ORMOND BEACH RESTORATION AND PUBLIC ACCESS PROJECT PLAN

Preferred Alternative and Preliminary Design Plan

Prepared for
California State Coastal Conservancy
The Nature Conservancy
City of Oxnard

May 2021

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TABLE OF CONTENTS

Ormond Beach Restoration and Public Access Project, Preferred Alternative and Preliminary Design Plan

Page

Page

Appendices

Page

List of Figures

Page

List of Tables

Page

Acronyms and Abbreviations

Acronym	Definition
ADA	Americans with Disabilities Act
BLVD	Boulevard
CCC	California Coastal Commission
CDFW	California Department of Fish and Wildlife
CRC	Coastal Restoration Consultants
CNDDB	California Natural Diversity Database
CRV	Coastal Resilient Ventura
CSUCI	California State University Channel Islands
DEM	digital elevation model
EPA	Environmental Protection Agency
ESA	Environmental Science Associates
ESHA	Environmentally Sensitive Habitat Areas
LiDAR	Light Detection and Ranging
JLUS	Joint Land Use Study
MAMP	Monitoring and Adaptive Management Plan
MHHW	Mean Higher High Water
MLLW	Mean Lower Low Water
MWD	Metropolitan Water District
NAVD88	North American Vertical Datum of 1988
NBVC	Naval Base Ventura County
NRC	National Research Council
OBGS	Ormond Beach Generating Station
OBRAP	Ormond Beach Restoration and Public Access Project
ODD #3	Oxnard Drainage Ditch #3
OLW	Ormond Lagoon Waterway
OPC	Ocean Protection Council
PAC	Public Access Constraints
PAO	Public Access Opportunities
PCB	polychlorinated biphenyls
ppt	parts per thousand
PWA	Philip William and Associates
QCM	quantified conceptual model
RC	Restoration Constraints

Acronym	Definition
RTK GPS	Real Time Kinematic Global Positioning System
RO	Restoration Opportunities
RWQCB	Regional Water Quality Control Board
SAC	Science Advisory Committee
SCC	State Coastal Conservancy
SCWRP or WRP	Southern California Wetland Recovery Project
SFEI	San Francisco Estuary Institute
SLAMM	Sea Level Affecting Marshes Model
SLR	sea-level rise
TMDL	Total Maximum Daily Load
TNC	The Nature Conservancy
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
UWCD	United Water Conservation District
VCWPD	Ventura County Watershed Protection District
WSE	water surface elevation

EXECUTIVE SUMMARY

Background

Ormond Beach, located in southern Ventura County in the city of Oxnard (**Figure ES-1**), is the most important coastal wetland restoration opportunity in Southern California (State Coastal Conservancy (SCC) 2016). It has long been targeted for ecological enhancement and improved public access owing to its proximity to the large population centers in Los Angeles, Ventura, and Santa Barbara Counties and to the relatively rare opportunity to protect and restore a large area of dune/wetland/upland habitat in Southern California.

The California State Coastal Conservancy, the City of Oxnard, and The Nature Conservancy (collectively "Project Partners") own a total of 630 acres that comprise the Project Area (**Figures ES-1 and ES-2**).[1] The Project Area extends along the Pacific Ocean shore from the residential and commercial areas of South Oxnard on the west to the Naval Base Ventura County (NVBC) Point Mugu on the east. The Project Partners are leading the Ormond Beach Restoration and Public Access Project (OBRAP), with the vision of a resilient coastal environment that inspires the enjoyment, use, and support of the local community and beyond. The OBRAP goals are:

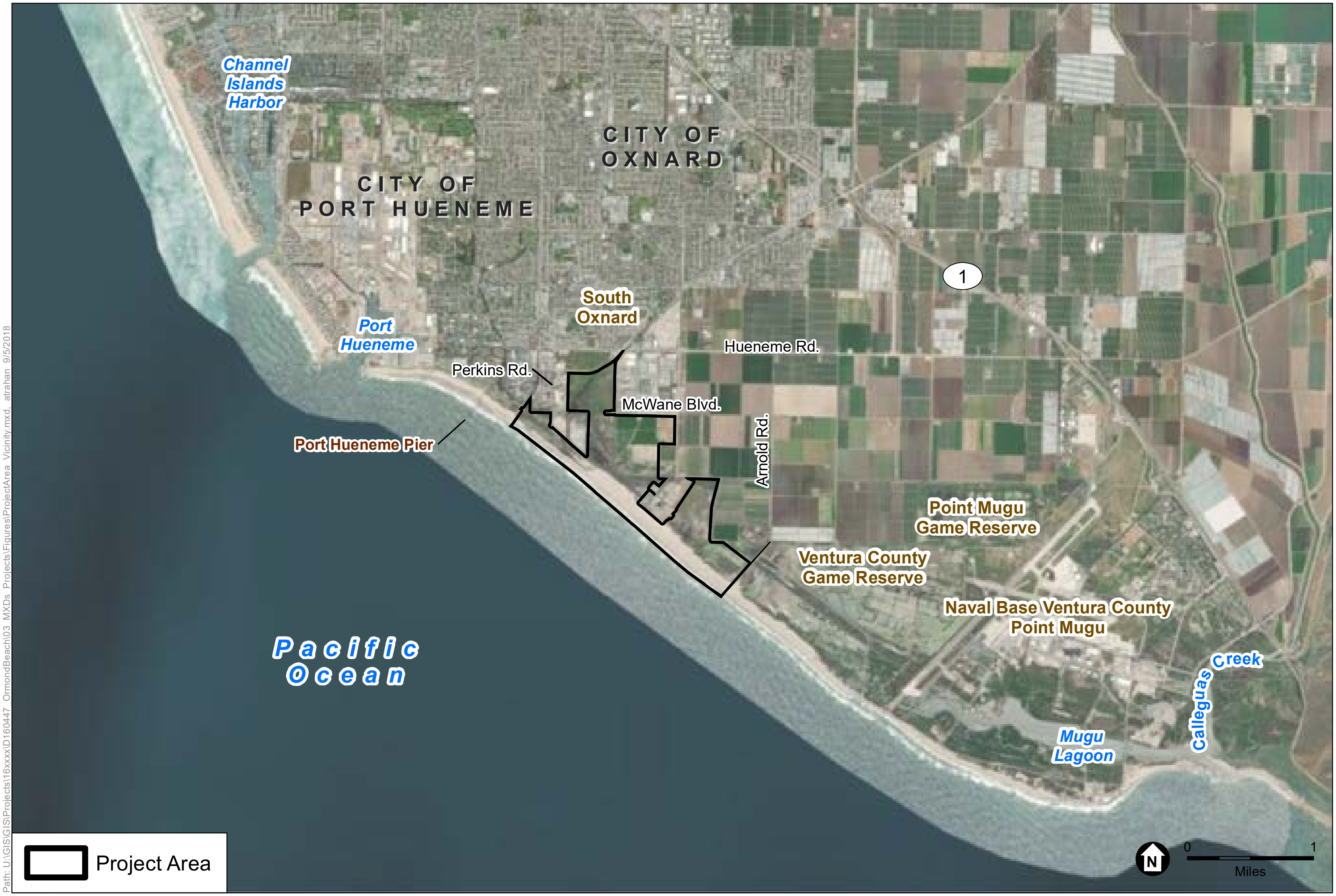
1. Preserve, enhance, and restore natural habitats and processes that support a dynamic and self-sustaining ecosystem at Ormond Beach.
2. Enhance opportunities for people to easily and safely visit Ormond Beach and enjoy the nature, educational opportunities, and recreation that are compatible with the restored Ormond Beach ecosystem.

The OBRAP Preferred Alternative and Preliminary Design Plan ("Plan") presents a preferred alternative and preliminary design for the Project Area, which will be the basis for the next phase of environmental review, final engineering design, regulatory approvals, and construction.

Plan Development Process

This phase of the planning process, which commenced in March 2017, included a review of prior work, public and stakeholder outreach, additional data collection and analyses, modeling of future conditions, and technical review. The Plan builds upon and supersedes the 2009 Ormond Beach Wetland Restoration Feasibility Study (Feasibility Study) developed by the SCC (Aspen 2009).

[1] In late 2020 TNC acquired another adjoining 20-acre parcel from Metropolitan Water District (MWD) (Section 2.6.1). This parcel is not included in the OBRAP Plan due to the timing of acquisition but will be incorporated in future planning phases.



SOURCE: ESRI 7/19/2016, City of Oxnard, Ventura County

Ormond Beach Restoration and Public Access Plan

Figure ES-1
Project Area and Vicinity

ESA

SOURCE: ESRI 7/19/2016, City of Oxnard, Ventura County

Ormond Beach Restoration and Public Access Plan

Figure ES-2
Site Map

ESA

A Scientific Advisory Committee (SAC) of technical experts was convened to review Plan goals, priorities, data gaps, alternatives, and adaptive management approaches (Section 6.3.3).

The Plan was informed by input from the local community and other stakeholders. The first round included a public workshop (June 21, 2017) to obtain input about the area, public access, visitor activities, and ideas for improvements. Door-to-door surveys were also conducted to obtain this information by the Central Coast Alliance United for a Sustainable Economy (CAUSE), in Spanish, English, and Mixteco, in several residential neighborhoods near Ormond Beach (Section 6.1.2). The Project Partners also met with neighboring landowners and potentially affected agencies to discuss opportunities and constraints (Section 4). Following release of the Preliminary Plan (May 2019) for public review and comment, the Project Partners held a second public workshop (July 31, 2019) and focus groups were held in South Oxnard for English, Spanish, and Mixteco speakers. This Plan has been prepared with consideration of public comments and it includes refinements to the preliminary Preferred Alternative (Section 6.5) and discusses the preparation of a preliminary design.

Preferred Alternative

The Preferred Alternative is designed to enhance and restore existing habitat, increase public access to the Project Area and adjacent beach in an ecologically sensitive manner, and allow for habitat changes in response to projected sea-level rise and landward shore migration (**Figure ES-3**). The Plan includes actions (**Table ES-1**) to restore a range of wetland habitats (freshwater, brackish, saltmarsh, and salt flats [“pannes”]) between the shoreline strand (sandy beach and dunes) and the uplands. Existing habitats will be enhanced and new habitats developed via earth moving to change topography and modify water flow and ponding, and vegetation management. The type and location of proposed restored habitats is based on historic and existing wetlands, topography, and special status plant and animal species. Public access features envisioned include pedestrian trails that provide views of habitats and access to the beach, trail links to existing roads, updated parking and a potential visitor center. The design alternative takes into consideration opportunities and constraints such as existing infrastructure, adjacent land uses, sea-level rise, flood potential, and protections for existing sensitive habitats and special-status species.

Organization of Plan

The Introduction (Section 1) provides background on the Project area, Project goals, planning process, and purpose and scope of the Plan. The Site Setting (Section 2) reviews past, present, and predicted future conditions without a Project. Historical Setting (Section 2.2) reviews natural conditions prior to development and changes over the last 250 years. Existing Conditions (Section 2.3) summarizes existing physical, hydrological, and biological conditions. Special-status species include salt marsh bird’s beak, tidewater goby, California least tern, western snowy plover, tidewater goby, Belding’s savannah sparrow and Ridgway’s rail.

SOURCE: ESRI 7/19/2016, City of Oxnard, Ventura County

Figure ES-3
Preferred Alternative and Preliminary Design of the Ormond Beach Restoration and Public Access Project

ESA

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TABLE ES-1
PREFERRED ALTERNATIVE RESTORATION AND PUBLIC ACCESS ELEMENTS BY AREA

Area	Design Element	Preferred Alternative
1	Restoration	• Weeding and planting in upland areas • Lagoon connection to Ormond Lagoon Waterway (OLW) moved to the east of Halaco properties • Lagoon connection to marsh in Area 3a increases capacity and leads to less frequent manual breaching
	Public Access	• All Primary trails at 12.0 elevation, Rustic trails at 11.0 -12.0 elevation where feasible, boardwalks at 13.0, Bridge/Pier at 15.0 • Bridge over tšumaš Creek • Bridge or boardwalk over Ormond Lagoon from island to beach • Boardwalk to overlook at Ormond Lagoon • Rustic trail to overlook • New bridge between Perkins and Ormond Lagoon • Expand Perkins Parking Lot footprint, adding 24 spaces • Restrooms, interpretive kiosk and docent station (±1,000 SF for school group focus), which can be relocated to accommodate sea level rise (SLR) • Bike racks and bike lockers (rental) • Primary trail in wetlands north of Perkins Road parking leading to West McWane Blvd.
2	Restoration	• Re-align OLW and grade to allow engagement with floodplain and brackish marsh • Minor grading to create gently sloping brackish marsh plain along new channel • Balance cut-fill within the area by filling old channel and adding flood protection around edges of property • Create smooth transition between Areas 2 and 3a • Create bioswale to capture nutrients in runoff from East McWane Blvd.
	Public Access	• New Major trailhead with 25+ parking spaces at West McWane Blvd. • Interpretive signage • New primary developed CA Coastal Trail heading east • Elevated wetland boardwalk to rustic loop trail • Bridge over OLW with birding overlook • Elevated overlook near East McWane Blvd. • Minor pedestrian and bike trailhead at Hueneme Road • Primary multi-modal trail at Hueneme Road (at-grade railroad crossing) to East McWane Blvd., CA Coastal Trail

TABLE ES-1 (CONTINUED)
PREFERRED ALTERNATIVE RESTORATION AND PUBLIC ACCESS ELEMENTS BY AREA

Area	Design Element	Preferred Alternative
3	Restoration	• Re-align OLW and grade to allow engagement with floodplain and brackish marsh • Minor grading to create gently sloping brackish marsh plain along new channel • Let habitat naturally convert from salt marsh to brackish marsh • Establish additional Coulter's goldfield populations in other areas the Project Area by collecting seed and distributing in appropriate areas • Weeding and planting in upland areas • Water control structure (culvert) under the railroad
	Public Access	• Primary multi-modal trail, CA Coastal Trail in north 3a • Overlook platforms • Bridge over OLW/agricultural ditch creek • Wetland boardwalks • Birding overlook platform with bird blinds • Wetland and dune boardwalks through Areas 3a and 3b • At-grade railroad crossing
4	Restoration	• Cease farming and excavate a series of shallow basins at increasing elevations from south to north • Water control structure (culvert) under the railroad • Basins will undergo type changes as sea level rises • Lower basin expected to support salt panne habitat at about 5 feet NAVD88[1] in the short term and evolve in to open water with moderate SLR • Middle basin(s) expected to support seasonal saline-affected wetlands at about 7 feet NAVD88 and evolve in to salt marsh and salt panne with moderate sea-level rise • Upper basin(s) expected to support seasonal wetlands and act as a bioswale at about 9 feet NAVD88 and evolve in to salt marsh and salt panne with greater sea-level rise • Establish salt marsh (below about 9 feet NAVD88) and transition zone vegetation (above about 9 feet) around basins
	Public Access	• Major trailhead and ±50 stall parking lot at East McWane Blvd. and Edison Drive intersection (Future, high point of Project Area) (could be moved south on Edison to former Metropolitan Water District parcel recently acquired by TNC). • Bike services for CA coastal trail riders, including racks, lockers, and minor repair station. • Visitor Center • Multi-modal primary elevated trail at 12 feet NAVD88, CA Coastal Trail

TABLE ES-1 (CONTINUED)
PREFERRED ALTERNATIVE RESTORATION AND PUBLIC ACCESS ELEMENTS BY AREA

Area	Design Element	Preferred Alternative
5	Restoration	• Block or reduce drainage through culverts between Area 5 and Oxnard Drainage Ditch (ODD) #3 • Remove levees and fill the ditch of ODD #3 between Areas 5 and 6 (the dead end channel) to create continuous marsh plain • Remove all old roads and building pads • Create series of shallow basins at increasing elevation • Lowest basin expected to support salt panne in the near term at about 5 feet NAVD88 and open water habitats with moderate sea-level rise • Middle basin expected to support seasonal saline-affected wetlands at about 6 feet NAVD88 and evolve into salt marsh and salt panne with moderate sea-level rise • Upper basin expected to support seasonal wetlands at about 8 feet NAVD88 and evolve in to salt marsh and salt panne with greater sea-level rise • Establish salt marsh (below about 7.5 feet NAVD88) and transition zone vegetation (above about 7.5 feet NAVD88) around basins
	Public Access	• Rustic trail to birding platform with wetland overlook • Opportunity for future connection to Edison Drive for loop trail
6	Restoration	• Maintain salt panne and salt marsh habitats with some weeding and revegetation as needed on higher spots • Restore upland habitats along ODD #3 levee • Remove levees and fill the ditch of ODD #3 between Areas 5 and 6 (the dead end channel) to create continuous marsh plain (in coordination with Oxnard Drainage District 2)
	Public Access	• CA Coastal Trail Class II bike trail on Arnold Road (per County of Ventura Local Coastal Plan) • Reconfigure Arnold Road parking for drop-off/turnaround only and Americans with Disabilities Act (ADA) parking • Bike-focused trailhead with bike lockers and bike racks • Elevated wetland overlook • Primitive trail along ODD #3 to Area 5 and beach, or along rustic trail to Area 6 and beach • Birding overlook in back dunes • Rustic seasonal trail from trailhead to beach (closed during nesting season or if inundated in winter)
7, 8, 9	Restoration	• Weeding and planting to restore back dune scrub habitat and expand foredune scrub habitat • Add sand fencing and seed native dune species to facilitate wind-driven sand capture and dune building
	Public Access	• Area 7: New and existing bird fencing • Area 7-9: Continue to maintain CA Coastal Trail along beach strand (includes Area 1) • Area 7: Primitive beach strand trail connects to backdune boardwalks in Area 3a and Area 3b • Area 8: Beach strand trail connects to Arnold primitive trail, dune overlook area • Area 9: Beach strand trail connects to Rustic trail at Arnold Road

NOTE:
[1] All elevations are in North American Vertical Datum of 1988 (NAVD88)

Future Conditions (Section 2.4) focuses on how the Project Area could evolve in response to sea-level rise. Predictions of future shore locations, condition of Ormond Lagoon and wetlands habitats are presented. Section 2.5 synthesizes the site's evolution for "No Project" as part of the baseline. Future conditions are forecast to include substantial narrowing of the beach, flooding of existing back-dune wetlands and conversion to open water lagoons, with potential landward migration of wetlands to higher elevations. Existing agricultural and industrial land uses in the Project Area and vicinity are likely to be impacted by higher sea levels.

Section 3 presents Project goals and objectives for restoration and public access, as well as implementation guidelines. Section 4 lays out opportunities and constraints for ecological restoration and public access, including the regulations that the Project would need to comply with (Section 4.3). Section 5 identifies habitat elements and public action features (trail types and site amenities) to be included in the Project design.

Based on the alternatives in the 2009 restoration feasibility study, three alternatives were developed to represent a range of ecological outcomes resulting from possible landscape modification and management (Section 6.2):

> *Alternative 1* was designed to enhance existing habitats through limited intervention, with an emphasis on preservation of salt marsh and salt panne habitats ("salt marsh theme").
>
> *Alternative 2* had a "habitat diversity theme" with moderate intervention to expand a wide diversity of wetland habitats, including realignment of Ormond Lagoon Waterway (OLW) to avoid the former Halaco site and increase brackish wetlands.
>
> *Alternative 3* emphasized connectivity of fragmented habitat and restoration of historical processes ("habitat connectivity theme"). This alternative proposed the most earthwork and greatest modification, including excavating a realigned OLW channel connecting to a new lagoon with its own mouth to the ocean.

Public access elements were chosen to be most compatible with each alternative, while also covering a range of amenities that could be substituted across alternatives. Access features are integrated into the Project Area so that multiple habitat types can be experienced and natural processes can be observed by visitors. Simultaneously, sensitive species protection requires controlled access in certain areas so that natural processes are not degraded nor are species such as nesting birds disturbed. Connectivity to roads and other trails and parking is provided along with access amenities (such as trails, staging areas, interpretive signs, viewing areas, and parking) for community members and visitors.

Each alternative was evaluated (Section 6.3) based on its evolution with projected sea-level rise, contribution to Project objectives, and review by the SAC. A Preferred Alterative (Section 6.4) was refined from the best elements of Alterative 2 for the western and central areas (TNC and City properties, Areas 1-4), and Alternative 3 for the eastern area (SCC property, Areas 5-6).

The Preferred Alternative concept design was presented in the Preliminary Plan (May 2019) for public review and input (summer-fall 2019). Based on consideration of public and other stakeholder input, the Preferred Alternative was refined (Section 6) and a preliminary design completed (Section 7).

This Plan addresses several of the data gaps and uncertainties identified in the prior Feasibility Study (Aspen 2009), and outlines actions to address remaining data gaps (Section 7) as the Project progresses through design refinement and environmental review. For example, surface water and groundwater levels and salinity vary substantially across the Project Area, and data collection is needed to quantify variability and discern trends of net changes. Additional information is needed to understand local soil and water conditions that affect plant establishment. Nevertheless, uncertainties in the responses to restoration actions are expected to remain. Therefore, an adaptive restoration approach is recommended, using a phased process to learn about habitat responses through implementation and monitoring of incremental restoration actions (Section 8.4).

Next Steps

This Plan presents a Preferred Alternative and preliminary design of the alternative. The next phases of design will further develop the restoration and public access elements in the OBRAP, including responses to environmental review, additional technical analysis, regulatory review and public comment. Additional technical studies are envisioned and these may refine the Project description, in compliance with the California Environmental Quality Act.

Next steps will include: 1) completing additional technical studies to inform environmental review, which are described in Section 8; 2) progressing design development (during environmental review and permitting) ; 3) initiating environmental review Plan; 4) proceeding with regulatory approvals and permitting; 5) preparation of construction documents (for Plan implementation after permits attained); and, 6) Plan implementation via construction and adaptive management (if approved). Opportunities for public review and comment will occur at each stage of design development and during environmental review and regulatory approvals.

In addition, identifying an entity to manage the Ormond Beach for the long term is a high priority of the Project Partners.

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SECTION 1
Introduction

1.1 Project Background

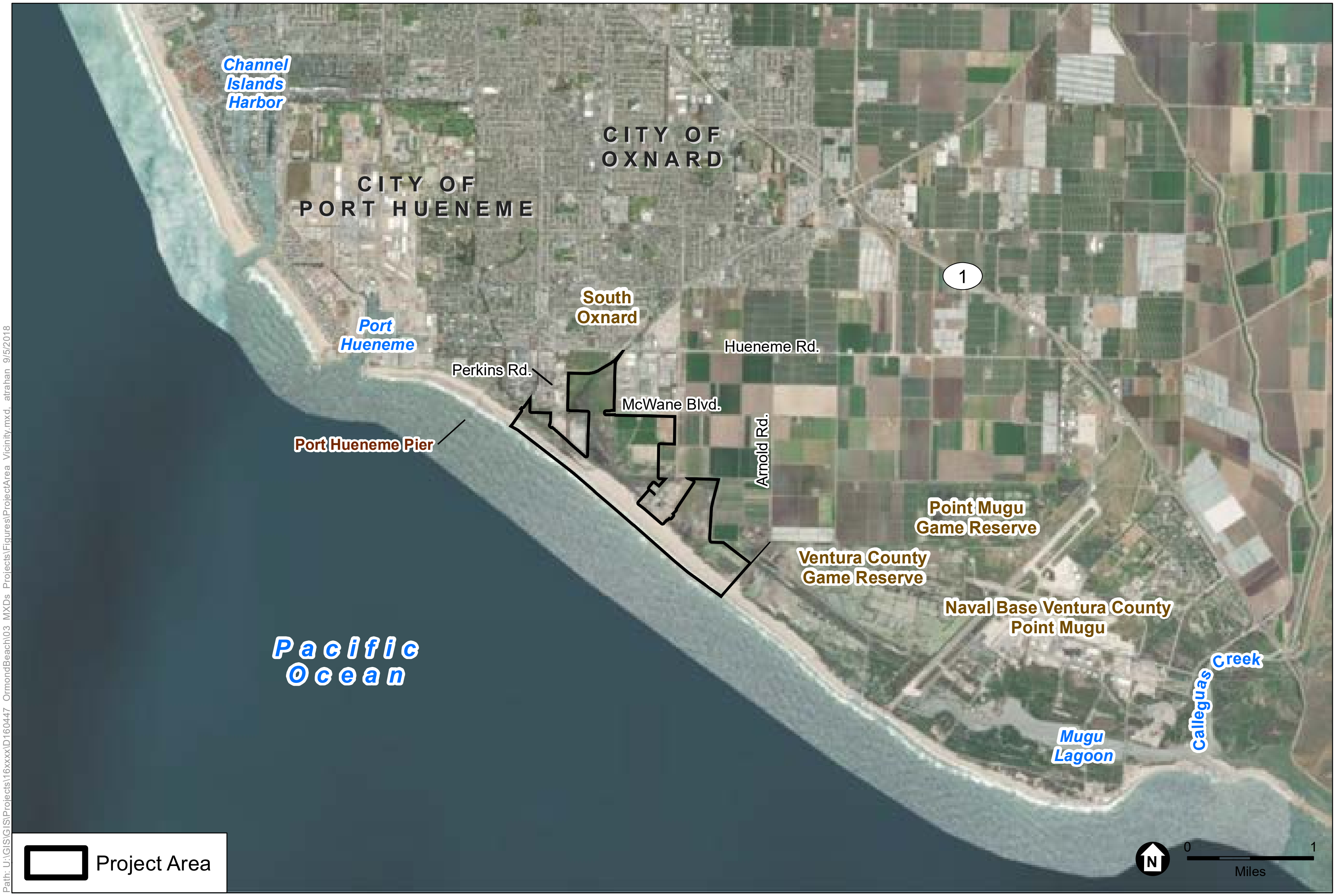
The Ormond Beach Coastal Area, which consists of Ormond Beach and its adjacent sand dunes, wetland and upland areas (collectively, Ormond Beach), has been identified by wetland experts as the most important coastal wetland restoration opportunity in Southern California (SCC 2016). The State Coastal Conservancy (SCC) and The Nature Conservancy (TNC) targeted Ormond Beach as a conservation priority in the early 1980s (TNC 2008). TNC partnered with SCC in 1999 to protect and restore the area. The City of Oxnard is also committed to restoring Ormond Beach, as reflected in its 2030 General Plan, which identifies numerous goals and policies for the area (City of Oxnard 2011). The SCC, TNC, and the City of Oxnard (collectively, "Project Partners") are leading the restoration of Ormond Beach. In 2016, SCC, TNC, and the City of Oxnard entered into a Memorandum of Understanding to collectively protect, manage, and restore the properties owned by the Project Partners at Ormond Beach.

1.2 Project Area

The Project Area consists of the properties currently owned by the Project Partners at Ormond Beach and spans 630 acres in the city of Oxnard along the County of Ventura coast (**Figure 1-1** and **Figure 1-2**; referred to as "Project Area" throughout this report). The SCC owns 260 acres, including a former tank farm site (acquired from Southern California Edison in 2002). The City of Oxnard holds 80 acres. TNC owns 290 acres, including an area in active agriculture.[2] The land comprises beach, dune, wetlands, and agricultural lands (Section 2.1 Project Setting). Historically, this region had a dynamic complex of coastal wetlands that were intermittently connected to rivers and the ocean (Section 2.2 Historical Setting). Humans have had dramatic impacts on the landscape through filling wetlands and lagoons, excavating channels, and allowing development to encroach on habitats.

Land surrounding the Project Area consists of open space, agricultural, and industrial uses (Section 2.3.2 Land Use and Infrastructure). The Halaco properties, a former smelter facility, are now part of an Environmental Protection Agency (EPA)-designated Superfund site, and adjacent to the TNC and City lands near Ormond Lagoon. The Ormond Beach Generating Station (OBGS) is located on the coast and surrounded by wetlands and dunes owned by the SCC. The southeastern portion of Ormond Beach is adjacent to the Naval Base Ventura County Point Mugu Naval Air Station (NBVC Point Mugu).

[2] In late 2020 TNC acquired another adjoining 20-acre parcel from Metropolitan Water District (MWD) (Section 2.6.1). This parcel is not included in the OBRAP Plan due to the timing of acquisition but will be incorporated in future planning phases.



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SOURCE: ESRI 7/19/2016, City of Oxnard, Ventura County

Ormond Beach Restoration and Public Access Plan

Figure 1-1
Project Area and Vicinity

ESA

SOURCE: ESRI 7/19/2016, City of Oxnard, Ventura County

Ormond Beach Restoration and Public Access Plan

Figure 1-2
Site Map

ESA

1.3 Goals

The Ormond Beach Restoration and Public Access Plan (OBRAP) is being undertaken by the Project Partners to achieve a vision of a resilient coastal environment that inspires the enjoyment, use, and support of the local community and beyond. The OBRAP has two goals:

1. Preserve, enhance, and restore natural habitats and processes that support a dynamic and self-sustaining ecosystem at Ormond Beach.
2. Enhance opportunities for people to easily and safely visit Ormond Beach and enjoy the nature, educational opportunities, and recreation that are compatible with the restored Ormond Beach ecosystem.

1.4 Existing Studies and Plans

The SCC, TNC, and the EPA have developed a significant body of documents evaluating baseline conditions and the feasibility of habitat restoration and public access at Ormond Beach. Key relevant planning documents that preceded development of the OBRAP are discussed below. Additional studies are referenced throughout the report as appropriate.

The Southern California Wetland Recovery Project (WRP) is an alliance of federal, state, and local officials working together with business and nonprofit organizations to acquire, restore, and expand coastal wetlands and watersheds throughout Southern California. The WRP developed a Regional Strategy that articulates the long-term goals and specific implementation strategies to guide restoration efforts. The Regional Strategy was updated in 2001 and 2018 (WRP 2018). The goals of the OBRAP (Section 5) are informed by the Regional Strategy.

In 2008, TNC developed a "Conservation Plan for the Lower Santa Clara River Watershed." The Ormond-Mugu system was prioritized as important habitat for many threatened and endangered species. Threats facing the Ormond-Mugu system include incompatible urban development, climate change, invasive plants, incompatible recreational use, and the Halaco Superfund Site. TNC's Conservation Plan identified restoration and land management actions for protected and public lands in the Ormond Beach area.

In 2009, SCC commissioned a restoration feasibility report to document the existing conditions, resources, sensitive species and plant communities, and to describe conceptual-level restoration alternatives at Ormond Beach. The "Ormond Beach Wetland Restoration Feasibility Study" (Feasibility Study) (Aspen 2009) The Feasibility Study also identified water supply and quality issues, information gaps, and opportunities and constraints for wetland restoration and public access. The OBRAP Plan builds off the 2009 Feasibility Study.

In 2010, TNC initiated Coastal Resilience Ventura County[3] (TNC 2016) as a partnership to provide science and decision-support tools to aid conservation, adaptation, planning projects and policymaking to address conditions brought about by sea level rise.

[3] http://coastalresilience.org/project/ventura-county/

In 2011, SCC contracted with the San Francisco Estuary Institute (SFEI) to compile data, maps and historical accounts in the "Historical Ecology of the Lower Santa Clara River, Ventura River, and Oxnard Plain" (SFEI, 2011). This report provides the basis for the historical conditions analysis (Appendix A).

In 2011, the City of Oxnard adopted its 2030 General Plan. The 2030 General Plan identifies Goal CD-21 (an updated Local Coastal Program that includes the restoration of the Ormond Beach wetlands and consideration of climate change) and Goal CD-22 (Environmentally sound Ormond Beach wetlands with appropriate public access) and implementing Policy CD-22.2 (Develop an Ormond Beach Visitor Access Plan). In addition, the 2030 General Plan includes GOAL ER-4 (Protected, restored, and enhanced sensitive habitat areas) with several implementing policies that are relevant to the Ormond Beach area, including Policy ER-4.1 (Encourage Protection of Sensitive Habitat), Policy ER-4.5 (Planning in Sensitive Areas). The 2030 General Plan also updated land use designations for the Ormond Beach area. The City is currently updating its Local Coastal Program (LCP), consistent with direction in its 2030 General Plan, to update land use designations, include restoration of the Ormond Beach wetlands, and plan for public access.

In 2015, EPA released its "Baseline Ecological Risk Assessment Remedial Investigation Report" (CH2MHill 2015) on the Halaco Superfund Site, which includes the Halaco Properties and portions of the Project Area. The report includes a description of the extent of environmental contamination at the Halaco Superfund Site, and identifies areas with relatively high risk of ecological impacts.

The Ventura County Watershed Protection District (VCWPD) provides flood control and watershed management in the vicinity of the Project Area. VCWPD has studied the management of the Ormond lagoon and sand berm via beach grooming (HDR 2008a, HDR 2011, VCWPD 2016, VCWPD 2017). They have also analyzed upgrades of the tšumaš Creek (formerly J Street Drain) flood conveyance capability and management of the Ormond Lagoon Waterway (OLW) (HDR 2008a, HDR 2008b, HDR 2012).

1.5 Purpose and Scope of the Plan

This OBRAP Preferred Alternative and Preliminary Design Plan ("Plan") presents a preferred alternative and preliminary design of the alternative. The next phases of design will further develop the restoration and public access elements, thereby refining the Plan in response to environmental review, additional technical analysis, regulatory review and public comment. This Plan incorporates and builds upon the 2019 OBRAP Preliminary Restoration Plan ("Preliminary Plan"), which described and assessed three alternatives for integrated habitat restoration and public access (Section 6) and identified a preliminary Preferred Alternative (Section 6.4). Each of the identified alternatives seeks to restore habitat functions within the context of existing opportunities and constraints and projected conditions with climate change. They also include an array of public access features, with an emphasis on supporting ecological goals and allowing the public to experience the natural beauty and habitats to be protected and restored. The Plan also outlines potential adaptive restoration and adaptive management frameworks to resolve key scientific uncertainties and inform development and implementation of a Preferred Alternative (Section 8).

This Plan is based on a review of historical and existing conditions, as synthesized from previous studies and plans, especially the 2009 Feasibility Plan (Aspen 2009), with new data collected in 2017. Input was solicited via public meetings (June 21, 2017 and July 31, 2019), a survey conducted by the Central Coast Alliance United for a Sustainable Economy[4] (CAUSE) (summer 2017), meetings with the SAC (October 3, 2017 and May 29, 2018 meetings), public comments on the preliminary plan (summer-fall 2019), and focus groups conducted by CAUSE (fall 2019). This Plan has been prepared with consideration of public comments and it includes refinements to the preliminary Preferred Alternative (Section 6.5).

This Plan was prepared collaboratively by the Project Partners and a team of consultants led by Environmental Science Associates (ESA). Coastal Restoration Consultants (CRC) performed site surveys and assisted in formulating ecological criteria and target habitat configurations. ESA and CRC developed the restoration alternatives and conceptual designs. ESA refined the alternatives and conducted modeling (water balance, lagoon morphology, and climate change projections) to assess likely outcomes for each alternative. True Nature led the design of public access elements. ESA prepared the engineering design, and CRC prepared the revegetation plan with ESA.

The Plan includes the following:

Section 2 summarizes existing, historical, and future site conditions, including technical studies that served as the basis for future conditions.

Section 3 presents the Project goals and objectives.

Section 4 describes opportunities and constraints, as well as the planning context for implementing the Project.

Section 5 describes ecological and public access Project elements.

Section 6 describes and evaluates the Project alternatives.

Section 7 presents the preliminary design of the Preferred Alternative

Section 8 identifies data gaps and uncertainties and outlines a framework for adaptive management.

Section 9 identifies contributors and reviewers of this report.

Section 10 contains the report references.

The Appendices provide supporting information and technical analyses:

A. Historical Conditions
B. Additional Information on Existing Conditions and Future Conditions No Project

[4] The Central Coast Alliance United for a Sustainable Economy (CAUSE) is a grassroots organization focused on social, economic, and environmental justice for working-class and immigrant communities.

C. Sea-Level Rise
D. Shore Migration and Overtopping (Beach QCM)
E. Ormond Lagoon Hydrology and Morphology (Lagoon QCM)
F. Wetlands Habitat Evolution Modeling (SLAMM)
G. Preliminary Design
H. Conceptual Revegetation Plan

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SECTION 2
Site Conditions

Historical, existing, and future site conditions are summarized to inform an assessment of site evolution pertinent to ecology and access. Future projections are focused on the effects of sea-level rise without consideration of potential human interventions, from this Project or otherwise.

The Project Setting (Section 2.1) defines the site and terminology used throughout this report. Historical Conditions (Section 2.2) summarizes landscape patterns and processes prior to direct modification, and the effects of human development in the past 250 years. Existing Conditions (Section 2.3) focuses on physical, hydrological and biological conditions, including special status plants and animals. Surrounding land use and infrastructure are described as well.

Future Conditions (Section 2.4) identifies the sea-level rise scenarios selected for the Project, and summarizes analysis accomplished to predict the site response to sea-level rise. Synthesis of Site Evolution – No Project (Section 2.5) provides a summary of the site trajectory considered in the development of the alternatives. The assessment of evolutionary trajectory emphasizes habitat conditions defined by dominant plant communities, with special focus on physical processes (hydrology, topography, geomorphology) that drive habitat changes and can be affected by restoration actions. This concept of physical processes driving habitat also informs public access design (Section 5.2). Potential future land expansion opportunities are described in Section 2.6.

