69 feet in length, with a mean width of 9 feet, a mean water depth of 1.7 feet, and a maximum water depth of 3.0 feet. The dominant substrate was silt/clay/sand. Undercut banks provide about 80% of the available shelter for fish, with the remaining cover provided by root masses. Both banks are composed primarily of sand/silt/clay substrates.

Downstream

Habitat immediately downstream of the of the pool at LDRJ 3 consists of a riffle 45 feet in length, with a mean width of 5 feet, a mean water depth of 0.3 feet, and a maximum water depth of 0.7 feet. The dominant substrate was gravel with small cobble as subdominant. Undercut banks and terrestrial vegetation provide about 80% of the available shelter for fish, with the remaining cover provided by root masses. The right bank is composed primarily of sand/silt/clay and the left bank is composed of cobble and gravel substrates.

LDRJ 4 and LDRJ 5 would be installed in a pool 216 feet in length, with a mean width of 18 feet, a mean water depth of 2.0 feet, and a maximum water depth of 4.2 feet. The dominant substrate was silt/clay/sand, with gravel as subdominant. Terrestrial vegetation and root masses provide about 75% of the available shelter for fish, with the remaining cover provided by undercut banks, SWD, and aquatic vegetation. Both banks are composed primarily of sand/silt/clay substrates.

Upstream

Stream habitat immediately upstream of the pool at LDRJ 4 and LDRJ 5 consists of a riffle 45 feet in length, with a mean width of 5 feet, a mean water depth of 0.3 feet, and a maximum water depth of 0.7 feet. The dominant substrate was gravel, with small cobble as subdominant. Undercut banks and terrestrial vegetation provide about 80% of the available shelter for fish, with the remaining cover provided by root masses. The right bank is composed primarily of sand/silt/clay and the left bank is composed of cobble and gravel substrates.

Downstream

Habitat immediately downstream of the pool at LDRJ 4 and LDRJ 5 is provided below for the installation of LDRJ 6.

LDRJ 6 would be installed in a pool 194 feet in length, with a mean width of 19 feet, a mean water depth of 2.2 feet, and a maximum water depth of 3.3 feet. The dominant substrate was silt/clay/sand, with gravel as subdominant. Undercut banks, SWD, and LWD provide about 70% of the available shelter for fish, with the remaining cover provided by root masses and terrestrial and aquatic vegetation. Both banks are composed primarily of sand/silt/clay substrates.

Upstream

Stream habitat immediately upstream of the pool at LDRJ 6 is provided above for the installation of LDRJ 4 and LDRJ 5.

Downstream

Habitat immediately downstream of the pool at LDRJ 6 consists of a short riffle 22 feet in length, with a mean width of 5 feet, a mean water depth of 0.2 feet, and a maximum water depth of 0.2 feet. The dominant substrate was gravel, with small cobble as subdominant. Root masses provide about 80% of the available shelter for fish, with the remaining cover provided by terrestrial vegetation and undercut banks. Both banks are composed primarily of cobble and gravel substrates.

Site 10: Tocaloma Floodplain Site – Floodplain Side-Channel Enhancement

A portion of the Tocaloma Floodplain Site will be graded to re-create a long (about 850-foot) side-channel to run through a floodplain consisting of an open, grassy area and dense willow/alder-dominated riparian corridor of the creek (see Figure 11 and Appendix B1). Vegetation clearing and grubbing and grading would be conducted to connect the upstream end of the side-channel to the base-flow channel of Lagunitas Creek; existing low-lying areas within the channel alignment will be retained and will terminate before reconnecting with the creek at the downstream end, allowing flows within the side-channel to complete the connection back to Lagunitas Creek. Work at the upstream end of the project would not require excavation into the base-flow channel of Lagunitas Creek, but would leave a berm between the creek and the excavated floodplain channel that would be breached by high flows during the first storm event. Spoils from the grading would be spread out on an upland slope along and below the adjacent Platform Bridge Road.

3.2.4 Methodology

Potential impacts to special status species (i.e., listed species and species of special concern) were evaluated based on the effects of construction of permanent LWD enhancement structures at Sites 3–9, floodplain channels (Site 10), and temporary work structures. Temporary work structures include clear-water creek diversions, flow deflection and turbidity containment structures, and bypass flow dissipaters. On Lagunitas and Olema Creeks, stream habitats and associated temporary direct and indirect effects were evaluated on individual species and habitats required by specific life stages (e.g., fish spawning, larval and juvenile rearing, adult holding habitat; shrimp habitat). Information used in the impact analysis included physical habitat data for Lagunitas and Olema Creeks within and adjacent to the proposed enhancement sites; species occurrence, abundance, and distributional information (site utilization on a temporal basis) for all life stages present within and adjacent to the proposed enhancement sites; locations of known spawning/breeding areas within and adjacent to the proposed enhancement sites; and results of completed surveys and available reports.

3.2.5 Impact Analysis – Proposed Project

Beneficial Effects

Installation of the proposed instream enhancement structures on Lagunitas Creek at Sites 3–8 and associated floodplain enhancement, and floodplain enhancement at the Tocaloma Floodplain (Site 10) would be beneficial to habitat for listed salmonids. These enhancements would increase winter habitat carrying capacity for coho salmon and steelhead trout, which was identified as the primary factor limiting the populations of both species in the Lagunitas Creek basin (Stillwater Sciences 2008). Additionally, proposed instream enhancement structures on Olema Creek at Site 9 will also increase winter habitat carrying capacity for coho salmon and steelhead. Providing additional winter floodplain habitat will result in a greater amount of rearing habitat available for juvenile coho salmon and steelhead and opportunities for juveniles to grow larger before migrating out to Tomales Bay as smolts, allowing for increases in the populations of both species.

Beneficial effects resulting from the proposed enhancement activities include substantially increasing the amount of LWD in the channel, sorting and storing of fine sediments, and, where safe and feasible, reconnecting the channel to its floodplain. As a result, the proposed instream enhancement activities at Sites 3–9 and floodplain enhancement at Site 10 (Tocaloma Floodplain) are designed to fulfill the goals of the (Lagunitas Creek Sediment TMDL Plan). These goals are as follows:

- To restore an annual spawning run within the Lagunitas Creek watershed of 1,300 or more adult coho salmon, achieved for at least 12 consecutive years.

