Watsonville Slough Ecosystem Restoration Project

NEPA Identification Code: EAXX-202-00-L3P-1727857596

Continuing Authorities Program Section 1135

Draft Detailed Project Report and Environmental Assessment

July 2025

US Army Corps of Engineers ®
San Francisco District

Pajaro Storm Drain Maintenance District Within Santa Cruz County

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DRAFT FINDING OF NO SIGNIFICANT IMPACT

Watsonville Slough Continuing Authorities Program Section 1135 Project
Santa Cruz County, California

The U.S. Army Corps of Engineers, San Francisco District (USACE) has conducted an environmental analysis in accordance with the National Environmental Policy Act of 1969, as amended. The Final Detailed Project Report and Environmental Assessment (DPR/EA) dated **DATE OF DPR/EA**, for the Watsonville Slough Continuing Authorities Program Section 1135 Project addresses ecosystem restoration opportunities and feasibility in the Santa Cruz County, California.

The Final DPR/EA, incorporated herein by reference, evaluated various alternatives that would restore the Watsonville Slough and its marsh from historic degradation caused by the USACE flood control project and associated agricultural reclamation to a more natural, less degraded condition in the study area. The Tentatively Selected Plan is the National Ecosystem Restoration (NER) Plan, which includes:

> Crossing improvements at West Beach Road on Watsonville Slough, which would support higher-capacity, fish-friendly culvert(s) that will accommodate the closed-lagoon water levels compared with the existing series of closed conduit culverts; raise an approximately 1,300 linear feet (LF) of W. Beach Road from the existing elevation to accommodate the new culvert(s); restoration measures such as invasive plant removal and native planting on both County- and State-owned land parcels; installation of a new flap gate on the adjacent Beach Road Agricultural Ditch to prevent the higher lagoon water levels from moving upstream; raise surface elevation of a parking lot at Palm Beach State Park to prevent nuisance flooding due to an increased mechanical breaching threshold, which is a critical part of restoration of natural mash hydrology; and installation of interpretive signage both in English and Spanish, which would inform locals and visitors to the Palm Beach State Park of the benefits of the wetland restoration.

In addition to a "no action" plan, two action alternatives were evaluated. The alternatives included: crossing improvements at W. Beach Road and restoration measures on State-owned parcel only (Alternative 4) and crossing improvements at W. Beach Road and restoration measures on both State- and County-owned parcels (Alternative 5; Tentatively Selected Plan). These alternatives are described in more detail in Section 3.9 of the DPR/EA.

For all alternatives, the potential effects were evaluated, as appropriate. A summary assessment of the potential effects of the Tentatively Selected Plan are listed in Table 1:

Table 1: Summary of Potential Effects of the Tentatively Selected Plan

	Beneficial effects	Insignificant effects	Insignificant effects as a result of mitigation*	Resource unaffected by action
Aesthetics	☐	☒	☐	☐
Air quality	☐	☒	☐	☐
Aquatic resources/wetlands	☒	☐	☐	☐
Invasive species	☒	☐	☐	☐
Fish and wildlife habitat	☒	☐	☐	☐

	Beneficial effects	Insignificant effects	Insignificant effects as a result of mitigation*	Resource unaffected by action
Threatened/Endangered species/critical habitat	☒	☐	☐	☐
Historic properties	☐	☐	☐	☒
Other cultural resources	☐	☐	☐	☒
Floodplains	☒	☐	☐	☐
Hazardous, toxic & radioactive waste	☐	☐	☐	☒
Hydrology	☒	☐	☐	☐
Land use	☐	☐	☐	☒
Navigation	☐	☐	☐	☒
Noise levels	☐	☒	☐	☐
Public infrastructure	☒	☐	☐	☐
Socioeconomics	☐	☐	☐	☒
Community impacts	☒	☐	☐	☐
Soils	☐	☒	☐	☐
Tribal trust resources	☐	☐	☐	☒
Water quality	☐	☒	☐	☐
Climate and weather	☒	☐	☐	☐

All practicable and appropriate means to avoid or minimize adverse environmental effects were analyzed and incorporated into the Tentatively Selected Plan. Best management practices (BMPs) as detailed in the DPR/EA will be implemented, if appropriate, to minimize impacts. The Tentatively Selected Plan is eligible for three different programmatic permitting vehicles: [1] National Oceanic and Atmospheric Administration (NOAA) Restoration Center (RC)'s Programmatic Approach to Endangered Species Act (ESA)/Essential Fish Habitat (EFH) Consultation Streamlining for Fisheries Habitat Restoration Projects for South-Central California Coast (S-CCC) Steelhead and Pacific groundfish species and Coastal Pelagic species, [2] State Water Resources Control Board Order called "Clean Water Act Section 401 Water Quality Certification and Waste Discharge Requirements for Restoration Projects Statewide" (WQ 2022-0048-DWQ) and [3] USACE's Nation-Wide Permit (NWP) 27 (Aquatic Habitat Restoration, Establishment, and Enhancement Activities), and all standard protection measures described in the programmatic approach are incorporated into the project description as conditions for the inclusion of this project to the programmatic approach. Section 4.12 of the DPR/EA includes General Protection Measures as well as Avoidance and Minimization Measures to reduce the potential for ancillary impacts to salmonids, other riparian and aquatic species, and their habitats during construction activities.

No compensatory mitigation is required as part of the Tentatively Selected Plan.

Public review of the draft DPR/EA and FONSI was completed on **DATE DRAFT EA AND FONSI REVIEW PERIOD ENDED**. All comments submitted during the public review period of the draft DPR/EA and FONSI will be responded to in the Final DPR/EA and FONSI.

Pursuant to section 7 of the Endangered Species Act of 1973, as amended, the U.S. Army Corps of Engineers determined that the Tentatively Selected Plan will not jeopardize the continued existence of the following federally listed species or adversely modify designated critical habitat: Tidewater Goby because of capture and handling from relocation should that be necessary prior to construction activities. In addition, the Tentatively Selected Plan may affect

but is not likely to adversely affect the following federally listed species or their designated critical habitat for California Red-legged Frog and S-CCC Steelhead. The Biological Assessment for Tidewater Goby and California Red-legged Frog was submitted to U.S. Fish and Wildlife Service (FWS) on June 25, 2025, and FWS concurred with the USACE' determination on **DATE OF CONCURRENCE LETTER**. The application for inclusion of the proposed project in NOAA RC's Programmatic Approach for ESA/EFH compliance was submitted, and the NOAA RC confirmed the eligibility and will provide the ESA/EFH coverage when 65% design is completed during the Design and Implementation (D&I) phase of the project (see Appendix A-7 for more detail).

Pursuant to Section 106 of the National Historic Preservation Act of 1966, as amended, the U.S. Army Corps of Engineers determined that the Tentatively Selected Plan has no effect on historic properties.

Pursuant to the Clean Water Act of 1972, as amended, the discharge of dredged or fill material associated with the Tentatively Selected Plan has been found to be compliant with section 404(b)(1) Guidelines (40 CFR 230). The proposed project would be qualified under USACE's NWP 27 (Aquatic Habitat Restoration, Establishment, and Enhancement Activities). Input and feedback through interagency coordination with the National Marine Fisheries Service (NMFS), FWS and other State agencies have been incorporated into the conceptual design, BMPs and NEPA mitigation measures for the Tentatively Selected Plan. The eligibility evaluation of NWP 27 under Clean Water Act Section 404(b)(1) Guidelines is found in Appendix A-5 of the DPR/EA.

A water quality certification pursuant to section 401 of the Clean Water Act will obtained from the Central Coast Water Quality Control Board prior to construction. Through the initial coordination with the Water Board, they stated that the Tentatively Selected Plan appears to meet the requirements of the Clean Water Act Section 401 Water Quality Certification and Waste Discharge Requirements for Restoration Projects Statewide, pending confirmation based on information to be developed during the D&I phase. All conditions of the water quality certification will be implemented to minimize adverse impacts to water quality.

A determination of consistency with the State of California Coastal Zone Management program pursuant to the Coastal Zone Management Act of 1972 will be obtained from the California Coastal Commission (CCC) prior to construction. The negative determination was submitted to CCC on June 25, 2025. The U.S. Army Corps of Engineers determined that the Tentatively Selected Plan is consistent with state Coastal Zone Management plans (Appendix A-6), pending confirmation based on information to be developed during the D&I phase. All conditions of the consistency determination shall be implemented to minimize adverse impacts to the coastal zone.

Although the proposed project is surrounded by Prime Farmland and Unique Farmland in the study area, it would not cause irreversible conversion of farmland would not occur in accordance with the Farmland Protection and Policy Act. All applicable environmental laws have been considered and coordination with appropriate agencies and officials has been completed.

Technical, environmental, and cost effectiveness criteria used in the formulation of alternative plans were those specified in the Water Resources Council's 1983 Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies. All applicable laws, executive orders, regulations, and local government plans were considered in evaluation of alternatives. Based on this report, the

reviews by other Federal, State and local agencies, Tribes, input of the public, and the review by my staff, it is my determination that the Tentatively Selected Plan would not cause significant adverse effects on the quality of the human environment; therefore, preparation of an Environmental Impact Statement is not required.

_____ _____

Date

Colonel James J. Handura
Colonel, Corps of Engineers
South Pacific Division Commander

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ACRONYMS AND ABBREVIATIONS

AAHU	Average annualized habitat unit
ACE	Annual Chance Exceedance
AMM	Avoidance and Minimization Measures
APE	Area of Potential Effect
AQMP	Air Quality Management Plan
ASACW	Assistant Secretary for the Army for Civil Works
BMP	Best management practices
CAA	Clean Air Act
CAAQS	California Ambient Air Quality Standards
CAP	Continuing Authorities Program
CARB	California Air Resources Board
CCC	California Coastal Commission
CDFW	California Department of Fish and Wildlife
CE/ICA	Cost Effectiveness/Incremental Cost Analysis
CEQA	California Environmental Quality Act
CFR	Code of Federal Regulations
CH4	Methane
CNDDB	California Natural Diversity Database
CNPS	California Native Plant Society
CO_2	Carbon dioxide
CO	Carbon monoxide
CWA	Clean Water Act
dBA	A-weighted decibels
DPR	Detailed project report
DPR/EA	Detailed Project Report and Environmental Assessment
DPS	Distinct population segment
DTSC	Department of Toxic Substances Control
EA	Environmental Assessment
EBM	Ecosystem Benefit Modeling
EFH	Essential fish habitat
EO	Element occurrence
EO	Executive order
EOP	Environmental Operating Principles
EP	Engineering Pamphlet
EQ	Environmental quality
ER	USACE Engineering Regulation
ESA	Endangered Species Act
ESHA	Environmentally sensitive habitat areas
FCA	Flood Control Act
FMP	Fisheries Management plan
FPPA	Farmland Protection Policy Act

FR	Federal Register
FTA	Federal Transit Administration
FWOP	Future without project conditions
FWP	Future with project conditions
FY24	Fiscal Year 2024
GHG	Greenhouse gas emissions
GI	General Investigation
GIS	Geographic Information System
H&H	Hydraulics and hydrology
HH&C	USACE Hydrology, Hydraulics, and Coastal
HIS	Habitat suitability index
HQUSACE	U.S. Army Corps of Engineers Headquarters
HTRW	Hazardous, toxic, and radioactive wastes
HU	habitat unit
IPaC	Information for Planning and Consultation
IPCC	Intragovernmental Panel on Climate Change
LCP	Local Coastal Program
LERRD	Lands, Easements, Rights-of-Way, Relocations, Disposal
LF	Linear feet
LUST	Leaking Underground Storage Tank
MBARD	Monterey Bay Air Resources Board
MBCP	Monterey Bay Community Power
MBTA	Migratory Bird Treaty Act
MMPA	Marine Mammal Protection Act
MSA	Magnuson-Stevens Fishery Conservation and Management Act
MSL	Mean sea level
N20	Nitrous oxide
NAHC	California Native American Heritage Commission
NAVD	North American Vertical Datum
NCCAB	North Central Coast Air Basin
NED	National economic development
NEPA	National Environmental Policy Act
NER	National Ecosystem Restoration
NFS	Non-Federal Sponsor
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural resources conservation service
NRHP	National Register of Historic Places
NSE	Non-Standard Estate
O&M	Operation and maintenance
OMRR&R	Operations, Maintenance, Repair, Replacement, and Rehabilitation
OSE	Other Social Effects

P&S	Plans and specifications
PCEs	Primary constituent elements
PDT	project delivery team
PED	Pre-construction Engineering and Design Phase
PG&E	Pacific Gas and Electric Company
PM	Particulate Matter
ppm	parts per million
PSDMD	Pajaro Storm Drain Maintenance District
PV	Pajaro Valley
QCM	Quantitative Conceptual Model
RE	Real Estate
RED	Regional Economic Development
RM	River mile
ROGs	Reactive organic gases
RSLC	relative sea level change
RWCQB	Regional Water Quality Control Board
S-CCC	South-Central California Coast Steelhead
SHPO	State historic preservation officer
SLF	Sacred Lands File
SLC	Sea level change
SR	State Route
SWRCB	State Water Resources Control Board
TMDL	Total Maximum Daily Load
TSP	Tentatively Selected Plan
USACE	U.S. Army Corps of Engineers
USCS	U.S. Coastal Survey
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
WQC	Water Quality Certification
WRDA	Water Resources Development Act
WSP	Western Snowy Plover
WWW	Watsonville Wetland Watch

1 INTRODUCTION

This document is a draft Detailed Project Report and Environmental Assessment (DPR/EA) for the Watsonville Slough Aquatic Ecosystem Restoration Section 1135 Study under the Continuing Authorities Program (CAP). The purpose of the study is to investigate and determine the extent of federal interest in a plan to restore and/or enhance the aquatic ecosystem along the lower Watsonville Slough in Santa Cruz County, California. The DPR/EA is an integrated document that combines a feasibility study report that describes the planning process pursuant to U.S. Army Corps of Engineers (USACE) planning policy, and the EA prepared in accordance with the National Environmental Policy Act (NEPA) of 1969, as amended (42 U.S.C. § 4321 *et seq*.), and the Department of Defense NEPA Implementing Procedures (DoD NEPA Procedures).

1.1 USACE Planning Process

The USACE's 6-step planning process is a structured approach to problem solving which provides a rational framework for sound decision making. The six steps occur iteratively and sometimes concurrently. Iterations of steps are conducted as necessary to formulate efficient, effective, complete, and acceptable plans, pursuant to requirements of Engineering Regulations (ER) 1105-2-100, Planning Guidance Notebook, portions of which have been superseded by ER 1105-2-103 (Chapters 1-3, November 2023) and EP 1105-2-58 (Appendix F CAP, 2019) and in accordance with the Risk-Informed Planning Manual (2017-R-03).

The feasibility study report presents descriptions of existing and expected future conditions of resources, formulation and evaluation of alternative plans, analyses of plan comparisons based on cost benefits and environmental effects of considered alternatives, and selecting a Tentatively Selected Plan. Each of the six steps in the USACE planning process aligns with one or more NEPA requirements. Pursuant to 42 USC 4336a (d), the EA should briefly discuss purpose and need for the proposed agency action. Pursuant to 42 USC 4332(C)(ii-iv), the EA should include a reasonable range of alternatives; reasonably foreseeable effects of the proposed action, including effects that cannot be avoided (i.e., significant effects); relationship between local short-term uses of the environment and maintenance and enhancement of long-term productivity; and any irreversible and irretrievable commitments of federal resources. Sections of this document denoted with an asterisk (*) in the section headings are required for NEPA compliance. Table 1-1 lists the planning steps, how they align with the NEPA elements, and where they appear in this document.

Table 1-1. Overview of DPR/EA Sections

USACE Planning Steps	Analogous NEPA Requirements	DPR/EA Sections
Identify Problems and Opportunities	Need for Action and Purpose	1.7 and 3.2
Inventory and Forecast Conditions	Affected Environment	2 and 4
Formulate Alternative Plans	Alternatives Including Proposed Action	3.7
Evaluate Alternative Plans	Environmental Consequences	4
Compare Alternative Plans	Alternatives Including Proposed Action	5
Select a Tentatively Selected Plan	Agency Preferred Alternative	5.3 and 6

1.2 Study Authority

This study was conducted under CAP Section 1135 of Water Resources Development Act (WRDA) of 1986 (P.L. 99-662). CAP projects are authorized to plan, design, and implement certain types of water resources projects without additional project-specific authorization. The USACE implementation guidance for CAP Section 1135 projects is contained in Engineering Pamphlet (EP) 1105-2-58, and the federal share of planning, design and implementation (D&I) cannot exceed $15,000,000 per project.

CAP Section 1135 provides for the review and modification of structures and operations of water resources projects constructed by the USACE for the purpose of improving the quality of the environment when it is determined that such modifications are feasible, consistent with the authorized project purposes, and will improve the quality of the environment in the public interest. In addition, if it is determined that a USACE water resources project has contributed to the degradation of the quality of the environment, restoration measures may be implemented at the project site or at other locations that have been affected by the construction or operation of the project, if such measures do not conflict with the authorized project purposes (EP 1105-2-58).

Since the 1930s, most of the original Watsonville Slough channel and tidal marsh system had been reclaimed for agriculture and was further constrained by adjacent residential land use and USACE federal levees which have decreased the total area of the Slough. The levees have isolated the Slough system from most fluvial processes and overflows. The remnant existing marsh plain has areas of robust native marsh, especially in low areas and immediately adjacent to the Slough. Other areas exhibit stunted growth of native species and encroachment by upland non-native weeds, suggesting a truncation of marsh hydrology. Protected species under the federal Endangered Species Act (ESA) such as the South-Central California Coast (S-CCC) Steelhead (*Oncorhynchus mykiss*) and the Tidewater Goby (*Eucyclogobius newberryi*) are negatively impacted by the lack of high-quality tidal marsh and coastal wetland habitat. Native and non-federally listed species are also affected by the lack of quality tidal marsh and coastal wetland habitat.

The nexus of this Watsonville Slough Aquatic Ecosystem Restoration Project to the CAP Section 1135, WRDA 1986 study authority is established by the following reasons:

- Presence of the federal levees allowed the conversion of lands for agricultural purposes, reducing the footprint of the slough/marsh over the years;
- Elimination of the overbank hydraulic connection between the Watsonville Slough and the Pajaro River reduced freshwater inflows into the Slough, resulting in a negative effect on the condition of the Slough and marsh over the years;
- Presence of the federal levees affects the water levels within the lagoon and slough during lagoon closures. Confined within the levee system, the water cannot spread out, resulting in higher water surface levels during backwater events within the slough and between the levees and farm berms, thus requiring mechanical breaching of the lagoon to prevent backwater flooding on critical access roads during heavy rainfalls. The

mechanical breaching of the lagoon has an adverse effect on the hydrologic condition, water quality and protected species under federal ESA within the tidal marsh.

1.3 Lead Federal Agency, Non-federal Sponsor, Cooperating and Participating Agencies*

The USACE San Francisco District is the lead federal agency in partnership with a local non-federal sponsor (NFS), Pajaro Storm Drain Maintenance District (PSDMD) for this CAP Section 1135 Study. In accordance with 42 U.S.C § 4336(a)(a)(3), the USACE invited other federal, state, local agencies, and tribes to be cooperating or participating agencies (see Environmental Appendix A-1 of this document for the project-specific public involvement plan and records of interagency coordination). The U.S. Fish and Wildlife Service (USFWS), National Oceanic and Atmospheric Administration (NOAA) Fisheries and U.S. Environmental Protection Agency (USEPA) participated as NEPA cooperating agencies.

There is also a long history of strong collaboration between state, local, non-governmental organizations, and special districts to advance complex environmental projects within the Watsonville Slough System and the greater Pajaro Valley watershed. Participating agencies include the California State Water Resource Control Board (Water Board), California Coastal Commission (CCC), California State Parks, Resource Conservation District of Santa Cruz County, City of Watsonville, Pajaro Valley Water Management Agency, Watsonville Wetlands Watch, Land Trust of Santa Cruz County, California Department of Fish and Wildlife Service, and others. These agencies and organizations have collaborated as technical advisors on local projects of a similar nature within the County of Santa Cruz since the creation of the Watsonville Slough System Conservation and Enhancement Plan in 2003.

1.4 Study Area*

The study area includes the areas directly and indirectly affected by the study alternatives. For this Watsonville Slough CAP Section 1135 Ecosystem Restoration study, the study area encompasses the lower Watsonville Slough and Pajaro River Lagoon, including extensive farmlands below San Andreas Road on its inland side, and extending to the Pajaro Dunes Community, the sandy beach between the Lagoon and the Pacific Ocean, and the surf zone where the Pajaro River meets the Pacific Ocean on the seaward side (Figures 1-1 and 1-2). Analyses conducted for this study utilized a 2018 LiDAR dataset provided by the local sponsor, which was developed from a 2016 USGS LiDAR dataset and supplemental ground survey data the local sponsor collected in 2018 for a flood vulnerability assessment. The PDT considers this level of information to be sufficient for the feasibility study and anticipates further ground data collection will be conducted in the D&I phase.

The “project area” is defined as the area of direct effects resulting from any project component considered in action alternatives, including areas to be potentially affected by construction activities of project elements and/or operation and maintenance (O&M) of implemented restoration measures for this study. The difference between the study area and project area is further clarified in Section 4.

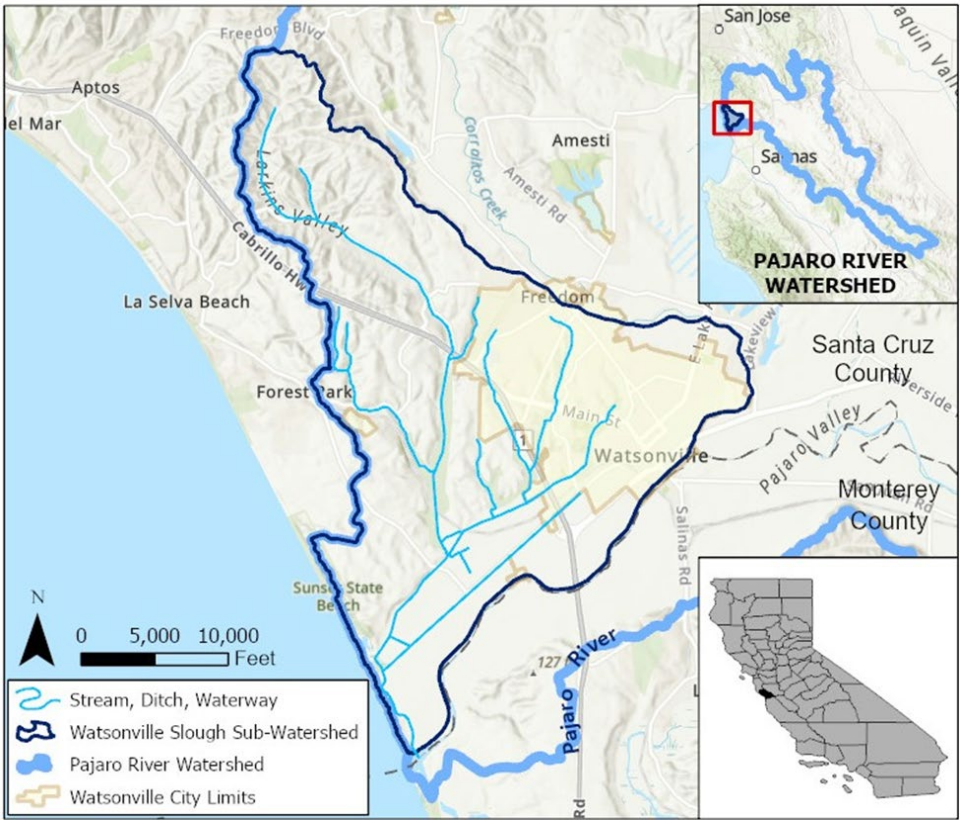


Figure 1-1. Watsonville Slough Locational Map

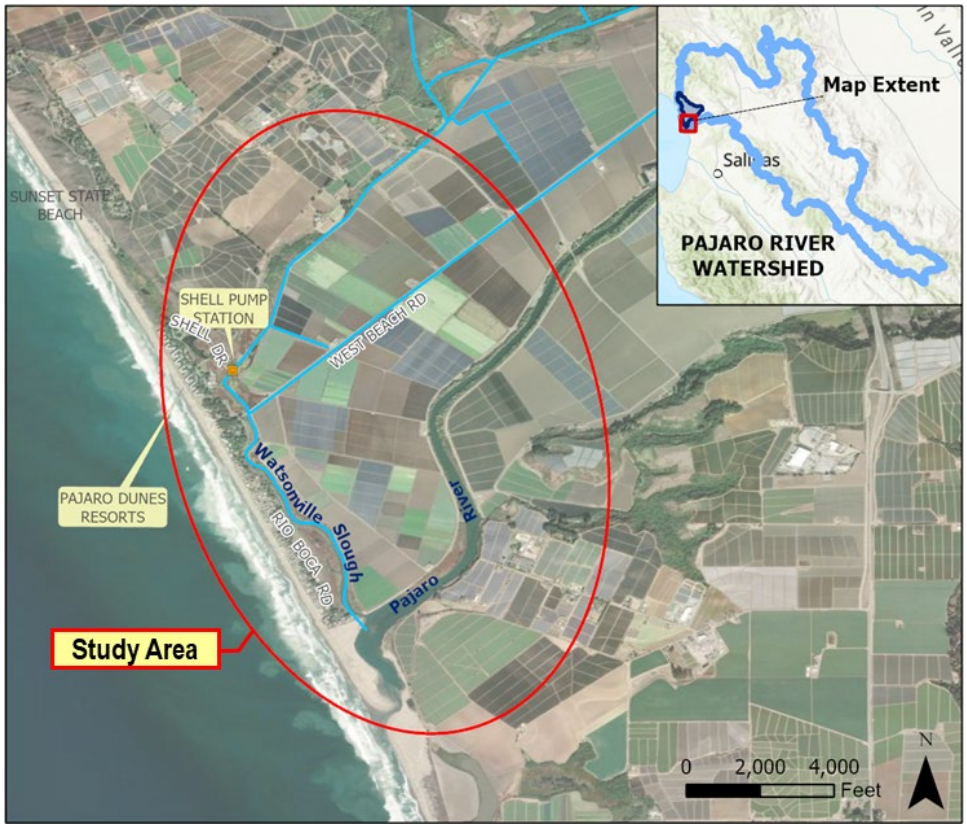
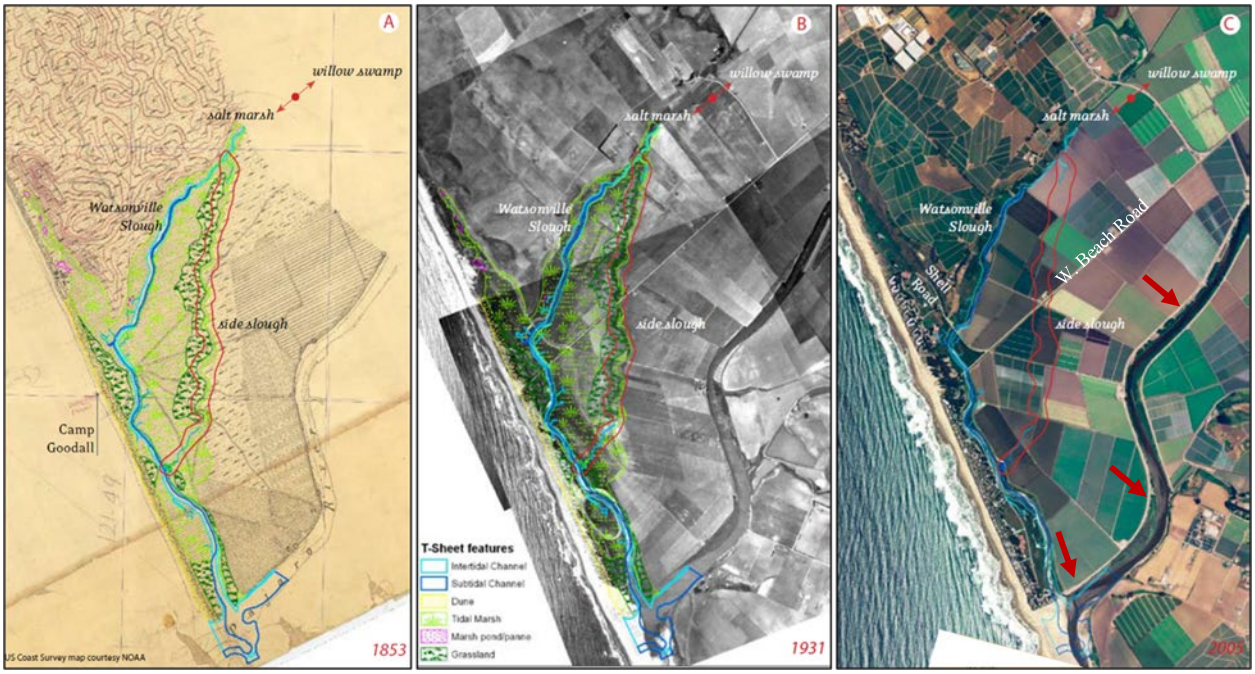


Figure 1-2. Study Area of Watsonville Slough CAP Section 1135 Study

1.5 Background and History

The Watsonville Slough, located within the Pajaro Valley, is the unceded territory of the Mutsun-speaking Calendaruc Tribe. The Amah Mutsun Tribal Band, comprised of the descendants of indigenous people taken to missions Santa Cruz and San Juan Bautista during Spanish colonization of the Central Coast, is today working hard to restore traditional stewardship practices on these lands. Restoration work completed for this study will be done in collaboration with the Amah Mutsun Tribal Band.

The United States Coast Survey (USCS) topographic sheets (T-sheets) mapped extensive tidal marsh, grasslands, dunes, and channels through the lower Watsonville Slough in 1853 (Figure 1-3, Panel A). By the 1930s, much of the wetlands had been reclaimed for agriculture, especially along the east bank of the lower Watsonville Slough (Figure 1-3, Panel B). Although side channels were filled and smoothed, the marshes along the Slough and side slough persisted. The conversion from tidal marsh and grasslands to agriculture was further fortified by the construction of the USACE levee system on the Pajaro River and its tributaries in 1949 (red arrows, Figure 1-3, Panel C).



Source: Adapted from Whipple, A. and Grossinger, R.

Figure 1-3. Historical Changes to Lower Watsonville Slough

In the late 1960s and early 1970s, the 550 condominiums, townhouses and single-family dwellings that make up Pajaro Dunes were built. The development spans 142 acres of oceanfront property on both sides of W. Beach Road (Figure 1-2). The development along the lower Watsonville Slough also created crossings at W. Beach Road and Shell Road. Historical development and land use conversion along the lower marsh and slough system also removed old tidal channels and created berms that impede flows between the slough and the marsh plain, further compromising marsh hydrology.

The constriction of the marsh plain and encroachment of development have proven incompatible with the natural lagoon closures. The fragmentation of the Watsonville Slough watershed reduced water circulation and groundwater recharge, and the introduction of pollutants to the slough has caused the Watsonville Slough to be listed as an impaired waterbody under the federal Clean Water Act (Section 303d) for elevated levels of pesticides, sediment, oils and grease, metals, and pathogens (Swanson Hydrology & Geomorphology 2003). Additionally, with the marsh floodplain confined by levees (both federal and agricultural levees), lagoon closures have led to flooding of infrastructure. Santa Cruz County has been mechanically breaching the seasonal Pajaro River sandbar for flood control purposes since the 1950s. Flooding at the W. Beach Road crossing triggers the need for mechanical lagoon breaching to lower the water levels and preserve vehicle and emergency access to the Pajaro Dunes community and Palm Beach State Park. However, mechanically breaching of the lagoon has truncated inundation period of marshes, resulting in encroachment of non-native and upland species to portions of the marsh.

1.6 Existing Projects, Programs and Studies

1.6.1 Pajaro River Flood Control Project (1949)

The existing USACE Pajaro River flood risk management project was authorized by the Flood Control Act (FCA) of 1944 (Public Law No. 534, 78th Congress, Ch. 665, 2nd Session). In 1949, USACE completed construction of flood control project levees on the Pajaro River and Salsipuedes Creek. The Pajaro levees were constructed from the river mouth up to river mile (RM) 11.8 on the right (north) bank and to RM 10.6 on the left (south) bank (Figure 1-4). The levees on Salsipuedes Creek were constructed from its confluence at the Pajaro River up to RM 2.6 on the right (west) bank and to RM 1.7 on the left (east) bank. At the time of construction, the levees were thought to be able to contain the 2% Annual Chance Exceedance (ACE) or 50-year flood event (i.e., there was a 2% chance in any year that flood flows would overtop the project). However, hydrologic analysis of subsequent floods in 1955 and 1958 indicated that the design capacity of the project as constructed in 1949, was closer to the 8% (12.5-year) ACE flood event on Pajaro River below the Salsipuedes Creek and the 10% (10-year) ACE flood event on Salsipuedes Creek (USACE 2004). In the 1966 FCA (Public Law No. 789, 89th Congress, Section 203, 2nd Session) Congress authorized USACE to improve the existing levee system and construct additional levees on Corralitos Creek, however the 1966 project was never constructed.

1.6.2 Pajaro River at Watsonville Flood Risk Management Project (2019)

In December 2019, USACE completed a reevaluation of the 1966 Pajaro River Flood Control Project authorization. The study recommended levee improvements consistent with those proposed in the 1966 and reaffirmed the authorization with a 2019 Director's Report. The purpose of the Pajaro River Flood Risk Management project is to reduce flood risk to the City of Watsonville, the Town of Pajaro, and surrounding agricultural lands. The project is needed to address the long history of flooding in the Pajaro Valley region. The project is currently in a Pre-construction Engineering and Design (PED) phase, with construction scheduled to proceed in Summer 2025. Figure 1-5 presents the authorized project.

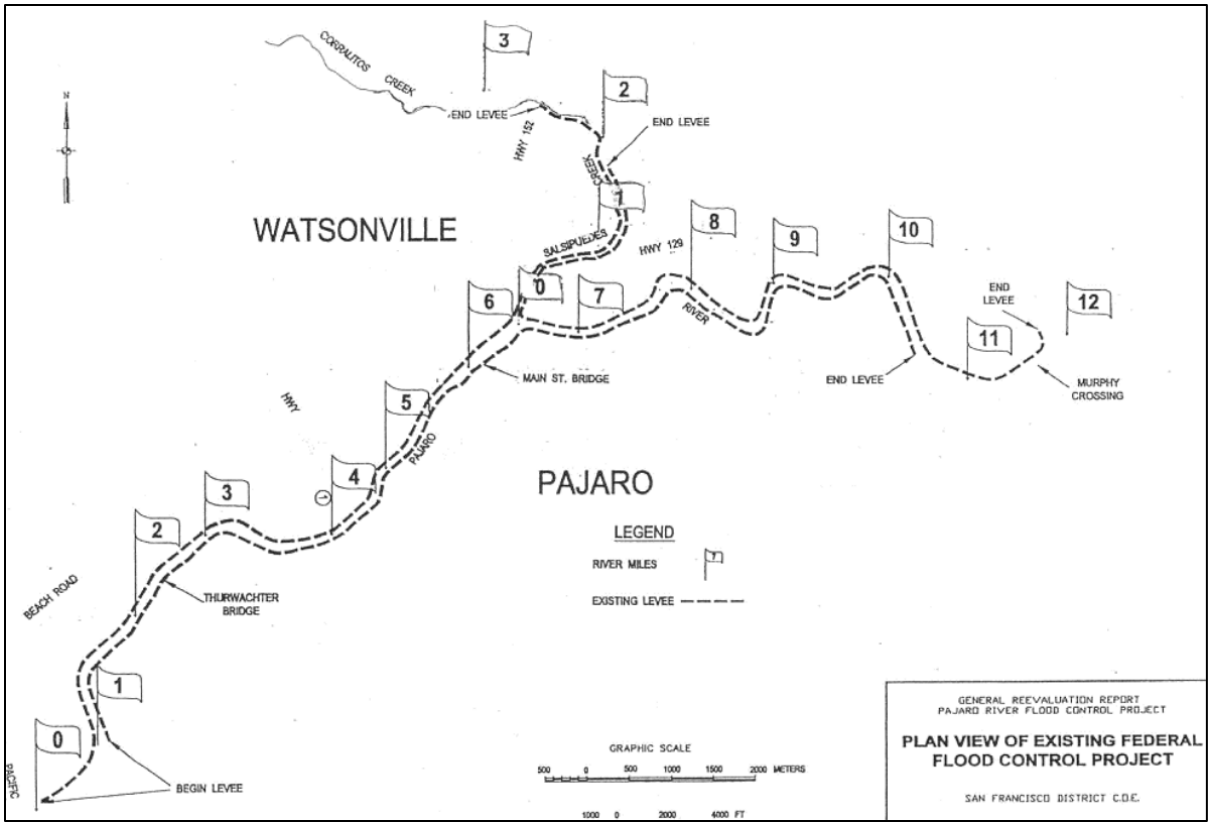


Figure 1-4. Pajaro River Flood Control Project (1949)

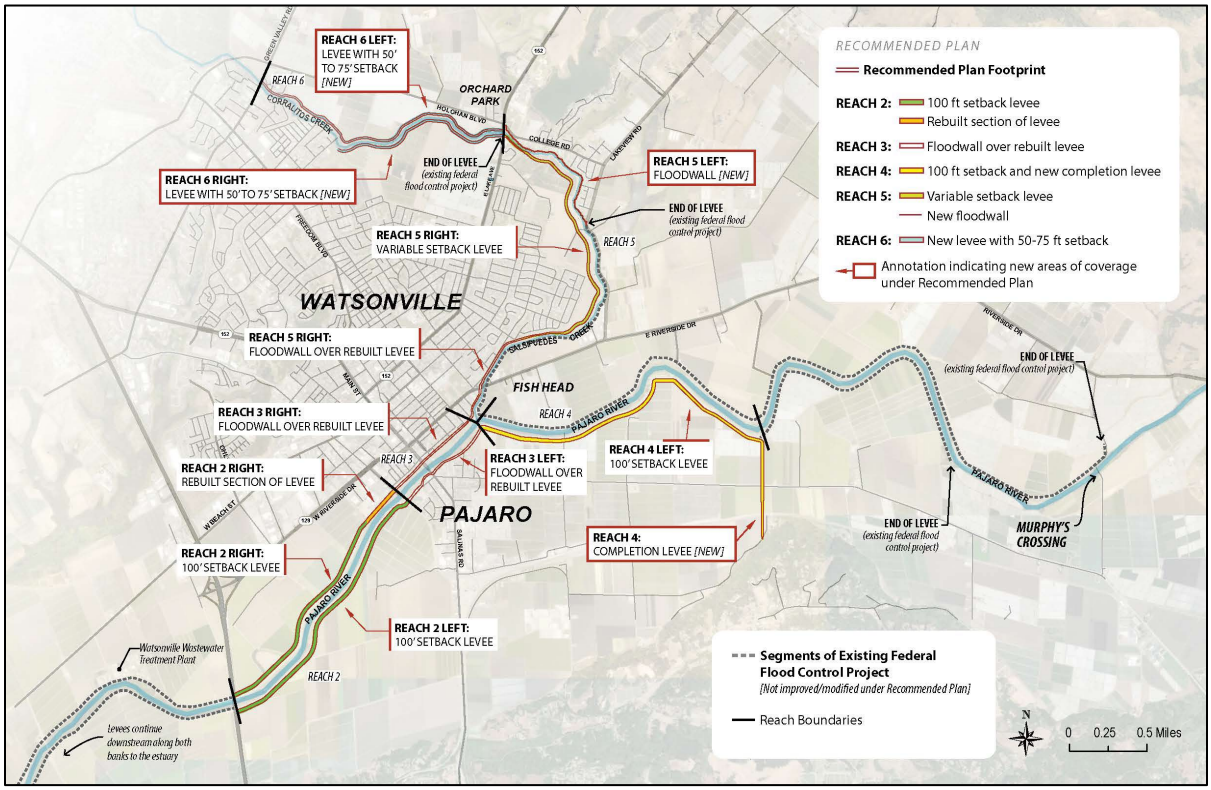


Figure 1-5. Pajaro River at Watsonville Flood Risk Management Project

1.6.3 USACE Pajaro PL 84-99 Right Bank Repairs Project

The project is located in Santa Cruz County in a mixed residential (behind the levees), recreational (trails on top of the levees and channel embankments), and agricultural area (adjacent to some of the levees). Between December 29, 2022, and March 31, 2023, Northern California received a series of heavy rainstorms. During these storms, the Pajaro River experienced severe flooding in the Pajaro River Basin; flooding occurred in Watsonville due to bank overtopping on the Salsipuedes Creek, and the left bank Pajaro River levees breached leading to extensive flooding within the town of Pajaro.

Pursuant to PL 84-99, Flood Control and Coastal Emergencies (FCCE) (33 U.S.C. 701n) (69 Stat. 186) for emergency management activities, the USACE has been repairing levees along the right Salsipuedes Creek and Pajaro River levee banks, and the repair work was complete in December 2024. Five of the sites (Sites A-E in Figure 1-6) are along the Salsipuedes Creek tributary, and seven sites (Sites F-L) are located along the Pajaro River upstream of the Salsipuedes confluence. Repair sites range from approximately 25 ft to 190 ft in length. Seven of the twelve identified repair sites are within the footprint of the planned Pajaro Flood Risk Management Project (see Section 1.6.2 above). Repair Sites A-E are within what has been identified as Reach 5, while repair sites F and G are within the footprint of Reach 4. Reach 5 is currently scheduled for construction in 2026 and Reach 4 is scheduled for construction in 2027.

1.6.4 Pajaro River Lagoon Sand Bar Breaching Project

A sandbar at the Pajaro River mouth generally forms in the late summer or early fall due to wave processes building up a beach berm. Natural breaches often occur during the early winter when higher fluvial flows from the Pajaro or winter waves can breach the sandbar. Based on the historical record of lagoon openings and closures from Santa Cruz County, the lagoon tends to close up to once or twice per year. During some years, ocean wave action and/or river flow is not sufficient to naturally breach the sandbar before flooding may occur. High water levels in the Lagoon can cause localized flooding in the agricultural and residential areas (e.g., Pajaro Dunes residential community) that surround the Lagoon and adjacent sloughs. Flooding can threaten Santa Cruz County roads, emergency access to and from Pajaro Dunes, the sewage collection and delivery network for Pajaro Dunes, as well as electrical infrastructure and property within the community. To prevent this localized flooding, Santa Cruz County initiated a mechanical breaching program in the 1950s (Figure 1-7). Prior to this time, residents were known to perform breaching activities independently (California Coastal Commission 2006).

Breaching of the sand bar occurs when the staff gage at the W. Beach Road crossing at Watsonville Slough reads +4.5 feet mean sea level (MSL) / +8.0 feet NAVD88 and substantial river flows are forecast, or when flooding is evident on W. Beach Road or Shell Road. Mechanical breaching of the sand bar would be timed to take place under the following conditions:

- After high tide has peaked and receded. This allows sufficient time for the river flow to widen and deepen the new breach enough to remain open through subsequent high tides. This also ensures that flood control is achieved while maintaining habitat.

- During daylight hours, to ensure that large waves are visible to minimize danger to the County staff conducting the breaching operation.

Channel excavation generally begins from the ocean side of the sandbar and works towards the Lagoon (USFWS 2016).

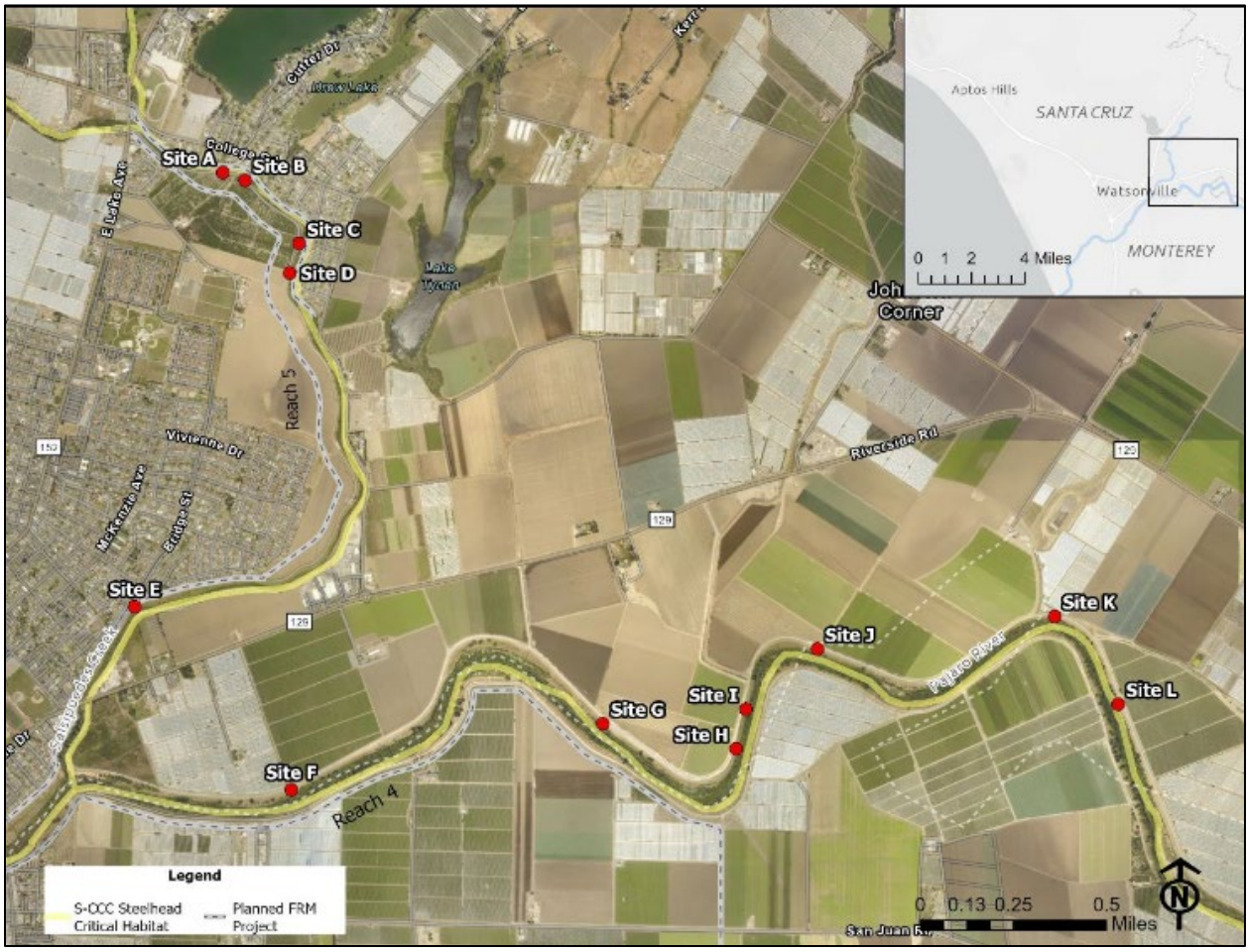


Figure 1-6. Pajaro PL 84-99 Right Bank Repair Sites

Figure 1-7. Pajaro River Lagoon Sand Bar Breaching Site Photos

1.6.5 Other Studies

Other studies have evaluated the Watsonville Slough hydrology and associated flood vulnerability assessments:

- Swanson & Associates, 8 May 1993. Pajaro River Lagoon Management Plan
- 2ndnature, July 2006. Comparative Lagoon Ecological Assessment Project
- Schaaf & Wheeler, 16 March 2007. Pajaro River Breaching Alternatives Analysis Work Program
- Krauss, Patsch, & Munger. Barrier beach breaching from the lagoon side, with reference to Northern California. Shore and Beach Vol. 76, No. 2, Spring 2008
- San Francisco Estuary Institute (SFEI), May 2008. Introduction to the Historical Ecology of the Watsonville Slough Watershed
- Balance Hydrologics Inc., 14 February 2014. Watsonville Sloughs Hydrology Study
- Behrens, Brennan, & Battalio. A quantified conceptual model of inlet morphology and associated lagoon hydrology. Shore & Beach, Vol. 83, No. 3, Summer 2015
- ESA Associates, 27 November 2018. Technical Memorandum: Pajaro Dunes and Lagoon Flood Vulnerability Assessment (ESA 2018)
- USACE, 13 September 2016. Trip Report

1.7 Purpose and Need*

1.7.1 Purpose*

The primary purpose of the CAP 1135 Watsonville Slough Aquatic Ecosystem Restoration study is to identify a technically feasible, economically justified, and environmentally acceptable recommendation to restore the Watsonville Slough and its marsh from historic degradation caused by the USACE flood control project and associated agricultural reclamation to a more natural, less degraded condition.

1.7.2 Need*

The Watsonville Slough system situated adjacent to Monterey Bay is one of the few remaining wetland resources within California Central Coast. Since the substantial changes in land use during European settlement began in the early 1800s, widespread clearing of native vegetation and reclamation of wetlands for agriculture took place, resulting in hydrologic changes and large losses of wetlands and native habitats in the late 1800s and early 1900s. The remaining acres of coastal wetlands are now threatened by continued development, erosion, pollution, and sea level change. With its connectivity of the study area to tidal flows and freshwater from the Pajaro River, Watsonville Slough represents a rare opportunity to restore an important ecological functions.

Tidally influenced sloughs and their associated marshes of the California Coast are the exclusive habitat of several critically endangered species – the Tidewater Goby and steelhead as well as other federally listed wildlife and plant species. The Tidewater Goby and Southern-Central California Coast (S-CCC) Steelhead occur in the study area, and are listed as endangered and threatened, respectively, under the federal ESA due primarily to fragmentation

and loss of habitat. According to USFWS surveys of Tidewater Goby, population numbers have decreased significantly due to a variety of factors, mostly anthropogenic. There is a great deal of interest on the national and local level in restoring coastal marsh habitat in sloughs with the goal of ensuring survival and encouraging stable populations of these species. For example, in 2013, the USFWS developed and adopted the Recovery Plan for Tidal Marsh Ecosystems of Northern and Central California that provides recommendations for restoring populations of these species via restoration of marsh habitat. Similarly, recovery plans for Tidewater Goby and steelhead have also been approved to bring together the best information that is available to aid recovery efforts by local and national organizations. Additionally, other species will benefit from the ecosystem restoration, not just threatened and endangered ones.

1.8 Significance of the Ecosystem Restoration

Environmental restoration is a priority in the USACE budgeting process for Civil Works program. In contrast to more traditional project outputs, many of the outputs of environmental restoration projects cannot be measured in monetary terms. Without the option of quantifying environmental outputs in monetary terms, other criteria must be considered for evaluating and justifying environmental restoration projects. One criterion is the “significance” of the environmental resource(s) associated with such projects. For this purpose, resource significance can be described in terms of institutional, public, and technical significance.

- Institutional significance means that the importance of an environmental resource is acknowledged in the laws, adopted plans, and other policy statements of public agencies, tribes, or private groups. San Francisco/Monterey Bay tidal marsh habitat and the species it supports have substantial institutional significance. The California Red-legged frog (*Rana draytonii*), steelhead, and Tidewater Goby are federally listed under the purview of the federal ESA. Numerous public agencies have developed plans and adopted policies to protect these species and their tidal marsh habitat. The aforementioned Recovery Plan for Tidal Marsh Ecosystems of Northern and Central California provides a regional vision for restoring California’s tidal marsh habitats. Because the objective of this study is to restore tidal marsh and aquatic ecosystem habitat that is essential to the survival of these federally listed endangered species, this project supports institutionally significant resources.

- Public significance means that some segment of the general public recognizes the importance of an environmental resource. There is a large segment of the general public that recognizes the value of restoring tidal marsh for its regional habitat value and for recreational opportunities it provides. The Watsonville Wetlands Watch has identified Watsonville Slough as a site which should be restored and protected. Santa Cruz County Land Trust, the Pajaro Valley Water District, and the residents of the Pajaro Dunes community are also keen on finding a solution whereby the hydrologic regime of the slough can be restored while reducing risk of flooding of the surrounding areas and maximizing habitat benefits for endangered and threatened species.

- Technical significance means that the importance of environmental resources is based on the scientific or technical knowledge or judgment of critical resource characteristics.

Technical significance is demonstrated by the federal ESA listing of the steelhead and Tidewater Goby, which is based on scientific and technical knowledge of the population status, life histories, and threats to these species that is well documented in the scientific literature. Given that the coastal marshes in the California Coast are the only habitat that supports these imperiled species, the USFWS, NMFS and other state and local agencies have concluded that their survival rests in large part on restoring and maintaining this critical resource.

1.9 Study Scope

In coordination with NFS and project stakeholders, the study team formulated and evaluated alternative plans to restore a more natural hydrologic regime and improve tidal marsh and coastal wetland habitat for native, culturally significant, and federally listed species. Technically and economically feasible alternatives that would meet the purpose and need for this feasibility study were evaluated, although alternatives that might be outside the CAP cost limit were initially screened out. This draft DPR/EA is an account of the feasibility study process and findings, including the analysis of how to avoid, minimize, and mitigate impacts resulting from the study alternatives.

1.10 Period of Analysis

The project base year (when the proposed project is expected to be operational) is 2028. The USACE uses a 50-year planning horizon for the evaluation of economic costs and benefits for civil works projects. Therefore, this study assumes a period of analysis from 2028 to 2078 to evaluate alternative plans.

2 AFFECTED ENVIRONMENT*

This section describes existing conditions (i.e., environmental baseline) and future without project (FWOP) conditions of important resources mostly in the study area. The FWOP conditions forecast the future conditions within the study area should the project not be constructed. The forecast of the FWOP condition reflects the conditions expected during the 50-year planning horizon (see Section 1.9), which characterizes the anticipated future effects of the No Action Alternative in NEPA terms. The existing conditions are defined as those at the time the study is being conducted.

In addition, it is anticipated that not all resources would result in changes by the project. For example, hazardous, toxic, and radioactive wastes (HTRW) was not evaluated because there were no HTRW sites within a 5,000-foot search radius from the project area. Therefore, HTRW are not discussed further in this report.

2.1 Geology, Soils and Seismicity

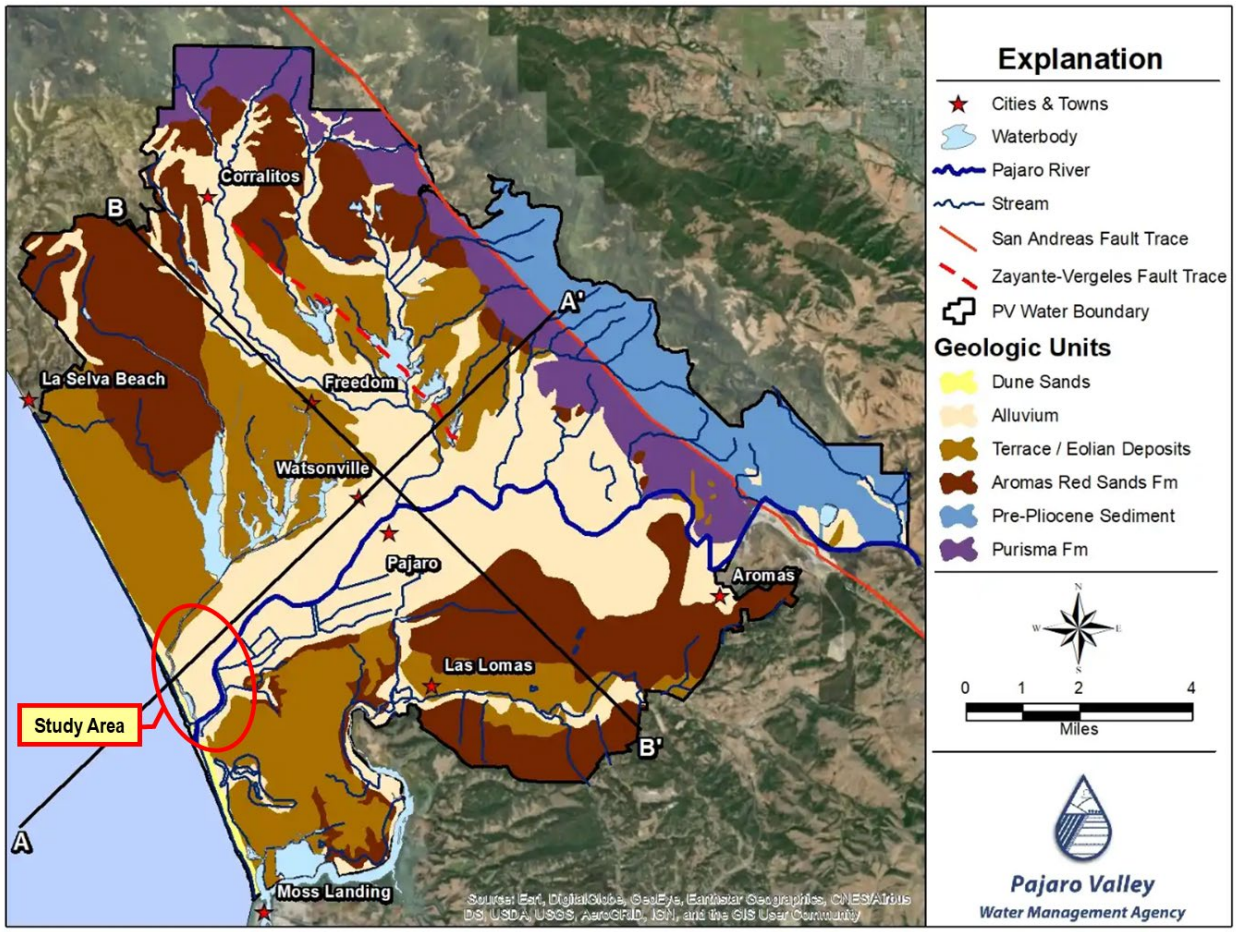
2.1.1 Geology

The Pajaro Valley that encompasses the Watsonville Sloughs watershed is situated within the tectonically active coastal plain area associated with the San Andreas Fault, a major tectonic plate boundary between the Pacific and North American Plates. Uplift of the western edge of the North American plate boundary created the relief between the Santa Cruz Mountains and the shoreline, presently nearly 3,000 feet above sea level (Figure 2-1).

The uplift extended high ground westward toward the coastline, exposing it to erosional forces from the ocean as well as from rainfall and runoff over the land. Over several hundred thousand years, erosion of the land surface, deposition of alluvial deposits, continued uplift of land, and periodic inundations by the ocean left a thick deposit of sediments that now underlay the Watsonville Sloughs watershed (Figure 2-2). These include Quaternary alluvial fan, stream, dune and estuarine deposits, and marine terrace deposits of materials ranging from gravels and unconsolidated sands (notably the Aromas Red Sands) to organic peats. Geomorphic processes of erosion and sediment deposition have worked over thousands of years eroding through the unconsolidated Quaternary deposits and carving the drainage network of the Sloughs visible today (Swanson Hydrology & Geomorphology 2003). The present-day landscape of narrow valleys, low foothills and terraces formed over 5,000 years ago. The flat-valley floors and organic peat soils indicate that soils were formed in quiet marsh areas, with little mineral sediment input, after the valley was originally formed (PV Water 2024).

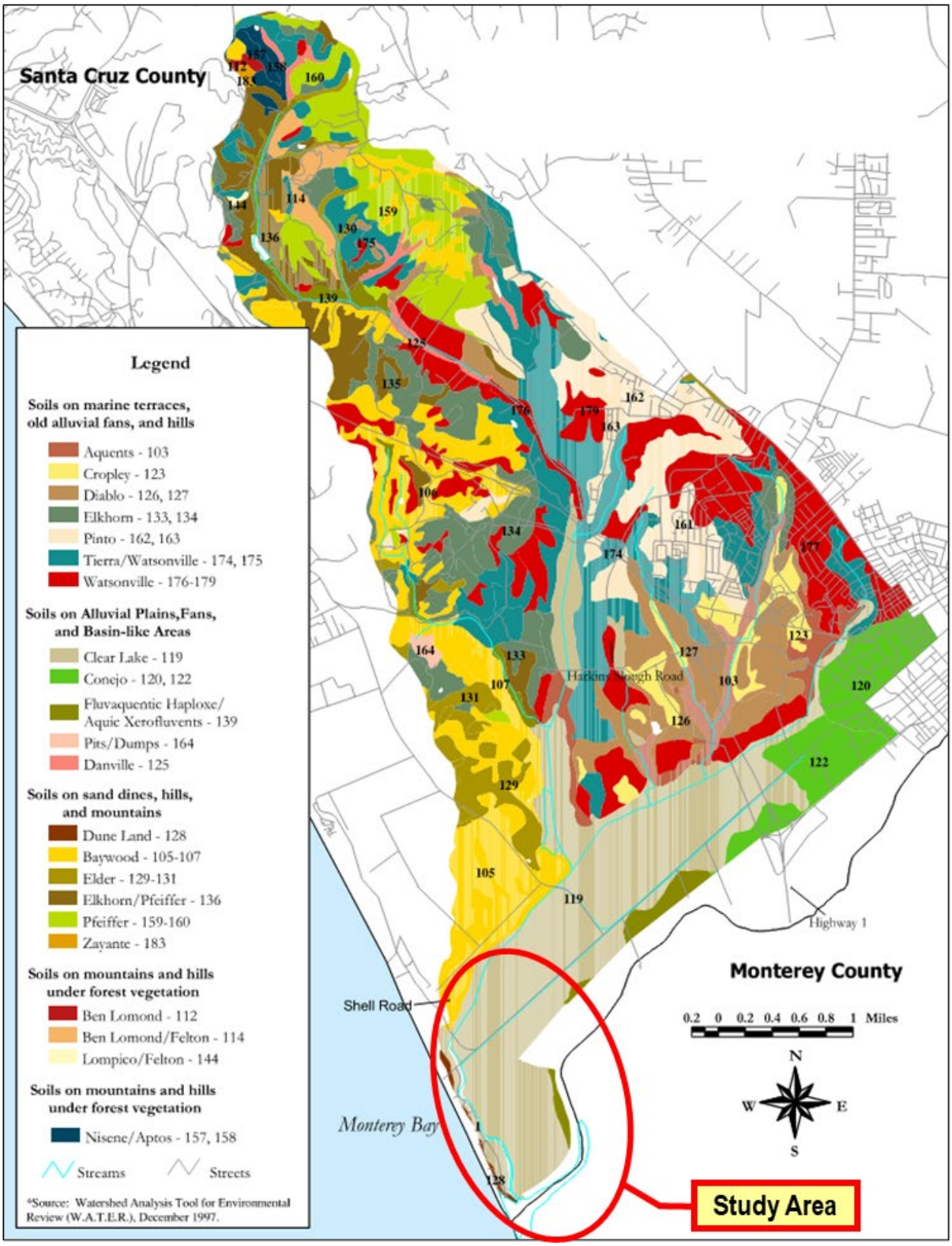
The lower reach of Watsonville Slough in which the study area is located, has been greatly influenced by erosion, sediment deposition and floodplain development of the Pajaro River, much of which occurred over the past 12,000 years. The development of the modern Pajaro River began over 300,000 years ago and includes the capture of the San Benito River system and erosion of the Pajaro Gap at Chittenden. However, since that time the Pajaro River has formed a broad valley floor from the Pajaro Gap to the ocean (approximately 10 miles). Exposed remnant channels of the original channel have apparent meander belt widths over 1,000 feet wide. This indicates equilibrium under Holocene conditions, although it is probable that tectonic

uplift and deformation of the valley floor continues (Swanson Hydrology & Geomorphology 2003).