2.1 Project Setting

The Project Area extends along the Pacific Ocean shore from the residential and commercial areas of South Oxnard on the north, down the coast to the NBVC Point Mugu on the south (**Figure 2-1**). The Project Area consists of several parcels (630 acres) currently owned by the Project Partners.[5] The Project Area is surrounded by industrial infrastructure including the Halaco properties (a former smelter plant and now part of a Superfund site), the Ormond Beach Generating Station, and the Port of Hueneme's rail line. For ease of reference, Figure 2-1 also designates several site areas within the Project Area (Areas 1-9), which are referred to throughout this report. The limits of each site area coincide with man-made features which affect habitat, access or both. These areas and their ownership are as follows:

- Area 1 – City of Oxnard property at north end of Project Area, including Ormond Lagoon and surrounding beach, dunes and channels
- Area 2 – TNC property around Ormond Lagoon Waterway (OLW)

[5] In late 2020 TNC acquired another adjoining 20-acre parcel from Metropolitan Water District (MWD) (Section 2.6.1). This parcel is not included in the OBRAP Plan due to the timing of acquisition but will be incorporated in future planning phases.

- Area 3a – TNC property near the Halaco slag heap and west of the railway
- Area 3b – TNC property near the OBGS power plant and south of the railway
- Area 4 – TNC lands currently in agriculture, north and east of the railway.
- Area 5 – SCC property on former tank farm
- Area 6 – SCC property near Arnold Road, including the salt marsh and salt panne habitats
- Area 7 –Beach and dunes owned by City of Oxnard, southwest of the TNC property.
- Area 8 – Beach and dunes owned by SCC, next to the former tank farm.
- Area 9 – Beach and dunes owned by SCC, near Arnold Road at south end of Project Area.

Figure 2-2 shows an overview of site topography of the overall Project Area. The site is very flat and low in elevation, with extensive perennial and seasonal wetlands, as well as agriculture on the TNC parcel in the central area. The wetlands result from high groundwater and seasonal ponding. The seasonal ponding results from the sandy beach and dune strand, which is elevated due to waves and winds, and blocks surface runoff from the land.

Drainage in and around the site has been modified for flood control and to enable various agriculture, commercial, and residential land uses. Three flood control channels (Hueneme Drain, tšumaš Creek, and OLW), converge and feed Ormond Lagoon (Figure 2-1). A shore-parallel channel called Oxnard Drainage Ditch #3 (ODD #3) connects with Mugu Lagoon. There are multiple other parcel-level drainage systems that connect to these channels. One consequence of these man-made channels is that water supply is concentrated in some areas, and reduced where wetlands existed historically. The salty conditions in the soil result from the proximity to the ocean, onshore winds, groundwater and occasional wave overwash into backshore areas, as well as salts in soils and runoff. The historical seasonal ponding and evaporation have concentrated salts, which are likely leached from the soils during storm runoff. The addition of freshwater to these areas results in brackish and salt marsh.

Existing habitats are depicted by type in **Figure 2-3**. There are a range of wetlands types, varying in salinity and water supply. The wetlands are primarily salt and brackish marsh, with extensive salt pannes and several special-status plants, such as salt marsh bird's beak. Wetlands in the vicinity of the OLW are slightly brackish. The beach strand includes areas used by protected bird species (California least tern and Western snowy plover), with substantial portions off-limits to public access during the nesting season.

Existing, authorized public access to the Project Area, particularly beach access, is quite limited in relation to the overall area. On the west, there is a public parking lot and access to an informal trail at the seaward end of Perkins Road, but the Ormond Lagoon blocks beach access. The public may also access the Project Area by walking along the beach from the Port Hueneme Beach Park, approximately 0.2 miles west of Ormond Lagoon. A second public parking lot and access point at the end of Arnold Road is used for beach entry and access to another informal walking trail.

SOURCE: ESRI 7/19/2016, City of Oxnard, Ventura County

Ormond Beach Restoration and Public Access Plan

Figure 2-1
Project Area and Site Areas

ESA

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SOURCE: ESA (2017), CA Coastal Conservancy LiDAR (2011)

Figure 2-2
Existing Topography

ESA

SOURCE: ESA (2017), CA Coastal Conservancy LiDAR (2011)

NOTE: Based on field mapping of site in Spring 2017. Minimum mapping unit was approximately one acre in most cases, so some small habitat features are not shown.

ESA

Figure 2-3
Existing Habitats

2.2 Historical Setting

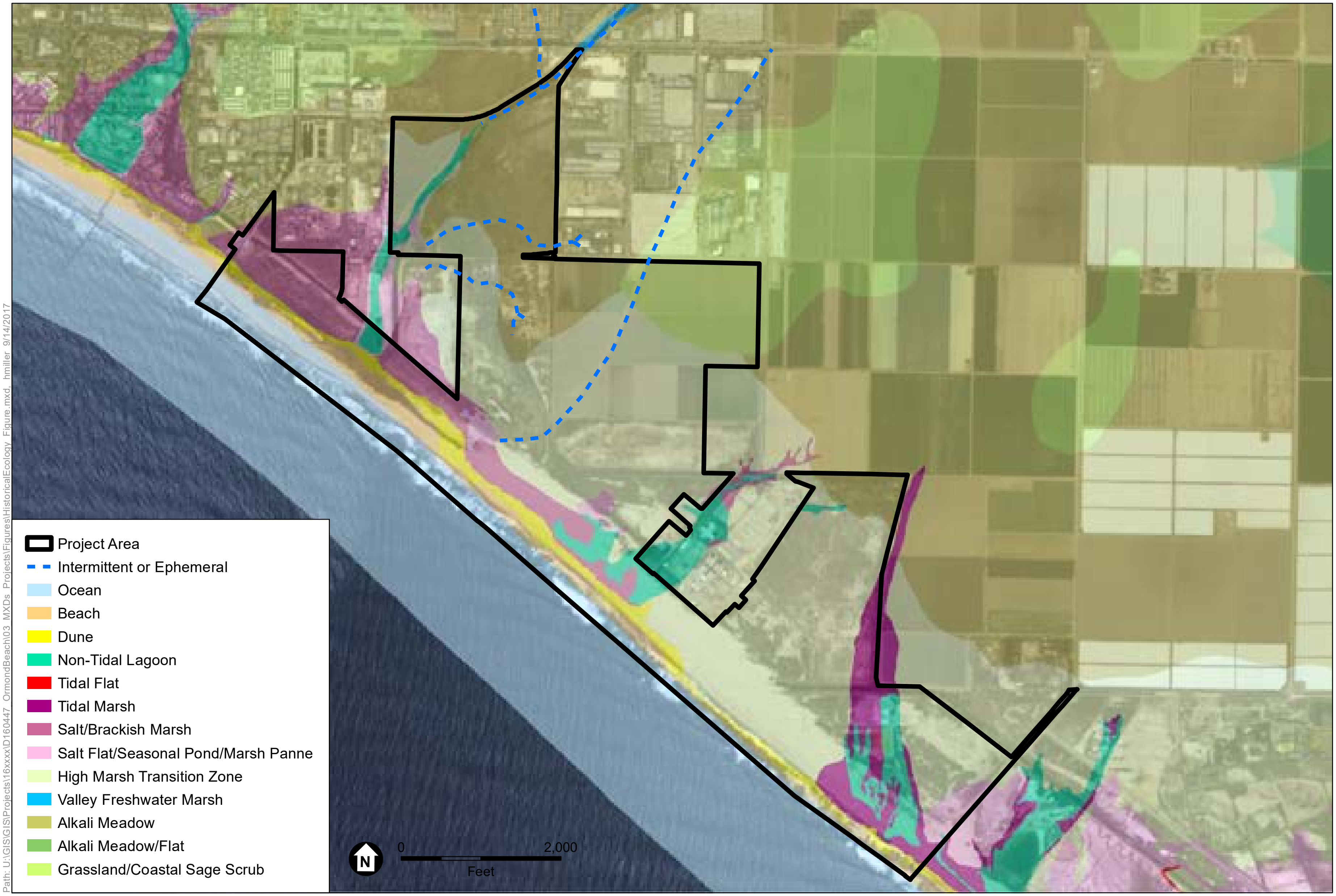
Understanding historical landscape patterns, their physical and ecological characteristics, the dynamic processes that shape the landscape, and the effect of human alterations is an important step in determining appropriate goals and opportunities for restoration and conservation. Appendix A reviews the region's historical ecology.

The Project Area is located on a large alluvial plain created by the deposition of sediment eroded from the surrounding mountains (**Figure 2-4**) (Beller et al. 2011). The major regional drainage systems are the Ventura and Santa Clara Rivers and Calleguas Creek. Waves and wind built the sandy shore and form a ridge of littoral (coastal) sand dunes that inhibits drainage of rainfall to the ocean, resulting in lagoons and back-dune wetlands. The Ormond Beach area once supported a large complex of wetlands formed by the mouth of the Santa Clara River as it moved across the Oxnard Plain over thousands of years (Beller et al. 2011). The Ormond Lagoon, a former river mouth, was once larger and had a greater tidal prism that may have kept the mouth open for extended periods regardless of watershed runoff conditions (PWA 2007). Historic maps suggest that many of the wetlands were generally non-tidal, saline, and hydrologically connected in wet years. Where there were year-round freshwater inflows, lagoons were permanently flooded and naturally breached somewhat regularly and therefore may have had some tidal influence intermittently. Prior to runway construction in the 1940's, wetlands closer to Mugu Lagoon had some tidal exchange in very wet years. Lagoons with only wet-season freshwater inputs were flooded after rains and then dried to salty flats. The seasonal lagoons and salt pannes were inundated occasionally with saltwater when storms or large wave events overwashed the dunes.

Small remnants of permanently flooded lagoon, seasonal lagoon, and other wetlands persist within the Project Area but with altered hydrology. Some wetland-upland transition and upland habitats remain as well, but almost all are on landforms that have been altered over the years by berms, levees, agriculture, and development.

Beach and dune habitats migrated landward in the middle of the 20th century, resulting in a conversion of over 100 acres of wetlands to dunes. The current beach and dune system is nearly twice as wide as it was in the mid-1940s, which is attributed to the construction and management of Port Hueneme. When the port breakwaters were constructed, most of the wave-driven sand transport that had moved from north to south was blocked or diverted into the Hueneme submarine canyon, causing Ormond Beach to erode. As the beach eroded, waves were able to reach the dunes more frequently and the dunes eroded as well. Subsequently, sand was dredged and pumped past Port Hueneme in 2- to 4-year intervals, causing the beach to aggrade seaward, resulting in a much wider beach. The erosion of dune vegetation allowed more wind-driven sand transport into the wetlands areas.

Humans have altered the landscape through filling of wetlands and lagoons, excavating channels, modifying drainages, and allowing development to encroach on habitats. Invasive plant species have altered the structure and composition of some habitats. Despite the impacts to the site, there remain important remnant habitats, extensive wetlands, and considerable opportunities for ecological restoration.



Path: U:\GIS\GIS\Projects\16xxxx\D160447_OrmondBeach\03_MXDs_Projects\Figures\HistoricalEcology_Figure.mxd, hmiller 9/14/2017

Source: ESRI 7/19/2016, San Francisco Estuary Institute, Ventura County,

Ormond Beach Restoration and Public Access Plan

Figure 2-4
Project Area Historic Ecology in the Early 1800s

ESA

2.3 Existing Conditions

The current shoreline of the Oxnard Plain is composed of the freshwater-brackish, intermittently closed estuaries of the Ventura and Santa Clara rivers; the non-tidal lagoon complexes marking former Santa Clara River mouths such as Ormond Beach, and the large, more tidally-influenced wetland system at Mugu (WRP 2018). As classified in the WRP Regional Strategy, Ormond Beach is part of a Fragmented River Valley Estuary, with several parcels of historical wetlands in close proximity but hydrologically disconnected from one another (WRP 2018).

Existing physical and biological conditions at the site are summarized in this section to offer comparison with historical conditions, provide a basis for changes associated with future sea levels, and establish the trajectory of the site without intervention. Infrastructure and public access existing conditions are described below and discussed in Section 4 Opportunities and Constraints.

2.3.1 Topography

The topography of the Project Area is rather flat and low in elevation (Figure 2-2). **Figures 2-5, 2-6 and 2-7** show detailed topographic mapping. According to SCC Light Detection and Ranging (LiDAR) dataset, most of the Project Area falls within the elevation range of 2 to 14 feet NAVD88.[6] A survey was completed by ESA in 2017 to validate the SCC LiDAR from 2011. As expected, the LiDAR data provide a good indication of site grades, with localized significant deviations (erroneous or missing elevations) where marsh and other vegetation and standing water interfere with the LiDAR, and where breaks in slope cannot be resolved by the elevation grid. For example, ground survey indicates the site grades in Area 3a marsh are locally more than 2 feet below, as indicated by the LiDAR.

Elevations of the beach along the Project Area range from 9.4 to 16.1 feet NAVD88. Dune crests achieve elevations of +15 feet NAVD88, but most are around 10 feet NAVD88, and lower in Area 9. High ground adjacent to OLW and ODD #3 in the form of embankment levees are around 10 feet NAVD88 and uneven. Area 4 slopes upward to the north and reaches elevation of 10 feet NAVD88 while the rest of the site is lower. Low areas are emergent brackish marsh in Areas 2 and 3a (estimated elevation of below 8 feet NAVD88 and potentially 6 feet and locally lower) and salt pannes in Areas 3b and 6 (5 to 6 feet NAVD88). OLW thalweg (low point) is about 3 feet NAVD88, and the low bed elevations in Ormond Lagoon are typically around 4 feet NAVD88 or higher except at the junction with OLW. Note that Ormond Lagoon geometry varies in response to sand transport caused by ocean and runoff processes. Developed areas in the west are generally at 10 feet NAVD88 and higher.

2.3.2 Surrounding Area Land Uses and Infrastructure

The area immediately surrounding the OBRAP site consists of agricultural, industrial, and military uses (City of Oxnard 2011) (**Figure 2-8**). Residential neighborhoods are also in close vicinity north and northwest of the Project Area (City of Oxnard 2011, City of Port Hueneme 2017).

6 All elevations are in North American Vertical Datum of 1988 (NAVD88)

Local Communities

The City of Oxnard's South Oxnard neighborhood lies north of the Project Area (Figure 1-1). Many of the residents of these neighborhoods are Latinx (73.5 percent per 2010 US Census Bureau Data), and 16.6 percent of residents earn at or below the federal poverty line. The state of California defines South Oxnard as a disadvantaged to severely disadvantaged community (California Department of Water Resources 2020). The state's Office of Environmental Health Hazard Assessment (OEHHA) ranked the City of Oxnard in the top 20 percent of the most environmentally burdened communities in the state (California EPA 2018).

The City of Port Hueneme is located northwest of the Project Area (Figure 1-1). The Port of Hueneme, owned and operated by the Oxnard Harbor District, and the NVBC in Port Hueneme together occupy approximately 60% of the City's total land area. The Hueneme Pier is a major draw and offers large parking lots. There is a residential population with parks and schools near the Project Area, with parks and bike paths leading towards the beach. Visitors can access the Project Area (Area 1) by walking south along the beach. Over half the residents of Port Hueneme (about 60 percent) identified as Hispanic or Latinx as of 2019, and 12.5 percent of residents have family incomes at or below the federal poverty level (U.S. Census Bureau, 2019). Although the City of Port Hueneme as a whole is not identified as a disadvantaged community based on median income, about 25 percent of its population lives within census block groups that meet the median income threshold to be considered a disadvantaged community (DWR 2021). None of the census tracts within Port Hueneme are within the top 25 percent scoring areas for overall environmental burden from CalEnviroScreen (CalEPA 2018).

Halaco Superfund Site

The Halaco properties (Figure 2-8, near Areas 1, 2 and 3a), located in the far southwest corner of the Project Area, formerly housed an industrial processing facility. The facility has been demolished and the properties are officially closed to the public; however, homeless encampments are periodically established and cleared from the properties. The Halaco Engineering Company operated a metal smelter from 1965 to 2004. The facility directly discharged waste into the waterways from 1965 to 1970, and in 1970, Halaco began pumping waste to unlined settling ponds. Halaco ceased all operations in 2004, leaving more than 700,000 cubic yards of waste. Testing by the EPA in 2009 and 2010 showed that soil, sediments, and groundwater have been contaminated by Halaco's wastes (CH2M Hill 2012). Elevated levels of aluminum, barium, beryllium, cadmium, chromium, copper, lead, magnesium, manganese, nickel, and zinc were found on the Halaco properties and in surrounding areas. In past sampling, elevated levels of ammonia and petroleum hydrocarbons were also detected. Elevated levels of radioactive thorium (and decay products) were found in some areas (CH2M Hill 2012). EPA added the Halaco Properties and surrounding contaminated areas (including portions of the TNC parcel (Areas 2 and 3a), the OLW and the Ormond Lagoon area (Area 1)) to the Superfund National Priorities List in 2007.[7]

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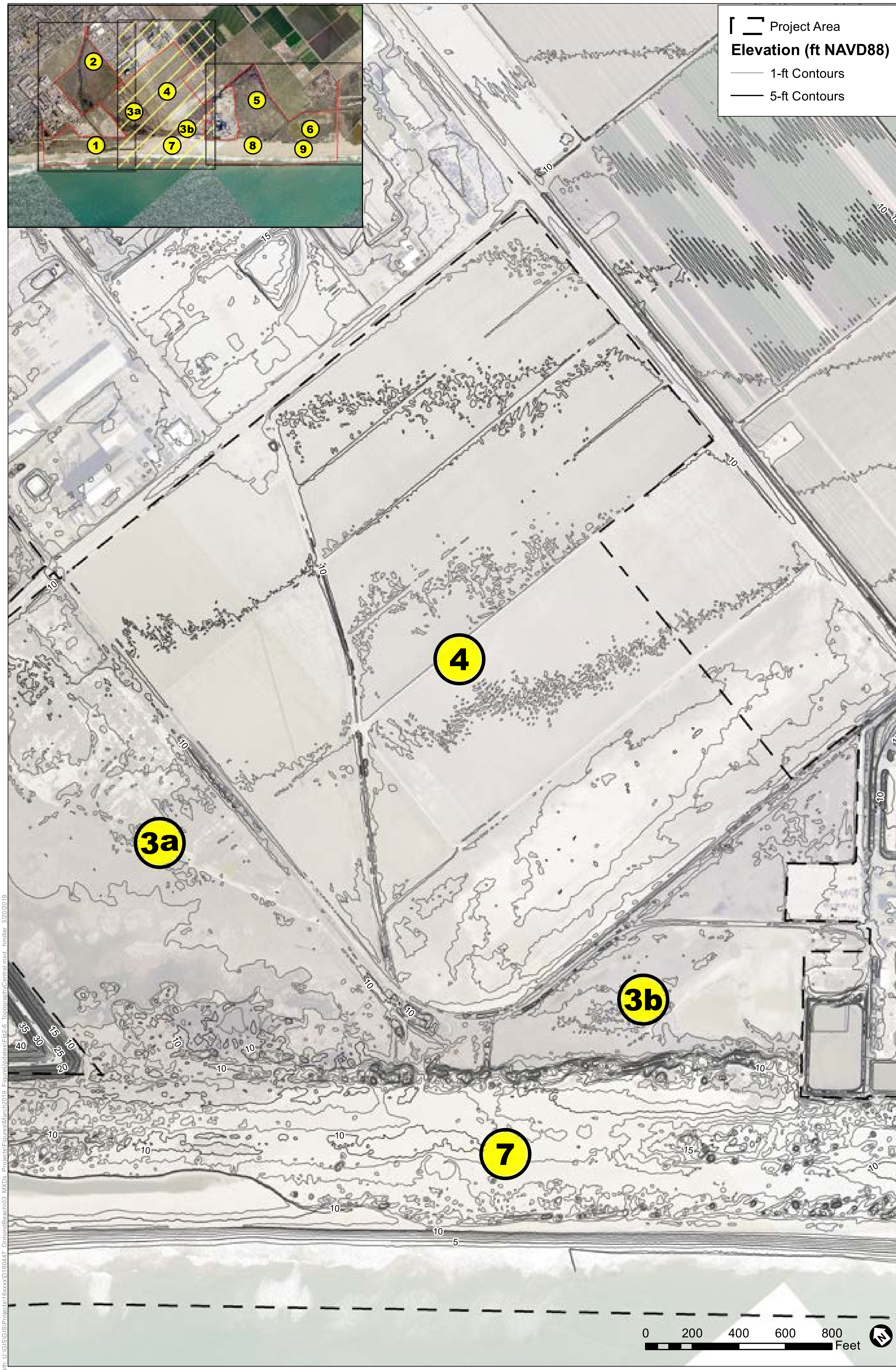
7 https://yosemite.epa.gov/r9/sfund/r9sfdocw.nsf/ViewByEPAID/CAD009688052

SOURCE:
LiDAR, SCC 2011
Imagery, County of Ventura, 2016

Ormond Beach Restoration and Public Access Plan

Figure 2-5
Topography- West Project Area

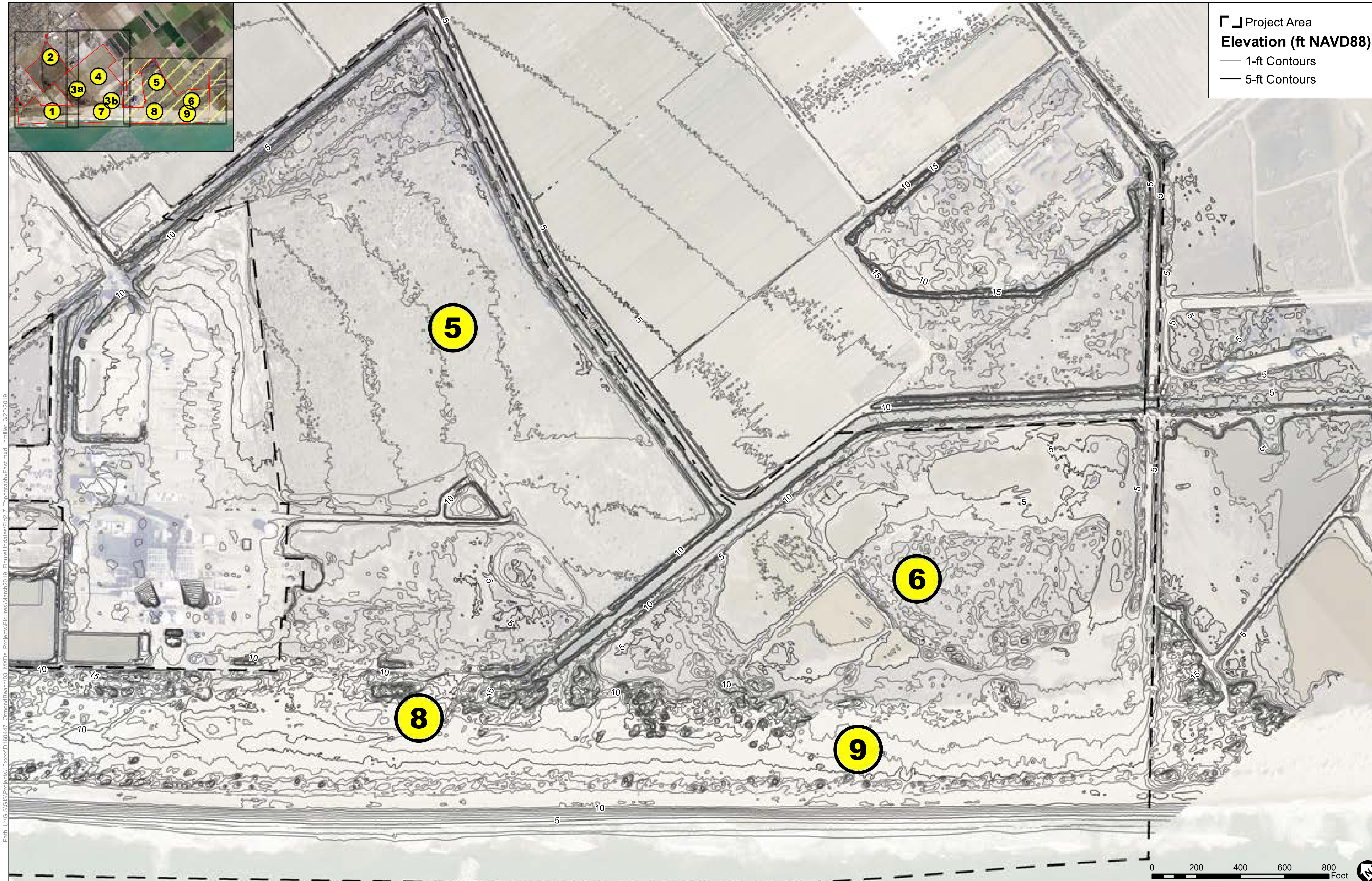
ESA



SOURCE:
LiDAR, SCC 2011
Imagery, County of Ventura, 2016

Ormond Beach Restoration and Public Access Plan

Figure 2-6
Topography- Central Project Area



SOURCE:
LiDAR, SCC 2011
Imagery, County of Ventura, 2016

ESA

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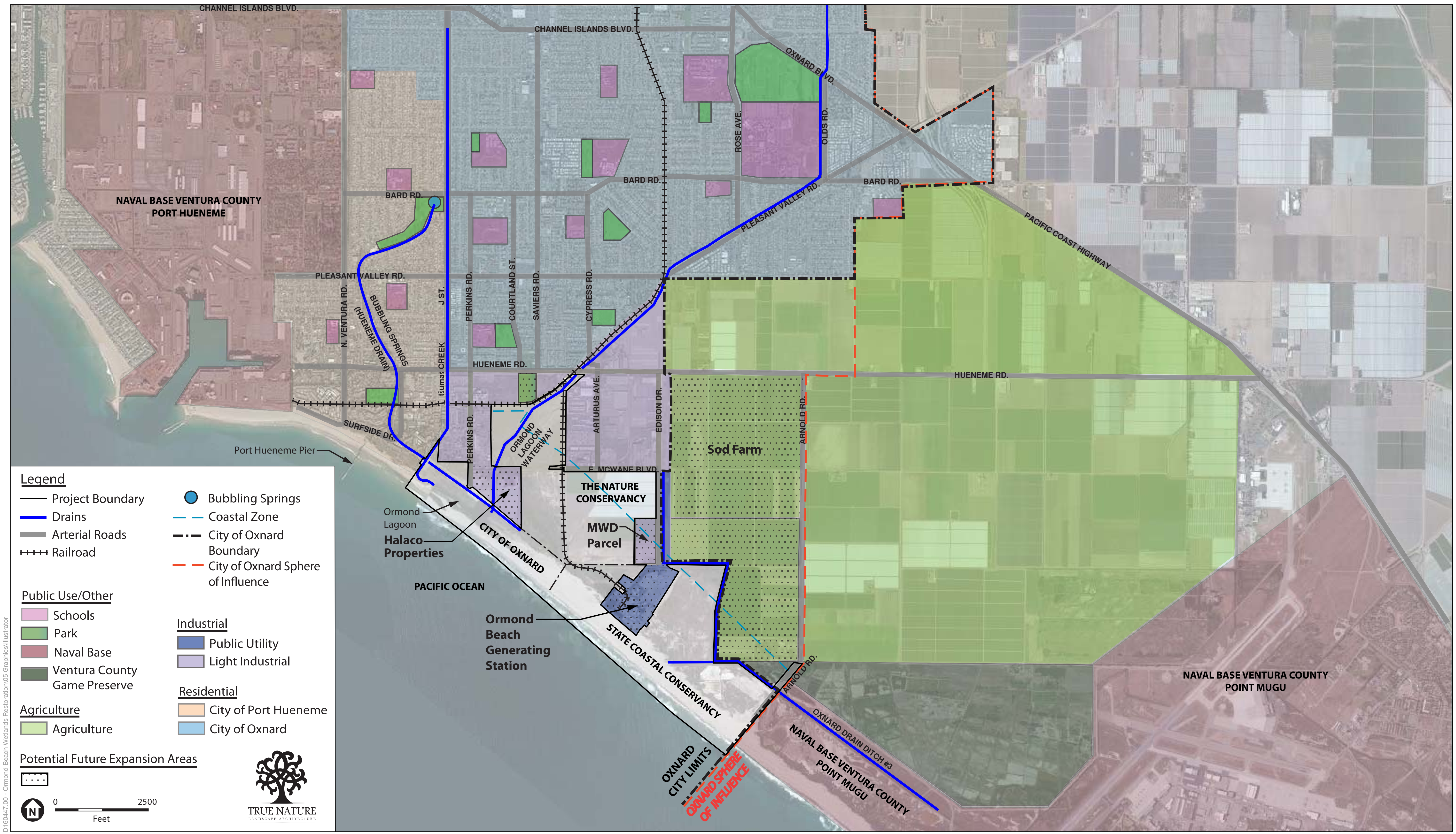
Figure 2-7
Topography- East Project Area



SOURCE: ESA, City of Oxnard 2030 General Plan (City of Oxnard 2011), Bing Maps, www.bing.com/maps

Figure 2-8
Project Area Land Use and Infrastruture

ESA

The EPA has not yet identified a plan or schedule, for cleanup of the site. EPA studies and planning are currently in progress. The Project Partners and EPA are working to coordinate OBRAP planning with Halaco Superfund Site cleanup to the extent possible.

Agriculture and Composting

The land between Edison Drive and Arnold Road to the northeast of the Project Area is largely agricultural with a smaller parcel for a composting facility (Figure 2-8). The agricultural land is owned and operated by Southland Sod Farms, which grows ten varieties of turf (Southland Sod Farms 2017). In the southeast corner, Agromin operates a composting facility, which converts almost 380,000 tons of recycled organic materials into compost, mulch, and other products annually (Agromin 2017). The two properties could be potential future acquisitions to the Project Area (Section 2.6), although the likelihood of acquiring them is not clear at this time.

Naval Base Ventura County - Point Mugu

Naval Base Ventura County (NVBC) Point Mugu is located southeast of the site (Figure 2-8). Per the NBVC Joint Land Use Study (JLUS) (Ventura County Transportation Commission and Matrix 2015):

> *Mission activities conducted on and from NBVC can generate potential impacts on surrounding community areas should incompatible land uses be allowed to develop… There are several elements that make up the mission footprint that extend outside the NBVC property boundaries.*

The NBVC Point Mugu and sea range footprint includes several elements listed below. These elements are described and their extents are mapped in the JLUS. The following list notes any overlap of the mission footprint with the Project Area.

- *Fixed-Wing Flight Tracks*: extends several hundred feet to the west of Arnold Road
- *Military Training Routes*: located in the northern portion of Ventura County outside of the JLUS study area and the Project Area
- *Imaginary Surfaces or height restrictions surfaces surrounding the runway*: an approach/ departure clearance surface extends over the Project Area. The surface slopes up from the runway by 1 foot for every 50 feet of distance from the runway, up to 500 feet. For reference, the OBGS smoke stacks are 12 feet below this surface (Navy staff, personal communication, May 2017).
- *Part 77 Vertical Obstruction Compliance*: in addition to the above, this element requires no vertical obstructions within certain height limits, which range from 200 to 300 feet over the Project Area.
- *Airfield Accident Potential Zones*: do not overlap with Project Area
- *Aircraft* Noise Contours: do not overlap with Project Area
- *Airspace Control*: includes the Project Area, but is not relevant to the OBRAP. (Note that airspace control is relevant to other airport operations)
- *Bird Air Strike Hazard (BASH) Relevancy Area*: the entire Project Area is within the BASH Relevancy Area and BASH is therefore a consideration for the OBRAP.

- *Sea Range and Special Use Airspace*: these areas are offshore and do not overlap with the Project Area.

In addition, the base requires safety zones/offsets for electromagnetic generation to avoid interference with base operations and explosive safety quantity distance arcs for ordinance/explosive ammunition storage. At this time, the electromagnetic radiation offset zone and explosive safety quantity distance arcs do not extend beyond the boundaries of the base at Arnold Road (Navy staff, personal communication, July 10, 2017). The base also supports sensitive wetland habitats and species, which are relevant to consider in the OBRAP.

The Navy has provided preliminary information indicating that the current Arnold Road parking lot is located on base property and is not compliant with base setback and clearance policies. There are concerns from the base regarding potential security issues from the Arnold Road parking. Further information is needed to confirm property ownership for the current Arnold Road parking lot.

Mugu Lagoon

Mugu Lagoon is located southeast of the Project Area (Figure 1-1). It has been relatively undisturbed due to protection by the U.S. Navy, and as a result, offers a local model for restoration. Additionally, Mugu Lagoon provides habitat in the area, which will be a source of plant material and wildlife for the Project Area. The arm of Mugu Lagoon that parallels the shore has a reduced tide range relative to the ocean, and the tidal response is very limited on the north side of the runway, at the boundary with the Project Area, due to additional conveyance restriction by culverts through the runway.

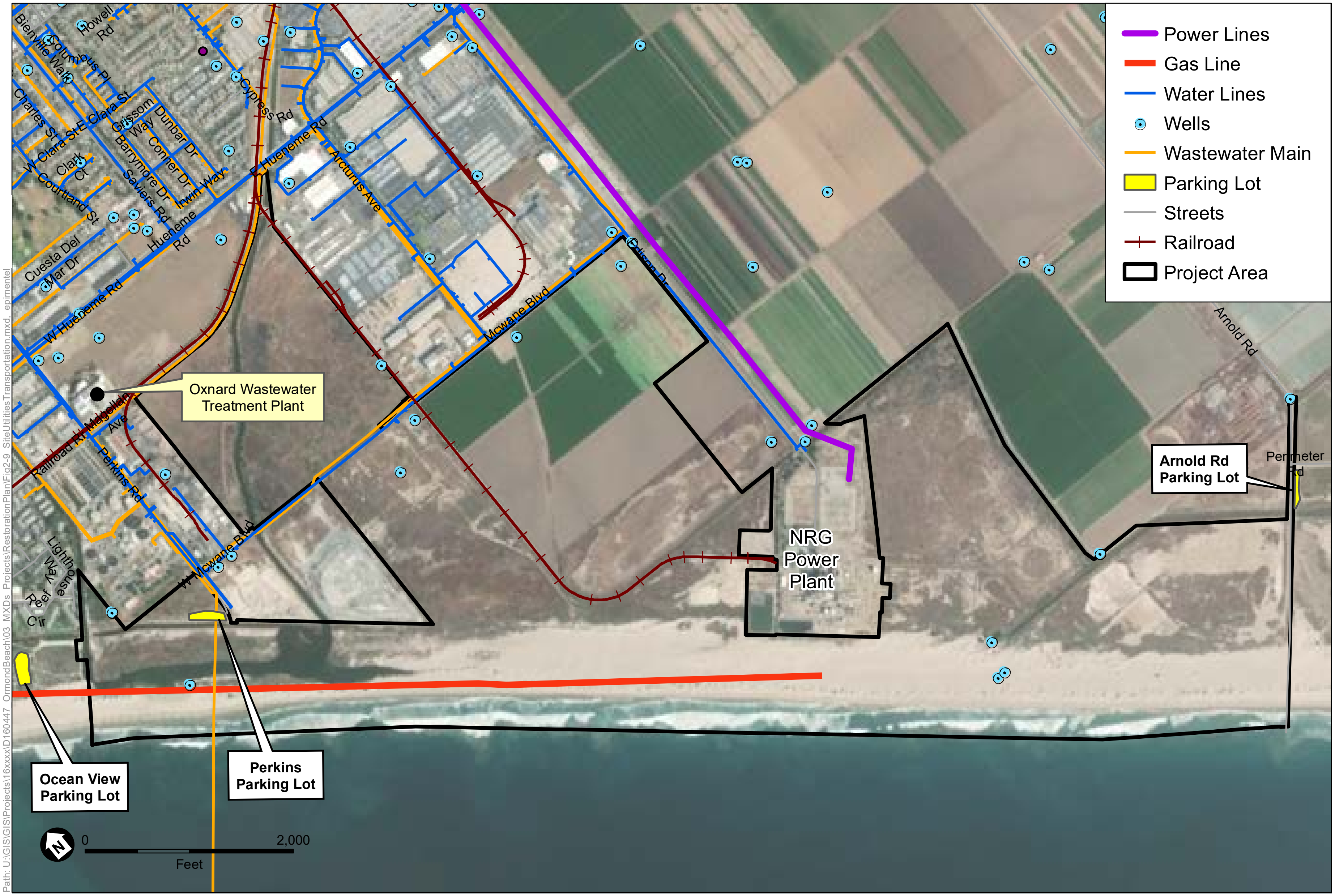
Public Utilities

Gas

The Southern California Gas Company maintains underground gas lines within the Project Area and surrounding area. Underground gas pipelines run along Edison Drive, McWane Boulevard (Blvd), and Perkins Road (Aspen 2009) (**Figure 2-9**). A petroleum pipeline owned by the Edison Pipeline & Terminal Company runs southeast from the eastern boundary of the Project Area parallel to the coastline towards the OBGS.

Electric (Ormond Beach Generating Station)

The Ormond Beach Generating Station (OBGS) and associated utility parcels are in the middle of the SCC parcel (Figure 2-8). The power plant is currently owned and operated by GenOn California South, GP (GenOn), having been owned originally by Southern California Edison, Reliant Energy, Inc., and then by NRG California South LP (NRG). The station is a natural-gas-fired steam electric generating facility with two steam turbine units, which have a generating capacity of 1,500 MW (Tetra Tech 2008). Such operations use ocean water in a single pass system (once-through-cooling or OTC) to cool steam for electricity production. The station operates one cooling water intake structure, which obtains water from the Pacific Ocean through a submerged intake conduit 1,950 feet offshore. Overhead power lines run from the station along the southeast side of Edison Drive (Figure 2-9).