- For native fish and aquatic wildlife species to be in good condition at the individual, population, and community levels.
- To protect and enhance the aesthetic and recreational values of the creek and its tributaries.

The effects, while beneficial, are considered less than significant.

Adverse Effects

Coho salmon, steelhead, freshwater shrimp, and Tomales roach occur in Lagunitas Creek and coho salmon and steelhead occur in Olema Creek and have been documented in the vicinity of the project sites. Because Lagunitas and Olema Creeks are perennial streams, project construction could directly and/or indirectly harm fish species, freshwater shrimp, and other aquatic organisms in the creeks.

The primary sources of adverse effects to these species are associated with in-channel construction activities including clear-water creek diversions and construction dewatering, the installation of the permanent LWD structures and the installation and removal of temporary structures including clear-water creek diversions, and flow deflection and turbidity containment structures. Dewatering activities at Sites 3 and 6–8 on Lagunitas Creek and Site 9 on Olema Creek could adversely affect fish, freshwater shrimp, and other aquatic species within the dewatered area. Water quality could also be affected by leakage from or around turbidity curtains, or if there were any accidental release of construction equipment hazardous substances used or stored during project construction (as described in Section 3.1, Soils and Water Resources).

Installation of permanent LWD structures and temporary clear-water creek diversions, flow deflection, and turbidity containment structures will likely involve the use of a vibratory hammer, which produces reduced sound levels relative to impact hammers. Vibratory driving noise levels are generally 10 to 20 decibels lower than impact hammer driving, with wood piles producing the lowest sound pressure levels. Based on available studies, impacts on fishes or other aquatic organisms have not been observed in association with vibratory hammers. This may be due to the slower rise time and the fact that the energy produced is spread out over the time it takes to drive the pile. As such, vibratory driving of piles is generally considered less harmful to aquatic organisms and is the preferred method. In addition, shallower water (e.g., water less than about 2 feet deep) does not propagate noise energy effectively, especially at lower frequencies (Urick 1983).

In the late summer–fall period, when construction is scheduled to occur, mean water depths in the vicinity of construction activities at the seven instream enhancement sites (Sites 3–9) varies from about 0.5 feet (in riffle, run, and glide habitats) to about 1.2 feet (in pool habitats). As a result, noise propagation in the shallow water habitats in the vicinity of the LWD installation sites would be minimal, with increased sound levels in pool habitats. However, sound propagation studies associated with the use of vibratory hammers on the Russian River showed that sound pressure levels were not measurable above the background noise created by the current (Reyff 2006). Thus, adverse effects to coho salmon or coastal steelhead are not anticipated in association with the use of vibratory hammers to install sheet pile, K-rails, or LWD structures. All impacts that occur are temporary and can be minimized to avoid take of the species and will not result in habitat removal and/or degradation. Implementation of **MM HYD-1a–MM HYD-1c**, **MM HYD-2**, and **MM BIO-1** would reduce the impact to less than substantial levels related to aquatic habitat and water quality and thus would not significantly affect overall habitat for fish, freshwater shrimp, and other aquatic species.

Because project activities will occur when stream flow is present in both Lagunitas Creek and Olema Creek, coho salmon, steelhead trout, Tomales roach, and California freshwater shrimp if present at the time could be directly and/or indirectly harmed by the construction-related activities. However, implementation of **MM BIO-2** would reduce the impact to coho salmon, steelhead trout, and Tomales roach to less than substantial; therefore, the proposed project would not significantly affect these species. Implementation of **MM BIO-3** would reduce the impact to California freshwater shrimp to less than substantial; therefore, the proposed project would not significantly affect this species or the overall population present within the enhancement reaches. The California red-legged frog and western pond turtle could also be present within the enhancement reach and could be directly and/or indirectly harmed by the construction-related activities. Implementation of **MM BIO-4** and **MM BIO-5** would reduce the impact to California red-legged frog and western pond turtle, respectively, to less than substantial levels; therefore, the proposed project would not significantly affect either species. Construction activities in floodplain areas at Sites 3–9 and at Site 10 (the Tocaloma Floodplain site) could impact several terrestrial wildlife species, including pallid bat or Townsend's big-eared bat. Implementation of **MM BIO-6** would reduce impacts to nesting birds and raptors to less than significant levels, and implementation of **MM BIO-7** would reduce impacts to the pallid bat and Townsend's big-eared bat and roosting habitat to less than significant levels. Additionally, implementation of **MM BIO-1** would reduce impacts during the overall construction period to less than substantial; therefore, the proposed project would not significantly affect any aquatic or wildlife species. Therefore, temporary impacts to coho salmon, steelhead, Tomales roach, California freshwater shrimp, California red-legged frog, western pond turtle, or other aquatic species, or to fish or wildlife movement or migration, are considered less than significant.

Cumulative Effects

For current and future projects, the cumulative analysis assumes the geographic area of analysis to be the Lagunitas Creek watershed, and identifies projects and actions currently taking place, or that are anticipated to take place in accordance with the Stewardship Plan. Two identified current and future projects will occur within the Lagunitas Creek watershed, including the fish passage restoration project at Jewell Creek and the Salmon Protection and Watershed Network's Lagunitas Creek Floodplain & Riparian Restoration project at Tocaloma. The Jewell Creek fish passage restoration project, which was constructed in 2016, is similar to the proposed project and has long-term beneficial effects to special-status species due to improved aquatic resource ecosystem function (ESA 2015). The Jewell Creek project, funded by a $935,000 grant award from CDFW, will help restore floodplains and improve habitat for critically endangered coho salmon on NPS lands near Olema. If other future projects are proposed within the Lagunitas Creek watershed, it is assumed that they would be consistent with the Stewardship Plan and that they would not substantially contribute to cumulative impacts to special-status species.