Source: PV Water 2024

Figure 2-1. Geologic Formations of Pajaro Valley



Source: County of Santa Cruz (2003)

Figure 2-2. Soils Association Map of Watsonville Sloughs Watershed

2.1.2 Local Soils

The study area is located primarily on fluvial floodplain geologic units, which contain sand and clay-rich terrace deposits. Watsonville Slough is filled with recent Holocene channel deposits consisting of soft fine-grained and organic (peaty) soils, and loose sands.

2.1.3 Seismicity

The study area is within a tectonically active fault zone due to the presence of multiple faults: San Andreas Fault and the Zayante Fault (Figure 2-1 in Section 2.1.1). Both have the potential to generate moderate to severe ground shaking from earthquake events, which are expected to occur in the future.

2.1.4 Liquefaction

Liquefaction refers to the phenomenon of loose, saturated, coarse-grained (sandy) soils losing strength during earthquakes. The project area is mapped as an area with very high susceptibility for liquefaction, as shown on the Santa Cruz County Geographic Information System (GIS) Hazard Map (County of Santa Cruz 2021). Lateral spreading results when liquefied soil masses fail on inclined slopes. Because the study area is located on primarily flat to topographically low areas, the study area is susceptible to low to moderate lateral spreading. There are many documented cases of liquefaction occurring along the Pajaro River during the 1906 and 1989 Earthquakes. The most common effects are sandy boils, lateral spreading of soil towards creek or river channels, and slope instability. The recent channel deposits should be considered potentially liquefiable. Liquefaction should be further evaluated during the D&I phase.

2.2 Hydrology and Water Resources

Watsonville Slough is a tributary to the Pajaro River. The Pajaro River Lagoon mouth and adjacent areas are characterized as a bar-built estuary, as the mouth of the Pajaro River intermittently opens and closes throughout the year as a function of freshwater, wave, and sedimentation processes. Hydrologic conditions in the study area are influenced by stream flows from Watsonville Slough and Pajaro River, and tidal forcing from Monterey Bay. More detailed hydrologic and hydraulic analysis is provided in Engineering Appendix B-1 of this document.

The Pajaro Valley is in a Mediterranean climate typical of central coastal California. This region is characterized by cool, wet winters and warm, dry summers. Over 90 percent of annual precipitation falls from November through April, and coastal fog is common in the summer and fall months (PV Water 2020). Rainfall is limited almost entirely to the winter season (November – April) when midlatitude storms are prevalent in the general study area. The rainfall amounts vary widely over the region due to topographic influences on the rainfall and range from near 48 cm in Monterey to over 150 cm in the Santa Cruz or Santa Lucia mountains. Cloud cover is a maximum during the dry season when the atmospheric mixed layer is well defined (NOAA 2024).

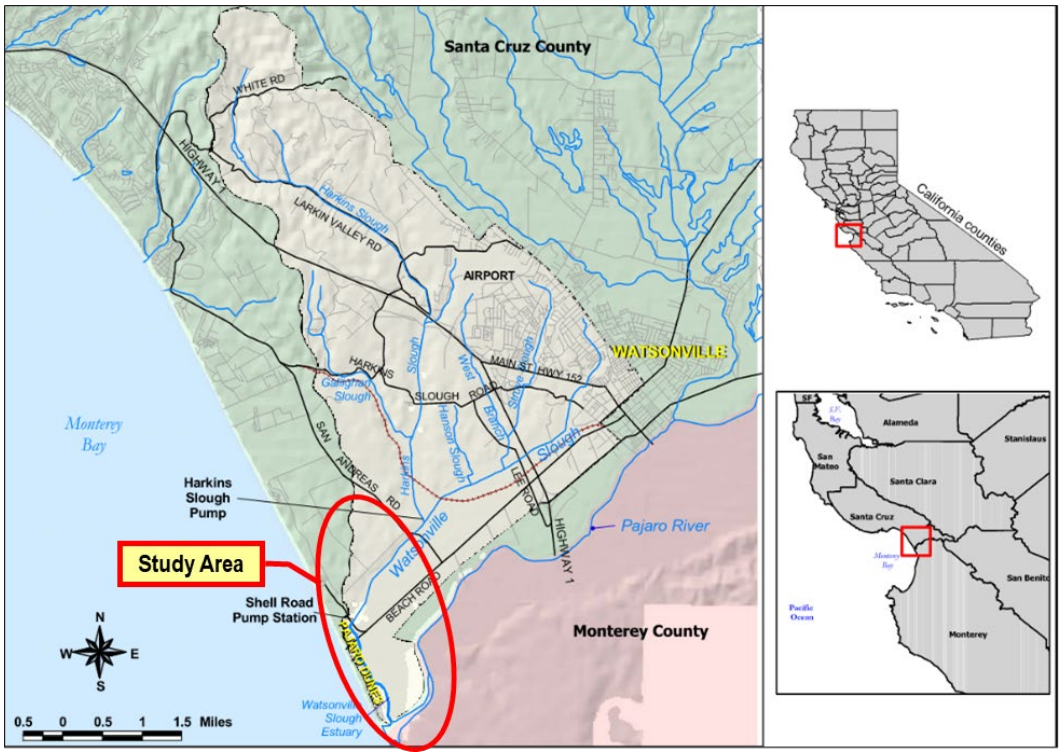
Under the FWOP conditions, northern latitudes and inland areas are expected to experience greater increases in temperatures than coastal areas. Daily extreme temperatures (i.e., coldest,

and warmest daily temperatures) are also expected to increase in most areas by mid-century (Vose et al 2017). Higher air temperatures are associated with an increase in the intensity of extreme precipitation events (Easterling et al 2017). Along the West Coast, atmospheric rivers are responsible for a significant portion of annual precipitation and have historically been connected to flood events (Kossin et al 2017). Weather projections indicate a greater frequency of atmospheric rivers in the future (Wehner et al 2017) and an increase in atmospheric river water vapor transport by the end of the 21st century (Easterling 2017).

Through the climate assessment conducted as part of this study, local sea level change was determined to be a significant driver expected to change hydrodynamic and sediment processes at the lagoon mouth and, thus, marsh hydrology. As sea levels change, the lagoon mouth is anticipated to transition to a permanently open and tidal connection, which exposes Watsonville Slough to greater saline influence around the project area and up the Slough channel. This would trigger shifts in marsh vegetation as the Slough become permanently open to oceanic influence.

2.2.1 Surface Water

The Watsonville Slough system drains a 12,500-acre (19.5 square miles) watershed from the coastal plain and foothills of southern Santa Cruz County into Monterey Bay. Watsonville Slough originates in the southeastern side of the watershed within the City of Watsonville, flows westward along the northern edge of the Pajaro River floodplain, intercepting drainage from tributary sloughs before discharging into the mouth of the Pajaro River at the southwest end of the watershed (Figure 2-3).



Source: County of Santa Cuz (2003)

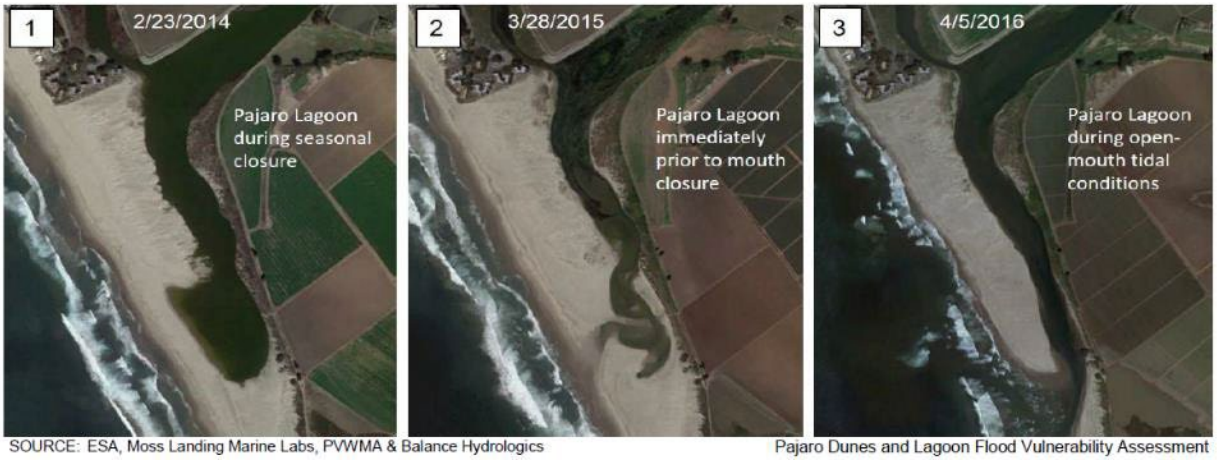
Figure 2-3. Watsonville Sloughs Watershed

The tributary sloughs (Gallighan, Harkins, Hanson, West Branch Struve, and Struve) are entrenched within coastal terraces where the terrain is characterized by flat valley floors of marsh and riparian wetlands with steep adjacent hillsides of grasslands, oak woodland, and chaparral. Harkins Slough is the longest drainage extending 7 miles inland through Larkin Valley to the headwaters situated 620 feet above sea level; Watsonville Slough flows into the Pajaro River at an elevation of 5 feet below mean sea level (Swanson Hydrology & Geomorphology 2003).

The Watsonville Slough at San Andreas Road crossing is the upstream boundary of our study area which includes the tidal, lower Watsonville Slough in the downstream of Shell Road. The tidal reach runs roughly 7,800 feet in an east south-easterly direction immediately behind the Pajaro Dune field to join the Pajaro River Lagoon directly upstream of the barrier beach. The tidal channel is crossed by W. Beach Road approximately 0.25 mile downstream of Shell Road; the W. Beach Road crossing has six 48-inch diameter reinforced concrete pipe culverts.

2.2.2 Pajaro River Lagoon

The mouth of the Pajaro River Lagoon periodically closes due to a beach berm that is formed by wave-driven sand transport during low river flows. When the Lagoon is closed, the study area becomes disconnected from tidal forcing, and water levels in the lower Watsonville Slough and throughout the bar-built estuary are determined predominantly by streamflow inputs and losses due to evapotranspiration and seepage/infiltration. When the Lagoon is open, both streamflow and tide stage play a role, with tidal fluctuations having a more significant impact on water levels in the Lagoon (Figure 2-4).

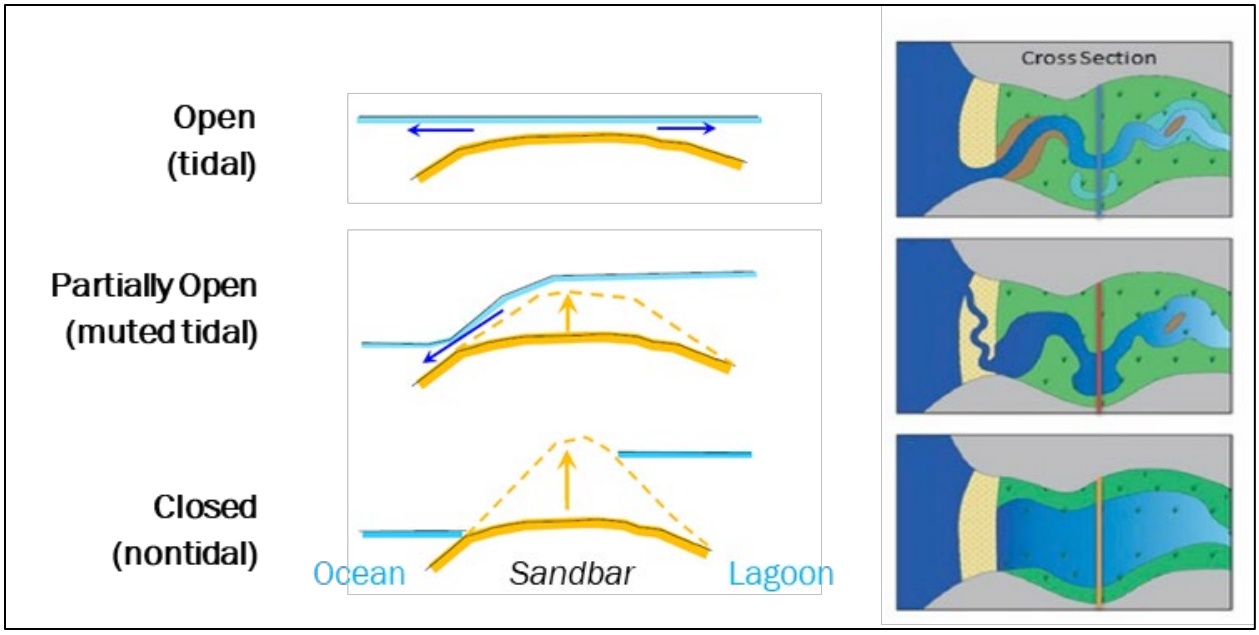


Source: ESA 2018

Figure 2-4. Pajaro River Lagoon under Open and Closed Conditions

These seasonal lagoon closures contribute significant hydrology to the marsh plains adjacent to the sloughs and rivers associated with these lagoons. Because of the complex hydrology associated with bar-built estuaries, their marsh plains are higher than those associated with strictly tidal, open estuaries. Therefore, much of the marsh plain in these systems is only inundated during lagoon closures as illustrated by Figure 2-5. These closures can last days to weeks and provide critical hydrologic support of the perched marshes in bar-built estuaries,

diversifying inundation ranges and the plant species supported by the marsh. However, the County of Santa Cruz has been mechanically breaching the seasonal Pajaro River sandbar for flood control purposes since the 1950s to minimize flood risk to the Beach and Shell Road intersection which provides emergency access for the Pajaro Dunes community and Pajaro Dunes CalFire Station #42. When water levels at the W. Beach Road staff gage reach +4.5 feet MSL (approximately 7 feet NAVD88), mechanical breaching activities may begin. On average, mechanical breaches conducted by the County occur around 8 feet NAVD88, as the roadway by the Beach and Shell Road intersection begins to flood.



Source: Clark and O'Connor 2019

Figure 2-5. The effect of Lagoon Closures on Marsh Hydrology

This mechanical breaching, in turn, has truncated the inundation period of marshes. Historic development and attempts to farm along the lower marsh and slough system have also removed old tidal side channels and created berms immediately adjacent to Watsonville Shough that impede flows between the slough and the marsh plain, further compromising marsh hydrology.

The lagoon closure frequency is an important element of the hydrologic conditions in the study area, and it is expected that it will be affected by future weather events, including intensifying storms and atmospheric rivers. However, the lagoon closure is dependent on multiple factors, making it difficult to predict future changes to mouth closure state. For example, projected intensification of storms could have conflicting effects on closure frequency: increased wave energy could result in more frequent closures, while increased streamflow from intense rainfall could result in more frequent openings (Thorne et al., 2021). Another variable related to sea level change and lagoon mouth closure is that of sedimentation or accretion in the marsh. Thorne et al (2021) shows that marshes in intermittently closed estuaries have higher initial elevation capital compared to open-estuary marshes and exhibit higher accretion rates due to closure events. The authors modeled marsh elevation change in response to sea level change

until 2100 for a range of California-based perennially open and intermittently open estuaries. Accretion was found to be highly influenced by the suspended sediment concentration and number and frequency of closure events. In particular, for systems with annual mouth closure, accretion kept pace with sea level change for sea level change rates up to 10 millimeters per year (0.0328 foot per year). Engineering Appendix B-1 (Hydrology, Hydraulics & Climate [HH&C]) of this document provides more detailed analyses of climate assessment and assumptions made for the FWOP conditions of the study area.

When the lagoon mouth is open, Watsonville Slough and lower Pajaro River are exposed to tidal influence. While the tidal signals are slightly muted further upstream the Slough due to friction, water levels by the W. Beach Road crossing and agricultural ditch are observed to be tidal. The following tidal datums from the NOAA Monterey tide gage station were assumed to be applicable for Watsonville Slough (Figure 2-6).

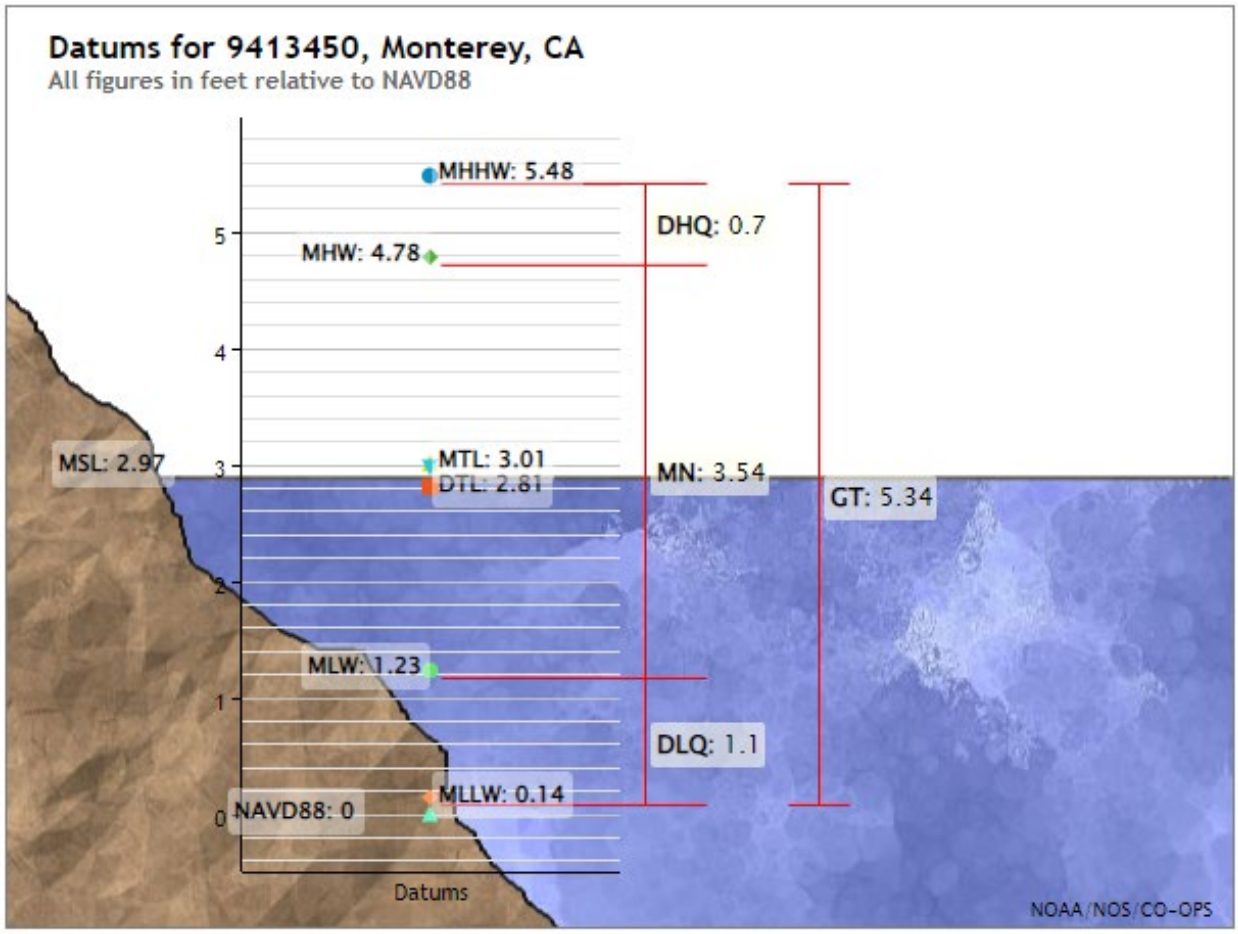


Figure 2-6. Tidal Datums for NOAA Monterey Tide Station (#9413450).

2.2.3 Sea Level Change

The NOAA Monterey station (#9413450) is the closest tide gauge to the study area (approx. 17.5 miles SSW), with an observed water level record from 1974 to present-day. NOAA generates a relative sea level trend estimate for the tide station location, based on the available

data record as shown in Figure 2-7. The observed mean sea level is rising at a rate of +1.67 millimeters/year (mm/year) (0.005479 ft/year) with a 95% confidence interval of +/- 0.73 mm/year (0.002395 ft/year). This translates to 0.55 ft over 100 years.

Projected estimates of relative sea level change from 1992 to 2125 were evaluated for the USACE Low, Intermediate and High curves from the USACE Sea-Level Change (SLC) Curve Calculator (Version 2022.72). The observed relative sea level trend of +1.67 mm/year (entered as 0.005479 ft/year) was used. The Project Delivery Team (PDT) reviewed sea-level change estimates from other federal and state agencies for the study area, which provided projections relative to mean sea levels at base year 2000. The OPC (2018) report estimates +0.5 to +1.1 feet rise in sea level by 2050 for the Monterey Region, under the 'Likely Range, High Emissions' scenario. Similarly, NOAA (2022) predicts approximately +0.5 to +1.0 foot of sea level change by 2050 along the West Coast.

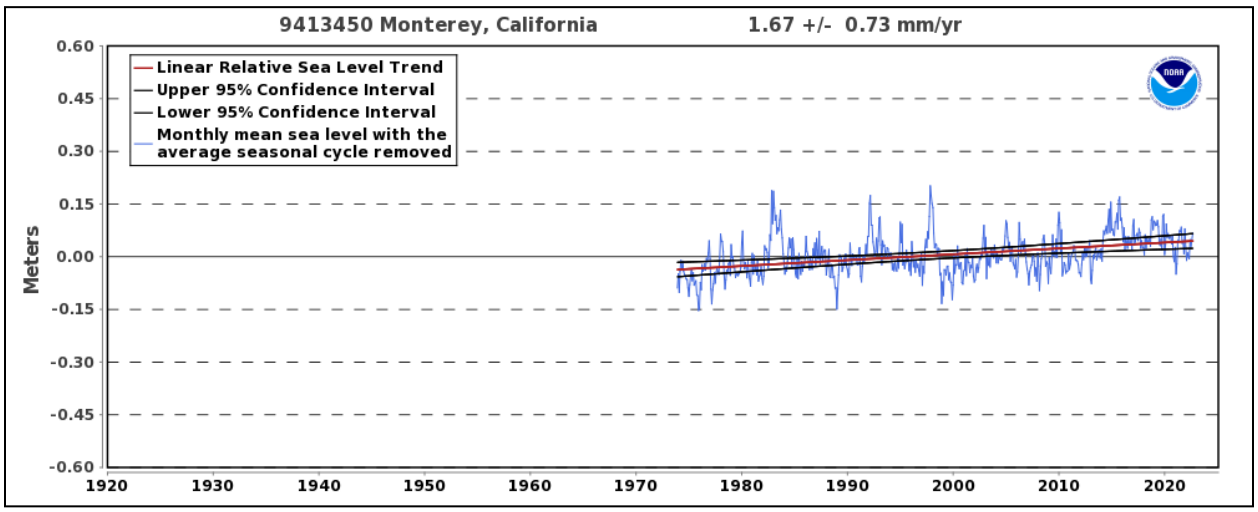


Figure 2-7. Relative Sea Level Trend for NOAA Monterey Station (#9413450)

The USACE Intermediate values for 2050 and 2075, +0.57 and +1.02 feet respectively, track closely with these projections. The PDT evaluated the sensitivity of the project and sensitivity of risks to the USACE Low, Intermediate and High SLC estimates. The Low SLC curve, which is based off the historic RSLC trend for the Monterey region, predicts +0.45 foot of SLC by 2075 and +0.73 feet by 2125. Assuming the Low curve, future tidal elevations would not be high enough to flood the marshplain because the existing marshplain in the study area is perched. The High SLC curve predicts approximately 3 feet of sea level rise by 2075 and over 7 feet by 2125. Sea level change mapping for the Pajaro River/Watsonville Slough area show extensive flooding of low-lying agricultural land adjacent to the study area beginning with 2 to 3 feet of sea level change. Under the High curve, the predicted permanent flooding of the lower Watsonville by future tidal action would trigger shifts in system hydrology, adjacent land use and access to the study area. Land use practices in the study area and its vicinity will have to shift drastically once this threshold of sea level rise is reached (>2 feet). The existing freshwater, low brackish marsh habitat in the study area would be converted to high brackish, saltwater marsh habitat over time. Refer to Appendix B-1 for further information on sea level change assumptions and hydraulic model input development.

2.2.4 Climate and Weather

Climate and weather impacts in California include loss of snowpack, sea level change, more extreme-heat days per year, an increase in the number of days with high ground-level ozone, larger forest fires, and increased drought in some parts of the state. Secondary effects are likely to include the displacement of thousands of coastal businesses and residences (because of SLC), impacts on agriculture, changes in disease vectors, and changes in habitat and biodiversity. As the CARB 2008 Scoping Plan noted, when enacting Assembly Bill 32, the California Legislature found that increasingly extreme weather events can cause detrimental effects to some of the state's largest industries—agriculture, winemaking, tourism, skiing, commercial and recreational fishing, and forestry—and to the adequacy of electrical power generation (CARB 2008).

2.2.5 Hydraulic Structures

Shell Road Culverts and Pump Station

Eight (8) 48-inch diameter reinforced concrete pipe culverts are located at Shell Road crossing over Watsonville Slough (Figure 2-8a). The culverts are equipped with vented flap gates on their downstream ends to prevent saltwater intrusion in the upstream direction. The Shell Road pump station (which was constructed in the early 1940s and is operated by the County of Santa Cruz), and an old flow control weir (Figure 2-8b) are located approximately 40 feet upstream of the Shell Road crossing. The weir is no longer functional or pertinent to current drainage conditions. Two pumps are operated in this location, with a combined discharge capacity of 5,300 gallons per minute (or 11.8 cubic feet per second [cfs]). The pumps move water in the downstream direction because Shell Road is intended to be the demarcation point between the freshwater channels and the tidally influenced lower Slough. The intersection of W. Beach and Shell roads is also subject to flooding and is the only route for emergency access to/from The Shorebirds (Pajaro Dunes North).

W. Beach Road Culverts

Downstream of Shell Road, Watsonville Slough extends approximately 1.5 miles in an east south-easterly direction and drains into the Pajaro River. The W. Beach Road crossing over Watsonville Slough is located 0.25 mile downstream of the Shell Road crossing; W. Beach Road has six 48-inch diameter reinforced concrete pipe culverts that do not have flap gates (Figure 2-9). The W. Beach Road crossing is inundated during high backwatering events, which correspond with periods of high precipitation/winter storms, and is the only route for emergency access to/from the Pajaro Dunes South and Palm Beach State Park.

Beach Road Agricultural Ditch

An agricultural ditch runs parallel to W. Beach Road and drains runoff from the surrounding agricultural parcels. This ditch extends from Lee Road and connects to the lower Watsonville Slough estuary by the W. Beach Road crossing. Presently, the ditch drains through a 42-inch corrugated metal pipe culvert and stone headwall. The outfall and ditch are open to tidal influence.

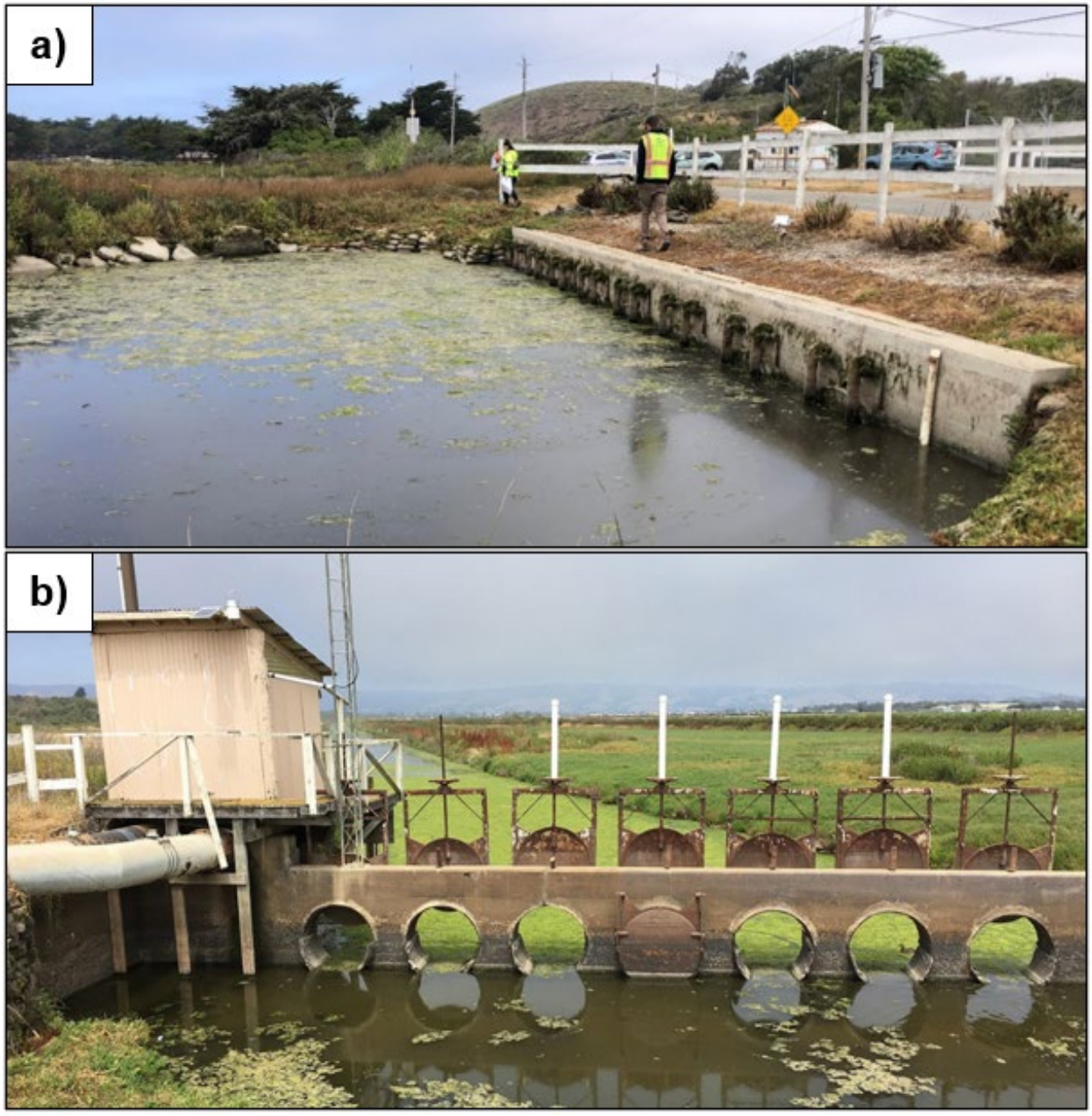


Figure 2-8. Shell Road Culverts and Pump Station

Note: a) Photo of Shell Road crossing with culverts and vent array, looking upstream; b) Photo of Shell Road crossing pump station with old flow control weir, looking upstream

Figure 2-9. W. Beach Road Crossing and Culverts

2.2.6 Surface Water Flooding

Prior to extensive hydrologic modifications within the Watsonville Slough and Pajaro River, the lower Watsonville Slough historically supported predominantly coastal marsh habitat connected by a network of intertidal and subtidal channels, and lagoon closures used to provide prolonged periods of inundation across the perched marsh plain. When the sandbar closes at the mouth of the Pajaro River, water levels would rise in the lagoon and its associated sloughs and marshes, providing a natural component to the overall hydrology of the marsh. However, existence of the Federal levees and other agricultural berms have isolated the Pajaro River and Watsonville Slough from its floodplain. In general, when lagoon closures occur, the water cannot spread out into the marsh plains but can only rise.

The Pajaro Dunes Communities (North and South) are periodically affected by flooding issues caused by the lagoon closure events when W. Beach Road (located about 1.3 miles upstream of the river mouth) is flooded (Figure 2-10). The flooding events can threaten emergency access to and from Pajaro Dunes, the sewage collection and delivery network for Pajaro Dunes, as well as electrical infrastructure and property within the community.

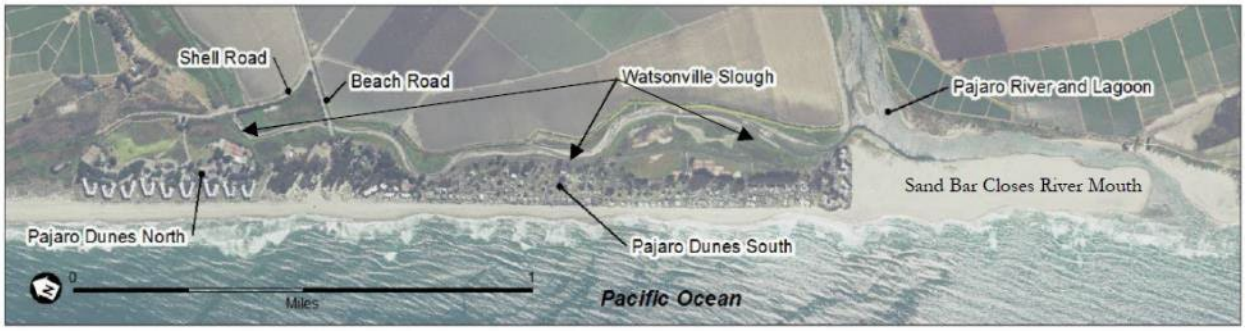


Figure 2-10. Lower Watsonville Slough (Source: ESA, 2018)

Regional hydrology studies for the Watsonville Slough system acknowledge the limited storage capacity available in the watershed. Based on the modeling analysis by Environmental Science Associates (2018), assuming an open lagoon mouth condition, sea level change of 14 inches (+14 inches in Pajaro River mouth) would result in a maximum water surface elevation of 9.7 to 9.8 feet NAVD88 water level between Shell Road and San Andreas Road due to increased tidal water levels. This would mean more frequent inundation (and saline influence) for any low-lying parcels in this segment under future conditions, assuming no improvements to the Shell Road pump station or to the existing berms along the Watsonville Slough. Saline intrusion is already a known issue in the area due to backflow from wave overtopping into the Lagoon and additional conversion to salt marsh vegetation in the lower Watsonville Slough watershed is expected.

As part of the present effort, the County's consultant, Environmental Science Associates, ran a lagoon model simulating the lagoon mouth response to future conditions, including a range of relative sea level change from 0 to 3 feet. The modeling showed that with increasing increments of relative sea level change that the lagoon mouth would transition from being seasonally closed to a permanently open, tidal connection. This means that over the long term, much of Watsonville Slough would be consistently exposed to tidal influence and saline waters.

In addition to the flooding on W. Beach Road during lagoon closure events mentioned above, the agricultural parcels on the left bank near the intersection of Shell Road and W. Beach Road (Figure 2-11) as well as parcels on the left bank of Watsonville Slough near San Andreas Road (upstream of Shell Road pump station; Figure 2-12) are known to flood occasionally due to overland flow from rainfall runoff during wet weather events. This flooding issue occurs both when the Lagoon is open and closed. A recent example of this flooding while the lagoon mouth is open occurred on January 8, 2023.

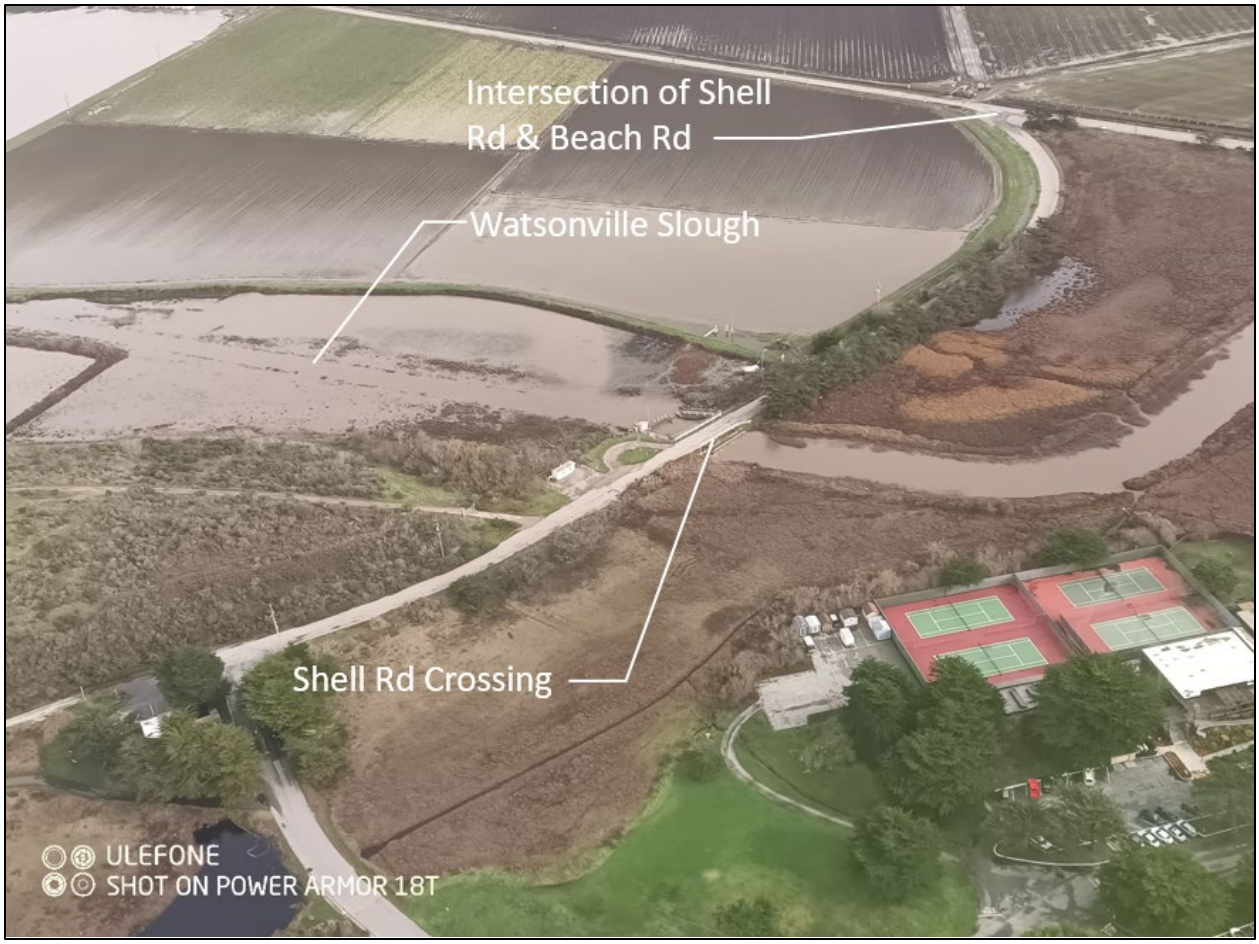


Photo taken by Santa Cruz County on January 9, 2023

Figure 2-11. Aerial Photo of Flooding on Agricultural Land Parcels on Left Bank of Watsonville Slough near Intersection of Shell Road and W. Beach Road

Photo taken by Santa Cruz County on January 9, 2023

Figure 2-12. Aerial Photo of Flooding on Agricultural Land Parcels on Left Bank of Watsonville Slough between San Andreas Road and Shell Road

2.2.7 Groundwater

Groundwater inflows include recharge from infiltration of precipitation, streamflow, and applied water from irrigation. Along with deep percolation of precipitation, streamflow infiltration is the other major source of natural recharge in Pajaro Valley. More than 80 percent of the recharge occurs within the Alluvial aquifer, owing to the distribution of outcrops and confining layers, and significant portions of recharge occur within outcrop areas of the Purisima Formation (10%) and the upper Aromas (7%). Recharge is driven by climate variations; recharge during wet periods can be more than double that from dry periods (PV Water 2020).

Groundwater outflow includes pumping from wells and tile drains, base flow or rejected recharge along streams, evapotranspiration, subsurface underflow to the offshore portions of the aquifer systems and discharge to the ocean along submarine rock outcrops (PV Water 2020). Groundwater levels in the Pajaro Valley Groundwater Basin have declined because of long-term groundwater overdraft, which has resulted in seawater intrusion (which has been documented since 1951 to date), groundwater quality degradation, and groundwater storage depletion. Most of the groundwater storage depletion has occurred in the Alluvial aquifer, with

substantial amounts of storage depletion also occurring in the upper Aromas and Purisima Formation aquifers (ESA 2020).

2.2.8 Water Quality

Surface Water Quality

Watsonville Slough water quality conditions are generally degraded. Degraded water quality in the Watsonville Slough is associated with sedimentation (from soil erosion); nutrients (nitrate and phosphate, and pesticides); ammonia; pesticides; heavy metals (copper, nickel, lead, and zinc); localized algal blooms, and low dissolved oxygen; and pathogens.

Source control best management practices (BMPs) have been determined to be best method to improve water quality in the Watsonville Slough. The designated beneficial uses of the Slough as outlined in the Basin Plan of the Central Coast Region (1994) are presented in Table 2-1. The beneficial uses of water contact recreation (REC-1) and non-contact water recreation (REC-2) are not supported in the Watsonville Slough because fecal coliform concentrations there exceed existing Basin Plan numeric water quality objectives protecting these beneficial uses.

The State Water Resources Control Board (SWRCB), with the concurrence of the US Environmental Protection Agency (USEPA) and Regional Water Quality Control Boards (RWCQB), establishes lists of all impaired water bodies within the state under Section 303(d) of the Clean Water Act (CWA), which requires the identification of water bodies that do not meet, or are not expected to meet, water quality standards (i.e., impaired water bodies). The affected water body, and associated pollutant or stressor, is then prioritized in the 303(d) List. The CWA further requires the development of a Total Maximum Daily Load (TMDL) for each listing. The Watsonville Slough is listed on the 303(d) List for several water quality constituents (Table 2-2).

Table 2-1. Beneficial Uses of Watsonville Slough (Central Coast Basin Plan 2019)

Water Contact Recreation	REC-1
Non-Contact Water Recreation	REC-2
Wildlife Habitat	WILD
Warm Fresh Water Habitat	WARM
Spawning, Reproduction, and/or Early Development	SPWM
Preservation of Biological Habitat of Special Significance	BIOL
Rare, Threatened, or Endangered Species	RARE
Estuarine Habitat	EST
Commercial and Sport Fishing	COMM
Source: Central Coast Regional Water Quality Control Board (2019)	

Table 2-2. List of 303(d) Water Quality Impairments for Watsonville Slough

Pollutant(s)	Potential Source	TMDL Schedule (Category 5 Criteria)*
Nitrate, Dissolved Oxygen	Agriculture, Domestic Animals/Livestock, Natural Sources, Urban Runoff/Storm Sewers	Required by 2018[a]
Toxicity, Turbidity	Unknown	Required by 2023[a]
DDE (Dichlorodiphenyldichloroethylene), Eshcherichia (E. Coli), Malathion		Required by 2027[a]
Fecal Coliform		Approved 2007[b]
Note: *Category 5 criteria: A water segment where standards are not met and a TMDL is required, but not yet completed, for at least one of the pollutants being listed for this segment. TMDL requirement status definitions for listed pollutants are a - TMDL still required, b - being addressed by USEPA approved TMDL.		
Data Source: California State Water Resources Control Board, 2018 California Integrated Report (Clean Water Act Section 303(d) List and 305(b) Report); available online: https://www.waterboards.ca.gov/water_issues/programs/water_quality_assessment/2018_integrated_report.html		

In 2006, the Central Coast Regional Water Quality Control Board (RWQCB) approved the Watsonville Slough Total Maximum Daily Load (TMDL) for pathogens, which was subsequently approved in 2007 by USEPA. The TMDL for pathogens in the Slough is a receiving water concentration equal to the numeric target for fecal coliform. The allocation to each responsible party is the receiving water fecal coliform concentration equal to the TMDL. These allocations focus on reducing or eliminating the controllable sources of fecal coliform.

Groundwater Quality

The total salt content in the groundwater of the Pajaro Valley Groundwater Basin is predominantly due to the seawater intrusion as the coastal area has the highest salt loading potential. Approximately 92 percent of the water used in the Pajaro Valley is pumped groundwater (PV Water 2020). Nitrogen loading to the groundwater in the Pajaro Valley is primarily from agricultural fertilizer and irrigation runoff, streamflow recharge, and sewer and septic systems.

2.3 Biological Resources

The Watsonville Slough lies near residential and urban communities, farmlands, and the Pajaro River. Since the historical land use conversion and urban development, the degradation of wildlife habitat has persisted because of contaminated water during flood events, lack of a hydrologic regime to support marsh vegetation, and constricted boundaries due to agricultural land use. Water is primarily contaminated due to agriculture runoff. Despite the low habitat quality that the lower slough provides, it connects to the mouth of the Pajaro River and Pacific

Ocean, and includes riparian, marsh, and marine habitat that support species in the immediate vicinity of the study area.

The wetland slough system, including Watsonville Slough, Struve Slough, and Harkins Slough is designated as an area of significant biological importance by the California Department of Fish and Wildlife (CDFW). The Watsonville Slough system is identified as a significant biotic resource in the Santa Cruz County Growth Management Plan. Sensitive plant and wildlife species have been identified based on the following database searches in California Natural Diversity Database (CNDDB) (CDFW 2024), U.S. Fish and Wildlife Services (USFWS) Information for Planning and Consultation database (IPaC) (USFWS 2024), and California Native Plant Society (CNPS) Inventory of Rare and Endangered Plants of California database (CNPS 2024).

2.3.1 Wildlife Habitat

Upland Habitat

Ruderal: Ruderal habitat, defined as areas where natural vegetation cover has been removed or disturbed by humans, occurs throughout the study area. Ruderal habitat is also present on the margins of agricultural ditches, cropland areas, and associated dirt roads. Common plant species observed in ruderal habitat include the following non-native grasses and forbs: English plantain (*Plantago lanciolata*), soft brome (*Bromus hordeaceus*), Harding grass (*Phalaris aquatica*), wild radish (*Raphanus sativus*), wild mustard (*Hirschfeldia incana*), Italian thistle (*Carduus pycnocephalus*), bristly ox-tongue (*Helminthotheca echioides*), annual yellow sweetclover (*Melilotus indicus*), and white sweetclover (*Melilotus albus*). Numerous species disperse, forage, or take cover, and several species breed in this community. Small mammals such as deer mice (*Peromyscus maniculatus*), California vole (*Microtus californicus*), brush rabbit (*Sylvilagus bachmani*), and Botta's pocket gopher (*Thomomys bottae*) are common residents in annual grasslands. Western fence lizards (*Sceloporus occidentalis*), gopher snakes (*Pituophis catenifer catenifer*), and other snakes are also likely to occur in this community (ESA 2020).

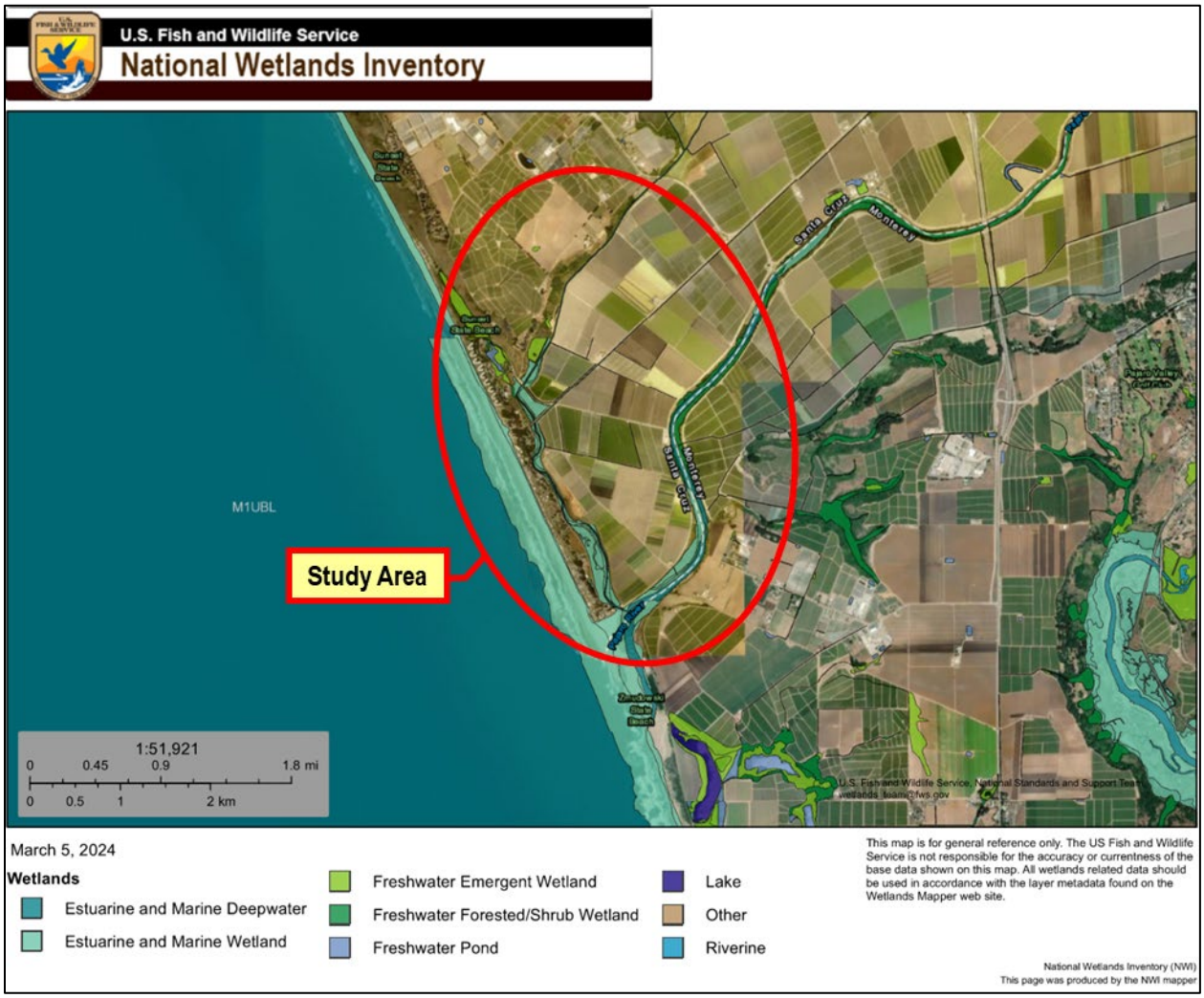
Cropland/Agriculture: The deep alluvial soils along the floodplain of the Pajaro River and tributaries, as well as the mild climate, support a variety of row crops such as strawberries, bush berries, cranberries, lettuce, broccoli, cauliflower, and cut flowers. Agricultural habitats are subject to periodic discing, planting, harvesting, and the application of pesticides, herbicides, fungicides, and fertilizers, which prevent the establishment of native plant species and communities. No special-status plant species would be expected in the active cropland agricultural areas. Agricultural areas can support wildlife species that have adapted to disturbances, but generally support few wildlife species because of their lack of diversity in vegetation and foraging opportunities (ESA 2020).

Urban/Developed: Urban/developed areas in the study area include housing, buildings and storage yards associated with farming, and roadways. Stands of upland landscape trees, including eucalyptus (*Eucalyptus* spp.), occur within the study area along W. Beach Road. No special-status plant species occur in these areas.

Wetland Habitat

The Watsonville wetlands comprise the Santa Cruz County's largest wetland system, including Watsonville Slough and its tributary sloughs: Gallighan, Harkins, Hanson, and East and West Struve. All are freshwater, except that the lower reaches of Watsonville Slough (where the study area is located) are seasonally brackish. The sloughs and their uplands support a diverse assemblage of waterbirds, raptors, blackbirds, sparrows, and other land birds (Santa Cruz Bird Club 2024). The USFWS' National Wetland Inventory (NWI) tool was used to map wetlands in the study area (Figure 2-13).

The Estuarine and Marine Wetland is the predominant wetland type in the study area. It consists of deepwater tidal habitats and adjacent tidal wetlands that are usually semi-enclosed by land but have open, partly obstructed, or sporadic access to the open ocean. In these habitats ocean water is occasionally diluted by freshwater runoff from the land.



Data Source: USFWS NWI 2024

Figure 2-13. Wetlands in Study Area

2.3.2 Aquatic Species

The aquatic habitat conditions in the Watsonville Slough have substantially deviated from those prior to the land use conversion. Stream type aquatic habitat in the Watsonville Slough watershed is limited by the watershed's small size, low elevation, and relatively low gradient. Most tributary streams are dry by early summer. Steelhead and cold-water trout had historically occurred in the lower Watsonville Slough prior to the land use conversion, but the habitat may be limited for sufficient abundance to support these species currently.

The lower Watsonville Slough estuary receives all the runoff from the entire Watsonville Slough Watershed, including the untreated concentrated agricultural drainage from the Beach Road Agricultural Ditch. The overall value to wildlife of the coastal salt marsh of Watsonville Slough estuary is adversely affected by pesticide runoff from adjacent agricultural lands, reducing the invertebrate fauna on which many vertebrates forage. The narrow width of the vegetated channel also places a constraint on the available habitat within the estuarine portion of the watershed (Swanson Hydrology & Geomorphology 2003).

Estuarine aquatic habitat is limited to the reach of Watsonville Slough downstream of the Shell Road Pump Station. This reach is a tributary arm of the Pajaro River Lagoon and supports water quality conditions and fish populations typical of the larger lagoon environment. Smith (1993) found twenty-five species of fish in the Pajaro River Lagoon of which nine were found in Watsonville Slough between Shell Road and the confluence with the lagoon. None of the species encountered by Smith are freshwater species. Threespine Stickleback (*Gasterosteus aculeatus*), Arrow Goby (*Clevelandia ios*), and Tidewater Goby (*Eucyclogobius newberryi*) are resident estuarine species. All others are marine species that use the lagoon and lower Watsonville Slough for spawning, juvenile rearing, or feeding. The reach is influenced by tidal circulation as well as freshwater inflows from upper watershed areas.

S-CCC Steelhead historically used and still currently use the lower Watsonville Slough system for foraging—an extension of the Pajaro River Lagoon—although there are no records of spawning habitats for this species prior to major land use conversion in the Watsonville Slough (both channel sediment and hydrology). Also, there are several federally managed fisheries that fall under Magnuson-Stevens Fishery Conservation and Management Act (MSA): Pacific groundfish species and Coastal Pelagic species. These species use the Pajaro River Lagoon and lower Watsonville Slough system at least seasonally for foraging. The Lagoon and lower Slough system are designated Essential Fish Habitat under the MSA for these species (Casagrande 2024).

2.3.3 Threatened and Endangered Species

Table 2-3 provides a list of potential federally endangered and threatened species that may be found within a 2-mile radius from the project area based on database searches from U.S. Fish and Wildlife Service's Information for Planning and Consultation (IPaC) website and National Marine Fisheries Service (NMFS) California Species List Tools website. Due to the large extent

of search area, not all species in the list are likely to occur in the action area[1]. The listed species' potential to occur in the action area is further determined by the presence and absence data based on the data query using RareFind 5 in California Department of Fish and Wildlife (CDFW)'s California Natural Diversity Database (CNDDB). Environmental Appendix A-2 of this document provides a list of ESA-listed species from USFWS IPaC database search.

Following the CDFW's CNDDB data review (Table 2-3), special-status species with a likely potential to occur within the action area are discussed in detail below.

Table 2-3. Federal Special-Status Wildlife, Fish, and Plant Species Potentially to Occur in Action Area

Common Name	Scientific Name	Status	Potential to Occur in Action Area
Mammals			
San Joaquin Kit Fox	*Eumetopias jubatus*	Endangered	Unlikely – although the species' current range overlaps the action area, there is no record of occurrence on CNDDB in the action area.[1,2]
Southern Sea Otter	*Enhydra lutris nereis*	Threatened	Unlikely – the species range does not overlap with Watsonville Slough.[2]
Birds			
California Condor	*Gymnogyps californianus*	Endangered	Unlikely – although the species' current range overlaps the action area, there is no record of occurrence on CNDDB in the action area.[1,2]
California Least Tern	*Sterna antillarum browni*	Endangered	
California Ridgway's Rail	*Rallus obsoletus obsoletus*	Endangered	
Hawaiian Petrel	*Pterodroma sandwichensis*	Endangered	
Least Bell's Vireo	*Vireo bellii pusillus*	Endangered	
Marbled Murrelet	*Brachyramphus marmoratus*	Threatened	
Short-tailed Albatross	*Phoebastria (=Diomedea) albatrus*	Endangered	
Western Snowy Plover [CH]	*Charadrius nivosus nivosus*	Threatened	Unlikely – the action area is within its critical habitat, and area of recently known distribution and relative abundance of snowy plovers and their seasonal use of beach habitats; there is no suitable habitat in the project area.

[1] Action area means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (Source: Section 7 Consultation Technical Assistance Glossary of Terms | FWS.gov)

Common Name	Scientific Name	Status	Potential to Occur in Action Area
Yellow-billed Cuckoo	*Coccyzus americanus*	Threatened	Unlikely – although the species' current range overlaps the action area, there is no record of occurrence on CNDDB in the action area.[1,2]
Reptiles			
San Francisco Garter Snake	*Thamnophis sirtalis tetrataenia*	Endangered	Unlikely – although the species' current range overlaps the action area, there is no record of occurrence on CNDDB in the action area.[1,2]
Amphibians			
California Red-legged Frog	*Rana draytonii*	Threatened	**Likely** – the action area is not within its critical habitat; however, it is within a high likelihood of species' predicted habitat by CNDDB; the nearest occurrence of California Red-legged Frog is approximately 1.25 miles upstream from the project area in Watsonville Slough.[1]
California Tiger Salamander	*Ambystoma californiense*	Threatened	Unlikely – although the species' current range overlaps the action area, there is no record of occurrence on CNDDB in the action area.[1,2]
Foothill Yellow-legged Frog	*Rana boylii*	Endangered	
Santa Cruz Long-toed Salamander	*Ambystoma macrodactylum croceum*	Endangered	Unlikely – although the species' current range overlaps the action area, there is no record of occurrence on CNDDB in the action area.[1,2]
Western Spadefoot	*Spea hammondii*	Proposed Threatened	
Fish			
Tidewater Goby [CH]	*Eucyclogobius newberryi*	Endangered	**Likely** – although the species' current range overlaps the action area, there is no record of occurrence on CNDDB in the immediate vicinity of W. Beach Rd; tidewater gobies are present in the Pajaro River Lagoon year-round and recede upstream in the Pajaro River during storm events; gobies may be beneficially affected by the project.[1,2]
South-Central California Coast Steelhead [CH]	*Oncorhynchus mykiss*	Threatened	**Likely** – although the species' current range overlaps the action area, there is no record of occurrence on CNDDB in the immediate vicinity of W. Beach Rd; migrating adult and juvenile steelhead may occur in Pajaro River mouth and lagoon; steelhead may be beneficially affected by the project.[1,2]

Common Name	Scientific Name	Status	Potential to Occur in Action Area
Insects			
Monarch Butterfly	*Danaus plexippus*	Candidate	Unlikely – the action area is within the CDFW's Areas of Conservation Emphasis (ACE) for Monarch overwintering sites[1]; Monarch butterflies typically arrive in Santa Cruz County in mid-October and leave in mid-February, therefore, it is unlikely that they would be affected by the project.
Crustaceans			
Vernal Pool Fairy Shrimp	*Branchinecta lynchi*	Threatened	Unlikely – the study area partially overlaps with the species' range which is exclusively in Pajaro River and Monterey County; there are no vernal pools and no record of occurrence on CNDDB in the study area.[1,2]
Flowering Plants			
Marsh Sandwort	*Arenaria paludicola*	Endangered	Unlikely – although the species' current range overlaps the study area, there is no record of occurrence on CNDDB in the study area.[1,2]
Monterey Gilia	*Gilia tenuiflora ssp. Arenaria*	Endangered	
Monterey Spineflower [CH]	*Chorizanthe pungens var. pungens*	Threatened	
Robust Spineflower [CH]	*Chorizanthe robusta var. robusta*	Endangered	
Santa Cruz Tarplant	*Holocarpha macradenia*	Threatened	

Table Notes:
CH = There is final critical habitat for this species and the action area overlaps the critical habitat.
1. CDFW 2024 - Based on RareFind 5 database searches in California Natural Diversity Database (CNDDB); available online at https://wildlife.ca.gov/Data/CNDDB/Maps-and-Data#43018407-rarefind-5
2. USFWS 2024 – Available online at https://ecos.fws.gov/

California Red-legged Frog

The California Red-legged Frog *(Rana draytonii)* (CRLF) is federally listed as a threatened species throughout its range in California. This frog historically occurred over much of the state from the Sierra Nevada foothills to the coast and from Mendocino County to the Mexican border. CRLFs typically breed in ponds, slow-moving creeks, and streams with deep pools that are lined with dense emergent marsh or shrubby riparian vegetation. However, CRLF can inhabit a wide variety of perennial aquatic habitats, including coastal lagoons, marshes, springs, stock ponds, and siltation ponds. In summer (non-breeding season), CRLFs are likely to be observed near a

deep pool in a creek or pond, where emergent vegetation, semi-submerged root masses, and undercut banks provide protection from predators. CRLFs use upland habitat such as open grasslands for foraging and dispersal. Prey includes invertebrates and small vertebrates. Suitable upland habitat includes moist seeps or springs, burrows, or moist debris piles for dispersal and aestivation.