SOURCE: Vivid, 2019, City of Oxnard, 2016; Ventura County, 2016; ESA, 2020

Ormond Beach Wetlands Restoration

Figure 2-9
Site Utilites and Transportation

ESA

In May 2010 the SWRCB adopted a Policy on the Use of Coastal and Estuarine Waters for Power Plant Cooling Policy (OTC Policy) to implement federal Clean Water Act Section 316(b) and reduce harmful effects of cooling water intake structures on marine and estuarine life. Power plant such as OBGS must either reduce intake flow and velocity (Track 1) or reduce impacts to aquatic life comparably by other means (Track 2). GenOn had planned to cease operations at OBGS prior to the December 31, 2020 compliance deadline.

However, the California Public Utility Commission has recommended the extension of OTC compliance deadlines for several stations including OBGS, in order to allow time for new clean electricity capacity to come online. In January 2020, GenOn and the City of Oxnard reached an agreement to extend the OTC compliance deadline to December 31, 2023, with the electricity revenues providing a source of funds to help with demolition and remediation. This plan was approved by the State Water Resources Control Board in September 2020.

Former Arnold Road Dump

The former Arnold Road Dump is a closed public disposal site located on SCC property at the terminus of Arnold Road with the Pacific Ocean. The dump was in operation from August 8, 1957 through March 7, 1960 and, because its period of operation occurred pre-regulation, there are minimal records and information on the facility. Though the exact footprint of the former waste disposal site is unknown, records estimate the Arnold Road Dump occupied approximately 30-acres in the southeastern portion of the Project Area (Diane Wahl, Ventura County Environmental Health Division, personal communication to Chris Kroll, SCC, February 17, 2017). The former dump site is within current dune and salt marsh/panne habitat where seasonal precipitation results in intermittent wetland and standing water.

Water and Wastewater

A 12-inch-diameter water line runs along McWane Blvd, extending west through the northern portion of the Project Area (Figure 2-9). A 16 inch-diameter water pipe runs north-south along Edison Drive on the eastern boundary of the Project Area. Wastewater pipes run along McWane Blvd, Hueneme Road, and along the Ventura County Railroad to the City of Oxnard Wastewater Division Treatment Plant. A 30–48-inch-diameter pipe runs from the Wastewater Division Treatment Plant into the ocean. There are nine water wells within the Project Area (Figure 2-9); however according to GIS data obtained from the County of Ventura, they are all inactive as of 2015.

Communication

Aboveground communication lines run along Casper Road, Arnold Road, McWane Blvd, Hueneme Road, and Edison Drive. Underground communication lines run along Arcturus Road and Perkins Road. Three parallel power lines originating at the OBGS run north along the east side of Edison Drive. Overhead power lines are also found along Hueneme Road, Perkins Road, Arcturus Road, Arnold Road, Casper Road, and McWane Blvd (Aspen 2009).

Railroad

The TNC parcel is bisected by the Ventura County Railroad, a short-line railroad serving industrial areas in the Port of Hueneme, South Oxnard, and the NBVC Port Hueneme (Figure 2-8 and Figure 2-9). One spur leads west to the NBVC Port Hueneme, and the other leads south and east toward the OBGS. Rail cars carrying motor vehicles frequently park on the spur crossing East McWane Blvd. These lines do not have passenger routes. The closest passenger rail line is the Metrolink Station located at the corner of Saviers Road and 4th Street, and the Oxnard Transit Center, located approximately 3.6 miles to the north of the Project Area.

2.3.3 Public Access

Roads

Roads within the OBRAP vicinity include Bluewater Way, Perkins Road, Arcturus Road, Hueneme Road, McWane Blvd, Edison Drive, and Arnold Road (Figure 2-8 and Figure 2-9). Arnold Road is located at the southern boundary of the Project Area, next to the NVBC Port Mugu. Arnold Road is a narrow, one-lane road that is poorly paved with little maintenance and subject to truck traffic.

Parking

The majority of the transportation in the vicinity of the OBRAP is via automobile, yet access to the OBRAP site via automobile is limited to two locations: Perkins Road and Arnold Road (Figure 2-9).

The Perkins Road parking lot is a small 50-stall lot located at the dead-end cul-de-sac of Perkins Road, adjacent to the Halaco Properties. The lot is elevated and does afford some ocean views over the coastal dunes. A series of trails and a small footbridge crosses Hueneme Drain and leads to an island in the Ormond Lagoon. The Perkins Road parking lot is also located adjacent to a small garden with signage and trails; however, the area has a locked entry. Trails also lead to the north, but dead end in the tšumaš Creek.

At the end of Arnold Road is a small, 20-stall parking lot, located along the NBVC Point Mugu fence. As noted above, the current Arnold Road parking lot is located on base property and is not compliant with base setback and clearance policies, which call for a 20-foot unobstructed zone at the fence line for security purposes. The lot is subject to flooding. The Arnold Road access point currently is isolated beyond agricultural fields, the Agromin composting facility, the game preserve, and NBVC Point Mugu.

Public Transit

Gold Coast Transit provides public bus transportation through the Oxnard and Port Hueneme area. There is bus service from neighborhoods such as northwest Oxnard, northeast Oxnard, and south and central Oxnard, but it requires up to three buses and over two hours to reach the beach at Port Hueneme. The majority of bus service adjacent to the Project Area is focused to the north and northwest of the site. There is only one bus stop at the corner of Hueneme Road and Perkins Road, which requires a 0.6-mile walk along Perkins Road, to the Perkins Road parking lot. The road is currently unattractive and many public respondents reported feeling unsafe in this area. There is a gap in bus service to the central south Oxnard area, with bus lines only on Saviers Road and across Pleasant Valley Road, leaving few options for residents without cars to access and take a bus to the Project Area. There are no bus routes to Arnold Road. There is bus service to Hueneme beach and pier, and it is possible to walk to the beach approximately 0.5 miles to reach the Project Area. The managed Ormond Lagoon breach location is located at this point, which means that this access route is only available when the lagoon is not breached.

Bicycles

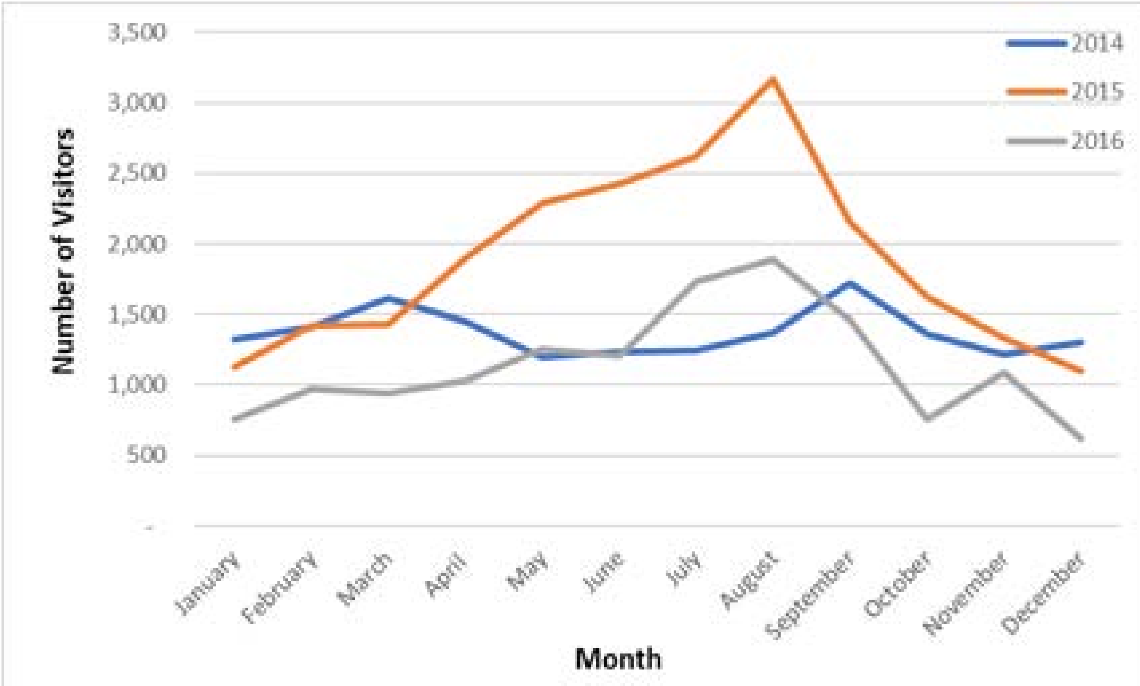
The Oxnard area has a number of planned and future bike routes. Many of the existing bicycle routes are located along arterial roads, including J Street and Saviers Road. These two routes pass by the northernmost point of the TNC parcel at Hueneme Road. The City of Oxnard Bicycle and Pedestrian Master Plan 2011 identifies the Beach's west end, near Perkins Road, as an "attractor" for bicyclists and pedestrians (Map 4-7: Bike and Pedestrian Attractors Model, City of Oxnard Bicycle and Pedestrian Master Plan) and has policies in support of bicycle use. Future planned bicycle routes are proposed mostly to the northwest of the Project Area. The County of Ventura General Plan and Coastal Trail Plan proposed alignment of a portion (Segment C2) of the California Coastal Trail along Hueneme Road north of the site, and identifies a potential pedestrian spur (Segment C2-A) leading down to the Beach roughly parallel to Arnold Road, subject to the OBRAP planning process. Two proposed Class A bike routes aligned with Hueneme Drain and tšumaš Creek could lead to the Project Area in the future, via the Port Hueneme Beach. Another proposed future line is aligned with the railroad line, along the north side of the TNC property. There are currently no Class A or other formalized bike paths to the site.

Visitor Use

Historical public access data for the Project Area is available through visitor logs kept by Walter Fuller at the Arnold Road access point from 2014–2016 (**Figure 2-10**). The data identifies the total number of monthly visitors encountered by Mr. Fuller, but does not necessarily identify all visitors to the Arnold Road, or the Project Area. The summarized data does not include a break-down of visitor activity, such as surfing, birdwatching and hiking. The greatest number of visitors were documented during July-September (range 1,243 to 3,163 visitors per month). Total number of visitors logged were 16,434 in 2014, 22,575 in 2015, 13,714 in 2016, and 15,580 in 2020 (W. Fuller, unpublished data).

The City of Port Hueneme records public access through the number of daily parking passes that are purchased at the Port Hueneme Beach parking lot. In July 2017, 16,400 daily passes were purchased, while 9,700 passes were purchased in August 2017. Local residents hold an additional 500 yearly passes that are not tallied in the daily passes count.

Additional information was solicited from community members regarding existing conditions, uses, and access. Project Partners held a public meeting on June 21, 2017 included a presentation, a survey on the SCC website, and small group table discussions in a workshop setting. Additionally, in July 2017 the Central Coast Alliance United for a Sustainable Economy (CAUSE) conducted a survey in South Oxnard to target Spanish- and Mixteco-speaking populations who did not attend this public meeting. (A second public meeting was held July 31, 2019, and CAUSE held focus groups in South Oxnard, to obtain input on the design alternatives.



SOURCE: W. FULLER 2016 Ormond Beach Restoration and Public Access Plan

Figure 2-10
Monthly Visitors Log at Arnold Road

Common responses regarding what things people like most about Ormond Beach, or the main characteristics of Ormond Beach, include love of the beach, birds, nature, solitude, open space, dunes, and undeveloped natural setting. The natural state of the site and uncrowded, natural characteristics of the native habitats are appealing.

Popular activities include walking (by far the most popular), bird watching, and viewing and enjoying nature. Other activities include observing animals and dolphins, educations, identifying plants, fishing, picnics, swimming or surfing, and relaxing enjoying the solitude of the beach. Workshop participants indicated on maps what activities they like to do and where they do them (**Figure 2-11**). Use appeared concentrated at Arnold Road and near Perkins/Hueneme Beach, with gaps of use in the more isolated center part of the beach. Based on use, it would appear that some visitors are accessing the beach near the OBGS, or they are walking from Arnold Road down the beach to the OBGS area. Additional activities, like hiking and bird watching, seem popular in the TNC parcel.

During July 2017, CAUSE conducted an in-person, door-to-door survey in the respondent's native language (Spanish, English, Mixteco) to collect information on the OBRAP. The CAUSE survey of 322 residents focused on seven neighborhoods with low-income residents of the South Oxnard neighborhoods east of J Street between Hueneme road and Pleasant Valley Road, directly north of the Project Area. The majority of respondents have never been to the Beach because they did not know it was there, although it is only one mile south of their homes. About half of the respondents visit the Beach, mostly less than five times per year.

Overall public feedback from the 2017 meeting, questionnaires and surveys indicates that most access is currently occurring from Arnold Road and Hueneme Beach Park, and use is concentrated along the Beach. Many respondents indicated that they are currently accessing the TNC property, but it was not clear if that access is sanctioned under TNC-led tours or if it is occurring by trespass. Many participants expressed safety concerns with the Perkins Road access point, and many female participants indicated that they would not consider going to the Project Area alone at Perkins Road. Many workshop attendees noted that they currently reach the Beach utilizing a car.

Many people surveyed, particularly those living closest to the area, were not aware of Ormond Beach or did not go to Ormond Beach even though they would like to because of difficulty accessing the area. They also said they did not go to Ormond Beach because of the industrial facilities, trash in the area, or what they considered a dangerous atmosphere. Homeless encampments at Ormond Beach have been increasing in recent years in the areas near Perkins Road, the dunes near the lagoon, and the Halaco Superfund Site. Issues include safety of visitors, health and safety of encampment residents, and environmental impacts from disturbance of vegetation and nesting birds, waste disposed in the dunes and lagoon, and disturbance of the contaminated wastes beside the Halaco slag pile.

2.3.4 Hydrology and Water Quality

This section describes the water bodies and key features of hydrology and water quality at the Project Area. Additional detail on field data collection in 2017 and discussion of physical processes shaping the landscape and biological communities is provided in Appendix B.

Water Bodies

The Project Area has four surface water drainages running through it (Hueneme Drain, tšumaš Creek, OLW, and Oxnard Drainage Ditch #3), tile drains on the agricultural fields, the Lagoon, the Pacific Ocean with the Beach along its border, and groundwater underlying it (Figure 2-1).

The Hueneme Drain, also referred to as the Bubbling Springs Drain, is fed by a natural spring (Bubbling Springs) and urban runoff from 610 acres within the City of Port Hueneme. Although the channel bottom is soft, its banks are lined with rip-rap or grouted rip-rap. The freshwater introduced to the surface via Bubbling Springs has a greater influence on surface hydrology during the summer and fall months when precipitation and runoff are absent (PWA 2007). The VCWPD pumps water from Hueneme Drain into tšumaš Creek where it joins the lagoon.

tšumaš Creek was constructed in 1960 to alleviate flood hazards and is fed by urban runoff from approximately 1,340 acres of residential areas in central Oxnard. When it was constructed, it was called J-Street Drain. The entire length of the channel upstream of the Hueneme Pump Station is lined with concrete (PWA 2007) and was renovated and widened in 2015 from the outlet to Hueneme Road in order to convey more water below flood stage.

Local residences of Oxnard and other parts of Ventura County currently visit the site for a variety of recreation and educational uses. Activities are typically concentrated near the limited existing parking lots and beach access, particularly at Arnold Road.

SOURCE: Bing Maps, www.bing.com/maps
OBRAP Public Meeting #1

Figure 2-11
Existing Visitor Access & Uses

ESA

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The OLW, formerly known as the Oxnard Industrial Drain, conveys runoff from industrial and agricultural areas on the east side of the City of Oxnard, and has the largest total watershed area (5,935 acres). The OLW channel is lined along its entire length, except for the section that begins approximately 500 feet downstream of Hueneme Road on TNC property. The drainage passes along the Halaco property and can transport contaminants to the lagoon.

The Lagoon stretches approximately 0.5 mile from tšumaš Creek to OLW (Figure 2-2) and is formed by stormwater draining to and ponding behind the dunes. The lagoon can become connected to the ocean following large rain events. Much of the year, the lagoon is maintained several feet higher than the Pacific Ocean by the naturally occurring beach berm. Groundwater contributions to the Lagoon are more likely in the winter/spring season when the water level is low and breaching conditions exist. In the summer/fall, groundwater tends to flow generally northward and inland (see Groundwater section below). VCWPD grooms the berm between the lagoon and the ocean to allow for natural breaching of the lagoon berm during storm events (VCWPD 2016, 2017).

Oxnard Drainage Ditch #3 (ODD #3) is under the authority of the Oxnard Drainage District No. 2.[8] It drains roughly 4,000 acres in two separate subwatersheds that are divided by Arnold Road. Agricultural fields on the surrounding Oxnard Plain drain into ditches, which then discharge to ODD #3.

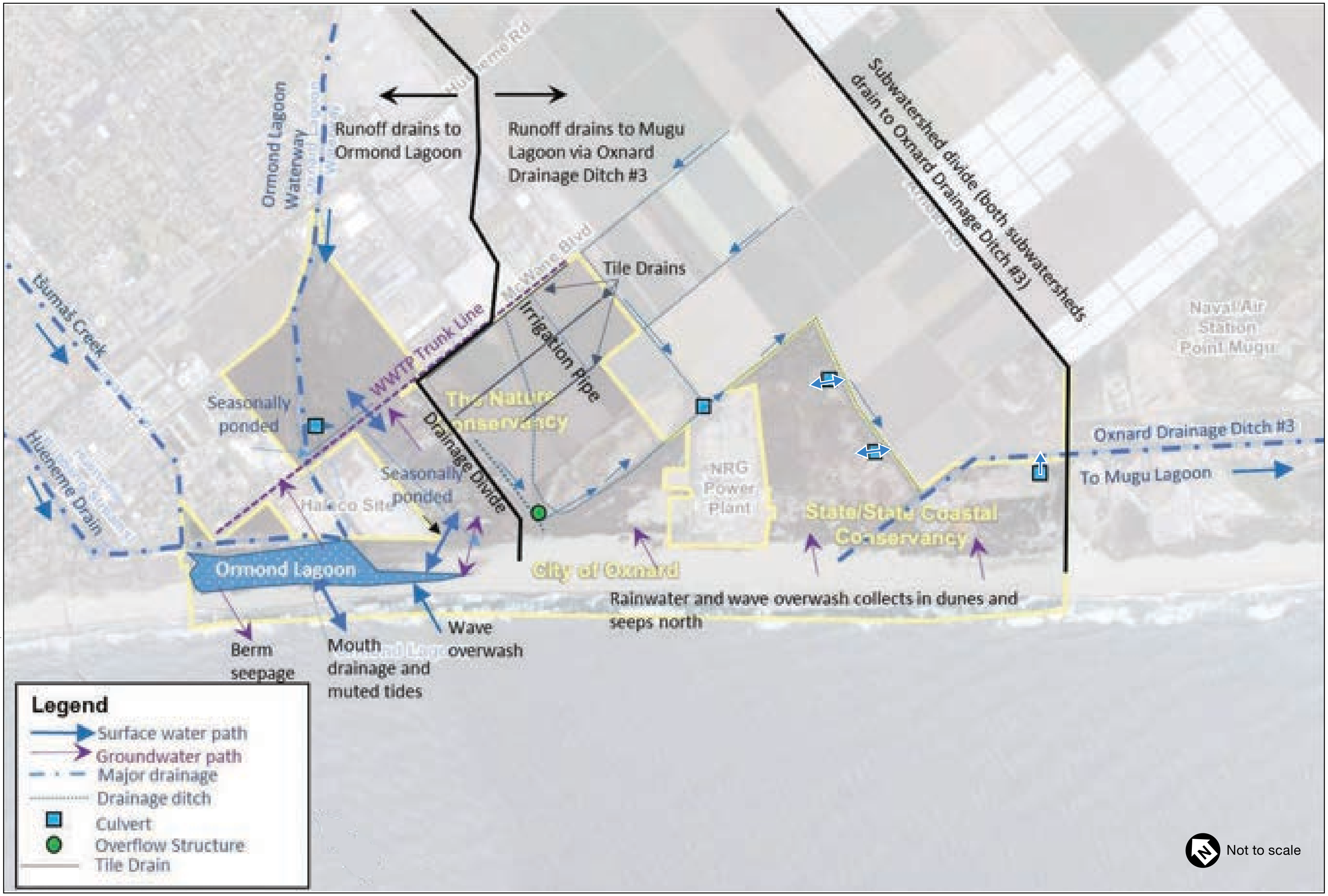
Tile drains located on the agricultural fields drain the fields to the surrounding ditches.

Runoff and Drainage

Water sources include rainfall, freshwater runoff, groundwater, wave overwash, and limited tidal inputs. A drainage divide bisects TNC parcel, with runoff in the western area of the Project Area (Areas 1 and 2) draining to OLW and Ormond Lagoon, as well as water flowing the opposite way, from OLW to Area 2 (**Figure 2-12**). The central area of the site (Areas 3 and 4) drains east to ODD #3, which drains to Mugu Lagoon through tide gates via the Navy Base. Area 3a can also be connected with Area 1 at high water stages, and likely via groundwater as well, in both directions (from lagoon to Area 3a and vice versa, depending on relative water levels).

Hydrologic conditions in the west area (Figure 2-5) are dominated by the surface drainages and lagoon dynamics. Freshwater runoff is quickly routed to the Ormond Lagoon via the channelized drainages of OLW, tšumaš Creek and Hueneme Drain. When the lagoon mouth is closed, the ponded water backs up into tšumaš Creek and OLW, and typically spills east and north into the TNC parcel Areas 2 and 3a (EPA 2008; CH2M Hill 2012). When large swell waves build a high

8 Oxnard Drainage District No. 2 operates surface and subsurface agricultural drainage systems east of the City of Oxnard. Historically, the water table in the Oxnard Plain was sufficiently high to prevent agricultural development (Ventura Local Agency Formation Commission 2005). Districts were formed to install and operate clay or tile pipe drainage systems to allow lands to be tilled. Oxnard Drainage District No. 1 was formed in 1918, and Oxnard Drainage District No. 2 was formed in 1926. There was an Oxnard Drainage District No. 3 formed in 1937, but because most of the territory in its boundaries had been developed for urban uses that District was dissolved and its remaining agricultural lands were merged into Oxnard Drainage District No. 2 in 1984. This district is also known as Oxnard Drainage District 2/3.



SOURCE: ESRI 7/19/2016, PWA (2007), CH2M Hill (2008, 2012), HDR (2008a)

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Figure 2-12
Schematic of Surface and Groundwater Flow Paths through the Project Area

ESA

beach berm, as on January 18, 2010, trapped runoff can flood developed areas further upstream (VCWPD 2010). When the mouth breaches and the lagoon drains, water is trapped in the TNC parcel as seasonal ponds. The mouth may remain open for several weeks, allowing muted tides to enter the lagoon, but the tide levels are several feet lower than the surrounding area. In these conditions, TNC parcel and portions of tšumaš Creek and OLW are hydrologically disconnected from the lagoon.

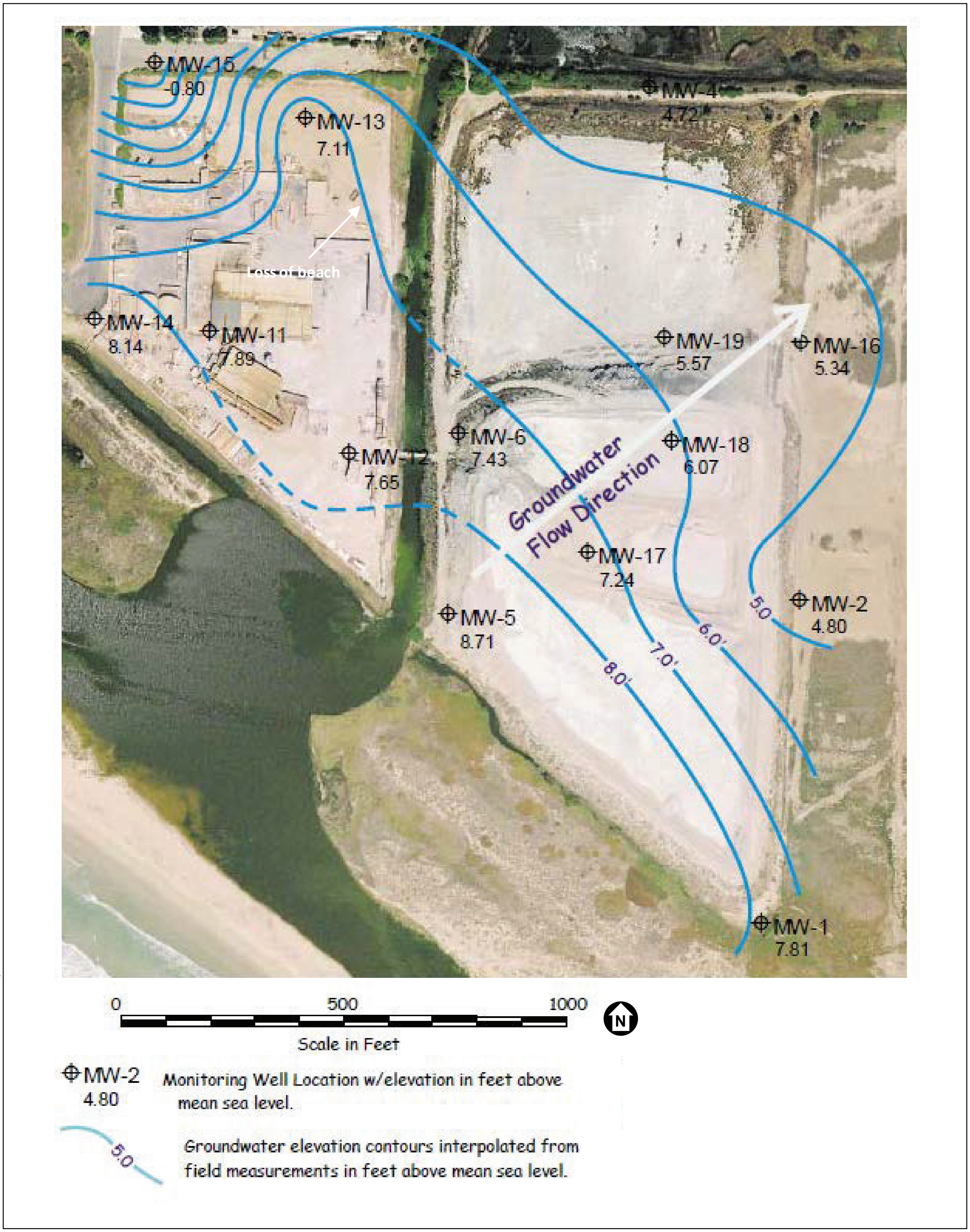
Runoff from the central area (Figure 2-6) drains from Areas 4 and 3b southeast to Mugu Lagoon via ODD #3. The eastern area (Figure 2-7) also drains to ODD #3. High rainfall on the agricultural lands draining to ODD #3 can sometimes overwhelm the drainage ditches and cause flooding, as seen in 2017 around Arnold Road. The leaky flap gate connecting Mugu Lagoon to ODD #3 connects muted tides (very small tide range) to the salt marsh, open water, and salt panne areas east of the SCC parcel. Water from ODD #3 does not typically flow into the Project Area, but the salt panne in the SCC parcel (Area 5) drains into the ditch.

Groundwater and Surface Water Levels

Shallow groundwater levels are seasonally dynamic, responding quickly to precipitation and runoff, and are affected by adjacent surface water levels in drainage channels, Ormond Lagoon, and the ocean. Water levels within the upper semi-perched aquifer fluctuate from a few feet below the surface at the end of the rainy season to about 10 feet below the surface by late fall (PWA 2007; United Water Conservation District [UWCD] 2018). Near the lagoon, groundwater tends to move northward away from the coast, even when the lagoon is open and lagoon water levels are low (**Figure 2-13**) (CH2M Hill 2008, 2012). Groundwater near OLW (monitoring well located near Hueneme Road, near the north end of Area 4) appears to be elevated due to the high water in OLW (UWCD 2018). Under the surface of the beach, groundwater responds to oceanic tide levels (PWA 2007). Dunes fronting TNC and SCC parcels are likely to absorb rainwater and wave overwash, and allow seasonal seepage of fresh or brackish groundwater toward seasonally ponded or salt panne areas immediately landward.

Groundwater and surface water levels were monitored during May to December 2017 at locations shown in **Figure 2-14**. The 2017 data were reviewed relative to prior studies and other available data, including recently collected data for a location close to OLW and Hueneme Road, near the north end of Area 4, which was provided by UWCD (UWCD 2018). These new data are generally consistent with prior data and findings, but also raise questions regarding groundwater dynamics and connectivity.

On the west side of the site, the groundwater elevations slope up to intersect with the Ormond Lagoon surface water level, which was 6.5 feet NAVD88 at its lowest observed level. In contrast, the shallow groundwater level adjacent to OLW is several feet lower. This description is consistent with groundwater data near the north limit of Area 4, near OLW and Hueneme Road, which shows elevations generally between 2 feet and 6 feet NAVD88, but reaching as low as 0 feet at times (UWCD 2018). This suppressed groundwater level has been attributed to infiltration into a wastewater trunkline buried below McWane Blvd. (CH2M Hill 2008, 2012), which implies that groundwater may depend partly on treatment plant operations, which may



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SOURCE: CH2M Hill (2008)

Figure 2-13
Groundwater Contours 2006

Path: U:\GIS\GIS\Projects\16xxxx\D160447_OrmondBeach\03_MXDs_Projects\March2019_FigureUpdates\Fig2-10_GageLocations.mxd, hmiller 3/20/2019

SOURCE: ESRI, City of Oxnard, Ventura County

Ormond Beach Restoration and Public Access Plan

Figure 2-14
Water Level and Groundwater Guage Locations, and Survey Transects

ESA

affect the flow in the culvert and the rate of groundwater infiltration. The UCWD data show water levels consistent with the OLW–Ormond Lagoon elevations except in the early 1990s and since 2015 when lower levels were recorded (UWCD 2015). The Ormond Lagoon and OLW water levels were similar during the 2017 monitoring period (**Figure 2-15**). These conditions are consistent with the dry season, whereas the wet season water levels have a greater range due to increased water inflows and breached mouth conditions. Groundwater levels measured between Ormond Lagoon and Area 3a, to the south of the Halaco slag pile (line labeled "Near Ormond Lagoon GW[9] [EPA]") show a close correlation with the lagoon; the pattern suggests flow from the Ormond Lagoon "backwater" into Area 3a with the flowrate increasing with surface connectivity especially above elevation 7 feet NAVD88.

In stark contrast is a groundwater level north of the Halaco pile (labeled "MW-32C GW") that is approximately 2 feet below the adjacent OLW surface water level, but is also correlated and indicating flow from the higher surface water to the groundwater. Farther north, lower groundwaterlevels were recorded during 2017, mostly between elevations 0 and 3 feet NAVD88, which is about 3 feet lower than MW-32C GW.

On the east side of the site (Area 6), groundwater elevations are interpreted to slope gently upward from the ocean's mean tide level (2.7 feet NAVD88), and vary from 3.2 to 4.3 feet NAVD88, as confirmed by June–December 2017 observations at the end of Arnold Road (Figure 2-15). Of interest, the groundwater levels in Area 6 (labeled "Arnold Rd. GW") fluctuated more than the surface water in nearby ODD #3. The groundwater fluctuations had a periodicity similar to the spring-neap tidal cycle, indicating an effect of the ocean tides. The limited fluctuations in the ODD #3 levels is associated with limited connection to Mugu Lagoon due to the constrained geometry of culverts and canals on the Navy Base.

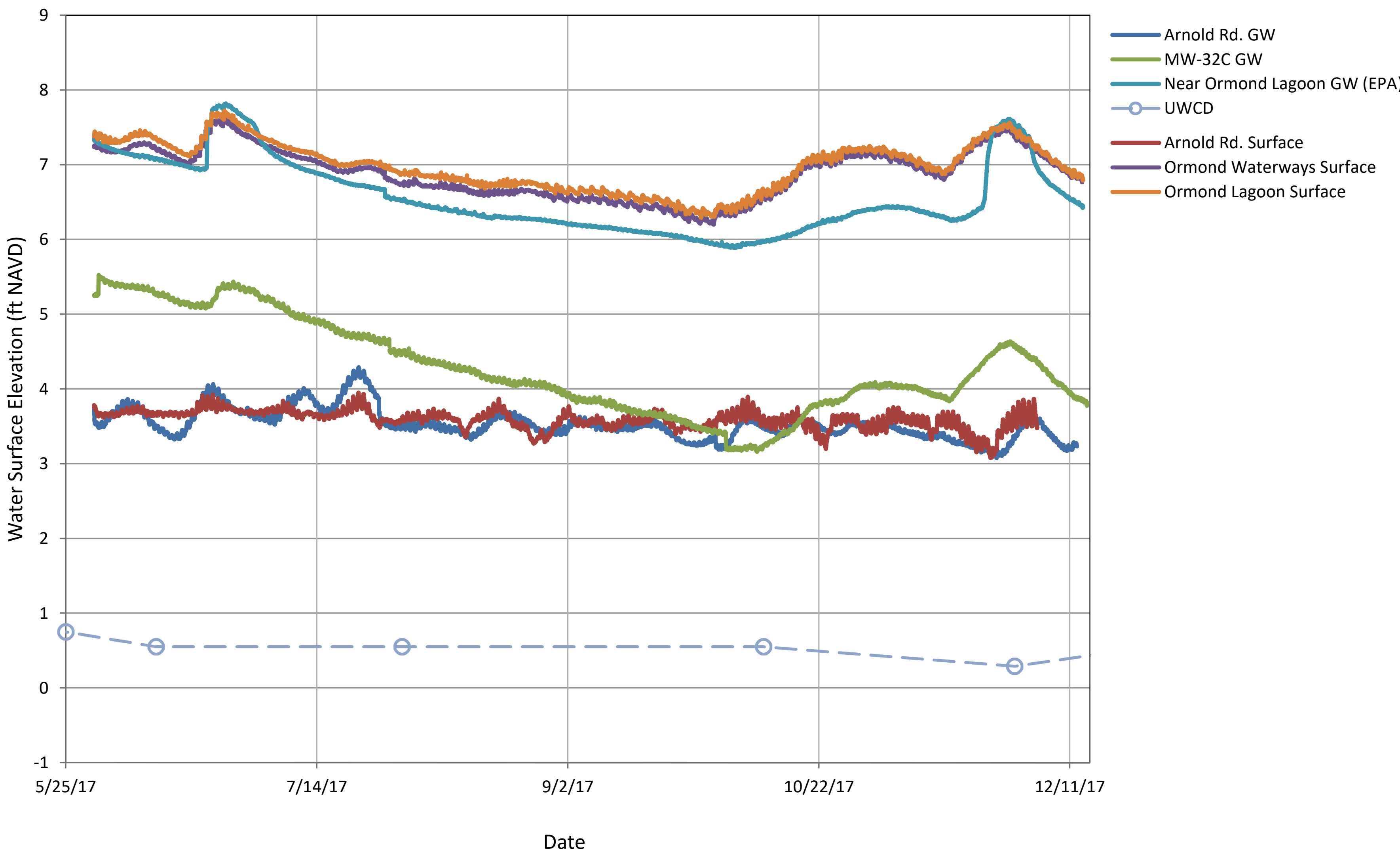
Salinity

Salinities were monitored during May to December 2017 at the same locations of water level monitoring (Figure 2-14). **Figure 2-16** presents the salinity time series. Also, water level and salinity were provided by the UWCD for a location close to OLW and Hueneme Road, near the north end of Area 4 (UWCD 2018).

Water levels and salinity are key drivers of coastal habitats. By definition, high soil moisture, either seasonal or perennial, drives wetland formation. High soil salinities due to regular influx of saltwater or concentration due to evaporation have resulted in salt marsh and salt panne habitats. Lower ground and/or water salinities have resulted in brackish marsh within the site. Changes in salinity in Areas 3a and 2 are attributed with a recent (last decade) conversion of salt marsh to brackish marsh.