Conclusion

Lagunitas Creek and its associated riparian corridor provide a movement corridor between the headwaters near Mount Tamalpais and its terminus, Tomales Bay. Conversely, Olema Creek and its associated riparian corridor also provide a movement corridor between the headwaters and the confluence with Lagunitas Creek. These creek corridors allow special-status and common aquatic wildlife species to safely disperse back and forth between suitable habitats upstream and downstream. Lagunitas Creek below Kent Lake and Nicasio Reservoir and its tributaries provide a relatively unimpeded waterway (along with its associated riparian corridor) and important movement corridors for fish (especially salmonids) and other aquatic species, which allow dispersal and subsequent gene flow between wildlife populations separated by roads and populated areas. In addition to the presence of listed coho salmon, steelhead trout, California freshwater shrimp, and possibly California red-legged frog, some aquatic species of special concern, including the Tomales roach and western pond turtle, could also occur within the project area.

Instream construction activities at the eight Lagunitas Creek sites, including installation of the LWD structures, clear-water creek diversions, flow deflection and turbidity containment structures, and bypass flow dissipaters at enhancement Sites 3–8, could adversely affect coho salmon, steelhead, California freshwater shrimp, California red-legged frog, Tomales roach, and western pond turtle. Instream construction activities at Site 9 on Olema Creek, including installation of the LWD structures, clear-water creek diversions, and turbidity containment structures, could adversely affect coho salmon, steelhead, California red-legged frog, Tomales roach, and western pond turtle. Additionally, floodplain enhancement activities on Lagunitas Creek at Sites 3–8 and at Site 10 (the Tocaloma Floodplain site) may temporarily disrupt wildlife movement within the project area. Temporary access and staging areas (i.e., vegetation removal) could impact birds and bats. However, the disturbance would only occur during project construction and the disruption of wildlife movement would be temporary. At Sites 3 and 6–9, upstream and downstream movement of aquatic species would be disrupted until the clear-water creek diversion has been installed and a flow bypass channel has been established. At Sites 4 and 5, upstream and downstream movement for fish or wildlife species would not be substantially disrupted at any time because only half the channel would be affected at any time during construction. Implementation of **MM BIO-1** through **MM BIO-7** would reduce the impact to coho salmon, steelhead trout, Tomales roach, California freshwater shrimp, California red-legged frog, western pond turtle, pallid bat, Townsend's big-eared bat, and nesting birds and raptors to less than substantial; therefore, the proposed project would not significantly affect these species.

Installation of the proposed instream enhancement structures at Sites 3–9 and associated floodplain enhancement, where applicable, and floodplain enhancement at Site 10 (the Tocaloma Floodplain site) would increase winter habitat carrying capacity for coho salmon and steelhead, which was identified as the primary factor limiting the populations of both species in the Lagunitas Creek basin (Stillwater Sciences 2008). Providing additional winter floodplain habitat would result in a greater amount of rearing habitat available for juvenile coho salmon and steelhead, allowing for increases in the populations of both species.

Therefore, temporary impacts to coho salmon, steelhead, Tomales roach, California freshwater shrimp, California red-legged frog, western pond turtle, or other aquatic species, or to fish or wildlife movement or migration, are considered less than significant.

3.2.6 Impact Analysis – No Action Alternative

Under this alternative no direct action would occur as a result of the project.

The need for increased winter habitat carrying capacity for coho salmon and steelhead would continue to be felt. The limiting need for additional winter floodplain habitat that would result in a greater amount of rearing habitat available for juvenile coho salmon and steelhead would continue to be felt. Increases in the populations of both species would be limited.

The adverse impacts described in this section would not be realized.

Project construction would not directly and/or indirectly harm fish species, freshwater shrimp, and other aquatic organisms in the creek.

In-channel construction activities, including clear-water creek diversions and construction dewatering, the installation of the permanent LWD structures, and the installation and removal of temporary structures including clear-water creek diversions, flow deflection, and turbidity containment structures would not impact species in the watershed.

Dewatering activities at Sites 3 and 6–9 would not adversely affect fish, freshwater shrimp, and other aquatic species within the dewatered area. Water quality would not be affected by leakage from or around turbidity curtains, and any accidental release of chemicals used or stored during project construction.

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3.3 VEGETATION RESOURCES

3.3.1 Introduction

This section describes vegetation resources in the project area. Potential impacts of the proposed project are evaluated in terms of their effect on vegetation resources. Where applicable, mitigation measures are recommended to minimize the potential for adverse effects on vegetation resources. In addition, this section summarizes the applicable laws, regulations, and policies associated with protection of vegetation resources, including special-status plant species and biological resources in general.

3.3.2 Regulatory Framework

NPS Natural Resource Policies and Guidelines. NPS has developed specific guidelines for the management of natural resources. The guidelines provide for the management of native and nonnative plant and animal species. They are designed to assist parks in developing resource management plans and action plans for specific park programs in all park management zones and special use zones as described in the NPS Management Policies 2006 and articulated in each park general management plan. The NPS Management Policies 2006 direct park managers to preserve natural resources, processes, systems, and values of park units in an unimpaired condition to perpetuate their inherent integrity and to provide present and future generations with the opportunity to enjoy them. Natural resources will be managed to preserve fundamental physical and biological processes, as well as individual species, features, and plant and animal communities. NPS will strive to understand, maintain, restore, and protect the inherent integrity of the natural resources, processes, systems, and values of the parks. These are described generally in the 1916 NPS Organic Act and in the enabling legislation or presidential proclamation establishing each park.

State

California Native Plant Protection Act. In addition to CESA, the California Native Plant Protection Act provides protection to endangered and rare plant species, subspecies, and varieties of wild native plants in California. The definitions of “endangered” and “rare” are closely parallel to the definitions of “endangered” and “threatened” plant species in CESA. The California Native Plant Protection Act lists are used by both USFWS and CDFW when considering formal species protection under FESA and CESA.