The Pajaro River and Watsonville Slough system are known habitat for the CRLF. However, the species has not been observed at the lower Watsonville Slough and Pajaro Lagoon. Critical habitat for CRLF does not overlaps with the study area and the nearest occurrence of this species in Watsonville Slough is approximately 1.25 miles upstream from the project area (CNDDB 2024). Because the study area is located within a high likelihood of species' predicted habitat by CNDDB, it was advanced to Effects Analysis in Section 4.

The critical habitat Unit SCZ–2 (Watsonville Slough) is located along the coastal plain in southern Santa Cruz County, north of the mouth of the Pajaro River and seaward of California State Route (SR) 1. It includes locations in the Watsonville Slough system, including all or portions of Gallighan, Hanson, Harkins, Watsonville, Struve, and the West Branch of Struve sloughs.

The Federal Register critical habitat designation notice for CRLF (50 FR Part 17) defines the primary constituent elements (PCEs) for the CRLF as follows:

- Space for individual and population growth and for normal behavior;
- Food, water, air, light, minerals, or other nutritional or physiological requirements;
- Cover or shelter;
- Sites for breeding, reproduction, or rearing (or development) of offspring; and,
- Habitats that are protected from disturbance or are representative of the historic geographical and ecological distributions of a species.

South-Central California Coast (S-CCC) Steelhead

South-Central California Coast (S-CCC) Steelhead (*Oncorhynchus mykiss*) was federally listed as threatened on August 18, 1997 (62 FR 43937) and January 5, 2006 (71 FR 833); updated April 14, 2014 (79 FR 20802). This S-CCC distinct population segment includes naturally spawned anadromous steelhead originating below natural and manmade impassable barriers from the Pajaro River to (but not including) the Santa Maria River (NMFS 2015).

S-CCC Steelhead in general have longer, streamlined bodies that are suited to the small, flashy streams of central and southern California. The life cycle of steelhead generally involves rearing in freshwater for 1-3 years before migrating to the ocean and spending from 1-4 years maturing in the marine environment before returning to spawn in freshwater. The ocean phase provides a reproductive advantage because individuals that feed and mature in the ocean grow substantially larger than native freshwater residents, and larger females produce proportionately more eggs; however, the freshwater phase provides protected rearing environment, relatively

free of competition and predators. Out-migration to the ocean (i.e., emigration) usually occurs in the late winter and spring. In some watersheds, juveniles may rear in a lagoon or estuary for several weeks or months prior to entering the ocean. The timing of emigration is influenced by a variety of factors such as photoperiod, streamflow, temperature, and breaching of the sandbar at the river's mouth (NMFS 2013).

S-CCC Steelhead currently use the action area, the Pajaro River Lagoon and nearshore environment adjacent to the Lagoon, as a migration corridor. Smolts pass through the Lagoon during their seaward migration, as do adults after they have spawned upstream. Adults also use the Lagoon during their migration to upstream spawning sites in the Pajaro River, although there is no data record for spawning habitat in Watsonville Slough (Personal communication with Casagrande 2024). Smolts and adults pass through the nearshore environment as they enter and exit the Lagoon. Because of low and warm summer stream flows, the Lagoon provides almost no potential summer rearing habitat for steelhead (Smith 2002), although in years of higher stream flows resulting in substantial conversion to freshwater, conditions for steelhead rearing might be good (Smith 1993). Unsuitable habitat between upstream spawning areas the Pajaro River and the Lagoon or habitat blocked by dry reaches in late spring or early summer apparently impairs juvenile steelhead use of the Lagoon (NMFS 2015).

In designating critical habitat, NMFS considers, among other things, the following requirements of the species: 1) space for individual and population growth, and for normal behavior; 2) food, water, air, light, minerals, or other nutritional or physiological requirements; 3) cover or shelter; 4) sites for breeding, reproduction, or rearing offspring; and, generally, 5) habitats that are protected from disturbance or arc representative of the historic geographical and ecological distributions of this species (50 C2R 424.12(b)). In addition to these factors, NMFS also focuses on PCEs and/or essential habitat features within the designated area that are essential to the conservation of the species and that may require special management considerations or protection.

The PCEs for S-CCC Steelhead and their associated essential features within freshwater and estuaries include:

1. Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation, and larval development;

   Freshwater rearing sites with: a) Water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; b) Water quality and forage supporting juvenile development; and c) Natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large docks and boulders, side channels, and undercut banks.

2. Freshwater migration corridors free of obstruction and excessive predation with water quantity and quality conditions and naturel cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival.

> Estuarine areas free of obstruction with a) Water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh- and saltwater; b) Natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels; and c) Juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation (70 FR 52488).

The critical habitat for S-CCC Steelhead includes Pajaro River Hydrologic Unit 3305, which overlaps with the action area (NMFS 2005).

Tidewater Goby

Tidewater Goby was listed as endangered on March 7, 1994 (59 FR 5494). Tidewater Goby is primarily an annual species in central and southern California, although some variation in life history has been observed. If reproductive output during a single season fails, few (if any) tidewater gobies survive into the next year. Reproduction typically peaks from late April or May to July and can continue into November or December depending on the seasonal temperature and amount of rainfall. Males begin the breeding ritual by digging burrows (3 to 4 inches deep) in clean, coarse sand of open areas. Females then deposit eggs into the burrows, averaging 400 eggs per spawning effort and males remain in the burrows to guard the eggs. Male tidewater gobies frequently forego feeding, which may contribute to the mid- summer mortality observed in some populations. Within 9 to 10 days, larvae emerge and are approximately 0.20 to 0.27 inch in length. Tidewater gobies live in vegetated areas until they are 0.60 to 0.70 inch long. When they reach this life stage, they become substrate-oriented, spending most of the time on the bottom rather than in the water column. Both males and females can breed more than once in a season, with a lifetime reproductive potential of 3 to 12 spawning events. Vegetation is critical for over-wintering tidewater gobies because it provides refuge from high water flows (USFWS 2016).

Tidewater Goby is endemic to California and typically inhabits coastal lagoons, estuaries, and marshes, preferring relatively low salinities of approximately 12 parts per thousand (ppt). The Tidewater Goby habitat is characterized by brackish estuaries, lagoons, and lower stream reaches where the water is fairly still but not stagnant. Tidewater gobies tend to be found in the upstream portions of lagoons. They can withstand a range of habitat conditions and have been documented in waters with salinity levels that range from 0 to 60 ppt, temperatures from 46 to 77 degrees Fahrenheit, and depths from approximately 10 inches to 6.5 feet. Tidewater Goby feed on small invertebrates, including mysids, amphipods, ostracods, snails, aquatic insect larvae, and particularly chironomid larvae; however, tidewater gobies of less than 0.30 inch in length probably feed on unicellular phytoplankton or zooplankton, similar to many other early-stage larval fishes (USFWS 2016).

Tidewater Goby have the potential to occur in the action area and have been documented in the lowermost reach of Watsonville Slough, downstream of the Shell Road Pump Station and Pajaro River with the highest abundance observed at the most upstream site sampled in Pajaro River approximately 2.9 miles above the confluence with Watsonville Slough (USFWS 2016).

Critical habitat Unit SC-8 (Pajaro River) includes the lower reach of the Pajaro River and Lagoon, as well as the lowermost 1.2 miles of Watsonville Slough south of W. Beach Road (78 FR 8746). Unit SC-8 is currently considered occupied by tidewater goby. The Federal Register critical habitat designation notice for tidewater goby (78 FR 8746) defines the primary constituent elements for tidewater goby as follows:

- Persistent, shallow (in the range of approximately 0.3 to 6.6 feet (0.1 to 2 meters)), still-to-slow-moving lagoons, estuaries, and coastal streams with salinity up to 12 parts per thousand, which provide adequate space for normal behavior and individual and population growth that contain one or more of the following:
    - Substrates (e.g., sand, silt, mud) suitable for the construction of burrows for reproduction;
    - Submerged and emergent aquatic vegetation, such as Sago pondweed (*Stuckenia pectinata*), ditch grass (*Ruppia maritima*), broadleaf cattail (*Typha latifolia*), and bulrushes (*Scirpus* spp.), that provides protection from predators and high flow events; or
    - Presence of a sandbar(s) across the mouth of a lagoon or estuary during the late spring, summer, and fall that closes or partially closes the lagoon or estuary, thereby providing relatively stable water levels and salinity.

2.3.4 Vegetation

Vegetation Category

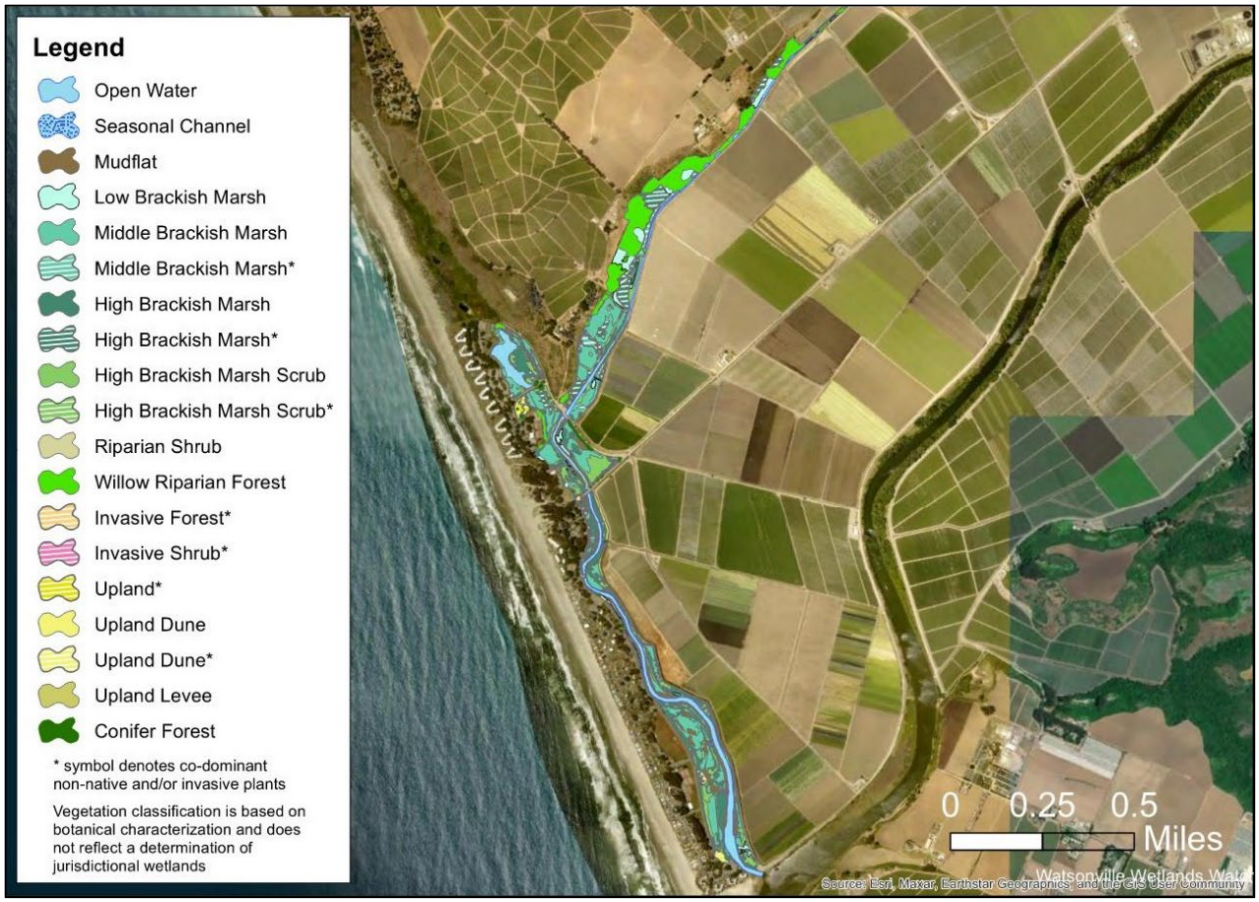
Mapping of vegetation was conducted by Watsonville Wetland Watch within the marsh and surrounding areas from the mouth of Watsonville Slough at the Pajaro River at the southern end of the project area, to the north encompassing the lagoon within the Pajaro Dunes North property and to the north-east where Watsonville Slough is crossed by San Andreas Road. Vegetation mapping efforts included a combination of field data collection and interpretation of aerial photography along with field reconnaissance and verification. Field surveys were conducted in June, July, and August of 2022.

Vegetation classification reflects the wetland indicator status of the dominant and co-dominant plant species within defined geographic areas and the expression of vegetation changes over small shifts in elevation and inundation. Low Marsh includes obligate wetland plants such as emergent monocots (*Schoenoplectus californicus*, *Typha* spp., *Bolboschoenus maritimus*), Marsh Jaumea (*Jaumea carnosa*), Silverweed (*Potentilla anserina*). Middle Marsh is characterized by Pickleweed (*Salicornia pacifica*) and its associates. High Marsh includes Saltgrass (*Distichlis spicata*), Mexican Rush (*Juncus mexicanus*), and Alkali Heath (*Frankenia salina*). Each category also had a modifier of * if invasive species were present at an estimated 25% or greater (Watsonville Wetland Watch 2023). These invasive species are typically xeric in nature, indicating potential hydrologic stress on the marsh plain. Table 2-4 and Figure 2-14 present the vegetation mapping data collected by Watsonville Wetland Watch.

Table 2-4. Vegetation Categories and Area

Category	Primary Vegetation Species	Area (Acres)
Open Water	Areas that are inundated year-round	16.78
Seasonal Channel	Channels convey water seasonally or with tidal cycles	0.15
Mudflat	Unvegetated areas seasonally or tidally exposed	8.31
Low Brackish Marsh	Obligate wetland plants, particularly emergent monocots (*Schoenoplectus californicus, Typha spp., Bolboschoenus maritimus*), Marsh Jaumea (*Jaumea carnosa*), Silverweed (*Potentilla anserina*)	6.71
Middle Brackish Marsh	Pickleweed (*Salicornia pacifica*) and associates (Frankenia salina when on marsh plain)	26.85
Middle Brackish Marsh*	Species above mixed with invasive weeds	2.69
High Brackish Marsh	Saltgrass (*Distichlis spicata*), Mexican Rush (*Juncus mexicanus*), Alkali Heath (*Frankenia salina*) when growing on berms or levees	15.29
High Brackish Marsh*	Species above mixed with invasive weeds	13.79
High Brackish Marsh Scrub	Gumplant (*Grindelia stricta*) or Coyote Bush (*Baccharis pilularis*) mixed with Saltgrass, Pickleweed, and Alkali Heath	13.67
High Brackish Marsh Scrub*	Species above mixed with invasive weeds	0.13
Willow Riparian Forest	Salix species, primarily *Salix lasiolepis*	17.29
Invasive Forest*	Eucalyptus species	0.31
Invasive Shrub*	Ngaio Tree (*Myoporum laetum*) and Pampas Grass (*Cortaderia species*)	0.14
Upland	Non-wetland, including native and non-native grasses	1.05
Upland Dune	Non-wetland with dune vegetation such as Mock Heather (*Ericameria ericoides*), Lizard Tail (*Erophyllum staechadifolium*), Beach Sage (*Artemisia pycnocephala*), and Buckwheat (*Eriogonum latifolium*)	1.01
Upland Dune*	Species above mixed with invasive weeds	0
Upland Levee	Flood control levees with ruderal vegetation such as Poison Hemlock (*Conium maculatum*), Mustard (*Brassica nigra*), and Radish (*Raphanus sativus*)	2.31
Conifer Forest	Monterey Cypress (*Cupressus macrocarpa*)	1.66

Note: *denotes presence of invasive species at an estimated 25% or greater
Data Source: Watsonville Wetland Watch (2023)



Source: Watsonville Wetland Watch (2023)

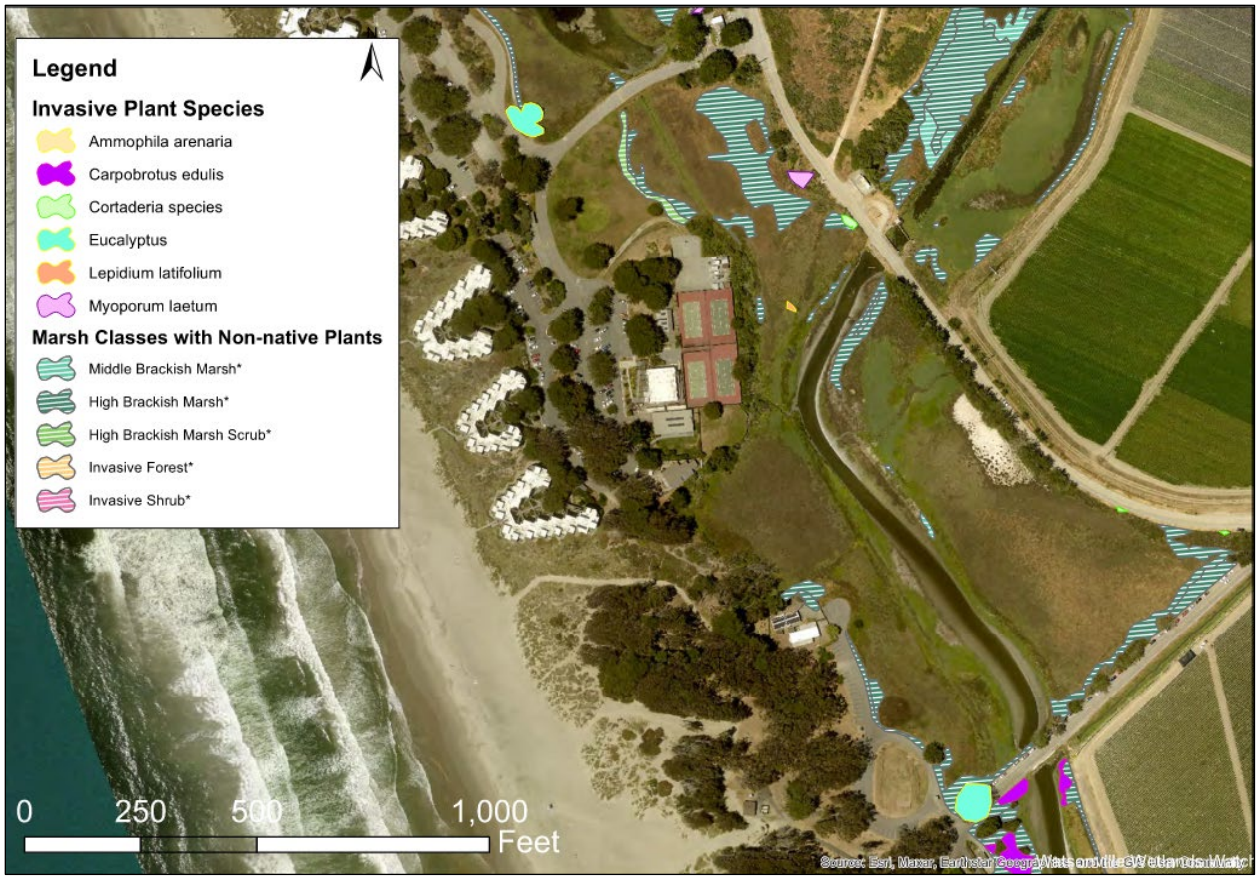
Figure 2-14. Vegetation Mapping Data for Watsonville Slough

Invasive and Non-native Plant Species Distribution

Invasive plant species include those with a ranking by the California Invasive Plant Council of moderate or higher and those species that are known within the watershed to become invasive within native habitats (Table 2-5; Figure 2-15).

Table 2-5. Invasive Plant Species

Common Name	Scientific Name	Cal-IPC rating	Acres
European Dune Grass	*Ammophila arenaria*	high	0.03
Iceplant	*Carpobrotus edulis*	moderate	0.51
Jubata Grass	*Cortaderia species*	high	0.02
Eucalyptus ssp.	*Eucalyptus*	none	0.51
Perennial Pepperweed	*Lepidium latifolium*	high	0.09
Ngaio	*Myoporum laetum*	moderate	0.12
Data Source: Watsonville Wetland Watch (2023)			



Source: Watsonville Wetland Watch (2023)

Figure 2-15. Invasive Species Mapping in Study Area

Based on the Hydrology & Hydraulics modeling analysis (see Engineering Appendix B-1) which was set up for 3 time-steps at Year 0, 25, and 50 for FWOP (a.k.a. No Action Alternative), the annualized inundation maps were created and compared with the existing vegetation mapping for the study area (Figure 2-16). The inundation map under the modeled existing condition (i.e., FWOP at Year 0) showed the areas with 50% or higher annualized inundation were generally mapped as mudflat or open water. Low marsh areas generally corresponded with approximately 15-50% annualized inundation. Areas of healthy pickleweed middle marsh were closely associated with annualized inundation ranges from 1 to 15%. Areas with 0-1% annualized inundation were mapped as one of the following: stressed pickleweed marsh, middle marsh co-dominant with xeric and exotic species, high marsh codominant with xeric exotic vegetation, or high marsh scrub, some of which was stressed.

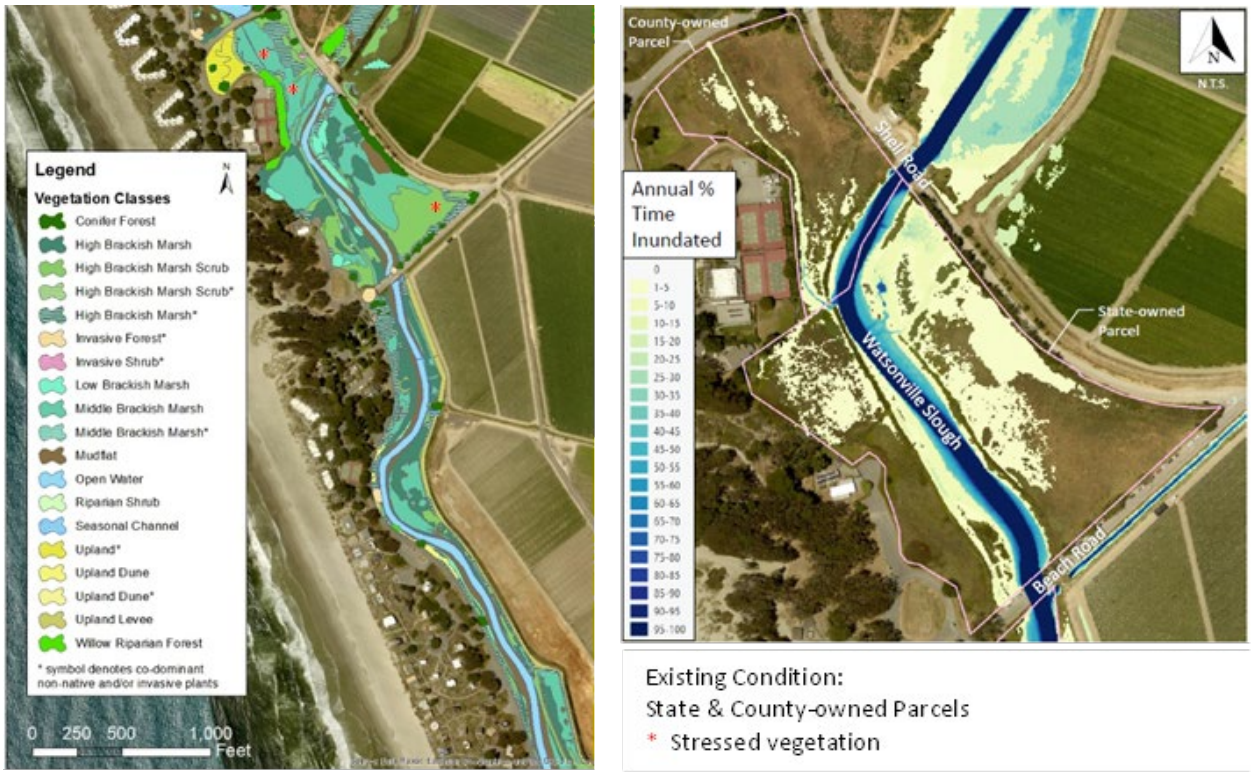


Figure 2-16. Comparison of Existing Vegetation Mapping and Modeled Existing Inundation Ranges

2.4 Cultural Resources

Cultural resources are defined as several different types of properties: precontact and historic archaeological sites; architectural properties such as buildings, bridges, and infrastructure; and resources that have cultural or traditional importance to Native American Tribes including traditional cultural properties and sacred sites. This analysis considers the potential effects of project implementation to cultural resources within the location of the proposed alternatives.

The methodology used for identifying historic properties and cultural resources in the study area includes review and development of environmental, precontact, ethnographic, and historical contexts associated with the area's cultural environment as well as meaningful consultation with Tribes. The historical contexts summarized below provides an overview on how significance and integrity is determined when evaluating archaeological and historic built resources. The information can also be used to provide an initial assessment of discovering unanticipated archaeological resources for certain ground disturbing activities.

2.4.1 Archaeological Context

Watsonville Slough is a remnant of a more expansive system of estuarine and freshwater marshes, linked to the natural breaching events of the Pajaro River Lagoon. The sloughs contain small but significant coastal habitats including salt marsh, brackish and freshwater marsh, and seasonal wetlands. Watsonville Slough provided rich natural resources which supported the Calendarruc, a Mutsun-speaking Ohlone group of indigenous peoples. Estimates

show that between 500 and 900 people lived within the Pajaro Valley prior to European contact, and that there was significant interaction between this group and other Mutsun-speaking peoples upstream (Milliken et al 2008). An overview of archaeological information, ethnographic/linguistic studies, and modern traditions which illustrates the settlement patterns, lifeways, languages, cultures, and beliefs of the indigenous peoples of California is summarized below, followed by a discussion of precontact historic properties commonly found along California's waterways.

The California coast has undergone dramatic landscape-scale changes since humans began to inhabit the region beginning 13,000 to 15,000 years ago. Archaeologists have developed individual, cultural, chronological sequences tailored to the archaeology and material culture of each subregion of California. Jones, et al. (2007), in *Prehistoric California: Colonization, Culture, and Complexity*, provide a framework for the interpretation of the Central Coast and the Monterey Bay Area. The authors divide human history on the Central Coast into six broad periods: the Paleo-Indian Period (pre-8000 B.C.), the Early Archaic Period (8000 to 3500 Before Common Era (B.C.E.)), the Early Period (3500 to 600 B.C.E.), the Middle Period (600 B.C.E. to 1000 C.E.), the Middle/Late Transition Period (1000 to 1250 C.E.), and the Late Period (1250–1769 C.E.). These periods have been largely defined based on distinctive bead types; typological analysis and radiocarbon dating of Olivella beads which shows the bead sequence in the Monterey Bay Area as generally similar to those of the California Central Valley and the Santa Barbara Coast (Ehringer et al. 2020). Economic patterns, stylistic aspects, and regional phases further subdivide cultural periods into shorter phases. This scheme uses economic and technological types, socio-politics, trade networks, population density, and variations of artifact types to differentiate between cultural periods.

Evidence of human habitation during the Paleo-Indian Period, characterized by big-game hunters occupying broad geographic areas, has not yet been discovered in the Monterey Bay Area. The oldest known occupation of the Monterey Bay area dates from around 5000 B.C.E., however data representing this earliest occupation are limited. The Early Archaic Period is represented by the Millingstone Culture (8000 to 3500 B.C.E.) and is marked by large numbers of lithic artifacts including milling slabs, crude core and cobble-core tools, and less abundant flake tools and large side- notched projectile points. Millingstone components have been identified at locations in Monterey County near Elkhorn Slough and Monterey Peninsula. Faunal remains indicate that Millingstone people exploited shellfish, fish, birds, and mammals, and with a majority of Millingstone sites less than 25 kilometers from the shoreline there appears to have been a focus on shellfish consumption. Virtually all the earliest known sites have been identified on the shore or in coastal valleys.

Several precontact archaeological sites have been recorded in the vicinity of the project. Most of these sites are located within agricultural fields on bluffs overlooking sloughs – areas ideal for exploiting the natural resources of the river, sloughs, and coastline. The sites generally consist of shell middens with lithic and ground stone scatters, and some with Native American burials. Previously excavated sites have produced an extensive and diverse artifact assemblage that includes: thousands of flaked stone artifacts (projectile points, bifaces, modified flakes, scrapers, cores, assayed cobbles, debitage); hundreds of ground stone and modified stone artifacts (milling slabs, hand stones, mortars, pestles, net weights, battered stones,

hammerstones); modified bone tools (awls); shell beads; abundant vertebrate faunal remains, including marine and freshwater fish (sharks, skates, rays, carps, minnows, rockfish, perch), and terrestrial, estuarine, and marine animals/birds (deer, elk, dusk, geese, seals, sea lions, snakes, rodents); shellfish remains, including estuarine, open beach, and rocky intertidal species (cockles, clams, barnacles, mussels, oysters); and a number of Native American burials. Previous excavations indicate that the project vicinity was occupied as early as the latter half of the Early Archaic Period, and during the Early and Middle Periods, which is suggestive of long-term habitation or repeated seasonal use (Ehringer et. al. 2020).

2.4.2 Ethnohistoric Context

In the designated Project area and vicinity, many contemporary descendants of the Indigenous People are commonly referred to as "Ohlone" or identify by their specific tribal band. The Ohlone people utilized eight distinct dialects within the Penutian language family and inhabited the region extending from what is now Richmond in the north to Big Sur in the south. They were organized into around fifty autonomous polities or tribelets. Upon European contact, it was noted that the Awaswas Ohlone dialect was spoken in the northern part of Santa Cruz County, while the Mutsun dialect was prevalent in the southern portion. Ethnographic records from the time of contact depict the Ohlone as residents of permanent villages, while also engaging in activities like staying in smaller camps for the collection or processing of seasonal resources such as acorns or shellfish.

2.4.3 Historic Context

Spanish colonial contact within the area began with the Portola expedition in 1769 and their travels through the region to find suitable lands for ranching/agriculture. In the historic era, cattle and sheep ranching dominated until the 1880s. During this time, fencing with wooden posts and barbed wire became a prominent feature across the landscape. Agriculture in the area became more intensive when farming shifted to wheat and barley cultivation. Early crops also included sugar beets and alfalfa. Apple orchards were the dominant crop in the Pajaro Valley for much of the 20th Century. While apple orchards remain, most of the agriculture in the Pajaro Valley has been replaced by crops that can be harvested more than once a year, including berries and vegetables. After World War II, Watsonville also became a frozen-food processing center.

The development of railroads, including the Southern Pacific and regional lines such as the Monterey and Salinas Valley Railroad and the Pajaro Valley Consolidated Railroad, allowed for distribution and improved marketing for the Central Coast Region. By the 1890s, Watsonville had a thriving freight business, serving the needs of the Pajaro Valley's agricultural commerce. Local farmers and fruit packing houses shipped strawberries, apples, and other fruits and vegetables to market at San Francisco and beyond. The development of the refrigerator car allowed produce to be shipped as far as Chicago and New York, opening new markets to Pajaro Valley's farmers. By 1901, the coast route was open and running between San Francisco and Los Angeles, further opening distribution routes.

Numerous ethnic groups have called Watsonville and the Pajaro Valley home since the mid-1800s, including those of Slavic, Chinese, Japanese, Filipino, and Mexican descent. Slavic groups entered the area as agriculture boomed after development of the railroads, first meeting

the need for field labor, and later entering the buying, shipping, and farming markets. At one point they controlled at least one-third of the orchards in and around Watsonville (Edwards and Farley 1974).

The Chinese entered the area after the Gold Rush and railroad-buildings eras, establishing fishing villages and providing field labor. By the mid-1880s, a Chinatown had been established in Watsonville along Main Street and Union Street to Maple Avenue. After the Chinese exclusion Act of 1882, availability of Chinese labor declined. The Japanese first immigrated into the area around 1892 on lumber-cutting contracts, but soon began to fill the need of low-cost farm labor left vacant by declining Chinese populations. The National Origins Act of 1924 restricted Japanese immigration, again leading to a decline in low-cost farm labor. In 1942, the Japanese were forcibly placed into internment camps for the duration of World War II. While many were reluctant to return to Pajaro Valley after the end of the war due to anti-Japanese sentiments, the establishment of a hostel at the first Buddhist Church and Japanese Language Buildings encouraged their return, and they established strawberry and flower growing industries (Edwards and Farley 1974).

Filipino immigrants first entered Pajaro Valley in the 1920s after the expiration of Hawaiian sugar contracts. By January 1930, anti-Filipino sentiments prompted the Northern Monterey County Chamber of Commerce to publicly state that whites had a supreme right to inhabit the county, setting off a race riot. On January 22, a mob of 700 whites attacked Filipinos in their homes, killing one Filipino man. The five days of the Watsonville riots had a profound effect on the attitude of California residents, and the California legislature explicitly outlawed Filipino-white intermarriage following 1933's Roldan v. Los Angeles County decision (Okada 2012). By 1934, the federal Tydings–McDuffie Act restricted Filipino immigration to fifty people per year, and a Repatriation Bill offered to pay Filipinos their passage back to the Philippines, but most declined and stayed in Pajaro Valley. Many were later drafted in World War II.

Mexican farm laborers became an increasingly important source of labor after the 1920s. During World War II, the United States encouraged Mexican immigration through the issuance of short-term agricultural labor contracts in anticipation of labor shortages due to the war. By the time the program ended in 1964, Mexicans had become the dominant source of farm labor in the Watsonville region. Today, Watsonville’s population is approximately 70 percent Latino, and they continue to provide over 90 percent of the farm labor.

During the Great Depression in the 1930s, many families migrated from the Dust Bowl of Oklahoma and the surrounding area to Pajaro Valley in search of work, establishing camps along the riverbanks. Competition between out-of-work white migrants and ethnic laborers led to an eruption of violence, and eventually more offers to provide free transport home to Mexicans and Filipinos who shared the same economic and labor profile (Edwards and Farley 1974).

2.4.4 Area of Potential Effects

The Area of Potential Effects (APE) is defined as the geographic area within which a project may directly or indirectly cause change to the character or use of historic properties. Historic properties may include buildings, structures, objects, sites, and districts that are listed in or determined eligible for listing in the National Register of Historic Places (NRHP). As shown in

Figure 2-17, this project's APE includes 112 acres, encompassing the construction footprint and 100-foot buffer in areas where changes in view or vibrations, fugitive dust, or auditory conditions during and after construction could impact properties within or adjacent to the construction footprint. The vertical APE extends 10 feet below ground surface and encompasses the maximum depth of ground disturbing activity for the crossing improvements and ecological restoration work.

2.4.5 Historic Properties

The National Register of Historic Places (NRHP) was established by the NHPA of 1966, as “an authoritative guide to be used by federal, State, and local governments, private groups and citizens to identify the Nation’s historic resources and to indicate what properties should be considered for protection from destruction or impairment” (36 CFR 60.2) (U.S. Department of the Interior, 2002). The NRHP recognizes a broad range of cultural resources that are significant at the national, state, and local levels and can include districts, buildings, structures, objects, prehistoric archaeological sites, historic-period archaeological sites, traditional cultural properties, and cultural landscapes. As noted above, a resource that is listed in or eligible for listing in the National Register is considered a “historic property” under Section 106 of the NHPA.

To be eligible for listing in the National Register, a property must be significant in American history, architecture, archaeology, engineering, or culture. Properties of potential significance must meet one or more of the following four established criteria:

A. Are associated with events that have made a significant contribution to the broad patterns of our history;

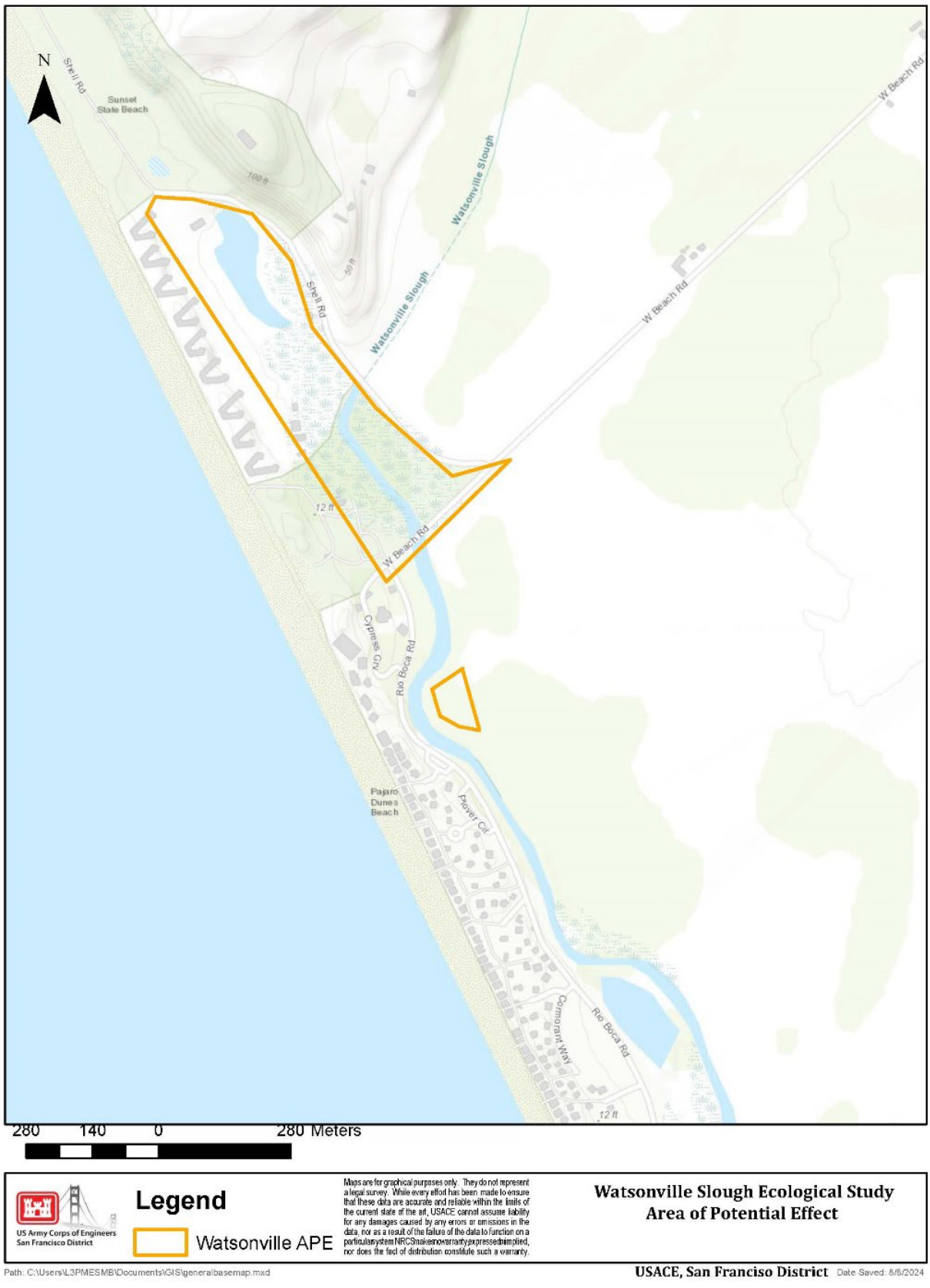
B. Are associated with the lives of persons significant in our past;

C. Embody the distinctive characteristics of a type, period, or method of construction or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or

D. Have yielded, or may be likely to yield, information important in prehistory or history.

In addition to meeting one or more of the criteria of significance, a property must have integrity. Integrity is defined as “the ability of a property to convey its significance” (U.S. Department of the Interior, 2002). The National Register recognizes seven qualities that, in various combinations, define integrity. The seven factors that define integrity are location, design, setting, materials, workmanship, feeling, and association. To retain historic integrity a property must possess several, and usually most, of these seven aspects. Thus, the retention of the specific aspects of integrity is paramount for a property to convey its significance.

Ordinarily religious properties, moved properties, birthplaces or graves, cemeteries, reconstructed properties, commemorative properties, and properties that have achieved significance within the past 50 years are not considered eligible for the National Register unless they meet one of the Criteria Considerations (A-G), in addition to meeting at least one of the four significance criteria and possessing integrity (U.S. Department of the Interior, 2002).



Note: The APE of this project is the location outlines in orange.

Figure 2-17. Area of Potential Effect

2.4.6 Archival Research

USACE completed a records search on December 2, 2021, at the California Historical Resources Information System's Northwest Information Center located in Sonoma State University (NWIC File No: 21-0722). No historic properties were previously identified within the APE, which has undergone extensive reconnaissance surveys as well as archival research, limited testing, and excavation. 22 previous archaeological investigations and cultural resource inventories were completed within a 1-mile radius of the APE. These studies were completed since the 1970s to identify archaeological resources that might be impacted by development within the Watsonville Slough and Pajaro Dunes area.

2.4.7 Tribal Consultation and Traditional Cultural Properties

The California Native American Heritage Commission (NAHC) maintains a confidential Sacred Lands File (SLF), which contains sites of traditional, cultural, or religious value to the Native American community. The NAHC was contacted on March 14, 2020, to request a search of the SLF. The results of the SLF search conducted by the NAHC indicated that no Native American cultural resources are known to be located within the study area (Appendix C [Cultural Resources] of this document). USACE initiated tribal consultation in 2021 and shared the results of this survey in 2023 (refer to Appendix C for a summary of all tribal consultation). To date, USACE is consulting with the Amah Mutsun Tribal Band regarding the identification and restoration of culturally significant plants in the project area. USACE will also collaborate with this tribe for interpretative signage on state park lands.

2.5 Aesthetics and Recreation

2.5.1 Aesthetics

Aesthetics is generally defined as the visual character of a landscape that contribute to the public viewer's experience and appreciation of that environment. Visual quality of a setting can be determined by the visual impression or attractiveness of a site to the public. The visual quality of a site may be defined as low, moderate, or high based on the natural and cultural characteristics of the region. The study area is located in unincorporated Santa Cruz County near the coastline of Monterey Bay. The study area is characterized by flat topography, and its visual character can be typified as rural agricultural croplands, a meandering slough interspersed with marshes and small ponds, and pockets of residential development and recreational features like sandy beaches by the coastline (Figure 2-18). Although the public view of the visual character is subjective, the visual quality of the study area is low to moderate.

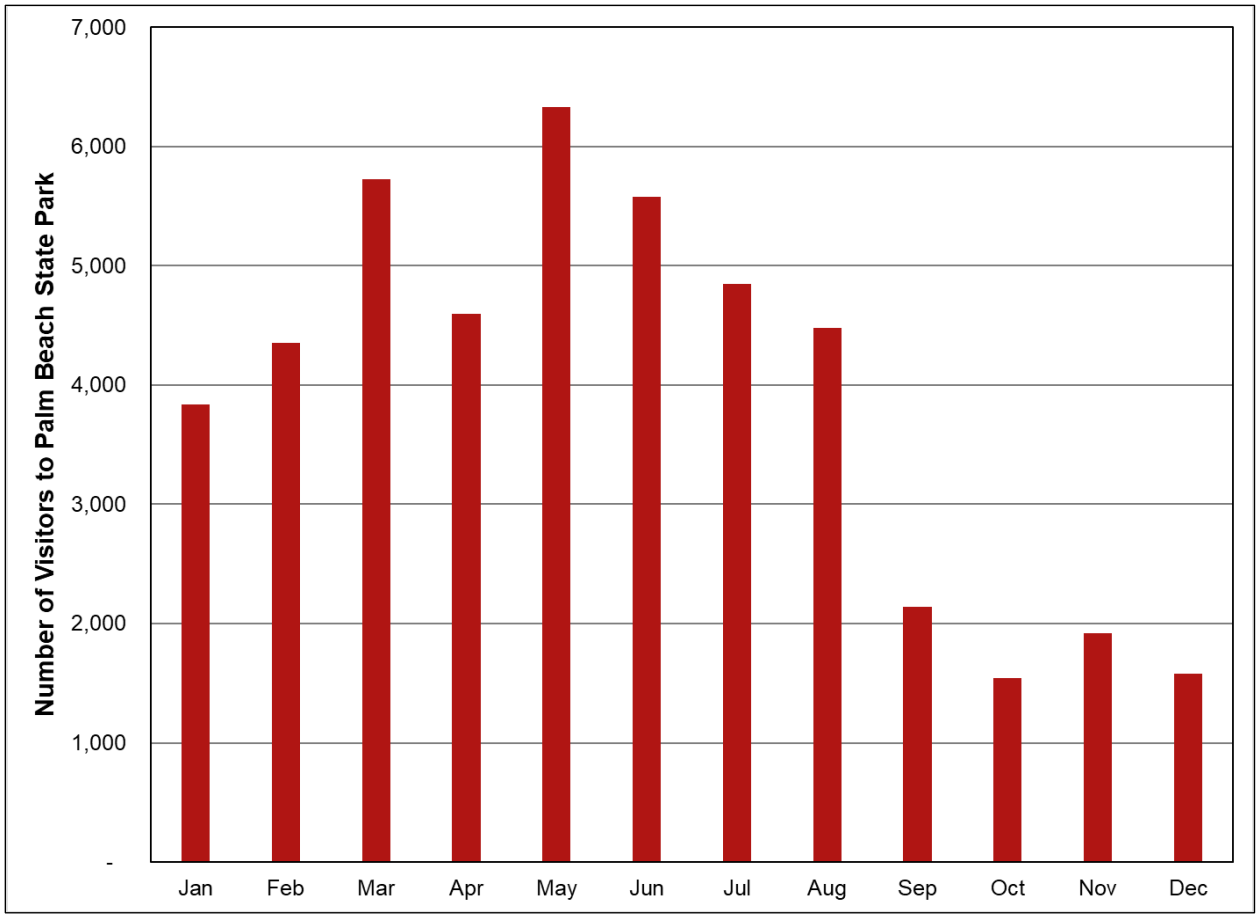
Photo Credit: Santa Cruz County

Figure 2-18. View of Study Area Looking North from Near Confluence of Watsonville Slough and Pajaro River

2.5.2 Recreation

Recreational activities in the immediate project area are limited due to lack of access, walkway, or roads. Currently, there are no official trails along the lower Watsonville Slough. There are state parks along in the vicinity of the lower Watsonville Slough. Closest of these is Palm Beach State Park located immediately north of the project area and W. Beach Road is the only access to this beach. Sunset State Beach is to the north and Zmudowski State Beach is to the south of the project area, but they are outside of our study area. Shorebird Lagoon is a brackish pond within the Pajaro Dunes Resort and is accessible by the residents of Pajaro Dunes community and guided birdwatching tours led by Audubon and similar groups.

Data for the monthly number of visitors to Palm Beach State Park in the vicinity of the project area during 2020-2023 were obtained from the State of California - Natural Resource Agency, Department of Parks and Recreation. Figure 2-19 presents the monthly visitorship to the Palm Beach State Park in 2021. 2021 was only the year with continuous monthly data, and the seasonally high number of visitors were observed in January through August with the maximum occurred in May, and the relatively low number of visitors was observed in September through December.



Data Source: State of California- Natural Resource Agency, Department of Parks and Recreation

Figure 2-19. Monthly Number of Visitors to Palm Beach State Park in 2021

2.6 Air Quality

The study area is within Monterey Bay National Marine Sanctuary which is situated on the eastern edge of a North Pacific Ocean high pressure system, which determines the predominant meteorological conditions for the region. Although substantial variations from these typical conditions occur both seasonally and from day to day, the Monterey Bay coastal climate is characterized by considerable day-to-day persistence and seasonal mean temperature variations of about 5°C, typical of other maritime climates. The mean wind direction is from the west northwest/northwest during the dry-season months (May through October) when the North Pacific high-pressure system is located at its more northern location. As this high-pressure region shifts south during the wet-season months (November through April), the mean wind direction changes to a more westerly direction. The wind speed at the Monterey climate station ranges from 3.5 to 4 meters per second (8-9 knot) averages in April through June to 2-3 meters per second (4-6 knot) averages in January (Renard 1995) due largely to the seasonal changes in the intensity of the North Pacific high-pressure system. Mean temperatures range from 16-18°C during the summer/early fall to 10-13°C during the winter/early spring, although considerable day to day variations exist (NOAA 2024).

The federal Clean Air Act (CAA) is the comprehensive federal law that regulates air emissions from stationary and mobile sources. Last amended in 1990, it requires the United States

Environmental Protection Agency (USEPA) to set National Ambient Air Quality Standards (NAAQS or "national standards") for six principal pollutants (termed as "criteria" air pollutants) prevalent in the atmosphere and found to be harmful to public health and the environment: ground-level ozone, carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), respirable particulate matter (PM), and lead. Separate standards were later established for PM less than 10 microns in diameter (PM_{10}) and PM less than 2.5 microns in diameter ($PM_{2.5}$). NAAQS for the criteria air pollutants have been established for specified averaging times which typically include 1-hour, 8-hour, 24-hour and annual averages based on health effects observed over the duration of exposure. Pursuant to the 1990 CAA amendments, the USEPA classifies air basins (or portions thereof) as "attainment" or "nonattainment" for each criteria air pollutant, based on whether the NAAQS have been achieved. USEPA further classifies nonattainment areas according to increasing severity of pollution as marginal, moderate, serious, severe, and extreme.

The study area is located within the Monterey Bay Air Resources District (MBARD) which is one of 35 air districts established by California Air Resources Board (CARB) to protect air quality in California. The study area is in attainment for all criteria air pollutants pursuant to Federal CAA.

2.7 Noise

Noise can be defined as unwanted sound or sound in the wrong place at the wrong time. Noise also can be defined as any sound that is undesirable because it interferes with speech and hearing, is intense enough to damage hearing, or is otherwise annoying. The definition of noise as unwanted sound implies that it has an adverse effect on human beings and their environment. Noise may be generated from a point source, such as a piece of construction equipment, or from a line source, such as a road containing moving vehicles. Typically, noise decreases with distance. The source of noise can vary from an occasional aircraft overflight to continuous noise from traffic on an adjacent street. The sound pressure level is measured on a logarithmic scale with the 0 dB level based on the lowest detectable sound pressure level that people can perceive (an audible sound that is not zero sound pressure level). The actual time period in which noise occurs is also important since noise that occurs at night tends to be more disturbing than that which occurs during the daytime.

Human response to noise varies considerably from one individual to another. The effects of noise at various levels can include interference with sleep, concentration, and communication, may cause physiological and psychological stress, and hearing loss. Given these effects, some land uses are considered more sensitive to noise levels than others due to the duration and nature of time people spend at these uses. In general, residences are considered most sensitive to noise as people spend extended periods of time in them including the nighttime hours. Therefore, noise impacts on rest and relaxation, sleep, and communication are highest at residential uses. Schools, hotels, hospitals, nursing homes, and recreational uses are also considered to be more sensitive to noise as activities at these land uses involve rest and recovery, relaxation and concentration, and increased noise levels tend to disrupt such activities. Places such as churches, libraries, and cemeteries, where people tend to pray, study, and/or contemplate, are also sensitive to noise but due to the limited time people spend at these uses, noise increase impacts are usually tolerable. Commercial, industrial, and agricultural uses are considered the least noise sensitive. Below is a description of the location of sensitive

receptors near the study area. In general, the above noise-sensitive uses are also considered sensitive to vibration impacts.

2.7.1 Sensitive Receptors

Noise exposure goals for various types of land uses reflect the varying noise sensitivities associated with those uses. Residences, hospitals, convalescent care facilities, schools, guest lodging, libraries, churches, and recreational uses are most sensitive to noise intrusion and therefore have more stringent noise exposure targets than manufacturing or agricultural uses that are not subject to impacts such as sleep disturbance.

The Pajaro Dunes North and South residential and vacation rental neighborhoods are located approximately 1,000 feet and 800 feet from the project area, respectively. The recreational areas included Palm Beach State Park in the immediate vicinity of the project area, with the parking lot approximately 350 feet away.

2.7.2 Noise Levels within the Study Area

The noise environment surrounding the study area is influenced by vehicular traffic along local access roads such as Shell Road and W. Beach Road. The sensitive receptors are surrounded by agricultural lands. Noise perceived as disruptive by residents in proximity to existing agricultural operations may result from the operation of agricultural machinery in the evening or early morning hours. In addition, operation of exterior exhaust and cooling system equipment typically used in greenhouse operations can be a source of noise that may affect surrounding sensitive receptors. However, residents living within agricultural areas are typically either involved with the agricultural industry or were informed of and accepted the noise levels that occur within agricultural areas when they elected to live in an agricultural area (Santa Cruz County General Plan 2020). Typical noise levels in rural agricultural and residential areas range from the mid-40s to upper 50s dBA (PV Water 2020). Table 2-6 summarizes typical ambient noise levels based on population density.

Table 2-6. Population Density and Associated Ambient Noise Levels

Population Density	dBA, Ldn
Rural	40–50
Suburban	
Quiet suburban residential or small town	45–50
Normal suburban residential	50–55
Urban	
Normal urban residential	60
Noisy urban residential	65
Very noisy urban residential	70
Downtown, major metropolis	75–80
Under flight path at major airport, 0.5 to 1 mile from runway	78–85
Adjoining freeway or near a major airport	80–90
Sources: Cowan 1984; Hoover and Keith 1996	

2.8 Land Use and Agricultural Resources

Agriculture is the most valuable industry in Santa Cruz County. Important crops in Santa Cruz County include strawberries, raspberries, lettuce, Brussels sprouts, cut flowers, apples, miscellaneous berries, and vegetables. Crops in the immediate vicinity of the study area are vegetables. Land use in the vicinity of the study area is primarily agriculture, open space and residential development surrounded by farmland to the north and residential development to the south.

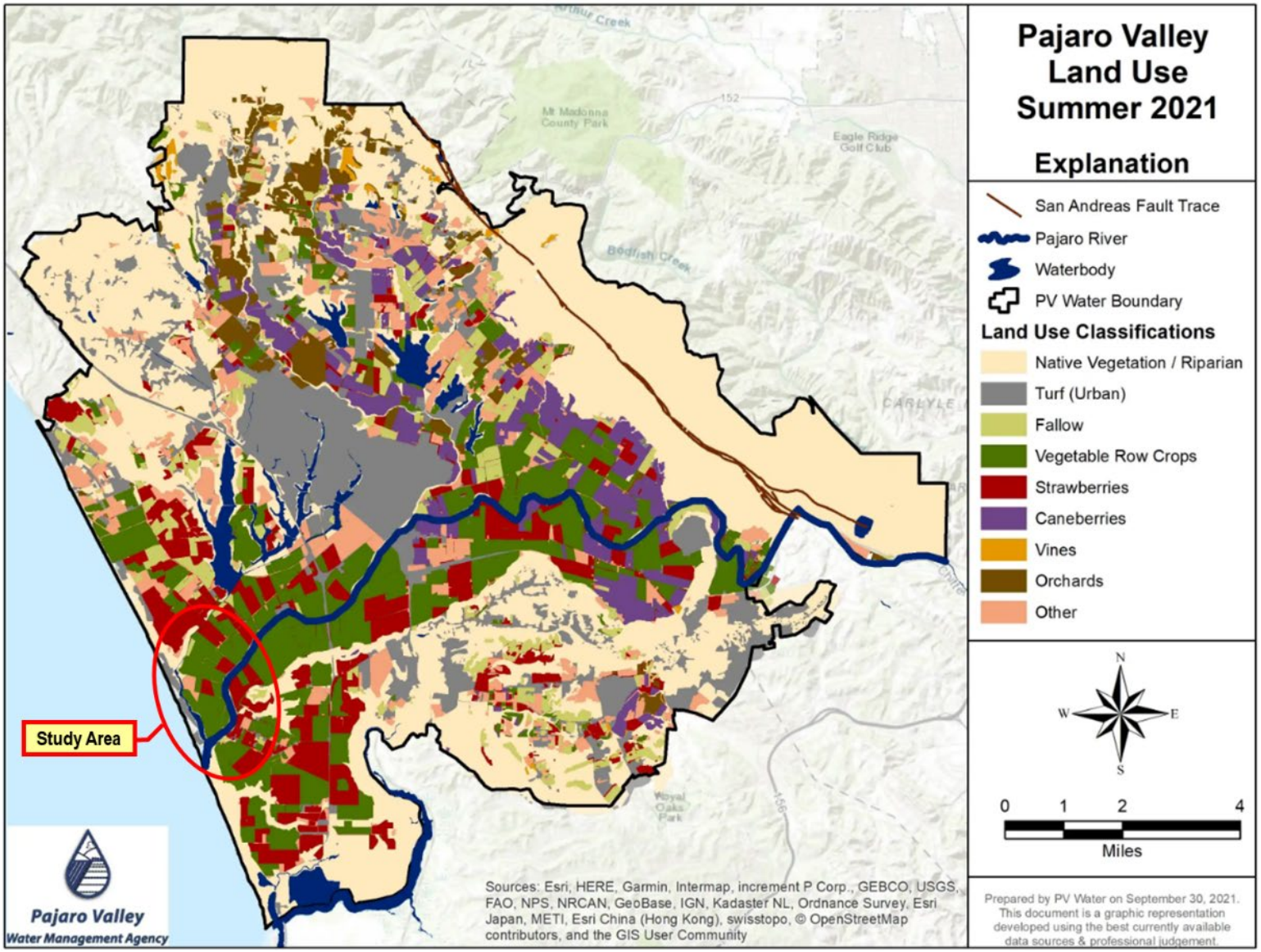
The Farmland Protection Policy Act (FPPA) is intended to minimize the impact Federal programs have on the unnecessary and irreversible conversion of farmland to nonagricultural uses. For the purpose of FPPA, farmland includes prime farmland, unique farmland, and land of statewide or local importance. Figure 2-20 presents a map depicting the areas designated as Prime Farmland, Farmland of Statewide Importance, Unique Farmland, and Farmland of Local Importance within the Pajaro Valley region within which the study area is located. Figure 2-21 presents the existing land use classifications and various crops grown in the region.

The study area is within the coastal zone. The California Coastal Commission administers the federal Coastal Zone Management Act along California's coastline by regulating the use of land and water within the coastal zone. Santa Cruz County has authority to approve coastal development permits within its jurisdiction pursuant to the provisions of its Local Coastal Program certified by the California Coastal Commission. The County's approved Local Coastal Program is integrated into the General Plan (2024).

In addition, some parcels in the Pajaro Valley have agricultural conservation easements. An agricultural conservation easement is a legal agreement between a landowner and a conservation organization or government agency that permanently protects land from development while keeping land in productive use.

Source: California Department of Conservation (2024)

Figure 2-20. Farmland Mapping



Source: PV Water 2024

Figure 2-21. Pajaro Valley Land Use as of Summer 2021

2.9 Traffic and Transportation

The Santa Cruz Metropolitan Transit District (Santa Cruz Metro) provides public transit service in the City of Watsonville. Santa Cruz Metro operates fixed-route bus service and Paratransit service throughout Santa Cruz County. However, Santa Cruz Metro does not provide any service to the vicinity of the study area due to the rural nature, as service is concentrated in the urbanized area of Watsonville to the east of SR 1. The primary method of getting around in the study area is via driving automobiles. The only access to residential area in Pajaro Dunes communities and state parks is via W. Beach Road. W. Beach Street runs in a southwest direction from the City of Watsonville and becomes W. Beach Road at the intersection of Shell Road. Because there were no observational data for traffic counts on W. Beach Road, the annual daily average traffic counts for W. Beach Street at various locations were obtained from Santa Cruz County to estimate a proxy of the traffic volume in the vicinity of the study area. The daily average traffic counts ranged from approximately 2,000 to 7,600 counts depending on the locations based on the data obtained in 2014-2022 (Table 2-7). Peak traffic volumes on roads in the study area during the week are associated with commute traffic and fall between 7:00 and 9:00 A.M. and 4:00 and 6:00 P.M. Weekend traffic volumes in the study area are high because of recreational traffic. Traffic in the study area also includes frequent large vehicles supporting agricultural operations.