Salinity data are more complex and interpretations are limited by the extent of available data, both in space and time (Figure 2-16). The salinity in the groundwater near Ormond Lagoon (13 to 17 parts per thousand [ppt]) was much higher than the surface salinity in the lagoon (mostly

9 The label GW on Figure 2-12 means "groundwater."



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SOURCE: ESA Water Level Gauges UWCD Groundwater Well

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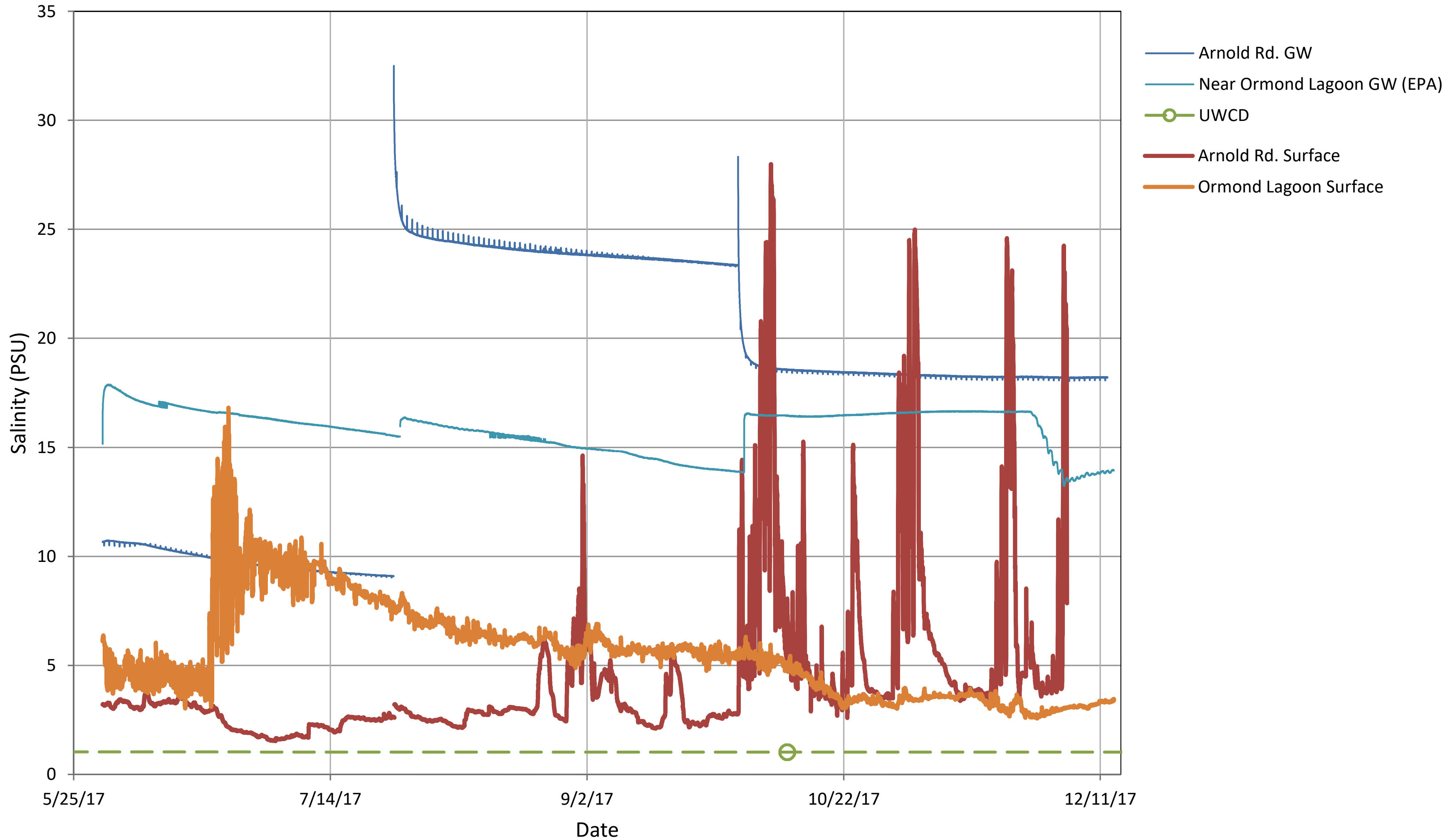
Figure 2-15
Water Levels

ESA



D160447.00 - Ormond Beach Wetlands Restoration\05 Graphics\Illustrator

SOURCE: ESA Water Level Gauges UWCD Groundwater Well

Ormond Beach Restoration and Public Access Plan

Figure 2-16
Salinity

ESA

3 to 10 ppt) except for a spike in lagoon salinity reaching about 17 ppt. These data imply that the lagoon salinity is affected by wave overtopping, likely higher at depth, and that groundwater salinity is not driven by lagoon surface salinity. Salinity of groundwater at SW-65 was very low, less than 2 ppt, which is nearly freshwater. For reference, the average ocean water salinity is 35 ppt.

Continuous salinity observations in the east near ODD #3 recorded different values and patterns than in the western area, described above. For example, the highest Ormond Lagoon surface salinity was less than the highest ODD #3 surface salinity, and the seasonal patterns are very different. Peak salinity of about 17 ppt occurred in the lagoon in June, probably as the result of wave overwash. The salinity then gradually decreased over subsequent months to a minimum below 5 ppt as inflow from the watershed freshened the lagoon. In ODD #3, the opposite seasonal trend occurred, with salinity starting below 5 ppt from June to August, then salinity increasing in September in a series of pulses that peaked at about 25–27 ppt. The groundwater salinity in Area 6 remained in the salty range (18–33 ppt), with spikes in the record indicating stratification being mixed during instrument disturbance. The groundwater salinity and nearby surface salinity are not positively correlated.

The lack of flowrate data for the western drainage channels inhibits our understanding of seasonal salinity in OLW and Ormond Lagoon. Absent information about irrigation practices in the ODD #3 watershed, the cause of these fall salinity peaks is not clear. While evaporation is a driver of increased salinity, changes in runoff and backwater from Mugu Lagoon may also have effects on salinity in ODD #3.

Additional salinity measurements were taken manually during occasional site visits. The data support the use of vegetation as an indicator of salinity. A salinity gradient exists across the site; 2017 salinity measurements were lowest in the northwest on TNC parcel in Area 2 (6 ppt in March to 16 ppt in late May), increasing toward the center in Areas 3a and 3b (5 ppt in March to 37 ppt in early June), and greatest in the east on the SCC parcel, Areas 5 and 6 (20 ppt March to 81 ppt late May).

Shallow basins in the southeast and center retain water from rainfall or waves overwashing the dunes during winter storms. The ponded water then evaporates during warmer months, creating hypersaline soils. Shallow brackish or salty groundwater and low-permeability soils can result in evaporation-driven concentration of salts in the surface soils. Data collected in Area 6 by U.S. Fish and Wildlife Service (USFWS) (WRA 2000) show correlation between salt marsh and salt pannes habitats and surface soil parameters (elevation relative to groundwater, texture, and salinity).

Water Quality

Halaco Superfund Site

The EPA designated the Halaco properties and surrounding contaminated areas (including portions of TNC property (Area 3a), the OLW, and the Ormond Lagoon area) as a Superfund Site in 2007. Testing by the EPA in 2009 and 2010 showed that soil, sediments, and groundwater have been contaminated by Halaco’s wastes (EPA 2011, CH2M Hill 2012).

The EPA completed a Baseline Ecological Risk Assessment Remedial Investigation for the Halaco Superfund Site (“Ecological Risk Assessment”) (CH2M Hill 2015). Metal concentrations are high around the edge of the slag heap and medium in portions of the TNC parcel (Area 3a) and Ormond Lagoon (**Figure 2-17**). Constituents found at elevated levels included aluminum, barium, beryllium, cadmium, chromium, copper, lead, magnesium, manganese, nickel, and zinc. **Figures 2-18a-c** show the relative ecological risk for soil/sediment at the surface (Figure 2-18a), 2-foot depth (Figure 2-18b), and 4-foot depth (Figure 2-18c). Note that the extent of sampling at 4-foot depth (Figure 2-18c) was less than sampling at the surface and at 2-foot depth (Figures 2-18a and b). The risk categories were defined as follows:

> “Category 0 samples had no exceedances and concentrations pose no risk to ecological receptors. Risks to ecological receptors cannot be excluded in Category 1 samples; however, uncertainties associated with [nondetects] and benchmarks suggest risks at these locations are de minimis. Risks in Category 2 samples are limited to one or two analyte-receptor combinations, and in terrestrial areas are limited to exceedances by plants; therefore, these risks are considered to be low. In comparison, risks for Category 3 samples are considered moderate (generally 2 or more receptors and analytes with exceedances), and those for Categories 4 and 5 are considered relatively high compared to other locations as there are multiple analytes and receptors with exceedances.” (CH2M Hill 2015)

According to this Ecological Risk Assessment, surface soil/sediment pose medium to high risks to ecological receptors in portions of the marsh on the TNC parcel (Area 2 south and Area 3a), and Ormond Lagoon. At 2-foot soil depth, the extent of medium to high risks is reduced. Limited sampling at 4-foot soil depth identified medium to high risks at two sample locations along the southern edge of the slag heap. However, Areas 2 and 3a were not sampled at 4-foot depth.

The Ecological Risk Assessment further concludes:

- “No risks were identified in surface sediment samples [in open water areas of Ormond Lagoon] … Additionally, there are no risks, except for one sample with a Category 2 ranking, in the 4-foot [depth]… In contrast to other areas of the Site, risks for the [Ormond Lagoon open water areas] increased from the surface to the 2-foot [depth] samples (Figures [2-17a] and [2-17b]. In this case, the contaminated sediments appear to have been buried by cleaner sediment at the surface…
- Aluminum, arsenic, cadmium, cobalt, silver, thallium, and dioxins/furans do not present a risk at the Site. Mercury in Halaco wastes does not appear to be different from the background level; thus, elevated mercury onsite is not likely site-related…
- Field surveys evaluating abundance and/or breeding success provide strong evidence that Belding’s savannah sparrows, western snowy plovers, and California least terns nesting at Ormond Beach are not adversely affected by contamination at the Halaco Site (see Section 2.8.5 for data sources and analyses). The level of confidence in this conclusion is relatively high because it is based on site-specific data.”

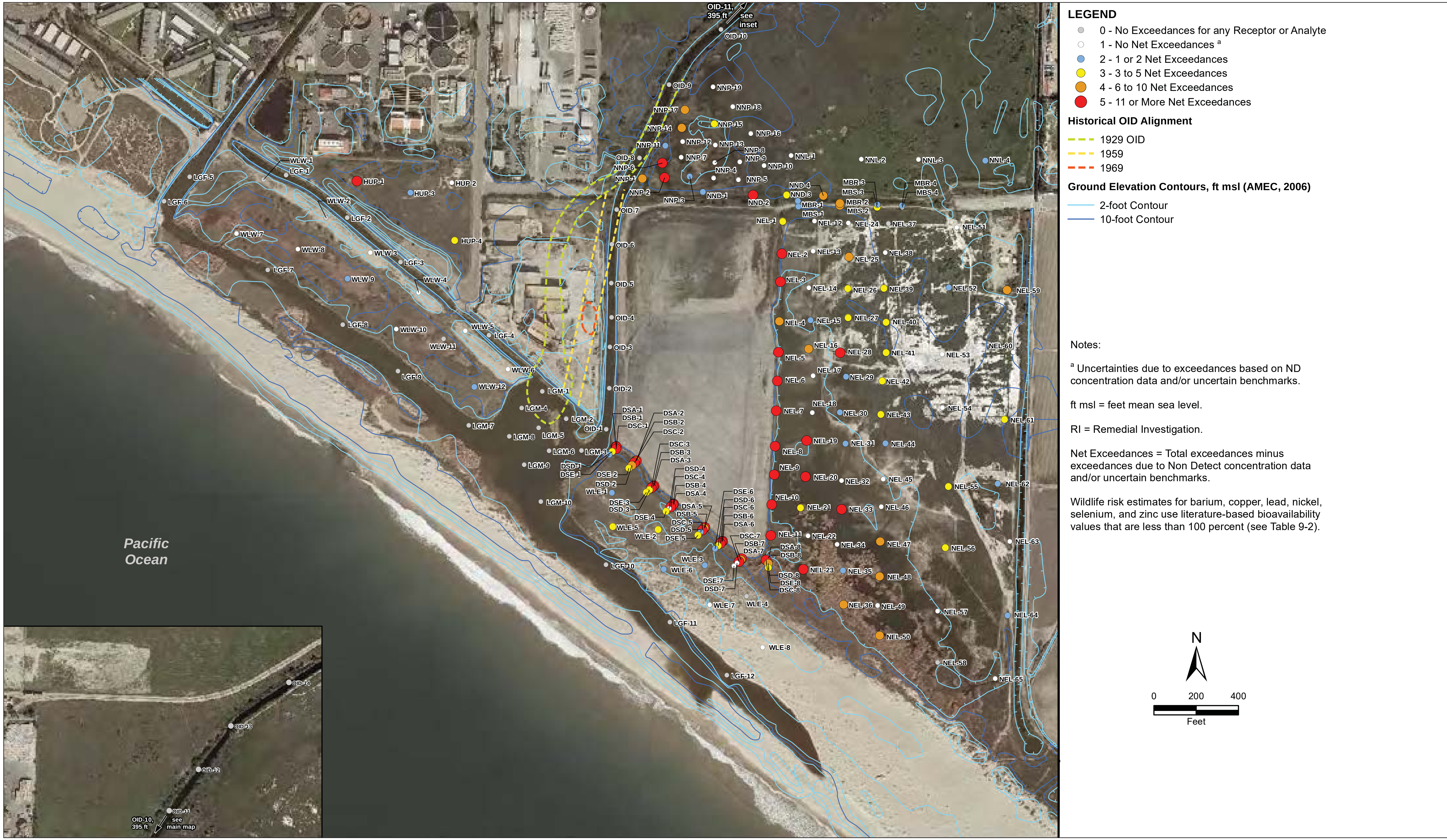
Risks identified for surface water exposures to aquatic biota, including tidewater goby, were not considered to be Halaco site-related. However, it was noted that contaminants found in surface water may originate elsewhere in the watershed, and fish are likely averaging concentrations across a range that likely includes areas outside of the Halaco Site (CH2M Hill 2015).

SOURCE: CH2M Hill 2015

Ormond Beach Restoration and Public Access Plan

Figure 2-17
Tier 2 Biological Sample Locations

ESA



SOURCE: CH2M Hill 2015

Ormond Beach Wetlands Restoration

Figure 2-18a
Relative Ecological Risk for Soil/Sediment, Surface

ESA

LEGEND

- 0 - No Exceedances for any Receptor or Analyte
- 1 - No Net Exceedances [a]
- 2 - 1 or 2 Net Exceedances
- 3 - 3 to 5 Net Exceedances
- 4 - 6 to 10 Net Exceedances
- 5 - 11 or More Net Exceedances

Historical OID Alignment

- 1929 OID
- 1959
- 1969

Ground Elevation Contours, ft msl (AMEC, 2006)

- 2-foot Contour
- 10-foot Contour

Notes:

[a] Uncertainties due to exceedances based on ND concentration data and/or uncertain benchmarks.

ft msl = feet mean sea level.

RI = Remedial Investigation.

Net Exceedances = Total exceedances minus exceedances due to Non Detect concentration data and/or uncertain benchmarks.

Wildlife risk estimates for barium, copper, lead, nickel, selenium, and zinc use literature-based bioavailability values that are less than 100 percent (see Table 9-2).

N

0 200 400

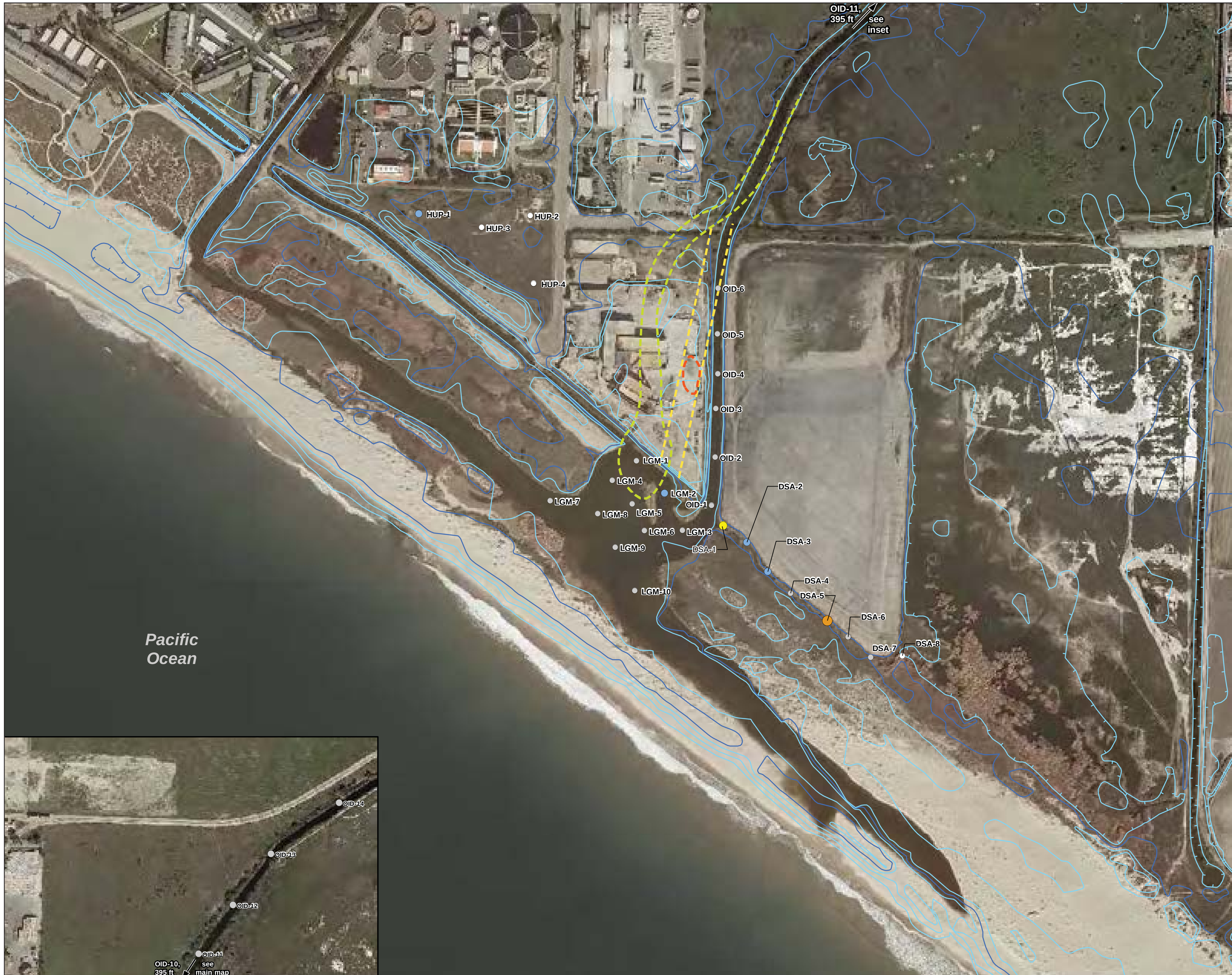
Feet

SOURCE: CH2M Hill 2015

Ormond Beach Wetlands Restoration

Figure 2-18b
Relative Ecological Risk for Soil/Sediment, 2-foot Depth

ESA



LEGEND

- 0 - No Exceedances for any Receptor or Analyte
- 1 - No Net Exceedances [a]
- 2 - 1 or 2 Net Exceedances
- 3 - 3 to 5 Net Exceedances
- 4 - 6 to 10 Net Exceedances
- 5 - 11 or More Net Exceedances

Historical OID Alignment

- 1929 OID
- 1959
- 1969

Ground Elevation Contours, ft msl (AMEC, 2006)

- 2-foot Contour
- 10-foot Contour

Notes:

[a] Uncertainties due to exceedances based on ND concentration data and/or uncertain benchmarks.

ft msl = feet mean sea level.

RI = Remedial Investigation.

Net Exceedances = Total exceedances minus exceedances due to Non Detect concentration data and/or uncertain benchmarks.

Wildlife risk estimates for barium, copper, lead, nickel, selenium, and zinc use literature-based bioavailability values that are less than 100 percent (see Table 9-2).

N

0 200 400

Feet

SOURCE: CH2M Hill 2015

Ormond Beach Wetlands Restoration

Figure 2-18c
Relative Ecological Risk for Soil/Sediment, 4-foot Depth

ESA

Agricultural and Urban Runoff

Water and sediment quality in tšumaš Creek, OLW, and TNC agricultural field drainage ditch may be impaired by pollutants from agricultural and urban runoff. The lagoon receives drainage from tšumaš Creek, OLW, and Hueneme Drain, as well as groundwater input and wave overtopping of the beach, all of which may contribute to the degraded water quality within the lagoon. Water quality monitoring between 1980 and 2002 showed periods of elevated levels (above typical levels found in natural systems) of ammonia, metals, anions, total dissolved solids (TDS), and enterococcus (Ent) (CH2M Hill 2012).

ODD #3 has been listed as an impaired water body on the California Clean Water Act Section 303(d) list (SWRCB 2010) since 1996 for the following pollutants: chemA[10] (tissue), concentrations of agricultural pesticides exceeding TMDL targets were found in ODD #3 in 2010 near Arnold Road and Edison Drive (EPA 2011). Monitoring in 2015–2016 found exceedances for nitrate, dissolved copper, DDT and byproducts, toxaphene, and bifenthrin (Larry Walker Associates 2016). Oxnard Drainage District No. 2, which manages ODD#3, indicates that water quality is not degraded at present (personal communication to Project Partners, October 22, 2018).

Pyrethroid pesticides are used locally in both agricultural and urban settings (Lindley et al. 2018). Pollutants or reduction in dissolved oxygen concentrations in the water can lead to a sudden local die-off of fish populations (also called a "fish kill"). A fish kill in tšumaš Creek in July 2015 was attributed to bifenthrin and other pyrethroids (CDFW 2015) following an unusual summer rain that occurred during peak pyrethroid applications to strawberries (Lindley et al. 2018).

2.3.5 Biological Resources

Plant Communities and Habitat Types

The Project Area includes a mix of aquatic, wetland and upland habitat types (**Table 2-1**). Select habitat types were "rolled-up" into a consolidated set in order to conform with wetland evolution modeling protocols and in recognition of the difficulty in discerning between fresh-brackish and salt-brackish habitats, as well as among upland habitats. The simplified habitats are listed in Table 2-1 and mapped in Figure 2-3.

The major habitat types found in the Project Area are described below.

Open Water

Open water is currently found in Area 1 at Ormond Lagoon, which totals 27.1 acres (4 percent of the Project Area). Open water areas are generally unvegetated but may support algae and submerged aquatic plants such as pondweed (*Ruppia maritima*). Salinities in the spring and early summer of 2017 ranged from fresh to brackish. In general, open water is maintained on site where it is deep enough to exclude cattail (approximately 3 feet).

[10] ChemA is the sum of toxaphene, dieldrin, and chlordane

TABLE 2-1
EXISTING HABITAT ACREAGES IN THE PROJECT AREA

Habitat Type	Acreage[1]	Habitat Type in Alternatives	Acreage
Open Water	27.1	Open Water	27.1
Beach/Strand	28.5	Beach/Strand	28.5
Coastal Dune/Back Dune	128.4	Coastal Dune	128.4
Salt Panne	25.9	Salt Panne	25.9
Salt Marsh	107.8	Salt Marsh	107.8
Brackish/Salt Marsh	25.0	Brackish Marsh	49.5
Fresh/Brackish Marsh	24.5		
Saline Seasonal Wetlands/Disturbed	78.8	Seasonal Wetlands	79.5
Willow Scrub	0.7		
Coyote Brush Scrub	29.7	Upland	96.6
Shrubs/Annual Grasses	49.0		
Berm and Ditch	17.9		
Agriculture	105.6	Agriculture	105.6
Total	**648.9**	**Total**	**648.9**

NOTE:
1 The Project Area boundary was created from imagery, parcel boundaries, and professional judgment. Project Area acreage for mapping habitat acres varies slightly from parcel ownership (630 acres).[11] A portion of this discrepancy is explained by the seaward extent of SCC's ownership.

SOURCE: CRC 2017, ESA 2017

Beach/Strand

The beach generally lacks vegetation in the Project Area, though beach saltbush (*Atriplex leucophylla*) and sea rocket do occur. This habitat changes dramatically in response to large wave events (causing erosion) and rebuilds during periods of low wave activity. Beach and strand is currently found in Areas 1, 7, 8, and 9, and totals 28.5 acres (4 percent of the Project Area).

Coastal Dune/Back Dune

Dune habitat is currently found in Areas 1, 7, 8, and 9, and totals 128.4 acres (20 percent of the Project Area). This habitat type includes large unvegetated areas of open sand with hummocks and dunes formed by the dominant plant species, red sand verbena (*Abronia maritima*), beach evening primrose (*Camissoniopsis cheiranthifolia*), and beach bur (*Ambrosia chamissonis*). Other species that occur in the dunes include beach saltbush (*Atriplex leucophylla*) and non-natives, such as sea rocket (*Cakile maritima*), European dune grass (*Ammophila arenaria*), and iceplant (*Carpobrotus edulis* and *Carpobrotus chilensis*). Limited back dune areas exist where the sand is stabilized. Typical species in these areas include coyote brush (*Baccharis pilularis*) and non-natives such as cobweb bush (*Plecostachys serpyllifolia*) and iceplant.

11 In late 2020 TNC acquired another adjoining 20-acre parcel from Metropolitan Water District (MWD) (Section 2.6.1). This parcel is not included in the OBRAP Plan due to the timing of acquisition but will be incorporated in future planning phases.

Salt Panne

Salt panne areas are seasonally ponded areas with hypersaline soils. These areas generally lack vascular vegetation. Salt panne areas support algae such as *Ulva intestinalis* when ponded. This habitat is currently found in Areas 3b and 6, and totals 25.9 acres (4 percent of the Project Area).

Salt Marsh

Salt marsh is currently found in Areas 1, 3a, 3b, 4, 5, and 6, and totals 107.8 acres (17 percent of the Project Area). Only the southern-most salt marsh area (Area 6) still receives direct seawater influence in the form of occasional wave overwash events. The salt marsh habitat type is generally dominated by pickleweed (*Salicornia pacifica*). Salt grass (*Distichlis spicata*) and fleshy jaumea (*Jaumea carnosa*) are common. Other salt marsh halophytes that are limited in distribution include sea lavender (*Limonium californicum*), alkali heath (*Frankenia salina*), arrow grass (*Triglochin concinna*), shore grass (*Distichlis littoralis*), Parish's glasswort (*Arthrocnemum subterminale*), spiny rush (*Juncus acutus*), Coulter's goldfields, and salt marsh bird's beak—all of which are typically only found in tidal systems. These higher diversity salt marsh areas mostly occur directly behind the dunes in Areas 6 and 3b, where some influence from the freshwater lens in the dunes may be keeping soil conditions in a "sweet spot" for species less tolerant of salinity extremes.

Brackish Marsh

Brackish marsh can vary along a salinity gradient. The brackish/salt marsh habitat type is dominated by fleshy jaumea, salt grass, alkali heath, and alkali bulrush. This habitat is limited to the seaward edge of the lagoon (Figure 2-3). Salty ground water may be important in supporting this habitat in the Project Area.

Fresh-brackish marsh is currently found in Areas 2 and 3a, and totals 24.5 acres (4 percent of the Project Area). This habitat type is dominated by tule (*Schoenoplectus californicus*) and cattail (*Typha* spp.). Other species include saltmarsh bulrush (*Bolboschoenus maritimus*) and pickleweed. The hydrology of these habitats is dominated by freshwater with minimal influence from either saltwater (wave overwash in to the lagoon) or salty soils (remnant of a time when the area had a connection to seawater).

Seasonal Wetlands

Saline seasonal wetlands generally occur in areas with a long history of disturbance and are dominated by a range of halophytic vegetation, including alkali weed (*Cressa truxillensis*), sand spurry (*Spergularia* spp.), seaside heliotrope (*Heliotropium curassavicum*), pickleweed, salt grass, alkali heath, and fat-hen (*Atriplex prostrata*). Non-native species are common, including Italian rye grass (*Festuca perennis*) and Australian saltbush (*Atriplex semibaccata*). It is not totally clear what the main hydrologic drivers of this habitat are. Soils are almost certainly saline and appear to be better drained than most of the salt marsh areas on site. During field surveys, there was no ponding in most of these areas. The water table may be very close to the surface (and perhaps brackish) in these areas.

Willow Scrub

Willow scrub habitat is isolated to a single patch of diminutive sandbar willow (Salix exigua) in the southernmost agricultural field (Figure 2-3). The presence of this rhizomatous species suggests that the field has not been deeply tilled for some time. The stunted growth suggests that the area is mowed somewhat frequently.

Coyote Brush Scrub

Coyote brush scrub generally occurs in disturbed areas and is dominated by coyote brush with an understory of non-native annual grasses. Some areas also support other native species such as mule fat (*Baccharis salicifolia*).

Annual grasses and shrubs are generally found in areas with a history of disturbance but not affected by saline soils or brackish groundwater. Vegetation is characterized by non-wetland species, mostly non-native grasses such as ripgut brome, Madrid brome, and foxtail barley. Other non-natives include Ngaio tree, Russian knapweed (*Acroptilon repens*), and white sweet clover (*Melilotus albus*). Native species include coyote brush and ragweed (*Ambrosia psilostachya*).

Shrubs/Annual Grasses

Annual grasses and shrubs are generally found in areas with a history of disturbance but not affected by saline soils or brackish groundwater. Vegetation is characterized by non-wetland species, mostly non-native grasses such as ripgut brome, Madrid brome, and foxtail barley. Other non-natives include Ngaio tree, Russian knapweed (*Acroptilon repens*), and white sweet clover (*Melilotus albus*). Native species include coyote brush and ragweed (*Ambrosia psilostachya*).

Berm and Ditch

These are artificial features created to convey water or drain shallow groundwater. Some of these features are probably maintained, while others are remnants of abandoned agriculture. Ditch-bottoms that are not permanently flooded and the edges of permanently flooded ditches generally support tule, cattail, and alkali bulrush. Berms support mostly non-native annual grasses such as ripgut brome (*Bromus diandrus*), Madrid brome (*Bromus madritensis*), and foxtail barley (*Hordeum* spp.) and trees such as Ngaio tree (*Myoporum laetum*), Peruvian pepper (*Schinus molle*), Brazilian pepper tree (*Schinus terebinthifolius*), and various species of *Eucalyptus*.

Agriculture

Areas that are currently in active agriculture were also mapped.

Special-Status Plant Species

Five special-status plant species are known to occur within 1 mile of the Project Area (**Table 2-2**). Their habitat requirements and distribution are described below. Note that elevated plant distributions are expected for coastal wetland plants in systems like Ormond Beach that do not get regular tidal exchange and where groundwater is not controlled by tidal processes. Since the system is perched above mean sea level, plant distributions are limited to higher elevations than typically expected under fully tidal systems. The physical conditions of inundation, soil saturation, and high soil salinity are important factors to consider in developing approaches to conserving these species under future climate change.

Nine additional special-status plant species were not observed within or immediately adjacent to the Project Area, but have a high potential to occur based on a presence of suitable habitat:

- Southern tarplant (*Centromadia parryi ssp. australis*): CNPS List 1B;
- Orcutt's pincushion (*Chaenactis glabriuscula var. orcuttiana*): CNPS List 1B;
- Dune larkspur (*Delphinium parryi spp. blochmaniae*): CNPS List 1B;
- Beach spectaclepod (*Dithyrea maritima*): State Threatened, CNPS List 1B;
- Small spikerush (*Eleocharis parvula*): CNPS List 4;
- Suffrutescent wallflower (*Erysimum insulare spp. suffrutescens*): CNPS List 4;
- Vernal barley (*Hordeum intercedens*): CNPS List 3;
- California spineflower (*Mucronea californica*): CNPS List 4; and,
- Estuary seablite (*Suaeda esteroa*): CNPS List 1B.

TABLE 2-2
SPECIAL-STATUS PLANT SPECIES DOCUMENTED WITHIN OR IMMEDIATELY ADJACENT TO THE PROJECT AREA

Species Name	Status	Habitat	Potential to Occur
Salt marsh bird's beak *(Cordylanthus maritimus* ssp. *maritimus)*	FE SE CNPS List 1B	Observed within several of the salt marsh habitats within the Project Area and to the southeast in the Ventura County Game Preserve (Aspen 2009) and throughout much of the salt marsh habitat on-site during surveys conducted by CRC and ESA in 2017. Additionally, this species was observed immediately southeast of the Project Area within the NBVC Point Mugu property on June 30, 2005.	Present
Spiny Rush *(Juncus acutus* ssp. *Leopoldii)*	CNPS List 4	Observed within much of the wetland habitat within the Project Area during previous surveys (Aspen 2009) and during surveys conducted by CRC and ESA in 2017.	Present
Woolly seablite *(Suaeda taxifolia)*	CNPS List 4	Observed in much of the wetland habitat within the Project Area (Aspen 2009).	Present
Red sand-verbena *(Abronia maritima)*	CNPS List 4	Observed throughout the southern foredune and transitional habitat within the Project Area during previous surveys (Aspen 2009).	Present
Coulter's goldfields *(Lasthenia glabrata* ssp. *coulteri)*	CNPS List 1B	Observed within the southern coastal salt marsh on-site during previous surveys (Aspen 2009) and west of the terminus of McWane Blvd., within the Project Area, during surveys conducted by CRC and ESA in 2017. Additionally, this species was observed on March 8, 2002, in the same general location as in 2017 (CNDDB 2017).	Present

Listing Status Key:

FE = Federally Endangered
SE = State Endangered
CNPS = California Native Plant Society list

SOURCE: CNDDB 2017, ESA 2017

Annual plants tend to have variable populations from year to year, usually in response to rainfall. The 2016–17 rain year was wetter than average at the Project Area and thus annual plants species were expected to have a good year. A field survey was conducted by CRC in 2017 to update mapping of salt marsh bird's beak and Coulter's goldfields, and document other special-status plants.

Salt Marsh Bird's Beak

Salt marsh bird's beak (*Cordylanthus maritimus* ssp. *maritimus*) is an annual plant that tends to establish in areas of low salt marsh cover, often on the edges between bare ground and vegetation. This species tends to be found in the same location year after year. The species is threatened here by conversion of salt marsh to brackish marsh.

This annual species was previously mapped throughout the Project Area, including a large patch north of the OBGS (Aspen 2009). Navy biologists have sporadically mapped this species in the SCC salt panne and marsh basin (adjacent to Arnold Road). In 2015 and 2016, Rancho Santa Ana Botanic Garden botanists surveyed the TNC property and documented a single salt marsh bird's beak plant in 2015 (Fraga and De Groot 2017). In May and June 2017, CRC surveyed all salt marsh areas. This species is generally easier to detect later in the season when individuals are larger and in flower. The 2017 survey found approximately 4,500 individual plants in total. More than 4,000 of these are in the wetland basin north of the OBGS (Area 3b) (**Figure 2-19**). Eighteen plants were found in two patches within the wetland basin immediately south of the OBGS. This species had not been documented in this area before. In the SCC salt panne and marsh basin (Area 6), 265 plants were found in multiple patches. Sixteen individuals were found in one patch on TNC property (Area 3a). Previous mapping efforts did not appear to estimate or count individual plants, so the population trend is unclear.

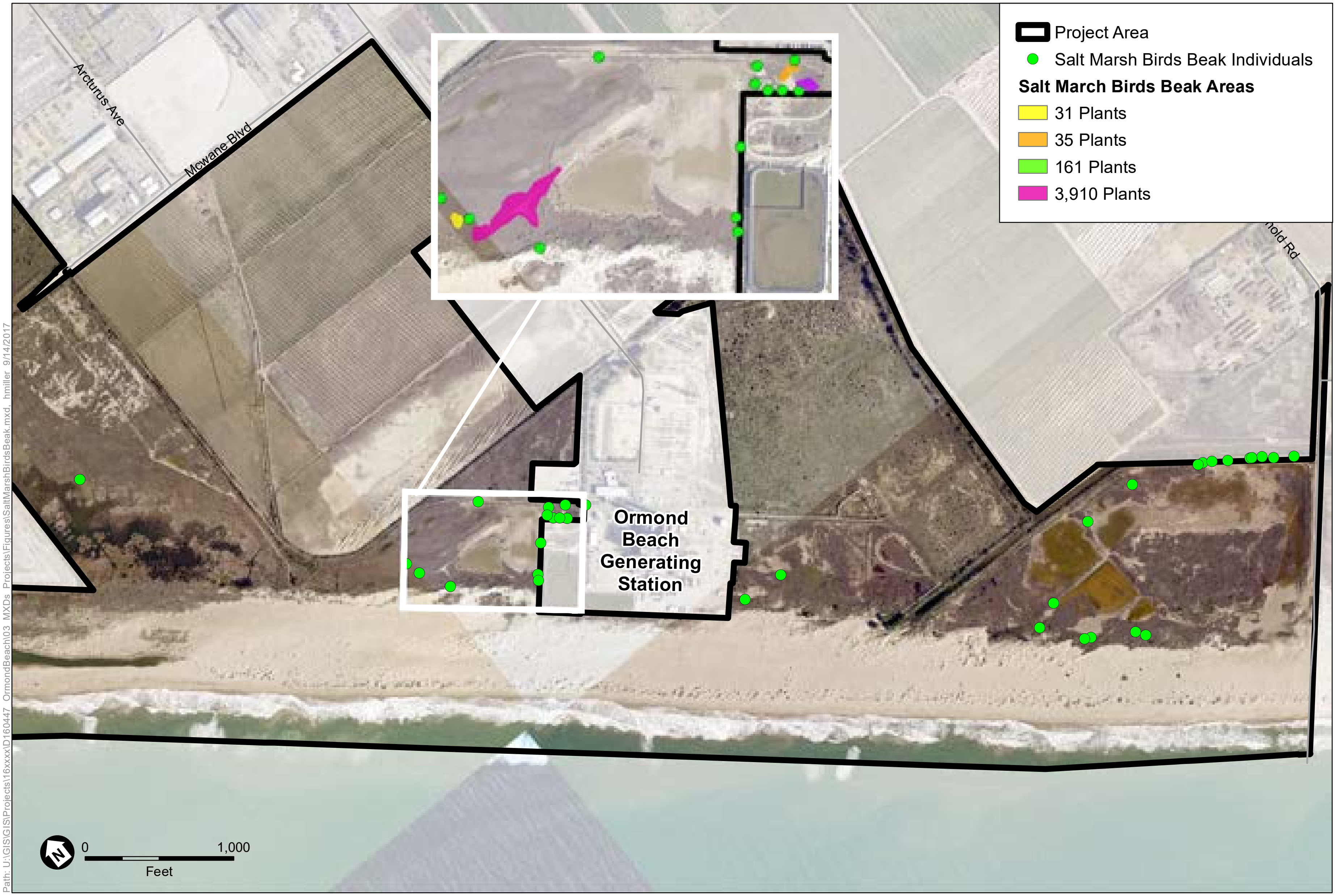
The large patch north of the OBGS seems to have shrunk in size since mapping done for the Feasibility Study (Aspen 2009). Much of the area where it was previously found now has dense salt marsh cover and is beginning to be invaded by salt marsh bulrush-–a sign that the area is becoming less salty than it was in the past.