3.3.3 Affected Environment

The proposed project area includes eight restoration and enhancement sites – seven sites (Sites 3–8 and Site 10) are located over an approximately 3.5-mile stretch of Lagunitas Creek, and the eighth site (Site 9) is on Olema Creek, off Bear Valley Road and across from the Point Reyes National Seashore Headquarters. No sensitive plant species or vegetation communities were observed in the project area (Appendix F). The project area is dominated by riparian vegetation along the creek with adjacent upland communities (Appendix F). The riparian canopy is generally dominated by red alder (*Alnus rubra*), box elder (*Acer negundo*), and willows (*Salix* spp.). Common understory plants include California blackberry (*Rubus ursinus*), stinging nettle (*Urtica dioica*), and mugwort (*Artemisia douglasiana*). Some invasive plants, such as Italian thistle (*Carduus pycnocephalus*), Scotch broom (*Cytisus scoparius*), and Japanese knotweed (*Fallopia japonica*), were found in the project area along Lagunitas Creek. Upland areas within and adjacent to the impacted areas include redwood (*Sequoia sempervirens*) forest, grasslands, and areas dominated by coast live oak (*Quercus agrifolia*) and California bay (*Umbellularia californica*).

No special-status plant species or sensitive vegetation communities were observed on the project sites and the project sites were generally unsuitable for such species (Appendix F). Tree inventories of the project Sites 3–10 were conducted by MMWD in February and March 2016 and January 2017 (MMWD 2017, included in Appendix B2 to this EA). The tree inventory identified "trees" as tree species exceeding 2 inches in diameter at breast height (per CDFW guidelines for 1600 Streambed Alteration Agreements). The tree inventory identified 652 trees that would be potentially impacted by the proposed project (predominantly small-diameter willows). A similar tree inventory will be conducted for Sites 7, 8, and 9.

3.3.4 Methodology

Field surveys were conducted on the project sites in May and July 2015 and on May 5, 2016. Jennifer Kalt of Humboldt State University's Cultural Resources Facility surveyed the project sites in their entirety with a 25-foot buffer and identified all plant species present (see Appendix F). In addition, a botanical survey of the project sites was conducted by an MMWD botanist on March 17, 2015, primarily looking for early-blooming rare species (Appendix F). Tree surveys were conducted as described above (Appendix F). Trees were identified as woody plants greater than 2 inches in diameter at breast height. All trees within the impact footprint of the proposed project were identified to genus and tallied. For the purposes of this document, potential impacts are generally described in terms of the nature of the impact, duration, intensity, type of impact (direct, indirect, and/or cumulative), and context.

3.3.5 Impact Analysis – Proposed Project

Direct impacts to vegetation resources in and surrounding the project area would be associated with construction activities (e.g., cutting trees along equipment access routes, clearing vegetation along the reconnected floodplain channels, and the installation of large woody debris structures adjacent to Lagunitas Creek) and the intended increased frequency of inundation of the existing floodplain within the targeted stretch of Lagunitas Creek. Changes in the frequency and duration of inundation of the floodplain and the volume of flow would be expected to result in changes in the composition of the plant community within the floodplain. To some degree, those changes would also be expected to affect ecology within the riparian corridor adjacent to the affected area. Both direct effects related to disturbance for construction and indirect effects related to altered abiotic conditions are addressed below.

Beneficial Effects

The proposed project would use a series of large woody debris structures installed at strategic locations within the Lagunitas and Olema Creek channels to raise water surface elevations and redirect flows into historic floodplains and side channels on a more frequent basis. At the Tocaloma Floodplain site (Site 10), an existing, remnant floodplain side channel would be excavated. The intent of this alteration is to restore a pattern of flooding that more closely approximates the historic flood regime that existed within Lagunitas Creek prior to the damming of Lagunitas Creek. As described in **MM BIO-8** (see Section 2.6, Mitigation and Monitoring, for text of all mitigation measures), MMWD shall prepare a Habitat Restoration and Monitoring Plan, which will be implemented as soon as construction is complete. The restoration and enhancement of natural hydrological processes and habitat within the creek is considered a beneficial effect for vegetation resources. It is possible that the enhancement of salmonid wintering habitat could result in top-down ecological effects that could influence the distribution or composition of plant species within the project area, but such changes are expected to be limited or imperceptible. Where non-native plants (especially non-native invasive plants such as Japanese knotweed) are removed during construction, they would be replaced with native plants using protocol developed in collaboration with NPS for controlling the spread of invasives. This protocol includes plants removed mechanically and/or by hand where they occur within any work areas. While these effects are beneficial, they are considered less than significant.

Adverse Effects

Adverse effects to vegetation related to the proposed project would predominantly be limited to construction impacts. Construction related effects include vegetation clearing for construction access, and the clearing of willow riparian vegetation within the Tocaloma Floodplain for excavation of the proposed reestablished side channel. The geographic extent of adverse effects on vegetation related to project construction would be limited to the immediate vicinity of the project and would be focused on staging, construction access routes, and areas cleared for conversion to aquatic habitat and are thus considered less than significant.

An area less than 1 acre would be cleared and grubbed to create site access routes and open the side channel for creek flow in the vicinity of Sites 3, 4, 5, and 6 (Kamman 2013, 2014). For

Site 7, four small staging areas, each approximately 700 square feet, would be placed along the creek near the individual planned project elements. For Site 8, two small staging areas of approximately 800 square feet each would be placed along the creek near the individual planned project elements. An area less than 1 acre would be cleared and grubbed to create site access routes and provide staging in the vicinity of Site 9. Less than 1 acre of predominantly willow riparian scrub would be uprooted for the excavation of the Tocaloma Floodplain channel (Balance Hydrologics 2013). Willow plants uprooted would be replanted along the bank of the floodplain.

The intensity of these impacts within the small geographic area could be considered limited. Riparian habitat in general represents a relatively small percentage of total land cover across the regional landscape and therefore is of relatively high conservation value. However, although the proposed impacts would remove riparian habitat within the proposed new floodplain, the total area of riparian habitat would remain roughly equivalent because the new, more frequently inundated side channels and floodplain would support the transition of previously upland habitat outside the hydrologic influence of the riparian corridor into new riparian habitat. The majority of the predominantly riparian vegetation that would be displaced would regenerate within a few growing seasons. The net effect would therefore be neutral in terms of total area of riparian habitat, and the temporary reduction in the total cover of riparian habitat within the project area would therefore constitute a small effect and would be considered less than significant.