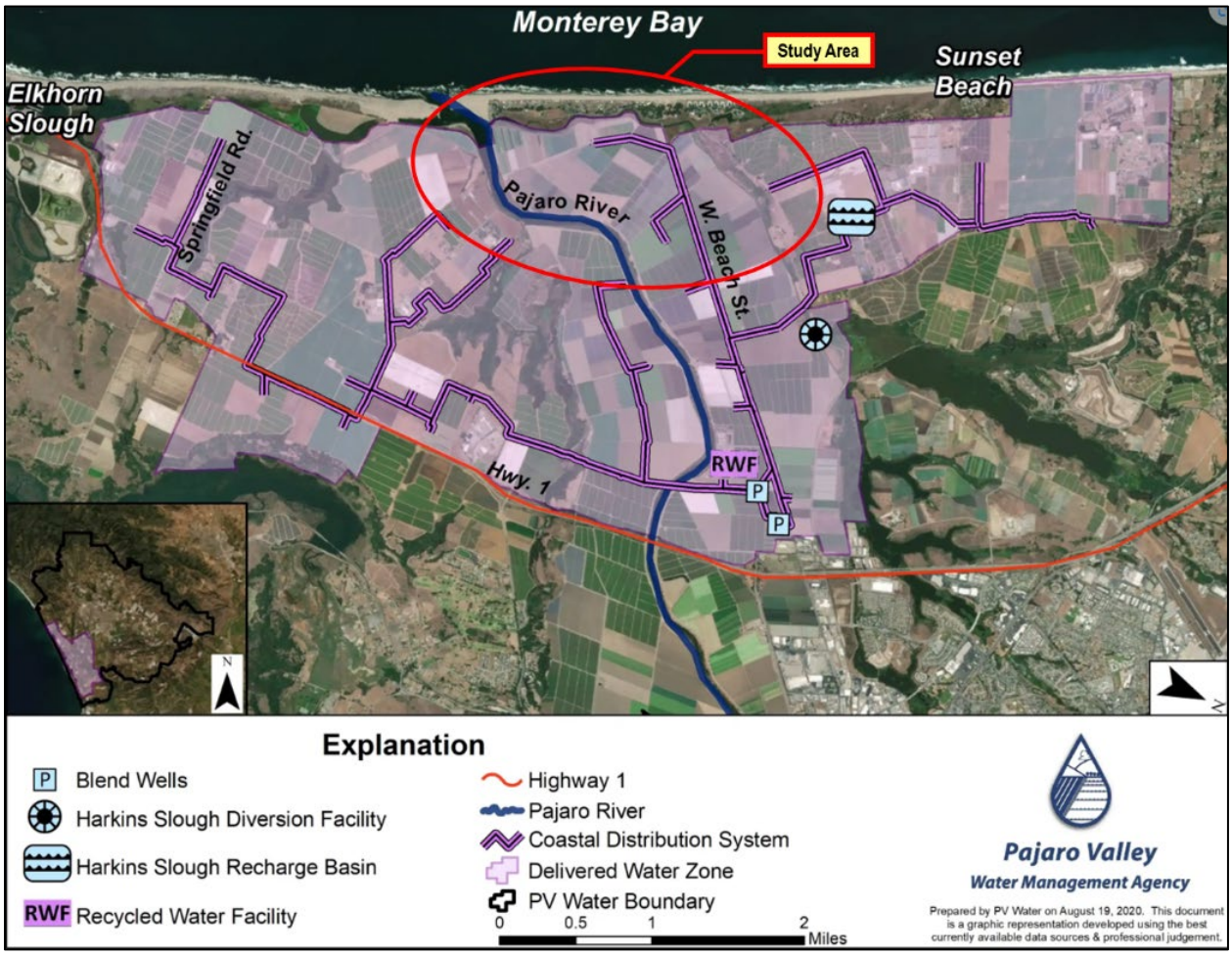
Table 2-7. Santa Cruz County Weekday Average Daily Traffic Counts 2014-2022

Location	From	To	Latest Count	Month/Year Counted
Industrial Rd	Route 129	W. Beach St	2,233	2/2015
Lee Rd	RR Tracks	W. Beach St	7,646	4/2017
Rodriguez St	W Lake Ave	W. Beach St	6,966	2/2015
Rodriguez St	W. Beach St	Riverside Dr-State HWY-129	6,994	2/2015
W. Beach St	Lee Rd	Industrial Rd	7,089	11/2022
W. Beach St	Walker St	Main St	5,190	2/2015
W. Beach St	Industrial Road	Harvest Dr	6,232	2/2015
W. Beach St	Harvest Dr	Walker St	6,874	2/2015
Data Source: Santa Cruz County Regional Transportation Commission (RTC) (2024)				

2.10 Public Services and Utilities

2.10.1 Water Supply

The Pajaro Valley Water Management Agency (PV Water) is the water purveyor for the lower Pajaro River watershed. PV Water's jurisdiction, the Pajaro Valley Groundwater Subbasin, encompasses approximately 75,000 acres in southern Santa Cruz County, northern Monterey County, and a small portion of San Benito County (PV Water 2023). Figure 2-22 shows the Coastal Distribution System, including the pipelines, the region that can receive delivered water, the Recycled Water Facility, blend wells, the Harkins Slough Diversion Facility, and the Harkins Slough Recharge Basin (PV Water 2024).



Source: PV Water 2024

Figure 2-22. Coastal Distribution System in Lower Pajaro Valley

2.10.2 Electricity and Natural Gas

Pacific Gas and Electric Company (PG&E) provides power and natural gas to residents and businesses in unincorporated Santa Cruz County area. As of 2018, residents and businesses in the County were automatically enrolled in Monterey Bay Community Power (MBCP)'s community choice energy program, which provides locally controlled, carbon-free electricity delivered on PG&E's existing lines.

2.10.3 Fire Department

Santa Cruz County Fire Department, District County Service Area (CSA) 48 County Fire service area includes a significant portion of unincorporated land surrounding the study area. The Pajaro Dunes community is covered by Santa Cruz County Fire Department, District CSA 4 Pajaro Dunes. The California Department of Forestry and Fire Protection (CalFIRE) CZU Pajaro Dunes Station #42 has contracts to provide fire protection and respond to emergencies to the District CSA 4.

2.10.4 Telecommunications

Telecommunications, including telephone, wireless telephone, internet, and cable, are provided by a variety of organizations. AT&T is the major telephone provider, and its subsidiary, DirectTV provides television and internet services. Cable television services in Santa Cruz County are provided by Charter Communications in Watsonville and Comcast in other areas of the County.

2.11 Communities in the Study Area

2.11.1 Population and Demographics

The study area's closest population centers are City of Watsonville, the unincorporated community of Pajaro Dunes, and the town of Pajaro in nearby Monterey County. Table 2-8 shows the historical trends in population in Santa Cruz County and Watsonville. The largest population increase occurred between 1970 and 1990; population has increased steadily since 2000.

Table 2-8. Population Statistics for Affected Area

	1970	1980	1990	2000	2010	2020
Santa Cruz County	123,790	188,141	229,734	255,602	262,382	270,861
Watsonville	14,719	23,662	31,099	44,265	51,199	52,590

2.11.2 Income and Employment

Income and employment statistics are a proxy for health of the local economy. Historical trends in labor force, employment, and unemployment rate for the Santa Cruz-Watsonville Metropolitan Statical Area are presented in Table 2-9. The statewide unemployment is included in Table 2-9 for comparison. In general, local unemployment is higher than the statewide employment statistics. Decreases in labor force and employment occurred in 2010 and 2020 in response to nationwide recessions. According to most recent American Community Survey, the median household income of Santa Cruz County is $102,146. The poverty rate is 12.9 percent which is slightly higher than the state of California which sits at 12.2 percent. The top employers in Santa Cruz County include education, healthcare, and government services as well as manufacturing and agriculture companies.

Table 2-9. Employment Statistics for Affected Area

Statistics	1990	2000	2010	2020
Labor Force	135,642	148,261	141,873	135,102
Employment	125,907	140,770	122,559	121,979
Unemployment Rate	7.20%	5.1%	13.6%	9.7%
Statewide Unemployment Rate	5.80%	4.90%	12.40%	10.20%
Source: Bureau of Labor Statistics, Employment Statistics Santa Cruz-Watsonville MSA				

The communities in the study area include communities of color (88 percent, which is greater than the state average of 61 percent. The communities experiencing low income within a 5-mile radius of the project site are 43 percent which is meaningfully greater than the state average of 28 percent. Figure 2-23 highlights the study area census tract and the surrounding census tracts considered to be disadvantaged communities, as defined by Section 160 of WRDA 2020.

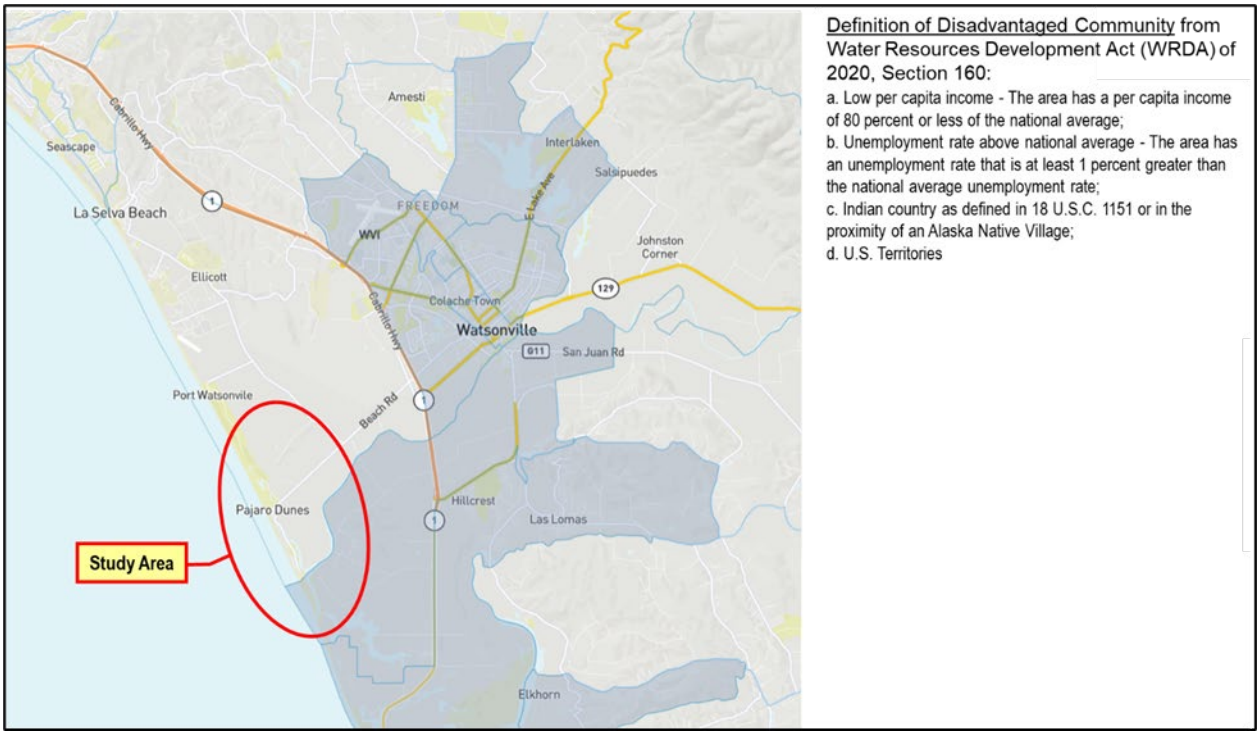


Figure 2-23. Disadvantaged Communities in the vicinity of Study Area

3 PLAN FORMULATION AND EVALUATION

Plan formulation is a structured and iterative process to develop and refine a reasonable range of alternative plans, then narrow down to a final array of feasible plans, from which a single plan may be recommended for authorization and implementation.

It begins with an understanding of the ecosystem through a synthesis of the existing conditions information to create a foundational ecological model of the Watsonville Slough lagoon and marsh ecosystem. This leads to a clear understanding of the problems, opportunities, objectives, constraints and considerations, which can then then help identify potential measures for solving the identified problems.

The formulation, evaluation, and comparison of alternative plans comprises the third, fourth, and fifth steps of the USACE planning process (Table 1-1 in Section 1.1 above), referred to collectively as plan formulation. Plan formulation for the Watsonville Slough CAP 1135 is being conducted in accordance with the six-step planning process described in *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies* (1983) and *Policy for Conducting Civil Works Planning Studies* (ER 1105-2-103, dated November 2023), which has superseded Chapter 1-3 of the Planning Guidance Notebook (ER-1105-2-100, dated April 2000).

3.1 Planning Framework

The Watsonville Slough CAP 1135 took the following approach to planning, which offers more detail of the iterative planning process used for this specific project than the basic six-step planning process presented in Table 1-1 of this report. Figure 3-1 summarizes the iterations of formulation, comparison, and selection to get to TSP, and each step is described more fully in the following sections.

1. The PDT leveraged charettes, planning workshops, and PDT meetings to gather information on existing conditions, problems, opportunities, objectives, constraints, and considerations.

2. The PDT synthesized the existing conditions information and identified problems to create a foundational ecological model of the Watsonville Slough lagoon and marsh ecosystem. This required a detailed look at existing vegetation and hydrology, as well as stressors and drivers likely to explain the degraded existing conditions.

3. The PDT leveraged charettes, planning workshops, and PDT meetings to identify restoration locations that could support desired habitats (e.g., coastal wetlands and marsh associated with the bar-built estuary). This included some areas that are currently mapped as having marsh vegetation but contain areas that exhibit invasion by upland weeds or stunted growth of marsh species.

4. An array of potential locations with preliminary conceptual restoration measures were developed to achieve marsh associated with bar-built estuaries. In some cases, a single location had multiple options for conceptual restoration measures associated with it. This

formed the initial array of planning measures (i.e., locations and reach-specific measures) that could be combined into alternatives.

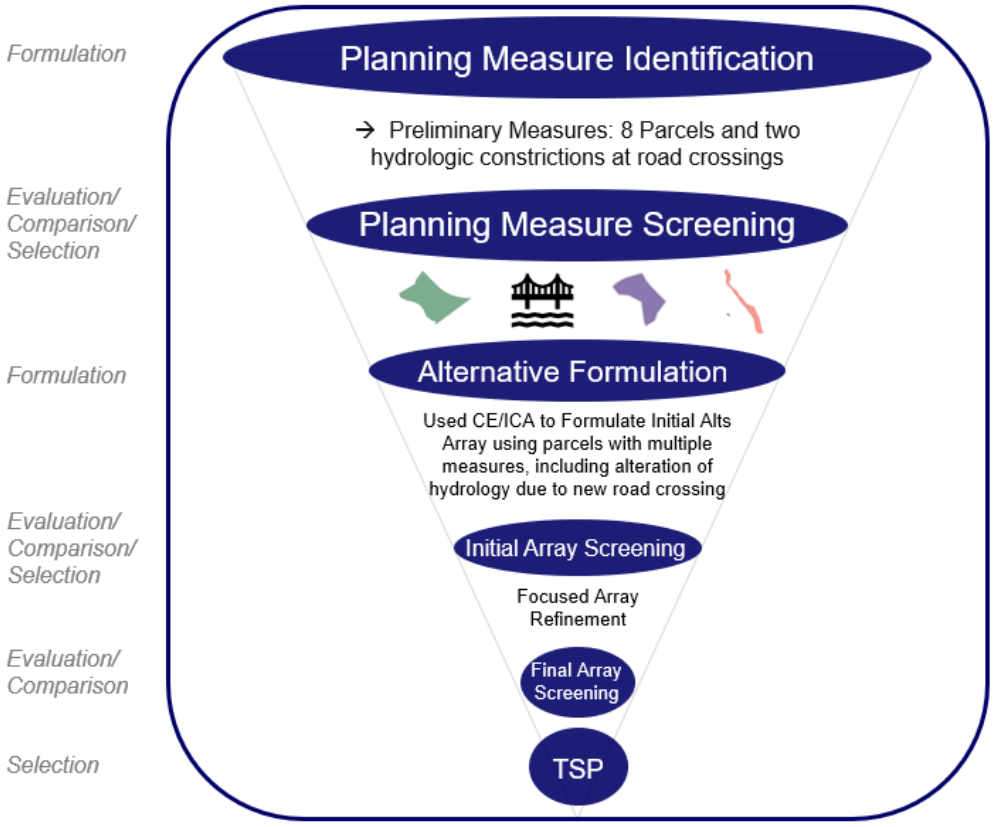


Figure 3-1. Planning Framework

5. This initial array of planning locations and measures were screened considering the study objectives, real estate availability, and whether a project including the measure was feasible within the CAP study financial limits, whether they resulted in unfavorable environmental tradeoffs to other listed species, resulting in a focused array of planning measures.

6. Because the underlying stressor to the ecosystem was shown to be truncated hydrology, a novel approach was developed for assessing ecosystem benefits, with the approval of the USACE's Ecosystem Restoration Center of Expertise (Eco-PCX) and vertical team. First hydraulic and hydrologic models were used to assess the annual percent inundation on the potential marsh plain under FWOP, and then under three different combinations of measures scenarios for each remaining parcel at year 0, 25, and 50, so determinations could be made as to the measures that improve hydrology the most (see Engineering Appendix B-1 [HH&C Appendix] of this document). These inundation results were then compared to vegetation mapping and divided into three categories: upland hydrology, marsh hydrology, and open water. For each planning measure (parcel plus specific restoration measures), the ecological benefit was measured as the increase in

acreage subject to marsh hydrology (see Appendix D [Ecosystem Benefit Modeling Appendix] of this document).

7. Ecosystem benefits were annualized using IWR Planning Suite and entered into Cost Effectiveness/Incremental Cost Analysis (CE/ICA) economic modeling, along with the annualized costs of the planning measures (see Appendix E [Economics] of this document). CE/ICA generated a final array of cost effective and best buy alternative plans.

8. Additional recreation features that were sensitive to the restored habitats and educational in natures were developed and the costs justified using recreation plan economic analysis tools.

9. These plans were assessed and compared, and a Tentatively Selected Plan (TSP) was selected.

3.2 Problems and Opportunities

Problems are undesirable conditions to be changed through the implementation of an alternative plan. Opportunities are positive conditions to be improved by an alternative plan. Solving problems and taking advantage of opportunities provide a basis for motivating and allocating the partners' pooled resources.

3.2.1 Problems

1. **Limited extent of estuarine marsh and related wetland habitat.** Land use practices and federal levees have limited surface and groundwater hydrologic processes and decreased the total area of estuarine marsh and related riparian-transitional estuarine wetland habitats associated with the Watsonville Slough and the Pajaro River lagoon and estuary by approximately 80%.

2. **Degraded quality of existing estuarine marsh.** Existing marsh plain includes areas of stressed marsh vegetation and invasion by upland exotics, indicating a truncation or shortening of the natural hydrology / inundation periods on the upper marsh plain. This is partially a result of mechanical breaching of the sand bar across the mouth of the Pajaro River to drain the lagoon and lower the surface water level within the estuary in order to preserve vehicle and pedestrian access to the Pajaro Dunes community and Palm Beach State Park. In doing so, the water that inundates the perched marsh plain during natural lagoon closures is also drained, truncating hydrology on the marsh plain and affects water chemistry by maintaining saline water conditions throughout the year, which limits aquatic wildlife species adapted to brackish water. Higher tidal water levels and more frequent lagoon closures are expected in the future, which will flood the road more frequently and require more frequent mechanical breaching, shifting the estuary to a fully open and saline condition, reducing hydrology to the perched marsh plain, and worsening groundwater inundation by seawater.

3. **Native and listed fish species have lost access to marsh plain.** Because land use and mechanical breaching have reduced the hydrologic connection between the slough and perched marsh plain, species such as steelhead and the federally endangered tidewater goby are negatively impacted by limited access to important rearing and foraging habitat.

3.2.2 Opportunities

1. Improve the quality and extent of estuarine marsh in Watsonville Slough.
2. Reduce the frequency of sandbar mechanical breaching and the associated environmental impacts of mechanical breaching (impacts to coastal, wetlands, air quality, water quality, species habitat).
3. Improve emergency and public access for residents, their guests, and visitors to Palm State Beach by reducing the frequency of road closures due to flooding.
4. Partner with tribal groups to incorporate tribal interests and traditional ecological knowledges as required by EP 1105-2-70, including the incorporation of native and/or culturally significant plants within the plant palette and tribal stewardship as part of revegetation measures.
5. Increase recreational opportunities and public education for the region's communities on the importance of natural lagoon function and estuary habitats.
6. Facilitate natural lagoon closures that reduce salinity in the lower estuary, forestalling seawater intrusion of the aquifer that negatively impacts agriculture.

3.3 Objectives, Constraints, and Considerations

This study is being conducted under the CAP Section 1135 for ecosystem restoration. The goal of this study is to restore aquatic ecosystem—estuarine marshes and related wetlands—in an area heavily modified by a previous USACE project. USACE's objective in ecosystem restoration planning is to contribute to National Ecosystem Restoration (NER) outputs. Therefore, the plan formulation prioritized meeting ecosystem restoration-related objectives, within the constraints and considerations identified. Planning constraints represent restrictions that limit formulation of alternative plans, whereas planning considerations represent concepts that formulation addressed, but which did not actually restrict formulation.

3.3.1 Objectives

The following planning objectives were identified during the planning charettes, with input from an interdisciplinary team, the non-federal sponsors, and agency partners. The objectives address the ecosystem restoration challenges and are consistent with the overall goals of the project to restore aquatic ecosystems in a heavily modified area. Objectives 1-4 are primary objectives related directly to the ecosystem restoration authority of the study. Objectives 5-11 address other problems and opportunities and are secondary objectives. These objectives were used to formulate and evaluate alternative plans.

1. Restore and improve estuarine marsh and related wetland habitat for native, culturally significant, and federally listed species.
2. Restore a more natural hydrologic regime and connectivity between the Watsonville Slough, the estuary associated with the Pajaro River lagoon, and the marsh plain to improve ecosystem function.
3. Improve aquatic ecosystem by maintaining fresher (less saline) water quality within the project area that supports the more diverse vegetative community of natural lagoon estuarine marshes.
4. Improve fish passage access to increase availability of marsh habitat to native fish species.
5. Increase recreational opportunities and public education.
6. Improve resilience to future extreme weather and sea level change.

3.3.2 Constraints

1. All real estate transactions must be with willing sellers.
2. The project cannot increase life safety hazard due to flooding.

3.3.3 Considerations

1. The project should consider the regional planning efforts for the Lower Watsonville Slough, including restoration proposed by others.
2. The project will mitigate any significantly exacerbate flooding in surrounding lands.

3.4 Conceptual Ecological Model Development

To address the problems and restoration opportunities associated with the Watsonville Slough CAP 1135 study, it was first necessary to understand the current stressors and drivers affecting the condition and quality of the marsh ecosystem associated with the estuary of the lower Pajaro River lagoon and Watsonville Slough. This section summarizes the investigations that led to a conceptual ecosystem model to which restoration measures could be linked.

3.4.1 Bar-built Estuary Associated with Watsonville Slough

Appendix D of this document (Ecosystem Benefit Modeling) begins with a literature review describing how bar-built estuaries function under natural, non-managed hydrology. The natural closures of lagoons provide essential hydrology to the perched marshes typical in bar-built estuaries. Open, tidal conditions frequently keep water in the sloughs themselves, or in the very low marsh immediately adjacent to them. Partially closed lagoons create somewhat elevated, muted tidal conditions that begin to back up onto the marsh plain, especially in areas with side channels and microtopographic relief. Much of the marsh plain is only inundated during lagoon closures, when backwater flooding leads to high water levels (Clark and O'Connor 2019). The closures are natural components of the hydrology of the perched marsh plains associated with these bar-built estuaries. These backwater events inundate the perched marsh plain, not only

contributing to the hydrology necessary for marsh plants but making the habitat accessible to young fish and other epibenthic species during critical lifecycles. This complex hydrology leads to diverse annual inundation regimes and diverse plant communities. For more information, see Appendix D and Section 2.2 of this report.

While approximately half of California's coastal confluences are bar-built estuaries with intermittently closed lagoons, a large percentage of those are subject to bar management, in which the river mouths are either periodically breached or permanently held open. Bar management decreases overall habitat condition in the associated estuarine marsh and reduces the number of native species supported on the marsh plain (Clark and Ross 2019). Decreasing the amount of bar management and restoring more natural hydrology to lagoons generally improves ecosystem function of associated marsh (Clark and Ross 2019, Largier et al. 2019).

Conversion of the historic marsh plain to agriculture represents one of the largest stressors on the ecosystem, as illustrated in Figure 1-3 under Section 1.5. Even after much of the marsh plain had been converted to agriculture, riverine floods and backwater flooding associated with natural lagoon closures had access to the floodplain until the federal levees were constructed on the Pajaro River and its tributaries in 1949. The federal levee is identified with red arrows in Panel C of Figure 1-3. Additional farm levees occur on the east side of Watsonville Slough. This system of federal and local levees maintains the converted agricultural lands and artificially confines lagoon and remnant marsh tracts.

Section 2.3.4 discusses the vegetation mapping completed on the remnant marsh tracts within the project area by Watsonville Wetland Watch. Existing conditions include areas of healthy marsh, in which native marsh vegetation is robust and creating a thick canopy across the marsh plain, but also areas of stressed marsh vegetation exhibiting sparse cover and stunted growth, often co-dominant with non-native or xeric species. Figure 3-2 illustrates the difference between healthy marsh, as shown in Insert B, and stressed marsh, as shown in Inserts A and C. Stunted "high and dry" marsh not only fails to support typical marsh vegetation but is not hydrologically connected to the aquatic ecosystem enough to support the habitat needs of threatened and endangered fish described in Section 2.3.3 of this report.

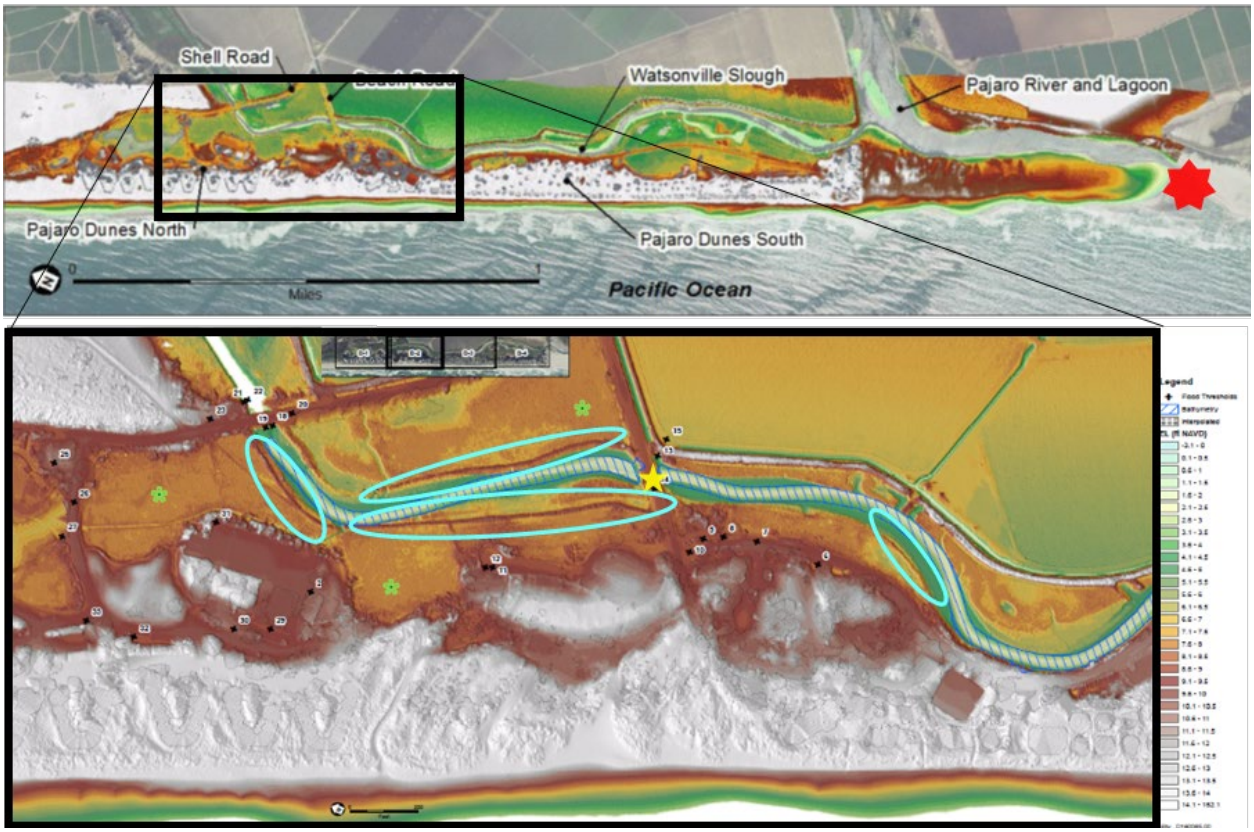
Note that red asterisks show areas of stressed marsh (inserts A and C) compared to areas exhibiting healthy marsh (insert B).

Figure 3-2. Stressed and Non-Native Vegetation Mapping

The PDT consulted with subject matter experts at the Central Coast Wetlands Group at Moss Landing Marine Laboratories, who have a research program dedicated to the ecology of marshes associated with “bar built estuaries”; Environmental Science Associates, who have studied and developed models on the hydrology of these systems; and, Watsonville Wetlands Watch, who have conducted vegetation mapping of the marsh plain. The result of these discussions identified that “truncated hydrology”, or limited inundation periods on the marsh plain, is likely responsible for the stressed marsh conditions and encroachment of upland species onto the Watsonville Slough marsh plain.

The PDT then turned to the task of identifying potential causes of truncated hydrology within the Watsonville Slough marsh plain. Several of these hydrology impediments are present. The

parcels immediately adjacent to the slough appear to have been laser-leveled in the past and are largely devoid of tidal channels or microtopographic heterogeneity (Figure 3-3, green asterisks). As such, water in the slough has limited access to the marsh plain during open-lagoon, low (i.e., tidal) water conditions. Complicating matters, a series of berms exist immediately adjacent to the slough, between the open water and the marsh plain. These appear to be side-cast berms associated with dredging the slough, but their origin is uncertain. These berms may also hinder water from entering the marsh plain during open-lagoon conditions (Figure 3-3, cyan ovals).



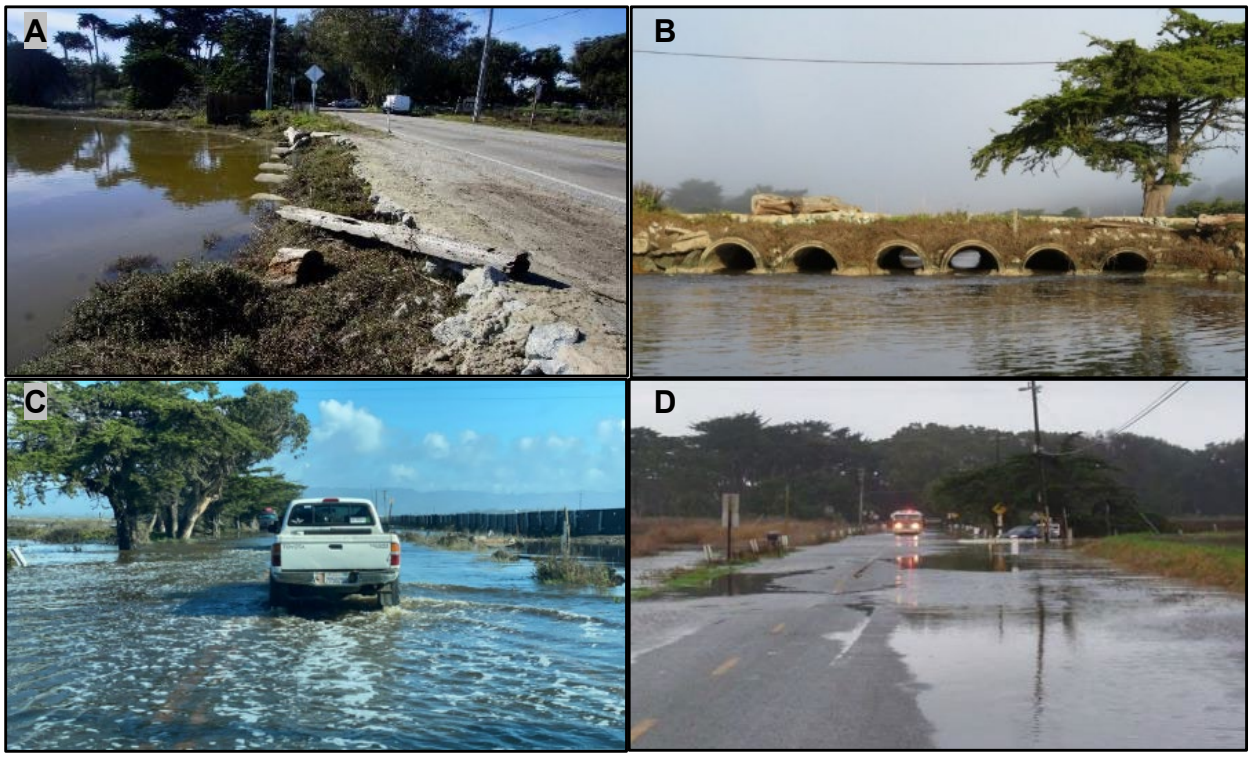
Note: Map identifies berms between slough and marsh plain (outlined in cyan ovals), a lack of channels on the marsh plain (green asterisks), and the undersized culverts and low crossing of W. Beach Road which gets flooded during natural lagoon closures (small yellow star), triggering the mechanical breaching of the lagoon at the mouth (large red star).

Figure 3-3. Factors That May Truncate Natural Marsh Hydrology

Most of the marsh plain is only inundated when lagoon closures raise the water levels in the estuary to the point they can move past the sidecast berms and onto the marsh plain, despite the lack of side channels.

The Watsonville Slough crossing at W. Beach Road (Figure 3-3, yellow star) currently consists of six 48-inch diameter culverts that are sufficient to carry flows during open-lagoon conditions (Figure 3-4, A and B), but are overtopped and insufficient to carry flows during closed lagoon conditions (Figure 3-4, C and D). Backwatering events result in flooding over the road and create hazardous driving conditions. The County maintains a water level sensor at the

intersection of Watsonville Slough and Beach Road that reflect conditions in Pajaro River lagoon, which inform mobilization readiness and, if needed, equipment mobilization and mechanical breach preparation. When backwater levels reach roughly 7.0 feet NAVD88 and are anticipated to rise further, the County may mechanically breach the lagoon at the mouth of the Pajaro River (Figure 3-3, red star) via excavator, draining the backwater flooding off the road and marsh plain, as described in more detail in Section 1 of this document.



Note: A) Looking west during high-tide, open lagoon conditions. B) Looking north during open lagoon conditions. C) Looking east during closed-lagoon conditions. D) Looking west during closed-lagoon conditions when a local firetruck had to traverse a flooded road. Note that in C and D, the culverts are completely overtopped and water in the lagoon and on the road are at the same level.

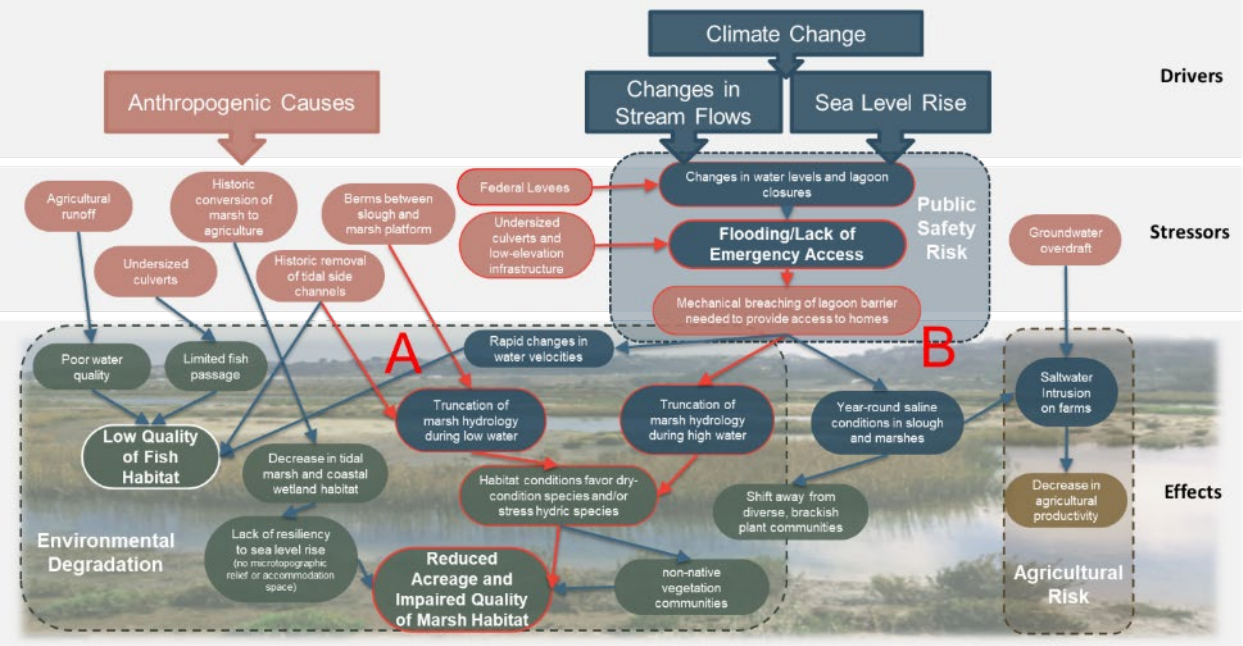
Figure 3-4. W. Beach Road Crossing of Watsonville Slough

The mechanical breaches have environmental impacts beyond potentially truncating the hydrology of the marsh. Maintaining the lagoon in an open state increases the percent of the year the lagoon experiences higher salinities, shifting marshes from diverse brackish communities to more saline ones (Clark and Ross 2019). The shift to more saline conditions also increases the potential of saltwater intrusion into the shallow aquifer.

3.4.2 Conceptual Ecological Model

Comparing the conditions at Watsonville Slough with the way bar-built estuaries are meant to function in California, the PDT developed a comprehensive conceptual ecological model (Figure 3-5). While many drivers, stressors, and effects are identified, the historic conversion of marsh to agriculture was identified as a primary stressor liming marsh acreage. Additionally, two potential pathways were identified that might account for the apparent truncation of hydrology on the remaining marsh plain. More details on the formation of the conceptual model can be

found in Appendix D of this document.



Note: Two pathways are shown that might explain the truncated hydrology apparent on the existing marsh plain: A) the removal of side channels and historic side cast berms prevent low slough water from entering the marsh plain, and B) the mechanical breaching of the lagoon prematurely drains high water from the marsh plain during lagoon closures.

Figure 3-5. Comprehensive Conceptual Ecological Model

3.5 Assumptions

During the planning effort, multiple planning assumptions were made based on the best available information:

- Land use practices will continue to limit tidal marsh and coastal wetland habitat.
- Investigations at the beginning of feasibility determined there were no willing sellers among the nearby farm tracts that could be used for restoration. As a result, it became a planning assumption that habitat improvements would have to occur within parcels of existing degraded marsh. As of 1 April 2023, parcels within the study area were commercially listed for sale. 270 acres of land were listed for $16.3 million, well beyond the 25% real estate procurement limit allowed for CAP 1135 projects. Brief conversations with the land trust groups suggest that land may be available for restoration and SLC accommodation in the future, but not in time for this project.
- The county has secured programmatic permitting for the breaching program which allows breaching at 7.0 NAVD88 to drain the lagoon and maintain access to the Pajaro Dunes Community and Palm Beach State Park, though typically breaching has occurred when water levels reach 8.0 NAVD88. Santa Cruz County lacks the funding to increase the size of the culverts at the W. Beach Road crossing to allow closed-lagoon water levels to pass through them and thereby improve hydrologic connectivity of the marsh.

There are no ongoing planning efforts or permitting associated with changes to the W. Beach Road crossing, so it is not part of the future without project condition.

- Native and listed fish and wildlife species will continue to be negatively impacted by limited access to high quality tidal marsh.

In addition, several assumptions can be made based on the effects of SLC on bar-built estuaries:

- As a result of anticipated future SLC, the frequency of lagoon mechanical breaching will increase. Impacts of increasing the frequency of breaching would transition the project area to a higher saltwater habitat, while continuing to leave areas of the marsh "high and dry" with poor habitat quality for fish and wildlife. This will have secondary negative effects, including potential saltwater encroachment into local shallow aquifers.

- Long-term SLC exceeding +3.0 feet, which occurs beyond 2120 on the USACE Intermediate SLC Curve and at 2075 on the USACE High SLC Curve, will convert the lagoon mouth with seasonal closures to becoming a permanently open, tidal connection.

3.6 Measures to Achieve Planning Objectives

Planning is an iterative process, starting with an initial array of considered locations, initial screening, and then identification of a final array of measures used for combining into plans, followed by additional screening, evaluations, assessments, and finally selections. In the following sections "planning measures" will be used to address both a location (aka parcel) and a set of restoration measures that could improve the hydrology and therefore marsh habitat associated with the parcel. Each parcel may have multiple planning measures associated with it, as different restoration measure "treatments" were assessed to determine which were most effective and efficient. In the initial array, the conceptual restoration measures are very general. The final array of planning measures includes both very specific extents for each parcel and specific restoration measures for the improvement of the hydrology. Each of the planning measures were assessed to determine benefits, and then the planning measures were combined into plans or alternatives using CE/ICA. These plans were compared to identify differences in ecosystem restoration or other benefits as well as environmental impacts and cost of implementation. CE/ICA was used to assess all possible combinations of planning measures and determine which produced ecological benefits most efficiently.

The team first looked at several parcels to see where restoration efforts would be most feasible. Then the team conducted hydrologic modeling to identify the measures that could provide the best ecological restoration benefits. These measures were then input into a model to assess what measures are the most cost effective at each location.

3.6.1 Initial Array of Locations

Ten restoration locations were identified and considered. Some of these are parcels where marsh could be expanded or improved, others are locations of hydrologic constrictions due to public infrastructure which, if improved, could lead to a change in the lagoon breaching program

and improved hydrology on marsh parcels (Figure 3-6, North to South):

1. Shell Road to Bryant Habert Property Reach
2. Shell Road crossing improvements allow the County to modify its breaching program and improve hydrology
3. Shorebirds Parcel
4. County-owned Parcel
5. State-owned Parcel
6. W. Beach Road crossing improvements allow the County to modify its breaching program and improve hydrology
7. Lower Mile Reach
8. Agricultural Land Adjacent to Lower Mile
9. Lower Reach of Pajaro River
10. McClusky Slough

These restoration locations and associated conceptual restoration measures were subject to an initial screening based on whether they exceeded the cost limit for the CAP, whether real estate would be available and not cost-prohibitive, whether they were an effective means for achieving the objectives of the project, and whether they met the Principles and Guidelines Criteria of:

- **Efficiency** – The potential benefits/outcome of the measure are greater than what could be provided by another measure/plan of equal or greater cost.
- **Effectiveness** – Extent to which a measure or alternative alleviates problem areas and meets planning objectives.
- **Acceptability** – Viability and appropriateness of an alternative from the perspective of the general public and consistency with existing federal laws, authorities, and public policies.
- **Completeness** – Extent to which an alternative provides and accounts for all features, investments, and/or other actions necessary to realize the planned effects, including any necessary actions by others.

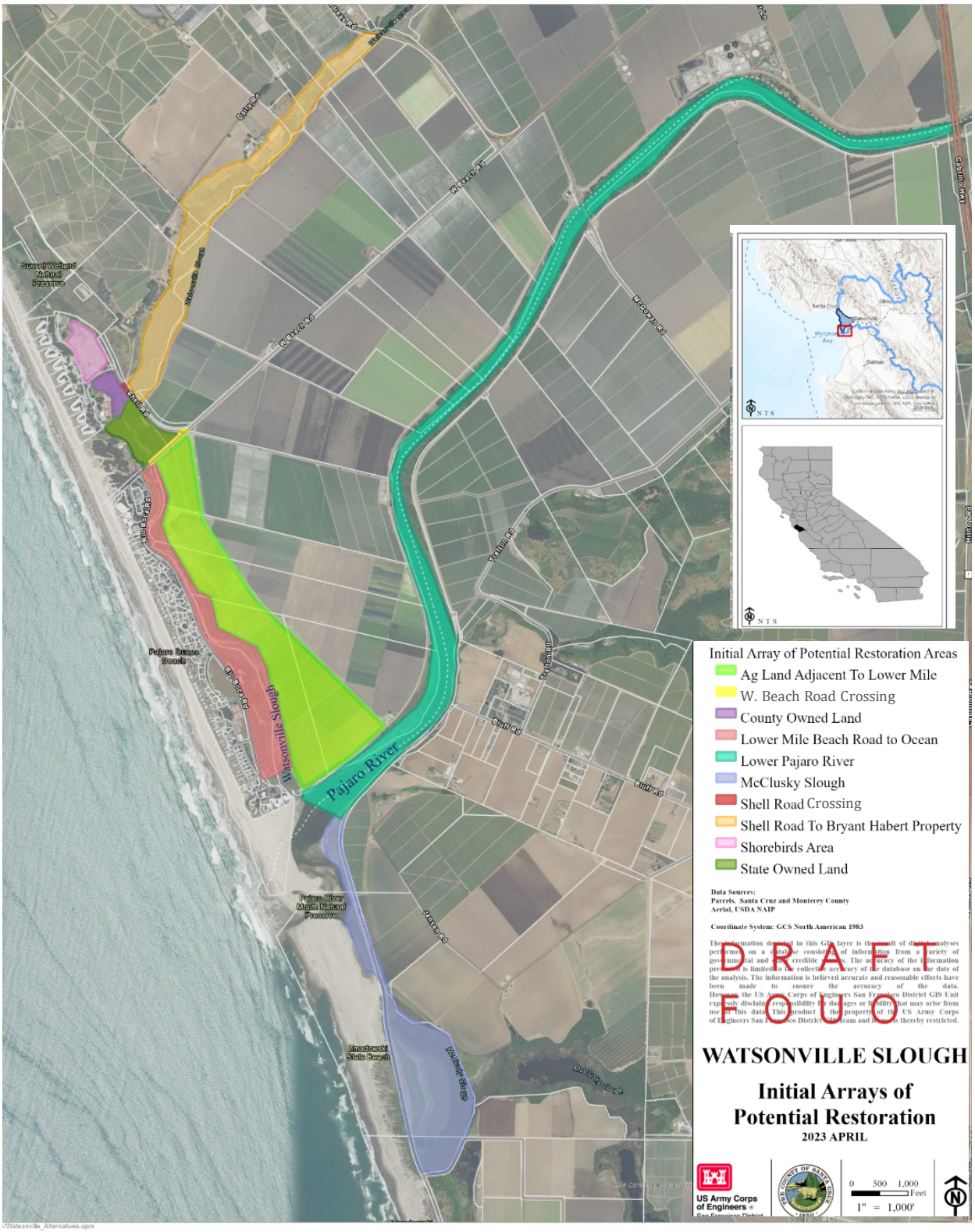


Figure 3-6. Initial Array of Potential Restoration Locations

The location screening (Table 3-1) removed several of the initial array of restoration measures and location. Some were screened because real estate was unavailable. Some were screened because the complexity of the measures required were likely to exceed the CAP spending limit, even as it was increased during feasibility from $10M to $15M. Others were screened because existing freshwater habitat supports red legged frog, and the tradeoffs associated with converting these areas to estuarine marsh were not deemed justified. Results of the screening produced four major alternatives components: three locations where marsh could be improved through several onsite measures, one location where the replacement of low culverts that cannot accommodate closed-lagoon water levels and raising of the road could remove a trigger for lagoon breaching and improve hydrology on the considered parcels and throughout the lagoon. These alternative components are carried forward in the next sections for further evaluation.

3.6.2 Final Array of Planning Measures (Locations and Measures)

The three locations retained for marsh restoration include the County Owned Parcel, the State-Owned Parcel, and two tracts along The Lower Mile (the stretch of slough between W. Beach Road and the confluence of Watsonville Slough), which are treated together due to common ownership) (Figure 3-7). Each of these parcels show some vegetative stress and invasion by exotics that suggest hydrologic truncation by one of the two pathways shown on Figure 3-5. Since the PDT did not know which pathway was causing the hydrologic stress, three sets of measures were proposed to improve the hydrology and thus marsh habitat on each parcel:

1. No Action
2. Grading of channels and breaching of sidecast berms on the parcels themselves (Earth Work)
3. Improving the W. Beach Road crossing by replacing and enlarging the culverts and raising the road to accommodate the improved culverts, enabling the County's to modify their breaching program (Crossing Improvements)
4. Both Crossing Improvements and Channel/Breach Earthwork

Table 3-1. Summary of Conceptual Measure/Location Screening and Rationale for Watsonville Slough CAP 1135

	Restoration Measure/Parcel (North to South)	Retained	Rationale / Screening Criteria / Notes
	Shell Road to Bryant Habert Property	NO	Not feasible within CAP. Target tidal habitats currently precluded by antiquated pump station, which is necessary to keep water fresh for farming. Removal would impact farmers. Restoration to riparian would require replacement of pump station at high cost. Real estate not currently available. Restoration in this area could be part of a large GI or local effort. (*Screening Criteria Used: Effectiveness, Efficiency, Acceptability, Real Estate Availability, CAP Scope)*
	Crossing Improvements: Shell Road	NO	Altering the crossing at Shell Road is not necessary to meet project objectives (Screening Criteria Used: Effectiveness)
	Shorebirds Parcel	NO	This is a very popular birding location for the local community. This popular site has paved access around a large freshwater pond. Any restoration measure to reconnect tidal influence would impact the existing freshwater habitat and associated benefits would be at the expense of the freshwater habitat. This would likely be met with resistance and is out of scope for a CAP project *(Screening criteria: Effectiveness, CAP Scope, Efficiency, OSE, Acceptability).*
	County Parcel	YES	Currently the parcel exhibits large areas of stressed and non-native marsh vegetation that would benefit from the project
	State Park Parcel	YES	Currently the parcel exhibits large areas of stressed and non-native marsh vegetation that would benefit from the project
	Crossing Improvements: W. Beach Road	YES	This is the most downstream crossing or Watsonville Slough. The hydrologic constriction by the undersized culverts causes emergency access hazards that frequently trigger the lagoon breaching, dewatering the marsh plain. Improving this crossing improves the hydrology beyond its footprint, into any retained parcels.
	Lower Mile	YES/ Partial	Restoration in this area would require several RE agreements with landowners that the project has no relationship with but because the land is currently tidally influenced, the PDT has retained this measure while the non-federal sponsor (NFS) works with the landowners to discuss RE acquisition.
	Ag land adjacent to Lower Mile	NO	This area was not available for purchase when Feasibility began. It recently went on the market for a price beyond the CAP limit. If it is purchased by a land trust, it may become available for restoration in the future as part of a large GI or local effort. *(Screening Criteria Used: Efficiency, Real Estate Availability, CAP Scope)*
	Lower Pajaro River	NO	Limited space for restoration. *(Screening Criteria Used: Effectiveness, Efficiency, Real Estate Availability)*
	McClusky Slough	NO	This restoration intended to reestablish tidal processes to an existing freshwater pond. This raises concerns with impacts to the Red Legged Frog populations which are freshwater-dependent and would be negatively impacted. RE acquisition would require relationship building with local landowners. The Slough is outside of the sponsor's jurisdiction and is in Monterey County so would increase scope of project. *(Screening Criteria Used: ESA Impacts, Real Estate, CAP Scope, Acceptability)*

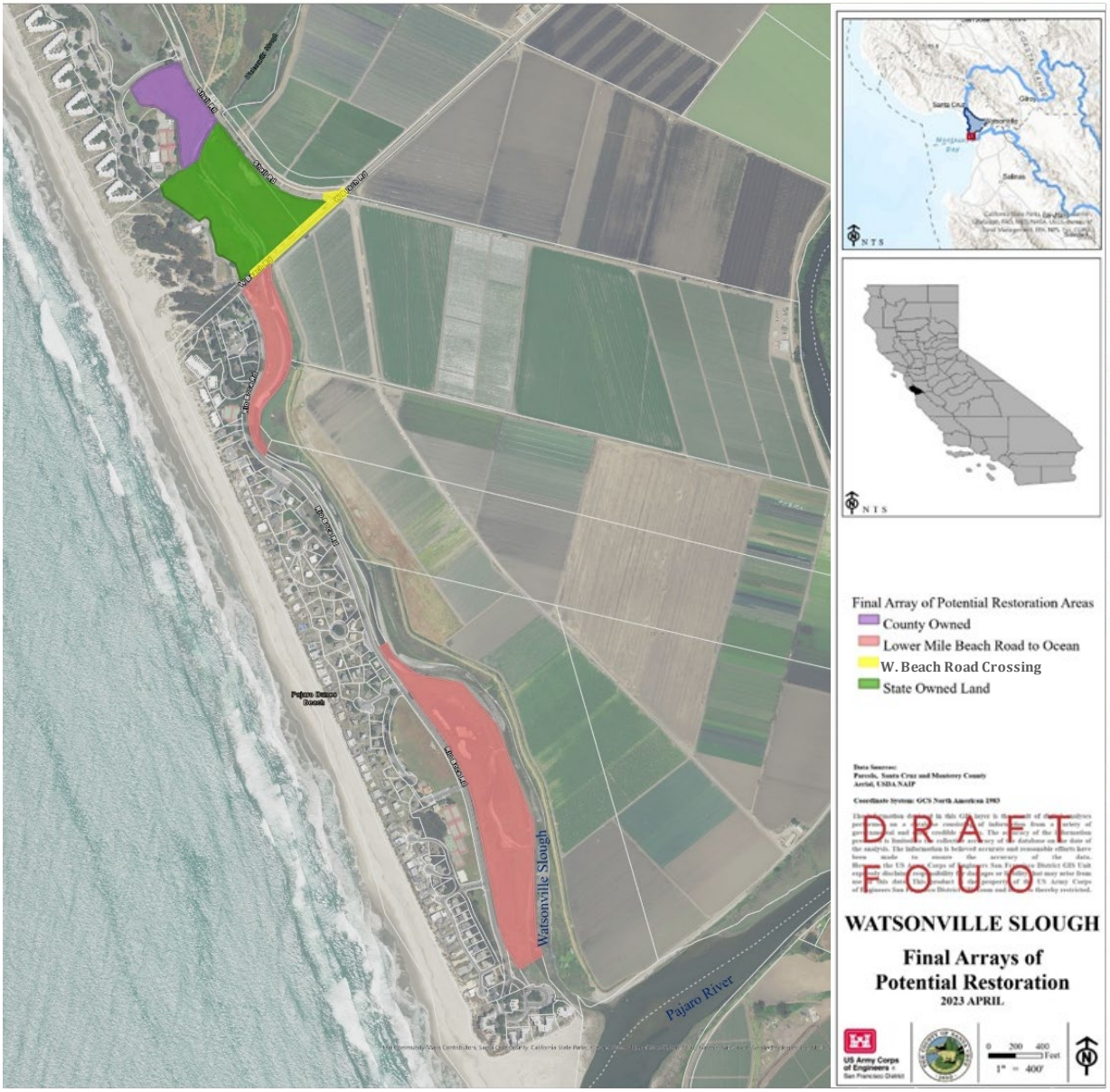
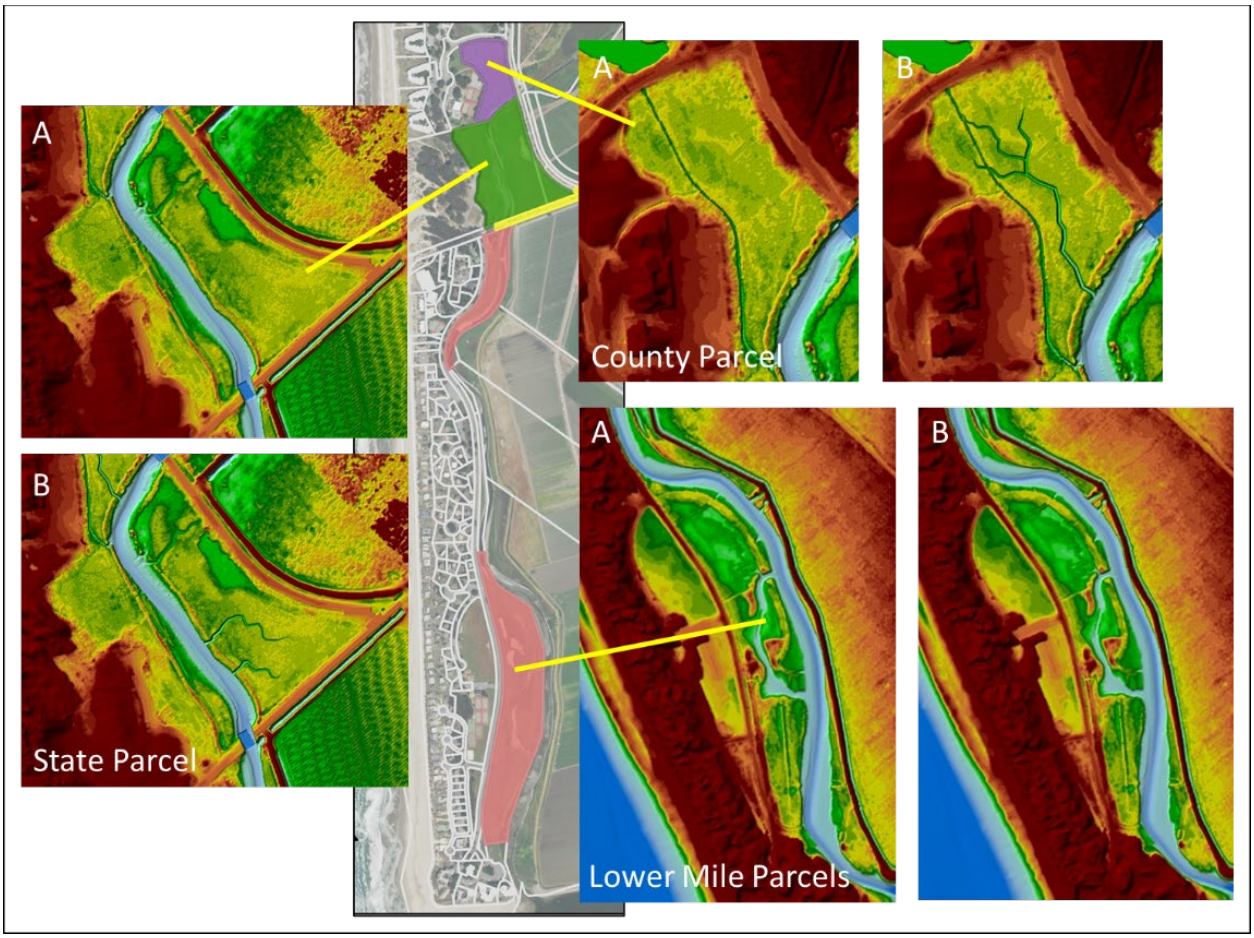


Figure 3-7. Final Array of Restoration Locations

For each of the restoration locations, the PDT developed a new restoration terrain of parcel-specific features, incorporating newly restored tidal creeks and/or breaches of the small side cast berms between the slough and marsh plain (Figure 3-8). These “Earthwork” measures were designed to counteract the truncation of hydrology during low water or tidal conditions and have a positive impact on Pathway A in the conceptual ecological model (Figure 3-9).

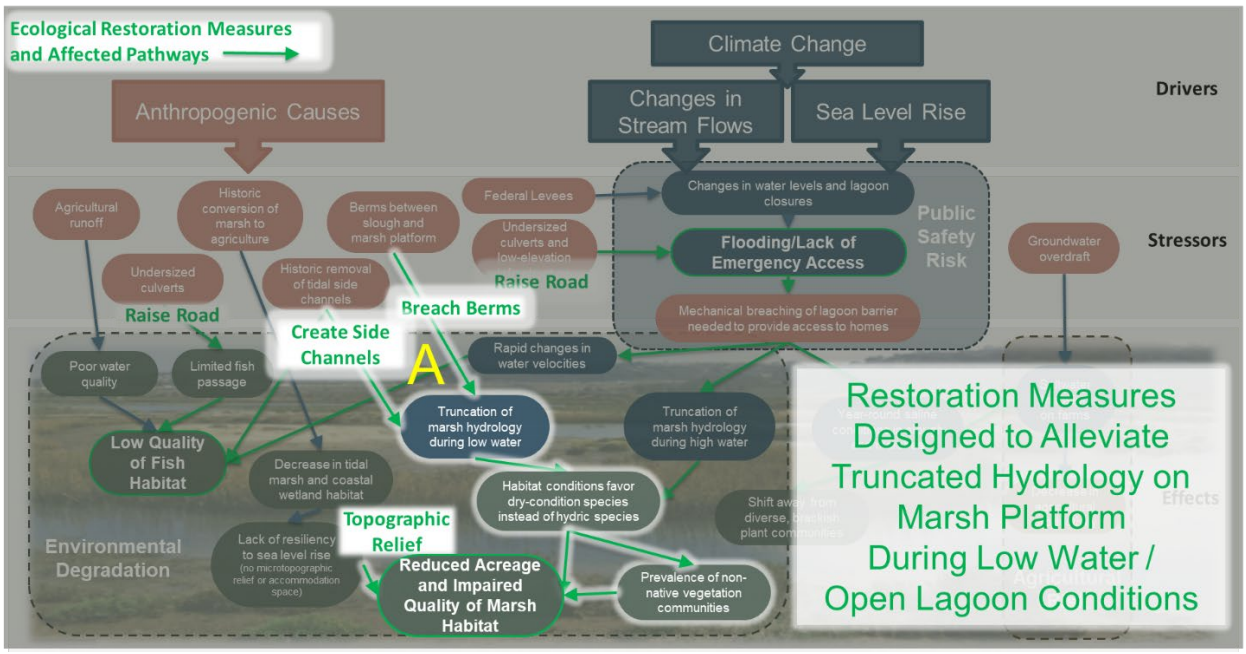
Measures that rectify the truncation of high-water inundation events include the modification of hydrologic constrictions and raising of critical infrastructure so the marsh plain may be inundated during closed-lagoon conditions without creating flood risk and safety concerns. The most relevant includes changes to the W. Beach Road crossing of Watsonville Slough. Replacing the six undersized culverts with a single, larger and higher culvert would allow the conveyance of closed-lagoon water levels. Enlarging and raising the culverts requires raising W.

Beach Road crossing at Watsonville Slough from 8.0 to 9.2 feet NAVD88, allowing the marsh plain to be inundated during lagoon closures without causing flooding of the road. The new culvert would support improved fish passage compared with the existing series of culverts. These measures, hereafter referred to as “Crossing Improvements”, are designed to affect Pathway B of the conceptual ecological model (Figure 3-10). More details for both the “Earthwork” and ”Crossing Improvements” measures can be found in the Appendix B-1 and Appendix D of this document.