The mean elevations of salt marsh bird's beak vary by about a foot among the three wetland basins. The lowest distribution (mean 5.8 feet NAVD88, range 5.3 to 6.5 feet) for plants in the SCC salt panne and marsh basin (Area 6) was nearly identical to the elevation distribution of salt marsh bird's beak in the muted tidal estuary at Carpinteria salt marsh in Santa Barbara County in 2017 (upper limit at Carpinteria 6.4 feet).[12] The mean elevations for the other two basins surveyed at Ormond Beach were 6.4 feet NAVD88 (range 5.3 to 6.5 feet) and 6.8 feet NAVD88 (range 6.0 to 8.0 feet). These values are similar to the median reported by Zedler (2000) for fully tidal systems.

Coulter's Goldfields

Coulter's goldfields (*Lasthenia glabrata ssp. coulteri*) tends to establish on salty soils in areas where there is little or no plant cover. It is an annual plant that usually grows in wetlands (salt marsh, playas, vernal pools) but is occasionally found in non-wetlands. In salt marshes, Coulter's

[12] Page, Doheny, Hoesterey, Johnson, Hubbard, and Shroeter. 2017. Unpublished data



SOURCE: County of Ventura 3/2016

Ormond Beach Wetlands Restoration

Figure 2-19
Salt Marsh Birds Beak Occurrences in 2017

ESA

goldfields is found on the edges of salt pannes (unvegetated flats with salty soils) or in vernal basins (shallow pools that form in the cool season) (Zedler 2000). The population size of Coulter's goldfields varies strongly with soil moisture and salinity between years (Noe 1999).

CRC conducted surveys in the Project Area for this species in March 2017 when flowering was at or near its peak. The only population known is on TNC property in Area 3a (**Figure 2-20**). The size of the population probably varies widely between years due to rainfall. Mapping in 2017 found a large population (estimated at over 100,000 individuals). Despite interannual fluctuations, the population overall is presumed stable; however, the eventual leaching of salts out of soils will eventually open up its current habitat to other species that might outcompete it.

Coulter's goldfields occurred at elevations between 8.1 and 9.6 feet NAVD88, with an average elevation of 8.9 feet. This average distribution was more than 2 feet higher than in the fully tidal estuary at Carpinteria salt marsh in 2017.[13] The distribution is also 1.3 feet higher than the median elevation reported by Zedler (2000).

Sea Blite

Sea blite[14] is a succulent-leaved perennial shrub of the goosefoot family (Chenopodiaceae). Plants that appear to be *Suaeda taxifolia* occur at the site along the path in the southern portion of the SCC salt panne and marsh basin (Area 6) and in a large patch in the southwest TNC marsh parcel (Area 3a) (Figure 2-20). Wooly sea blite grows in saline habitat at the margins of salt marshes and coastal dunes and bluffs (California Native Plant Society 2018).

Spiny Rush

Spiny rush (*Juncus acutus* ssp. *Leopoldii)* establishes on the edge of salt marshes, under moderately high salinities without inundation. This species was observed in 2017 scattered throughout the wetlands on SCC property (Areas 3b, 5, and 6) (Figure 2-20). Surveys indicate the species is expanding at the site since the Feasibility Study (Aspen 2009), which may be a result of the conversion of salt marsh to brackish marsh.

Red Sand Verbena

Red sand verbena (*Abronia maritima*) is common and widely distributed throughout the dunes (Figure 2-20). This plant establishes in dune habitat and fills an important role in dune building. Surveys indicate the species is expanding at the site.

Wildlife

The Feasibility Study (Aspen 2009) provides the starting point for special-status wildlife species in the Project Area. CNDDB records were updated and habitat suitability assessed (**Figure 2-21**). CRC biologists made opportunistic observations of wildlife while conducting plant surveys.

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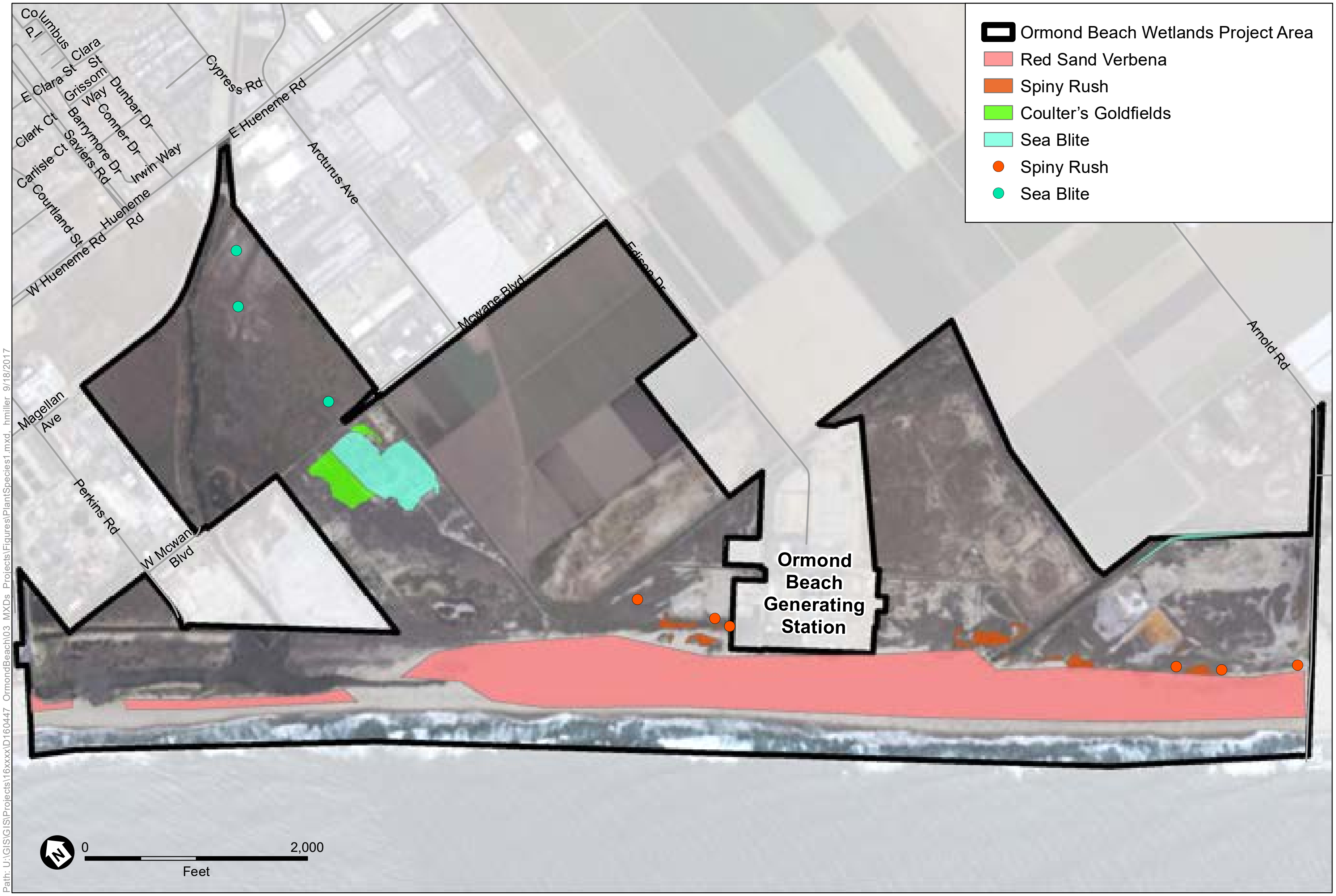
13 Page, Doheny, Hoesterey, Johnson, Hubbard, and Shroeter. 2017. Unpublished data

14 Two special-status sea blites were previously documented on the site by others: woolly sea blite (*Suaeda taxifolia*) and California sea blite (*Suaeda californica*). However, *Suaeda taxifolia* is highly variable in appearance, and *Sueda californica* is now known to occur only north of Point Conception (USFWS 2010). Therefore, *Sueda californica* is not likely to be present on-site.

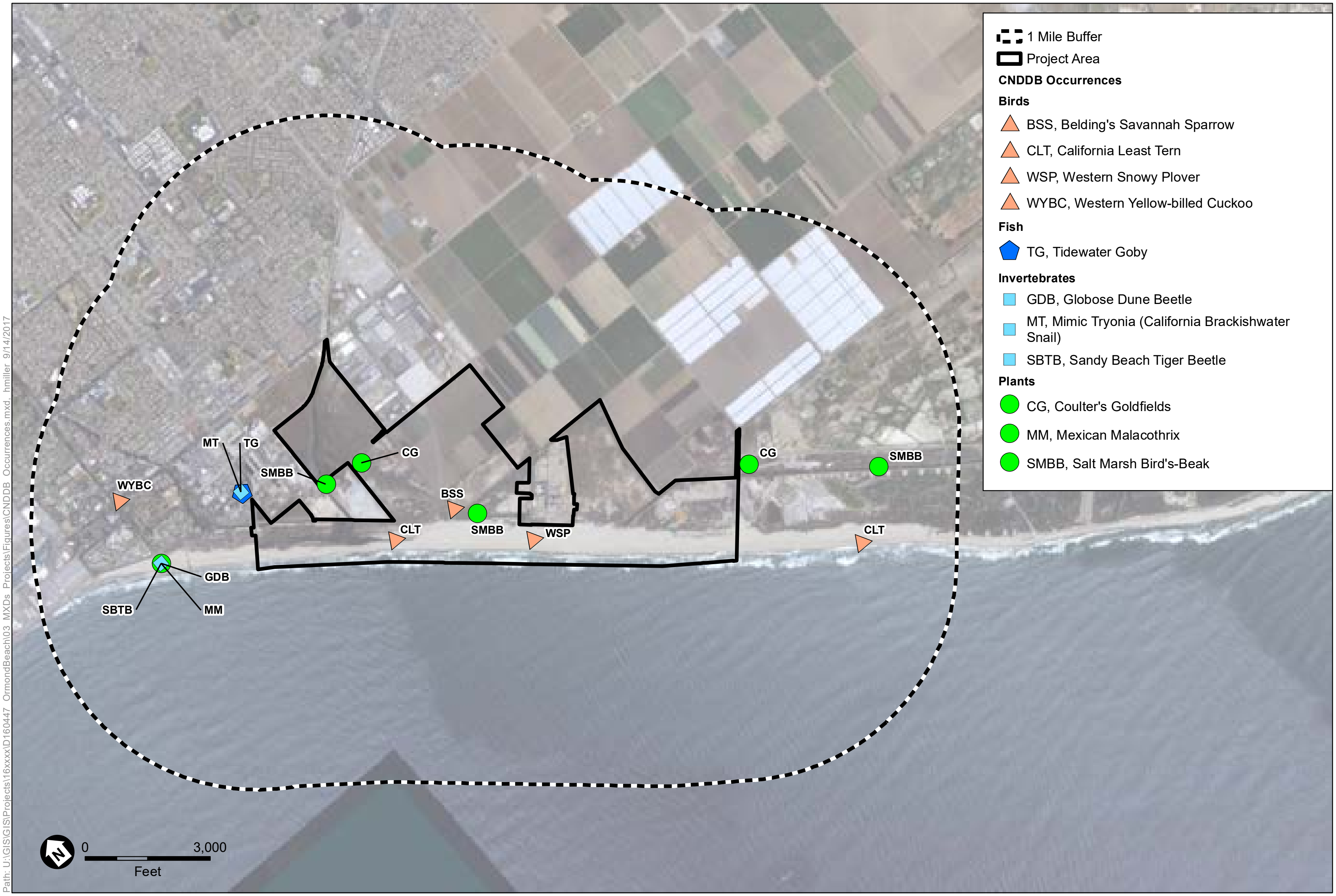


SOURCE: ESRI 7/19/2016

Ormond Beach Wetlands Restoration

Figure 2-20
Coulter's Goldfields, Sea Blite, Spiny Rush, and
Red Sand Verbena Occurrences in 2017

ESA



SOURCE: ESRI 7/19/2016, CNDDB

Ormond Beach Wetlands Restoration

Figure 2-21
CNDDB Occurrences

ESA

Survey data by others was used where available. Focused surveys will need to be done in the future to support CEQA and permitting. The current observations are included to help assess restoration alternatives and the extent to which they might benefit or impact some species.

A total of 25 special-status wildlife species are known or are highly likely to occur within 1 mile of the Project Area (**Table 2-3**). Of particular interest are five species (four birds, one fish) that occur at the site and are listed as a federally or state threatened or endangered species:

- Western Snowy Plover (*Charadrius alexandrius* spp. *nivosus*)
- California Least Tern (*Sterna antillarium* ssp. *browni*)
- Belding's Savannah Sparrow (*Passerculus sandwichensis* ssp. *beldingi*)
- Light-footed Ridgway's Rail (*Rallus longirostris levipes*)
- Tidewater goby (*Eucyclogobius newberryi*)

TABLE 2-3
SPECIAL-STATUS WILDLIFE SPECIES DOCUMENTED AT OR NEAR THE PROJECT AREA

Species Name	Status	Habitat	Potential to Occur
Fish			
Tidewater goby (*Eucyclogobius newberryi*)	FE CSC	The brackish open waters in the northwest corner of the Project Area provide suitable habitat for this species. This species was documented in the Lagoon by USFWS, Ventura Office in 2006 (Aspen 2009) and by ESA in the Lagoon in April 2017. Additionally, this species was observed within the J Street Drain in March 2007, just northwest of the Project Area (CNDDB 2017), and in November 2015 (USFWS 2013a).	Present
Birds			
American Peregrine Falcon (*Falco peregrinus* ssp. *anatum*)	FP	Suitable foraging and roosting habitat is available throughout the Project Area and a small population is currently present at NBVC Point Mugu (Aspen 2009).	High
Western Snowy Plover (*Charadrius alexandrius* spp. *nivosus*)	FT BCC CSC	Present year-round at Ormond Beach. Several nest and roost in the southern foredune habitat and forage along shoreline and open waters (Aspen 2009); this species was observed nesting and foraging within the saltmarsh habitat and foraging within the southern foredune habitat within the Project Area during surveys conducted by CRC and ESA in 2017. Additionally, this species was observed foraging in the southern foredune habitat on September 1, 2015 (CNDDB 2017).	Present
California Least Tern (*Sterna antillarium* ssp. *browni*)	FE SE FP	A small colony nest and roost in the southern foredune habitat at south Ormond Beach, using open water habitat for foraging (Aspen 2009); this species was observed foraging within flooded drainages on-site as well as regular fly-over during surveys conducted by CRC and ESA in 2017. Additionally, this species was observed within the Project Area in 1996; note in observation specified that the species has been documented breeding within the immediate vicinity since 1936 (CNDDB 2017).	Present
Light-footed Ridgway's Rail (*Rallus longirostris levipes*)	FE, SE	Ridgway's Rail were not detected during field surveys in 2017. A single individual bird was detected in April 2016 and in 2013 during protocol surveys (Hall 2016). No birds were detected in follow-up surveys in May 2016.	Present
Belding's Savannah Sparrow (*Passerculus sandwichensis* ssp. *beldingi)*	SE	Present in fragmented patches of saltmarsh habitat throughout the Project Area, but concentrated primarily (1) between the Halaco properties and Ormond Beach Generating Station (OBGS), and (2) the saltmarsh in the southern portion of the Ventura County Game Preserve (Aspen 2009); this species was observed on-site during surveys conducted by CRC in 2017. Additionally, two breeding pairs were observed between the OBGS and the NBVC Point Mugu fence line and 18 pairs were observed between the Edison and Halaco properties on May 23, 2006 (CNDDB 2017).	Present

TABLE 2-3 (CONTINUED)
SPECIAL-STATUS WILDLIFE SPECIES DOCUMENTED AT OR NEAR THE PROJECT AREA

Species Name	Status	Habitat	Potential to Occur
Birds (cont.)			
Double-crested Cormorant (*Phalacrocorax auritus*)	CSC	Large colonies roost in the uplands immediately adjacent to the coastal freshwater/brackish marsh dominated by *Schoenoplectus* sp., *Typha* sp., and *Distichlis* sp. (Aspen 2009).	Present
White-faced Ibis (*Plegadis chihi*)	CSC	The coastal freshwater/brackish marsh dominated by Schoenoplectus provides suitable habitat for this species (Aspen 2009).	Present
Cooper's Hawk (*Accipiter cooperii*)	CSC	Roost and forage in upland habitats within the Project Area (Aspen 2009).	Present
Sharp-shinned Hawk (*Accipiter striatus*)	CSC	Roost and forage in upland habitats within the Project Area.	Present
Northern Harrier (*Circus cyaneus*)	CSC	Suitable nesting/roosting habitat available throughout the Project Area. Observed foraging over upland, salt and freshwater marshes, and ruderal areas (Aspen 2009).	Present
White-tailed Kite (*Elanus caeruleus*)	FP	Observed in non-native grassland, mixed transitional and coastal freshwater/brackish marsh dominated by *Schoenoplectus* sp. (Aspen 2009).	Present
Merlin (*Falco columbaries*)	CSC	Observed foraging in sod farm habitat. May also forage in open upland habitats. Not believed to breed in Project Area (Aspen 2009).	High (Foraging)
Long-billed Curlew (*Numinous americanus*)	BCC CSC	Observed foraging along the shoreline at the beach and in the open, dry ponds of the Ventura County Game Preserve (Aspen 2009).	Present
Western Burrowing Owl (*Athene cunicularia* ssp. *hypugea*)	BCC CSC	The non-native annual grassland and roadside berms within Project Area provide habitat (Aspen 2009).	High
Loggerhead Shrike (*Lanius ludovicianus*)	BCC CSC	Observed in the vicinity of non-native annual grassland habitats northeast of the Project Area (Aspen 2009).	High
California Horned Lark (*Eremophila alpestris* ssp. *actia*)	CSC	Regularly observed foraging in the sod farms. Non-native grassland and mixed transitional areas within Project Area also provide habitat (Aspen 2009).	High
Tri-colored Blackbird (*Agelaius tricolor*)	BCC CSC	Suitable emergent wetland habitat is available along Oxnard Industrial Drain, adjacent coastal freshwater/brackish marsh habitat, and dense emergent wetland vegetation at the managed duck ponds southeast of the Project Area (Aspen 2009).	High
Mammals			
Southern California saltmarsh shrew (*Sorex ornatus* ssp. *salicornicus*)	CSC	Potential habitat is available in many of the southern coastal salt marsh and coastal freshwater/brackish marsh habitats throughout the Project Area. This species was observed in the brackish marsh northeast of the Halaco properties, within the Project Area (Aspen 2009).	Present
San Diego black-tailed jackrabbit (*Lepus californicus* ssp. *bennettii*)	CSC	Observed in the southern foredune area southeast of the Halaco properties, within the Project Area. Other potential habitat includes the non-native grassland and mixed transitional habitats (Aspen 2009).	Present
Amphibians and Reptiles			
South Coast garter snake (*Thamnophis spiralis* ssp.)	CSC	One individual was observed crossing Arnold Road adjacent to the cultivated sod fields. Suitable habitat within the Project Area includes upland, salt marsh and brackish marsh (Aspen 2009).	High
Southern California legless lizard (*Anniella stebbinsi*)	SSC	Common in the back dune areas of the site, especially where there is iceplant (T. Munro-Burgess pers. obs.)	High

TABLE 2-3 (CONTINUED)
SPECIAL-STATUS WILDLIFE SPECIES DOCUMENTED AT OR NEAR THE PROJECT AREA

Species Name	Status	Habitat	Potential to Occur
Invertebrates			
Sandy Beach tiger beetle (*Cicindela hirticollis* ssp. *gravida*)	G5T2/ S2	Observed within foredune habitat in Port Hueneme in 1979 approximately 0.5 mile northwest of the Project Area. However, this species is presumed to be extirpated from the original location.	Medium
Globose dune beetle (*Coelus globosus*)	G1G2/ S1S2	Observed within foredune habitat in Port Hueneme on July 17, 1926 approximately 0.5 mile northwest of the Project Area. This species is likely extirpated from this location.	Medium
Wandering (saltmarsh) skipper (*Panoquina errans*)	G4G5/ S2[1]	Observed in the southern coastal salt marsh, coastal freshwater/brackish marsh, and non-native annual grassland within the general vicinity of the Project Area (coyote brush/western ragweed association, Aspen 2009).	High
California brackishwater snail (*Tryonia imitator*)	G2/S2	Observed within the within the J Street Canal in March of 2007, just northwest of the Project Area (CNDDB 2017).	High

Listing Status Key:

FE = Federally Endangered
SE = State Endangered
ST = State Threatened
FP = Fully Protected
CSC = California Species of Special Concern
BCC = USFWS Bird of Conservation Concern
G#/S# = Global/state rank by World Conservation Union

NOTE:
1 Extremely rare in California, considered globally imperiled by the World Conservation Union

SOURCE: CNDDB 2017, ESA 2017, WFVZ 2013, 2016

California Least Tern

The California Least Tern (*Sterna antillarium* ssp. *browni*) nests on the bare sand near the lagoon. The adults forage for fish in the lagoon and nearshore waters (Hartley 2017). This species was regularly observed flying over the site and diving for fish in open water habitats throughout the site during all of the field visits in 2017 (**Figure 2-22**). As of late June 2017, there were more than two-dozen nests established on bare sand near the lagoon. VAS surveys (2003-2018) indicate a high concentration of nesting on the beach south of the lagoon on City property in Area 7 (Cynthia Hartley, VAS, personal communication to Kim True, August 29, 2018).

Disturbance of nests by humans and dogs, and chick predation by gulls and ravens, have impacted nesting success.

Western Snowy Plover

The Western Snowy Plover (*Charadrius alexandrius* spp. *nivosus*) inhabits the beach, dunes, and salt panne on the SCC parcel (Figure 2-22). In 2017, nests were dispersed over the entire 2-mile length of Ormond Beach (Hartley 2017). Chicks and fledglings were either at the salt panne to the south or near the lagoon (Hartley 2017). VAS surveys (2003-2018) in Area 7 indicate a high concentration of nesting on the beach south of the lagoon on City property, and extending south to SCC property in front of the OBGS (C. Hartley, VAS, personal communication to K. True, August 29, 2018).

SOURCE: ESRI

Ormond Beach Wetlands Restoration

Figure 2-22
Bird Observations in 2017

ESA

Disturbance of nests by humans and dogs and especially predation of plover chicks by gulls and ravens have impacted nesting and fledging success over the years.

Belding's Savannah Sparrow

Belding's Savannah Sparrow (*Passerculus sandwichensis beldingi*) nest in pickleweed (*Salicornia pacifica*) in coastal salt marshes. In 2017 CRC observed (visually and audibly) several individuals in different areas of Ormond Beach, including an adult feeding a juvenile in the salt marsh adjacent to Arnold Road in June 2017 (Figure 2-22). Surveys for this species every five years or so at Ormond Beach between 1977 and 2015 identified between 15 and 61 pairs on territories (Zembal et al. 2015). In 2015, Mugu Lagoon had over 1,100 breeding pairs, which amounted to about one third of the statewide population (Zembal et al. 2015). Bird point counts conducted in 2016 on TNC property found 39 individuals: 11 in the farm fields and 28 in the wetland areas (Hall 2016). The pickleweed habitats at the site are appropriate for supporting nesting.

Areas that have converted from salt marsh to brackish marsh (cattail and tule) will generally not support nesting for this species. The conversion of salt marsh to brackish marsh is a threat to the species on-site.

Light-Footed Ridgway's Rail

Light-footed Ridgway's Rail (*Rallus longirostris levipes*) nest in tidal salt marshes, preferring tall intertidal cordgrass (*Spartina foliosa*) where it builds a floating nest. Nesting in muted tidal or non-tidal areas of tidal marshes has been documented at Mugu Lagoon and Carpinteria Salt Marsh in spiny rush (*Juncus acutus*) and saltmarsh bulrush (*Bolboschoenus maritimus*). Single individuals of this species have been observed on TNC property within the Project Area in 2013 and 2016 (Hall 2013, 2016). These birds were presumably short-term visitors from Mugu Lagoon since this species relies almost exclusively on prey (invertebrates and small fish) that occur in intertidal or sub-tidal marsh habitats, which are largely absent in the Project Area.

Tidewater Goby

The Tidewater Goby (*Eucyclogobius newberryi*) has been consistently documented in the Ormond Lagoon over the last several years (Aspen 2009, HDR 2011, USFWS 2013a&b, Cardno 2014 and 2017). In 2013, fish rescues on various dates in November and December captured a total of 7,399 tidewater gobies in the lower J Street Drain (tšumaš Creek) construction area as part of the VCWPD's J Street Drain Project (Cardno 2014). Post-construction monitoring has continued to find tidewater gobies throughout the lagoon: May 2015 (425 gobies), October 2015 (5 gobies, note this was after a fish kill in July 2015), April 2016 (59 gobies), October 2016 (184 gobies), April 2017 (100 gobies) (Cardno 2015a, 2015b, 2016a, 2016b, 2017). The lagoon mouth was closed for all surveys, and salinity range was 2–13 ppt.

Favorable habitat attributes at Ormond Lagoon include a seasonally closed lagoon, shallow low-salinity waters, still-to-slow-moving water, sand and silt substrate, and submerged and emergent aquatic vegetation, such as pondweed (*Ruppia maritima*), bulrush (*Scirpus* spp.), and cattail (*Typha latifolia*) (USFWS 2013).

As discussed previously, VCWPD grooms the berm between the lagoon and the ocean to allow for natural breaching of the lagoon berm during storm events. The approach of linking berm grooming to storm events is designed to protect tidewater goby populations; in response to pre-storm environmental cues, the fish will move upstream and thereby minimize the likelihood of being washed out to sea when the berm breaches (Chris Dellith, USFWS, personal communication to Laura Riege, TNC, October 5, 2017).

The fish community in the lagoon includes native species such as staghorn sculpin (*Leptocottus armatus*), topsmelt (*Atherinops affinis*), striped mullet (*Mugil cephalus*), and long-jawed mudsucker (*Gillichthys mirabilis*); and non-native species such as mosquitofish (*Gambusia affinis*), sailfin molly *(Poecilia latipinna*), and Mississippi silverside (*Menidia audens*) (CDFW 2015, Cardno 2017). Tidewater gobies and silversides have been the most abundant fish species in the Lagoon in recent surveys (2015–2017). In other estuaries and coastal streams, the presence of non-native fishes, particularly centrarchids (sunfish, bass), can pose a threat to tidewater goby.

A recent study raised concerns about possible impacts from pesticide runoff from surrounding agriculture and urban areas into Ormond Lagoon (Lindley et al. 2018).

Reptiles

The Southern California legless lizard (*Anniella stebbinsi*, a subspecies of legless lizards *Anniella pulchra*) is often locally abundant in coastal sand dunes and a variety of interior habitats, including sandy washes and alluvial fans (Stebbins and McGinnis, 2012). This species is common in the back dune areas of the Project Area, especially where there is iceplant (Trisha Munro-Burgess, ecologist, personal communication with CRC). This fossorial species readily abandons its tail when threatened. To avoid injury to individuals, CRC did not conduct new surveys, but it is assumed that Southern California legless lizards are present throughout vegetated dune areas (**Figure 2-23**).

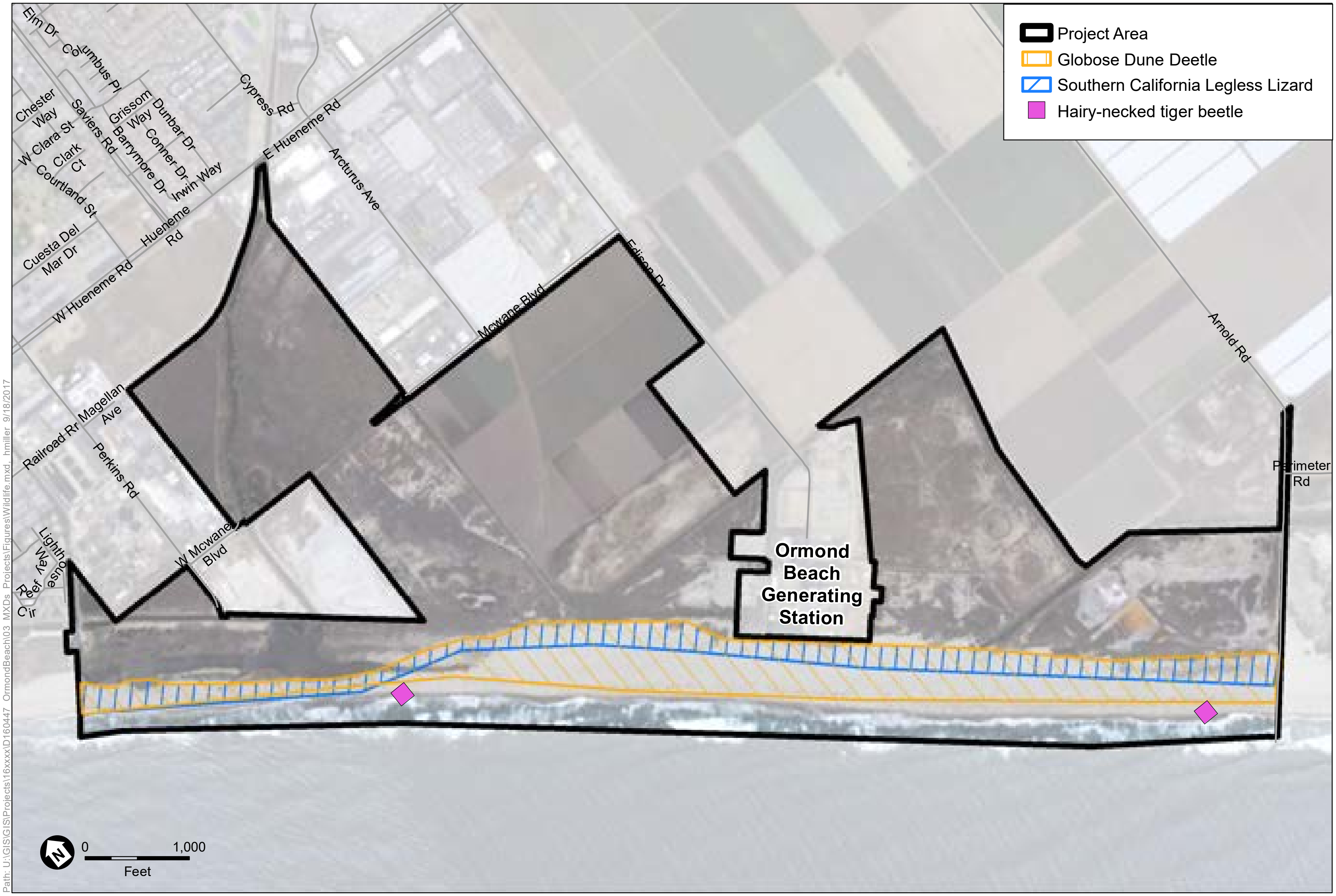
The presence of garter snakes is discussed in the Feasibility Study (Aspen 2009) and no new surveys have been conducted since.

Invertebrates

CRC observed evidence of both ciliate dune beetles (*Coelus ciliate*) and globose dune beetles (*Coelus globose*) throughout the dunes (Figure 2-23). CRC observed adult hairy-necked tiger beetles (*Cicindela hirticollis gravida*) on the beach on June 7, 2017. Several individuals were observed on the beach seaward of the lagoon and seaward of the SCC salt panne and wetland (Figure 2-23).

Wetlands, Waters, and ESHA

Potential jurisdictional waters and wetlands of the U.S. and State and Coastal Commission Environmentally Sensitive Habitat Areas (ESHA) were estimated within the Project Area to guide the development of restoration and public access alternatives. This analysis is not a jurisdictional delineation and is not sufficient for CEQA, permitting, or other regulatory use. Mapping of potential wetlands and waters was based on vegetation and signs of hydrology. Soils were not analyzed. The minimum mapping unit was approximately one acre; smaller scale variation exists throughout the



SOURCE: ESRI 7/19/2016

Ormond Beach Wetlands Restoration

Figure 2-23
Other Wildlife Observations in 2017

ESA

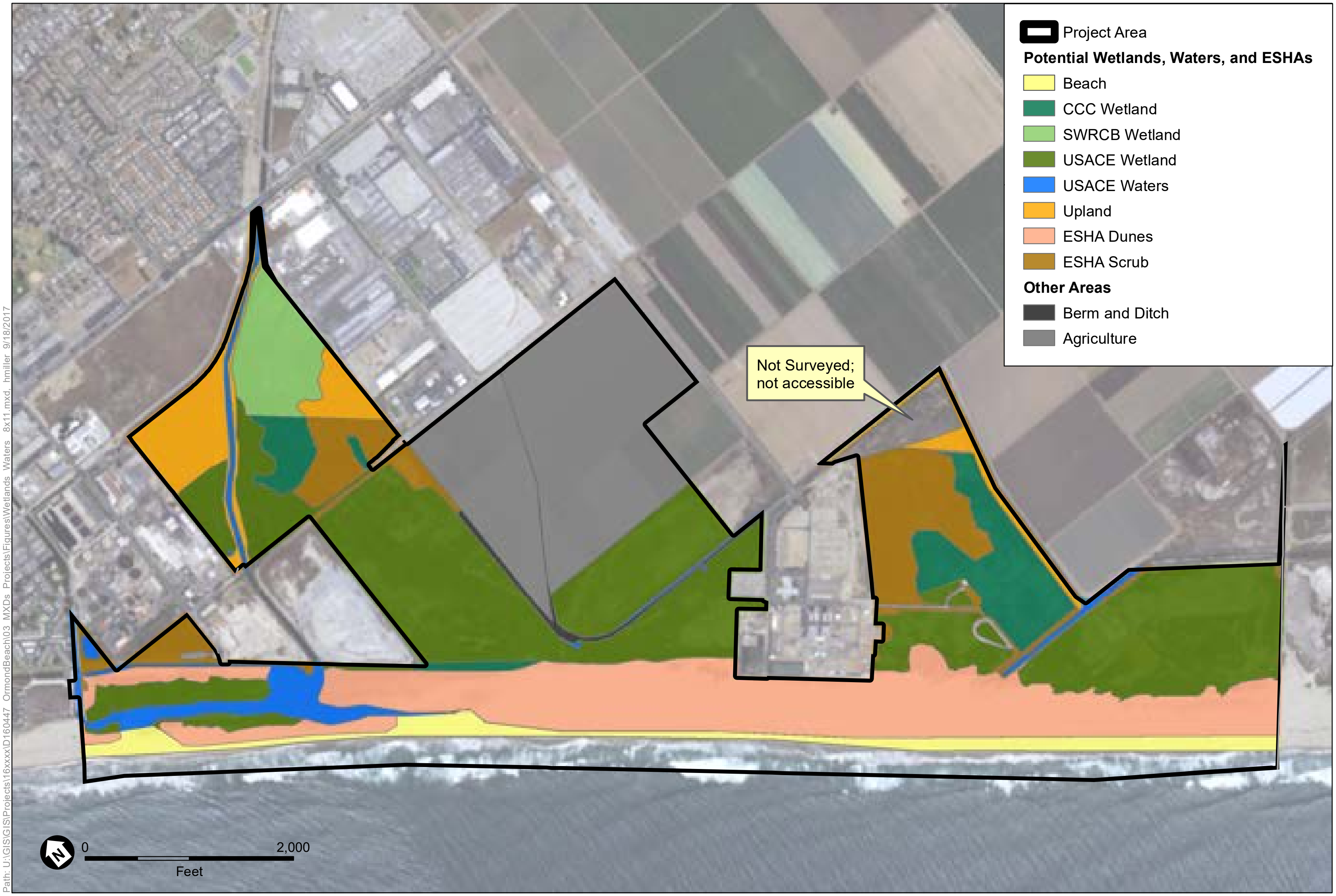
site that will need to be mapped during later phases of planning and permitting. ESHA were mapped following Coastal Commission guidelines but final mapping of ESHA and buffers will need to be done in consultation with Coastal Commission staff in later phases of planning. This analysis (**Figure 2-24**) shows that a large proportion of the site (**Table 2-4**) is environmentally sensitive. Eight different potential types of jurisdictional areas were identified on site:

- *U.S. Army Corps of Engineers (USACE) Wetlands* – these include all areas that likely meet the three-parameter wetland criteria of the USACE.
- *USACE Waters* – these include areas that the USACE would likely consider Waters of the US (many of these areas have narrow fringing wetlands areas that were too narrow to map in this effort)
- *California Coastal Commission (CCC) Wetlands* – these are one-parameter seasonal or groundwater-fed wetlands located within the coastal zone
- *State Water Resources Control Board (SWRCB) Wetlands* – these are one-parameter seasonal or groundwater-fed wetlands outside of the coastal zone
- *ESHA Dunes* – all of the dune areas on site
- *ESHA Scrub* – some of the coyote brush scrub within the coastal zone might qualify as coastal sage scrub ESHA
- *Beach* – jurisdictional lines within this zone were not mapped at this time as they will move depending on whether the beach is narrow (winter) or wide (summer)
- *Upland* – areas that probably will not qualify as ESHA or wetland (though some of these areas are likely within buffers for such areas)

TABLE 2-4
WETLANDS, WATERS, AND ESHA IN THE PROJECT AREA

Habitat	Acreage
USACE Wetlands	206.4
USACE Waters	27.0
CCC Wetlands	35.8
SWRCB Wetlands	20.2
ESHA Dunes	128.4
ESHA Scrub	56.4
Beach	28.5
Upland	37.5

Areas in active agriculture were also mapped. There are several berms and ditches within the Project Area, parts of which may or may not be exempt from federal or state jurisdiction depending on current and historic patterns of maintenance. Determining those patterns was beyond the scope of this analysis.