Indirect effects related to construction of the proposed project could include creating a favorable environment for invasive non-native or ruderal plant species that are highly competitive in disturbed environments. The proposed project involves more than an acre of disturbance in total, including clearing, grubbing, and excavation. Replanting would be required to reduce the possibility of non-native species establishing in areas disturbed by the proposed project. Replanting is included in the list of action items identified for the proposed project (Appendices B1 and B2) as well as in **MM BIO-8** and **MM BIO-9**. As a result, the intensity of this potential adverse effect is minimized as a project feature and the effect would be very limited and considered less than significant.

Indirect adverse effects on vegetation could include impacts to water quality during construction. However, these effects would be minimized by the clear-water creek diversion program described in Chapter 2, Project Description (see also Appendix D), as well as by implementaion of **MM HYD-1**c. Implementation of **MM BIO-10** (construct during the fall), **MM HYD-1a** (stormwater and erosion control BMPs), and **MM HYD-1b** (spill prevention and countermeasure plan) would also minimize water-quality-related indirect effects to vegetation resources. Furthermore, because the project site was not found to contain any special-status plant species or sensitive natural communities that could be threatened by the indirect ecological effects of the project, those effects would be very limited and are considered less than significant.

Cumulative Effects

Cumulative effects to vegetation would result if projects in proximity to the proposed project were implemented concurrently or in close succession such that the limited impacts of the projects, when considered in isolation, compound to result in a more significant impact by magnifying the geographic context, intensity, or duration of a particular effect. The proposed project could occur within the same time frame as a number of other small restoration projects in the region as described in Chapter 2, Table 2. However, because the proposed project is not directly adjacent to these other projects and would not result in impacts to any sensitive plant species or natural communities and because the project's potential effects related to disturbance, like those of other projects, would be addressed through replanting, the proposed project would not contribute considerably to any potential cumulative effects.

Conclusion

The project's effects on vegetation resources are primarily localized and beneficial in the long term, because it implements strategies to control long-term channel incision and to restore natural hydrology and species habitat. The potential for adverse effects to vegetation resources is primarily limited to short-term effects during and immediately following construction/ installation activities in the local area and immediately downstream. Implementation of **MM BIO-10** and **MM HYD-1a–MM HYD 1c** address short-term construction-related effects on water quality, whereas implementation of **MM BIO-8** and **MM BIO-9** address restoration of vegetation communities temporarily impacted during construction. On a cumulative scale, the project is one of several actions being implemented throughout the watershed to improve water quality and species habitat within Lagunitas Creek.

3.3.6 Impact Analysis – No Action Alternative

Under this alternative no direct action would occur as a result of the project; therefore, vegetation would not be disturbed. Adverse effects to vegetation related to construction of the proposed project would not occur under this project. Indirect effects related to construction of the proposed project that could include creating a favorable environment for invasive non-native or ruderal plant species that are highly competitive in disturbed environments would also not occur under the No Action Alternative. The No Action Alternative would have no impact in combination with cumulative impacts in the project area. However, the potential benefit where invasive non-native plants are removed during construction and replaced with native plants would also not occur.

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3.4 WILDLIFE

3.4.1 Introduction

The project site is located in the ecologically diverse Northern California Coast Ecological Section, Marin Hills and Valley subsection (Miles and Goudey 1997). This subsection is characterized by mountains and hills with rounded ridges, steep and moderately steep hillsides, and narrow canyons. Dominant regional natural plant communities include redwood forest, Douglas-fir forest, coastal oak woodland, coastal scrub, and grasslands. The climate is temperate, with mean annual precipitation of 47.41 inches and mean annual temperatures ranging from a high of 70.5°F to a low of 45.0°F (Western Regional Climate Center 2013).

3.4.2 Regulatory Framework

Federal

Migratory Bird Treaty Act

Migratory birds are protected by USFWS under the provisions of the Migratory Bird Treaty Act of 1916, as amended (16 U.S.C. Chapter 7, 703–712), which governs the taking, killing, possession, transportation, and importation of migratory birds, their eggs, parts, and nests. The take of all migratory birds is governed by the Migratory Bird Treaty Act's regulation of taking migratory birds for educational, scientific, and recreational purposes and requiring harvest to be limited to levels that prevent over utilization. Executive Order 13186 (signed January 10, 2001) directs each federal agency taking actions that would have or would likely have a negative impact on migratory bird populations to work with USFWS to develop a Memorandum of Understanding to promote the conservation of migratory bird populations. Protocols developed under the Memorandum of Understanding must include the following agency responsibilities:

- Avoid and minimize, to the extent practicable, adverse impacts on migratory bird resources when conducting agency actions.
- Restore and enhance habitat of migratory birds, as practicable.
- Prevent or abate the pollution or detrimental alteration of the environment for the benefit of migratory birds, as practicable.

The executive order is designed to assist federal agencies in their efforts to comply with the Migratory Bird Treaty Act; it does not constitute any legal authorization to take migratory birds. Take, under the Migratory Bird Treaty Act, is defined as the action of, or an attempt to, pursue, hunt, shoot, capture, collect, or kill (50 CFR 10.12). The definition includes "intentional" take

(take that is the purpose of the activity in question) and “unintentional” take (take that results from, but is not the purpose of, the activity in question).

NPS Management Policies 2006

The following excerpt from the NPS Management Policies 2006 applies to the proposed project:

> The National Park Service will preserve and protect the natural resources, processes, systems, and values of units of the national park system in an unimpaired condition to perpetuate their inherent integrity and to provide present and future generations with the opportunity to enjoy them.

Local

3.4.3 Affected Environment

The project area consists of riverine and riparian habitat that supports a variety of wildlife species. Special-status wildlife species and aquatic wildlife species likely to occur within the project site are addressed in Section 3.2, Special-Status Species. Common terrestrial wildlife species that were not included in those analyses but are likely to occur within the project area include species such as black-tailed deer (*Odocoileus hemionus columbianus*), dusky-footed woodrat (*Neotoma fuscipes*), raccoon (*Procyon lotor*), North American opossum (*Didelphis virginiana*), coyote (*Canis latrans*) and striped skunk (*Mephitis mephitis*). Numerous bird species including riparian species, waterfowl and raptors have potential to occur in the project area as well. Common aquatic species occurring in Lagunitas Creek include Pacific lamprey (*Entosphenus tridentatus*), several species of sculpin (*Cottus* spp.), Sacramento sucker (*Catostomus occidentalis*), threespine stickleback (*Gasterosteus aculeatus*), California giant salamander (*Dicamptodon ensatus*), and rough-skinned newt (*Taricha granulosa*).