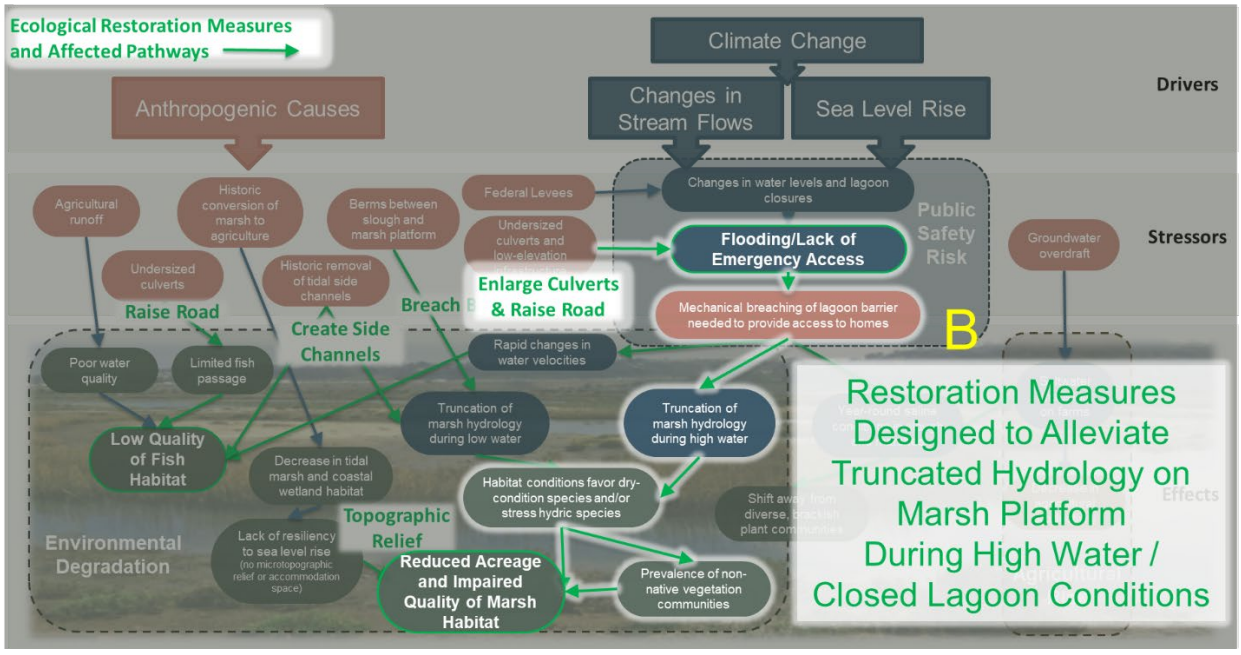
Note: For each parcel in the final array of locations, earthwork measures were designed to improve the terrain from existing conditions (A labels) to a terrain that included "earthwork" measures in the form of berm breaches and the excavation of side channels designed to improve marsh hydrology (B labels). More details can be found in Appendix B-1 of this document.

Figure 3-8 “Earthwork” Designs



Note: Earthwork measures, including breaching existing berms between the slough and marsh plain and excavating new side channels into the marsh plain, and using the material to create microtopographic relief, all address Pathway A of potential marsh hydrology truncation in the conceptual ecological model.

Figure 3-9 Measures that Affect Pathway A



Note: Enlarging the culverts at the W. Beach Road crossing of Watsonville Slough so that they can convey the closed-lagoon water levels and adjusting the road height to accommodate them would allow the marsh plain to be inundated without flooding the road and triggering the county to breach the lagoon. This would positively affect Pathway B in the conceptual ecological model.

Figure 3-10. Measures that Affect Pathway B

Each of the three restoration areas or parcels can potentially be subject to one of four "treatment" scenarios or sets of restoration measures, leading to a total of twelve planning measures (combined locations and restoration measures) that can be combined into potential plans, as illustrated in Table 3-2. Note that these are the building blocks of alternatives, and not alternatives themselves.

Table 3-2. Array of Planning Measures

Parcels	Treatment Scenarios			
	No Action/	Channel/Breach Earth Work Only	Crossing Improvements/ Longer Lagoon Inundation Only	Crossing Improvements and Earth Work
	(NA)	(EW)	(CI)	(CIEW)
County Parcel	County NA	County EW	County CI	County CIEW
State Parcel	State NA	State EW	State CI	State CIEW
Lower Mile Parcels	Lower Mile NA	Lower Mile EW	Lower Mile CI	Lower Mile CIEW

3.6.3 Ecological Benefits of Final Array of Planning Measures

Details of the approach used to determine the ecological benefits of measures designed to improve marsh hydrology are described across Appendix D and Appendix B-1 of this document. Appendix D includes the ecological basis for the hydrologic approach to modeling bar-built estuaries (Section 2), the conceptional model for Watsonville Slough (Section 3), an overview of the measures being assess and a very high-level overview of the H&H modeling (Section 4). Appendix B-1 includes much more detailed descriptions of the hydrology (Section 2), restoration measures including terrains and the determination of lagoon breaching thresholds (Section 3), hydraulic modeling and the resulting Percent Time Inundated heat maps (Section 4), and the role of sea level change in projections (Section 5). Finally, Appendix D details how the modeled Percent Time Inundated heat maps were compared to existing vegetation maps to determine the inundation ranges that support robust marsh vegetation, creating a habitat suitability index calibration for modeled marsh hydrology that became the foundation for the Habitat Units used in this analysis (Section 5).

To determine the combination of restoration measures that are most effective at extending the acreage of the marsh plain subject to annual inundation ranges preferred by target marsh species, the PDT developed a methodology that combined several hydrologic models. Short (2-month) HEC-RAS 6.3 model runs within Watsonville Slough were conducted for different lagoon regimes: Open Lagoon Dry Season, Open Lagoon Wet Season, Closed Lagoon Dry Season, and Closed Lagoon Wet Season (Figure 3-11, first column). These model runs generated four "heat maps" for Percent Time Inundated within HEC-RASMapper (Figure 3-11, middle column). These were brought into GIS and combine via a weighted average into a single Annual Percent Time Inundated heat map (Figure 3-11, last column). The weights for the percent of the year the lagoon was in each of the four states was based on 10 years of empirical data for existing

conditions and were based on Lagoon Quantitative Conceptual Model (QCM) (Behrens 2015) for the forecasts. Assumptions around the lagoon mouth behavior patterns at the downstream boundary were informed by Lagoon QCM (Behrens et al. 2015). This allowed the results of the four HEC-RAS runs for each alternative to be combined, weighting each regime by the percent of the year it prevailed, based on Lagoon QCM results. Mechanical breaches were implemented at 8.0 feet or 9.2 feet NAVD88, depending on whether the crossing improvements were part of a modeled scenario. The model also considered sea level change over the life of the project, and how that would change lagoon dynamics (also modeled with Lagoon QCM). The process for generating the annualized heat maps of inundation on the marsh plain is summarized in Figure 3-11.

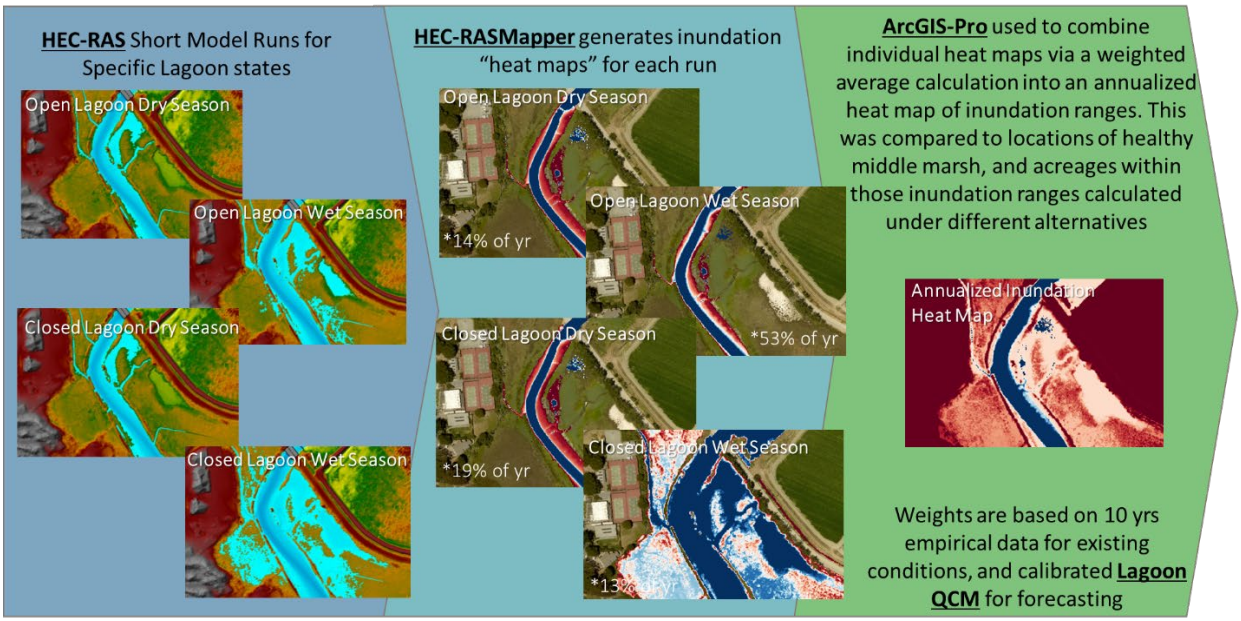
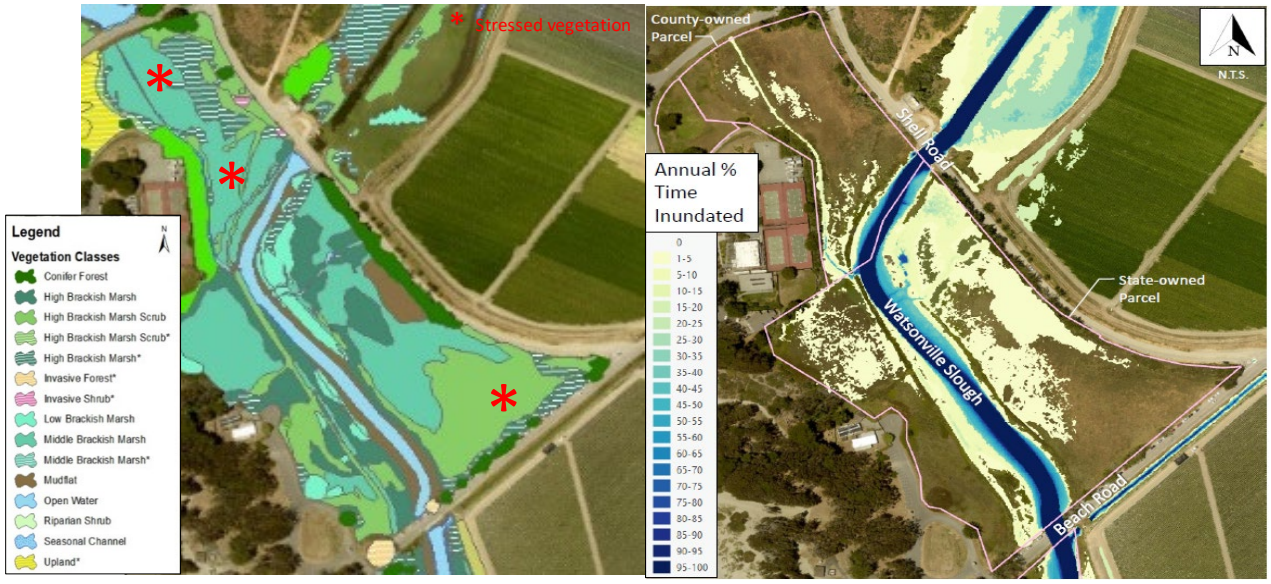


Figure 3-11. Summary of Marsh Ecological Benefit H&H Modeling Based on Changes in Marsh Plain Hydrology

The Ecological benefit H&H modeling resulted in annualized inundation heat maps for each of the following scenarios: No Action (Future without Project), Crossing Improvements, Earth Work, and Crossing Improvements + Earth Work. These heatmaps were binned into annual inundation ranges (0-1%, 1-5%, and 5% increments from 5-100%) to ease analysis and visualization of the data and clipped to the restoration locations so that planning measures could be "mixed and matched" in different alternative plans.

To correlate the inundation maps with habitat, the inundation heat map for No Action, Year 0 (i.e., existing modeled inundation) was compared with existing vegetation mapping of Watsonville Slough completed by Watsonville Wetlands Watch (Figure 3-12). Areas modeled as being wetter than 50% inundation were generally mapped as mudflat or open water. Low marsh corresponded with approximately 15-50% modeled annual inundation. Areas of healthy pickleweed middle marsh were closely associated with modeled inundation ranges between 1-15%. Areas modeled as 0-1% annual inundation were mapped as one of the following: stressed pickleweed marsh, middle marsh co-dominant with xeric and exotic species, high marsh

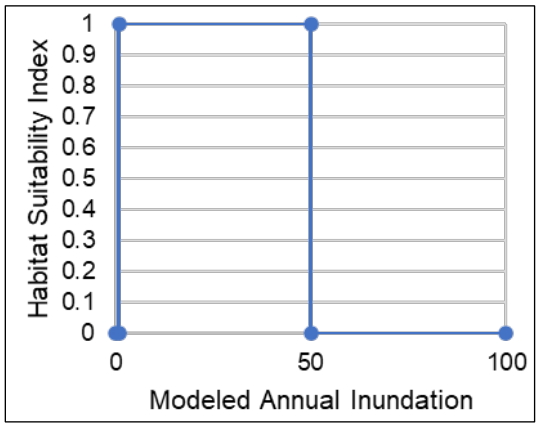
codominant with xeric exotic vegetation, or high marsh scrub, some of which was stressed.



Note that hatched vegetation types include exotics and upland species. Red asterisks show areas of stressed, stunted vegetation. Open water and mudflats correspond with 50-100% modeled annual inundation. Low marsh corresponds with 15-50% modeled annual inundation. Middle marsh corresponds with 1-15% modeled annual inundation. Areas mapped as 0-1% support stressed middle marsh, exotics, some stressed high marsh, and high marsh scrub.

Figure 3-12. Comparison of Mapped Existing Vegetation and Modeled Existing (i.e., No Action, Year 0) Inundation

This mapping led to a very simple "Habitat Suitability Index" or HSI to determining ecological benefits. For the purposes of tracking ecological benefits across the restoration measures, target "marsh hydrology" was determined to be 1-50% modeled annual inundation, which received a 1 in this index (Figure 3-13). This broad range of inundation included the low and healthy middle marsh, and some areas of health high marsh.



Note: Model Annual Inundation between 1-50% received a "1" in the suitability index, because it correlated with the broad mapping of healthy marsh. Inundation between 0-1% received a 0 because this is where the stressed or invaded marsh occurred. 50-100% inundation also received 0 because it was typically mudflat and open water.

Figure 3-13. Marsh Habitat Suitability Index

Even though some healthy high marsh is mapped in the areas modeled as having 0-1% annual inundation, signification portions of those areas are either stressed or co-dominant with xeric non-native and invasive species. This indicates that these are “high and dry” areas of the marsh affected by the truncated hydrology, as identified by the subject matter experts consulted for the study. These areas received a “0” in the HSI because they are too dry to support healthy marsh (Figure 3-13). Likewise, inundation ranges from 50-100% receive an HSI of “0” because they are too wet to support healthy marsh, typically being mapped as mudflat or open water. Note that sea level change is included in all analyses, and therefore the projected benefits.

With correlation between habitat and inundation established, the binned inundation heat maps were clipped to the three parcels being considered as restoration measures/locations (County-owned, State-owned, and Lower Mile). The results were exported to Excel for analysis.

The purpose of the ecosystem restoration project at Watsonville Slough is to expand marsh hydrology across the marsh plain. To assess the effectiveness of the restoration measures at each parcel, Habitat Units (HU) (i.e., the acreage within the 1-50% inundation times the HSI of 1 for marsh hydrology) was calculated over the life of the project for each scenario. Average Habitat Units for three time-steps, Years 0, 25, and 50, were annualized into a single Average Annualized Habitat Unit (AAHU) per parcel per restoration scenario (Table 3-3). Finally, the No Action or “Future Without Project” AAHUs are subtracted from all scenarios to show the benefits of the restoration measures in Table 3-4.

Table 3-3. Average Annualized Habitat Units for Each Parcel and Restoration Scenario

	No Action Years 0-50, Annualized HUs	Earth Work (EW) Years 0-50, Annualized HUs	Crossing Improvements (CI) Years 0-50, Annualized HUs	Crossing Improvements + Earth Work (CIEW) Years 0-50, Annualized HUs
County	0.69	0.78	3.41	3.37
State	4.58	4.69	10.03	9.98
Lower Mile	10.39	10.45	14.1	14.08

Table 3-4. Benefits for Each Parcel and Restoration Scenario

	No Action Years 0-50, Annualized Benefits	Earth Work (EW) Years 0-50, Annualized Benefits	Crossing Improvements (CI) Years 0-50, Annualized Benefits	Crossing Improvements + Earthwork (CIEW) Years 0-50, Annualized Benefits
County	0	0.09	2.72	2.68
State	0	0.11	5.45	5.4
Lower Mile	0	0.06	3.71	3.69

3.7 Array of Alternatives*

Because the team did not know which combinations of measures at each site would combine into the most effective plans, CE/ICA was used to generate all possible plans, and a preliminary list of cost-effective plans, from with the final array of alternatives was developed after considering risks and other factors.

3.7.1 Generation of Plan Alternatives Using CE/ICA

The marsh hydrology benefits associated with each planning measure shown in Table 3-4 (location and specific hydrology restoration measure measures), along with the costs associated with the restoration measures at each location, were entered into the IWR Planning Suite II to conduct the CE/ICA analysis (Appendix E). Each parcel had multiple potential treatment scenarios, as shown in Table 3-4. As stated previously, each column of the table had separate modeling runs associated with it, the results of which were then clipped to the parcels to allow CE/ICA to mix and match different planning measures into alternative plans. However, there were limitations on the combinability of the planning measures.

First, each parcel could only be used once. For instance, no plan could combine County EW with County CI because they inhabit the same space.

In addition, no plan could combine a parcel treatment that included crossing improvements with a treatment for a different parcel that excluded the crossing improvements (e.g., County EW could not be combined with State CI) (Table 3-5). Once the crossing was improved to accommodate closed-lagoon water levels for one parcel, it was improved for all of them. However, plans could combine channel improvements for one parcel with “No Action” on another. The PDT was advised that even if the changes to inundation will occur to other parcels in the lagoon, the study can only claim them as project restoration benefits if the real estate is purchased and monitored. So, if a parcel is not included in an alternative that includes crossing improvements, that simply means that the real estate costs associated with controlling the parcel, removing exotics, replanting, and monitoring were not part of the plan, and therefore the benefits are not being counted, even though the beneficial hydrologic shift is likely occurring within other marsh parcels.

Table 3-5 illustrates the combinability of different measures. An alternative plan may be composed of one, two, or three parcels by selecting No Action (NA) for excluded parcels. Parcels receiving Earth Work Only (EW) measures may be combined with either other EW or NA parcels, as shown in Table 3-5 by the blue-green fill in the table. Parcels receiving Crossing Improvements Only (CI) may be combined with either other CI parcels, NA parcels, or parcels receiving crossing improvements and earthwork (CIEW), as illustrated by the lime-green fill in Table 3-5. Parcels with Earth Work Only measures cannot be combined with any parcels with Crossing Improvements, because once the culverts are replaced and the crossing is improved for one parcel, it is improved for all of them.

Table 3-5. Combinability of Parcels and Treatments in CE/ICA

Parcels	Treatments (Combinability shown via like colors)			
	No Action/ Don't Include[1] (NA)	Channel/Breach Earth Work Only (EW)	Crossing Improvements/ Higher Lagoon Inundation Only[2] (CI)	Crossing Improvements/ AND Channel/Breach Earthwork[2] (CIEW)
County Parcel				
State Parcel				
Lower Mile Parcels				

Notes:
1. "No Action" for a given parcel indicates that real estate will not be secured for it and no exotic plant removal, planting, or monitoring will occur. It can be combined either with other parcels in plans that include channel improvements, or those that don't.
2. These measures are dependent on the one-time cost of crossing improvements (i.e., culvert replacement and road raise) at the W. Beach Road crossing, regardless of how many parcels are included in a plan.

CE/ICA generated 35 plans based on these combinability rules. Six were identified as cost effective, and the only best buy plans were the No Action Plan and Alternative. The No-Action Plan is always a best buy and Alternative 7 was a best buy because it has the lowest Average Annual Cost Per Habitat Units (AAHU) (Table 3-6; Figure 3-14) . Combined, these eight best buy and cost-effective plans were included in the preliminary array of alternatives under consideration. All costs were annualized utilizing the FY24 Federal Interest Rate of 2.75%. Table 3-6 shows the preliminary array of alternatives and CE/ICA results (see Appendix E of this document for more detail). Note that the first three alternatives, those without the crossing improvements, offer very little expansion of marsh hydrology and therefore very high AAHU. The crossing improvements and consequent change in the breaching threshold of the lagoon positively affect the hydrology much more on each parcel than the excavation of channels does (e.g., compare Alternative 2 and Alternative 5).

Table 3-6. Output from CE/ICA, FY24 Price Level, 2.75% Discount Rate

Alt. ID	Plan Alternative	Output (AAHUs)	Total Cost ($1000)	Annualized Cost ($1000)	Average Cost ($1000/ AAHUs)	Incremental Cost ($1000)	Inc. Output (AAHUs)	Inc. Cost Per Output
0*	No Action Plan	0.00		0.00	0.00	0.00	0.00	0.00
1	State – Earth Work/ Channels	0.11	289.89	34.90	317.40	34.91	0.11	317.40
2	State, County – Earth Work/ Channels	0.20	628.11	94.50	472.60	59.60	0.09	662.10
3	State, County, Lower Mile – Earth Work/ Channels	0.26	875.67	155.70	598.70	61.20	0.06	1,019.70
4	Crossing Improvements, State – No Earth Work	5.45	5,752.72	268.10	49.20	112.50	5.19	21.70
5	Crossing Improvements, County, State – No Earth Work	8.17	5,956.04	322.80	39.50	54.70	2.72	20.10
6	Crossing Improvements, State, Lower Mile – No Earth Work	9.16	6,046.55	326.20	35.60	3.30	0.99	3.40
7*	Crossing Improvements, County, State, Lower Mile – No Earth Work	11.88	6,249.87	380.90	32.00	54.70	2.70	20.10
	Note: Of the 35 alternatives CE/ICA analyzed, seven plans were identified as either cost effective or best buy plans. Only the No Action Plan and Alternative 7 are Best Buys, as indicated by the asterisks. *Costs in FY24 Price Level							

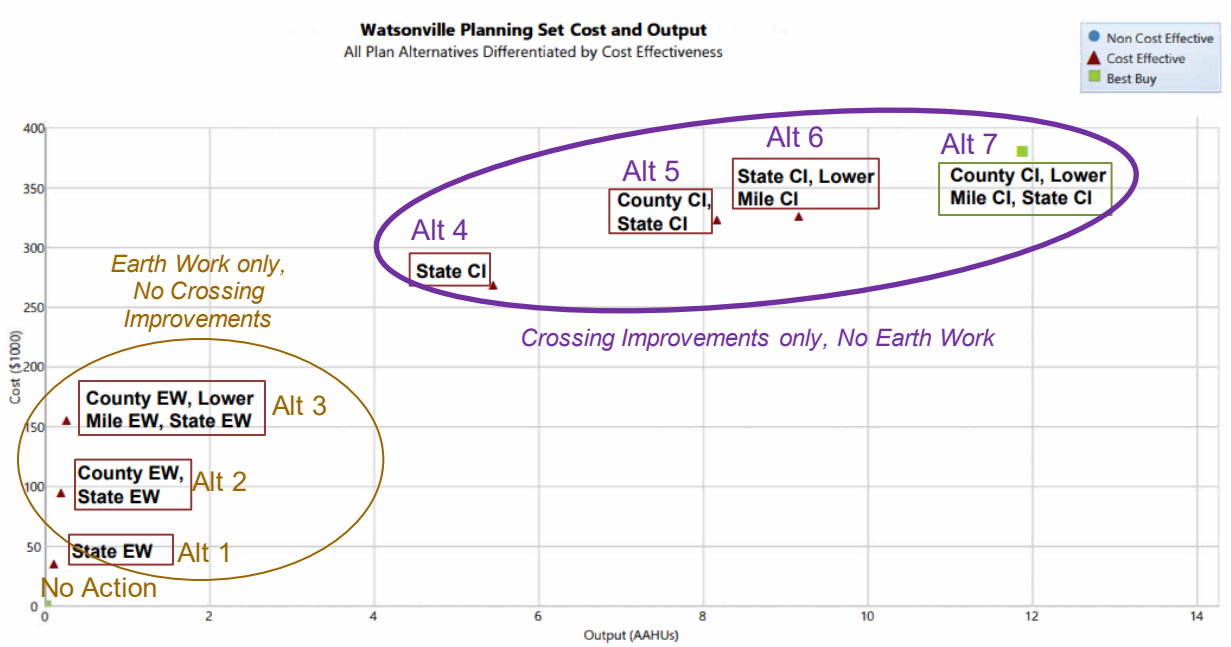


Figure 3-14. Summary of CE/ICA Results

3.7.2 Preliminary Array of Alternatives

Eight alternatives were included in the preliminary array for comparison, including a No Action Alternative. The eight alternatives were identified by CE/ICA as either cost effective (Alternatives 1-6) or best buy (No Action and Alternative 7) plans (Figure 3-14). The NFS did not request consideration of a Locally Preferred Plan.

No Action Alternative— In this scenario, the federal government would take no action to address ecosystem restoration in Watsonville Slough. Ecosystem degradation associated with truncated hydrology will persist over time.

Alternative 1: State Parcel Earth Work Only – Alternative 1 restores previously removed tidal side channels in the State-owned parcel to facilitate tidal conveyance through the existing marsh, as well as several breaches in the existing side cast berms (See Figure 3-3 and Figure 3-8). This results in the expansion of marsh hydrology to 0.11 formerly “high and dry” acres or roughly <1% of the parcel. Because the modification of the hydrology is so limited, it’s unclear whether removal of exotics and planting with native marsh species would be successful. Alternative 1 adds 0.11 AAHUs.

Alternative 2: County-owned and State-owned Parcels Earth Work Only – Alternative 2 restores previously removed tidal side channels in the County-owned and State-owned parcels to facilitate tidal conveyance through the existing marsh, as well as several breaches in the existing side cast berms (See Figure 3-3 and Figure 3-8). This results in the expansion of marsh hydrology to 0.2 formerly “high and dry” acres on the County-owned and State-owned parcels, or roughly 1% of the area of the two parcels. Because the modification of the hydrology is so

limited, it's unclear whether removal of exotics and planting with native marsh species would be successful. Alternative 2 adds a total of 0.2 AAHUs.

Alternative 3: County-owned, State-owned, and Lower Mile Parcels Earth Work Only – Alternative 3 restores previously removed tidal side channels in the County, State, and Lower Mile Parcels to facilitate tidal conveyance through the existing marsh, as well as several breaches in the existing side cast berms (See Figure 3-3 and Figure 3-8). This results in the expansion of marsh hydrology to 0.26 formerly "high and dry" acres on the County-owned, State-owned, Lower Mile parcels, or roughly 1% of the area of the three parcels. Because the modification of the hydrology is so limited, it's unclear whether removal of exotics and planting with native marsh species would be successful. Alternative 3 results in 0.26 AAHUs.

Alternative 4: Crossing Improvements at W. Beach Road and State-owned Parcel with No Earth Work – Alternative 4 includes the replacement of six pipe culverts with higher-capacity, fish-friendly culverts that will accommodate the closed-lagoon water levels and raising of W. Beach Road to enable the County to change their typical breaching threshold of the lagoon from 8.0 feet to 9.2 feet NAVD88, restoring marsh hydrology by improving inundation of "high and dry" portions of the marsh plain. The crossing of the slough will include an open-bottomed culvert design to improve fish passage potential. This results in the expansion of marsh hydrology to 5.45 formerly "high and dry" acres on the State-owned parcel, or roughly 40% of the parcel. In addition, the project will remove exotics and xeric species from the formerly "high and dry" areas and plant them with native marsh species. Alternative 4 adds 5.45 AAHUs to the study area.

Alternative 5: Crossing Improvements at W. Beach Road, County-owned Parcel with No Earth Work, and State-owned Parcel with No Earth Work – Alternative 5 includes the replacement of six pipe culverts with higher-capacity, fish-friendly culverts that will accommodate the closed-lagoon water levels and raising of W. Beach Road to enable the County to change their typical breaching threshold of the lagoon from 8.0 to 9.2 feet NAVD88, restoring marsh hydrology by improving inundation of "high and dry" portions of the marsh plain. The crossing of the slough will include an open-bottomed culvert design to improve fish passage potential. This results in the expansion of marsh hydrology to 2.72 formerly "high and dry" acres on the County-owned parcel, or roughly 56% of the parcel, and the expansion of marsh hydrology to 5.45 formerly "high and dry" acres on the State-owned parcel, or roughly 40% of the parcel. In addition, the project will remove exotics and xeric species from the formerly "high and dry" areas and plant them with native marsh species. Alternative 5 results in a total of 8.17 AAHUS.

Alternative 6: Crossing Improvements at W. Beach Road, State-owned Parcel with No Earth Work, and Lower Mile Parcels with No Earth Work – Alternative 6 includes the replacement of six pipe culverts with higher-capacity, fish-friendly culverts that will accommodate the closed-lagoon water levels and raising of W. Beach Road to enable the County to change their typical breaching threshold of the lagoon from 8.0 feet to 9.2 feet NAVD88, restoring marsh hydrology by improving inundation of "high and dry" portions of the marsh plain. The crossing of the slough will include an open-bottomed culvert design to improve

fish passage potential. This results in the expansion of marsh hydrology to 5.45 formerly "high and dry" acres on the State-owned parcel, or roughly 40% of the parcel, and to 3.71 formerly "high and dry" acres on the Lower Mile parcels, or roughly 16% of those parcels. In addition, the project will remove exotics and xeric species from the formerly "high and dry" areas and plant them with native marsh species. Alternative 6 adds 9.16 AAHUs to the study area.

Alternative 7: Crossing Improvements at W. Beach Road, County, State, and Lower Mile Parcels with No Earthwork – Alternative 7 includes the replacement of six pipe culverts with higher-capacity, fish-friendly culverts that will accommodate the closed-lagoon water levels and raising of W. Beach Road to enable the County to change their typical breaching threshold of the lagoon from 8.0 feet to 9.2 feet NAVD88, restoring marsh hydrology by improving inundation of "high and dry" portions of the marsh plain. The crossing of the slough will include an open-bottomed culvert design to improve fish passage potential. This results in the expansion of marsh hydrology to 2.72 formerly "high and dry" acres on the County-owned parcel, or roughly 56% of the parcel. It results in the expansion of marsh hydrology to 5.45 formerly "high and dry" acres on the State-owned parcel, or roughly 40% of the parcel. And it results in expansion of marsh hydrology to 3.71 formerly "high and dry" acres on the Lower Mile parcels, or roughly 16% of those parcels. In addition, the project will remove exotics and xeric species from the formerly "high and dry" areas and plant them with native marsh species. Alternative 7 results in 11.88 AAHUs.

3.8 Plan Evaluation

3.8.1 Principles and Guidelines Criteria Evaluation

The final array of alternatives, as described above, was evaluated by projecting, and comparing the FWP and FWOP conditions. Plan formulation focused on addressing the identified problems and meeting study objectives, including those responsive to national, state, and local concerns. Consideration of state and local objectives in concert with national objectives necessitates the inclusion and assessment of a broad range of benefits and impacts, both qualitative and quantitative. Alternative plans were assessed to determine if they have net benefits in total and by type. The two action alternatives and the No Action Alternative carried into the final array were evaluated on the *Principles and Guidelines Criteria*, as summarized in:

- Effectiveness – Extent to which a measure or alternative alleviates problem areas and meets planning objectives.
- Efficiency – The potential benefits/outcome of the measure/plan provide the greatest increases in output for the least increases in cost, i.e., they have the lowest incremental cost per unit of output (per PGN, p. E-153).
- Acceptability – Viability and appropriateness of an alternative from the perspective of the general public and consistency with existing federal laws, authorities, and public policies.
- Completeness – Extent to which an alternative provides and accounts for all features, investments, and/or other actions necessary to realize the planned effects, including any necessary actions by others.

Effectiveness measures how well the plans meet study objectives. While the hydrology-based ecological benefit scores used in the CE/ICA address many of the ecosystem benefit objectives, they only represent the improvement to marsh hydrology within the footprint of the restored ecosystem. They do not capture improvement associated with removal of large patches of exotic species and replanting, nor do they capture the effects of fish passage. Effectiveness at meeting objectives was discussed by the team for each objective (see Section 3.3 of this report). The results of this assessment are presented in Table 3-7.

Table 3-7. Plan Evaluation for Principles and Guidelines Four Criteria

Preliminary Array of Alternatives based on CE/ICA output of Final Planning Measures	Screening Criteria: Effectiveness						Screening Criteria: Effectiveness Summary	Screening Criteria: Efficiency		Screening Criteria: Acceptability	Screening Criteria: Completeness
	Primary Project Objectives: Ecosystem Restoration				*Secondary Objectives (scores not included in effectiveness summary)*						
	Restore and improve tidal marsh and coastal habitat that can support native species/ diversity (Objective 1)	Restore a more natural hydrologic regime and connectivity on the marsh plain to improve ecosystem function (Objective 2)	Improve the aquatic ecosystem by maintaining fresher (less saline) water quality through the project area (Objective 3)	Improve fish passage access to increase availability of marsh habitat to native fish species. (Objective 4)	Increase recreational opportunities and public education (Objective 5)	Improve resilience to extreme weather and sea level change by increasing accommodation space (Objective 6)	Meets Primary Objectives (1-4)	CE/ICA Ranking	Certainty versus Risk to Schedule and Budget Associated with Real Estate[2]	Implementable from a Legal and Policy Standpoint	Benefits Realized without Further Action from Others
	Green = High Yellow = Med Red= Low	Green = High Yellow = Med Red= Low	Green = High Yellow = Med Red= Low	Green = High Yellow = Med Red= Low	Green = High Yellow = Med Red= Low	Green = High Yellow = Med Red= Low	Green = High Yellow = Med Red= Low	Green = High Yellow = Med Red= Low	Green = High Certainty/Low Risk Yellow = Med Risk Red= Low Certainty/High Risk	Green = Yes Yellow =Yes, with coordination Red= No	Green = Yes Red= No
No Action	1	1	1	1	1	1	1	1	3	3	1
Alt 1: State EW only	1.1	1.1	1	1	2	1	1.05	1.1	3	3	3
Alt 2: State and County EW only	1.15	1.1	1	1	2	1	1.06	1.15	3	3	3
Alt 3: State, County, and Lower Mile EW only	1.2	1.1	1	1	2	1	1.08	1.2	1.5	2	3
Alt 4: Raise Beach Road and State with No Earth Work	2.2	3	3	3	3	3	2.8	2.2	3	3	3
Alt 5: Raise Beach Road, County and State with No Earth Work – **NER Plan**	2.8	3	3	3	3	3	2.95	2.8	3	3	3
Alt 6: Raise Beach Road, State and Lower Mile with No Earth Work	2.8	3	3	3	3	3	2.95	2.8	1.5	2	3
Alt 7: Raise Beach Road, County, State, and Lower Mile with No Earth Work	3	3	3	3	3	3	3	3	1.5	2	3

[2] This criterion represents impacts of alternatives that include the Lower Mile parcel and the risk to the budget and schedule associated with acquiring LERRDS because this parcel is owned by a homeowners association.

The PDT assessed how each of the plans and their associated measures effectively address the objectives of the study by rating each alternative on a scale of one to three, with one indicating low or no effect, and three representing that the plan fully addresses the objective within the project scope. As shown in Table 3-7, Alternatives 1 to 3, the plans that rely on the excavation of side channels to restore hydrology to the marsh plain, do not accomplish any of the primary ecosystem restoration objectives of the study, nor do they accomplish the secondary objectives. Because they all include the State Parcel, they have an opportunity to include educational signage, and so a moderate score for that one objective is indicated for Alternatives 1 to 3. Alternatives 1 to 3 also score poorly in efficiency. As shown in the CE/ICA analysis (Table 3-6 and Figure 3-14), these alternatives have Average Annual Costs per Average Annualized Habitat Unit (AAHU) that are an order of magnitude higher than the other plans. They do very little to improve the marsh hydrology on their respective parcels, in all cases affecting between <1 and 2% of the parcels' acreage.

Alternatives 4 to 7 address the objectives well, though to varying degrees, because different combinations of parcels are identified for the removal of exotics and replanting, with Alternative 4 affecting the least area, and Alternative 7 the most. Although the hydrology-based scores used for ecosystem benefits in the CE/ICA showed more improvement for the Lower Mile parcels than the County-owned parcel, the County-owned parcel is exhibiting more signs of hydrologic stress and is in greater need of restoration efforts, and scores were adjusted accordingly, giving Alternatives 5 and 6 comparable scores for improving marsh habitat.

Alternatives 6 and 7 also scored higher than Alternate 5 in efficiency. Alternative 7 is the largest scale plan and has the lowest incremental cost per incremental output, and is therefore a Best Buy plan. However, some nuances of parcel improvement in the study area were not captured in the CE/ICA. The Lower Mile parcels are not as perched as the other parcels and are already dominated by marsh hydrology and open water/mudflat hydrology (Figure 22 of Appendix D). As a result, the hydrologic improvement associated with the County's new breaching threshold allowed by the W. Beach Road crossing improvements affect only 16% of the Lower Mile Parcels, not because the measures are ineffective, but because so little upland hydrology acreage occurs. Additionally, most of the improved upland hydrology is edge habitat, abutted against a major roadway. So while Alternatives 6 and 7 include a greater number of quality adjusted acres, the improvement of the Lower Mile Parcel has a smaller impact on the ecosystem. It is primarily adding edge habitat near a busy sidewalk, road, and park, not improving a block of interior marsh habitat, as is the case in both the County and State parcels.

An additional column was added under Efficiency in Table 3-7 to address the potential risk to schedule and costs associated with Real Estate that is not captured in the Real Estate costs associated with the alternatives captured by CE/ICA. These risks became apparent after CE/ICA was run and are associated with the fact that the Lower Mile parcels are owned by the Pajaro Dunes South Homeowner's Association. Real Estate transactions with homeowners' associations have proven to be a significant real estate risk that has caused problems for recent CAP studies.

Finally, Alternatives 3, 6, and 7, all scored lower than the others in the "Legally Implementable" category to address the real estate risk associated with the Lower Mile parcels. Real Estate risk mentioned above could put the project costs above the Federal limit for CAP projects.

With all of these considerations, Alternative 5 was identified as the NER plan. It creates the most benefits within the plans that do not include real estate risk that might put the project costs outside of CAP.

3.8.2 *Principles and Guidelines* Four Accounts Evaluation

Additionally, plans were assessed on the *Principles and Guidelines* four accounts:

- National Economic Development (NED) – the value of national output of goods and services
- Regional Economic Development (RED) – changes in regional income and employment
- Environmental Quality (EQ) – riparian habitat, aquatic habitat, cultural resources, and trucking air emissions from sediment disposal offsite
- Other Social Effects (OSE) – life safety, community impacts, and critical infrastructure resiliency

Comprehensive documentation of total benefits of project alternatives, including equal consideration of economic, environmental, and social categories has been undertaken in accordance with the Assistant Secretary for the Army for Civil Works (ASACW) Policy Directive on the "Comprehensive Documentation of Benefits in Decision Document," dated 5 January 2021. The PDT assessed how each of the plans and their associated measures effectively address the Comprehensive benefits metrics by rating each alternative on a scale of one to three, with one indicating low or no effect, and three representing that the plan fully addresses the metric within the project scope. The PDT assessed how each of the plans and provided benefits in each of the accounts, as summarized below:

Most of the potential benefits are to the EQ account, and most of those are addressed by objectives of the study. Additional EQ benefits are to marine species that may use the marsh plain as a nursery habitat during when it is inundated during closures, and the incidental benefits that the restored hydrology associated with the County's modified breaching program will have to marshes beyond the study area. In all cases, Alternatives 1 to 3 offer very little benefit, and Alternatives 4-7 very similar benefits to the EQ benefits associated merely with restoring hydrology, varying only in the extent of marsh restoration revegetation and monitoring (Table 3-8). Benefits in the OSE account is also all tied to study objectives and tied either to the crossing improvements or the recreational and educational signage associated with the State parcel. As such, Alternatives 4 to 7 all score identically high for the OSE account, where Alternatives 1 to 3 all have low scores. RED benefits include the ability of the project to provide jobs and income to local communities, which Alternatives 4 to 7 are expected to do to a modest amount. Additionally, money will be saved by the County for plans that involve the crossing improvements since some mechanical breaching will be avoided. Because the Watsonville Slough CAP 1135 Study is an ecosystem restoration study, the only notable NED element is the recreation and educational signage that can be part of any plan that includes the State Parcel.

Table 3-8. Comprehensive Benefit Evaluation of Plans

Preliminary Array of Alternatives based on CE/ICA output of Final Planning Measures	Benefit Account EQ								Benefit Account OSE			Benefit Account RED		Benefit Account NED
	Restore and improve tidal marsh and coastal habitat that can support native species/diversity (Obj 1)	Restore a more natural hydrologic regime and connectivity to improve ecosystem function (Obj 2)	Maintain brackish water for ecosystem (Obj 3) and forestall saltwater intrusion of aquifer	Benefits to fish species needing access to marsh plain (Obj 4)	Reduce impacts associated with mechanically breaching of sandbar (air quality, noise).	Benefits as marine species nursery	Incidental benefits to marshes outside the project area	Avoid Historic and Cultural Resources	Improve emergency and public access /public safety	Provide Recreation and Education Opportunities (Obj 5)	Support the needs of local communities visiting the project area	Local Income and Employment	Money saved by avoiding breaching the lagoon	Recreational Unit Day Value (Obj 5)
	Green = High Yellow = Med Red= Low	Green = High Yellow = Med Red= Low	Green = High Yellow = Med Red= Low	Green = High Yellow = Med Red= Low	Green = High Yellow = Med Red= Low	Green = High Yellow = Med Red= Low	Green = High Yellow = Med Red= Low	Green = High Yellow = Med Red= Low	Green = High Yellow = Med Red= Low	Green = High Yellow = Med Red= Low	Green = High Yellow = Med Red= Low	Green = High Yellow = Med Red= Low	Green = High Yellow = Med Red= Low	Green = High Yellow = Med Red= Low
No Action	1	1	1	1	1	1	1	3	1	1	1	1	1	1
Alt 1: State EW only	1.1	1.2	1	1.3	1	1.1	1	3	1	1	1	1.3	1	1
Alt 2: State and County EW only	1.15	1.2	1	1.3	1	1.1	1	3	1	2	2	1.3	1	2
Alt 3: State, County, and Lower Mile EW only	1.2	1.5	1	1.5	1	1.2	1	3	1	2	2	1.5	1	2
Alt 4: Raise Beach Road and State with No Earth Work	2.2	3	3	3	3	2.5	3	3	3	3	3	2	3	3
Alt 5: Raise Beach Road, County and State with No Earth Work	2.8	3	3	3	3	2.5	3	3	3	3	3	2	3	3
Alt 6: Raise Beach Road, State and Lower Mile with No Earth Work	2.8	3	3	3	3	2.5	3	3	3	3	3	2	3	3
Alt 7: Raise Beach Road, County, State, and Lower Mile with No Earth Work	3	3	3	3	3	2.5	3	3	3	3	3	2	3	3

3.9 Final Array of Alternatives*

After evaluating the plans generated by CE/ICA, the PDT screened the alternatives further to a final array of alternatives for the NEPA analysis.

Alternatives 1 to 3 were screened because they did not adequately meet the study objectives.

Alternatives 6 to 7 were also screened. As described in section 3.8.1, though Alternative 7 was found in CE/ICA to be a Best Buy plan, nuances not captured by CE/ICA led the PDT to screen alternatives that included Lower Mile parcels. The Habitat Units gained in the Lower Mile parcels included significant amounts of edge habitat, which is not as important to the overall ecosystem as the core marsh habitat improved in the State and County parcels. In addition, Real Estate risk associated with the Lower Mile parcels being held by a homeowner's association could impact schedule and increase costs in a manner not captured in CE/ICA, potentially to the point that the project would not be legally implementable without a waiver. In addition, even when removed from the alternatives the Lower Mile parcels will still be subject to the improved marsh hydrology resulting from the change in lagoon breaching. They will simply not receive additional planting or monitoring. For all these reasons, the PDT screened alternatives that included the Lower Mile parcels and focused further assessment on smaller cost effective plans.

After this final screening, the three alternatives advanced as the final array of alternatives:

- No Action
- Alternative 4: Crossing Improvements at W. Beach Road and State-owned Parcel with No Earthwork
- Alternative 5: Crossing Improvements at W. Beach Road, County-owned Parcel with No Earthwork, and State-owned Parcel with No Earthwork

Both Alternatives 4 and 5 include the enlarged culvert at W. Beach Road crossing that can carry the closed-lagoon flows and would improve fish passage, as well as the associated road raise to accommodate the larger culverts and prevent local flooding that has triggered the County to breach the lagoon. Neither alternative involves any excavation of side channels or breaches of the existing side cast berms. Alternative 4 also includes the costs of real estate for the State-owned parcel, along with removal of exotics and interplanting on that parcel. Alternative 5 includes the costs of real estate, exotic removal, and interplanting on both the County-owned and State-owned parcels.

4 ENVIRONMENTAL EFFECTS AND CONSEQUENCES*

This section describes the potential environmental effects of the final array of alternatives (see Section 3.9). An impact is considered significant if it has an adverse, unmitigable effect to any resource category relative to the relative to the FWOP described in Section 2. Additionally, NEPA requires federal agencies to consider direct, indirect, and cumulative impacts. Direct effects are caused by the action and occur at the same time and place. Indirect effects are caused by the action and are later in time or farther removed. The assessment of environmental effects is based on the hypothetical conditions that are expected with the implementation of a reasonable range of alternatives.

Analysis of No Action Alternative is required under NEPA to provide a comparative baseline against which other alternatives are evaluated. Under the No Action Alternative, there would be no crossing improvements on W. Beach Road. No removal of exotics and interplanting would occur. In absence of a federal project such as Alternative 4 or 5, none of the anticipated benefits to aquatic and wetland habitats in the study area would occur.

Action Alternatives (Alternatives 4 and 5) include replacement of the existing culverts with an enlarged culvert at W. Beach Road crossing, which would serve higher flow capacity during the closed-lagoon events and improve fish passage, the associated road raise of W. Beach Road to the intersection of Shell Road, and restoration measures such as the removal of non-native vegetation and replacement with native marsh plantings on State-owned parcel only (Alternative 4) or both State- and County-owned parcels (Alternative 5). Construction of the Action Alternatives would take approximately 5 months including preconstruction site preparation, out-of-water work cleanup, restoration of ground disturbance areas, and invasive plant removal and planting of native plants; however, in-water work would only occur between June 15 and September 30. Figure 4-1 presents the project area including the area where construction activities would occur (i.e., construction limits of work), and State- and County-owned parcels as well as the extent of the study area.

Because potential adverse environmental impacts are exclusively associated with the construction of common project elements listed below, there are a lot of similarities in effects for most resource categories between the two Action Alternatives. The only project element that is different between Alternatives 4 and 5 is whether to include real estate of State-owned parcel (Alternative 4), or both State-and County-owned parcels (Alternative 5) for the removal of exotic and xeric species and planting native species in the formerly high and dry areas (Figure 4-2). Therefore, the discussion of effects analysis for Alternatives 4 and 5 is combined and grouped into a sub-section called “Action Alternatives” for each resource category to avoid any repetition. When there are differences in effects and/or benefits between the two alternatives, they will be further called out to discuss the differences under some of resource categories.

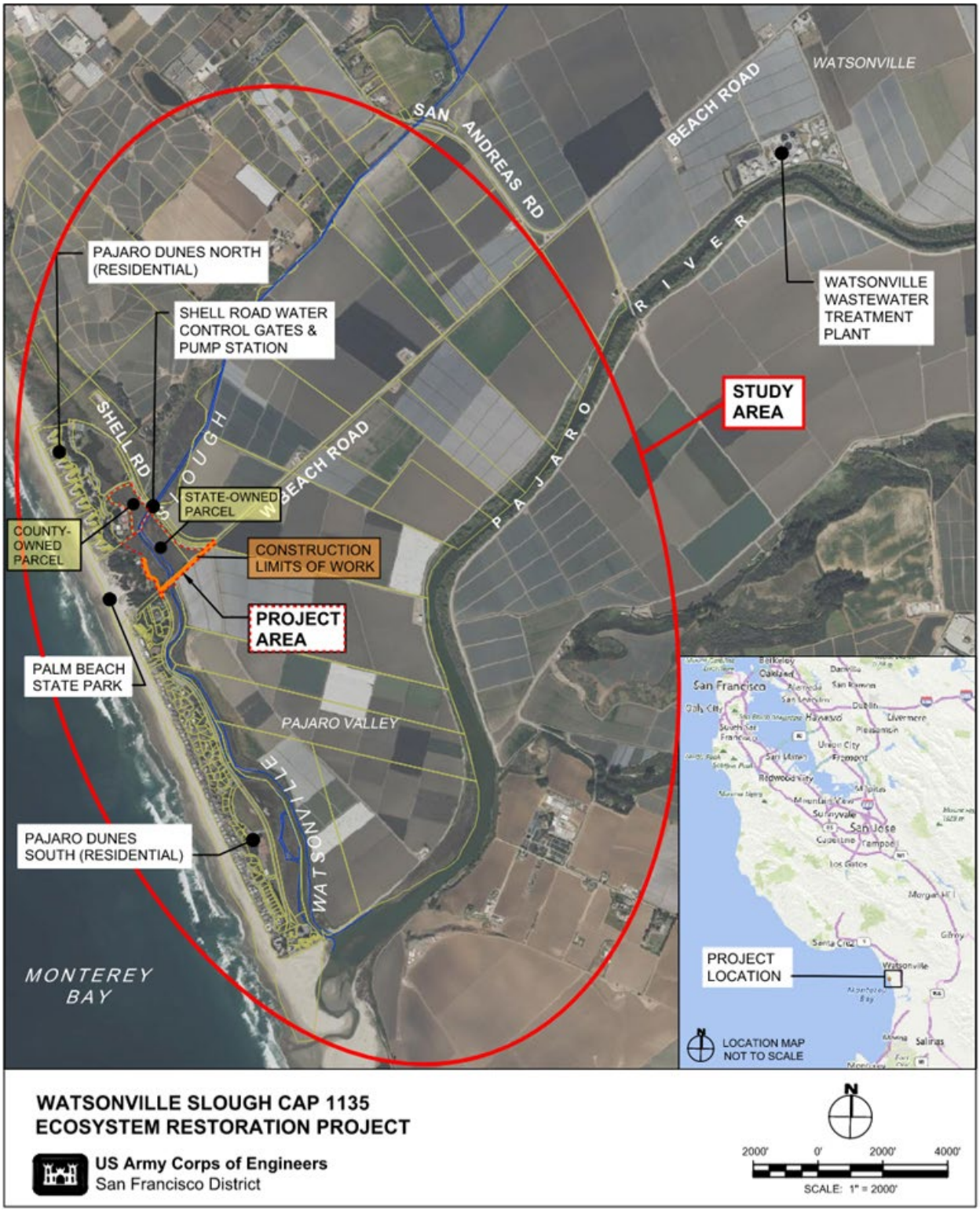


Figure 4-1. Study Area and Project Area for Action Alternatives

Figure 4-2. Project Elements for Action Alternatives

There are common project elements of Alternatives 4 and 5 and they are as follows:

1. Install one 32-foot wide, 8-foot high, pre-cast, and embedded culvert with higher flow capacity, which would support improved fish passage compared to the existing six 48-inch closed conduit culverts (Figure 4-3).

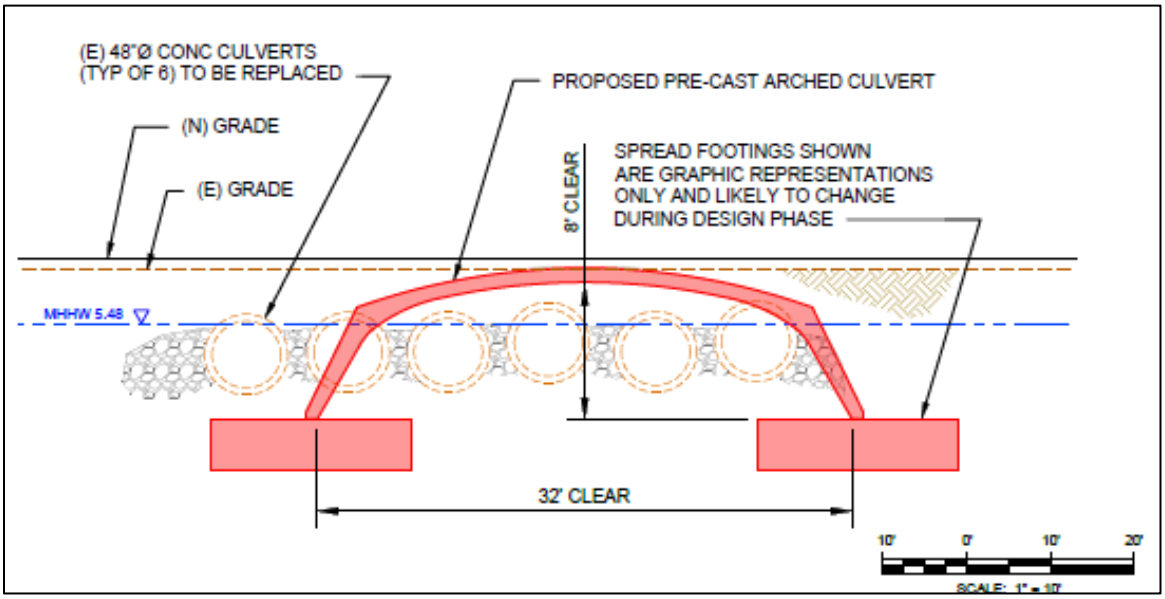


Figure 4-3. Conceptual Design of Proposed Fish-friendly Culverts

2. Raise an approximately 1,300 linear feet (LF) of W. Beach Road from the existing elevation to accommodate the new culvert(s) with a higher crown elevation.

3. Install a new flap gate on the adjacent Beach Road Agricultural Ditch to prevent the higher lagoon levels from moving upstream.

4. Raise surface elevation of a parking lot to 9.2 feet NAVD88 for Palm Beach State Park immediately adjacent to the crossing of the W. Beach Road and Slough to prevent nuisance flooding.

5. Install interpretive signage both in English and Spanish to inform locals and visitors to the Palm Beach State Park of the benefits of the wetland restoration.

4.1 Geology, Soils and Seismicity

For the purposes of this analysis, an effect on geologic and local soil resources may be considered significant if an alternative would:

- Induce landslide that would result in loss of life or substantial injury;
- Result in substantially accelerated soil erosion or loss of topsoil; or
- Substantially increase the risk of landslide or slope failures.

4.1.1 No Action Alternative

The geomorphology of a stream is influenced by sediment production, transport, and deposition patterns in the waterway over time. The lower Watsonville Slough is a low gradient area which is conducive to sediment deposition. Due to the extensive agricultural land use activities in the middle and lower Watsonville Slough watershed, fine sediments (silts, fine sand, and clay) would be generated from eroded agricultural land, and then transported to the study area and Pacific Ocean. In the study area, significant erosion would occur during large runoff events on exposed agricultural lands. The lower Slough was routinely dredged until 1983 to remove accumulated sediments and maintain its drainage (Swanson Hydrology & Geomorphology 2003). Although the dredging has stopped due to lack of funding since 1983, the Santa Cruz County staff stated that the sediment deposition has been low in the project area, indicating that the sediment deposition and erosion rates may have reached an equilibrium currently. However, anticipated effects of SLC in the Pajaro River/Watsonville Slough area would cause some additional flooding in the low-lying agricultural land in the study area, which could potentially drive increased localized erosion.

4.1.2 Action Alternatives

Construction activities for crossing improvements at W. Beach Road would be the same for both Alternatives 4 and 5 and involve excavation of approximately 2,500 cubic yards of material from the existing roadway and culverts. Prior to initiating construction activities, fencing or flagging or other practical means will be erected to demarcate the limits of the project activities, including the boundaries of designated staging areas; ingress and egress corridors; stockpile areas for spoils disposal, soil, and materials; and equipment exclusion zones.

The construction work during culvert replacement in the Slough would be performed in a dry condition by dewatering and occur during dry season so that the erosion of topsoil would be minimized. All open flow temporary diversion will be lined with filter fabric or other appropriate liner material to prevent erosion. Best management practices (BMPs) will be employed to minimize construction impacts during in-water work. Refer to Sections 4.12.1 and 4.12.2, respectively for BMPs and avoidance and minimization measures (AMMs) that would be implemented to reduce soil erosion during construction. Also, Section 4.12.2 provides a full description of proposed AMMs.

Construction effects to soil erosion would be localized to the project area, specifically to those areas cleared, grubbed, excavated, and graded. All temporarily disturbed areas will be de-compacted and seeded/planted with an assemblage of native plant species suitable for the project area. A preliminary planting plan is prepared in coordination with Watsonville Wetland Watch and Amah Mutsun Tribal Band so that the project can leverage local and indigenous knowledge in selection and long-term management of native plants (see Environmental Appendix A-3 of this document). The plan includes such details as a schedule, plans for grading of disturbed areas to pre-project contours, planting palette with plant species native to the project area, invasive species removal, performance standards, success criteria, and maintenance requirements (e.g., weeding and replanting). Revegetation activities will commence as soon as is practicable after construction activities at the project area are complete.

Initially for both Alternatives 4 and 5, there could be a temporary impact due to increased erosion from the exposure of topsoil immediately following the construction period. However, with successful revegetation of the disturbed areas, they would become stabilized, resulting in a long-term benefit to channel erosion beyond the existing conditions.

As part of habitat restoration efforts on State-owned parcel (Alternative 4), or both State- and County-owned parcels (Alternative 5), patches of invasives and non-native plants would be removed, and plantings would be installed in any areas disturbed by construction (approximately 0.5 acre on the State-owned parcel), and in patches where exotics have been removed or native plants are particularly stressed (approximately 1 acre on the County-owned parcel and 0.5 acre on the State-owned parcel outside of areas affected by construction). Alternatives 4 and 5 would remove approximately 0.5 and 1.5 acres of non-native vegetation, respectively, and replace it with native marsh plantings; therefore, Alternative 5 would have more areas where there would be temporary disturbance to the topsoil due to invasive removal and revegetation compared to the Alternative 4.

Overall, both Alternatives 4 and 5 would provide long-term beneficial effects to preventing soil erosion as vegetation would retain more local soils although a less than significant adverse effect is anticipated on soil erosion during construction.

4.2 Hydrology and Water Resources

For the purposes of this analysis, an effect on hydrology and water resources may be considered significant if an alternative would result in:

- Increased effects on the community from flooding; or
- Violation of laws or regulations adopted to protect or manage the water resource system in the study area.

4.2.1 No Action Alternative

The NFS' consultant (Environmental Science Associates) used the Lagoon Quantified Conceptual Model (QCM) to forecast lagoon mouth responses under the FWOP (i.e., No Action Alternative) and with-project (FWP; crossing improvements and County's increased lagoon breach threshold) conditions assuming SLC from 0 to +3 feet, in increments of +0.5 foot. The range and increments of SLC were decided based sea level changes projected across the Low, Intermediate and High Curves using the USACE SLAT tool, which is compliant with USACE ER 1100-2-8162. The PDT selected the Intermediate curve for planning and analysis, which predicts +0.57 foot of SLC by 2050 and +1.02 feet by 2075.

The QCM results showed that the lagoon water levels would rise with ocean water levels and exceed the County's existing typical breach threshold of 8.0 feet NAVD88 more frequently under the FWOP condition until the lagoon effectively transitions to a permanently open tidal connection under high SLC amounts, e.g. greater than 2.5 feet SLC. The number of events where the lagoon water level is predicted to reach the County's breach threshold would decline with higher SLC for both FWOP and FWP conditions because the lagoon system starts to transition to a permanently open, tidal connection beyond SLC of +1.5 feet (Figure 4-4). Additional discussion of shifts in lagoon hydrology as a function of SLC is discussed in the

Engineering Appendix B-1 of this document.

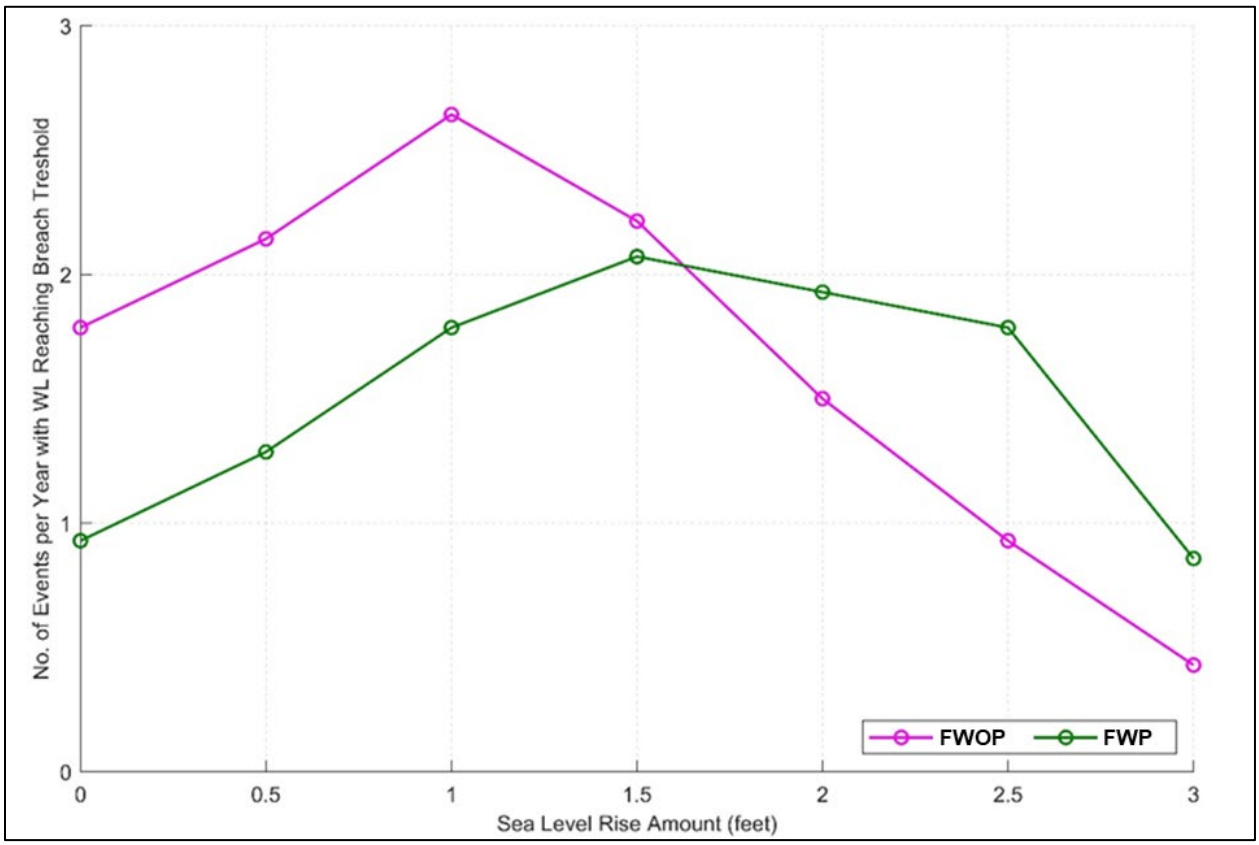


Figure 4-4. Predicted Average Number of Events per year where Lagoon Water Level Reaches the County's Respective Breach Thresholds under FWOP and FWP Conditions

Therefore, under No Action Alternative, the duration of a lagoon closure event would be shortened because the water level is predicted to reach the County's existing typical breaching threshold (i.e., 8.0 feet NAVD88) more frequently, which in turn, would trigger more frequent mechanical breaching by the County to prevent flooding and loss of emergency access to the Pajaro Dunes communities. Additionally, the potential water quality impacts from discharge of agricultural runoff during the County's mechanical breaching would be higher compared to the existing condition because more frequent breaching would be required under the No Action Alternative.