SOURCE: ESRI 7/19/2016

Ormond Beach Wetlands Restoration

Figure 2-24
Potential Wetlands, Waters, and Environmentally Sensitive Habitat Areas

ESA

Overall, a large portion of the site will likely fall under state or federal jurisdiction. During the development of restoration alternatives, it will be important to consider approaches that are self-mitigating to the extent that different types of jurisdictional areas might be altered. This analysis may also be useful in the development of public access alternatives to the extent that trails and other features might impact jurisdictional areas.

2.3.6 Cultural Resources

This information is based on a review of the report *Cultural Resources in the Ormond Beach Wetlands Restoration Area* by Chester King (2005). The study included a cultural resources records search through the South Central Coastal Information Center (SCCIC), several field surveys, and limited subsurface investigation. It also describes known Native American settlements in the region and summarizes previous archaeological resources work conducted near Ormond Beach. The Project Area falls within King's study area, which encompassed a larger total area.

SCCIC Records Search

A records search at the SCCIC was conducted in 2004 for the study area; a records search survey buffer is not provided in the report. The results indicate that approximately 75 percent of the Project Area has been included in previous investigations (see VN-127, -236, -380, -900, -1081, and -1961). These studies were conducted between 1978 and 2001, although the majority of the Project Area was surveyed prior to 1992.

The number, types, and locations of cultural resources on file at the SCCIC for the study area are not provided in the report. Instead, the results of each previous investigation are summarized. This summary indicates that the following resources may be in or near the Project Area:

- CA-VEN-555 loci A and B: Prehistoric archaeological site with two distinct shell scatters (Pismo clam) originally documented in 1978 at the end of Arnold Road. The site was re-visited in 1990 and could not be re-located, but may have been obscured by accumulated sand deposits. Possibly the Arnold Road Site documented by Richard Van Valkenburgh in the 1930s.
- P-56-100156: Prehistoric isolate consisting of a quartzite flake documented in 2001 located on the east side of Arnold Road.
- P-56-150029, -152779, and -152781: Three historic structures without associated site records on file. The locations of these three resources are unknown.

Field Survey

Field surveys of areas identified as having a higher potential for the presence of archaeological sites (based on a review of maps, aerial photographs, geology, and historic data) were conducted in September and October of 2004. Locations of higher potential are provided in an appendix to the report (the appendix was not available to ESA during preparation of this document). Survey was conducted by walking transects along drainage ditches with visible ground surface. The survey area was limited to the Southland Sod Farm (outside the Project Area) and City of Oxnard/ Metropolitan Water District (MWD) parcels (within or partially within the Project Area).

The field survey yielded the identification of the following potential resources, none of which appear to have been assigned temporary identifiers or formally recorded on Department of Parks and Recreation (DPR) 523 Forms. The exact locations for most of these potential resources are not known.

- Shell scatter and sandstone cobbles on alkali soil (within Project Area on MWD property)
- Broken concrete drainage pipe related to 1898 Oxnard Sugar Beet Company operations (within City of Oxnard/MWD parcels)
- Pieces of broken marine shell (location unknown)
- Light shell scatter (location unknown)
- Barn (used for a storage shed) that appears to be more than 50 years old (Southland Sod Farm)

Subsurface Investigation

In October 2004, King conducted limited subsurface investigation of the shell concentration and cobbles on alkali soil. A total of three 10-centimeter diameter auger holes (Auger 1-3) were excavated down to between 60 and 80 centimeters within the MWD property. The results of the investigation were inconclusive as to whether the materials represented a cultural or natural deposit and King recommended additional research to clarify their origin.

Data Gaps

The King study concludes there is a potential for intact, buried archaeological resources related to Native American occupation of the area and recommended additional studies be conducted to assess the potential for significant cultural resources to be encountered during ground disturbing activities. Prior to dredging or other restoration activities resulting in ground disturbance, the soils should be assessed in order to find out if archaeological resources could be encountered.

Although the previous studies encompassed up to 75 percent of the site, the studies were conducted between 1978 and 2005. Since it has been more than 10 years since studies were conducted, an updated cultural resources assessment encompassing the entire proposed Project Area should be conducted. The cultural resources assessment should include a cultural resources records search through SCCIC, review of historic topographic maps and aerials photographs on file to understand the land use history, a Sacred Lands File search, a pedestrian survey of the entire Project Area, and the preparation of a cultural resources assessment report.

2.4 Future Conditions

Under future sea-level rise conditions, the Project Area will undergo a series of hydrologic changes as the beach responds geomorphically to the rising water levels. The beach will likely respond to rising oceanic water levels by migrating inland (transgressing) and shifting upward. Depending on the rate of transgression, the existing dune system may be eroded, since higher oceanic water levels would mean that existing dunes would be exposed to waves on a more frequent basis. If the future lagoon and wetland system are allowed to migrate inland, the hydrology may remain similar in the future, although the groundwater table will likely shift upward along with the rising tides, and habitats will also migrate up and landward in proportion to sea-level rise but also effected by grades, soils, and infrastructure.

Future conditions were analyzed in more detail in order to diagnose the future no-project conditions as well as influence development of the restoration and access alternatives. Sea-level rise is discussed in Section 2.4.1. Subsequent sections address shore migration, lagoon evolution, and habitat migration.

2.4.1 Sea-Level Rise

Future sea-level rise ("SLR" in context of scenario discussions) scenarios were chosen for this Project based on the latest California guidance (OPC 2018) and prior work for Coastal Resilience Ventura (CRV) (ESA PWA 2013). For this analysis we selected the Medium and High SLR scenarios from CRV, which are within the range of California guidance for low to moderate risk tolerance levels (30–40 inches and 60–80 inches, respectively). The sea-level rise values are also similar to those used in the Regional Strategy for southern California wetlands (SCWRP 2018). Use of the CRV values also provide continuity with the coastal planning since the County of Ventura and the City of Oxnard are using coastal hazard maps based on the CRV scenarios (ESA 2013).

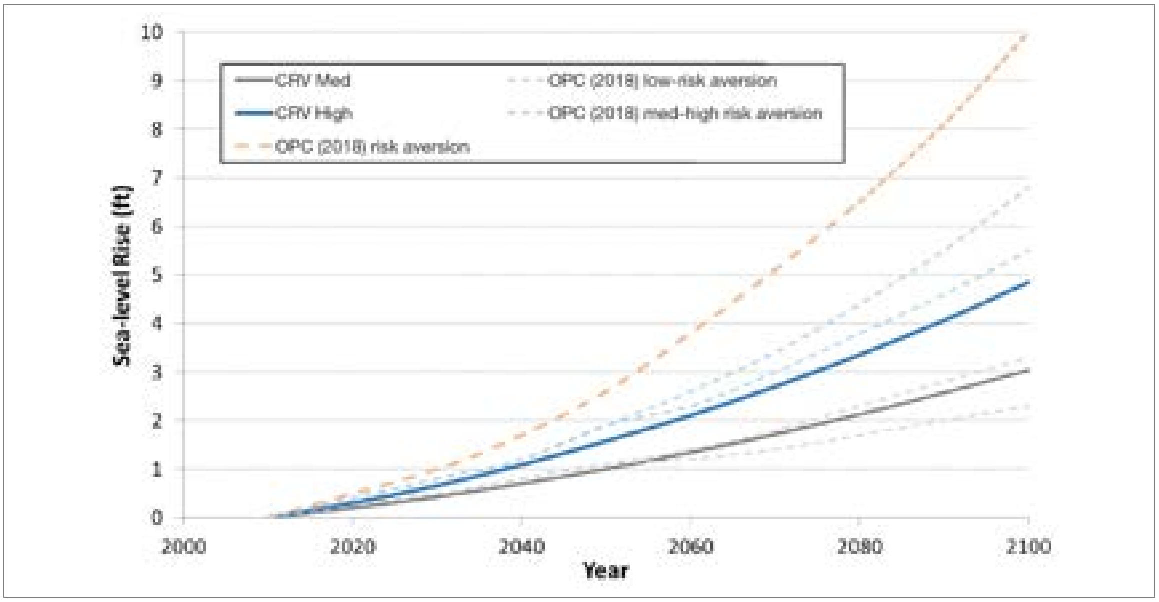
The selected sea-level rise values for Medium and High scenarios are listed in **Table 2-5** and graphed in **Figure 2-25**. These values range from 1 to 2 feet of sea-level rise by mid-century (years 2050–2060), and 3 to 5 feet for the end of century (year 2100). These scenarios were used to develop coastal hazard maps for all of Ventura County, and have been used for coastal zone planning. Figure 2-25 compares these CRV scenarios with the most recent State guidance (OPC 2017; 2018, derived from Griggs et al. 2017). The CRV medium and high scenarios are similar to the most recent OPC low-risk-aversion and medium-high-risk-aversion scenarios, respectively, and hence adequate for this study. For reference, the Regional Strategy selected 61 cm for 2050 and 166.5 cm for 2100 (Appendix 3 to SCWRP 2018), which are similar to the values used in this study (see "High SLR" Table 2-5, 64 cm for year 2060 and 148 cm for 2100). Note that these prior studies (CRV by ESA PWA 2013; SCWRP 2018) analyzed sea-level rise scenarios prior to the release of California's update to policy (OPC 2018), which is based on and followed the update of science (Griggs et al. 2017). Additional information about sea-level rise science and policy is provided in Appendix C – Sea-Level Rise.

TABLE 2-5
SEA-LEVEL RISE SCENARIOS USED IN THIS STUDY, FROM CRV

Year	Low SLR	Medium SLR	High SLR
2030	6 cm (2.3 inches)	13 cm (5.2 inches)	20 cm (8.0 inches)
2060	19 cm (7.4 inches)	41 cm (16.1 inches)	64 cm (25.3 inches)
2100	44 cm (17.1 inches)	93 cm (36.5 inches)	148 cm (58.1 inches)

NOTE: SLR = SEA-LEVEL RISE

SOURCE: ESA PWA 2013



SOURCE: ESA 2013, OPC 2017

Ormond Beach Restoration and Public Access Plan

Figure 2-25
Sea-level rise scenarios from CRV and draft policy update

2.4.2 Shore Migration and Wave Overtopping

Sea-level rise will raise the elevation of surface waves, causing the beach to be reformed at a higher elevation and to migrate landward a distance of between 10 and 100 times the amount of sea-level rise. At Ormond Beach, we expect that sufficient room exists for this beach migration. Dunes will also migrate as long as there is sufficient dry beach to supply wind-blown sand: however, we do not expect the wind-blown sand transport rate to be sufficient to match the rate of shore migration with sea-level rise. The Ormond Lagoon will expand landward with higher water levels, primarily into relatively low areas, but the expansion will be impeded where the backshore is raised and armored (e.g., near Perkins Road). Hence, we expect that the existing dunes and wide inter-dune sandy strand will be reduced in width in Area 1, as will the existing Ormond Lagoon. At the same time, we expect Ormond Lagoon to shift toward the northeast and into the lowlands of Area 3a, behind the migrating beach. In addition, the narrowing beach-dune strand will allow wave overtopping to occur more frequently, thereby delivering saltwater and sand to the back dune wetlands at greater rates than occur now.

Shore migration was modeled using a beach quantified conceptual model (QCM – Beach) that uses cross-shore volume balance (Bruun 1962) and equilibrium profile (Dean 1990) equations consistent with the overall methodology described by Everts (1985) and using beach surveys collected by ESA in 2017. Additional information is provided in Appendix D – Shore Migration and Overtopping (Beach QCM).

Figure 2-26 shows the three locations selected for the shore migration analysis, which are locations of beach surveys. **Figure 2-27** shows the projected shore migration over time. The red line in each figure approximates the landward edge of the beach-dune strand. The shore migration modeling indicates that:

- The existing Ormond Lagoon will be "squeezed" into a smaller available space between the shore and backshore.
- The dunes in Areas 7 and 8 will persist.
- The low-relief dunes in Area 9 will be eroded such that wave overtopping will likely be more frequent.

Graphs in Figure 2-27 show the elevation of shore along the lines with the corresponding labels in Figure 2-26. Transect E is located on the west side at Ormond Lagoon (Area 1). Transect H is located in the central portion of the Project Area where the dune area is widest (Area 7). Transect I is located from the beach (Area 9) across to Area 6 where dunes are less vegetated and lower, and wave runup is known to occasionally reach the wetlands landward of the sandy dunes. These locations were selected to represent the three different coastal conditions that exist at the Project Area (west –Transect E, lagoon; center – Transect H, high and wide dune field; and east – Transect I, low and overtopped dune hummocks).

At each of these three locations, the shore geometry is shown in black. For example, in the top schematic in Figure 2-27, the black solid line is based on a survey of ground elevations (beach transect I), the black dashed line is derived from lidar, and the blue dashed line is the water surface of Ormond Lagoon at the time of the lidar data collection. The vertical, red and dashed line corresponds to the landward edge of the beach-dune strand and corresponds to the red line in Figure 2-26. The horizontal position is a scale in feet with a "zero" location inland of the changes. The width of the existing lagoon is depicted by the blue, dashed line. Note that the vertical scale is exaggerated to clarify the relief. Future shore geometries are shown in other colors, per the figure legend. As sea level rises, the wave-shaped seaward face of the profile responds rapidly by migration, while landward elevations are held steady. Note that at Transect E, the waves overtop the beach and reach the lagoon, and hence this "overwash" area also migrates with the seaward beach.

At Transect E the existing Ormond Lagoon is impacted by shore migration. Note that the lagoon width decreases in 2030 and approaches zero in 2060. By 2100 the beach migrates inland of the existing dune and the extent of lagoon is difficult to predict. This profile modeling neglects scouring of the backshore, which may happen during breaching events with rapid drainage and high OLW discharge. Therefore, the resulting lagoon footprint may be larger than implied by the beach migration modeling. Also, large expanses of low-elevation areas in Area 3b and 3a are likely to pond during high beach levels, indicating that the lagoon may "shift" location to the north and east.

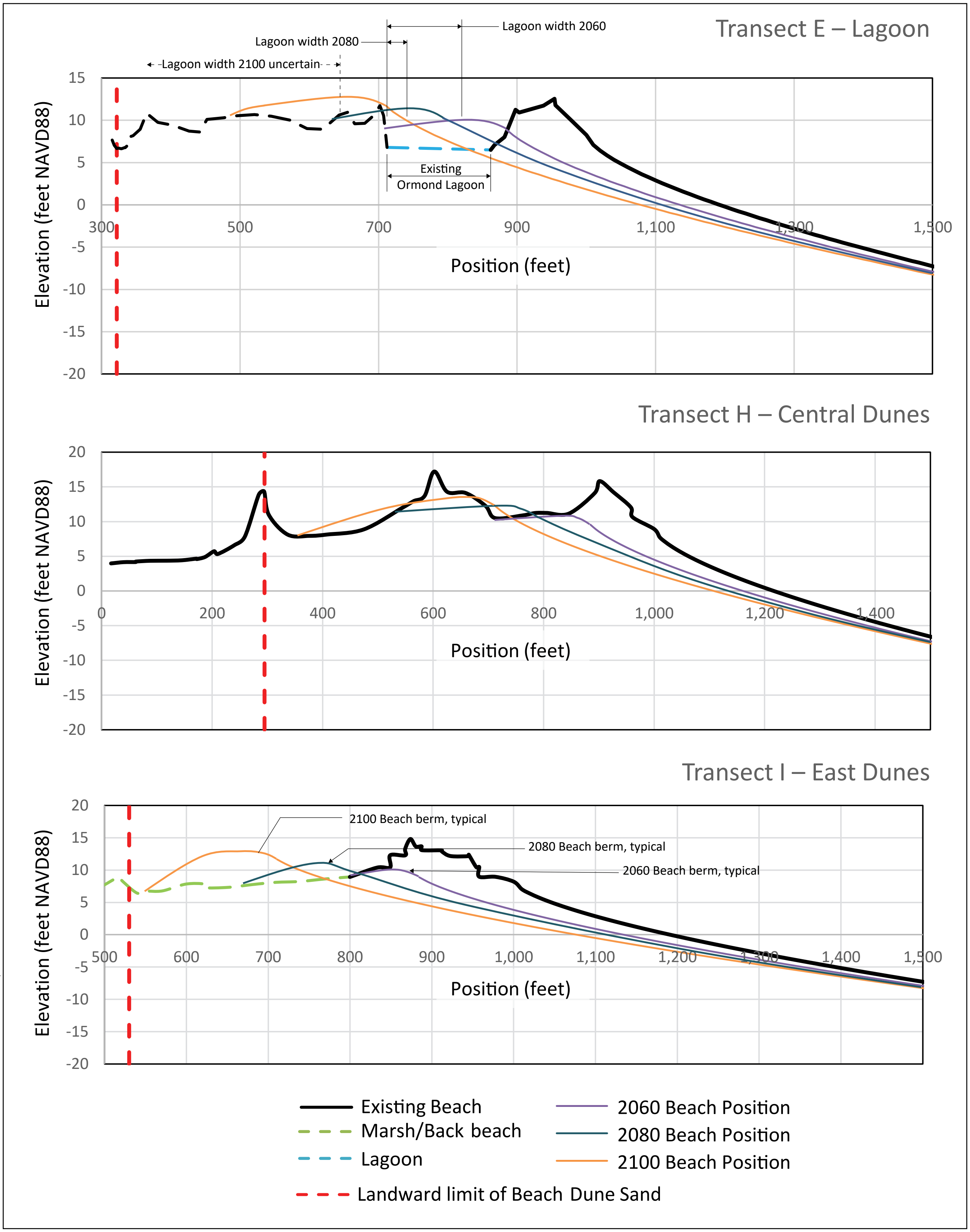
At Transect H, waves are not predicted to overtop the dunes sufficiently to cause the sand deposition in the lee of the dunes, resulting in a reduction of the width of the dune field.

SOURCE: ESA Survey (6/2017)

Ormond Beach Restoration and Public Access Plan

Figure 2-26
Beach Transects Locations

ESA



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SOURCE: ESA, 2017

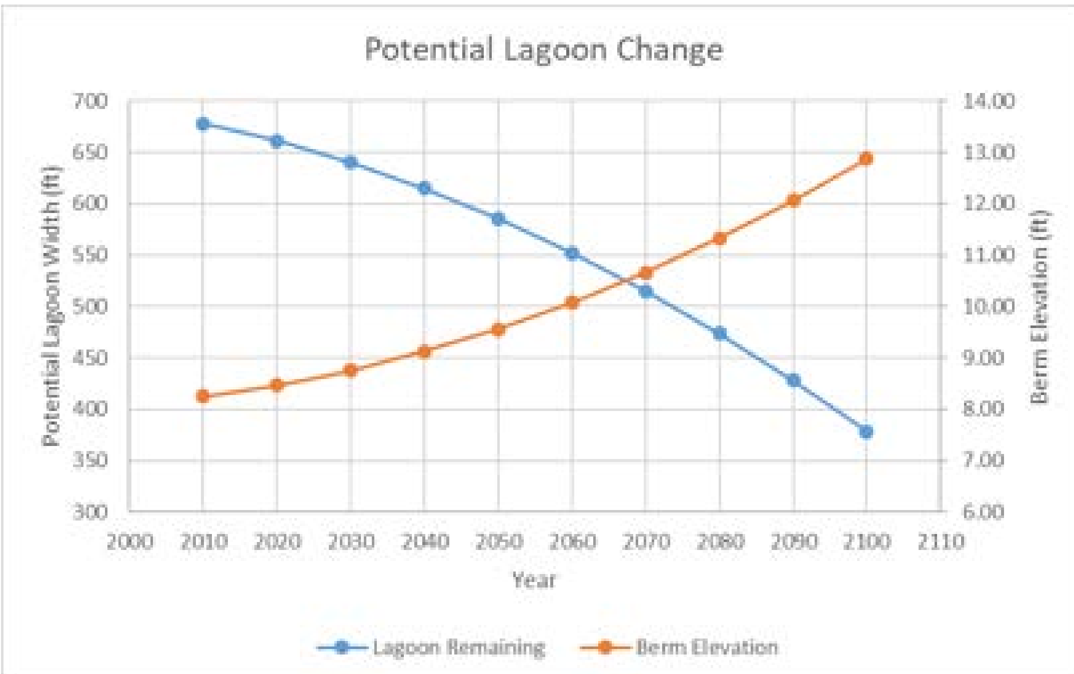
NOTE: Transect E (top) is located at western beach strand Area 1 at Ormond Lagoon; Transect H is located at central beach strand 7 near backshore Area 3 and Transect I is located at eastern beach strand Area 9 near backshore Area 6.

Ormond Beach Restoration and Public Access Plan

Figure 2-27
Beach Transect Elevations

ESA

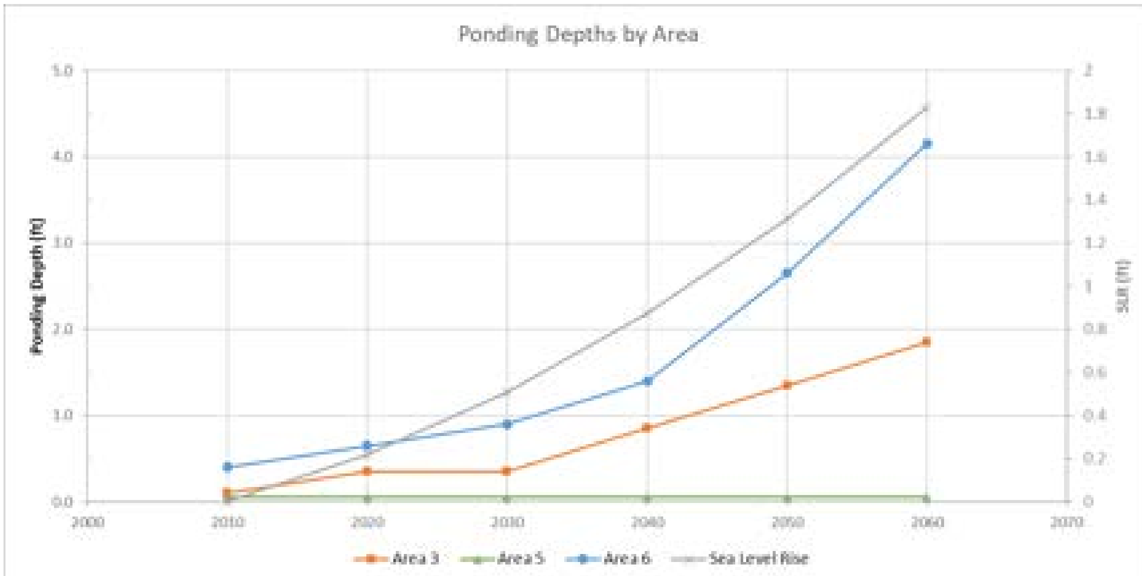
The reduction of space available for the existing Ormond Lagoon is depicted graphically in **Figure 2-28**. Figure 2-28 shows the increase in beach berm elevation (brown line) with sea-level rise and the corresponding reduction of the shore width available for lagoon formation (blue line). The available space is calculated as the distance between the shore line and the landward limit of the beach-dune strand (located in Figure 2-26). The beach berm elevation is derived from the profile change modeling (Figure 2-27). As SLR results in the landward migration of the shore line (see Figure 2-27), the width of the beach-dune strand is projected to reduce from over 600 feet to less than 400 feet by the year 2100. The beach berm elevation is projected to rise to nearly 13 feet NAVD88 by 2100. These projections correspond to sea-level rise scenario of 4.6 feet by 2100: Higher sea levels would result in reduced space for Ormond Lagoon. The lagoon evolution is further analyzed in Appendix E – Ormond Lagoon Hydrology and Morphology (Lagoon QCM).



Ormond Beach Restoration and Public Access Plan

Figure 2-28
Sea-Level Rise Induced Drivers to Ormond Lagoon Change

Wave overtopping is expected to increase due to the reduction in the width of the barrier beach and erosion of the dunes. The amount of overtopping was computed using the wave runup values from CRV (ESA 2013) for Areas 7 to 3 and Areas 9 to 5 and 6. Overtopping was computed using published equations driven by the height that potential wave runup exceeds the dune crest (FEMA 2005). The modeling of overtopping accounted for water losses resulting from travel over the beach-dune strand landward of the dune crest using a methodology derived from Laudier et al. (2011). A 1-year recurrence value for total water level (elevation of wave runup, including coincident tide) was used to compute overtopping volumes. The overtopping volumes were then converted to ponding depth in each back shore area based on the topography derived from LiDAR. **Figure 2-29** is a graph of the results, in terms of ponding depth over time, along with the sea-level rise curve. Area 6 ponding will increase about 200 percent by 2060 (from 0.5 feet to 1.5 feet), and much more in the latter half of the century. Area 5 is not expected to experience an increase in ponding from wave overtopping based on existing grades, at least as indicated by the 1-year event. Area 3 ponding is predicted to increase from about 0.1 foot to about 1.0 feet by mid-century, and to 2 feet by the end of century. These are approximate calculations of a complex physical process, but do indicate a strong likelihood of increased saltwater delivery.



Ormond Beach Restoration and Public Access Plan

Figure 2-29
Sea-Level Rise Induced Overtopping and Ponding in Areas 3, 4, and 5

2.4.3 Ormond Lagoon

A lagoon quantified conceptual model (QCM) was developed to investigate Ormond Lagoon, assess response to sea-level rise and evaluate restoration alternatives. This section summarizes the existing conditions analysis. Alternatives analyses are provided in Section 6. Details on the setup of the model are provided in the Appendix E – Ormond Lagoon Hydrology and Morphology (Lagoon QCM).

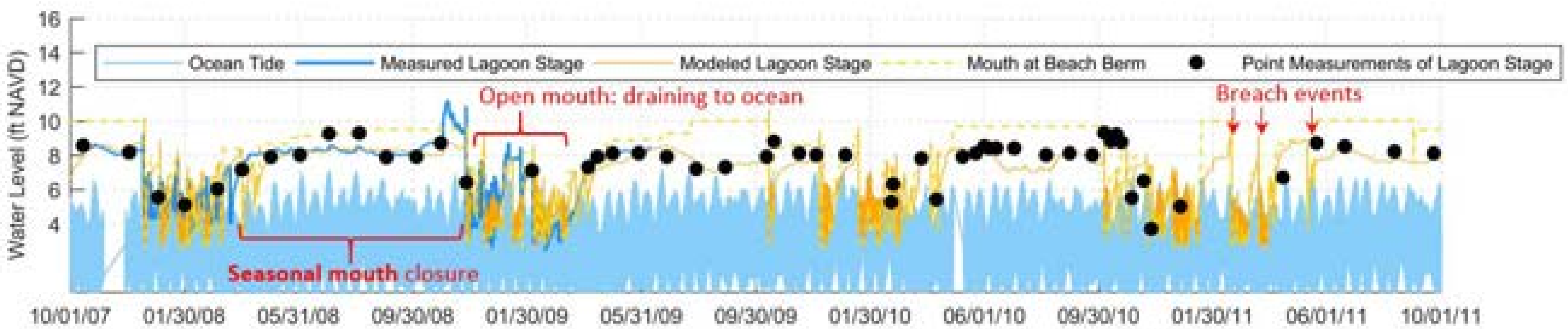
The lagoon QCM complements the additional tools described in this report, the beach QCM and Sea Level Affecting Marshes Model (SLAMM). The beach QCM (Section 2.4.2) provided coastal boundary conditions which informed the sea-level rise scenarios modeled by the lagoon QCM. The lagoon QCM provides detailed information on temporal changes in mouth morphology, seasonal lagoon water levels, and brackish areas, which supplement the more spatially-detailed habitat information provided by the SLAMM model (Section 2.4.4). The lagoon QCM was also used to analyze the three Project alternatives (as described in Section 6.3.1), and to predict future changes under each alternative with sea-level rise.

The QCM was run from October 2007 to October 2017, a 10-year period that includes a range of wet and dry years, and a high overlap of available data sets for testing the model. **Figure 2-30** shows a subset of the time series of measured water levels and modeled water levels, chosen to highlight certain behaviors. Although the exact timing of the measured closure and breaching events are not always captured, the model reproduces a number of important aspects of the existing Ormond Lagoon, such as: (1) periods of mouth scour during high watershed runoff, (2) mouth closure during high wave events, (3) stabilization of the water level at 8-9 feet NAVD88 during seasonal closure events, and (4) natural mouth breaching during floods.

Under present conditions, Ormond Lagoon spills water out to the ocean during the winter months, when runoff from local municipal and agricultural runoff is highest. Flows from the watershed are concentrated into a series of drainage channels, which cause flood flows to rapidly arrive at the lagoon during rainfall events, and to rapidly tail off after rainfall ceases. The lagoon receives little tidal action when the mouth is open to the ocean, owing to its high elevation on the beach. When runoff declines in the spring, wave action closes the mouth seasonally, usually for periods of at least 4 to 6 months. During these closure periods, residual runoff ponds in the closed lagoon, but balances with seepage and evaporative losses, giving relatively stable water levels of about 8 to 8.5 feet NAVD88 in the dry season. Ormond Lagoon is an estuary lagoon with a drainage outlet (not a tidal lagoon and not a tidal inlet), as described in Behrens et al. 2015, and generally consistent with the multiple historical lagoon estuaries depicted in the historic maps and ecology interpretations (see Section 2.2 Historical Setting).

To explore how future changes could influence the behavior of Ormond Lagoon, ESA ran the QCM model for same (2007–2017) time series with 3 feet of sea-level rise. **Figure 2-31** presents outlet mouth closure frequency under existing conditions and with 3 feet of sea-level rise. **Figure 2-32** shows the hydrology statistics in terms of water level, wetted area and volume for existing conditions and with 3 feet of sea-level rise. With sea-level rise, the model predicts that Ormond Lagoon will continue to have periods of seasonal closure and times when water spills out to the ocean with limited tidal action. A similar seasonal pattern with winter and spring breaches is still observed, although the pattern is less pronounced. The number of days the lagoon is closed is anticipated to increase and closures are predicted to last longer than under existing conditions. During some years, the mouth of the lagoon may be closed for the entire year. Future changes in climate are expected to affect rainfall and runoff, and land use changes may also affect runoff: These future changes are not addressed in this study.

Water levels in the lagoon during closure periods are anticipated to be higher than under existing conditions, with typical closure elevations between 10 and 11 feet NAVD88. Flood flows may cause water levels in the lagoon to reach up to 13 feet NAVD88. Note that typical ocean tides with 3 feet of sea-level rise will regularly exceed 10 feet NAVD88. However, the County intervenes by grooming the beach to limit water levels above flood stage, which is about 9 feet NAVD88; more frequent interventions will be required to limit flooding as the sea level rises, and alternative adaptation actions will likely be necessary. Grooming refers to grading the beach to a lower elevation to facilitate overtopping and drainage to the ocean. While beyond the scope of this Project, management actions would affect hydrology, and hence ecology and access.



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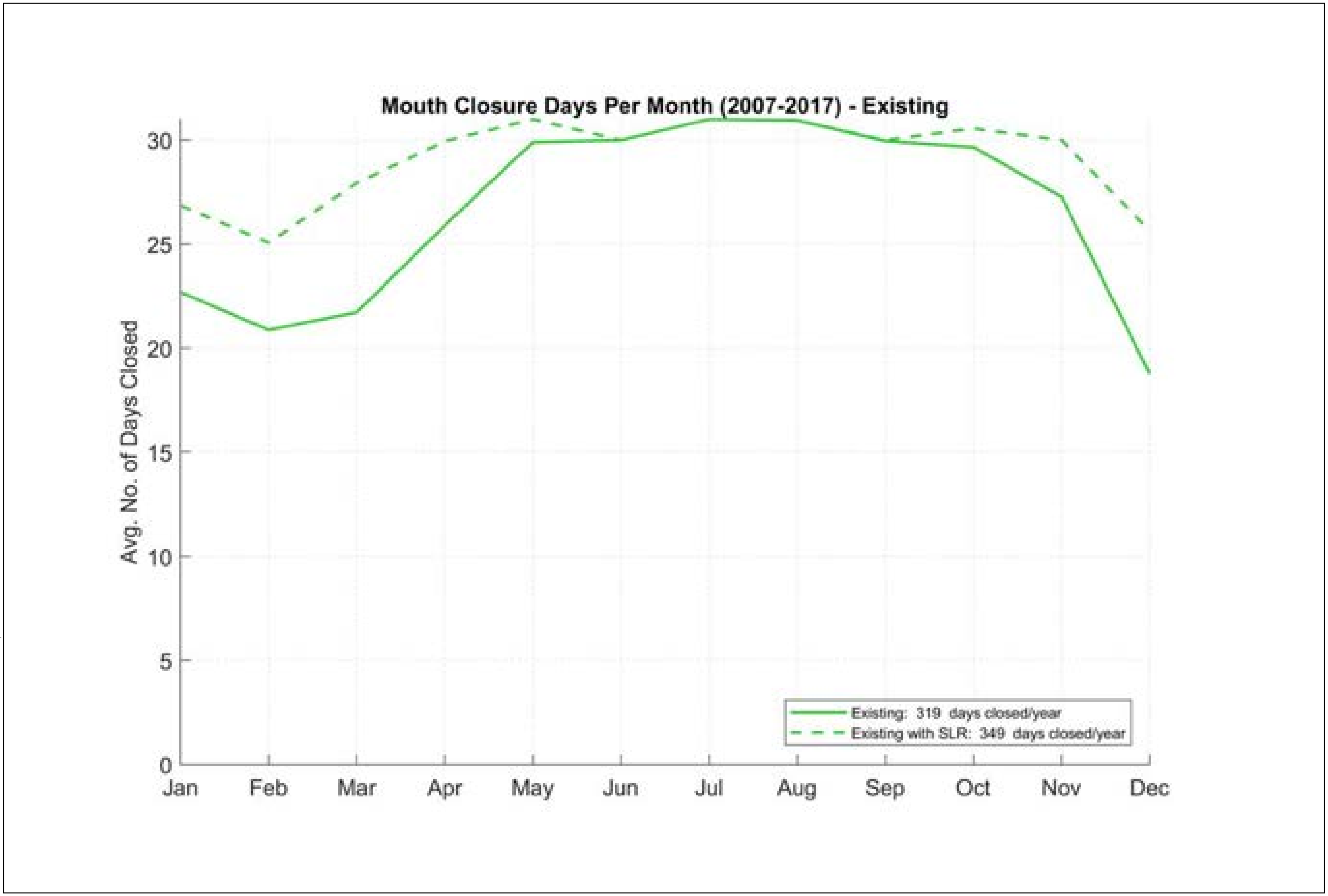
SOURCE: ESA

Figure 2-30
Comparison of Modeled and Observed Water Levels in Ormond Lagoon

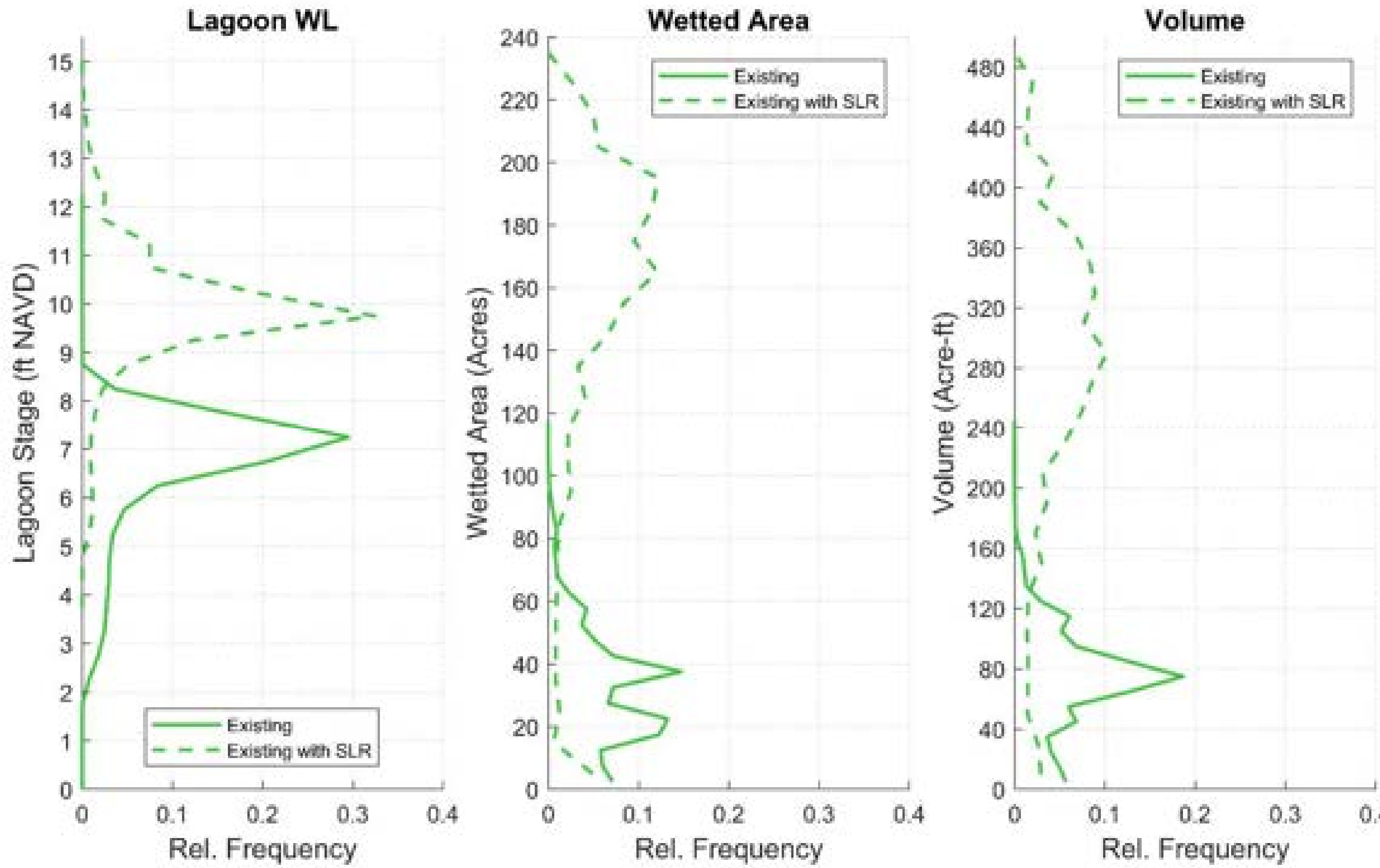
ESA



SOURCE: ESA QCM model

Figure 2-31
Lagoon Mouth Closures in Days per Month
Existing Conditions (No Project)

ESA



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SOURCE: ESA QCM model

Figure 2-32
Modeled Lagoon Stage (Water Level) (left), Area (middle), &
Volume (right) Probability Distributions for 2007–2017; Existing Conditions (No Project)

ESA

As the mouth remains closed more frequently and for longer durations, the amount of wetted area covered by the lagoon and the volume of water stored will increase. These results imply that the increase in the extent of inundated areas behind the dune line would contribute more to impoundment of water than to maintaining an open mouth. As sea-level rise increases water levels above 3 feet, more frequent open-mouth conditions may result. For Ormond Beach area, the very low topography would not constrain the water surface at these higher sea-levels, and a more detailed analysis of the basin hydrology is required to provide meaningful projections.