3.4.4 Methodology

For the purposes of this chapter, the following parameters have been used to evaluate the consequences of the project on wildlife:

- The spatial distribution of the species affected
- The proportion of the species range, affected by the action
- The life history of the species, and response to disturbance (if known)

3.4.5 Impact Analysis – Proposed Project

Beneficial Effects

The proposed project has been designed to modify hydrologic conditions within the subject reach of Lagunitas Creek to enhance existing floodplain and side channels, and facilitate more frequent inundation of those features. More frequent inundation of those channels is expected to provide more winter habitat for coho salmon and steelhead trout. This is a beneficial effect for those species and is addressed in Section 3.2. Other fish and aquatic wildlife could also use the additional winter habitat. The modification of the stream is likely to have limited direct effects on other wildlife populations, but the resulting restoration of coho salmon and steelhead trout populations could constitute a permanent (but less than significant) beneficial effect for wildlife species that could predate coho or steelhead (e.g., sculpin, North American river otter (*Lontra canadensis*), waterfowl, and belted kingfisher (*Megaceryle alcyon*)).

Adverse Effects

The proposed project would result in temporary impacts to wildlife as a result of construction. Construction impacts would include disturbance of riparian habitat for construction equipment access routes and staging areas, and construction noise. Temporary loss of habitat for construction access and staging areas would constitute a very limited effect. The area impacted would be relatively small and all cleared or graded areas would be replanted after construction as described in **MM BIO-8** (see Section 2.6, Mitigation and Monitoring, for text of mitigation measures). Impacts related to construction noise would be limited. Noise effects would be limited to the duration of construction and construction would be timed to avoid periods of high sensitivity for wildlife (such as breeding, nesting, and early development). Implementation of **MM BIO-6** would avoid impacts to nesting birds. Implementation of **MM BIO-7** would avoid impacts to roosting bats and bat maternity sites. Indirect adverse effects on wildlife species could include impacts to water quality during construction. However, these effects would be minimized by the clear-water creek diversion program described in Chapter 2, Project Description (see also Appendix D) as well as **MM HYD-1c**. Implementation of **MM BIO-10** (construct during the late summer/fall), **MM HYD-1a** (stormwater and erosion control BMPs), and **MM HYD-1b** (spill prevention and countermeasure plan) would also minimize water quality indirect effects to wildlife species. These effects are considered less than significant.

Cumulative Effects

Specific projects that may occur in the general area are identified in Chapter 2, Table 2. At this time it does not appear that any of the named cumulative projects are scheduled in such a way as to have significant cumulative impacts on wildlife combined with the proposed project. Like the proposed project, projects on adjacent facilities or trails would be timed to avoid sensitive periods for wildlife and would be limited in duration; therefore, the cumulative effects would remain limited. In addition, the mitigation measures proposed for this project in combination with similar (primarily construction) mitigation included in other projects will avoid cumulative adverse impacts.

Conclusion

The project's effects on wildlife resources would be primarily localized and beneficial in the long term, because it implements strategies to control long-term channel incision and to restore natural hydrology and species habitat. The potential for adverse effects to wildlife resources would be primarily limited to short-term effects during and immediately following construction/installation activities in the local area and immediately downstream. Implementation of **MM BIO-9** and **MM HYD-1a** through **MM HYD-1c** addresses short-term construction-related effects on water quality, whereas implementation of **MM BIO-8** addresses restoration of the areas wildlife communities might use and that would be temporarily impacted during construction. On a cumulative scale, the project is one of several actions being implemented throughout the watershed to improve water quality and species habitat within Lagunitas Creek.

3.4.6 Impact Analysis – No Action Alternative

Under this alternative, no direct action would occur as a result of the project. Construction-related disturbances required for engineered log structure installations and floodplain enhancements would be avoided under the No Action Alternative. Flow and floodplain conditions of the creek would remain the same as under current conditions.

3.5 CULTURAL RESOURCES

3.5.1 Introduction

Native American settlement, European exploration, and eventual colonization by Spaniards and Americans in Marin County left a legacy of important archaeological and historic resources. The NPS Cultural Resources Management Guidelines (NPS 1998) recognizes five types of cultural resources: archaeological resources, historic structures, ethnographic resources, cultural landscapes, and museum objects. At least 124 Native American archaeological sites exist within Point Reyes National Seashore, primarily on the coastal lowlands. These known prehistoric sites are primarily shell middens, voluminous deposits of rich organic soil with a relatively high content of local shell, created by human habitation of the site. The park also has 92 historic terrestrial archaeological sites. These sites typically reflect historic occupation and use of the peninsula, first by homesteaders and dairy ranch communities, and later by government lighthouse and lifesaving personnel and private radio telecommunications companies.

3.5.2 Regulatory Framework

Antiquities Act of 1906

The Antiquities Act (PL 59-209, 34 Stat. 225, 16 U.S.C. 432, and 43 CFR, Part 3) provides for the protection of historic or prehistoric remains, "or any antiquity," on federal lands. It protects historic monuments and ruins on public lands. It was superseded by the Archaeological Resources Protection Act (1979) as an alternative federal tool for prosecution of antiquities violations in the national park system.

Archaeological Resources Protection Act of 1979

The Archaeological Resources Protection Act (PL 96-95, 93 Stat. 712, 16 U.S.C. 470aa et seq., and 43 CFR, Part 7, subparts A and B; 36 CFR) secures the protection of archaeological resources on public or Native American lands and fosters increased cooperation and exchange of information between private and government landholders and the professional community in order to facilitate the enforcement of resource protection and the education of present and future generations. The act regulates excavation and collection on public and Native American lands. Prior to issuance of a permit, it requires notification of Native American tribes who may consider a site of religious or cultural importance. The act was amended in 1988 to require the development of plans for surveying public lands for archaeological resources and systems for reporting incidents of suspected violations.