4.2.2 Action Alternatives

The QCM results showed that the average number of flood stage events per year in the lagoon would be reduced by approximately 50% for the FWP compared to the FWOP (i.e., No Action Alternative) condition until SLC reaches +1.5 ft (Figure 4-4). The lagoon is expected to be permanently open with tidal connection and need for mechanical breaching would gradually decrease beyond SLC of +1.5 ft which is projected to occur after the 50-year planning horizon. The reduced frequency of the County's mechanical breaching would provide beneficial effects to overall water quality in the study area during heavy rainfall events because the inundated marsh plain would allow infiltration of pollutants in the runoff from adjacent farmlands, vegetative uptake of nutrients in fertilizers, and soil contact of the runoff to decrease contaminant (i.e.,

pesticides) loading into the receiving water.

The QCM results also showed that for the lagoon closure events that last longer than a week, the average delay in the County's mechanical breaching under the FWP condition is approximately 5 days compared to FWOP. Note that the QCM results were derived from simplifying assumptions although the delay in lagoon closure events would be event-specific depending on the specific streamflow, wave, and tide levels; therefore, only the relative difference between the FWOP and FWP conditions is considered a meaningful comparison. The delay in the County's mechanical breaching events under FWP would allow perched areas of the marsh plain that are normally dry to become wet during closure events, resulting in beneficial effects to the marsh plain. Additionally, the prolonged lagoon closure events would provide more groundwater recharge opportunities so that the freshwater in the Slough and marsh plain could infiltrate and percolate into the aquifer. Overall, both of Action Alternatives would have beneficial effects by providing a more natural hydrologic regime and connectivity between the slough and the marsh plain.

As mentioned in Section 4.1.2, the culvert replacement work for both Alternatives 4 and 5 would require a temporary diversion of stream flow to facilitate construction activities for both Alternatives 4 and 5. This would be accomplished by the installation of two cofferdams at both ends of an approximately 100-foot long stream segment and dewatering of the stream for construction. Because in-water work would occur during the dry season, the low stream flow of approximately 1-2 cfs is anticipated and the Slough water would be initially pumped dry using a 4 or 6-inch diameter diesel pump after the two cofferdams are constructed. The pumped water would be released into the marsh plain (upstream, downstream, or both), and the discharge outlet would be equipped with a perforated pipe diffuser or similar to dissipate the discharge momentum. The pumped discharge flow would be diverted into vegetated areas before allowing water to flow back into the downstream of the dewatered stream segment. Once pumped, the work area around the existing culverts would be dried out (by time and winds) and then the dry condition would be maintained with periodic pumping of nuisance water using 2-inch gas-powered pump(s) or smaller electric pump(s). Water diversion would also be required at the agricultural ditch that runs parallel to W. Beach Road near the toe of the south bank.

Because the culvert replacement is a common project element for both Alternatives 4 and 5, the water quality impacts associated with dewatering and stream diversion would be the same for both alternatives. Increased turbidity would be caused by the release of suspended solids from stream diversion and increased flow in the downstream. As mentioned in Section 2.2.6, Watsonville Slough is listed on the 303(d) List for several water quality constituents including turbidity and toxicity. Because the pumped discharge flow would be diverted into the vegetated areas in the vicinity of the project area, the marsh plain would act as a filter for fine sediment and minimize turbidity impacts in the downstream. Also, construction activities such as the demolition of the existing culvert structure, installation of the new culvert and bank reconstruction, may cause a temporary increase in turbidity and fine sediment.

To minimize the potential for the increased turbidity during construction, major ground-disturbing activities would be limited to the typical dry season in-water work period (June 15 through September 30) including other work such as clearing and grubbing at the site in this timeframe. Both Alternatives 4 and 5 would include the implementation of BMPs to minimize surface runoff

and erosion, and to prevent contamination from fuel or oil leaks by construction machinery in the channel. Erosion-control practices and dust-control measures would also be implemented within the project area and staging areas to minimize water or airborne release of sediment or particulates into the Slough. The chosen construction contractor would also be required to prepare a storm water pollution prevention plan (SWPPP) prior to initiating project construction. Stormwater, turbidity, and erosion control structures (e.g., silt fence and silt curtain) would also be in place to limit sediment from entering the Slough. Refer to Sections 4.12.1 and 4.12.2, respectively for BMPs and AMMs specific to soil erosion and water quality during construction. Only temporary, short-term increases in suspended solids and turbidity are anticipated during construction of the Alternatives 4 and 5. Thus, any water quality impacts associated with suspended solids, turbidity and toxicity would be less than significant.

Operation of the Alternatives 4 and 5 is not expected to significantly affect turbidity or suspended particulates in the Slough. Maintenance activities would mainly involve off-channel restoration measures such as occasional replanting and selective removal of non-native species; therefore, it is not expected to affect water quality in the Slough.

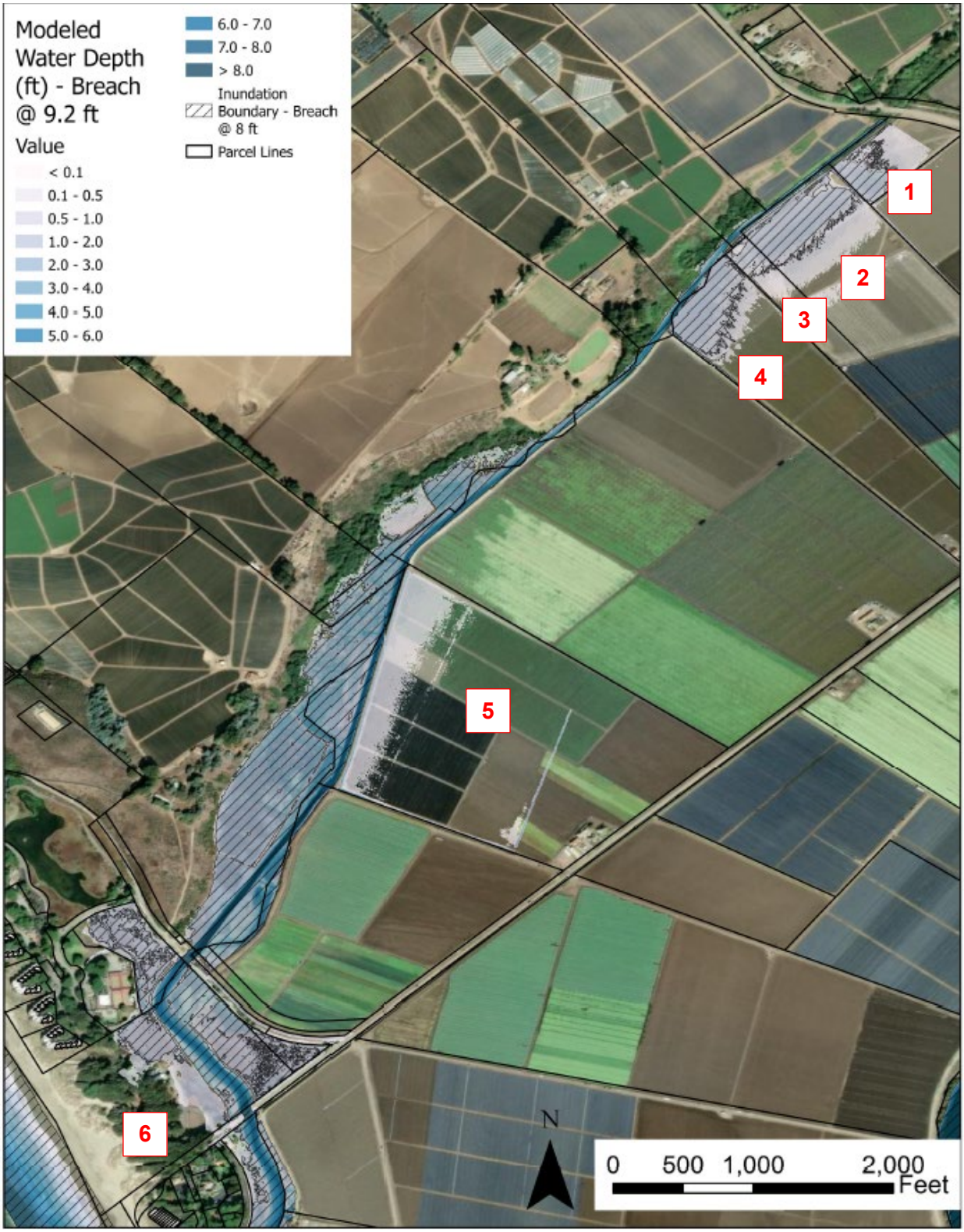
On the other hand, there is a potential for changes in the extent of flooding on some parcels upstream under both Alternatives 4 and 5 because of less frequent beaching by the County and resultant prolonged inundation of the marsh plain. As mentioned in Section 2.2.4, the existing flooding issues in agricultural land parcels would continue to persist due to lack sufficient protective berms in the upstream of the Shell Road pump station. There are six parcels for which feasibility-level analysis indicates potential changes in flood extent and depth resulting from implementation of either of the Action Alternatives (Figure 4-5). Flooding issues in these six parcels are known to occur independent of this project and whether the lagoon mouth is open or closed; however, the County's proposed increased lagoon breach threshold would alter flooding in terms of water depth and spatial extent. Five of those six parcels are located along the left bank of Watsonville Slough, upstream of Shell Road pump station, and used as agriculture. The sixth parcel is on the right bank of Watsonville Slough between Shell Road and W. Beach Road, and it is owned by California State Parks.

There are two categories with respect to defining the area of potential changes in flooding: (1) area that is "newly flooded"; and (2) area that is flooded in the FWOP but may experience an increase in depth of flooding due to the County's increased breach threshold. To estimate the land area that falls into the "newly flooded" category, the feasibility-level hydraulic model results were exported and GIS tools were used to calculate the difference in inundation area between the FWOP and FWP conditions. The results of those calculations by parcel are presented in Table 4-1 and Figure 4-5.

For both Alternatives 4 and 5, easements are proposed on certain parcels of land to address potential changes in flood extent. These would be refined in design and implementation with the refinement of the hydraulic model.

Table 4-1. Area of Flooding in Without Project vs. With Project Conditions on Land Parcels of Interest for Closed Lagoon, Wet Season Model Scenario

Parcel ID in the Figures in Figure 4-5	Parcel Number	Area flooded in Without Project Conditions (acres)	Area flooded in With Project Conditions (acres)	Area of "Newly Flooded" Land (acres)
1	052-191-50	2.0	3.8	1.8
2	052-191-56	4.3	8.9	4.6
3	052-191-21	0.8	2.2	1.4
4	052-191-20	3.4	4.9	1.5
5	052-171-21	0	18.4	18.4
6	052-161-13	1.8	4.5	2.7
Note: "Area flooded" is calculated only for the portions of each parcel that are on the landward side of the berms along Watsonville Slough using feasibility-level hydraulic modeling.				



Note: Inundation extents of No Action Alternative for the same model scenario are shown in hatched overlay. The six parcels that have potential changes to flood extent are annotated with red numbers.

Figure 4-5. Maximum Water Depth for Closed Lagoon, Wet Season Model Scenario under Action Alternatives

4.3 Biological Resources

For the purposes of this analysis, an effect on biological resources may be considered significant if an alternative would result in:

- Substantial long-term direct and indirect adverse effects to special status species or through habitat modification of designated critical habitat and EFH listed by the USFWS and NMFS;
- Significantly degrade established native resident or migratory wildlife corridors; or
- Adverse effects on federally protected wetlands as defined by CWA Section 404.

4.3.1 No Action Alternative

There are no known current plans to restore or further develop the study area. While the County's General Plan speaks generally about "enhancing ecology" within and near the study area, there is no detailed design process or implementation strategy underway other than that being undertaken through the feasibility study of this project. Therefore, it is reasonable to assume that if this project is not implemented, the Santa Cruz County would continue in the manner that the biological resources are currently managed. Under the No Action Alternative, habitat conditions in the lower Watsonville Slough would be further degraded due to the County implementing more frequent mechanical breaching and artificial draining of the Pajaro River Lagoon. Invasive species in the study area are expected to continue to spread. For example, European beachgrass, jubatagrass and perennial pepperweed would likely become more dominant unless actively managed or slowly outcompeted by trees if they are able to spread. The extent of estuarine and marine wetlands may expand with SLC over time, but the quality of wetland habitat would degrade with more frequent human intervention such as artificial draining of the Lagoon.

Under No Action Alternative, no habitat restoration actions nor crossing improvements on W. Beach Road would occur. Without replacing the culverts and raising the road, a natural hydrologic regime and connectivity between the slough and the marsh plain would be further fragmented beyond the existing condition (see Appendix D of this document for more detail). The inundation of the marsh plain during lagoon closures is one of key conditions to support more diverse vegetative communities in lagoon systems. However, the conditions under No Action Alternative would be further degraded than those of stressed marsh vegetation and xeric-species invasion currently in the study area. Additionally, under the No Action Alternative, the fish barrier at W. Beach Road crossing would remain, and the habitat quality around the crossing would remain poor because there would be lack of submerged and emergent aquatic vegetation, prey base, rearing habitat for juvenile steelhead and suitable substrate for gobies.

4.3.2 Action Alternatives

Wildlife Habitat

Section 2.3.1 describes the existing wildlife habitats and vegetation communities in the study area. As described therein, ruderal, wetland, agricultural and urban areas occupy the immediate vicinity of the project area. The construction and maintenance activities associated with the

Action Alternatives (Alternatives 4 and 5) would take place largely within the wetland area around W. Beach Road and would result in temporary impacts to wetland and terrestrial habitats. Construction activities would include clearing of some existing riparian vegetation to construct a temporary road within the slough on either south or north side of the existing crossing at W. Beach Road, demolish the existing culverts, and install a new culvert with fish passage. Approximately 1,300 LF of road raise from the crossing to the intersection of Shell Road would also be part of construction activities. Staging of equipment would be on a vacant land located approximately 1,000 feet south from the project area, and immediately adjacent to agricultural land parcels and riparian habitat along the Slough. The staging area identified for this project is already used for stockpiling of soils and staging of agricultural equipment, and temporary easement will be obtained prior to construction.

Based on ecosystem benefit modeling results, healthy wetland area would increase by 5.4 acres and 8.1 acres for Alternative 4 and Alternative 5, respectively, in State-and County-owned parcels combined. The currently high and dry marsh plain would be converted to healthy wetland marsh over a 50-year project life based on the average annualized habitat unit (see Appendix D of this document for more detail). Under the Alternative 5, the State-and County-owned parcels in the project area would expand the wetland area by approximately 45% of the total area.

Additionally, as part of habitat restoration efforts on State-owned parcel only (Alternative 4), or both State- and County-owned parcels (Alternative 5), patches of invasives and non-native plants would be removed, and plantings would be installed in any areas disturbed by construction (approximately 0.5 acre on the State-owned parcel), and in patches where exotics have been removed or native plants are particularly stressed (approximately 1 acre on the County-owned parcel and 0.5 acre on the State-owned parcel outside of areas affected by construction); therefore, Alternatives 4 and 5 would remove approximately 0.5 and 1.5 acres of non-native vegetation, respectively, and replace it with native marsh plantings.

Temporary adverse effects to marsh and wetland habitat from vegetation clearing during construction would be slightly higher for Alternative 5 compared to Alternative 4. However, these effects would be minimized by restoring the disturbed area after construction. Moreover, operation and maintenance of Alternative 5 would benefit more marsh habitats in a long term through improved ecological function in a larger area. By removing invasives, and replanting with natives, the Alternative 5 would provide long-term benefits to wildlife habitat as vegetation that is planted matures and invasive species are reduced over time. The improvement of understory cover would also benefit wildlife as it provides enhanced habitat complexity and provides for additional refuge opportunity.

Aquatic Species

Both of Alternatives 4 and 5 replace the existing culverts at W. Beach Road crossing with a larger, fish friendly culvert that can accommodate the high water during natural lagoon closures. By replacing the culverts and raising the road, a more natural hydrologic regime and connectivity between the slough and the marsh plain would be maintained to improve ecosystem function. The inundation of the marsh plain during lagoon closures is primarily backwater flooding, which is typically less saline than the normal tidal flows. Native and non-native fish species are located above and below the W. Beach Road crossing and both would

benefit from the removal of existing culverts, daylighting the slough bottom substrates and the reconnection of aquatic habitat. Also, transitioning the stressed wetland environment back to a healthy marsh and riparian habitat would benefit native fish, protected fish species and amphibians. The Action Alternatives would have long-term benefits on aquatic habitat by restoring the quality and removing fish barrier at W. Beach Road.

During construction and maintenance activities, short-term sediment impacts in the downstream of the project area are expected to be similar for Alternatives 4 and 5, which are temporarily increased turbidity and suspended particulate concentration during dewatering and stream diversion. The potential for the adverse effects on turbidity and other water quality constituents as well as measures that will be implemented to minimize these effects to a less than significant level are discussed in the soils, hydrology and water resources section (Sections 4.1.2 and 4.2.2). Also, the study area is located within designated Essential Fish Habitat (EFH) for groundfish and coastal pelagic species (market squid, finfish). Stream diversion would result in short-term loss of habitat space and short-term reductions in macroinvertebrates (food for EFH species). The duration and magnitude of direct effects to EFH associated with the Alternatives 4 and 5 will be minimized using multiple minimization measures discussed in Sections 4.1.2 and 4.2.2.

For both Alternatives 4 and 5, the construction impacts to aquatic species would be short-term and temporary and would not result in any significant adverse effects on aquatic habitat. Short-term adverse effects on aquatic habitat will be offset by long-term beneficial effects to the function and value of the aquatic habitat.

Threatened and Endangered Species

Protected species listed as threatened or endangered under the federal ESA are described in Section 2.3.3. Two federally listed fish species (S-CCC Steelhead and Tidewater Goby) have moderate to low potential to occur in the action area. The CRLF is known to occur in the action area, but the nearest recorded observation of this species occurred approximately 1.25 miles upstream from the project area; therefore, the CRLF has low potential to be affected by Alternative 4 or 5. In the rare event that the CRLF are observed during preconstruction survey, a USFWS approved biologist will coordinate with USFWS and will determine measures for avoiding or minimizing impacts to CRLF individuals. Refer to Section 4.12.2 for mitigation measures for CRLF during construction such as adhering to the work window of June 15 through September 30 and capture/release protocol during electrofishing activities.

S-CCC Steelhead currently use the study area for juvenile rearing and feeding through the Pajaro River Lagoon and Pajaro River mainstem as a migration corridor. Smolts pass through the Lagoon during their seaward migration, as do adults after they have spawned upstream in the Pajaro River. There is no data record for spawning habitat in Watsonville Slough (Personal communication with Casagrande 2024). Because of low and warm summer stream flows, the Lagoon and lower Watsonville Slough provide almost no potential summer rearing habitat for steelhead. Construction activities for Alternatives 4 and 5 will occur during summer season when the channel flow is typically low and water temperature is high; therefore, it is unlikely that juvenile steelhead are present during culvert replacement work. In the rare event that they observed during preconstruction survey, the Capture and Relocation of Salmonids Guidelines

provided by NMFS would be followed by a qualified fisheries biologist to capture and relocate steelhead (and other native fish) prior to construction of the water diversion structures (e.g., cofferdams). Refer to Section 4.12.2 for mitigation measures specific to salmonids and special status species.

Tidewater Goby would have the potential to occur in the study area and have also been documented in the lowermost reach of Watsonville Slough, downstream of the Shell Road Pump Station and Pajaro River with the highest abundance observed at the most upstream site sampled in Pajaro River approximately 2.9 miles above the confluence with Watsonville Slough (USFWS 2016). The Santa Cruz County has been conducting annual fish survey data in Pajaro Lagoon and Watsonville Slough at the confluence with Pajaro River since 2014, and Tidewater Goby have only been found in 2 years of the recent past 6 years. If they observed during preconstruction survey, the capture and relocation guidelines similar to the ones for steelhead provided by NMFS would be followed by a qualified fisheries biologist to capture and relocate gobies (and other native fish) prior to construction of the water diversion structures (e.g., cofferdams).

Staging areas will be established for equipment storage and maintenance, construction materials, fuels, lubricants, solvents, and other possible contaminants in coordination with resource agencies. Staging areas will have a stabilized entrance and exit and will be located at least 100 feet from bodies of water unless site-specific circumstances do not provide such a setback, in such cases the maximum setback possible will be used. If an off-road site is chosen and if special-status species are potentially present, the biological monitor will survey the selected site to verify that no aquatic resources would be disturbed by staging activities. At the project site within the study area that experiences foot traffic, the USACE will post interpretive signs describing the presence of listed fish and/or critical habitat as well as highlighting their ecological and cultural value.

USACE will develop a plan for pile-driving activities to minimize noise impacts to special status species and submit it to relevant agencies for approval prior to the start of in-water pile driving activities. Measures will be implemented to minimize underwater sound pressure to levels below fish thresholds for peak pressure and accumulated sound exposure levels. The plan will describe the least impactful method to aquatic organisms, and will identify the number, type, and size of piles, estimated sound levels caused by the driving, how many piles will be driven each day, qualifications of monitors, any other relevant details on the nature of the pile driving activity, and the actions that will be taken to ensure a project stays within the required sound exposure thresholds. Pile driving will occur during an approved in-water work window of June 15 to September 30 with reduced currents and only during daylight hours. Pile driving will be conducted with vibratory or low/nonimpact methods (i.e., hydraulic) that result in sound pressures below threshold levels to the extent feasible. An agency-approved biologist will be on site during pile-driving activities to minimize effects to special status species that could be present. If any stranding, injury, or mortality to special status species is observed, federal and state wildlife agencies will be notified in writing (e.g., via email) within 24 hours and in-water pile driving will cease until the applicable federal and/or state agencies provide guidance on how to proceed.

Potential effects to threatened and endangered species are expected to be very similar for Alternatives 4 and 5. The culvert replacement work under Alternatives 4 and 5 may adversely affect S-CCC Steelhead and Tidewater Goby due to, and CRLF because of the proposed capture/relocation measures during dewatering although they have low potential to be present in the project area during construction because the construction will occur during a period of low flows (1 to 2 cfs) and water temperatures are expected to be high. Therefore, adverse effects to these species may not occur if no individuals are detected. Construction impacts are expected to be minor, temporary and localized, and the implementation of BMPs and AMMs would minimize adverse impacts to those protected species during construction activities. Over the long term, these species would have slightly increased benefits from Alternative 5 as restoration of both parcels would result in additional improved habitat quantity and quality, and fish passage for steelhead and gobies over Alternative 4.

Potential effects to CRLF are expected to be minimal because it is very unlikely that this species is present in the project area during construction. Additionally, the implementation of BMPs and AMMs including the environmental work window for in-water work between June 15 and September 30 is expected to avoid and minimize adverse impacts during construction activities. CRLF breeding season typically is from late November to late April, which is outside of the construction period. The sites used for rearing of larvae and metamorphs include streams with deep pools, backwater streams and creeks, natural and artificial ponds, and freshwater marshes and lagoons. The lower Watsonville Slough does not provide rearing habitat of deep pools and backwater for CRLF in the summer because the flow is very low and the Pajaro Lagoon is typically open. Therefore, Alternatives 4 and 5 are not likely to adversely affect CRLF because the likelihood that this species would be present in the study area during construction is discountable.

Vegetation

Potential effects to vegetation are expected to be the same during the culvert replacement work under Alternatives 4 and 5. Although the construction activities would include clearing of some existing riparian vegetation, removal of riparian vegetation would be avoided where feasible, and vegetation clearing would be carefully designed to preserve wherever feasible trees with high ecological value (snags, living trees with cavities, or other large, mature trees), as well as any special status plants, and to remove invasive species. Preconstruction surveys for special status plants and high ecological value native trees would be conducted to identify and preserve them where possible. In areas where avoidance is not practicable, native trees and shrubs to be removed for construction would be preserved, transplanted, and incorporated into the planting scheme to the extent possible.

During construction, the spread of noxious weeds and invasives will be controlled to the greatest extent practicable. Equipment will be required to be washed and free of weed seeds and inspected to ensure it is compliant before starting work. Disturbed areas will be seeded with a native grass seed mix, including a fast-germinating sterile grass to provide immediate cover and reduce bare ground. See Sections 4.12.1 and 4.12.2 for BMPs and AMMs specifically to prevent spread of invasive species and revegetate disturbed areas during construction.

Post-construction, all graded areas outside of active channels would be revegetated with native

riparian species to restore habitat, control erosion, and prevent invasive reestablishment. During revegetation, erosion control fabric, hydromulch, or other mechanisms would be applied as appropriate to provide protection to seeds and help them retain moisture. Revegetated areas would be regularly monitored for survival until minimum survival or cover is achieved. If soil moisture is deficient, new vegetation would be supplemented with water until vegetation is firmly established. If invasive plant species colonize revegetated areas, hand and or mechanical removal and replanting with additional native species would be performed.

As part of habitat restoration efforts on State-owned parcel (Alternative 4), or both State- and County-owned parcels (Alternative 5), patches of invasives and non-native plants would be removed, and plantings would be installed in any areas disturbed by construction (approximately 0.5 acre on the State-owned parcel), and in patches where exotics have been removed or native plants are particularly stressed (approximately 1 acre on the County-owned parcel and 0.5 acre on the State-owned parcel outside of areas affected by construction); therefore, Alternatives 4 and 5 would remove approximately 0.5 and 1.5 acres of non-native vegetation, respectively, and replace it with native marsh plantings. The removal of these patches of non-native vegetation will help prevent the spread of non-natives to other portions of the lower Watsonville Slough. While the Alternative 5 would have more areas where there would be temporary disturbance to the existing vegetation during invasive removal and revegetation activities compared to the Alternative 4, Alternative 5 is expected to provide a higher long-term benefit to native plant communities in the study area as revegetated areas become stabilized over time.

Overall, Alternatives 4 and 5 would have no significant adverse effects during construction while they provide long-term beneficial effects to vegetation.

4.4 Cultural Resources

The principal federal law addressing historic properties is the National Historic Preservation Act (NHPA) of 1966, as amended (54 United States Code of Laws [USC] 300101 et seq.), and its implementing regulations (36 CFR Part 800). Section 106 requires a federal agency with jurisdiction over a proposed federal action (referred to as an “undertaking” under the NHPA) to account for the effects of the undertaking on historic properties, and to provide the Advisory Council on Historic Preservation (ACHP) an opportunity to comment on the undertaking. The term “historic properties” refers to “any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register” (36 CFR Part 800.16(*l*)(1)). The implementing regulations (36 CFR Part 800) describes the process for identifying and evaluating historic properties, for assessing the potential of adverse effects from federal undertakings on historic properties, and seeking to develop measures to avoid, minimize, or mitigate adverse effects.

The steps of the Section 106 process are accomplished through consultation with the State Historic Preservation Officer (SHPO), federally recognized Indian tribes, local governments, and other interested parties. The goal of consultation is to identify potentially affected historic properties, assess effects to such properties, and seek ways to avoid, minimize, or mitigate any adverse effects on such properties. The agency also must provide an opportunity for public involvement (36 CFR 800.1(a)). Consultation with Indian tribes regarding issues related to

Section 106 and other authorities (such as NEPA and Executive Order No. 13007) must recognize the unique government-to-government relationship held between the Federal Government and Indian tribes, as set forth in Executive Order 13175, 65 FR 87249 (Nov. 9, 2000), and Presidential Memorandum of November 5, 2009.

4.4.1 No Action Alternative

Under the No Action Alternative, no historic properties would be affected in the lower Watsonville Slough. However, cultural resources located outside the APE would be degraded over time as more frequent flooding would occur with SLC causing erosion damage to these sites and potentially washing them away or exposing them to the public.

4.4.2 Action Alternatives

This analysis includes a records search of data obtained from the Northwest Information Center (NWIC File No: 21-0722), tribal consultation, and a pedestrian archaeological survey. The entire study area has gone through extensive reconnaissance surveys as well as archival research and limited archaeological testing and excavation. Twenty-two cultural resource investigations were completed within a 1-mile radius of the APE. No historic properties were identified within the APE, though 12 cultural resources are located within a 1-mile radius. All archaeological resources near the project area are situated on a bluff above Watsonville Slough, or on surrounding terraces nearby the Pajaro River.

A search of the Native American Heritage Commission (NAHC) Sacred Lands File indicated that no Native American cultural resources have been identified in the APE. NAHC provided a list of Tribes culturally affiliated with the study area who may have knowledge of resources within or adjacent to the APE. USACE initiated tribal consultation in 2022 and shared the results of this survey in 2024 (refer to Appendix C for a summary of all 106 consultation). USACE is actively consulting with the Amah Mutsun Tribal Band for the study and will work with the tribe to incorporate Indigenous Knowledge into the restoration plans and to assist in the designing of interpretive signage.

A formalized pedestrian survey of the APE was completed in 10 meter transects by San Francisco District archaeologists Stephanie Bergman Sahinoglu and Kathleen Ungvarsky. W. Beach Road was documented as a historic built environment resource that is recommended as not eligible to the National Register of Historic Places (NRHPS). W. Beach Road was established by the late nineteenth century, when it was used for travel to Camp Goddall, a seaside resort established in 1882 and was associated with the short-lived Port of Watsonville. The port suffered extensive storm damage in 1904 and 1912, and by 1913 had completely shut down (Edwards and Farley 1974). No historic features of the road are evident. No other cultural resources were identified. The likelihood of encountering buried archaeological resources is very minimal due to the project being located in a marsh plain that historically was inundated. No historic properties were identified in the APE for the project. However, due to the presence of large, multi-component archaeological resources located near the APE, a cultural resources awareness training is recommended for the entire project. This training will be conducted by a USACE Secretary of the Interior qualified archaeologist prior to any ground disturbing activity. Alternatives 4 and 5 would not affect historic properties or the surrounding environment.

Therefore, the appropriate finding is No Historic Properties Affected. If historic resources are inadvertently uncovered during construction, work would be halted immediately and a USACE archeologist would be notified, whom would in turn notify the appropriate SHPOs and/ or tribes. The construction work would not be continued until the area is inspected by a USACE archeologist and other appropriate parties. If they determine that the resources require further consultation, USACE will notify the appropriate SHPO and/ or tribes to determine next steps, including when construction could recommence.

4.5 Aesthetics and Recreation

For the purposes of this analysis, an effect on aesthetics and recreation may be considered significant if an alternative would:

- Substantially reduce or increase access and use of existing recreational facilities or their availability;
- Substantial degradation of visual character of the site;
- Result in physical deterioration of existing recreational facilities; or
- Substantial damage to scenic resources.

4.5.1 No Action Alternative

Under No Action Alternative, recreational opportunities in the lower Watsonville Slough would remain as they have in the recent past. However, they would be degraded over time with more frequent flooding of the W. Beach Road crossing, thus the County would conduct more frequent mechanical breaching of Pajaro River sandbar as SLC occurs. The adverse effects of more breaching by the County would be visual impacts from the presence of construction equipment, stressed native marsh vegetation, and invasion of non-native vegetation as the natural tidal marsh in the study area becomes drier as of a result of artificial draining of the wetland. Therefore, the quality of aesthetics is expected to be degraded over time under the No Action Alternative while access to recreational facilities may be similar to existing conditions.

4.5.2 Action Alternatives

The existing aesthetics and recreational features in the study area are described in Section 2.5. As stated in that section the visual character of the low Watsonville Slough is characterized by flat topography with rural agricultural croplands, a meandering slough interspersed with marshes and small ponds, and pockets of residential development; the Watsonville Slough is not considered scenic.

Aesthetics

Potential effects to aesthetics in the immediate vicinity of the construction site are expected to be the same during the culvert replacement work under Alternatives 4 and 5. There would be temporary effects to the aesthetic environment in and around the project area because of the presence of construction equipment, but significant adverse impacts to aesthetics are not expected. Much of the construction activity, such as the operation of heavy-duty equipment and hauling of materials, would be confined to the active construction site. Staging of construction

equipment and materials would take place in a vacant land which is already used as a site for stockpiling and staging of soils and heavy farming equipment.

Visibility of construction and maintenance activities would be primarily limited to the project area and may be visible from nearby parking facilities at the Palm Beach State Park. Temporarily exposed soils, rocks, and other natural materials could be visible to beach goers and residents immediately following construction of the culvert replacement. However, areas with exposed soil would be replanted with native vegetation after construction or major maintenance activities are completed. After vegetation has established, the appearance of the project area is expected to be visually blended in with existing healthy marsh if not improved over time with mature native plants.

Any aesthetic impacts from construction activities would be temporary; construction equipment would be similar to agricultural machinery used in the vicinity; and post-construction revegetation would help restore the natural visual character of the study area. During invasive removal and native planting activities, because Alternative 5 has more areas of invasive removal and revegetation for the implementation of restoration measures and maintenance activities compared to the Alternative 4, Alternative 5 would take longer or have more heavy equipment and trucks, resulting in higher visual impacts although they are minor. However, the implementation of Alternative 5 is expected to benefit more for native plants and wildlife in study area. Therefore, any potential aesthetic impact would be less than significant.

Recreation

Potential effects to recreation in the study area are expected to be the same during the culvert replacement work under Alternatives 4 and 5. The existing recreational features in the study area are the access to Palm Beach State Park and its parking facility. Both Alternatives 4 and 5 would ensure the access to Palm Beach State Park and its parking at all times during construction by constructing a temporary road at W. Beach Road although street parking access on the north side of the W. Beach Road would be limited and all visitors to the Palm Beach State Park would have to park at the designated parking lot which will be open at all times during construction. To mitigate impacts to street parking for beachgoers and recreationists, signage alerting the public parking closures on W. Beach Road will be posted. As shown in Figure 2-19, there are relatively higher visitors during June-August and lower in September and October; the proposed construction period is from June 1 to October 31. Therefore, the impact of limited parking area would be temporary and less than significant as visitors would be provided with alternative parking at the State Park instead of the street parking. Although Alternative 5 has more areas of invasive removal and native planting activities, it would not have any adverse impact to recreation because access to W. Beach Road and parking would be open at all times. However, the implementation of Alternative 5 is expected to benefit more for native plants and wildlife in study area; thus, wildlife-dependent recreational activities may be enhanced in the future.

4.6 Air Quality Effects Analysis

The effects analysis for air quality involves evaluating expected criteria air pollutant emissions to determine whether they would exceed the de minimis thresholds as established by the Clean Air Act. These de minimis thresholds form the basis of the metric for determining significant effects

in this effects analysis for air quality. Where if criteria air pollutant emissions exceed a de minimis threshold it would result in a finding of significant impact for air quality.

4.6.1 Air Quality Effects from the No Action Alternative

Effects to air quality from the no action alternative are expected from the sporadic use of construction equipment to unplug the mouth of the slough annually, as well as from emissions from additional trips for evacuations and emergency response if the area is flooded that it affects the Pajaro Dunes Community.

Poor air quality resulting from construction activities and air pollutants can have significant adverse effects on health to the project area but also the overall vicinity. Construction sites often generate dust and particle matter, which can exacerbate respiratory conditions such as asthma, chronic bronchitis, and other chronic obstructive pulmonary diseases. Additionally, emissions from construction equipment and machinery contribute to elevated levels of NOx and volatile organic compounds, further degrading air quality. Prolonged exposure to these pollutants can lead to cardiovascular problems, impaired lung function, and increased susceptibility to respiratory infections. Addressing these health risks requires persistence to air quality regulations, implementation of dust control measures, and ongoing monitoring to safeguard public health. Additionally, flooding can cause mold to grow which is known to have effects to the body, including respiratory health.

In addition to air pollutant emissions, emissions of fugitive dust would also be generated by construction activities. Studies have shown that the application of BMPs at construction sites substantially controls fugitive dust (WRAP 2006), and individual measures have been shown to reduce fugitive dust by anywhere from 30 percent to 90 percent (WRAP 2006). For all projects, the BAAQMD recommends the implementation of its Basic Control Mitigation Measures (BAAQMD 2017). Implementation of these dust control avoidance and minimization measures would be adequate to control impacts from construction fugitive dust.

4.6.2 Air Quality Effects from the Action Alternatives

Effects to air quality from Alternatives 4 and 5 are expected from the use of construction equipment during the construction season to replace existing culverts in the Watsonville Slough and restoration work. Emissions from additional trips for evacuations and emergency response if the area is flooded such that it affects the Pajaro Dunes Community, however, at a decreased frequency compared to the No Action Alternative.

Although poor air quality can still have health effects with any alternative, they are generally less severe with the Alternatives 4 and 5 compared to the No Action Alternative. The impacts are more temporary and short-term during the construction period, though the emissions can still be significant.

In addition to air pollutant emissions, emissions of fugitive dust would also be generated by construction activities associated with grading and earth disturbance, stockpiling, travel on paved and unpaved roads, and other activities. Studies have shown that the application of BMPs at construction sites substantially controls fugitive dust (WRAP 2006), and individual measures have been shown to reduce fugitive dust by anywhere from 30 percent to 90 percent

(WRAP 2006). For all projects, the BAAQMD recommends the implementation of its Basic Control Mitigation Measures (BAAQMD 2017). Implementation of these dust control avoidance and minimization measures would be adequate to control impacts from construction fugitive dust.

4.6.3 Air Quality Health Considerations and Prevention Measures

To reduce the impact of activities on air quality, several preventative measures will be implemented to control emissions and reduce particulate matter. Measures like catalytic converters and other emissions control systems on construction machinery and utilizing low-sulfur diesels fuels in equipment will minimize the emission of harmful pollutants. Additionally, applying water to exposed soil and construction surfaces will prevent fugitive dust generation, while covering hauled materials effectively reduces the dispersion of particulate matter. Incorporating regular maintenance schedules for equipment will ensure optimal performance and reduce potential emissions. By combining these strategies with adherence to environmental regulations and best practices, project areas will substantially limit their impact on air quality and public health.

4.6.4 NEPA Effects Determination for Air Quality

According to the EPA's Current Nonattainment Counties for All Criteria Pollutants (Greenbook) the project area is not located in a county that is in non-attainment or maintenance for any criteria air pollutant as regulated under the Clean Air Act. As the project is not anticipated to result in emissions in exceedance of a de minimis threshold, it is concluded that emissions from air pollutants would have less than significant impacts.

4.6.5 Clean Air Act Determination of De Minimis Emissions

According to the EPA's Current Nonattainment Counties for All Criteria Pollutants (Greenbook) the project area is not located in a county that is in non-attainment or maintenance for any criteria air pollutant as regulated under the Clean Air Act. Emissions from the project are therefore considered *de minimis* and is following the Clean Air Act.

4.6.6 Greenhouse Gas Emissions

Currently, there are no established federal thresholds of significance for greenhouse gas emissions. Therefore, this section discusses greenhouse gas (GHG) emissions, but does not include a significance threshold or impact assessment.

4.6.7 GHG Emissions Modeling Methodology and Assumptions

It is important to recognize the distinction between theoretical analysis provided by models, such as the NEAT model, and real-world conditions. These models rely on constant rates and simplifies assumptions to generate their conclusions and analyses, offering a structured theoretical framework. While they provide valuable insight and clear representation of potential impacts, they may not fully account for the complexities and variability inherent in real-world environments. Factors such as fluctuating traffic patterns, weather conditions, and varying operational activities can cause significant deviations from model predictions. Consequently, a conversative approach is used in the analysis when using these constant rates to account for

potential uncertainties which is defensible as it shows a scenario where emissions are at a higher rate, even when real-world conditions differ from theoretical assumptions.

When analyzing GHG emissions, it is essential to consider both upstream and downstream emissions, as well as their broader interconnected effects. Upstream emission refers to those generated during the production and transportation of materials and resources, while downstream emissions pertain to those resulting for the end use or disposal of the project outputs. This holistic approach acknowledges that projects do not exist in isolation; rather, they influence and are influenced by adjacent activities and processes. Figuratively, this interconnectedness implies that decisions and emissions from one project can have ripple effects on others, potentially altering regional air quality and regularity compliance. Although specific impacts may not currently be under discussion, it is crucial to maintain an awareness of these interdependencies to ensure comprehensive environmental management and adherence to the overall goals to protect air quality.

4.6.8 No Action Alternative

Under the No Action Alternative, which is the baseline scenario for the emissions calculations, includes two breach events, general operations and maintenance, and two evacuations per year over a 50-year planning horizon. As refenced in Table 4-2 the event frequency is seen as an increase because of SLC, leaving the average number of breaching events to be increased. Each of these breaching events are assumed to last 10 days, with worker vehicles averaging 25 miles per day, while excavators and rubber-tired loaders were assumed to operate for 4 hours per day, which is a worst-case scenario estimation. Additionally, 230 passenger vehicles (one per apartment or housing unit on the sandbar) were assumed to travel 20 miles per breaching round trip and 5 worker vehicles travel 15 miles per day round trip to occur each breach. General O&M involves 10 worker vehicles averaging 25 miles per day over 10 days annually including before or after an event which can include consistent monitoring of river water height at different locations, checking of wildlife and biology, or collecting of water samples to be processed. This was documented inside the Pajaro River Mouth Sandbar Breaching Program Description. Further details and the process of calculations for greenhouse gas emissions are provided in Environmental Appendix A-4 of this document. This needs to be prefaced that actions needed for the sandbar breaches and O&M needs are the baseline conditions of the area and would be occurring without the project being present.

Table 4-2. Long-Term Emissions (Metric Tons)

Alternative	CO_2	CH_4	N_2O	CO_{2eq}
No Action	23.0	9.78E-04	1.05E-02	26.2
Alternative 4	7.4	3.13E-04	3.63E-03	8.5
Alternative 5	7.4	3.13E-04	3.63E-03	8.5
Note: Includes Evacuations, Breaching Equipment, and Operations Emissions				

4.6.9 Action Alternatives

The long-term indirect emissions encompass greenhouse gas emissions for No Action Alternatives are a result from the two breaching and evacuation events that are assumed to occur annually. Opting for Alternatives 4 and 5 results in a reduction of CO_2, CH_4, and N_2O long-term indirect emissions compared to the baseline scenario with including one breaching and evacuation event per year that is averaged from Table 4-2 above. This reduction underscores the environmental benefits associated with choosing these alternatives.

During the construction period spanning one season for the Action Alternatives, short-term direct emissions from construction activities contribute to the increasing atmospheric greenhouse gases. There would be no greenhouse gas emissions present during the No Action Alternative sine there would be no construction taking place. Construction equipment emissions were assessed over 138 workdays within the construction timeline. The greenhouse gas analysis results for short-term emissions are shown in Table 4-3 for Action Alternatives. Please note that Alternatives 4 and 5 exhibit identical construction emissions due to their identical construction plans and equipment requirements. To find further information on equipment list and calculations, see Environmental Appendix A-4. While there are some differences among the alternatives, including additional parcels in Alternative 5, it is being assumed that the worker trips would be categorized as the same even though the tasks required might be different. For the No Action, O&M emissions account for worker trips, which has been listed to include tasks like wildlife inspections or water sample collection. When assessing the different alternatives, it uses the same O&M needs but with the tasks differing slightly. For instance, under Alterative 5 worker trips would focus more on planning and invasive species removal. Although there may be minor variation, it is considered the differences between the alternatives to be negligible.

Table 4-3. Short-Term Emissions (Metric Tons)

Alternative	CO_2	CH_4	N_2O	CO_{2eq}
No Action	0	0	0	0
Alternative 4	247	0.01	0.80	484
Alternative 5	247	0.01	0.80	484

4.6.10 Gross and Net Total Emissions based on Action Alternatives

The greenhouse gas emissions data presented in Table 4-3 indicate that both Action Alternatives are projected to emit lower amounts of CO_2 and CO_2 equivalents compared to the No Action Alternative. To come to these conclusions, we were able to use to equations 4A-D mentioned below to calculate the wetlands emissions. With this, we were able to use the nitrous oxide production rates based on the habitat and aquatic type of 0.13 (grams N_2O/m^2/year) for emergent and 0.37 for forest/shrub. With these numbers and emissions factors known, the USACE NEAT Model was used to calculate the gross and net total greenhouse gas emissions (Table 4-4). Alternative 5 exhibits higher emissions than Alternative 4, which aligns with the larger parcel acreage combing State- and County-owned parcels, unlike Alternative 4 which only includes State-owned parcel. Note that methane (CH_4) and nitrous oxide (N_2O) emissions would increase in Action Alternatives compared to the No Action Alternative. This is attributable to the

anticipated increase in freshwater presence relative to saltwater under the Action Alternatives. The elevated concentrations of N_2O and CH_4 in freshwater environments due to higher plant production are primarily influenced by nutrient availability, oxygen levels, presence of organic matter, and the specific microbial communities and processes that would increase in freshwater conditions. In other words, due to implementing an Action Alternative, there will be more freshwater than saltwater which will result in higher levels of CH_4 and N_2O which is represented in Table 4-8. Environmental Appendix A-4 also presents USACE NEAT Model assumptions and equations used to calculate gross and net total emissions.

Table 4-4. Gross and Net Total Emissions

	Gross Emissions		Net Emissions	
No Action Alternative	**Pounds**	**Metric Tons**	**Pounds**	**Metric Tons**
Carbon Dioxide (CO_2)	-4,385,201	-1,989	0	0
Methane (CH_4)	1,979	1	0	0
Nitrous Oxide (N_2O)	3,672	2	0	0
Carbon Dioxide Equivalents (CO_2e)	-3,241,587	-1,470	0	0
Alternative 4	**Pounds**	**Metric Tons**	**Pounds**	**Metric Tons**
Carbon Dioxide (CO_2)	-6,667,651	-3,024	-2,282,451	-1,035
Methane (CH_4)	12,686	6	10,707	5
Nitrous Oxide (N_2O)	4,477	2	805	0
Carbon Dioxide Equivalents (CO_2e)	-5,016,444	-2,275	-1,774,857	-805
Alternative 5	**Pounds**	**Metric Tons**	**Pounds**	**Metric Tons**
Carbon Dioxide (CO_2)	-7,618,882	-3,456	-3,233,681	-1,467
Methane (CH_4)	14,137	6	12,158	6
Nitrous Oxide (N_2O)	4,638	2	966	0
Carbon Dioxide Equivalents (CO_2e)	-5,883,461	-2,669	-2,641,874	-1,198
Green shaded cells denote net negative emissions are expected which is advantageous for the environment Red shaded cells denote net positive emissions are expected which is disadvantageous for the environment				

4.7 Noise

For the purposes of this analysis, an effect on noise may be considered significant if an alternative would:

- Exceed Federal Transit Administration (FTA) construction noise guidelines criteria of 90 dBA during daytime hours or 80 dBA during nighttime hours at residential receptors, or 100 dBA during any hour at other receptors.

4.7.1 No Action Alternative

Under No Action Alternative, there would be no change in noise effects to sensitive receptors in the project area.

4.7.2 Action Alternatives

Existing noise conditions within the study area are described in Section 2.7.2. Noise levels surrounding the project area are varied depending on the time of day activities occurring but generally range from 40-50 dBA for rural setting. Common activities that may cause elevated noise levels in the vicinity of the project area include running diesel powered generators, trucks, and farming equipment.

Both Alternatives 4 and 5 would involve noise associated with the construction and periodic maintenance of the restoration features within and adjacent to State-owned or both State- and County-owned parcels. Such activities could result in temporary increases in noise levels in these areas above ambient conditions. There would be no difference in noise generated by Alternatives 4 and 5 because noise generating activities are related to a common project element, i.e., culvert replacement. Noise generated by the restoration work on the two marsh parcels would be minimal and effects from vegetation removal and planting on these parcels would be negligible. The nearest sensitive noise receptor is the Palm Beach State Park parking lot facility approximately 350 feet away from the culvert replacement site. There are also residential areas approximately 1,000 feet away from the project area to the nearest units of the Pajaro Dunes North and South communities in the northwest and southwest. Construction activity noise levels within the project area would fluctuate depending on the particular type, number, and duration of uses of various construction equipment. Construction related material haul trips would raise ambient noise levels along haul routes, depending on the number of haul trips made and types of vehicles used. In addition, certain types of construction equipment generate impulsive noises (such as pile driving). Table 4-6 shows typical noise levels during different construction stages.

Table 4-6. Typical Construction Noise Levels

Construction Phase	Noise Level (dBA, Leq)[1]
Ground Clearing	84
Excavation	89
Foundations	78
Erection	85
Finishing	89
Note: [1]Average noise levels correspond to a distance of 50 feet from the noisiest piece of equipment associated with a given phase of construction and 200 feet from the rest of the equipment associated with that phase. Source: USEPA, 1971	

Table 4-7 shows typical noise levels produced by various types of construction equipment. Construction activities associated with the project would be temporary in nature and related noise impacts would be short-term. Construction activities could substantially increase ambient noise levels at noise-sensitive locations, especially if they occurred during nighttime hours, noise from construction. Construction activities will generally be limited to daylight hours, to the extent feasible.

Table 4-7. Typical Noise Levels for Common Construction Equipment (at 50 feet)

Equipment	Lmax (dBA)
Air Compressor	78
Backhoe	78
Cement Mixer Truck	79
Cement Pump Truck	81
Chain Saw	84
Compactor	83
Crane	81
Concrete Saw	90
Dozer	82
Excavator	81
Dump Truck	76
Flat Bed Truck	74
Front End Loader	79
Forklift	75
Generator	81
Grader	85
Paver	77
Pick-up Truck	40
Roller	80
Tractor	40
Tree Chipper	87
Source: Federal Highway Administration 2006	

At the nearest receptor (the nearest parking lot at Palm Beach State Park) approximately 350 feet from the construction site, noise from the loudest activity (concrete saw at 90 dBA) would be reduced to 69 dBA based on FTA formula for Distance Correction Factor Equations for General Noise Assessment (FTA 2018) assuming stationary sources to be conservative. This is below the significance threshold of 100 dBA during any hour at non-residential receptors. The nearest receptors from the project area would experience slightly higher than the typical noise level in rural communities (i.e., 40-50 dBA) during daytime while construction activities are underway. To minimize any potential effects from construction-related noise, construction activities will be limited to daylight hours, to the extent feasible. While construction activities would be largely constrained to the daylight, pumps associated with the stream diversion for dewatering will run on a 24-hour basis for approximately 3 months during culvert replacement. However, the surrounding land uses in the immediate vicinity are agricultural and parks, and human activities are expected minimal during nighttime in the study area. It is expected that the residents of the Pajaro Dunes North and South communities in the northwest and southwest from the project area would not be affected by the noise from pump operation due to the long distance. The nighttime construction activities such as pump operations would be temporary and short-term and would not represent a significant new source of noise in the project area.

Construction-related material haul trips would raise ambient noise levels along haul routes, depending on the number of haul trips made and types of vehicles used. Noise levels that would occur along the vehicle routes associated with a passing vehicle would range from a 40-dBA to 80-dBA range, depending on the type of vehicle and distance to the listener. Given the limited number of vehicles that would be associated with construction and maintenance of the Action Alternatives, the limited number of days per year that trips would occur, and that the dBA range would be below 90 dBA in the daytime, noise levels associated with off-site vehicle trips would be negligible and would result in a less than significant impact.

Operation and maintenance of the Action Alternatives would not result in any noise-related impacts. While maintenance activities would primarily consist of vegetation management, they could infrequently include activities such as repairing or adjusting structures using heavy equipment. Given this, maintenance noise levels could intermittently and temporarily rise to construction-level noise, but for a few hours a day. The avoidance and minimization measures described above for construction related noise would be applied for maintenance noise as well. Given the infrequent and temporary nature of maintenance activities and the proposed minimization measures, this impact would be insignificant.

Refer to Sections 4.12.1 and 4.12.2, respectively for BMPs and AMMs specific to noise and vibration abatement measures during construction. With implementation of BMPs and AMMs, no significant impacts to sensitive receptors are anticipated from either of the Action Alternatives.

Therefore, construction, operation, and maintenance for the Alternatives 4 and 5 are not expected to result in significant adverse impacts on noise in the study area.

4.8 Land Use and Agricultural Resources

For the purposes of this analysis, effects on land use, planning and zoning would be considered significant if it would result in the following:

- Physically divide an established community;
- Conversion of public open space into urban- or suburban-scale uses;
- The creation of incompatible land use types;
- Conflict with applicable land use plan, policy, or regulation of an agency with jurisdiction over the project (including but not limited to the general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect; or
- Convert farmland to non-agricultural use.

4.8.1 No Action Alternative

Under the No Action Alternative, there would be no change in existing farmland or land use conditions. The lands in the study area would continue to be affected by the lagoon closures, and consequently, experience periodical flooding due to the low infrastructure. Over time, there is the potential for farmland in the study area to be purchased by local land trusts for further salt marsh restoration, but the scope and scale of these efforts are not known at this time.

4.8.2 Action Alternatives

Farmland, including prime and unique farmland, in the study area is discussed in Section 2.8. Both Alternatives 4 and 5 would not result in the irreversible conversion of any farmlands to other uses. The California Department of Conservation designates most land parcels in the study area as Prime Farmland with some areas designated as Farmland of Statewide Importance and Unique Farmland. The Action Alternatives would include the crossing improvement and restoration features in the project area. The State- or County-owned parcels are not currently under agricultural production and are not designated as farmland under California's most recent Farmland Mapping Monitoring Program (FMMP) database (2024).

While the proposed construction areas are within the Slough channel, staging and access routes for the Action Alternatives would occur on a vacant land in the vicinity of the property designated as Prime farmland under the FMMP; however, it has been offered by the property owner for temporary staging and access purposes. This area would be temporarily affected during construction but given its current use as staging and stockpiling of farming purpose, any impacts would be minimal and it could be returned to the agricultural use post construction. Therefore, no irreversible conversion of farmland would occur under either of the Action Alternatives. Since no irreversible conversion of farmland will occur, no reporting or consultation are necessary for the Alternatives 4 and 5 under the Farmland Protection Policy Act.

Therefore, no significant adverse effects to prime, unique, other farmlands or conflict with the land use plan of the Santa Cruz County General Plan are expected from the Action Alternatives.

4.9 Traffic and Transportation

For the purposes of this analysis, an effect on traffic and transportation may be considered significant if an alternative would result in:

- Substantially increase traffic in relation to existing traffic load and capacity of the roadway system;
- Substantially disrupt the flow of traffic;
- Expose people to significant public safety hazards resulting from construction activities on or near the public road system;
- Reduce the supply of parking spaces sufficiently to increase demand above supply;
- Cause substantial deterioration of the physical condition of nearby roadways; or
- Interfere with emergency vehicle access.

4.9.1 No Action Alternative

Under No Action Alternative, there would be continued disruption due to W. Beach Road closures during flooding events, and the associated safety issues and emergency response delays. The No Action Alternative would induce changes in existing traffic patterns or transportation conditions in the study area during road closures and mechanical breaching events.

4.9.2 Action Alternatives

Both of Action Alternatives (Alternatives 4 and 5) would result in increased light and heavy duty truck traffic associated with transport of crews, contractors, equipment, materials, construction vehicles, and haul trucks on roadways used to access the project staging and construction site, Truck hauls of borrow material and construction material would generate most of the construction-related traffic. Road access to the project area would be provided via W. Beach Road and Shell Road from SR 1, SR 152, and SR 129, all of which are designated as truck routes by the California Department of Transportation (Caltrans).

The primary construction zone would be around the area of roadway raise/improvement along W. Beach Road and the culvert replacement at the crossing. Trucking access to the project area would be from W. Beach Road from the east (coming from City of Watsonville) and Shell Road. The project needs to maintain emergency access through W. Beach Road because it is a primary access route to/from the Pajaro Dunes Community and Palm Beach State Park. Access would be maintained at all times via construction of a temporary road so that emergency and service vehicles (e.g., fire, garbage trucks) would be able to service the area. Most of the proposed construction will take place Monday through Friday from 7 a.m. to 7 p.m. (with possible infrequent work on weekends) and thus increases in traffic associated with the Action Alternatives would be experienced primarily on weekdays.

Both Action Alternatives would have about five dump trucks (each with 10 cubic yard capacity) driven 10 miles per day on weekdays during construction. The construction work force would likely come from Santa Cruz, Monterey, Santa Clara and San Benito Counties via SR 1 and/or

SR 152. Vehicle trips would originate from a variety of locations and distances, but the primary ingress and egress corridors for construction haul trucks and deliveries to the project area would be via W. Beach Street. Delivery trucks would use streets in the immediate area of the project area to access the construction and staging area. Construction debris may be transported from the project area to Buena Vista Landfill.

The existing level of traffic counts on W. Beach Street ranges 2,000 to 7,600 counts on an annual average basis depending on routes (Table 2-7 in Section 2.9), and a temporary addition of up to 50 vehicle trips per day during construction would not cause a significant change in congestion on public roadways in the study area. Maintenance-related traffic for either of Action Alternatives would be periodic and minimal compared to construction related traffic. It would similarly result in insignificant increases in traffic volumes on roadways in the project area. Operation of the project would result in no additional traffic in the study area.

To avoid any adverse effects from the vehicle traffic that would be associated with the Action Alternatives, the selected construction contractor would be required to prepare a Traffic Control Plan to ensure safe and efficient traffic movement throughout the study area. The Traffic Control Plan would identify access routes as well as alternative emergency routes, where necessary, to avoid areas most affected by construction-related traffic. The contractor would also be required to provide signage where appropriate to alert motorists, cyclists, and pedestrians of potential delays and alternative routes. Flagging for construction vehicles would be used if necessary to temporarily control traffic on roadways and protect public safety. Given these measures, the Action Alternatives would not be expected to impact motorist, bicycle, or pedestrian safety.

Furthermore, transportation associated with the Action Alternatives would not permanently degrade, damage, or wear down roadways used to access the project area. Public roadways in the study area are designed to accommodate the routine traffic of heavy vehicles associated with the operation of large farmlands in the region and thus the minimal increase in construction-related traffic would not be expected to affect such roadways.

Therefore, Action Alternatives would have a less than significant effect on traffic and transportation based on the minimal increase in weekday vehicle trips expected in relation to existing traffic levels in the vicinity of study area and the measures proposed to provide traffic safety and protection of roadway conditions.

4.10 Public Services and Utilities

For the purposes of this analysis, effects on public services and utilities would be considered significant if an alternative:

- Interfere with emergency response plans or emergency evacuation plans;
- Result in inadequate emergency access or impediments to emergency services;
- Result in the net reduction in utility services provided; or
- Result in the net increase in public services required.

4.10.1 No Action Alternative

Under the No Action Alternative, it is anticipated that more interruption to essential public services provided CalFIRE CZU Pajaro Dunes Station #42 as more frequent flooding on the W. Beach Road crossing would occur. The W. Beach Road is the only access to Palm Beach State Park and Pajaro Dunes Resort so that their essential service and emergency medical services would be disturbed during flooding events. Other utility services such as water supply, electricity & natural gas, telecommunication, etc., would not be expected to change conditions under the No Action Alternative.

4.10.2 Action Alternatives

Both Alternatives 4 and 5 would provide benefits to emergency services as they would reduce the frequency of flooding on W. Beach Road crossing. However, several utilities have been identified in the project area and would need to be relocated during construction (Table 4-8). A utility survey will be conducted prior to the D&I phase of this project, verify the existing information, and the need for utility relocation will be further evaluated. A water main and sewer line, owned by the City of Watsonville, run below/underneath the W. Beach Road crossing. Pacific Gas & Electric (PG&E) owned utilities are also in the immediate vicinity of the culvert replacement in addition to a low-voltage pressure transducer that Santa Cruz County owns and maintains to monitor water levels for the Pajaro River Sandbar Mechanical Breaching Program. Initial gas line mapping was provided by PG&E but has not been verified. Overhead high-voltage electrical power lines run parallel to the north bank of W. Beach Road before crossing the road at both sides of the project area. Utilities may impact the location of cofferdams for dewatering and would need to be further investigated during the D&I phase of this project.

Table 4-8. Affected Known Utilities in Vicinity of Culvert Replacement Site

Item	Known Utility	Location	Owner
1	12-inch D Water Main line buried in roadway	At the box culvert, W. Beach Road	City of Watsonville
2	6-inch D Sewer (forced) line, buried in roadway	At the box culvert, W. Beach Road	City of Watsonville
3	Natural gas line(s), buried	In W. Beach Road and in slough south? of (E) culverts	PG&E
4	Power lines, overhead and buried	Along W. Beach and Shell Road	PG&E
5	Communication: fiber optics cable TV (To be verified during D&I)	Overhead (on PG&E poles) + buried	Unknown
6	Low voltage pressure transducer for water level monitoring, buried and above grade	Downstream of (6) culverts, right bank and pole mounted	Santa Cruz County

Before the start of construction, utility locations shall be verified through field surveys and any buried utility lines shall be clearly marked where construction activities would take place and on the construction specifications before of any excavation activities begin. In case of potential accidental damage to a utility line, a response plan will be prepared by USACE contractors, to ensure a minimal interruption to utility services to residents at Pajaro Dune communities.