2.4.4 Wetland Habitats Evolution

As the sea level rises, the beach and wetland habitats at Ormond Beach are expected to change due to increasing inundation and geomorphic migration inland. This study used SLAMM to predict potential habitat changes in the Project Area that would be caused by sea-level rise. SLAMM is a software program that simulates wetland conversion and shoreline change due to sea-level rise (Warren Pinnacle Consulting [WPC] 2016). SLAMM uses ground elevation and slope, along with an initial habitat map and a sea-level rise curve, to estimate the conversion and migration of habitat areas over years to decades. Details of this study's application of SLAMM are provided in Appendix F – Wetlands Habitat Evolution Modeling (SLAMM) and summarized in this section.

This study was performed with SLAMM version 6.7 because it is the latest iteration of the software and includes some features developed for California estuaries and perched lagoon systems (WPC 2016). Previously, the Coastal Resilience Ventura project applied SLAMM version 6.2 beta to the stretch of shoreline including both Ormond Beach and Mugu Lagoon to the southeast (ESA PWA 2014). Although these two versions of the model used somewhat different input data sets and methodologies to project habitat evolution, the findings from the two studies are generally similar. Both indicate that Ormond Beach will begin to experience a notable increase in inundation after 2 feet of sea-level rise, and the effect of sea-level rise escalates to inundate nearly all the Project Area as sea-level rise approaches 5 feet.

SLAMM's key inputs are ground elevations, habitat mapping, and sea-level rise. Ground elevations and habitat mapping were updated to incorporate data collected in 2017. For sea-level rise, the CRV "High SLR" sea-level rise curve was used, for consistency with that prior work and other County of Ventura planning, as discussed above. This curve projects sea-level rise of 4.8 feet at 2100.

A key feature of the most recent version of SLAMM is that it allows definition of subareas with different hydrologic parameters. For Ormond Beach, we defined two main subareas for the model: the Ormond Lagoon Subarea and the Arnold Road Subarea. The Ormond Lagoon Subarea was defined to capture the effects of perched Ormond Lagoon water levels on habitat conversion in the west, and the Arnold Road Subarea was defined to capture the effects of rising groundwater levels on habitat conversion in the east. The rest of the domain includes developed areas, which are assumed to have unchanged land use from their current development, and the exposed beach and dune areas, which directly experience the open ocean tides and waves. The hydrology of each subarea was characterized based on water level and barrier beach crest observations.

Sea-level rise will cause landward transgression of ocean water levels and waves, which, in turn, will cause erosion and shift the beach and dunes further inland. These processes were addressed outside SLAMM, in the manner described above, and then overlain on the SLAMM results. The shore transgression (migration landward and up with sea-level rise) modeling is described in Appendix D – Shore Migration and Overtopping (Beach QCM). The habitat bands were shifted up with sea-level rise at each profile location and then interpolated. The shore habitat bands were then superimposed on the habitat mapping predicted by SLAMM. Note that SLAMM does not differentiate between "salt panne" and "mud flat" very well since these are often divided by salt supply and flushing patterns that are not captured in the model; thus, "salt panne" and "mud flats" are grouped and labeled "unvegetated flats" in the SLAMM results so as not to over-state model confidence in the distinction.

Results for the No Project scenario are incorporated into the next section, as part of the synthesis of the site's evolution.

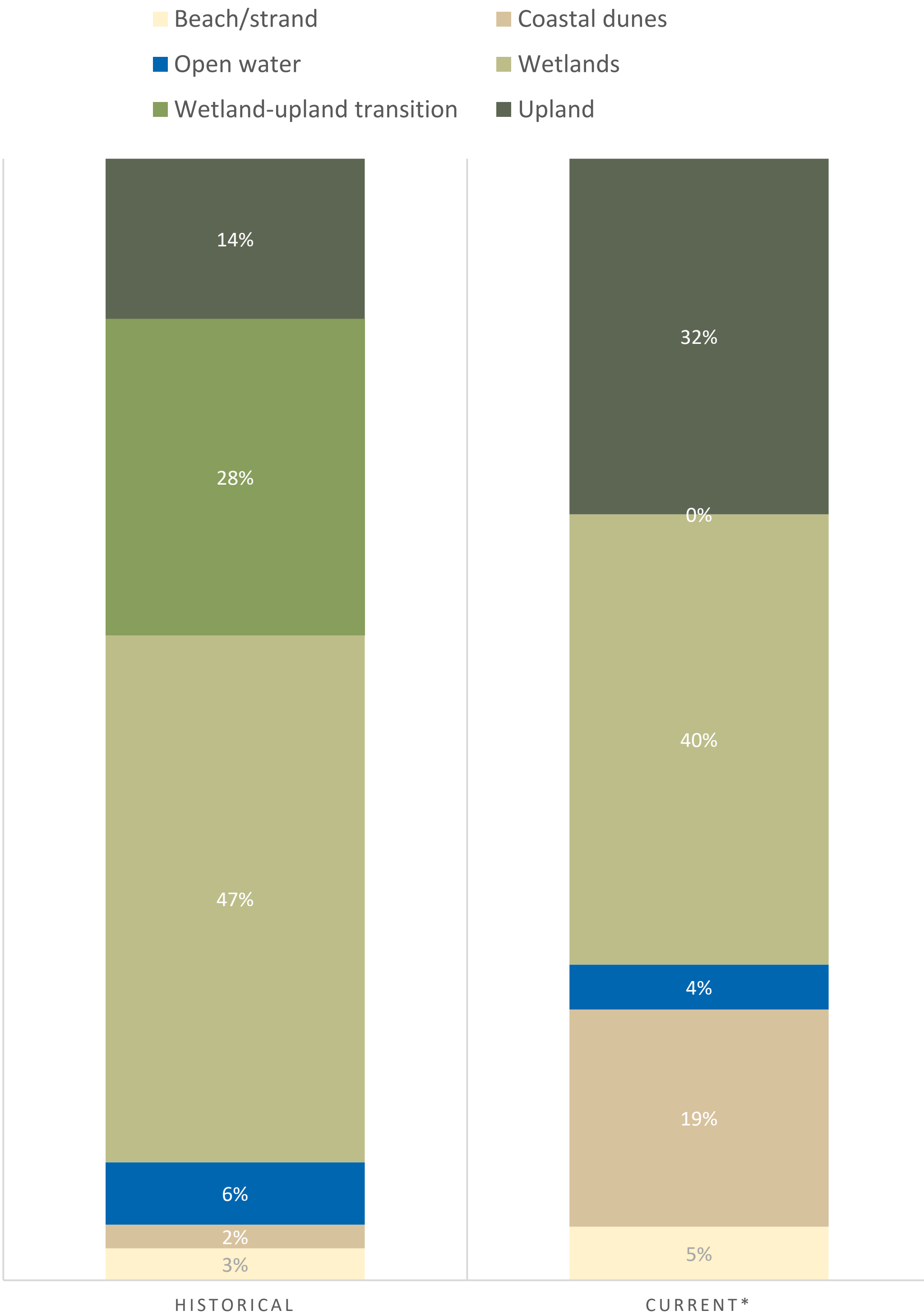
2.5 Synthesis of Site Evolution – No Project

The Project Area has experienced loss of wetlands due to land use changes and public works projects. The losses are quantified by comparing the habitat acreage percentages of the historical and existing conditions (**Figure 2-33**). The historical habitat acreages were taken from the SFEI historic ecology assessment (Beller et al. 2011). To account for the natural ecological boundaries and distribution, the historic extent was defined by the five coastal lagoons between Hueneme and Mugu. Historically, wetlands covered nearly half the Project Area (47 percent) but now cover about 40 percent of the site. Wetlands plus wetland-upland transition covered about 75 percent of the site historically with an additional 14 percent upland for a total wetland/transition/upland of 89 percent, whereas wetland and upland (including potential transitional elevations) now covers about 62 percent of the Project Area.

Forty percent of the Project Area is characterized as wetland habitat (Figure 2-33 excluding beach, dune, open water and upland) and direct encroachments are limited, indicating that the degraded wetland conditions will likely improve. However, there are uncertainties and concerns about some processes. For example, the backwater from Ormond Lagoon may be influencing the conversion of salt marsh to brackish marsh in Areas 2 and 3a, which may impact several rare habitat and plant populations. Interestingly, the sandy beach and dune strand have become slightly larger, which is attributed to the construction and management of Port Hueneme.

Sea-level rise is projected to have a significant effect on habitats by the end of the century and potentially as early as mid-century. **Figures 2-34 through 2-37** show existing habitats and projected future habitats for years 2060, 2080, and 2100, respectively. These figures were constructed by applying SLAMM, and adjusted using beach migration projections computed from the Beach QCM.

Standing water will become more prevalent with 2 feet of sea-level rise (approximately by 2060, see Figure 2-35), with salt pannes and salt marsh being inundated first. Fortunately, the site includes upland areas that can provide space for migration of these habitats in Areas 2, 4 and 5.



* Agricultural area (106 ac) and coyote brush scrub (30 ac) were grouped into “upland”.
Willow scrub (<1 acre) was grouped with surrounding “seasonal wetlands”.

D160447.00 - Ormond Beach Wetlands Restoration\05 Graphics\Illustrator

SOURCE: SFEI 2011, CRC 2018

Figure 2-33
Historical Habitat Distribution

ESA

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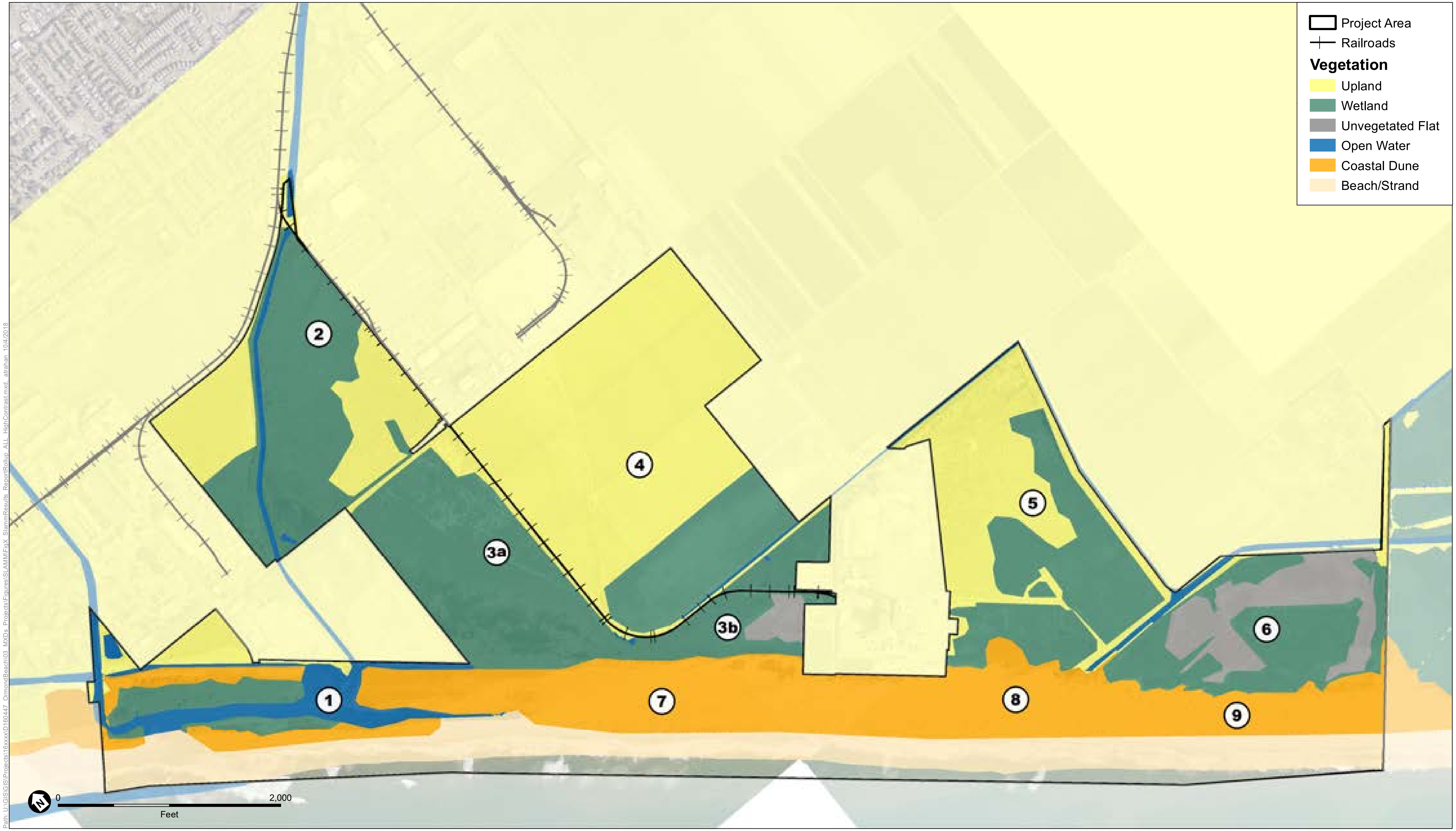
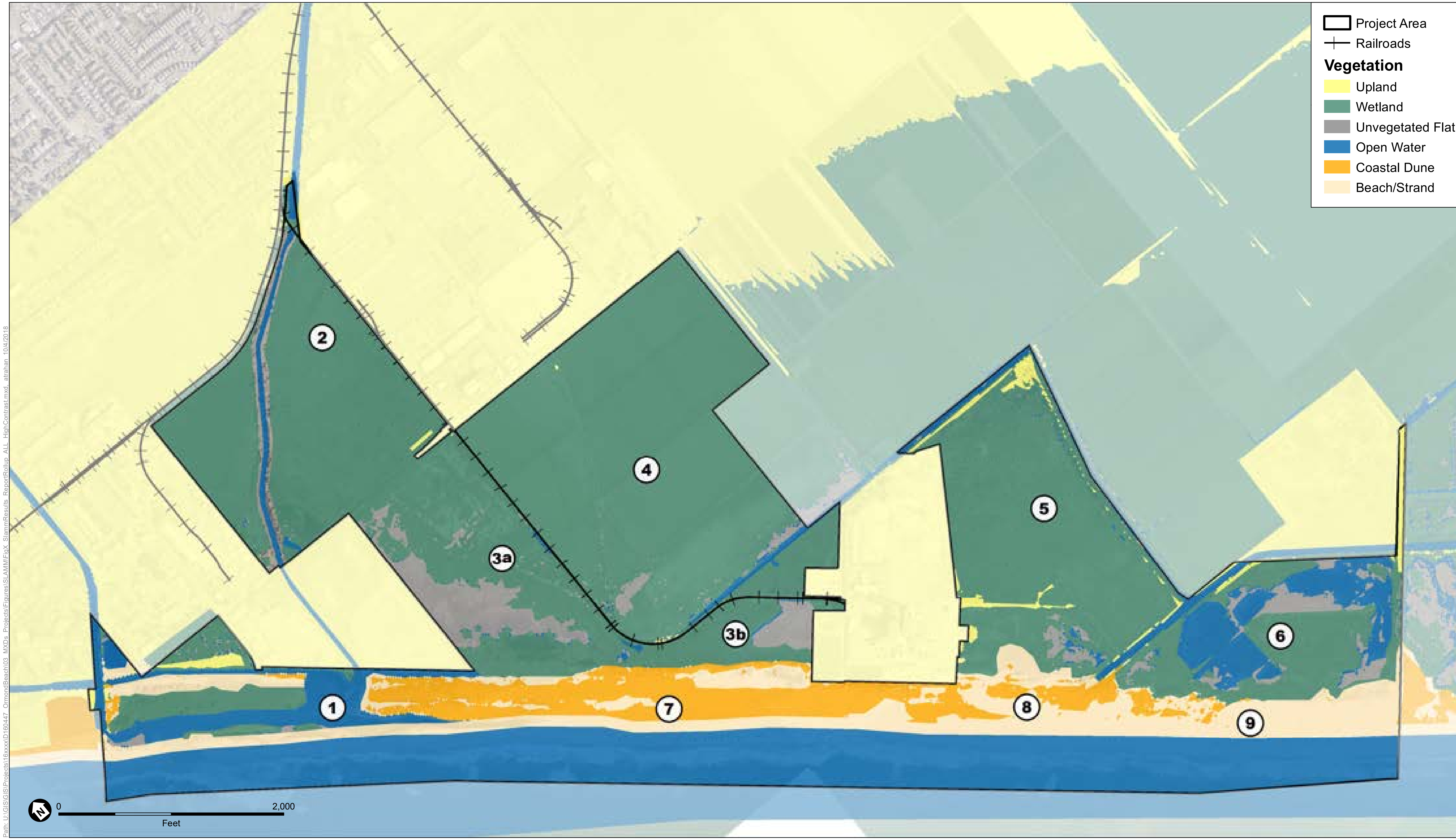


SOURCE: ESA (2017), CA Coastal Conservancy LiDAR (2011)

Ormond Beach Restoration and Public Access Plan

Figure 2-34
SLAMM Results with Beach Transgression
Existing Conditions, Current-Day

ESA

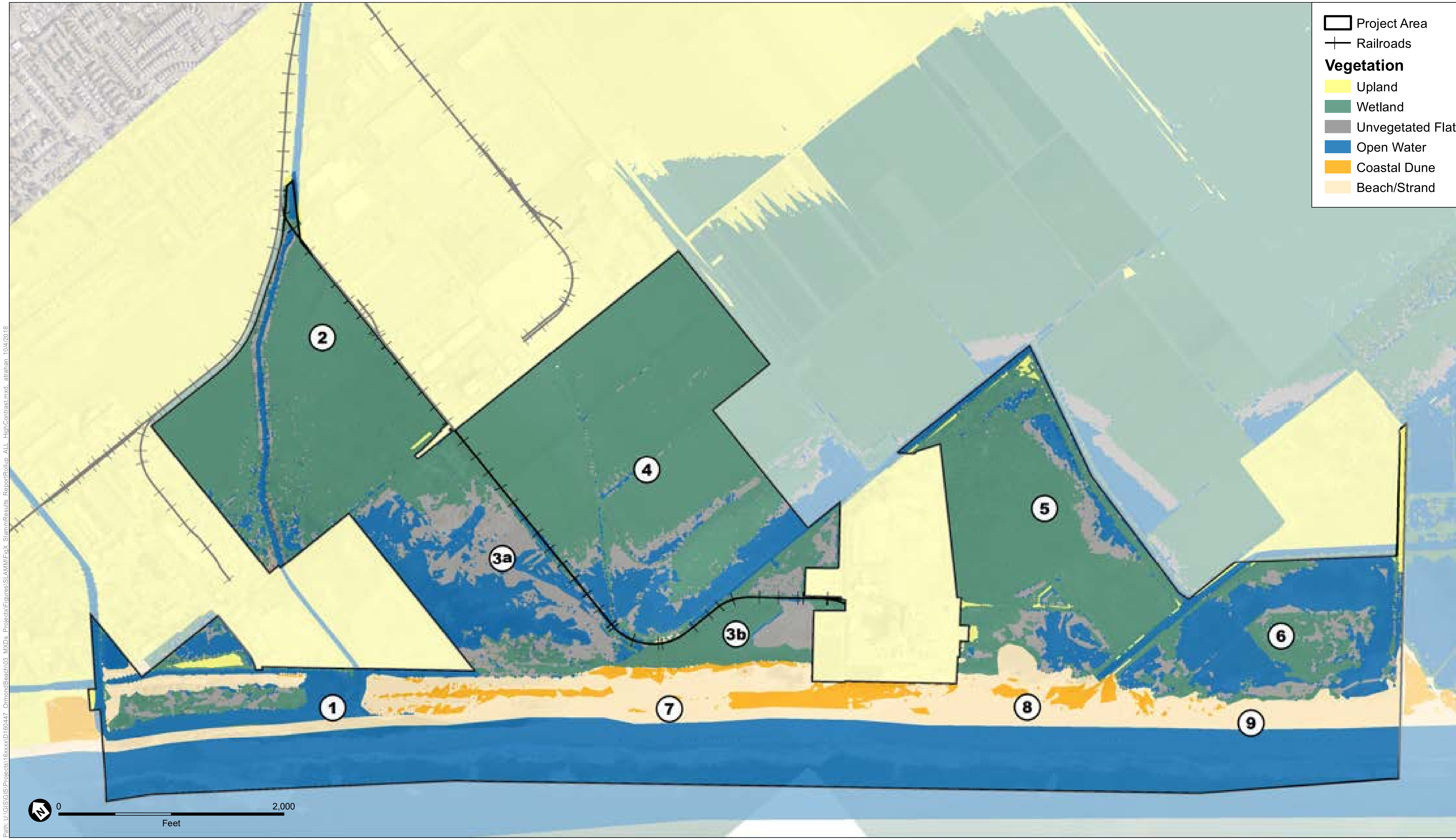


SOURCE: ESA (2017), CA Coastal Conservancy LiDAR (2011)

Ormond Beach Restoration and Public Access Plan

Figure 2-35
SLAMM Results with Beach Transgression Existing Conditions, 2060, +2.1 ft SLR

ESA



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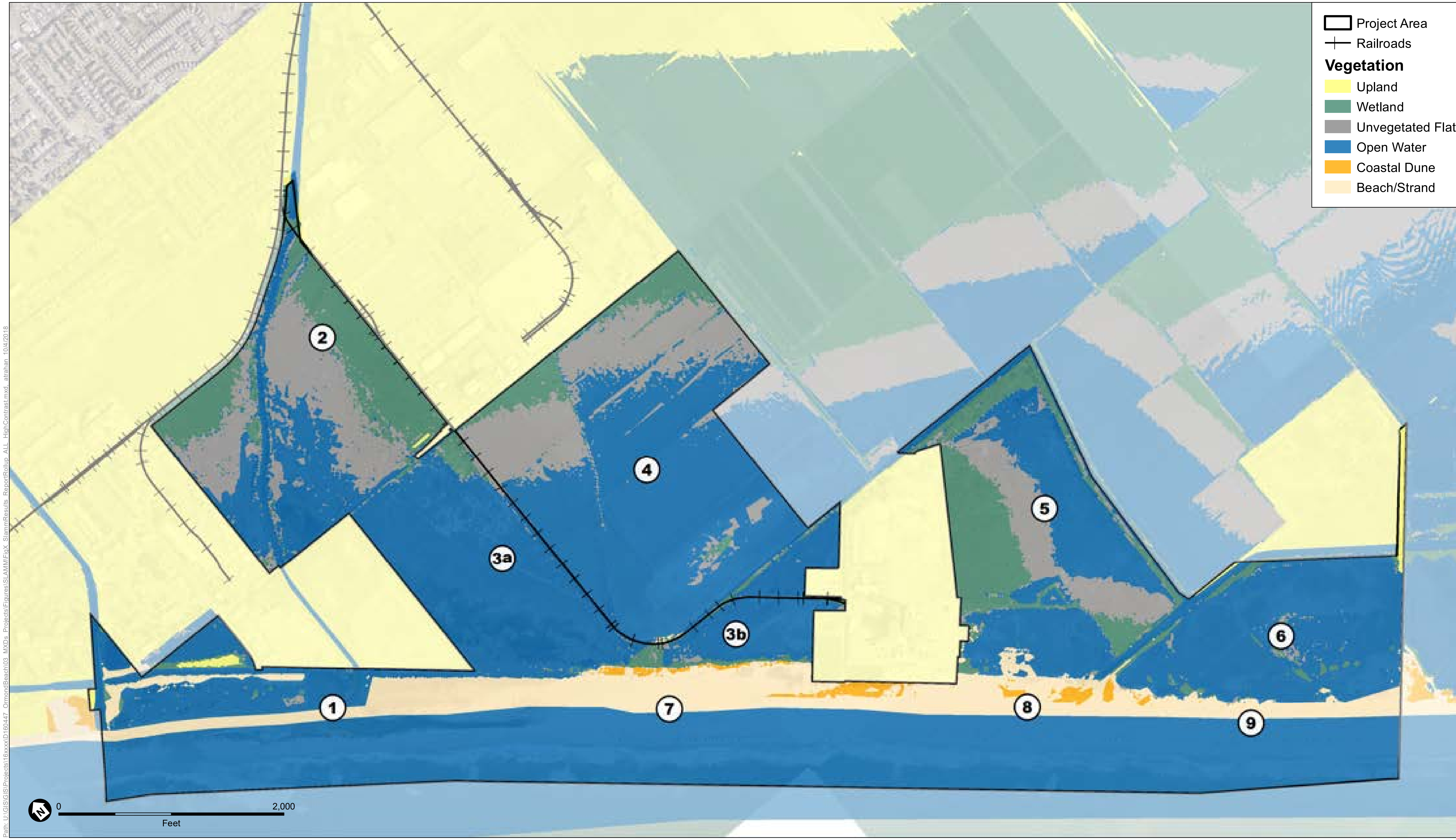
SOURCE: ESA (2017), CA Coastal Conservancy LiDAR (2011)

Figure 2-36
SLAMM Results with Beach Transgression
Existing Conditions, 2080, +3.4 ft SLR



SOURCE: ESA (2017), CA Coastal Conservancy LiDAR (2011)

Ormond Beach Restoration and Public Access Plan

Figure 2-37
SLAMM Results with Beach Transgression
Existing Conditions, 2100, +4.8 ft SLR

ESA

By the end of century when over 4 feet of sea-level rise is possible, we expect that the site will have much more standing water, and space for marshes would be limited to only higher portions of the Project Area, as well as adjacent properties, depending on land uses. Sea-level rise will also cause the shore to migrate landward, most likely maintaining a beach but diminishing the dunes and allowing more frequent wave overwash into the backdune marshes and pannes.

The figures show the progression of habitats and increase in ponded water. In particular:

- Ormond Lagoon is predicted to narrow as the shore migrates landward, and the potential water level rise as the beach rises.
- The higher lagoon waters will spread inland and essentially shift the lagoon into the low Area 3a.
- Groundwater augmented by wave overtopping will create a saline lagoon in Area 6, spreading into Area 5.
- Upland areas are projected to convert to saline and brackish wetlands, although it is not clear whether the rate of conversion will keep pace with the more rapid sea-level rise projected for the end of the century.

Note that the future predicted habitats are uncertain owing to both modeling limitations and uncertainty in water levels. Adaptive actions in response to future flooding are also factor that could locally change water levels and grades. For example, the projections indicate flooding in Oxnard around Areas 1 and 2, and flooding of the railway between Areas 3 and 4, which imply that either land use or other changes will be needed.

2.6 Potential Future Expansion

Expansion of the Project Area may occur in the future as a result of new land acquisitions and land use changes. Potential land acquisitions and changes are described below and shown in Figure 2-8.

2.6.1 MWD Parcel[15]

Recently, TNC acquired from the Metropolitan Water District (MWD) a rectangular parcel (20 acres) located adjacent to Edison Drive, TNC parcel, and the OBGS. This site is an attractive location for parking and access toward the Beach. Expanding the OBRAP project to include the MWD parcel could:

- Provide space for parking and other visitor serving facilities
- Additional area for habitat and future wetland migration with sea-level rise.

There are no apparent constraints beyond those associated with non-ownership.

[15] The MWD parcel was added to the project area while this report was being finalized and hence is not yet incorporated into the Plan.

2.6.2 Sod Farm

The Southland Sod Farm Property (aka “Sod Farm”) is an agricultural area north and west of Area 5 and the Ormond Beach Generating Station (OBGS) comprising about 561 acres between East Hueneme Road, Edison Drive, Arnold Road and the OBRAP site.

The addition of the Sod Farm property if acquired would greatly expand the restoration site, and also:

- Provide space for wetland migration with future sea-level rise due to higher site grades
- Potential improvement of water quality downstream by reduction of pollutants, biological nutrient reduction
- Reduced downstream flood potential via additional storage
- Access facilities
- Interim agricultural uses

Constraints are likely to be similar to other agricultural properties (e.g., Area 4), and not expected to be an impediment to restoration and public uses.

2.6.3 Ormond Beach Generating Station

The OBGS comprises about 50 acres between the middle portion of the restoration area (Areas 3 and 4) and the eastern portion (Areas 5 and 6), from Edison Drive to the dunes. The OBGS was originally constructed to produce electricity in the 1970s.The OBGS was expected to close by December 2020 in compliance with a State policy restricting power plants with “once-through-cooling.” However, the City has negotiated an agreement with GenOn, and the plant will continue to operate through 2023, as approved by the State Water Resources Control Board in September 2020. The future owner and land use for this parcel have not been determined.

The addition of the OBGS property could benefit the OBRAP:

- Habitat connectivity between the middle and eastern portions of the restoration site
- Public access to the beach without crossing railways
- Parking, with good access off Edison Drive
- Location for visitors’ center, potentially with an interpretive element addressing land use changes
- Remove unnatural structures and activities

Potential constraints that are apparent:

- Substantial structure demolition and removal (The agreement between the City and GenOn requires GenOn to shore up revenue and place $25 million into a trust fund so the plant can eventually be demolished, possibly in the 2025 to 2027 time frame)

- Possible water and soil contamination

2.6.4 Halaco Properties

The privately-owned Halaco properties—an 11-acre area where the metal smelter was located and an adjacent 26-acre area where the large waste pile is located—are both located at the southern end of the OLW, between Areas 1, 2, and 3. These properties are part of an EPA designated Superfund Site for which the EPA is presently developing a remediation plan (CSCC 2016). There are no current plans for acquisition of these parcels.

Incorporation into the OBRAP would facilitate restoration and public access goals. The 2030 General Plan designates the privately-owned Halaco properties as “Resource Protection” and the Local Coastal Plan identifies both properties as being located within the Ormond Beach Coastal Zone Area with a coastal land use designation of Coastal Dependent Industrial. Future opportunities and constraints will depend on remediation planning and implementation which at present is not defined.

2.6.5 Gateway Park

The City’s 2030 General Plan designates the privately-owned 8.15-acre property on Hueneme Road, near the southern end of Saviers Road (Area 2) as “Park.” This property and adjacent properties have long been identified as a potential “gateway park” area for Ormond Beach, which could also include a visitor/education center.

The Preferred Alternative identifies a visitors’ center in Area 4 (East McWane Blvd and Edison Drive). Development of the visitors’ center would be expected to take place during a later phase of the OBRAP.

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SECTION 3
Goals and Objectives

The overarching vision for the OBRAP is a resilient coastal environment that inspires the enjoyment, use, and support of the local community and beyond.

The Project Partners refined a set of goals and objectives, based on the Feasibility Study (Aspen 2005, 2009) and guiding scientific principles and considerations developed by the SAC (Ormond Beach SAC 2016). The OBRAP goals are also informed by two regional planning efforts: the Coastal Resilience Ventura project (ESA PWA 2014) and the Southern California Wetlands Recovery Project (SCWRP) Regional Strategy Update (SCWRP 2018).

The Project Alternatives are evaluated relative to how well they meet the following objectives and sub-objectives under Section 6.3.

3.1 Restoration Goal and Objectives

The restoration goal of the OBRAP is to preserve, enhance, and restore natural habitats and processes that support a dynamic and self-sustaining ecosystem at Ormond Beach.

Specific objectives and sub-objectives include the following:

1. Restore diverse, interconnected native habitats that consider the historical,[16] current, and future landscape context.
    a. Enhance and restore habitats including: beach; dune; coastal lagoon; seasonally ponded saline wetland and salt flat; high marsh and wetland-upland transition zone; upland; and riparian.
    b. Enhance and restore habitat for Project Area special-status, rare, and extirpated species where feasible (e.g., tidewater goby, California least tern, western snowy plover, Belding's savannah sparrow, and salt marsh bird's beak).
2. Restore physical and biological processes that sustain native habitats and ecosystems.
    a. Restore physical processes, such as hydrology, sediment dynamics, and water quality.
    b. Restore biological processes, such as vegetation composition and structure and food web dynamics.

[16] Historical refers to conditions up to the late 1800s prior to direct modification and development of portions of the Ormond Beach Wetlands, as documented in the report "Historic Ecology of the lower Santa Clara River, Ventura River, and Oxnard Plain" (Beller et al. 2011).

   c. Allow for a mosaic of self-sustaining habitats that are naturally dynamic, which change and move over time in response to physical processes (e.g., inundation during storm events, wave over-washing, and dune migration and change driven by winds).
   d. Create large areas of interconnected habitat with broad transition zones (i.e., ecotones).
   e. Provide and enhance ecological and hydrological connectivity within the site and with the site's watershed, the coast, and, if feasible, Mugu Lagoon.
   f. Provide natural buffers between core habitat areas and adjacent development and public access points.

3. Restore an ecosystem that is naturally resilient (i.e., able to respond, recover, and adapt) to climate change and sea-level rise.
   a. Promote resiliency to projected future climate change, including accelerated sea-level rise, extreme coastal storms, precipitation variability and extremes (i.e., drought and flood cycles and magnitudes), saline groundwater intrusion, and temperature.
   b. As the sea level rises, allow for dunes to migrate landward, wetland types to change within the site, and upland and transition zone habitats to convert to wetland.
   c. Consider local and regional changes in species distributions due to climate change and the potential for assisted migration of imperiled species to or from the site
   d. Employ restoration as a nature-based climate change adaptation approach that provides ecological benefits (such as reducing flood and erosion hazards) and promotes natural habitat as protection to developed areas ("green infrastructure") as an alternative to human-built structures such as concrete channels and seawalls ("grey infrastructure").

4. Restore habitats that contribute to regional ecological wetland recovery goals.
   a. Implement the WRP Regional Strategy goals and principles.
   b. Enhance the site's ecological function as a part of an interconnected system of wetland and upland habitats along the coast, the Pacific flyway, and inland (e.g., by enhancing wildlife corridors; conditions that support migrating birds; and connectivity with Mugu Lagoon, the Santa Monica Mountains, and Los Padres National Forest).
   c. Consider opportunities to accommodate certain coastal wetland habitats and species that have experienced disproportionate loss at local and regional scales.

3.2 Public Access Goal and Objectives

The public access goal for the OBRAP is to enhance opportunities for people to easily and safely visit Ormond Beach and enjoy the nature, educational and research opportunities, and recreation that are compatible with the restored Ormond Beach ecosystem.

Specific objectives and sub-objectives include the following:

1. Provide improved access features, such as staging areas, trails, interpretive signs, viewing opportunities, restrooms, shade structures, picnic tables, benches, trash cans, and safe parking consistent with preserving natural ecosystems and minimizing disruption to natural processes, habitats and associated species, and ecological functions (e.g., that do not conflict with sand dune formation and lagoon hydrology).