National Historic Preservation Act of 1966, as amended

The National Historic Preservation Act (PL 89-665, 80 Stat. 915, 16 U.S.C. 470 et seq., and 36 CFR 18, 60, 61, 63, 68, 79, and 800) requires agencies to take into account the effects of their actions on properties listed in or eligible for listing in the National Register of Historic Places. The Advisory Council on Historic Preservation has developed implementing regulations (36 CFR 800) that allow agencies to develop agreements for consideration of these historic properties. NPS, in consultation with the Advisory Council on Historic Preservation, the California State Historic Preservation Officer, American Indian tribes, and the public, has developed a Programmatic Agreement for operations and maintenance activities on historic structures. This 1995 Programmatic Agreement (available on the web at http://www.achp.gov/npspa1.html) provides a process for compliance with National Historic Preservation Act and includes stipulations for identification, evaluation, treatment, and mitigation of adverse effects for actions affecting historic properties.

American Indian Religious Freedom Act

The American Indian Religious Freedom Act (PL 95-341, 92 Stat. 469, 42 U.S.C. 1996) declares it official policy to protect and preserve the inherent and constitutional right of the Native American, Eskimo, Aleut, and Native Hawaiian people to believe, express, and exercise their traditional religions. The act provides that religious concerns should be accommodated or addressed under the National Environmental Policy Act or other appropriate statutes.

3.5.3 Affected Environment

All sites but Site 9 are located within the boundaries of the Olema Valley/Lagunitas Loop Ranches Historic District, determined eligible for the National Register of Historic Places (Neubacher 2008). Site 9 is 140 meters (460 feet) west of the Historic District. Sites 7, 8, and 9 (Olema Creek Site) and Site 10 (the Tocaloma Floodplain Site) are within the boundaries of the McIsaac Ranch, and project Sites 3, 4, 5, and 6 are within the boundaries of the Neil McIsaac Ranch. The North Pacific Coast Railroad (P-21-000487) is considered a contributor to this district. The Cross Marin Trail follows the North Pacific Coast Railroad grade and the trail's paved path would be used to access project Sites 3–6.

Contributing features to the McIsaac Ranch located within the current study area include the buildings, corrals, and structures that are part of the main ranch complex; the Tocaloma Bridge; a water tank; the McIsaac Ranch concrete pads; the McIsaac Ranch Watering Troughs; and the McIsaac Ranch Roads (P-21-02681). The Tocaloma Bridge would be used to access project Sites 3–6 and the McIsaac Ranch Watering Troughs (Engel 2011a) are located in the Tocaloma Floodplain project area.

The Cross Marin Trail follows the alignment of the North Pacific Coast Railroad, segments of which have been documented throughout Sonoma and Marin Counties (Goodsell 2014). The section of railroad grade that would be used for access has been converted to a paved trail, and the railroad alignment is the only aspect of this resource that remains intact in this segment. The Tocaloma Bridge would be used to access the Cross Marin Trail from Platform Bridge Road, and is considered a historic property by NPS (Engel 2011b).

A portion of the McIsaac Watering Trough Features site and the associated concrete pad are located within the Tocaloma Floodplain project area. These features are considered contributing features of the McIsaac Ranch, part of the Olema Valley/Lagunitas Loop Ranches Historic District. One hundred feet of the concrete slab is in the area proposed for equipment travel and the watering troughs are located approximately 50 feet west of a high-flow channel excavation area.

No other resources or properties were identified in the current project area as a result of this investigation.

3.5.4 Methodology

During the spring of 2015 and the summer of 2016, the Humboldt State University Cultural Resources Facility conducted cultural resources investigations for the proposed Lagunitas Creek Winter Habitat Enhancement Implementation project to identify and record cultural resources that could be affected by implementation of the project (Salisbury and Roscoe 2015, 2016). In order to complete this investigation, the Cultural Resources Facility conducted correspondence with the Native American Heritage Commission, local Native American tribal representatives, and other interested parties.

A pedestrian field survey and a project area record search at the California Historical Resources Information System Northwest Information Center in Rohnert Park California were also completed.

Possible impact to cultural resources may include actions that could do the following:

- Fail to conform to NPS Management Policies or Director's Orders
- Cause direct or indirect adverse effects to properties listed or eligible for listing on the National Register of Historic Places or the California Register of Historical Resources, or that contribute to a National Historic Landmark District
- Violate laws relating to archaeological and ethnographic sites
- Change established recreational, educational, religious, or scientific uses of the project area
- Alter aesthetic resources or viewsheds in the project area

At this time, no further cultural resource studies for the proposed project are recommended.

3.5.5 Impact Analysis – Proposed Project

Beneficial Effects

The project is not designed to specifically focus on, restore, or otherwise benefit cultural resources.

Adverse Effects

Most of the potential for impact to cultural resources from creek enhancement projects comes from disturbance of soils during manual or mechanical removal. The use of heavy equipment to dig or otherwise move soils on the site or along access paths could unearth or partially uncover subsurface or surface archaeological or historic resources. Impacts such as these would be mitigated by **MM CUL-1** and **MM CUL-2** (see Section 2.6, Mitigation and Monitoring, for text of mitigation measures), which include strict requirements for contractors to cease work if any potential resources are encountered and for the use of fencing or other protective measures to shield existing resources.

The Cross Marin Trail follows the alignment of the North Pacific Coast Railroad, segments of which have been documented throughout Sonoma and Marin Counties (Goodsell 2014). The section of railroad grade that would be used for access has been converted to a paved trail, and the railroad alignment is the only aspect of this resource that remains intact in this segment. The Tocaloma Bridge may be used to access the Cross Marin Trail from Platform Bridge Road and is considered a historic property by NPS (Engel 2011b). Proposed project activities would not change or impact these resources, nor would they cause an adverse effect to these historic properties.

A portion of the McIsaac Watering Trough Features site and the associated concrete pad are located within the Tocaloma Floodplain project area. These features are considered contributing features of the McIsaac Ranch, part of the Olema Valley/Lagunitas Loop Ranches Historic District (Salisbury and Roscoe 2015). One hundred feet of the concrete slab is in the area proposed for equipment travel and the watering troughs are located approximately 50 feet west of the high-flow channel excavation area (Figure 11). All of the McIsaac Ranch features would remain intact and unaltered as a result of project implementation of **MM CUL-1**.