Therefore, Alternatives 4 and 5 would have beneficial effects on public services for providing emergency services to Pajaro Dunes communities and visitors at the Palm Beach State Park, and a less than significant effect on utilities because minimal service interruptions are expected during construction activities. There are no anticipated effects to utilities associated with the restoration parcels and therefore there are no differences in effects between Alternative 4 and 5.

4.11 Cumulative Effects

Although the NEPA statute does not require analyzing the cumulative effects of agency actions, to fully disclose the potential impacts, cumulative effects analyses are included herein. For purposes of this document, a cumulative effect as an effect on the environment that results from the incremental effect of an action when combined with other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative effects for the study were evaluated by identifying any past, present, or reasonably foreseeable future projects in and around the study area that could have impacts which, if combined with the impacts of the proposed alternatives, could combine to create a cumulative effect under NEPA. The other projects assessed under cumulative effects analysis are established in Section 1.6.

The potential effects of these other projects are combined with the potential adverse or beneficial effects of the proposed alternatives to determine the type, length, and magnitude of potential cumulative effects. The effects from these projects could be individually minor but when combined could be collectively significant actions. Significance of cumulative effects is determined by meeting the specified criteria identified under each environmental resource section in Section 4 above to evaluate impacts from the combination of the proposed alternatives and the other related projects discussed below. Those effects that cannot be avoided or reduced to less than significant are more likely to contribute to cumulative effects in the area.

The geographic and temporal scope that could be affected by the Action Alternatives would be similar for Alternative 4 and 5 because most effects are associated with construction activities for the crossing improvements at W. Beach Road, and those effects would vary depending on the type of environmental resource being considered. Adverse effects from either alternative are generally expected less than significant because of a short-term and temporary nature of construction-related activities and would generally be confined in a geographic scope of the immediate project area. The temporal scope would be limited to effects for the estimated duration of construction, which is estimated a 5-month construction period beginning approximately in June 2028. Potentially affected air and water resources extend beyond the confines of the project area due to the dynamic nature of these resources. Any projects that would be constructed concurrently with this project are described in Section 1.6, and they are:

- Pajaro River at Watsonville Flood Risk Management Project (FRM)
- USACE Pajaro PL 84-99 Right Bank Repairs Project (PL 84-99)
- Pajaro River Lagoon Sand Bar Breaching Project (Breaching)

Table 4-9 presents combined effects of the project with incremental effects of other past, present, and reasonably foreseeable future actions in the general geographic areas on different resources addressed in this section.

Table 4-9. Scope of Cumulative Effects by Resource Category

Resource Category	Geographic Scope	Temporal Scope	Cumulative Effects
Geology, Soils and Seismicity	Study area/construction footprint	Duration of construction	Any potential effects on soil erosion from projects that might be constructed concurrently, such as the FRM, PL 84-99, and Breaching (if summer breaching is needed) projects would be localized and short-term; therefore, the cumulative effects would be less than significant.
Hydrology and Water Resources	Lower Watsonville and associated floodplain area	Construction period and resulting period of performance for a new culvert	Implementation of the Watsonville CAP 1135 project would improve hydraulic conveyance in the study area and significantly reduce flood risk to the surrounding community. Similarly, all of FRM, PL 84-99, and Breaching projects would provide flood risk reduction benefits. Therefore, these projects would result in beneficial cumulative effects to water resources.
Biological Resources	Lower Watsonville, Pajaro River Lagoon, adjacent wetland habitats and associated connectivity to the migration corridor	Construction period and establishment period for mitigation and vegetation	Implementation of the Watsonville CAP 1135 project would contribute to expansion of wetland habitat by restoring a more natural hydrology and proposed restoration measures. All of FRM, PL 84-99, and Breaching projects incorporate various avoidance and minimization measures to protect biological resources within the watershed during construction; therefore, the cumulative effects would be less than significant.
Cultural Resources	Study area/construction footprint	Duration of construction	Any potential effects on cultural resources from projects that might be constructed concurrently, such as the FRM, PL 84-99, and Breaching (if summer breaching is needed) projects would be localized; therefore, the cumulative effects would be less than significant.
Aesthetics	Lower Watsonville and Palm Beach State Park	Construction period and establishment period for wetlands; period of performance for new recreation features period	Short-term impacts to visual resources would result from the presence of construction equipment in project area and the river corridor and the removal of vegetation to facilitate construction activities. Watsonville CAP 1135 project would result in a net increase of marsh vegetation in the project area, overall improving the aesthetic condition of the long-term.

Resource Category	Geographic Scope	Temporal Scope	Cumulative Effects
Recreation	Lower Watsonville and Palm Beach State Park	Construction period and establishment period for wetlands; period of performance for new recreation features period	Similarly, the short-term impacts to recreation is anticipated by limited parking space in and around project area; however, the proposed project would improve a long-term recreational opportunities by maintaining access to W. Beach Road and installing bilingual interpretive signs at Palm Beach State Park to educate visitors about the connections between the beach, lagoon, and marsh ecosystems, and their connection to Indigenous people. Therefore, overall cumulative effects on recreation would be less than significant.
Air Quality	MBARD	Duration of construction	The related projects discussed in Section 1.6 would all contribute to emissions of criteria pollutants during construction throughout the region. Any projects that might be constructed concurrently, such as the FRM, PL 84-99 Reach 4, and Breaching (if summer breaching is needed) projects could contribute to a cumulative effect on air quality. However, the distance from the FRM and PL 84-99 Reach 4 is likely sufficient to ensure that any emissions are dispersed prior to any combined impacts with the Watsonville CAP 1135 project. The Breaching project could potentially be interfered with Watsonville CAP 1135 project. However, the heavy equipment required for Breaching project is minimal so that the combined effects would be insignificant.
Greenhouse Gas Emissions	MBARD	Duration of construction and resulting period of performance for wetland vegetation.	Implementation of the Watsonville CAP 1135 project would contribute to expansion of wetland habitat so that the proposed project would provide a long-term benefit in reduction of GHG emission through carbon sequestration. All of FRM, PL 84-99, and Breaching projects would incorporate various avoidance and minimization measures to reduce GHG emissions during construction; therefore, the cumulative effects would be less than significant.

Resource Category	Geographic Scope	Temporal Scope	Cumulative Effects
Noise	Immediate vicinity of the study area/construction footprint	Duration of construction	Any potential effects on soil erosion from projects that might be constructed concurrently, such as the FRM, PL 84-99 Reach 4, and Breaching (if summer breaching is needed) projects would be localized; therefore, the cumulative effects would be less than significant.
Land Use	Study area/construction footprint	Construction period and resulting period of performance for a new culvert.	Implementation of the Watsonville CAP 1135 project, and other related projects such as FRM, PL 84-99, and Breaching would not convert any exiting land use; therefore, there would be no cumulative effects on land use.
Traffic and Transportation	Immediate vicinity of the study area/construction footprint	Duration of construction	Watsonville CAP 1135 project would not have a significant impact on local roadways or traffic in the study area. Regionally, the contribution from the action alternatives to the highway system is minimal. Potential cumulative impacts would be less than significant due to distance from the other related projects such as FRM and PL 84-99 Reach 4. Additionally, traffic generated by the Breaching project would be minimal so that the combined effects would be insignificant.
Public Services and Utilities	Study area/construction footprint	Construction period and resulting period of performance for a new culvert	Implementation of the Watsonville CAP 1135 project and all related projects such as FRM, PL 84-99, and Breaching would contribute to flood risk reduction and would benefit communities in the study area at risk of flooding by taking them out of the floodplain. Relocation, retrofit and replacement of utilities would be coordinated with service and utility providers so as not to lead to overlapping impacts during construction. Therefore, cumulative effects to public services and utilities would be beneficial.

4.12 Avoidance, Minimization and Mitigation Measures

4.12.1 Construction Best Management Practices

Given the location of the project area and adjacent agricultural operations, the following BMPs will be implemented to minimize construction impacts:

- Access roads and disturbed ground along construction routes will be wetted (for dust control as a simpler alternative) regularly to prevent dust from leaving the construction area.
- Stockpiles (e.g., debris, soil, sand, other materials) that can produce dust will be wetted or covered.
- All fill material, rubble, and spoil will be covered while in transport to/from the project site.
- All construction equipment would be cleaned before entering and upon leaving the study area to prevent introduction or spread of invasive species.
- Equipment previously used in a waterway or wetland will be disinfected to prevent spread of aquatic disease organisms.
- Use of construction mats at exits to public roads to limit mud from heavy equipment
- Implement additional mitigation measures as required by programmatic permits (see Section 4.12.2 below).

4.12.2 Temporary Impact Avoidance and Minimization Measures

To protect the existing sensitive resources and conservation values in the project area during construction activities, general protection measures and all applicable site-specific avoidance and minimization measures to avoid and/or minimize potential short-term, long-term, and cumulative adverse effects. Table 4-10 presents a list of proposed AMMs while implementing Alternative 4 or 5. The mitigation measures described in Table 4-10 below were incorporated into the analysis contained in Section 4 in order to reduce or compensate for adverse effects resulting from the Action Alternatives.

Table 4-10. Avoidance and Minimization Measures

Mitigation Measure	Timeframe	Performance Standards
General Protection Measures		
Receipt and Copies of All Permits and Authorizations	Prior to construction; during construction	Work will not begin until all necessary permits and authorizations have been received (e.g., USFWS, NMFS, State and Regional Boards, CDFW). USACE will ensure that a readily available copy of the applicable agency permits and authorizations (e.g., USFWS Biological Opinion, NMFS Biological Opinion, Section 404 permit, etc.) is maintained by the construction foreman/manager on the project site for the duration of project activities.
Construction Work Windows	During construction	Construction work windows is required in order to avoid impacts to aquatic resources and associated beneficial uses during the wet season. USACE will follow the applicable Regional Board's construction work windows, unless otherwise approved.
Construction Hours	During construction	Construction activities will generally be limited to daylight hours, to the extent feasible. If nighttime construction is necessary, including in tidally influenced waters where tides may limit daylight access and work schedules, all project lighting (e.g., staging areas, equipment storage sites, roadway, and construction footprint) will be selectively placed and directed onto the roadway or construction site and away from aquatic habitats. Light glare shields will be used to reduce the extent of illumination into aquatic habitats. If the work area is near surface waters, the lighting will be shielded so that it does not shine directly into the water.
Environmental Awareness Training	Prior to construction; during construction	Prior to engaging existing or new personnel in construction activities, new construction personnel will participate in environmental awareness training conducted by an agency-approved biologist or resource specialist.* Construction personnel will be informed regarding the identification, potential presence, legal protections, avoidance and minimization measures, and applicable general protection measures for all aquatic resources with the potential to occur within or immediately adjacent to the project site. Construction personnel will be informed of the procedures to follow should aquatic resources be disturbed during construction activities. For projects where the agency-approved biologist or resource specialist is not regularly on the project site, training may be provided via online/web-based meeting with an interactive portion (e.g., web-based or in-person discussion) to be included during remote training sessions. For projects that may continue over an extended duration and require excessive training events, a training video developed under the supervision of the FWS-approved biologist or resource specialist may be used to train new personnel, as long as an FWS-approved biologist or resource specialist is available via phone to answer questions about the training or that may arise during construction. Footnote: * Agency-approve monitor refers to monitors who demonstrate qualifications and can be approved by CDFW, NMFS, and/or USFWS and accepted by approving Water Board.
Environmental Monitoring	Prior to construction; during construction	A resource specialist will ensure that all applicable protective measures are implemented during project construction. The resource specialist will have authority to stop any work if they determine that any permit requirement is not fully implemented. The resource specialist will prepare and maintain a monitoring log of construction site conditions and observations, which will be kept on file.
Work Area and Speed Limits	Prior to construction; during construction	Construction work and materials staging will be restricted to designated work areas, routes, staging areas, temporary interior roads, or the limits of existing roadways. Prior to initiating construction or grading activities, brightly colored fencing or flagging or other practical means will be erected to demarcate the limits of the project activities, including the boundaries of designated staging areas; ingress and egress corridors; stockpile areas for spoils disposal, soil, and materials; and equipment exclusion zones. Flagging or fencing will be maintained in good repair for the duration of project activities. Vehicles will obey posted speed limits on public roadways and will limit speeds to 20 miles per hour (mph) within the project area on unpaved surfaces and unpaved roads (to reduce dust and soil erosion) or in areas where special status species have the potential to occur. Speeds greater than 20 mph may be permitted in the project area where special-status species are not expected to occur (e.g., within areas from which special-status species have been excluded) and where there is no risk of generating excessive dust (e.g., surfaces are paved, saturated, or have been treated with other measures to prevent dust).
Environmentally Sensitive Areas	During construction	Monitoring, flagging, or fencing will be used, where appropriate, to minimize disturbance to environmentally sensitive areas (e.g., waters and wetlands). If fencing is used: - Fencing used must be approved by CDFW and/or USFWS for compatibility with species under their jurisdiction, as applicable, that may occur on site. - The agency-approved biologist or resource specialist will determine the location of fencing prior to the start of construction (e.g., between active work area(s) and sensitive resources). - Fencing will remain in place throughout the duration of the construction activities and will be inspected and maintained regularly by the agency approved biologist or resource specialist until completion of the project. - Repairs to the fencing will be made within 24 hours of discovering any failure. - Fencing will be removed when all construction equipment is removed from the site, the area is cleared of debris and trash, and the area is returned to natural conditions.

Mitigation Measure	Timeframe	Performance Standards
Prevent Spread of Invasive Species	During construction	The spread or introduction of invasive exotic plant species by arriving vehicles, equipment, imported gravel, and other materials, will be avoided to the maximum extent possible. When practicable, invasive exotic plants in the project areas will be removed and properly disposed of in a manner that will not promote their spread. Equipment will be cleaned of any sediment or vegetation at designated wash stations before entering or leaving the project area to avoid spreading pathogens or exotic/invasive species. Isolated infestations of noxious weeds identified in the project area will be treated with approved eradication methods at an appropriate time to prevent further formation of seed and destroy viable plant parts and seed. Wash sites must be in confined areas that limit run-off to any surrounding habitat and on a flat grade. Upland areas will use rice straw or invasive species-free local slash/mulch for erosion control, while the remainder of the project area will use certified, weed-free erosion control materials. Mulch must be certified weed free. USACE will follow the guidelines in the CDFW's California Aquatic Invasive Species Management Plan (CDFW 2008) and Aquatic Invasive Species Disinfection/Decontamination Protocols (CDFW 2016), where relevant. Construction supervisors and managers will be educated on weed identification and the importance of controlling and preventing the spread of noxious weeds. USACE will follow any applicable local guidance to prevent the spread of invasive animal species. Construction supervisors and managers will be responsible for implementation of appropriate protocols (e.g., disinfection of equipment and footwear) to prevent the spread of invasive animals.
Practices to Prevent Pathogen Contamination	Prior to construction; during construction	USACE will review and implement restoration design considerations and best management practices as published by the Working Group for Phytophthoras in Native Habitats (www.calphytos.org), when there is a risk of introduction and spread of plant pathogens in site plantings. (http://www.suddenoakdeath.org/welcome-to-calphytos-org-phytophthoras-in-native-habitats/resources/#restoration.)
Equipment Maintenance and Materials Storage	During construction	Vehicle traffic will be confined to existing roads and the proposed access route(s). All machinery must be in good working condition, showing no signs of fuel or oil leaks. Oil, grease, or other fluids will be washed off at designated wash stations prior to equipment entering the construction site. Inspection and evaluation for the potential for fluid leakage will be performed daily during construction. Where possible, and where it would not result in greater impact to aquatic resources, no equipment refueling, or fuel storage will take place within 100 feet of a body of water. All fuel and chemical storage, servicing, and refueling will be done in an upland staging area or other suitable location (e.g., barges) with secondary containment to prevent spills from traveling to surface water or drains. USACEs will establish staging areas for equipment storage and maintenance, construction materials, fuels, lubricants, solvents, and other possible contaminants in coordination with resource agencies. Staging areas will have a stabilized entrance and exit and will be located in upland areas to the extent possible and at least 100 feet from bodies of water unless site-specific circumstances do not provide such a setback or would result in further damage to sensitive resources, in which case the maximum setback possible will be used. Fluids will be stored in appropriate containers with covers and properly recycled or disposed of offsite. Machinery stored on site will have pans or absorbent mats placed underneath potential leak areas as a precautionary measure to further reduce the potential for impact from an unintended or previously undetectable leak.
Material Disposal	During construction	All refuse, debris, unused materials, and supplies that cannot reasonably be secured will be removed daily from the project work area and deposited at an appropriate disposal or storage site. All construction debris will be removed from the project work area immediately upon project completion. The Water Quality and Hazardous Materials measures (below), will be implemented as applicable to ensure proper handling and disposal of hazardous materials.
Fugitive Dust Reduction	During construction	To reduce dust, construction vehicles will be speed restricted as described in GPM-6, Work Area and Speed Limits when traveling on non-paved surfaces. Stockpiled materials susceptible to wind-blown dispersal will be covered with plastic sheeting or other suitable material to prevent movement of the material. During construction, water (e.g., trucks and portable pumps with hoses) or other approved methods will be used to control fugitive dust, as necessary. Dust suppression activities must not result in a discharge to waters of the state unless such discharges are approved by the State or Regional Board.
Trash Containment and Removal	During construction	During project activities all trash will be properly contained within sealed containers and removed from the work site and disposed of as necessary to maintain a trash-free work area (e.g., trash containers will not be used beyond capacity and fully close/seal).
Project Cleanup after Completion	During construction	Work pads, temporary falsework, and other construction items will be removed from the 100-year floodplain by the end of the construction window. Removal of materials must not result in discharge to waterbodies.
Revegetate Disturbed Areas	Prior to construction; post construction	All temporarily disturbed areas will be de-compacted and seeded/planted with an assemblage of native riparian, wetland, and/or upland plant species suitable for the area. USACE will develop a revegetation plan, including (as applicable) a schedule; plans for grading of disturbed areas to pre-project contours; planting palette with plant species native to the project area; invasive species management; performance standards; success criteria; and maintenance requirements (e.g., watering, weeding, and replanting). Plants for revegetation will come primarily from active seeding and planting; natural recruitment may also be proposed if site conditions allow for natural recruitment to reestablish vegetation and avoid potential negative risks associated with erosion and impacts to water quality. Plants imported to the restoration areas will come from local stock, and to the extent possible, local nurseries. Only native plants (genera) will be used for restoration efforts. Certified weed-free native mixes and mulch will be used for restoration planting or seeding. Revegetation activities within and adjacent to waters of the state will commence as soon as is practicable after construction activities at a site are complete.

Mitigation Measure	Timeframe	Performance Standards
General In-Water Measures		
Appropriate In-Water Materials	Prior to construction; during construction	Selection and use of gravels, cobble, boulders, and instream woody materials in streams, and other materials (e.g., oyster shells, other substrates) for reef/bed restoration will be performed to avoid and/or minimize adverse impacts to aquatic resources, special-status aquatic species, and their habitats. On-site gravels will be screened and sorted; gravels imported from a commercial source will be clean-washed and of appropriate size. As necessary to protect aquatic species, placement will be overseen by an agency-approved Monitor; implementation timing will be determined based on the least amount of overlap, or impact on, all aquatic natural resources that may be affected and the timing of their use of the receiving area. Imported gravel from outside the project watershed will not be from a source known to contain historic hydraulic gold mine tailings, dredger tailings, or mercury mine waste or tailings. Materials that may foul or degrade spawning gravels, such as sand or soil eroding from sand bag or earthen dams will be managed to avoid release and exposure in salmonid streams. Oyster shells or other substrates for reef/bed restoration will be cured and inspected to be free of pathogens and/or non-native species.
In-Water Vehicle Selection and Work Access	During construction	If work requires that equipment enter wetlands or below the bank of a waters of the state, equipment with low ground-pressure (typically less than 13 to 20 pounds per square inch (psi)) should be selected where feasible to minimize soil compaction. Low ground pressure heavy equipment mats should be used if needed to lessen soil compaction. Hydraulic fluids in mechanical equipment working in the waters of the state, will not contain organophosphate esters. Vegetable based hydraulic fluids are preferred, where feasible. The amount of time this equipment is stationed, working, or traveling in the waters of the state will be minimized. All equipment will be removed from the aquatic feature during non-work hours where appropriate or returned to the agency-approved staging area in the aquatic feature.
In-Water Placement of Materials, Structures, and Operation of Equipment	During construction	Material used for bank stabilization or in-water restoration will minimize discharge sediment or other forms of waste to waters of the state. Where feasible, construction will occur from the top of the stream bank, or on a ground protection mat underlain with filter fabric, or a barge. All materials placed in streams, rivers or other waters will be nontoxic. Any combination of wood, plastic, cured concrete, steel pilings, or other materials used for in-channel structures will not contain coatings or treatments, or consist of substances toxic to aquatic organisms (e.g., zinc, arsenic, creosote, copper, other metals, pesticides, or petroleum-based products) that may leach into the surrounding environment in amounts harmful to aquatic organisms. Except for the following conditions, equipment must not be operated in standing or flowing waters without site-specific approval from State or Regional Board staff: - All construction activities must be effectively isolated from water flows to minimize the potential for runoff. This may be accomplished by working in the dry season or dewatering the work area in the wet season. - When work in standing or flowing water is required, structures for isolating the in-water work area and/or diverting the water flow must not be removed until all disturbed areas are cleaned and stabilized. The diverted water flow must not be contaminated by construction activities. - All open flow temporary diversion channels must be lined with filter fabric or other appropriate liner material to prevent erosion. Structures used to isolate the in-water work area and/or divert the water flow (e.g., coffer dam or geotextile silt curtain) must not be removed until all disturbed areas are stabilized.
In-Water Staging Areas and Use of Barges	During construction	Construction equipment and project materials may be staged in designated agency-approved staging areas. Existing staging sites, maintenance toe roads, and crown roads will be used to the maximum extent possible for project staging and access to avoid affecting previously undisturbed areas. For projects that involve in-water work for which boats and/or temporary floating work platforms are necessary, buoys will be installed so that moored vessels will not beach on the shoreline and anchor lines will not drag. Moored vessels and buoys will not be within 25 feet of vegetated shallow waters.
Cofferdam Construction	During construction	Cofferdams may be installed both upstream and downstream, and along portions of the cross section of a channel or other waterway if necessary to isolate the extent of the work areas. When feasible, construction of cofferdams will begin in the upstream area and continue in a downstream direction, allowing water to drain and allowing fish and aquatic wildlife species to leave (under their own volition), from the area being isolated by the cofferdam, prior to closure. The flow will then be diverted only when construction of the upstream dam is completed and the work area has been naturally drained of flow, at this point, the downstream dam, if necessary, would be completed and then flow would be diverted around the work area. Cofferdams and stream diversion systems will remain in place and fully functional throughout the construction period. In order to minimize adverse effects to aquatic species, stream diversions will be limited to the shortest duration necessary to complete in-water work. In-water cofferdams will only be built from materials such as sandbags, plastic, clean gravel (possibly wrapped in impermeable material), rubber bladders, vinyl, steel, or earthen fill, in a manner that minimizes siltation and/or turbidity. Sandbags may only be used to build cofferdams upstream of spawning gravels when filled with clean gravel (or other material acceptable to the approving Water Board). Where possible, cofferdams should be pushed into place. If pile driving (sheet piles) is required, vibratory hammers should be used and impact hammer should be avoided. If necessary, the footing of the cofferdam will be keyed into the channel bed at an appropriate depth to capture the majority of subsurface flow needed to dewater the streambed. When cofferdams with bypass pipes are installed, debris racks will be placed at the bypass pipe inlet in a manner that minimizes the potential for fish impingement and/or entrapment. As needed and where feasible, bypass pipes will be monitored for accumulation of debris. All accumulated debris will be removed. When appropriate, cofferdams will be removed so surface elevations of water impounded above the cofferdam will not be reduced at a rate greater than one inch per hour. Cofferdams in tidal waters should be removed during the lowest possible tide and in slack water to the extent feasible to minimize disturbance and turbidity. This will minimize the probability of fish and other aquatic species stranding as the area upstream becomes

Mitigation Measure	Timeframe	Performance Standards
		dewatered. All dewatering/diversion facilities will be installed such that natural flow is maintained upstream and downstream of project areas. An area may need to be dewatered for long enough to allow special-status species to leave on their own before final clearance surveys and construction can begin.
Dewatering/Diversion	Prior to construction; during construction	The area to be dewatered will encompass the minimum area necessary to perform construction activities. USACE will provide a dewatering plan with a description of the proposed dewatering structures, and appropriate types of BMPs for the installation, operation, maintenance, and removal of those structures. The period of dewatering/diversion will extend only for the minimum amount of time needed to perform the restoration activity and to allow special-status species time to leave on their own before final clearance surveys and construction can begin. Where feasible and appropriate, dewatering/diversion will occur via gravity-driven systems, and where water is pumped from within the construction area, it should be pumped to upland areas (where feasible) and to a location where it can infiltrate without return flows to the watercourse. Dewatering/diversion will be designed to avoid direct and preventable indirect mortality of fish and other aquatic species. If special-status fish species may be present in the area to be dewatered, a fish capture and relocation plan will be developed and implemented for review and approval by appropriate agencies (e.g., CDFW, NMFS, USFWS, as applicable). Stream flows will be allowed to gravity flow around or through the work site using temporary bypass pipes or culverts. Bypass pipes will be sized to accommodate, at a minimum, twice the expected construction-period flow, to not increase stream velocity, and will be placed at stream grade. Conveyance pipe outlet energy dissipaters will be installed to prevent scour and turbidity at the discharge location. When use of gravity-fed dewatering is not feasible and pumping is necessary to dewater a work site, a temporary siltation basin and/or use of silt bags may be required. Silt fences or mechanisms to avoid sediment input to the flowing channel will be installed adjacent to flowing water. Water pumped or removed from dewatered areas will be conducted in a manner that does not contribute turbidity to nearby receiving waters. Where possible, pumps will be refueled in an area well away from the stream channel. Fuel absorbent mats will be placed under the pumps while refueling. Equipment working in the stream channel or within 25 feet of a wetted channel will have a double (i.e., primary and secondary) containment system for diesel and oil fluids. All work will comply with the CDFW Fish Screening Criteria (CDFW 2001) and NMFS Fish Screening Criteria for Anadromous Salmonids (NMFS 1997). Pump intakes will be covered with mesh per the requirements of current fish screening criteria to prevent potential entrainment of fish or other aquatic species that could not be removed from the area to be dewatered. The pump intake will be checked periodically for impingement of fish or other aquatic species. Diverted flows must be of sufficient quality and quantity, and of appropriate temperature, to support existing fish and other aquatic life both above and below the diversion. Pre-project flows must be restored to the affected surface water body upon completion of work at that location. Where diversions are planned, contingency plans will be developed that include oversight for breakdowns, fueling, maintenance, leaks, etc.
Fish and Aquatic Species Exclusion While Installing Diversion Structures	During construction	Fish and other aquatic species will be excluded from occupying the area to be dewatered by blocking the stream channel above and below the area to be dewatered with fine-meshed block nets or screens while coffer dams and other diversion structures are being installed. Block net mesh will be sized to ensure aquatic species upstream or downstream do not enter the areas proposed for dewatering. Mesh will be no greater than 1/8-inch diameter. The bottom of the net must be completely secured to the channel bed. Block nets or screens must be checked at least twice daily at the beginning and end of the workday and cleaned of debris to permit free flow of water. Block nets or screens will be placed and maintained throughout the dewatering period at the upper and lower extent of the areas where aquatic species will be removed. Net placement s temporary and will be removed once dewatering has been accomplished or construction work is complete for the day.
Removal of Diversion and Barriers to Flow	Post construction	Upon completion of construction activities, any diversions or barriers to flow will be removed in a manner that will allow flow to resume with the least disturbance to the substrate and consideration of turbidity levels. Alteration of creek beds will be minimized to the maximum extent possible; any imported material that is not part of the project design will be removed from stream beds upon completion of the project.
In-Water Pile Driving Plan for Sound Exposure	Prior to construction; during construction	USACE will develop a plan for pile-driving activities to minimize impacts to special-status species and submit it to relevant agencies for approval prior to the start of in-water pile driving activities. Measures will be implemented to minimize underwater sound pressure to levels below fish thresholds for peak pressure and accumulated sound exposure levels. Thresholds levels for special-status fish under NMFS jurisdiction are established in the Fisheries Acoustic Work Group's Agreement in Principle for Interim Criteria for Injury to Fish from Pile Driving Activities (FAWG 2008) and may be used as a guideline for special-status fish. The plan will describe the least impactful method to aquatic organisms, and will identify the number, type, and size of piles, estimated sound levels caused by the driving, how many piles will be driven each day, qualifications of monitors, any other relevant details on the nature of the pile driving activity, and the actions that will be taken to ensure a project stays within the required sound exposure thresholds.
In-Water Pile Driving Methods	During construction	Pile driving will occur during approved work windows with reduced currents and only during daylight hours. Pile driving will be conducted with vibratory or low/nonimpact methods (i.e., hydraulic) that result in sound pressures below threshold levels to the extent feasible. Applied energy and frequency will be gradually increased until necessary full force and frequency are achieved. If it is determined that impact hammers are required and/or underwater sound monitoring demonstrates that thresholds are being exceeded, the contractor will implement sound dampening or attenuation devices to reduce levels to the extent feasible; these may include the following:

Mitigation Measure	Timeframe	Performance Standards
		- A cushioning block used between the hammer and pile. - Use of a confined or unconfined air bubble curtain. - If feasible, pile driving could be done in the dry area (dewatered) behind the cofferdam. Pile driving will follow the criteria outlined in the most recent version of the California Department of Transportation's Technical Guidance for Assessment and Mitigation of the Hydroacoustic Effects of Pile Driving on Fish (Caltrans 2015).
Sediment Containment during In-Water Pile Driving	During construction	Caissons or a continuous length of silt curtain, fully surrounding the pile driving area, must be used as necessary and as practicable to protect aquatic resources and to provide sediment containment while construction activities are occurring if working in a wetted channel. The silt curtain will prevent the release of a turbidity plume and trap sediment that may become suspended as a result of the pile driving. The bottom of the silt curtains must be weighted with ballast weights or rods affixed to the base of the fabric to resist the natural buoyancy of the silt curtain fabric and lessen its tendency to move in response to currents. Where feasible and applicable, the floating silt curtains must be anchored and deployed from the surface of the water to just above the substrate. The silt curtain must be monitored for damage, dislocation or gaps and must be immediately repaired where it is no longer continuous or where it has loosened. The silt curtain must restrict the surface visible turbidity plume to the area of pile construction and must control and contain the migration of re-suspended sediments at the water surface and at depth.
Pile-driving Monitoring	During construction	An agency-approved biologist will be on site during pile-driving activities to minimize effects to special-status species that could be present. If any stranding, injury, or mortality to special-status species is observed, federal and state wildlife agencies will be notified in writing (e.g., via email) within 24 hours and in-water pile driving will cease until the applicable federal and/or state agencies provide guidance on how to proceed.
Water Quality and Hazardous Materials		
Staging Areas and Stockpiling of Materials and Equipment	During construction	Staging, storage, and stockpile areas must be outside of waters of the state. To the extent feasible, staging will occur on access roads or other previously disturbed upland areas, such as developed areas, paved areas, parking lots, areas with bare ground or gravel, and areas clear of vegetation, to avoid aquatic habitats and limit disturbance to surrounding habitats. Similarly, all maintenance equipment and materials (e.g., road rock and project spoil) will be restricted to the existing service roads, paved roads, or other determined designated staging areas. Staging areas will be established for equipment storage and maintenance, construction materials, fuels, lubricants, solvents, and other possible contaminants in coordination with resource agencies. Staging areas will have a stabilized entrance and exit and will be located at least 100 feet from bodies of water unless site-specific circumstances do not provide such a setback, in such cases the maximum setback possible will be used. If an off-road site is chosen and if special-status species are potentially present, the Biological Monitor will survey the selected site to verify that no aquatic resources would be disturbed by staging activities. Stockpiling of materials, portable equipment, vehicles and supplies (e.g., chemicals), will be restricted to the designated construction staging areas. If rain is predicted in the forecast during the dry season, and stockpiled soils will remain exposed and unworked for more than 7 days, then erosion and sediment control measures must be used. If there is a high-wind scenario (to be defined by the approving Water Board as appropriate for an individual project site), then soils will be covered at all times. During the wet season, no stockpiled soils will remain exposed, unless properly installed and maintained erosion and sediment controls are in place on and around the stockpile. Temporary stockpiling of material onsite will be minimized. Stockpiled material will be placed in upland areas far enough away from aquatic habitats that these materials cannot discharge to a water of the state.
Erosion and Sediment Control Measures	Prior to construction; during construction	USACE will develop and implement erosion and sediment control measures (or plan), which will include appropriate BMPs to reduce the potential release of water quality pollutants to receiving waters. BMPs may include the following measures: - Employ tackifiers, soil binders, or mulch as appropriate for erosion control. - Install sediment erosion control measures, such as straw bales, silt fences, fiber rolls, or equally effective measures, at repair areas adjacent to stream channels, drainage canals, and wetlands, as needed. Sediment control measures will be monitored during and after each storm event for effectiveness. Modifications, repairs, and improvements to sediment control measures will be made as needed to protect water quality. - No sediment control products will be used that include synthetic or plastic monofilament or cross-joints in the netting that are bound/stitched (such as straw wattles, fiber rolls, or erosion control blankets), and which could trap snakes, amphibians, and other wildlife.
Hazardous Materials Management and Spill Response Plan	During construction	As part of the SWPPP or Erosion Control Plan, USACE will prepare and implement a hazardous materials management and spill response plan. USACE will ensure that any hazardous materials are stored at the staging area(s) with an impermeable membrane between the ground and hazardous material and that the staging area is designed to prevent the discharge of pollutants to groundwater and runoff water. USACE will stop work, follow the spill response plan, and arrange for repair and clean up by qualified individuals of any fuel or hazardous waste leaks or spills. USACE will notify regulatory agencies within 24 hours of any leaks or spills. USACE will properly contain and dispose of any unused or leftover hazardous products off-site. USACE will use and store hazardous materials, such as vehicle fuels and lubricants, in designated staging areas located away from stream channels and wetlands, according to local, state, and federal regulations, as applicable.

Mitigation Measure	Timeframe	Performance Standards
In-Water Concrete Use	Prior to construction; during construction	A dewatering plan must be submitted and approved by State and/or Regional Boards for in-water concrete use. Where possible, poured concrete should be excluded from contact with surface or groundwater during initial curing, ideally for 30 days after it is poured. During that time, runoff from the concrete will not be allowed to enter surface or groundwater. If this is not feasible due to expected flows and site conditions, commercial sealants that are non-toxic to aquatic life may be applied before it comes into contact with flowing water. Only sealants that have been tested and found nontoxic to freshwater aquatic life, including benthic macro-invertebrates, may be used on concrete surfaces that could come into contact with flowing water. Concrete is considered to be cured when water poured over the surface of concrete consistently has a pH of less than 8.5. (Note: Demonstration of nontoxicity to aquatic life may be evaluated by measuring survival of test organisms in a 96-hour bioassay. The bioassay should be performed according to the most up-to-date protocols in 40 C.F.R. part 136, currently Methods for Measuring the Acute Toxicity of Effluents and Receiving Water to Freshwater and Marine Organisms, 5th Edition (EPA-821-R-02-012), including sample collections, handling, and preservation per U.S. EPA protocols).
Accidental Discharge of Hazardous Materials	During construction	Following an accidental discharge of a reportable quantity of a hazardous material, sewage, or an unknown material, the following applies (Wat. Code, Â§ 13271): As soon as (A) discharger has knowledge of the discharge or noncompliance, (B) notification is possible, and (C) notification can be provided without substantially impeding cleanup or other emergency measures then: - first call - 911 (to notify local response agency) - then call - Office of Emergency Services (OES) State Warning Center at: (800) 852-7550 or (916) 845-8911 - Lastly, follow the required OES procedures as set forth in: http://www.caloes.ca.gov/FireRescueSite/Documents/CalOESSpill_Booklet_Feb2014_FINAL_BW_Acc.pdf Following notification to OES, the discharger will notify the State or Regional Board (and other agencies requiring notification in their respective permits), as soon as practicable (ideally within 24 hours). Notification may be via telephone, e-mail, delivered written notice, or other verifiable means.
Vegetation/Habitat Disturbance and Revegetation Measures		
Avoidance of Vegetation Disturbance	During construction	USACE will minimize, to the greatest extent feasible, the amount of soil, terrestrial vegetation, emergent native vegetation, and submerged vegetation (e.g., eelgrass and kelp in marine areas, or submerged aquatic vegetation in brackish and freshwater areas) disturbed during project construction and completion and using methods creating the least disturbance to vegetation. Disturbance to existing grades and native vegetation, the number of access routes, the size of staging areas, and the total area disturbed by the project will be limited to the extent of all temporary and permanent impacts as defined by the final project design. All roads, staging areas, and other facilities will be placed to avoid and limit disturbance to waters of the state and other aquatic habitats (e.g., streambank or stream channel, riparian habitat) as much as possible. When possible, existing ingress or egress points will be used and/or work will be performed from the top of the creek banks or from barges on the waterside of the stream or levee bank, or dry gravel beds. Existing native vegetation will be retained as practicable, emphasizing the retention of shade-producing and bank stabilizing trees and brush with greater than 6-inch diameter branches or trunks. Where possible, vegetation disturbance and soil compaction will be minimized by using low ground-pressure (typically less than 13 to 20 pounds psi) equipment that exerts less pressure per square inch on the ground than other equipment. To minimize impacts to vegetation, select equipment with a greater reach.
Native and Invasive Vegetation Removal Materials and Methods	During construction	If riparian vegetation is to be removed with chainsaws or other power equipment, machines that operate with vegetable-based bar oil will be used, as practicable. All invasive plant species (e.g., those rated as invasive by the California Invasive Plant Council or local problem species) will, if feasible, be removed from the project site, using locally and routinely accepted agriculture practices. Invasive plant material will be destroyed using approved protocols and disposed of at an appropriate upland disposal or compost area. Invasive plant materials stockpiled at sites known to experience flash flooding outside the flood season will be removed within 15 days of the initial creation of the stockpile in order to contain the potential spread of invasive plant material. Stockpiling of invasive plant materials is prohibited during the flood season.
Revegetation Materials and Methods	Post construction	Upon completion of work, site contours will be returned to preconstruction conditions. Where disturbed, topsoil will be conserved (and watered at an appropriate frequency) for reuse during restoration to the extent practicable. Native plant species comprising a diverse community structure (plantings of both woody and herbaceous species, if both are present) that follow an agency-approved plant palette will be used for revegetation of disturbed and compacted areas, as appropriate. Revegetate Disturbed Areas, which also allows for revegetation through natural recruitment (e.g., in tidal and managed wetlands and working landscapes where disturbed areas typically revegetate more quickly through natural recruitment than through seeding). Any area barren of vegetation as a result of project implementation will be restored to a natural state by mulching, seeding, planting, or other means with native trees, shrubs, willow stakes, erosion control native seed mixes, or herbaceous plant species following completion of project construction. Irrigation may also be required in order to ensure survival of containerized shrubs or trees or other vegetation, depending on rainfall. Soils that have been compacted by heavy equipment will be de-compacted, as necessary, to allow for revegetation at project completion as heavy equipment exits the construction area.

Mitigation Measure	Timeframe	Performance Standards
Revegetation Erosion Control Materials and Methods	During construction; post construction	If erosion control fabrics are used in revegetated areas, they will be slit in appropriate locations as necessary to allow for plant root growth. Only non-monofilament, wildlife-safe fabrics will be used. All plastic exclusion netting placed around plantings will be removed after 2 years or sooner if practicable.
Revegetation Monitoring and Reporting	Post construction	All revegetated areas will be maintained and monitored for a minimum of 2 years after replanting is complete and until success criteria are met, to ensure the revegetation effort is successful. The standard for success is at least 60% absolute cover compared to pre-project conditions at the project site or at least 60% cover compared to an intact, local reference site (or an available reference site accepted by the approving Water Board). If an appropriate reference site or pre-project conditions cannot be identified, success criteria will be developed for review and approval by the approving Water Board on a project-by-project basis based on the specific habitat impacted and known recovery times for that habitat and geography. USACE will prepare a summary report of the monitoring results and recommendations at the conclusion of each monitoring year.
General Herbicide Use	During construction	Chemical use is restricted in accordance with approved application methods and best management practices designed to prevent exposure to non-target areas and organisms. Any chemical considered for control of invasive species must be approved for use in California, adhere to all regulations per the California Environmental Protection Agency (CEPA 2011 or most recent version), and be applied by a licensed applicator under all necessary state and local permits. Use herbicides only in a context where all treatments are considered, and various methods are used individually or in concert to maximize the benefits while reducing undesirable effects and applying the lowest legal effective application rate, unless site-specific analysis determines a lower rate is needed to reduce non-target impacts. Treat only the minimum area necessary for effective control.
Herbicide Application Planning	Prior to construction; during construction	Written chemical application recommendations should be provided by USACE from a certified Pest Control Advisor (PCA) (CEPA 2011). The PCA can ensure that legal, appropriate, and effective chemicals are used with appropriate methodologies. Field scouting must be done before application, and the licensed Applicator (CEPA 2011) must be on-site to lead all applications and will adhere to standard protection measures for application. Prior to field scouting or application, the PCA or licensed applicator, will receive Environmental Awareness Training for the project so that they are aware of special status species and habitats present at the project site.
Herbicide Application Reporting	Post construction	The licensed applicator will keep a record of all plants/areas treated, amounts and types of herbicide used, and dates of application, and pesticide application reports must be completed within 24 hours of application and submitted to applicable agencies for review. Wind and other weather data will be monitored and reported for all application reports.
Capture and Relocation of Salmonids Guidelines		
Capture and Relocation of Salmonids Guidelines for a Qualified Biologist	During construction	A qualified fisheries biologist shall perform all seining, electrofishing, and fish relocation activities. The qualified fisheries biologist shall capture and relocate salmonids and other native fish prior to construction of the water diversion structures (e.g., cofferdams). The qualified fisheries biologist shall note the number of salmonids observed in the affected area, the number of salmonids relocated, and the date and time of collection and relocation. The qualified fisheries biologist shall have a minimum of three years of field experience in the identification and capture of salmonids, including juvenile salmonids. The qualified biologist will adhere to the following requirements for capture and transport of salmonids: a) 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 down the pool and then seining or dip netting fish. b) Notify the RC one week prior to capture and relocation of salmonids to provide RC or NMFS staff an opportunity to attend. c) Initial fish relocation efforts will be conducted 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 if there is water in the isolated construction area. In these instances, additional fish could be captured that eluded the previous day's efforts. If water is left in the construction area, dissolved oxygen levels sufficient for salmonid survival must be maintained. d) At project sites with high summer water temperatures, perform relocation activities during morning periods. e) Prior to capturing fish, determine the most appropriate release location(s). Consider the following when selecting release site(s): - Similar water temperature as capture location - Ample habitat for captured fish - Low likelihood of fish reentering work site or becoming impinged on exclusion net or screen. f) Periodically measure air and water temperatures and monitor captured fish. Temperatures will be measured at the head of riffle tail of pool interface. Cease activities if health of fish is compromised owing to high water temperatures, or if mortality exceeds three percent of captured salmonids.

Mitigation Measure	Timeframe	Performance Standards
Fish Relocation using Electrofishing	During construction	The following methods shall be used if fish are relocated via electrofishing: 1. All electrofishing will be conducted according to NMFS' Guidelines for Electrofishing Waters Containing Salmonids Listed Under the Endangered Species Act (NMFS 2000). 2. The backpack electro-fisher shall be set as follows when capturing fish: Voltage setting on the electro-fisher shall not exceed 300 volts. Initial Maximum A) Voltage: 100 Volts 300 Volts B) Duration: 500 Î¼s (microseconds) 5 ms (milliseconds) C) Frequency: 30 Hertz 30 Hertz 3. A minimum of three passes with the electro-fisher shall be utilized to ensure maximum capture probability of salmonids within the area proposed for dewatering. 4. Water temperature, dissolved oxygen, and conductivity shall be recorded in an electrofishing log book, along with electrofishing settings. 5. A minimum of one assistant shall aid the fisheries biologist by netting stunned fish and other aquatic vertebrates.
Fish Relocation using Seines	During construction	The following methods shall be used if fish are removed with seines. 1. A minimum of three passes with the seine shall be utilized to ensure maximum capture probability of all salmonids within the area. 2. All captured fish shall be processed and released prior to each subsequent pass with the seine. 3. The seine mesh shall be adequately sized to ensure fish are not gilled during capture and relocation activities.
Relocation of Salmonids using either Electrofishing or Seining	During construction	The following methods shall be used during relocation activities associated with either method of capture (electrofishing or seining): 1. Fish shall not be overcrowded into buckets, allowing no more than 150 0+ fish (approximately six cubic inches per 0+ individuals) per 5 gallon bucket and fewer individuals per bucket for larger/older fish. 2. Every effort shall be made not to mix 0+ salmonids with larger steelhead, or other potential predators, that may consume the smaller salmonids. Have at least two containers and segregate young-of-year (0+) fish from larger age classes. Place larger amphibians in the container with larger fish. 3. Salmonid predators, including other fishes and amphibians, collected and relocated during electrofishing or seining activities shall not be relocated so as to concentrate them in one area. Particular emphasis shall be placed on avoiding relocation of predators into the salmonid relocation pools. To minimize predation of salmonids, these species shall be distributed throughout the wetted portion of the stream to avoid concentrating them in one area. 4. All captured salmonids shall be relocated, preferably upstream, of the proposed construction project and placed in suitable habitat. Captured fish shall be placed into a pool, preferably with a depth of greater than two feet with available instream cover. 5. All captured salmonids will be processed and released prior to conducting a subsequent electrofishing or seining pass. 6. All native captured fish will be allowed to recover from electrofishing before being returned to the stream. 7. Minimize handling of salmonids. However, when handling is necessary, always wet hands or nets prior to touching fish. Handlers will not wear insect repellants containing the chemical N,N-Diethyl-meta-toluamide (DEET). 8. Temporarily hold fish in cool, shaded, aerated water in a container with a lid. Provide aeration with a battery-powered external bubbler. Protect fish from jostling and noise and do not remove fish from this container until time of release. 9. 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 those allowed by CDFW and NMFS, fish shall be released and rescue operations ceased. 10. In areas where aquatic vertebrates are abundant, periodically cease capture, and release at predetermined locations. 11. Visually identify species and estimate year-classes of fish at time of release. Count and record the number of fish captured. Avoid anesthetizing or measuring fish. Also identify hatchery (clipped adipose fin) and wild fish. 12. If more than 3 percent of the salmonids captured are killed or injured, the project permittee shall contact the RC (currently Joe Pecharich (707) 575-6095 or at joe.pecharich@noaa.gov). The RC will then contact NMFS within 24 hours. 13. The purpose of the contact is to review the activities resulting in take and to determine if additional protective measures are required. All salmonid mortalities must be retained, placed in an appropriately sized, zip-sealed bag, labeled with the date and time of collection, fork length, location of capture, and frozen as soon as possible. Frozen samples must be retained until specific instructions are provided by NMFS.
Mitigation Measures for Special Status Species		
Preconstruction Surveys	During construction	If special-status plants are present and/or special status terrestrial animal species habitat is present (e.g., stationary habitat such as burrows, bird nests, cavities for bats, etc.), where appropriate, based on project-specific requirements, a qualified, agency-approved biologist with experience on the identification of all applicable life stages of the special-status species will conduct reconnaissance-level preconstruction surveys and implement additional measures, as appropriate, to protect the species from construction-related disturbance before work begins. The intent of the survey is to assess current species habitat and

Mitigation Measure	Timeframe	Performance Standards
		use locations in the project area immediately prior to construction. Special-status plant species surveys shall be conducted in the appropriate blooming period, as applicable, prior to the start of construction for proper plant identification. If construction activities cease for more than five consecutive days, and there is potential for special-status species to re-occupy the site, the agency-approved biologist will re-survey the project area and implement measures, as appropriate. USACE can choose to assume animal species presence, forgo preconstruction surveys, and implement additional protection measures, as appropriate, to protect special status species from construction-related disturbance. Additional species guild-specific pre-construction requirements are described below and may supersede this general species protection measure, as applicable.
Environmentally Sensitive Areas and/or Wildlife Exclusion	During construction	Monitoring, flagging, and/or fencing will be used to minimize disturbance to environmentally sensitive areas (e.g., waters and wetlands). If fencing is used: - The agency-approved biologist or resource specialist will determine the location of the fencing prior to the start of construction (e.g., between active work area(s) and sensitive resources). - Fencing will remain in place throughout the duration of the construction activities, and will be inspected and maintained regularly by the agency-approved biologist or resource specialist until completion of the project. - Repairs to the fencing will be made within 24 hours of discovery. - Fencing will be removed when all construction equipment is removed from the site, and the area cleared of debris and trash, and returned to natural conditions.
Species Protection Construction Work Windows	During construction	Construction work windows may be required, depending on whether or not the project involves in-water construction and/or whether special-status species have potential to occur onsite.
Species Capture, Handling and Translocation	Prior to construction; during construction	Special-status species capture, handling, and translocation will only be conducted by an agency-approved biologist(s). Required permitting will be needed prior to any capture, handling, and relocation. If translocation of special-status species is needed, USACE will prepare a special-status species translocation plan to be reviewed and approved by the agency(ies), as appropriate, prior to project implementation. The plan will include capture and translocation methods, translocation site, and post translocation monitoring, if applicable. If capture, handling, and translocation is necessary due to dewatering activities, refer to the protective measures for Dewatering Activities, under general protection measure IWW 6 and follow the agency-approved translocation plan.
Special-Status Species Entrapment Prevention	During construction	All excavated, steep-walled holes or trenches will be covered with appropriate covers (e.g., thick metal sheets or plywood) at the end of each workday. Covers will be placed so that trench edges are fully sealed with rock bags, sand, or other appropriate material. Alternatively, one or more escape ramps such as fill dirt or wood planking will be installed at an angle no greater than 30 degrees, to allow wildlife to escape. Before holes or trenches are filled, sealed, or collapsed, the holes or trenches will be thoroughly inspected for trapped animals. Any animals discovered will be allowed to escape voluntarily or will be relocated by an agency-approved biologist.
Airborne Noise Reduction	During construction	Equipment, including noise abatement systems, will be maintained in good working order. If construction noise has the potential to adversely affect special-status species, USACE will include site specific measures for construction activities to minimize impacts. Muffler (or spark arrester) damage must be promptly remedied, to the degree practicable, to meet sound attenuation standards.
Mitigation Measures for California red-legged frog		
Work Windows	During construction	For the California red-legged frog and California tiger salamander, project activities in uplands will be confined to May 1 through October 31, unless there is a rain event forecast likely to generate measurable fall, rain of 1 inch or greater, at which time work will cease for the fall season. For project activities in occupied aquatic breeding habitat, grading and other disturbance will avoid the breeding season and will be limited to between July 1 and October 31, unless preconstruction surveys and monitoring demonstrate that young-of-year (recently metamorphosed) amphibians have dispersed from the breeding habitat. In that case, based on the recommendation of the USFWS-Approved Biologist, and with written approval from the USFWS (e.g., email), USACE may proceed with work in aquatic breeding habitat prior to July 1. Work in a pool or wetland may also begin before July 1 if the wetland has been dry for a minimum of 30 days before initiating work.
Nonnative Animal Removals	During construction	During electrofishing activities, in or near California red-legged frog occupied habitat, a USFWS-Approved Biologist will precede the electrofishing crew and survey for California red-legged frogs. If any California red-legged frogs are detected, they will be captured and held outside the waterbody until the electrofishing activities at that location have been completed. All individuals would then be immediately returned to the point of capture. California red-legged frog tadpoles will not be removed from habitat during electrofishing. If a tadpole is shocked then it should be captured (e.g., placed in shallow container) and monitored until it regains function, and then released at point of capture. If it does not regain function then should be reported as a mortality. If California red-legged frogs are detected but escape capture, the USFWS-Approved Biologist will determine measures for avoiding or minimizing impacts to individuals (i.e., leave the area or limit the duration of shocking pulses).

5 PLAN COMPARISON AND SELECTION

Section 3 presents the benefits associated with each plan in the preliminary array, the degree to which the plans address the study objectives and meet the four study criteria, as well as the comprehensive benefits associated with the *Principles and Guidelines* four accounts. Based on those evaluations, several plans were screened based on effectiveness, efficiency, and risks associated with real estate, leaving two alternative plans in the final array of alternatives in addition to the No Action alternative (Figure 5-1):

- No Action
- Alternative 4: Crossing Improvements at W. Beach Road and State-owned Parcel with No Earth Work
- Alternative 5: Crossing Improvements at W. Beach Road, County-owned Parcel with No Earth Work, and State-owned Parcel with No Earth Work

Section 4 illustrates the potential impacts associated with these alternatives. This section synthesizes those results to facilitate the selection of a plan.

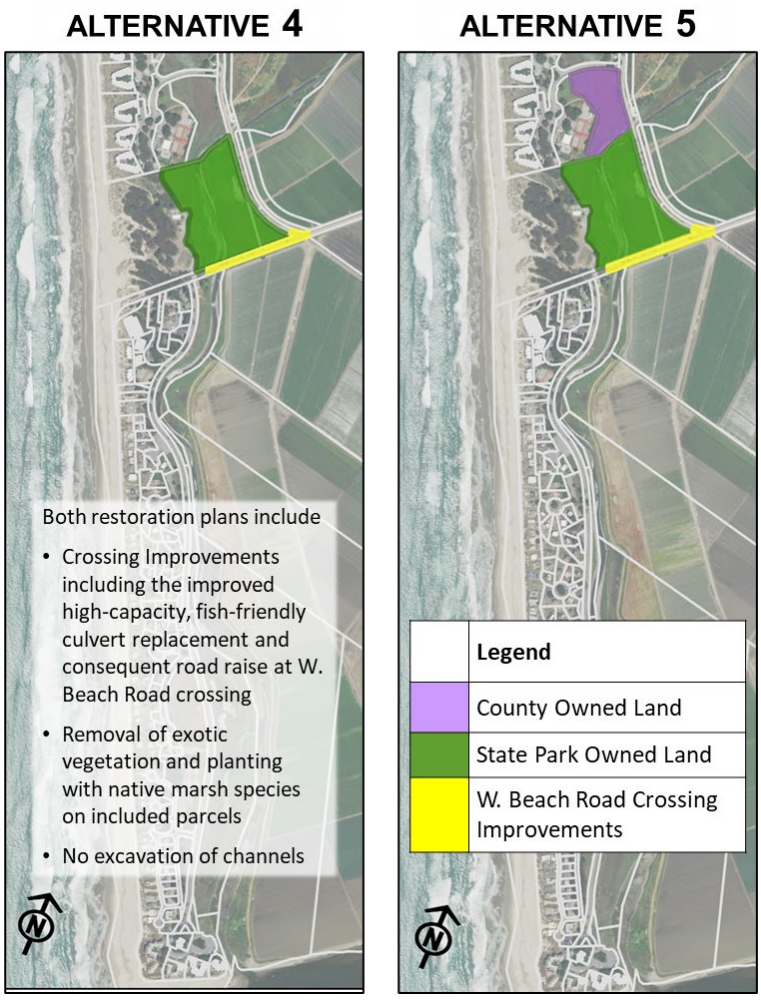


Figure 5-1. Final Array of Alternatives

5.1 Plan Comparison

The two plans that were retained into the final array are similar in many ways. Both replace the existing set of small culverts that are overtopped during lagoon closures in existing conditions with higher-capacity, fish friendly culverts that can accommodate closed-lagoon water levels. Both raise W. Beach Road and relocate facilities to allow the change to a more natural hydrology that can inundate the marsh plain without causing hazards to human health and safety or reduced access to the state beach. As such, both equally address Objectives 2 through 4 and Objective 6 (see Table 3-7 in Section 3.8.1).

Both plans also include removal of exotics and limited revegetation on the State-owned parcel. Because the State-owned parcel is adjacent to the existing State Beach parking lot and interpretive signage, the Watsonville Slough CAP 1135 project can add additional interpretive signage to the area, reflecting the improvements to the marsh habitat through the improvement of marsh hydrology and the importance of native marsh-dependent plants and animals. Since both plans can accommodate this feature, both equally address Objective 5 (Table 3-7).

Since all of these benefits are associated solely with the change in hydrology due to the enlarged culverts and other crossing improvements at W. Beach Road, and that design is the same in both plans, so too are the temporary impacts to the environment associated with the construction of the culvert replacement and road raise (e.g., less than 0.5 acre temporary impacts to marsh, temporary air quality impacts from construction equipment, dewatering, etc.), and any impacts associated with the higher breach threshold (Section 4).

Where the plans differ is in the amount of marsh for which real estate is secured, exotics are removed, and areas planned for replanting and monitoring. Alternative 4 only incudes the State-owned parcel and though it is less perched and stressed than the County parcel, modeling shows that 40% of the parcel will shift from upland to marsh hydrology as a result of the project. This change in hydrology will allow a significant portion of the parcel to be restored to healthy marsh.

Alternative 5 include both the State- and County-owned parcels (Figure 5-1). The County-owned parcel is the most perched of any of the parcels considered in the study, and it has the largest area of stressed and exotic vegetation, despite being the smallest in overall acreage. Approximately one acre of invasive species needs to be removed and replanted with marsh species. Because the xeric weeds have gotten a foothold on this parcel, it is unlikely that the marsh would restore to native species on its own once the hydrology was made more natural. The additional expense of clearing and replanting is necessary for full restoration of the marsh. Because the CE/ICA benefits were based on the change in marsh hydrology alone, while the costs included planting, restoration of the County-owned parcel appears less efficient. However, the County-owned parcel stands to benefit the most from the restoration actions. It gains the highest percentage of change from upland to marsh hydrology, 56% of the County-owned parcel, leading to a 45% improvement over the combined State- and County-owned parcels included in Alternative 5. Because the County-owned parcel has the most exotics of the parcels considered, Alternative 5 removes the largest extent of non-native species, reducing the ability of those seeds to spread downstream into the State-owned parcel and beyond.

Table 5-1 synthesizes information from Sections 3 and 4. Both action alternatives address the objectives of the study well, as shown by the similar average scores for the Four Criteria derived from Table 3-7 in Section 3.8.1. The two plans are even closer on the Four Accounts comprehensive benefits scores derived from Table 3-8 in Section 3.8.2. Alternative 5 includes more restoration (Restored AAHUs, Table 5-1), and more restoration in the part of the lower Watsonville Slough least likely to revert to healthy marsh on its own, due to the prevalence of non-native invasive vegetation. The inclusion of the County parcel also lowers the average cost per AAHU an incremental cost per AAHU. These benefits come at essentially no additional impact to the environment, since the bulk of construction is associated with the crossing improvements at W. Beach Road, which is the same for both plans (Table 5-1).

Table 5-1. Comparison of Final Array of Alternatives

Alternative	**No Action**	**Alternative 4: Crossing Improvements at W. Beach Road and State-owned Parcel with No Earth Work**	**Alternative 5: Crossing Improvements at W. Beach Road, State- and County-owned parcels with No Earth Work**
Total AAHUs (marsh hydrology based)	5.27	10.72	13.44
Restored AAHUs (marsh hydrology based)	0	5.45	8.17
Average “Four Criteria” Score (1-3)	1.5	2.86	3
Average “Four Accounts” Score (1-3)	1.14	2.84	2.88
Acres of Exotic Invasives Plants Removed	0	0.5	1.5
Percent of Area with Improved Marsh Hydrology	0	40	45
Impacts associated with construction	0	same	same
Incidental Benefits Associated with More Natural Lagoon Hydrology	0	same	same
Average Annual Cost ($1000)	0	266.94	321.6
Total Cost ($1000)	0	5752.72	5956.04
Average Cost ($1000/ AAHUs)	0	49.198	39.514

Considering all these factors, the PDT ranked the plans, where a rank of 1 represents the top choice of the PDT and a rank of 3 is the last choice (Table 5-2).

Alternative 5 is the top ranked alternative. The additional costs are justified by the benefits associated with the addition of the County-owned parcel. These include the benefits captured in the CE/ICA as well as the reduced risk of non-native vegetation spreading downstream by actively removing and replanting areas that are some of the most infested in the lower Watsonville Slough. Alternative 5 has a lower cost per AAHU (Table 5-1).

Table 5-2. Ranking of Final Array of Alternatives

Alternative	Rank
No Action	3
Alternative 4: Raise W. Beach Road and State-owned Parcel with No Earth Work	2
Alternative 5: Raise W. Beach Road, State- and County-owned parcels with No Earth Work	1

Alternative 4 is ranked second. While it has higher cost per AAHU, provides less restoration, and leaves a significant acreage of non-native vegetation that might spread into restored areas untouched, it still addresses the objectives of the study (Table 3-7; Table 5-1).

No Action Alternative is ranked third, or last.

5.2 Identification of the NER Plan

The plan that reasonably maximizes benefits compared to costs best meets the Principles and Guidelines Criteria for evaluation and is therefore the National Ecosystem Restoration (NER) plan and is Alternative 5. Of the plans in the final array Alternative 5 has the lowest cost per unit of output, making it the most efficient plan in addition to the plan with the greatest restoration output. Alternative 5 also performs the best out of the final array of alternatives across the four accounts (Table 3-8; Table 5-1), making it the Comprehensive Benefits plan as well.

5.3 Plan Selection

Alternative 5 (Crossing Improvements at W. Beach Road, State- and County-owned parcels with No Earth Work) was selected as the Tentatively Selected Plan[3] (TSP). Environmental Appendix A-5 presents a project description of the TSP. It meets all the ecosystem restoration planning objectives and is efficient, complete, and acceptable, while also maximizing benefits across the EQ, OSE, RED and NED accounts. It is also the preferred plan of the non-federal sponsor.

5.4 Deviations from the NER Plan

There are no deviations from the NER plan.

[3] At the time of TSP, the alternative that included crossing improvements removal of exotics on the County and State Parcels was called Alternative 6. Since TSP, the PDT added planting costs and had to rerun CE/ICE, which shifted the order of the alternatives slightly. Alternative 5 is fundamentally the same alternatives selected during the TSP milestone.

6 TENTATIVELY SELECTED PLAN

6.1 Plan Accomplishments

Alternative 5 meets the primary objectives of restoring and improving estuarine marsh and related wetland habitat for native, culturally significant, and federally listed species. It restores marsh hydrology to 8.17 acres of formerly “high and dry” marsh across two parcels, and removes 1.5 acres of non-native vegetation, replacing it with native marsh plantings. The removal of these patches of non-native vegetation will help prevent the spread of non-natives to other portions of the lower Watsonville Slough.

Alternative 5 replaces the culverts at the W. Beach Road crossing with a larger, fish friendly culvert that can accommodate the high water during natural lagoon closures. It also raises the road at and adjacent to the crossing. This road crossing is currently at 8.0 feet NAVD88 and its flooding is the trigger for the County to conduct unnaturally premature mechanical breaching of the entire Pajaro River Lagoon, including the lower Watsonville Slough. By replacing the culverts and raising the road, a more natural hydrologic regime and connectivity between the slough and the marsh plain may be maintained to improve ecosystem function. The inundation of the marsh plain during lagoon closures is primarily backwater flooding, which is typically less saline than the normal tidal flows. Inundation of the marsh plain with this less saline water is a driver for that supports more diverse vegetative communities in lagoon systems with natural hydrology. Longer closed-lagoon periods with fresher water will also improve the sustainability of nearby agricultural lands by forestalling saltwater intrusion into the aquifer. Fewer artificial mechanical breaches also mean fewer environmental impacts associated with those breaches, including air quality concerns and abrupt disruptions of the lagoon habitat.

At its current height of 8.0 feet NAVD88, the road is frequently flooded during lagoon closures, causing risks to human safety. In addition to the environmental benefits highlighted above, raising the road to accommodate the larger and higher culvert will confer several other benefits. It will improve emergency and public access for residents and visitors by reducing the frequency of road closures due to flooding. It will support the needs of local communities that visit the public state beach via W. Beach Road. The addition of interpretive signage at Palm State Park about the marsh restoration will increase recreational opportunities and public education.

Finally, by improving the W. Beach Road crossing to accommodate closed-lagoon water levels, Alternative 5 will improve resilience to extreme weather events and sea level change by increasing the area available to accommodate increased water levels and/or extending the ability of the lagoon to maintain natural hydrology that will support future resiliency initiatives. These hydrologic benefits to the ecosystem, now and into the future, do not merely benefit the County and State parcels. More natural lagoon hydrology will benefit marshes throughout the Pajaro River Lagoon and estuary. It will also serve as an important first step in a longer-term effort to restore portions of the lower Watsonville Slough to marsh. A recent purchase of agricultural acreage adjacent to Watsonville Slough is intended for marsh restoration. By raising the breaching threshold to secure a more natural lagoon hydrology and removing non-native vegetation that could easily spread into other newly restored areas, Alternative 5 is improving the restoration potential of the next set of restoration projects.

6.2 Plan Components

Through the extensive plan evaluations using existing data, ecosystem benefit modeling, collective expertise, and professional judgement, the USACE San Francisco District determined a proposed plan that allows more natural lagoon hydrology by making crossing improvements at W. Beach Road to accommodate closed-lagoon water levels up to 9.2 feet NAVD88. These crossing improvements include replacing the existing, closed culverts at W. Beach Road, which cannot accommodate the closed-lagoon hydrology due to their low elevation with higher-capacity, open-bottom culverts, and consequently raise the W. Beach Road elevation. This proposed project would allow a longer closure of the naturally formed sandbar lagoon, which would more closely mimic natural hydrology of the marsh and promote healthy marsh vegetation.

The proposed project specifically includes the following components (Figure 6-1):

1. Install one 32-foot wide, 8-foot high, pre-cast, and embedded fish-friendly culvert with higher flow capacity, which would support improved fish passage compared with the existing series of six 48-inch closed conduit culverts;

2. Raise an estimated 1,300 linear feet (LF) of W. Beach Road from the existing elevation to accommodate the new culvert;

3. Install a new flap gate on an adjacent Beach Road agricultural ditch to prevent the higher lagoon levels from moving upstream;

4. Raise surface elevation of a parking lot less than half a foot on average to at least 9.2 feet NAVD88 for Palm Beach State Park immediately adjacent to the crossing of the W. Beach Road and Slough to prevent nuisance flooding;

5. Remove exotic and xeric species and planting approximately 1.5 acres of the formerly high and dry areas and 0.5 acres of temporary impacts with native marsh species; and

6. Install interpretive signage both in English and Spanish, which would facilitate use for underserved communities and inform locals and visitors to the Palm Beach State Park of the benefits of the wetland restoration.

The PDT will consider a higher culvert height and road raise in D&I phase, which may provide additional resilience to SLC at the project site. The project does not include any new areas of recreational access. However, the restored wetland can potentially increase the visual enjoyment of the area and offers educational opportunities. The marsh restoration project remains committed to making a meaningful impact on both the environment and public awareness. With the support of California State Parks and local tribes, one to three bilingual interpretive signs will be installed at Palm Beach State Park to educate visitors about the connections between the beach, lagoon, and marsh ecosystems, and their connection to indigenous people. We plan to collaborate with a local sign maker to ensure quality craftsmanship that support the local community. Additionally, the news signs will incorporate design elements to match existing state park signage for a cohesive visitor experience.

Figure 6-1. Proposed Project Components

6.2.1 Project Components for Improved Hydrology and Fish Passage

Project Components 1 through 4 are all in service of creating a more natural lagoon hydrology that periodically and seasonally inundates much of the marsh plain. Modifying these infrastructure elements will allow for a change in the County's existing lagoon breaching program to allow water levels up to 9.2 feet NAVD88, at which point other infrastructure flooding would trigger the breach. Modeling has shown that this modest increase in breach threshold increases the modeled Percent Time Inundated in portions of the marsh plain currently exhibiting stunted marsh species growth or invasion by non-native xeric species and brings it within a range typical of the portions of the marsh plain currently supporting healthy marsh. The water level inundations between 8 and 9.2 feet NAVD88 are critical to the marsh plain hydrologic restoration. Without that underlying change in hydrology, there's no reason to project that marsh species will thrive in the currently high and dry portions of the marsh plain. The change in hydrology allowed by these infrastructure changes is foundational to the restoration.

The proposed project will replace existing six 48-inch closed culverts with a fish-friendly culvert which will be designed according to NOAA Fisheries Guidelines for Salmonid Passage at Stream Crossings in California (2023). The guidelines are also adapted from culvert design criteria published by many federal and state organizations including the California Department of Fish and Game (CDFG 2001). The conceptual design of the proposed fish-friendly culvert (Figure 6-2) meets the requirements for Hydraulic Design method based on the NOAA Fisheries Guidelines.

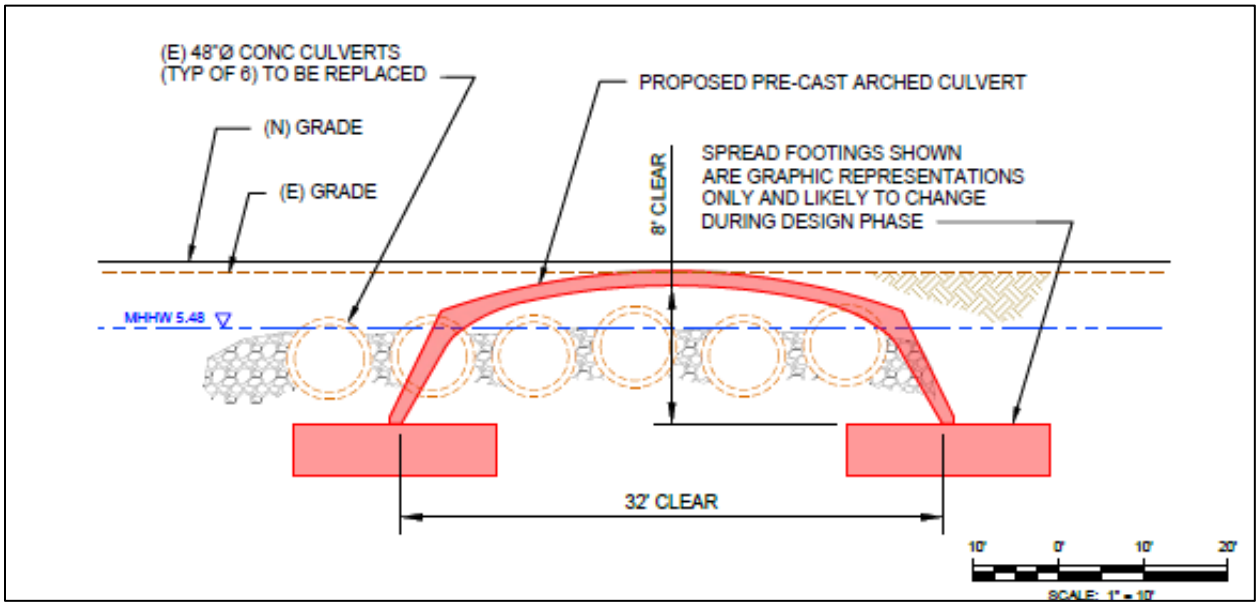


Figure 6-2. Conceptual Design of Fish-Friendly Culvert

Project Components 1-4 would be constructed after building a temporary road on the north side of W. Beach Road in the slough (Figure 6-3; Appendix B-2 [Civil Design Appendix]). The proposed work would be within the temporary impact threshold associated with the programmatic permit being pursued, and it would require dewatering of the work area. Environmental Appendix A-7 includes application forms for inclusion in the NOAA Restoration Center Santa Rosa Office Programmatic Approach Application and State Water Resources

Control Board Order WQ 2022-0048-DWQ.

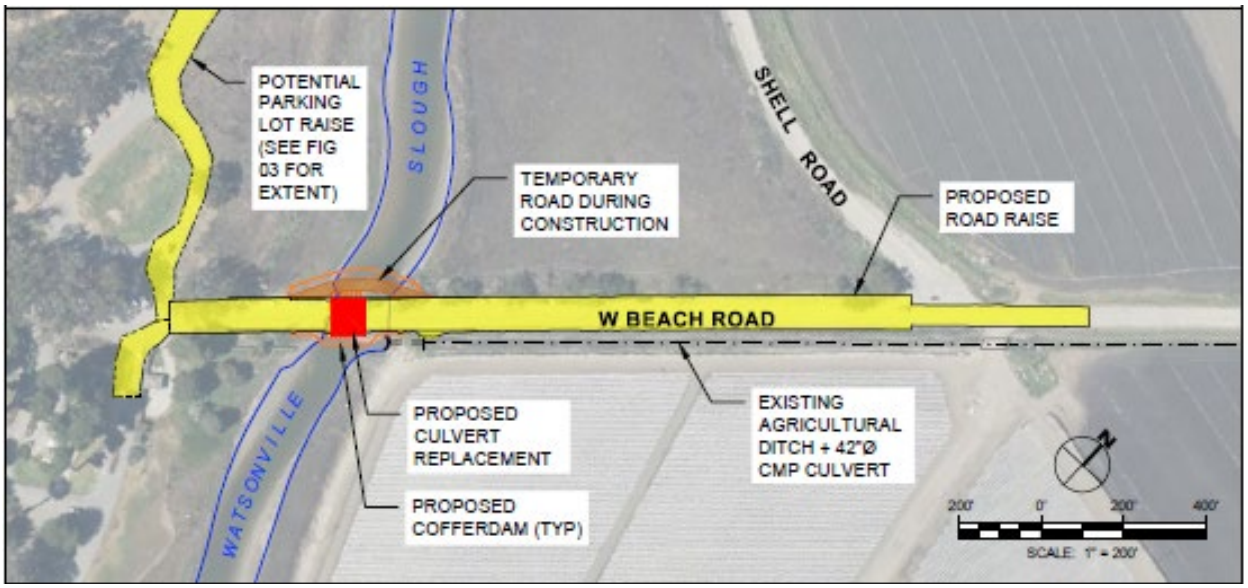


Figure 6-3. Proposed Construction Method of Project Components 1 to 4

6.2.2 Project Components for Improved Marsh Vegetation – Planting Plan

The Project Component 5 is designed to jumpstart the vegetative response to the improved marsh hydrology. Mapping of vegetation was conducted by Watsonville Wetland Watch (WWW) within the marsh and surrounding areas from the mouth of Watsonville Slough at the Pajaro River at the southern end of the project area, to the north encompassing the lagoon within the Pajaro Dunes North property and to the north-east where Watsonville Slough is crossed by San Andreas Road. Vegetation mapping efforts included a combination of field data collection and interpretation of aerial photography along with field reconnaissance and verification. Field surveys were conducted in June, July, and August of 2022. The planting plan will be refined in the D&I phase, in coordination with WWW and Amah Mutsun Tribal Band, so that the project can leverage local and indigenous knowledge in selection and long-term management of native plants. WWW also maintains a native plant nursery consisting of native stock may be used on the implementation.

Exotic Plant Removal

Prior to planting, the project area would be treated to remove existing invasive vegetation. Mapped patches of invasives and non-native plants will be removed in the County-owned parcel and State-owned parcel. Preliminary mapping will be updated in the next phase as the PDT works through D&I, but the priority will be on removal of high- Cal-IPC rated species. Preliminary mapping of invasives in the area indicates several notable patches. In addition, patches of native marsh co-dominant with exotic species occur in the area, especially on the County-owned parcel, which has approximately an acre of such areas. Exotics would also be removed from these areas, with care take to not disturb natives to the extent possible. A small (approximately 0.1 acre) ecotone would be established at the corner of W. Beach Road and Shell Road to avoid nuisance flooding and enhance the ecosystem of the marsh.

Preliminary Planting Plan

Plantings would be installed in any areas disturbed by construction (approximately 0.5 acre on the State-owned parcel), and in patches where exotics have been removed or native plants are particularly stressed (approximately 1 acre on the County-owned parcel and 0.5 acre on the State-owned parcel outside of areas affected by construction). Collectively, these will now be referred to as habitat restoration sites.

The habitat restoration sites will be planted with native plant material either collected locally from seed, live cuttings, or propagated container plants. Most planting in the habitat restoration sites would depend on success of collection of local native seeds and live cuttings. Some seed would be propagated, and container grown by the restoration contractor or contract grown by nurseries specializing in the taxa required from plant stock from the local area (e.g., from the nursery run by WWW or local tribes) to ensure the greatest chance of successful establishment. More details on the planting plan, temporary irrigation, and container plant practices can be found in Appendix A-3.

6.2.3 Project Components for Improved Recreational and Educational Experience

The proposed project does not include any new areas of recreational access. However, the restored wetland can potentially increase the visual enjoyment of the area and offers educational opportunities. The marsh restoration project remains committed to making a meaningful impact on both the environment and public awareness. With the support of California State Parks and local tribes, one to three bilingual interpretive signs will be installed at Palm Beach State Park to educate visitors about the connections between the beach, lagoon, and marsh ecosystems, and their connection to Indigenous people. We plan to collaborate with a local sign maker to ensure quality craftsmanship that support the local community. Additionally, the new signs will incorporate design elements to match existing state park signage for a cohesive visitor experience.

6.3 Lands, Easements, Rights-of-Way, Relocations, and Disposal

The Tentatively Selected Plan for the Watsonville Slough Ecosystem Restoration Project encompasses approximately 23.32 acres of land purchased in Fee, 38.16 acres of Permanent Flowage Easement, 0.05 acres of Channel Improvement Easement, and 3.08 acres of Temporary Work Area Easements for construction staging and access. Table 6-1 provides a breakdown of LERRDs required for the Tentatively Selected Plan by parcel, owner, and acreage. The parcels owned by the State of California Parks will be transferred to the NFS and will not require the use of a non-standard estate (NSE), as previously considered.

The estimated costs of LERRDs are detailed in Table 6-2. More information can be found in Appendix G.

Table 6-1. Requirements of Lands, Easements, Rights-of-Way, Relocations, and Disposal (LERRDs) for Tentatively Selected Plan

Standard Estate	APN	Landowner	Approximate Acreage
Fee	052-381-05	Santa Cruz County	4.79
Fee	052-161-07	State Of California	1.11
Fee	052-161-13	State Of California	17.42
Permanent Flowage Easement	052-171-21	Beach Rd Properties, LLC	18.42
Permanent Flowage Easement	052-191-20	Radovich, Barney M	4.91
Permanent Flowage Easement	052-191-21	Fujii, Bros Farms	2.19
Permanent Flowage Easement	052-191-50	Fujii, George M	3.79
Permanent Flowage Easement	052-191-56	Fujii, Bros Farms	8.85
Temporary Work Area Easement	052-231-04	Keith, Diana C	1.71
Temporary Work Area Easement	052-231-05	Robdon Properties, LLC	1.19
Temporary Work Area Easement	052-231-22	Pajaro Dunes Association	0.18
Channel Improvement Easement	ROW (West Beach Road)	ROW (West Beach Road)	0.05

Table 6-2. Total Estimated Real Estate Costs

Land Acquisition Cost	**Total Cost**
Fee Simple	$233,200
Permanent Flowage Easement	$715,500
Temporary Easements (TWAE/ TWAE Staging)	$10,928
Estimated Incremental Costs (43%)	$412,640
Subtotal	$1,372,268
Additional Anticipated Severance Damages	$83,500
TOTAL Unrounded	$1,455,768
TOTAL Rounded with Incremental Costs	**$1,460,000**
Administrative Costs	
Fed RE Admin	$250,000
Non-Fed RE Admin	$384,000
15% Contingency on Non-Fed RE Admin	$57,600
15% Contingency on Fed RE Admin	$37,500
Total	**$2,189,100**

6.4 Cost Estimate

Table 6-3. Project Implementation Costs, FY26 Price Level

WATSONVILLE SLOUGH CAP 1135 PROJECT DESIGN AND IMPLEMENTATION COSTS*			
	Cost-shared	**Non-Fed**	**Total**
Lands, Easements, Rights-of-Way, Relocations, Disposal (LERRD)			
Relocations (Utilities)		$713,000	$713,000
Relocations (Road Raise Construction)		$1,081,000	$1,081,000
Relocations (Road Raise Design)		$238,000	$238,000
Relocations (Road Raise Construction Management)		$147,000	$147,000
Lands and Damages		$1,455,000	$1,460,000
Federal RE Administration		$288,000	$288,000
Non-Fed RE Administration and Incidental		$442,000	$442,000
LERRDs Subtotal	**$0**	**$4,364,000**	**$4,364,000**
Design			
Engineering and Design *(includes 26% contingency)*	$3,354,000		$3,354,000
Design Subtotal	**$3,354,000**		**$3,354,000**
Construction			
Construction *(includes escalation, overhead, profit, bond & 32% contingency)*	$7,633,000		$7,633,000
Construction Management *(calculated as approximately 15 % of construction estimate)*	$1,251,000		$1,251,000
Construction Subtotal	**$8,884,000**		**$8,884,000**
Monitoring and Adaptive Management			
Total Monitoring	$295,000		$295,000
Total Adaptive Management	$294,000		$294,000
Monitoring and Adaptive Management Subtotal	**$589,000**		**$589,000**
Project First Costs (Total LERRDs, Design, Construction, Monitoring and Adaptive Management)	**$12,827,000**	**$4,364,000**	**$17,191,000**
Note: *Cost estimates are in 2026 dollars.			

Table 6-4. Cost Apportionment Table, FY26 Prices

	Fed	Non-Fed	Total
Feasibility Phase			
Total Feasibility Phase	**$1,287,500**	**$1,187,500**	**$2,475,000**
D&I Phase			
Design, Construction, Monitoring, Adaptive Management	$12,827,000	$0	$12,827,000
LERRD	$0	$4,364,000	$4,364,000
Subtotal	$12,827,000	$4,364,000	$17,191,000
Total D&I Phase	**$12,827,000**	**$4,364,000**	**$17,191,000**
Feasibility & D&I Phase			
Feasibility Phase	$1,287,500	$1,187,500	$2,475,000
D&I Phase	$12,827,000	$4,364,000	$17,191,000
Total Cost Apportionment	**$14,114,500**	**$5,551,500**	**$19,666,000**

6.5 Operations, Maintenance, Repair, Replacement and Rehabilitation (OMRR&R)

After the project is constructed, the Government shall furnish the NFS with an Operation, Maintenance, Repair, Rehabilitation, and Replacement Manual (hereinafter the "OMRR&R Manual") and copies of all as-built drawings for the completed work. The OMRR&R of this project will be at 100% non-federal expense; however, USACE will perform inspections. The Inspection of Completed Works (ICW) program is an Operations and Maintenance (O&M) program that provides for USACE inspections of federally constructed projects, including ecosystem restoration projects. Typical inspection activities for the built elements of the Tentatively Selected Plan would include periodic condition inspections of the roadway, new culverts, and State Parks parking lot, especially after winter/high backwatering events. Inspection of the roadway and culverts would evaluate general condition and any potential impact on function, such as any cracks or depressions in roadway surface, depressions/scour/piping by guardrail, high water marks, sedimentation in culvert (if any), erosion by culvert, signs of overtopping and any major changes since original construction.

At the end of the monitoring and adaptive management period, when the District Commander determines that construction and habitat establishment of the project is complete, the District Commander shall so notify the NFS in writing within 30 calendar days of such determination, and the NFS, at no cost to the Government, shall operate, maintain, repair, rehabilitate, and replace the project, or such functional portion thereof.

The NFS shall conduct its operation, maintenance, repair, rehabilitation, and replacement responsibilities in a manner consistent with the project's authorized purpose and in accordance with applicable federal laws, regulations, and the Government's specific directions in the OMRR&R Manual. The Government and NFS shall consult on any subsequent updates or amendments to the OMRR&R Manual. Any additional monitoring and adaptive management that is required beyond the 7-year period, until ecological success criteria are achieved, would

be the responsibility of the NFS. Recreational features will be maintained by the County of Santa Cruz or a local public entity, to be determined as recreation features are refined. The anticipated annual cost of OMRR&R is $8,578.

A draft OMRR&R manual will be developed preceding a project's final design state and used by the County of Santa Cruz, and USACE will ensure that the project is maintained to USACE standards, including the new breach threshold for the County. Annual and periodic ICW inspections will be performed for the implemented project which will be based on the OMRR&R requirements and current USACE maintenance standards. The OMRR&R manual will provide a detailed description of the management activities for the culverts, road, vegetation, and other activities to provide for the management of the project.

6.6 Project Risks

A number of risks are being actively managed by the PDT.

- No geotechnical studies were done for this feasibility study. The feasibility design relies on borings provided by the County for locations close to the W. Beach Road crossing, but not at the exact location of the culvert replacement. The risk associated with the lack of subsurface investigation in the design is reflected in the cost estimate developed. Appropriate geotechnical investigations will need to be implemented during the D&I phase before the culvert replacement and road raise design can be finalized.

- After over a year of coordination and as of October 2024, the California State Parks has tentatively determined it can provide the USACE's standard estate, fee title, for the State lands needed for this study. The study's real estate plan (REP) will document this and the cost estimate will reflect a fee title land transfer. There is uncertainty and associated risk that State Parks' headquarters will ultimately determine that they cannot provide fee title to transfer land ownership to the NFS. If this become the situation, a non-standard estate may need to be developed during the D&I phase. This represents very little cost risk but potential schedule risk during D&I. The State has verbally said that a decision could take up to a year.

- The study assumes Santa Cruz County, of which the NFS is a department, will not breach the lagoon until water height reaches 9.2 feet NAVD88. The 9.2-foot elevation is the water level where other major infrastructure would begin to flood (state park buildings, Shell Road, Pajaro Dunes Gatehouse). It is also the elevation that forms the basis of the calculated ecosystem benefits to the marsh plain associated with the project.

  The study has incorporated several features to limit the extent of closed lagoon water levels expanding into other use areas. For instance, the road crossing design includes a replacement of the current agricultural ditch culvert with a flap gate that will prevent the backup of water into adjacent agricultural lands. It is assumed that that smaller infrastructure will be modified to alleviate impacts from flooding. This assumption was deemed reasonable during the TSP Milestone. Breaching the lagoon is costly (i.e., $20K/breach as of 2021), requires environmental coordination and permitting, and the

timing of the breaching is unpredictable. Santa Cruz county is committed to reducing the breaching frequency based on the results of this study that show that 9.2 feet NAVD88 is acceptable. While this threshold will be reviewed during D&I, any adjustments to it would be unlikely to change the Tentatively Selected Plan but could affect the extent of benefits. To protect the federal investment and ensure the actualization of forecast benefits, the NFS has agreed to enter into a Memoranda of Understanding with the USACE to amend their breaching program in accordance with the CAP 1135 project, thus mitigating the risk.

- Infrastructure that will remain in the post-project flooding footprint is generally small and minor and inexpensive adjustments could protect them. Santa Cruz county is committed to the coordination to help ensure these protections will occur. However, there is potential nuisance flooding onto agricultural fields that lack sufficient protective berms upstream of the pump station. This potential nuisance flooding is being addressed in the Real Estate Plan through Flowage Easements. It's possible that during the D&I phase, the need other flowage easements are identified, but as the potential flooding is expected to be minor and temporary, the expected costs of any such additional flowage easements are not expected to alter the result of this feasibility study.

- There is a chance that the study needs a waiver related to the federal costs being over the federal limit. Since the TSP, design and cost updates have reflected increases in costs, and the federal costs are currently expected to be more than $10M. However, because the ATR/MSC reviews could result in a reduction of costs, and because WRDA 2024 raised the federal limit for the CAP 1135 authority to $15M, SPN has determined that it would be premature to seek a waiver at this point. The team will wait to determine if a waiver is necessary once ATR/MSC review is complete and there is more clarity on the likely timing of the implementation guidance for WRDA 2024.

6.7 Cost Sharing

Please see Table 6-4 in Section 6.4 for cost sharing between Federal and NFS.

6.8 Design and Construction

6.8.1 Scheduling

Construction is anticipated to begin in June 2028 and would take approximately 5 months including preconstruction site preparation, out-of-water work cleanup, restoration of ground disturbance areas, and invasive plant removal and planting of native plants; however, in-water work would only occur between June 15 and September 30 or dry season.

The in-water work window is during the dry season when flows to the Watsonville Slough are low. During the dry season the Slough (with little to no precipitation) has low flows of approximately 1-2 cfs. The upstream flow is also influenced by Shell Road Pump Station located approximately 1,200 feet north of the project area. Flows and releases from this pump station may need to be scheduled and noted to potential bidders to provide safe water handling around the project area in addition to the flow in the Slough. Fish barriers would first be installed outside of the limits of the cofferdams for fish removal.

Table 6-5 provides an overview of the schedule for completion of the feasibility study, project design, construction, monitoring and adaptive management.

Table 6-5. Project Tentative Schedule

Task	Scheduled Date
Detailed Project Report Approval	December 2025
FONSI Signed	February 2026
Project Partnership Agreement Executed	June 2026
60% Designs	January 2027
100% Designs	Summer 2027
Construction	Summer 2028
Physical Construction Complete	Fall 2028
Monitoring and Adaptive Management	Fall 2028-Fall 2035 (7 years planned; 10 years maximum allowed)

6.8.2 Construction Access Routes and Staging Access

The primary construction zone would be around the area of roadway raise/improvement along W. Beach Road and the culvert replacement at the crossing. Trucking access to the project area would be from W. Beach Road from the east (coming from City of Watsonville) and Shell Road. The project needs to maintain emergency access through W. Beach Road because it is a primary access route to/from the Pajaro Dunes Community and Palm Beach State Park. Access would be maintained at all times so that emergency and service vehicles (e.g., fire, garbage trucks) would be able to service the area. The USACE will further consult with the County and local fire and safety departments on access needs during D&I.

The USACE has identified a potential staging area (approx. 56,800 sq. ft.) south of the W. Beach Road crossing (see Figure 6-1 in Section 6.2) to store equipment and stockpile materials, debris, etc. as a primary staging area. The haul route would pass through agricultural fields, approximately 0.35 miles from staging area to the culvert replacement site. Dust control would be required by the contractor to limit impacts to adjacent agricultural, waterways, and residential areas. The USACE has also initiated discussions with State Parks, who operates Sunset Beach and Palm Beach State parks, and Pajaro Dunes on a temporary area in the parking lot for contractor use (e.g., rest area, eye wash station, etc.) next to the W. Beach Road and Rio Boca Road intersection.

6.8.3 Flow and Dewatering

The culvert replacement work area will be dewatered and initially pumped dry using a 4 or 6-inch diameter diesel pump. It is anticipated that the contractor will pump the water into the marsh plain (upstream, downstream, or both). Outlet energy will likely be reduced by using a perforated pipe diffuser or sprinklers to disperse with initial flow into vegetated areas before allowing water to flow back into the Slough. Once pumped, the work area around the existing culverts would need to be dried out (by time and winds) and then periodically maintained with pumping of nuisance water. The exact layout and configuration of the dewatering system will be further developed during the D&I Phase.

Nuisance (water) pumping will be required due to leakage of the retained slough water past the cofferdams. Typically, 2-inch gas-powered pumps (or smaller electric pumps) are suitable for this operation. The water leakage will be monitored, and the pumps would be run on an as-needed basis. In addition to nuisance pumping, a Slough bypass pumping system would be needed to transfer (summer) Slough flows from upstream of the north side cofferdam to downstream of the south cofferdam during construction. Similarly, there may be bypass pumping required to transfer water from the agricultural/tidal ditch at south bank around the southern cofferdam.

The exact details of the bypass system will be refined during the D&I phase, based on mitigation measures required by the programmatic permits.

6.8.4 Monitoring and Adaptive Management during Construction

No sensitives species are expected to limit the potential construction windows. However, biological, and cultural resource monitors on-site during earth-disturbing activities, as applicable.

6.8.5 Design and Implementation Phase Commitments

While the project has been designed and described at an appropriate level for feasibility, several tasks have been identified that allow for the refinement of the design in D&I. These tasks are noted below:

- Geotechnical borings around the crossing of Watsonville Slough at W. Beach Road will be conducted before final design of the crossing improvements to ensure structural stability of the design.

- The H&H model will be revised with better elevational data where vegetation may have impacted the LiDAR to ensure any changes to flood extent are accurately identified so that flowage easements may be purchased.
- The PDT will consider whether it is cost effective to raise the crossing and associated infrastructure higher than 9.2 feet NAVD88 to improve resilience to extreme weather events. A Cultural Awareness Training will be provided during the pre-construction meeting by an SOI-qualified archaeologist. Workers will be instructed on what to do if they discover artifacts or human remains during construction (e.g., immediate work stoppage, notification procedures).
- The planting palette and plan will be finalized in coordination with the tribes and local non-profits to include not only appropriate native plants, but also plants of cultural significance to the tribes.
- Language and graphics for the interpretive signage will be developed in coordination with the tribes, local non-profits, and state parks.
- USACE submitted an application form for Inclusion in the NOAA Restoration Center's Programmatic Approach for the compliance with ESA and MSA; however, the ESA/MSA coverage could not be obtained until 65% design is completed (see Appendix A-7 for more detail). Therefore, the PDT will coordinate with the NOAA Restoration Center during D&I to provide 65% plans and construction documents (including dewatering/fish relocation plan) for the ESA/MSA coverage.
- Outreach during D&I

6.9 Monitoring and Adaptive Management

Appendix A-3 (Preliminary Planting Plan and Monitoring and Adaptive Management Plan) of this document contains the combined monitoring and adaptive management plan for the proposed project. Monitoring and adaptive management prior to the determination of success are the responsibility of USACE and cost shared with the NFS. Following successful establishment of project features, the project would be maintained by the NFS as required by the OMRR&R manual. As specified by Section 1161 of WRDA 2016, the requirement for operation and maintenance of the non-structural and non-mechanical elements of the project by the NFS will cease ten years after ecological success has been determined. The project components address the ecosystem restoration objectives that requires three monitoring elements: Hydrology, Fish Passage Access, and Vegetation (Table 6-6). A summary of the monitoring tasks and success criteria are in Table 6-7. If the success criteria are not met, several adaptive management strategies may be employed.

Table 6-6. Project Components, Ecosystem Restoration Objectives, and Monitoring Elements

Project Components	***(Overarching) Primary Project Objectives: Ecosystem Restoration***			
	Restore and improve estuarine marsh and related wetland habitat that can support native species/diversity (Objective 1)	Restore a more natural hydrologic regime and connectivity on the marsh plain to improve ecosystem function (Objective 2)	Improve the aquatic ecosystem by maintaining fresher (less saline) water quality through the project area (Objective 3)	Improve fish passage access to increase availability of marsh habitat to native fish species. (Objective 4)
Types of Monitoring	Blue = Hydrology Green = Vegetation Orange = Fish Access	Blue = Hydrology Green = Vegetation Orange = Fish Access	Blue = Hydrology Green = Vegetation Orange = Fish Access	Blue = Hydrology Green = Vegetation Orange = Fish Access
1: Fish-friendly culverts with higher flow capacity to accommodate closed-lagoon conditions (allows higher breach threshold)	X	X	X	X
2: Raise Road to 9.2 ft NAVD88 (allows higher breach threshold)	X	X	X	
3: Install new flap gate to prevent higher lagoon levels moving upstream onto farms (allows higher breach threshold)	X	X	X	
4: Raise surface elevation of State Parks parking lot and adjacent areas to 9.2 ft NAVD88 (allows higher breach threshold)	X	X	X	
5: Remove exotic and xeric species and plant formerly high and dry areas with native marsh species	X			
6: install interpretive signage in both English and Spanish				

Table 6-7. Summary of Assumed Monitoring Tasks and Success Criteria

Monitoring	Assumed Tasks for Monitoring	Frequency	Success Criteria
Hydrology	Existing pressure transducer located at W. Beach Road crossing and maintained by the County will be used to document higher water depths and longer duration data compared with those prior to implementation of the proposed project.	Data will be transferred from the County summarized as part of the annual monitoring reports, though no additional field work is necessary	Seasonal water levels on marsh plain between 8.0 and 9.2 feet NAVD88.
Vegetation Monitoring	Visual surveys/transects during peak growing season. Assume coverage of all replanted areas. Assume monitoring for percent cover of natives and non-natives, survival of plantings, and observations of damage to habitat would be recorded.	Annually for 7 years or until success has been achieved	70% cover of planted areas by Year 5; 90% relative cover native marsh species for three consecutive years
Fish Access	Upstream and downstream openings of culverts will be measured manually to ensure sufficient access is available.	Annually for 7 years	No major blockages or other barriers to fish usage; at least 50% of channel has one foot of water above bed at low tide

6.9.1 Hydrology

If the success criteria established in Table 6-7 are not met by the Adaptive Management checkpoints (Year 3 and Year 5, post planting), the following measures would be implemented to adaptively manage the site for success.

- If monitoring results show that the lagoon water is not reaching levels between 7.0 and 9.2 feet NAVD88 during closures, an investigation regarding the reason will be conducted. If the reasons are natural (i.e., closures occurred during low-rain years and water levels never surpassed 7.0 feet) no direct action will take place, but the monitoring program may be extended to ensure that higher water levels are reached in this dynamic system.

- If it appears that breaching the side cast berms would help high water enter the marsh plain, small breaches may be added as directed by a restoration biologist.

- If data show that the natural lagoon closure was approaching 7.0 feet NAVD88 and no flooding was occurring or was imminent to infrastructure adjacent to Slough, and then the lagoon was breached mechanically, the County would be informed that their breach was out of compliance with the goals and requirements of the Watsonville Slough CAP 1135 project, and regulatory actions could be appropriate.

6.9.2 Vegetation

If the success criteria established in Table 6-7 are not met by the adaptive management checkpoints (Year 3 and Year 5, post planting), the following measures would be implemented to adaptively manage the site for success.

- Replanting may be needed if the success criteria for native vegetative cover are not being met. Monitoring results should be used to assess the underlying cause of inadequate cover, which may require that additional adaptive management actions be implemented to support successful replanting. Adaptive management actions could include targeted revegetation, such as replanting varieties of species that are exhibiting the greatest growth and survival, or planting at elevations that are exhibiting the greatest growth and survival.

- Non-native species management may be needed if monitoring results show that the success criteria for nonnative species present are not met, or if nonnative species are impacting the survival of native species. Adaptive management measures may include adjustments to nonnative control methods, such as plant removal, grading of site to remove nonnative roots, or mowing and selective removal of non-native species at optimal times for native growth.

- Plant protection may be needed if the success criteria for native vegetative cover are not being met. If monitoring results show that plantings are failing due to predation or

trampling, then adaptive management actions would include plant cages or protective fencing that could be installed to protect plantings.

6.9.3 Fish Passage Access

If the success criteria established in Table 6-7 are not met by the adaptive management checkpoints (Year 3 and Year 5, post planting), the following measures would be implemented to adaptively manage the site for success.

- Any large blockages created by trash or other debris would be cleared.
- Excessive sedimentation in the culvert affecting conveyance will be cleared.

6.10 Environmental Commitments

The list of environmental commitments is described in Sections 4.12.1 and 4.12.2.

6.11 Project-Specific Considerations

There are no project-specific considerations.

6.12 Environmental Operating Principles (EOP)

The Tentatively Selected Plan for the Watsonville Slough Ecosystem Restoration Study supports each of the seven USACE Environmental Operating Principles:

1) The Tentatively Selected Plan will strive to achieve environmental sustainability by restoring critical features that support aquatic and wetland ecosystem function and habitat value along the lower Watsonville Slough and its associated marsh plains to support native fish and wildlife, in particular declining populations of threatened and endangered salmonid species.

2) The Tentatively Selected Plan recognizes the negative impacts during construction activities and implements BMPs and mitigation measures to reduce short-term impacts to less than significant.

3) The Tentatively Selected Plan seeks balance and synergy among human development activities and natural systems by synergistically restoring rare and scarce habitats within a system that also provides for emergency access to Pajaro Dune Community during flooding.

4) Formulation of the recommended plan followed and ensured compliance with applicable laws demonstrating the USACE will accept responsibility and accountability.

5) The Tentatively Selected Plan improves cumulative impacts to the environment by reducing future detrimental impacts while reversing historic trends in degrading habitat function and value. The plan recognizes the interdependence of life and the physical environment by restoring hydrologic processes that is more natural to aquatic organisms and riparian plant communities.

6) Through extensive and on-going coordination and outreach with other federal, tribal, and state agencies, scientific experts from universities, and the public, the recommended plan will continue to build and share an integrated scientific, economic, and social knowledge base.

7) Through numerous interagency workshops and public outreach efforts since the inception of the study, the PDT has listened to and learned from the perspectives of individuals and groups interested in USACE civil works projects by including other USACE projects within the larger Pajaro Valley watershed.

6.13 Views of the Non-Federal Sponsor

Sponsor Support and Capability. The NFS, PSDMD, and its partner and owner of the real estate for the project, fully support the implementation of Alternative 5 as the TSP and will submit a statement of self-certification of financial capability to accompany the final DPR package. They are willing and financially able to support the project moving forward through plans and specifications (P&S) and implementation. The sponsor has conducted significant construction efforts in the Pajaro Valley and has a funding stream to implement the project. The sponsor has clear legal authority to conduct an ecosystem restoration project with a federal partner.

Sponsor Responsibilities. As part of the implementation of the selected plan, the PSDMD, a subset of Santa Cruz County, or the County itself would become a cosigner on the Project Partner Agreement (PPA) for the next phase since they either have or would acquire all necessary LERRDs and seek crediting or reimbursement for those costs in excess of the required cost share.

To obtain work in kind credit, all work must be performed in accordance with federal, state, and local laws and regulation. Any regulated materials recovered as part of the abatement process would be disposed of in a certified landfill.

The non-federal sponsor shall provide the real property interests, placement area improvements, and relocations required for construction, operation, and maintenance of the project.

The NFS is responsible for all aspects of planning and conducting the mechanical breaching program at the Lagoon mouth.

If providing in-kind contributions as a part of its 25% cost share, the NFS shall obtain all applicable licenses and permits necessary for such work. As functional portions of the work are completed, the NFS shall begin operation and maintenance of such work. Upon completion of the work, the non-federal sponsor shall so notify the Government within 30 calendar days and provide the Government with a copy of as-built drawings for the work.

The NFS shall prevent obstructions or encroachments on the project (including prescribing and enforcing regulations to prevent such obstructions or encroachments) that might reduce the level of ecosystem restoration and recreational benefit the Project affords, hinder operation and maintenance of the Project, or interfere with the project's proper functional.

Notwithstanding any other provision of this Agreement, the NFS shall be responsible for all

costs more than the Federal Participation Limit.

Following the final DPR approval, this project would be eligible to enter a PPA to advance the project from Feasibility phase into final design.

7 ENVIRONMENTAL COMPLIANCE*

The USACE will ensure that the proposed project complies with all relevant environmental laws, regulations, and executive orders (EOs), and are obtained in implementing the project. The NFS (i.e., PSDMD) is responsible for addressing State requirements including compliance with the California Environmental Quality Act.

7.1 Environmental Compliance Table

Major environmental compliance regulations and status of compliance with a brief statement summarizing how the proposed project will comply with the requirements are summarized in Table 7-1 for the environmental laws, regulations, and EOs that are only applicable to this project.

Table 7-1. Summary of Environmental Compliance

Statute or Executive Order (EO)	Status of Compliance
Coastal Zone Management Act and California Coastal Act	The California Coastal Commission administers the federal Coastal Zone Management Act along California's coastline by regulating the use of land and water within the coastal zone. Santa Cruz County has authority to approve coastal development permits within its jurisdiction pursuant to the provisions of its Local Coastal Program certified by the California Coastal Commission. The County's approved Local Coastal Program is integrated into the General Plan. All Project components are within the Coastal Zone as defined in the California Coastal Commission's Coastal Zone Boundary maps. >> Ongoing – Construction of the Tentatively Selected Plan which is within the Coastal Zone and would require a Coastal Zone Management Act (CZMA) consistency determination. Draft Negative Determination was prepared (Environmental Appendix A-6) and was submitted to the California Coastal Commission for their concurrence.
Clean Air Act	The Clean Air Act of 1970 (CAA, amended 1977, and 1990, 42 USC 7401 et seq.) established national ambient air quality standards (NAAQS). California had established its own standards prior to federal standards and because of its unique meteorological settings, they are more stringent than the federal standards. California standards, known as the California ambient air quality standards (CAAQS), are listed in Table 2-6 and are at least as protective and for many pollutants are more stringent than the federal standards. >> In compliance – the project area is within North Central Coast Air Basin and in attainment for all NAAQS' criteria air pollutants; however, Ozone and PM_{10} are in non-attainment under CAAQS. The air emission of the Tentatively Selected Plan is within *de minimus* thresholds for those two pollutants.

Statute or Executive Order (EO)	Status of Compliance
Clean Water Act Clean Water Act Section 404 – Discharge of Dredged or Fill Material	Section 404 of the CWA regulates the discharge of dredged or fill material (e.g., fill, pier supports, and piles) into waters and wetlands of the United States. >> In compliance – it was determined that the Tentatively Selected Plan would be qualified under U.S. Army Corps of Engineers' Nation-Wide Permit 27 (Aquatic Habitat Restoration, Establishment, and Enhancement Activities). For USACE civil works projects, the Corps does not issue itself a permit; however, as a federal agency, the Corps does not seek approval on the fish passage design from the California Department of Fish and Wildlife but instead seeks input through coordination with the NMFS.
Clean Water Act Section 401 – Water Quality Certification	Under Section 401 of the CWA, Water Quality Certification (WQC) is required for any activity that requires a federal permit or license, and that may result in discharge into navigable waters. >> Ongoing – it was determined that the Tentatively Selected Plan would fit under a programmatic State Water Resources Control Board Order WQ 2022-0048-DWQ called "Clean Water Act Section 401 Water Quality Certification and Waste Discharge Requirements for Restoration Projects Statewide" and has been in coordination with Water Board.
Clean Water Act Section 402 – National Pollutant Discharge Elimination System Permitting	Under Section 402 of the CWA, discharge of pollutants to navigable waters is prohibited unless the discharge complies with general or individual National Pollutant Discharge Elimination System (NPDES) permits. This includes both point-source and nonpoint-source (i.e., stormwater) discharges. >> In compliance – the construction site of the Tentatively Selected Plan is not over 1 acre, so that Section 402-point source discharge permit is not required; however, the proposed project will implement BMPs during construction activities and mitigation measures to reduce water quality impacts through General In-Water Measures, Staging Areas and Stockpiling of Materials and Equipment, Storm Water Pollution Prevention Plan and Erosion and Sediment Control Measures.
Endangered Species Act (16 U.S.C. § 1531 et seq.), as amended	The federal Endangered Species Act (ESA) protects threatened and endangered species and their designated critical habitat from unauthorized take. Section 9 of the ESA defines take as to "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." In accordance with Section 7 of the ESA, federal agencies are required to consult with the USFWS and/or NMFS on actions may affect listed species to ensure that any action authorized, funded, or carried out by them is not likely to jeopardize threatened or endangered species, or result in the destruction or adverse modification of designated critical habitat. >> Ongoing – Biological assessment for the threatened and endangered species under USFWS jurisdiction was prepared (Environmental Appendix A-2) and submitted to USFWS. For the species under NMFS' jurisdiction, it was determined that the Tentatively Selected Plan would fit under NOAA Restoration Center's Programmatic Biological Opinion because it would benefit aquatic and wetland habitat by replacing existing culverts with a fish friendly culvert and restoring wetland habitats; therefore, ESA Section 7 and MSA Consultation is conducted through NOAA Restoration Center's Programmatic Approach application process. USACE submitted an application form for Inclusion in the

Statute or Executive Order (EO)	Status of Compliance
	NOAA Restoration Center's Programmatic Approach for the compliance with ESA and MSA; however, the ESA/MSA coverage could not be obtained until 65% design is completed (see Appendix A-7 for more detail). Therefore, the PDT will coordinate with the NOAA Restoration Center during D&I to provide 65% plans and construction documents (including dewatering/fish relocation plan) for the ESA/MSA coverage.
Farmland Protection and Policy Act	The Farmland Protection and Policy Act requires an evaluation of the relative value of farmland that could be affected by decisions sponsored in whole or part by the federal government. >> In compliance – the project area is surrounded by Prime Farmland and Unique Farmland, but the proposed project would not cause irreversible conversion of farmland will occur. Pending Natural Resources Conservation Service (NRCS)'s confirmation.
Fish and Wildlife Coordination Act (16 U.S.C. §§ 661 666c)	Under the Fish and Wildlife Coordination Act, any federal agency that proposes to control or modify any body of water must first consult with the United States Fish and Wildlife Service (USFWS) or the National Marine Fisheries Service (NMFS), as appropriate, and with the head of the appropriate state agency exercising administration over wildlife resources of the affected state. >> In compliance – USACE and USFWS mutually agreed that USFWS would not provide a Fish and Wildlife Coordination Act (FWCA) report due to their high workload but have been providing feedback as part of interagency coordination and workshops. USFWS comments were addressed via email on May 2, 2023 (see Environmental Appendix A-1)
Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. § 1801 et seq.)	Essential fish habitat (EFH) is defined under the Magnuson – Stevens Fishery Conservation and Management Act (MSA) as those waters (i.e., aquatic areas and associated physical, chemical, and biological properties) and substrate (i.e., sediments, hardbottom, structures underlying the waters, and associated biological communities) necessary to fish for spawning, feeding, or growth to maturity. In accordance with the MSA, federal agencies are required to consult with NMFS on proposed actions authorized, funded, or undertaken by the agency that may adversely affect EFH for fish species covered under a fisheries management plan (FMP). >> In compliance – MSA Consultation is conducted through NOAA Restoration Center's Programmatic Approach application.
Marine Mammal Protection Act (16 U.S.C. § 1361 et seq.)	Under the Marine Mammal Protection Act (MMPA), all species of marine mammals are protected. The MMPA prohibits, with certain exceptions, the "take" of marine mammals. Under the MMPA, take is defined as the means "to hunt, harass, capture, or kill, or attempt to hunt, harass, capture, or kill." >> In compliance – the Tentatively Selected Plan is not expected to affect any MMPA-listed species.

Statute or Executive Order (EO)	Status of Compliance
Migratory Bird Treaty Act (16 U.S.C. §§ 703 712)	The Migratory Bird Treaty Act (MBTA) established special protection for migratory birds by regulating hunting or trade in migratory birds. >> In compliance – the proposed project would result in long-term benefits to migratory birds by increasing the amount and quality of wetland habitat in the lower Watsonville Slough. Migratory bird habitat would be further investigated during the D&I phase to determine whether any negative effects would occur. The USACE would coordinate appropriate actions with USFWS and conduct pre-construction surveys to monitor the locations of birds' nests.
National Historic Preservation Act; Executive Order (EO) 11593: Protection and Enhancement of the Cultural Environment; Archaeological and Historic Preservation Act of 1974, (16 USC 469 et seq)	This law is intended to preserve historic and archaeological sites. Section 106 of the NHPA requires that each federal agency identify and assess the effects its actions may have on historic properties while consulting with the SHPO as part of the review process. >> Ongoing– archaeological and cultural resource consultation are described in Sections 2.4, 4.4 and Appendix C of this document.
EO 11990, Protection of Wetlands	This EO intends to avoid to the extent possible the long- and short-term adverse impacts associated with the destruction or modification of wetlands and to avoid direct or Indirect support of new construction in wetlands wherever there is a practicable alternative. >> In compliance – There may be pockets of seasonal freshwater marsh in the proposed project area. The proposed project is not expected to affect wetlands negatively; would have an overall positive effect of enhancing wetland habitat functions and values by reducing the frequency of mechanical breaching of Pajaro River Lagoon.
EO 13112 and 13751, Invasive Species	These EOs intend to prevent the introduction of invasive species and provide for their control and to minimize the economic, ecological, and human health impacts that invasive species cause. >> In compliance – The proposed project would comply with these EO's by removing invasive plants and restoring native marsh vegetation species. The proposed project would improve extent and conditions of native plant species during revegetation and monitoring period. Required operation and maintenance of the project area by the NFS after ecological success is determined will continue to deter the influence of invasive plants.
EO 13175, Consultation and Coordination with Indian Tribal Governments	This EO intends to establish regular and meaningful consultation and collaboration with tribal officials in the development of Federal policies that have tribal implications, to strengthen the United States government-to-government relationships with Indian tribes, and to reduce the imposition of unfunded mandates upon Indian tribes. >> In compliance – Tribes identified through the NAHC have been included in Section 106 and NEPA efforts to identify and assess effects to cultural resources. The USACE will continue to coordinate and consult with non-federally recognized tribes to ensure the protection of their tribal and cultural resources.

7.2 Public Involvement

7.2.1 Agency Coordination

Agency coordination began in September 2021. A formal letter to request agency participation was sent February 7, 2022. USACE and USFWS mutually agreed that USFWS would not provide a FWCA report due to their high workload but have been providing feedback as part of interagency coordination and workshops. USFWS comments were addressed via email on May 2, 2023 (see Environmental Appendix A-1 for the records of interagency coordination).

Coordination has been made throughout the planning process with a number of Federal, State and local agencies listed below.

A. Federal agencies that participated as NEPA cooperating agencies:

1) U.S. Environmental Protection Agency (USEPA)
2) U.S. Fish and Wildlife Service (USFWS)
3) National Marine Fisheries Service (NMFS)
4) Advisory Council – Historic Preservation

B. State and local agencies that participated as NEPA participating agencies:

1) California State Historic Preservation Officer (SHPO)
2) Central Coast Regional Water Quality Control Board (Central Coast RWQCB)
3) California Coastal Commission (CCC)
4) California State Parks
5) California Department of Fish and Wildlife (CDFW)
6) State Lands Commission (SLC)
7) Pajaro Regional Flood Management Agency (PRFMA)
8) Pajaro Storm Drain Maintenance District (PSDMD)
9) Pajaro Valley Water Management Agency (PV Water)
10) Resource Conservation District of Santa Cruz County (SCNRCD)
11) Santa Cruz County Farm Bureau
12) Santa Cruz County Flood Control and Water Conservation District – Zone 7
13) Santa Cruz County Mosquito and Vector Control (MVC)

C. Other organizations:

1) Elkhorn Slough National Estuarine Research Reserve
2) Land Trust of Santa Cruz County
3) Equity Committee, City of Watsonville
4) Pajaro Dunes Association
5) Watsonville Wetlands Watch (WWW)
6) Environmental Science Associates (ESA)
7) Kittleson Environmental Consulting
8) Moss Landing Marine Labs

Table 7-2 presents a summary of key project meetings and interagency coordination.

Table 7-2. Summary of Key Meetings and Coordination

Date	Description
September 1, 2021	Introductory Coordination Meeting
September 21, 2021; November 1, 2021; November 19, 2021	Multiple Interagency Workshops
December 16, 2021; January 28, 2022; March 1, 2022	Multiple Interagency Screening Measures Meetings
June 1, 2022	Interagency Coordination Meeting
March 23, 2023	Interagency Alternatives Screening
April 20, 2023	USACE Technical Progress Update with Agencies
July 17, 2023	Scope and Technical Update with USFWS
February 7, 2024	Interagency Site Visit
May 20, 2024	Amah Mutsun Tribal Band Meeting
Jan 21, 2022 and Ongoing	Tribal Coordination and Consultation
TBD	Public Meeting

7.2.2 Tribal Consultation

USACE obtained a list of tribes culturally affiliated with the project area from the Native American Heritage Commission (NAHC) on 14 March 2020 (see Appendix C of this document). The following Ohlone tribes were identified as tribal consulting parties under Section 106 and participating agencies under NEPA:

1. The Amah Mutsun Tribal Band
2. Amah Mutsun Tribal Band of Mission San Juan Bautista
3. Costanoan Ohlone Rumsen-Mutsun Tribe
4. Indian Canyon Mutsun Band of Costanoan
5. Muwekma Ohlone Indian Tribe of the SF Bay Area

Tribal parties were invited to participate in several planning workshops early on before the formulation of alternatives. In June 2022, the Tribes listed above were consulted again under Section 106 for this study and invited to participate in site visits or cultural resource surveys for the identification of tribal resources. In December 2022, follow up emails and phone calls were made to the Tribes. Beginning in April 2024, the USACE has been consulting regularly with the Amah Mutsun Tribal Band for this project.

The Amah Mutsun Tribal Band is interested in collaborating on all projects located within their ancestral territory, which includes the entire Pajaro River Basin. The tribe has specifically requested that the USACE utilize Indigenous Knowledge to identify tribal resources. Overall, the ongoing tribal consultation emphasizes collaboration efforts, the importance of cultural resource management using Indigenous Knowledge, and the Amah Mutsun Tribal Band's desire for meaningful involvement in the planning and execution phases of local projects.

Following tribal consultation with the Amah Mutsun Tribal Band, USACE will continue to work with the Tribe on conducting restoration activities. The tribe will be invited on site visits to identify culturally significant plants suitable for restoration in the study area. This work will take place during the project's design phase. USACE also intends to collaborate with the tribe to develop interpretive signage for the project.

7.2.3 List of Statement Recipients

To be added - Refer the reader to an appendix that includes a list of the agencies, organizations, and persons to whom USACE sent copies of the draft report for review.

7.2.4 Public Comments Received and Responses

To be added after a 30-day public comment period ends.

8 DISTRICT ENGINEER RECOMMENDATION

In making the following recommendations, I have given consideration to all significant aspects in the overall public interest, including environmental, social and economic effects, engineering feasibility and compatibility of the project with the policies, desires and capabilities of the Pajaro Storm Drain Maintenance District (PSDMD), the California State Parks, and other non-federal interests.

I recommend that the TSP (Alternative 5: Crossing Improvements at W. Beach Road, State- and County-owned parcels with No Earth Work) for ecosystem restoration in Watsonville Slough be authorized for implementation, as a federal project, with such modifications thereof as in the discretion of the Commander, U.S. Army Corps of Engineers, may be advisable. The TSP is fully detailed in this integrated Detailed Project Report and Environmental Assessment. The TSP consists of restoring marsh hydrology to 8.17 acres of formerly “high and dry” marsh plain across two parcels by replacing the existing, undersized culverts at W. Beach Road with a larger, fish friendly culvert that can accommodate the high water during natural lagoon closures. These larger culverts and the associated raising of W. Beach Road will allow more natural lagoon hydrology to persist throughout the estuary and associated marsh plain. The TSP also removes 1.5 acres of non-native vegetation and replaces it with native marsh plantings. The removal of these patches of non-native vegetation will help prevent the spread of non-natives to other portions of the lower Watsonville Slough. The project also provides many secondary benefits, including the improvement of emergency and public access for residents and visitors by reducing the frequency of road closures due to flooding. It will support the needs of local communities that visit the public state beach via W. Beach Road and provide accommodation for sea level change. The addition of interpretive signage at Palm State Park about the marsh restoration will increase recreational opportunities and public education.

The estimated cost (2026 price level, fully-funded including feasibility study costs) of the TSP is $19,666,000 with an estimated federal cost of $14,114,500 and an estimated non-federal cost of $5,551,500 The estimated annual OMRR&R cost is $8,578 (2024 price levels). Federal implementation of the TSP would be subject to the non-federal sponsors agreeing to comply with applicable federal laws, regulations, and policies, including but not limited to:

a. Provide a minimum of 25 percent, but not to exceed 50 percent, of creditable design and construction costs allocated to structural, nonstructural, natural, or nature-based flood risk management features, and 50 percent of construction costs allocated to recreation, as further specified below:

1. Provide all lands, easements, rights-of-way, and placement areas and perform all relocations determined by the Federal Government to be required for the project;

2. Provide, during construction, any additional contribution necessary to make its total contribution equal to at least 25 percent of construction costs for culvert replacements, exotic plant removal, planting, and monitoring associated with aquatic ecosystem restoration and 50 percent of construction costs for recreation;

b. Prevent obstructions or encroachments on the project (including prescribing and enforcing regulations to prevent such obstructions or encroachments) that might reduce the level of ecosystem restoration the project affords, hinder operation and maintenance of the project, or interfere with the project's proper function;

c. Keep the recreation features, access roads, parking areas, and other associated public use facilities, open and available to all on equal terms;

d. Operate, maintain, repair, rehabilitate, and replace the project or functional portion thereof at no cost to the Federal Government, in a manner compatible with the project's authorized purposes and in accordance with applicable federal laws and regulations and any specific directions prescribed by the Federal Government;

e. Give the Federal Government a right to enter, at reasonable times and in a reasonable manner, upon property that the non-federal sponsor owns or controls for access to the project to inspect the project, and, if necessary, to undertake work necessary to the proper functioning of the project for its authorized purpose;

f. Hold and save the Federal Government free from all damages arising from design, construction, operation, maintenance, repair, rehabilitation, and replacement of the project, except for damages due to the fault or negligence of the Federal Government or its contractors;

g. Perform, or ensure performance of, any investigations for hazardous, toxic, and radioactive wastes (HTRW) that are determined necessary to identify the existence and extent of any HTRW regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. 9601-9675, and any other applicable law, that may exist in, on, or under real property interests that the Federal Government determines to be necessary for construction, operation, and maintenance of the project;

h. Agree, as between the Federal Government and the non-federal sponsor, to be solely responsible for the performance and costs of cleanup and response of any HTRW regulated under applicable law that are located in, on, or under real property interests required for construction, operation, and maintenance of the project, including the costs of any studies and investigations necessary to determine an appropriate response to the contamination, without reimbursement or credit by the Federal Government;

i. Agree, as between the Federal Government and the non-federal sponsor, that the non-Federal sponsor shall be considered the owner and operator of the project for the purpose of CERCLA liability or other applicable law, and to the maximum extent practicable shall carry out its responsibilities in a manner that will not cause HTRW liability to arise under applicable law; and

j. Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended, (42 U.S.C. 4630 and 4655) and the Uniform Regulations contained in 49 C.F.R Part 24, in acquiring real property interests necessary for construction, operation, and maintenance of the project including those

necessary for relocations, and placement area improvements; and inform all affected persons of applicable benefits, policies, and procedures in connection with said act.

The recommendations contained herein reflect the information available at this time and current departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to higher authority as proposals for authorization and implementation funding. However, prior to transmittal to higher authority, the sponsor, the states, interested federal agencies, and other parties will be advised of any modifications and will be afforded an opportunity to comment further.

Date	Virginia R. Brickner Lieutenant Colonel, U.S. Army District Commander and Engineer

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APPENDICES

A. Environmental Appendix

A-1. Records of Interagency Coordination

A-2. Biological Assessment for Protected Species under U.S. Fish and Wildlife Service's (USFWS) Jurisdiction and Information Planning and Conservation System (IPaC) Database Search

A-3. Preliminary Planting Plan and Monitoring & Adaptive Management Plan

A-4. Greenhouse Gas Emission Analysis

A-5. Proposed Project Description

A-6. Coastal Zone Management Act, Negative Determination

A-7. Application Form for Inclusion in the NOAA Restoration Center Santa Rosa Office Programmatic Approach Application and USACE South Pacific Division's Approval to Defer Endangered Species Act and Magnuson-Stevens Fishery Conservation and Management Act (ESA/MSA) Compliance for Species Managed by NOAA to D&I Phase

B. Engineering Appendix

B-1. Hydrology, Hydraulics & Climate (HH&C) Appendix

B-2. Civil Design Appendix

B-3. Geotechnical Appendix

C. Cultural Resources Appendix

D. Ecosystem Benefit Modeling Appendix

E. Economics Appendix

F. Cost Engineering Appendix

G. Real Estate Appendix