Cumulative Effects

In general, the proposed actions would contribute very little to overall park trends in cultural resource integrity. The other projects described in Chapter 2, Project Description, Table 2, do not involve significant cultural resource impacts, and mitigation proposed for this and other projects would protect the specific resources in the project area from inadvertent impacts, thus protecting the overall Historic District.

Conclusion

Although site surveys for cultural resources did not document the presence of cultural resources in the area, the potential for the proposed actions to encounter such resources remains. However, the implementation of **MM CUL-1** and **MM CUL-2** would ensure that project actions are not likely to affect cultural resources in the short or long term.

3.5.6 Impact Analysis – No Action Alternative

Under the No Action Alternative, there would be no activities on site and as such there would be no construction-related or cumulative impacts to cultural resources.

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3.6 VISITOR EXPERIENCE AND RECREATION

3.6.1 Introduction

National parks are valued for the recreational and aesthetic resources they provide to the public, both visitors and nearby residents. Park visitors expect national parks to provide beauty, a sense of quiet, and opportunities for hiking, bird-watching, and other recreational pursuits. With more than 50% of its lands in public ownership or conservation easement, Marin County is one of the leaders in the San Francisco Bay region in terms of protecting open space and providing access to both residents and visitors. Some of the largest tracts of undeveloped land within the county are its national parks, including the north district of Golden Gate National Recreation Area.

3.6.2 Regulatory Framework

The NPS 2006 Management Policies emphasizes that "providing opportunities for appropriate public enjoyment is an important part of the Service's mission" (NPS 2006, Section 8.1). Specifically, a key principle of the 2006 Management Policies is to "employ a tone that leaves no room for misunderstanding the National Park Service's commitment to the public's appropriate use and enjoyment, including education and interpretation, of park resources, while preventing unacceptable impacts."

In some instances, public access is not allowed on all areas of NPS lands (e.g., working ranch lands). However, based on the guidance documents discussed above, NPS requires that walks or paths that connect to accessible features need to be made accessible and that key features in the park need to be made accessible. However, paths need to be kept consistent with preserving the natural and cultural resources of the park, if the same experience can be provided on some portion of the alignment or a different trail. California has also developed handicap access standards through California Building Code, Title 24 regulations, although the Title 24 standards are intended for urban facilities and not necessarily rural and park-type trails.

3.6.3 Affected Environment

The Cross Marin Trail through Golden Gate National Recreation Area and Samuel P. Taylor State Park features a mostly shaded, paved multiple-use path that winds along Lagunitas Creek. The Cross Marin Trail is an easy 4-mile path (one way) from Tocaloma to the main picnic area in Samuel P. Taylor State Park. It is a level path that winds through riparian habitat, and the combination of creek and trees makes this a popular family-friendly trail for hiking and biking. The trail provides a safe and enjoyable way for visitors to access Lagunitas Creek and the redwood groves that have made the park so popular. Other trails that connect to the Cross Marin Trail are as follows: Ox Trail, South Creek Trail, North Creek Trail, and Pioneer Tree Trail. The Cross Marin Trail runs adjacent to the section of Lagunitas Creek for project Sites 3–6 only. At

Sites 7–10, there are no publicly accessible trails. The unpaved road that is the old railroad grade that runs parallel to Lagunitas Creek, on the west side of the creek, adjacent to Sites 7, 8, and 10, is not open to the public for use. There are no trails in the vicinity of Site 9 on Olema Creek.

3.6.4 Methodology

Impacts on visitor experience and recreation were determined through an assessment of changes in access to park uses and potential change in quality of visitors' experiences while undertaking popular activities within the project vicinity. Short-term impacts would be related to construction activities. Long-term impacts would result from any permanent changes in access to recreation activities and the types of activities available in the project area. Beneficial impacts would result from improvements in access to activities or the enjoyment associated with visitor activities. Adverse impacts would result from reduction in access to visitor activities, reduction in the range of activities, or changes that would reduce visitor enjoyment.

3.6.5 Impact Analysis – Proposed Project

Adverse Effects

The Cross Marin Trail is used by hikers, bicyclists, and equestrians. During project construction (primarily in August and September), visitors could be excluded from areas where heavy equipment is in use, but not excluded from using the Cross Marin Trail. The segment of the trail at the project site would not be closed for public use during construction but some limited control of access may be needed, at certain times of the day causing minor detours or short delays in access. Because the expected delays of visitor access along the Cross Marin Trail would be brief, there would be no long-term impact on other recreational facilities.

Use of the other segments of the Cross Marin Trail or other nearby trails could increase during the project construction period; however, the increase would not be permanent and would not result in significant crowding or substantial physical deterioration of the other trails. In addition, the proposed project does not affect other recreational facilities outside of the Cross Marin Trail and would not cause a permanent increase in the use of other existing recreational facilities.

In addition, visitors may experience short-term adverse effects from noise and visual intrusions due to equipment use. However, due to the short-term nature of the project activities, the impacts would be less than significant.

The proposed project would not encroach on high fire threat areas, because restoration locations are within Lagunitas Creek. Additionally, although machinery could be a source of sparks or fire, proposed minimal short-term use of such vehicles leaves a low potential to generate fires. The potential for encounter hazardous materials in soil and water is low, and proposed construction activities are not considered a potential source of significant levels of hazardous materials exposure for the project sites.

Cumulative Effects

It is possible that small restoration projects in the region could occur in the same time frame as this project. However, like the proposed project, the projects described in Chapter 2, Project Description, Table 2, would not result in significant long-term impacts to any recreational opportunities or threats to public safety. As such, when considered with other projects within the region, the project's contribution would not be cumulatively considerable.

Conclusion

The project's effects on the recreational experience would be localized and short term and would be beneficial in the long term because it implements strategies to reintroduce natural elements through strategic placement of large woody debris. The potential for adverse effects to the recreational experience is primarily limited to short-term effects during and immediately following construction/installation activities in the local area.

3.6.6 Impact Analysis – No Action Alternative

Under the No Action Alternative, there would be no activities on site and as such there would be no construction-related or cumulative impacts to visitor experience or recreation.

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CHAPTER 4
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CHAPTER 5
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