2. Enhance opportunities for recreation, including walking/hiking, wildlife viewing and bird watching, picnicking, fishing, and surfing.
3. Improve local community connectivity to Ormond Beach.
   a. Connect regional and local bicycle and/or multi-use trails to the Ormond Beach trail networks.
   b. Provide directional and informational signs at local public transportation stops or entry points.
4. Identify the segment of the California Coastal Trail through Ormond Beach, with connections to the proposed trail alignment to the southeast and northwest of the site.
5. Establish buffers to protect sensitive species while allowing visitors to view these habitats in a manner consistent with their protection (e.g., maintaining adequate distances between public access features and sensitive habitats and use of bird blinds).
6. Ensure compatibility with and minimize disturbance to adjacent land uses.
7. Encourage community involvement and participation in restoration and/or management activities.

3.3 Alternative Development Guidelines

The following guidelines were considered in the development of alternatives and the adaptive management framework. The purpose is to ensure that the OBRAP Preferred Alternative avoids or minimizes potential impacts to resources and neighboring land uses where possible; is consistent with existing plans and regulations; can be implemented in a phased approach if necessary; and includes a science-based adaptive management framework for evaluation, decision-making and management. The guidelines include:

1. Minimize impacts to sensitive habitats.
2. Limit contaminant concentrations from upstream and adjacent (e.g., Halaco properties) sources (e.g., excess nutrients, heavy metals, organic compounds) below State/federal standards and other published/accepted levels of adverse effect.
3. Avoid impacts to the restored ecosystem and public access from existing operations on adjacent properties.
4. Avoid impacts to existing operations on adjacent properties.
   a. Maintain or improve the existing level of flood protection.
   b. Consider compatibility with adjacent agriculture practices.
5. Be consistent with natural resource management, habitat restoration, and flood protection as known at adjacent NBVC Point Mugu.
6. Support recovery plans for rare, threatened, and endangered species and their listed critical habitats.
7. Employ adaptive management to learn, improve management, and address restoration and scientific uncertainties.

8. Design and implement Project elements in a manner that is timely, feasible, cost-effective, and sustainable.
    a. Phase implementation to start delivering ecological benefits within the near term and in the long term as funding and additional areas become available.
    b. Employ design, implementation, and maintenance practices that minimize the need for or intensity of ongoing maintenance and management (e.g., planting design and irrigation, weed control).
9. Prepare and implement a long-term monitoring and management plan for:
    a. Maintenance and management (e.g., invasive control, trespass prevention) with realistic (limited) scale, frequency and costs.
    b. Learning and adaptive actions consistent with regional and statewide protocols.
10. Monitor restoration performance using methods consistent with regional protocols to inform adaptive management and allow for statewide comparison of monitoring results.
11. Include quantifiable measures of success, and base goals on scientific evaluation of feasible alternatives.

SECTION 4
Opportunities and Constraints

The OBRAP faces a variety of opportunities and constraints, shaped by historic, existing, and future conditions. The Feasibility Study (Aspen 2009) identified opportunities and constraints for a larger footprint in the course of considering a broader "unconstrained alternative." The OBRAP reviewed and updated potential opportunities and constraints for habitat restoration and public access improvements. Potential opportunities will require further evaluation to confirm feasibility and to develop concepts and alternatives using these opportunities. Note that opportunities are often informed by constraints, and vice-a-versa. When applicable, associated constraints or opportunities are addressed briefly in each discussion.

4.1 Restoration Opportunities and Constraints

Table 4-1 outlines the current opportunities and constraints related to habitat restoration.

TABLE 4-1
RESTORATION OPPORTUNITIES AND CONSTRAINTS

Opportunities	
1.	Maintain the beach and dunes over the long-term with future sea-level rise.
2.	Enhance and restore a diverse array of wetland habitat types and ecotones that are resilient to sea-level rise and climate change.
3.	Restore a hydrologic connection between the Ormond Beach wetlands and Mugu Lagoon via ODD #3.
4.	Expand and enhance the lagoon's existing intermittently open and closed lagoon wetland habitat and potentially create a new lagoon not subject to mouth management.
5.	Route water from OLW to the Project Area.[1]
6.	Incorporate best management practices and treatment wetlands into the Project Area to improve the lagoon water quality.
7.	Enhance and restore seasonally inundated wetland and salt flat habitat.
8.	Restore creek channels and associated wetland habitats, thereby reducing channelization and increasing infiltration of freshwater channel inflows.
9.	Phasing of the Project if land acquisition is delayed, which could allow development and refinement of adaptive management techniques that promote long-term habitat viability and sustainability.[1]
10.	Support wetland restoration and enhancement with supplemental water sources that may be available. Potential sources identified in 2009 include the Calleguas Municipal Water District Brine Line, City of Oxnard Brine Line, seawater effluent from the OBGS, agricultural water from United Water Conservation District, and recycled water from the City of Oxnard.[1]

TABLE 4-1 (CONTINUED)
RESTORATION OPPORTUNITIES AND CONSTRAINTS

Constraints	
1.	The channels that flow into and through the Project Area, including tšumaš Creek, OLW, and ODD #3, carry polluted water and sediment to and/or through the Project Area.
2.	The Halaco properties, Ventura County Railroad spur, and OBGS limit ecological connectivity across the site.
3.	Flooding of local industrial properties should not be increased and restoration should not conflict with flood management functions of tšumaš Creek, OLW, and/or the lagoon.
4.	The potential for bird air strike hazards for the NBVC Point Mugu to the southeast should not be increased.
5.	Halaco Properties and portions of the Project Area adjacent to the Halaco Properties are part of the Halaco Superfund Site and may require remediation prior to restoration.
6.	Historic Arnold Road dump could be a source of contaminants.
7.	Trespass, unauthorized uses, vandalism, and trampling of sites could affect restoration outcomes

NOTES:
1 This opportunity or constraint was first identified in the 2009 Feasibility Study (Aspen 2009)

4.1.1 Restoration Opportunities (ROs)

RO #1: Maintain the beach and dunes over the long-term with future sea-level rise.

Ormond Beach provides a large stretch of coastline in where the backshore is largely natural open space—a unique opportunity for Southern California. The beach and dune system can therefore move landward along much of the Project Area's coastline in response to future sea-level rise and beach erosion, allowing the beach and dunes to persist over many decades with several feet of sea-level rise (see Section 2.4.2 for a more precise forecast of response to sea-level rise). In contrast, coastal development and hardened infrastructure such as sea walls, roads, and buildings in other locations may "squeeze" beaches as the sea level rises, leading to beach loss and risk of flooding or damage to the developed areas by high tides and storm surges.

The ability for the beach and dunes to migrate inland over the long-term also provides the opportunity to maintain the ecological systems in the Project Area. By retaining critical habitat, ecological functions and services are preserved, such as bird nesting habitat and wetlands.
A long-lasting beach and dune system also provides a natural buffer from coastal flooding and preserves access to a beach for future generations that could lose many other beach access opportunities due to sea-level rise.

The ability of the beach and the dunes to migrate and persist depends on sand supply and the relative rates of beach and dune migration. The Santa Clara River supplies sand to the Oxnard coast and waves transport sand down the coast to the beach in episodic cycles that depend on storms and dredging at Port Hueneme. Winds blow sand from the beach to build dunes. Adequate sand supply is necessary to maintain the beach and dunes. Also, if the rate of beach recession in response to coastal erosion with sea-level rise reduces sand supply to the dunes or is faster than the rate of wind-driven dune migration, the dunes could narrow over time. These processes will therefore be assessed in a sea-level rise assessment for the OBRAP.

RO #2: Enhance and restore a diverse array of wetland habitat types and ecotones that are resilient to sea-level rise and climate change.

In the late 1800s, the Ormond Beach area supported a diverse array of wetlands including a fresh/brackish non-tidal lagoon, salt/brackish marshes supported by rainfall and beach overwash events, seasonal ponds that dried to salt flats, and dune swale wetlands in and behind the dune system. The Project Area provides the opportunity to restore a similar diversity of wetland habitats and the ecotones between them and adjacent uplands. Given that the Project Area extends almost a mile inland, there is also the opportunity for this mosaic of habitats to move inland with future sea-level rise, thereby maintaining the diversity of habitats with climate change.

The inland migration of wetland habitats with sea-level rise and resulting changes in habitat and "evolution" of the Project Area depends on many factors, including site topography, sedimentation and accretion, the influence and changes in the timing and quantity of fresh water and saltwater flows and groundwater inputs, and resulting vegetation response. These processes will also be assessed in a sea-level rise assessment for the OBRAP.

RO #3: Restore the historic hydrologic connection between the Ormond Beach wetlands and Mugu Lagoon via Oxnard Drainage Ditch #3.

The current ODD #3 provides the potential opportunity to create a muted-tidal connection between the Project Area and Mugu Lagoon. ODD #3, which is maintained by the Oxnard Drainage District No. 2, currently serves as an agricultural drainage ditch for agricultural fields to the north of the Project Area. The ditch drains toward the east under Arnold Road, through the NBVC Point Mugu, and through a series of culverts under the Naval Base runway and South L and M Avenues to Mugu Lagoon. The ocean tide range is muted and reduced by the mouth of Mugu Lagoon and the series of culverts along ODD #3. Within the Project Area, the ditch primarily conveys agricultural drainage downstream, however, the ditch experiences some backwater tidal influence. The culverts under the Navy runway are partially filled-in and blocked with sediment. In cooperation with the Navy, impediments to tidal flows in the ditch could be removed, for example by cleaning out the runway culverts and/or removing drainage structures along the ditch. The ditch could be connected to restored wetlands on the Project Area, which would increase the volume of tidal flows (tidal prism) and could support muted-tidal marsh.

Additional information, assessment, and coordination with the Navy are required to determine the feasibility of this connection. Ongoing coordination with the Navy is expected to yield additional information. In order for this connection to be feasible, it would need to reduce potential effects to the Navy and agricultural operations. Navy considerations include the potential to increase inundation of wetlands on the base, thereby potentially increasing bird air strike hazards, and that construction near the runway (e.g., to remove sediment and/or expand the culverts) would affect use of the runway. In addition, as discussed in Constraint 2 below, ODD #3 water and sediment quality is impaired (polluted) by pesticides and PCBs and contains sediment that is toxic to benthic organisms. These pollutants would need to be addressed in planning a connection to ODD #3, for example by not restoring a connection before water and sediment quality pollutants are remediated. Finally, any proposed changes to the structures or flows within the ODD #3 will require the cooperation and agreement of the Oxnard Drainage District No. 2.

RO #4: Expand and enhance the lagoon's existing intermittently open and closed lagoon wetland habitat and new lagoon habitat

The existing lagoon provides intermittently open and closed lagoon wetland habitat that supports sensitive species such as the federally-endangered tidewater goby. The existing lagoon habitat could be expanded by connecting the lagoon to restored wetland areas to the west and along the OLW to the north. The VCWPD currently maintains the lagoon outlet for flood management by lowering the beach berm to an elevation of 8.9 feet NAVD88, which allows for storm flows to overtop the berm and reduces flood levels in the lagoon and channels (see RC #4 below for additional discussion). Expanding the lagoon habitat could provide additional flood storage and reduce the need to maintain and lower the beach berm, which could potentially enhance habitat conditions in the lagoon. Alternatively, or in addition, creation of a new lagoon not subject to mouth and water level management could be considered.

Further hydrologic and ecologic assessment is required to identify restoration actions to expand the lagoon (e.g., new channel connections), evaluate the hydrologic response (e.g., change in lagoon water levels and flood levels), and evaluate potential ecological benefits (e.g., effect of increased closure on tidewater gobies).

RO #5: Route water from Ormond Lagoon Waterway to Project Area.

OLW flows through the North TNC Marsh, through the middle of the Halaco properties and into the Lagoon. There is an opportunity to divert high flows to the Project Area, construct a new channel into the Project Area, and then fill or block the existing channel upstream of the Halaco properties. The OLW flows would be used to enhance wetlands in Area 2. There could be a benefit to flood management by separating the channel from the most vulnerable properties and an improvement to water quality by avoiding the Halaco properties.

The OLW is maintained by the VCWPD upstream of TNC's property and they have a maintenance easement on TNC's property. Realignment of the OLW will require a Watercourse Permit from the VCWPD and a revision to their easement.

RO #6: Incorporate BMPs or treatment wetlands into the Project Area to improve lagoon water quality.

Water quality in Ormond Lagoon is degraded, due to pollutants in agricultural and urban runoff that drains into tšumaš Creek, OLW, Hueneme Drain, and TNC agricultural field drainage ditch. Filtering or treating urban or agricultural runoff can help improve water quality before flows enters Ormond Lagoon. When water flows across a broad area such as a wetland, pond, or swale, it slows down and many suspended solids settle out or are trapped by vegetation (EPA 2004). Other pollutants are removed or transformed into other forms that may be more or less soluble or bioavailable (EPA 2004). Implementing strategies upstream can reduce potential for on-site exposure and toxicity (Sutula and Stein 2003).

Constructed treatment wetlands, which usually combine a sedimentation pond followed by a series of wetland cells, use natural processes to assist partially in treating a water source or effluent (EPA 2000). Low flows and the "first flush" or rising limb of storm hydrographs could be routed through treatment wetlands; however, higher storm flows would need to bypass treatment wetland due to storage limitations. A survey of freshwater wetlands in southern California found that treatment wetlands reduce contaminants relative to inflow conditions (Brown et al. 2008). However, these systems require long-term, regular management and maintenance, which would be an ongoing expense for the Project. EPA guidelines recommend constructed treatment wetlands be sited in uplands to avoid impacts to existing wetlands (EPA 2000). Suitable locations would be limited to Areas 2 and 4. In addition, these wetlands often pose a risk of elevated sediment contaminants and/or toxicity (Brown et al. 2008). Given these considerations, and the desire to have naturally functioning system, constructed treatment wetlands are likely not cost-effective.

Expansion of vegetated wetlands surrounding the OLW and the Ormond Lagoon may lower inputs of nutrients or sediment-borne contaminants to the lagoon and thereby improve water quality. Rerouting the OLW through the wetlands on TNC property in Area 3a would improve connectivity of the channel with the wetland floodplain, which could also facilitate deposition of sediments.

Best management practices (BMPs) such as vegetated filter strips and bioswales can help filter out pollutants without the intensive construction and ongoing management of a constructed treatment wetland. The treatment capacity will be more modest, but the system will function more naturally. These BMPs have been used in other southern California systems, and have been recommended to improve Ormond Lagoon water quality for tidewater goby (Lindley et al. 2018).

Further hydrologic and water quality assessment would be required to assess the potential water quality benefit based on the required size of a treatment wetland, extent of nutrient processing, resulting reduction in the lagoon, and operational costs. Also, consideration will be given to the potential for site contamination and associated wildlife effects by reviewing water quality data and, if needed, conducting additional analysis.

RO #7: Enhance and restore seasonally-inundated wetland and salt flat habitat.

Salt flat and non-tidal seasonally-inundated wetland habitat could be restored behind the beach dunes similar to the historic habitats present in the late 1800s. The existing salt flat area at Arnold Road is likely supported by residual soil salinity, direct precipitation, clay soils that pond water, as well as occasional wave overtopping of the lower elevation dunes and overflow from ODD #3 during periods of high rainfall and flow in the ditch. The former tank farm area was also inundated and supported wetlands after heavy rainfalls during the 2016/2017 winter. These areas and others could be enhanced or restored as seasonally inundated wetland and/or salt flat habitat by restoring and/or managing hydrologic connections to surface water flows, groundwater, and tidal and/or wave overtopping inputs.

Seasonally-inundated habitats are highly variable in space and time and depend on many inherently uncertain factors, such as annual rainfall and large wave events coinciding with high tides. Habitats could be largely dry during extended periods of drought, such as the multi-year drought prior to 2016. Different types of vegetation might expand or contract during droughts. Pickleweed will grow lower in basins due to decreased flooding stress. Droughts might also result in higher soil salinities, which favor salt marsh vegetation over brackish species such as tule and cattail. Extended wet periods will favor the expansion of tule and cattail as soil salinities drop and years of especially high rainfall might lead to the upward contraction of pickleweed.

The dynamic nature of such wetlands is important for wildlife as well. For instance, the salt panne on the SCC parcel near Arnold Road provide nesting areas for western snowy plovers in dry years when the area is not flooded. In wet years, when the salt panne is flooded, the area becomes an important foraging area for this species due to the invertebrates that the ponded saline water supports.

The uncertainty and variability in habitat inundation is likely to increase with climate change, with the potential for longer periods of drought followed by winters with more extreme rainfall. The potential hydrology, inundation regime, uncertainties, and effects of climate change for seasonally-inundated habitats can be evaluated in a subsequent water balance assessment for the OBRAP.

RO #8: Restore creek channels and associated wetland habitats, thereby reducing channelization and increasing infiltration of freshwater channel inflows.

The OLW and the drainage ditch through TNC agricultural field are remnants of historic intermittent or ephemeral drainages (Beller et al. 2011). A portion of the ODD #3 also follows a historic “finger” of tidal marsh. These historic features and their hydrology and habitats have been heavily modified through channelization. These and other channels, such as tšumaš Creek, could be enhanced and connected to restored wetlands adjacent to the channels. Freshwater creek flows could support restored riparian, freshwater wetland, and brackish marsh habitats. Reconnecting these channels to restored wetland habitats would reduce channelization and could allow for creek flows to infiltrate into wetland soils. This provides the opportunity to enhance surface water and groundwater patterns to support restoration across the Project Area. This approach could also create wetlands that provide water and sediment quality treatment functions.

As discussed above and in Constraint #2 below, water and sediment quality in ODD #3 is impaired by pollutants. Water and sediment quality in OLW, tšumaš Creek, and TNC agricultural field drainage ditch may also be impaired by pollutants from agricultural and urban runoff. For example, a fish kill in tšumaš Creek in 2015 was attributed to pyrethroid pesticide (CDFW 2015). Water and sediment quality impairments would need to be considered further and addressed in planning enhanced connection to these channels, for example by not restoring a connection before water and sediment quality pollutants are remediated, including upstream measures by others to reduce pollutant loading. If restored wetlands are used to provide water and sediment quality treatment functions, portions of the wetlands may require maintenance to remove sediments that accumulate pollutants. This could be accomplished by creating treatment wetland areas that are specifically planned, designed, and maintained for treatment functions.

RO #9: Phasing of the OBRAP and adaptive management.

Although the Project Partners have been pursuing the acquisition of additional parcels, their availability, and the timing of their availability, is currently unknown. Due to this uncertainty, it is possible that implementation of the OBRAP may require phasing to accommodate future land purchases, as well as resolve other logistical issues such as funding for implementation (Aspen 2009). In addition, phasing of the OBRAP may provide opportunities for the development and refinement of adaptive management techniques that promote long-term habitat viability and sustainability. "Adaptive restoration" (Zedler 2016) could also be used to reduce uncertainty among restoration actions. This approach uses field experimentation to simultaneously compare multiple actions, preferably in phased tests, so that early results can inform later restoration (Zedler 2016).

RO #10: Support wetland restoration and enhancement with supplemental water sources that may be available.

The Feasibility Study (Aspen 2009) identified five supplemental water sources other than groundwater that could be used at the Project Area: the Calleguas Municipal Water District Salinity Management Pipeline, the City of Oxnard brine line, seawater effluent from the OBGS, agricultural water from United Water Conservation District, and recycled water from the City of Oxnard. Many of these sources, however, may no longer be available, such as the City of Oxnard's brine line and the OBGS, which is projected to cease operations. Supplemental water could be used to maintain water levels in certain areas, but a final determination of needs cannot be determined until final design plans for the OBRAP are completed.

4.1.2 Restoration Constraints (RCs)

RC #1: The channels that flow into and through the Project Area, including tšumaš Creek, OLW, and ODD #3, carry polluted water and sediment to and/or through the Project Area.

The EPA and the Regional Water Quality Control Board (RWQCB) have listed ODD #3 for water and sediment quality and established TMDLs for pesticides, PCBs, and sediment toxicity (EPA 2011). The responsible parties identified by the EPA and RWQCB will be required to implement remediation actions to meet the TMDLs; however, the RWQCB has not yet developed or adopted schedules for TMDL implementation (E. Mutkowska, VCWPD, personal communication., July 21, 2017). The timing for remediation of ODD #3 is, therefore, uncertain. Oxnard Drainage District No. 2, which manages ODD#3, indicates that water quality is not degraded at present (personal communication to Project Partners, October 22, 2018).

While the EPA has not listed tšumaš Creek and the OLW as impaired or polluted, these channels likely carry pollutants from urban and agricultural runoff. A fish kill in tšumaš Creek was likely due to exposure to pyrethroid pesticides (CDFW 2015). The USFWS is concerned about impacts of pyrethroids on tidewater goby (Lindley et al. 2018).

The OBRAP could address this constraint of impaired water and sediment quality using one or more of the following approaches (as described above under RO #6):

- Do not enhance the hydrological connection to ODD #3 until its TMDLs are met and water and sediment quality is remediated. A connection with the ditch could be planned for in a later restoration phase after remediation.
- Include water and sediment quality BMPs and/or treatment wetland features within the Project Area to treat portions of the flows from tšumaš Creek, OLW, and ODD #3. Portions of the treatment wetlands would need to maintained periodically by removing any accumulated contaminated sediment and vegetation. BMPs such as vegetated filter strips and bioswales would be a less intensive approach to filter out contaminants (Lindley et al. 2018).
- Implement a monitoring and adaptive management approach in which water and sediment quality would be monitored within restored habitat areas to assess whether pollutants and/or emerging constituents of concern are accumulating and approaching unacceptable levels for habitat protection and regulatory requirements, such as sediment quality objectives for wetlands as established by the State Water Quality Control Board. Adaptive management actions could be planned and implemented to reduce the potential for pollutants to accumulate, such as coordinating with the RWQCB and responsible parties upstream, managing and/or modifying hydrologic connections and any treatment wetlands to improve water and sediment quality conditions, and/or potentially removing sediments if and where pollutants accumulate.

RC #2: The Halaco Properties, Ventura County Railroad spur, and Ormond Beach Generating Station limit ecological connectivity across the Project Area.

The privately-held Halaco properties and OBGS properties and the Ventura County Railroad spur limit ecological, as well as public access, connectivity as follows:

- The Halaco properties limit the habitat connectivity along the north side of the lagoon and between the lagoon and habitat along the OLW upstream of the Halaco properties. Lagoon habitats do connect to habitats to the east and north of the Halaco properties and these connections could be enhanced (e.g., by possibly creating a new distributary channel for OLW to the east of the Halaco properties that would support a wetland habitat corridor).
- The OBGS and Edison Drive limit wetland habitat connectivity between the western and eastern halves of the Project Area. The beach and the dunes currently provide connectivity; however, this may be reduced as beach erosion and dune migration occur. The OBRAP could consider potential opportunities and benefits of facilitating habitat and wildlife connections across Edison Drive, such as wildlife passage culverts or other measures.
- The Ventura County Railroad spur segregates TNC agricultural field from the rest of the Project Area. As discussed in PAO #3 below, the railroad does not plan to abandon its easement, and the railroad spur is, therefore, a long-term constraint. Site observations indicate some hydrologic connection from Area 4 to Area 3b via a culvert and overflow of ODD #3. However, these connections are not confirmed or defined adequately at this time. The railway is easily crossed by foot in most areas where train cars are not parked. The constraint formed by the railway could be addressed by installing culverts under the railroad to provide hydrologic and wildlife connectivity, which would be planned and designed to minimize any effects to the railroad.

RC #3: Flooding of local industrial properties should not be increased, and restoration should not conflict with flood management functions of tšumaš Creek, OLW, and/or the lagoon.

Flooding occurs when freshwater trapped behind the beach begins to expand the lagoon and back up tšumaš Creek and the OLW. This can be mitigated by managing the beach at an elevation of 8.9 feet NAVD88 prior to forecasted rainfall events. Minor flooding begins to occur at stages of 9.4 to 10.9 feet NAVD88, and flooding begins to heavily impact the Oxnard waste water treatment plant and International Paper plant for stages above 11 feet NAVD88. Strategic grading as part of the Project design in areas prone to flooding can also reduce chances of flooding of these areas. This will be examined in future Project steps.

This flood management constraint can be addressed by planning the restoration to maintain or reduce existing flood levels, a for example by expanding the lagoon habitats that provide additional flood storage capacity.

RC #4: The potential for bird air strike hazards for the Naval Base Ventura County Point Mugu to the southeast should not be increased.

NBVC Point Mugu, located immediately south of the SCC parcel, has an active airfield. Wildlife can be a hazard to flight operations if they enter an airport's approach or departure airspace. According to the NBVC Point Mugu Air Installations Compatible Use Zones Study (US Navy 2015), aircraft mishaps at the base (including but not limited to bird strikes) have been infrequent (six during 1990–2014), generally close to the runway itself and/or more than 8,000 feet from the boundary at Arnold Road. To reduce hazards, the Federal Aviation Administration and the military recommend locating land uses that attract birds and other wildlife (including wetlands) at least 10,000 feet from active movement areas of the airfields (US Navy 2015). This zone would extend into Areas 6 and 9, where dunes, salt panne, and salt marsh occur. This constraint can be addressed through design and coordination with the NBVC Point Mugu in siting of new wetland features, especially any open water areas. Creation of wetlands outside the 10,000-foot buffer (i.e., all Areas except 6 and 9) could potentially reduce hazards to the airfield by providing alternative habitat away from the base.

RC #5: Portions of the Project Area adjacent to the Halaco Properties are part of the Halaco Superfund Site and may require remediation of water or soil contamination prior to restoration.

EPA's plans, funding and schedule are uncertain for remediating the Halaco Superfund Site, including portions of TNC property immediately east of the slag pile and portions of the City of Oxnard's property to the south of the Halaco properties and slag pile. If these areas require remediation prior to restoration, the OBRAP could potentially implement the restoration in coordination with EPA's remediation efforts or restoration of areas within the Superfund Site could be phased and deferred until after the areas are remediated through the EPA's process. If the OBRAP includes excavation to below the groundwater table, then the extent of any groundwater plume would need to be defined in order to determine if special procedures and safety measures are needed, especially for any dewatering activities and handing of soils in contact with impacted groundwater. OBRAP implementation should also consider potential EPA access needs to assure damage to restored areas does not occur during remediation activities. The Project Partners and EPA are working to coordinate OBRAP planning with site cleanup to the extent possible.

RC #6: Historic Arnold Road dump could be a source of contaminants.

The end of Arnold Road was a site of uncontrolled dumping during 1950s and 1960s. However, there are no records of what was dumped, and no testing was conducted since it was already inactive by the 1980's when the County tested solid waste (Diane Wahl, County of Ventura Environmental Health Division, pers. comm. December 2017). This information should be noted in the CEQA document and permitting. If there is no site disturbance, leaving the dump in place would be unlikely to re-suspend or expose legacy pollutants. If this area is to be disturbed by restoration activities, then appropriate plans for health and safety would be developed as part of implementation. Increased exposure to coastal hazards (e.g., waves and high water) with sea-level rise could also disturb the site and expose pollutants in the future.

RC #7: Trespass, unauthorized uses, vandalism, and trampling of sites could affect restoration outcomes.

As seen throughout much of coastal Southern California, homelessness is a significant problem in Ventura County and at Ormond Beach. The Project Area's remote location makes it difficult to control unauthorized uses, camping and vandalism. Unauthorized use of the Project Area may result in trampling of restoration areas, contamination of soils and waters, accumulation of trash and hazardous materials and vandalism of visitor amenities. The Project Partners and the County of Ventura take their responsibility to the homeless community seriously and are working to address this issue constructively and in concert with the police department, county social services and homelessness advocates. See also Public Access Constraint #2 below.

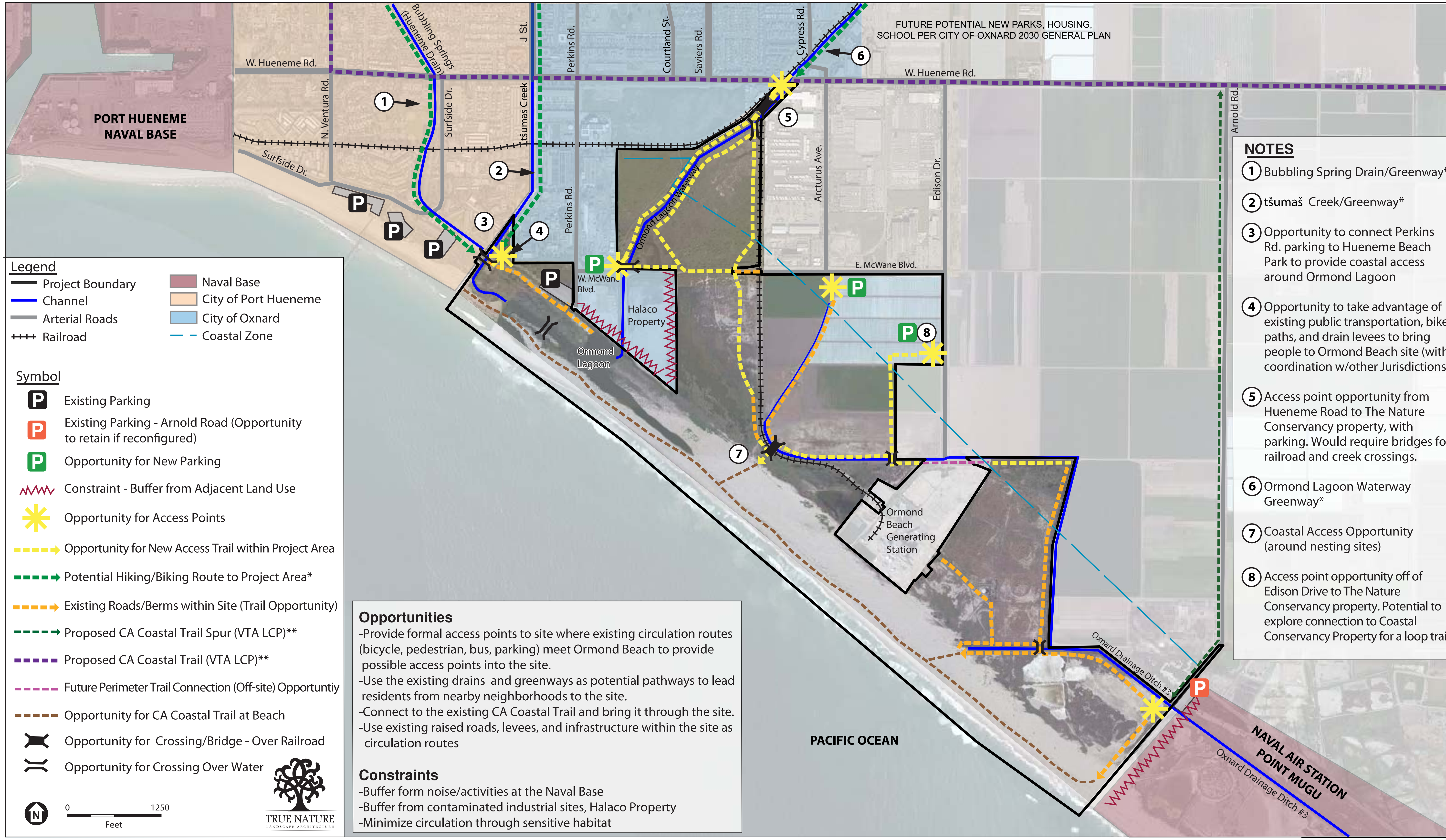
4.2 Public Access Opportunities and Constraints

The different opportunities and constraints for public access are summarized in **Table 4-2** and illustrated in **Figure 4-1**. As identified in the Feasibility Study, public recreation and education are important goals of the OBRAP, but must be compatible with habitat restoration.

4.2.1 Public Access Opportunities (PAOs)

PAO #1: Provide trails and entrances that connect to existing bike paths and potential future bike paths.

Enabling and promoting bicycle use to the Project Area is compatible with sensitive habitat and ecosystem health, would result in less vehicle emissions, and requires less paving than automobiles, which require larger roads and large parking lots. Bicycle transportation provides opportunities to access the Project Area via bus routes or bike paths from, including from neighborhoods adjacent to the Project Area. Facilitating pedestrian, bike, and public transportation also helps preserves the existing sense of remoteness and wilderness currently experienced by visitors at the Project Area.



SOURCE: ESA, City of Oxnard 2030 General Plan, *City of Oxnard Bicycle & Pedestrian Facilities Master Plan 2011, **County of Ventura Coastal Area Plan 2017, Bing Maps, www.bing.com/maps

Figure 4-1
Public Access Opportunities and Constraints

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TABLE 4-2
PUBLIC ACCESS OPPORTUNITIES AND CONSTRAINTS

Opportunities	
1.	Provide trails and entrances that connect to existing bike paths and potential future bike paths.
2.	Use existing public and private paths as proposed circulation routes through the Project Area.
3.	Connect proposed paths to the beach at points closest to beach to minimize distance through sensitive habitats.
4.	Use adjacent existing creek channel corridors and green belts (i.e., Bubbling Springs Green Belt) to lead visitors from neighboring areas to the Project Area by providing trail connections in the Project Area.
5.	Provide new and/or enhanced public entrances to the Project Area, including: • Northwest entrance, which could utilize existing parking lots at Hueneme Beach including and using the adjacent Bubbling Springs Drain and Green Belt to lead visitors to the Project Area • Hueneme Road entrance through TNC's property, which extends to Hueneme Road • East McWane Blvd. entrance • West McWane Blvd. entrance
6.	Involve neighboring schools in stewardship programs.
7.	Stimulate ecotourism in Port Hueneme, Oxnard, and County of Ventura by providing a variety of activities for local residents and attracting tourists, which can drive opportunities for the local economy.
8.	Inspire and inform a diverse community that is actively engaged in using, enjoying, and protecting Ormond Beach.
9.	Extend the Oxnard, Camarillo, and Ventura Greenbelt to the Project Area.[1]
10.	Create a trail system to connect portions of the Project Area, and serve as extension of the California Coastal Trail.[1]
11.	Create bike trails within the Project Area that are incorporated into the City of Oxnard's Bicycle Facilities Master Plan. (This plan was completed in 2012, and the only relevant recommendation was extending a bike lane on Perkins Road to the Project Area).[1]
12.	Construct a future visitor center and/or educational center.[1]
13.	Provide public safety elements and access for fire department, security, and law enforcement.
14.	Address the scarcity of overnight accommodations for lower and middle-income individuals and families on the coast
Constraints	
1.	Public transportation options for visitors to the Project Area are limited.
2.	Existing and potential new entrances are remote and should consider safety and vagrancy issues.
3.	Future sea-level rise could cause inundation of low elevation public access features.
4.	Options for Parking Lot expansion constrained at Arnold Road.
5.	Limited parking, vehicular, and pedestrian (e.g., trail) access.[1]
6.	Physical barriers to pedestrian access such as channels and property line fences.[1]
7.	Public use disturbance of existing and newly restored sensitive species and their habitat or nesting areas such as the western snowy plover and California least tern.[1]
8.	Prominent current and past industrial uses (e.g., the OBGS, its associated transmission lines, the WWTP and the Halaco Site), which diminish visual quality and the public's perceived recreational/outdoor "experience".[1]

NOTES:
1 This opportunity or constraint was first identified in the 2009 Feasibility Study (Aspen 2009)

There are different classes of trails allowing for various levels of traffic and environmental impact (Ventura County Coastal Area Plan [Ventura County Planning Division 2017]). Many of these types of trails are currently existing or planned by local adjacent jurisdictions, and are illustrated in Figure 4-1. These types of trails include:

- **Type A: Multi-Modal Trails** – Accommodates more than one user group. Minimum of hikers/walkers and bicyclists
  - **Type A-1: Shared Routes** – Located within a public easement, public park, public trails (parks/beaches), or near the outer edge of a public right-of-way. Separated horizontally from the paved portion of the road.
  - **Type A-2: Separate within Public Right-of-Way Routes** – Bicyclists and hikers/walkers have separate paths, but follow the same route. Located within a public easement, public park, public trails (parks/beaches), or near the outer edge of a public right-of-way.
  - **Type A-3: Equestrian and Mountain Bike Routes** – Shared unpaved trail. Located away from public roads. May be used by hikers/walkers.
- **Type B: Single Mode Routes** – Accommodates one user group.
  - **Type B-1: Walking/Hiking Routes** – Accommodate walkers or experienced hikers. May be paved or unpaved. May be located within a public right-of-way (e.g., paved sidewalk), along a wide beach within a walkable surface at low tide, or a hiking trail.
  - **Type B-2: Bicycle Routes** – Class 1 or Class 2 Bike Paths. In limited circumstances may be Class 3 Bike Path.

Opportunities exist to connect these types of trails to the Project Area. The type of trail, i.e., multi-modal or single mode, can be determined based on the type of trails, which are planned or exist adjacent to the Project Area, and the level of sensitivity of the habitat areas on the Project Area through which the trail traverses.

Existing drainage channel berms, road, and possibly existing roads or disturbed areas adjacent to the railroad tracks, currently provide the best opportunities for providing locations with which to align trails. These features are all elevated, which both allows views into habitat areas for bird viewing and makes them preferable for longer-term changes due to sea-level rise. In addition, these features take advantage of existing topography and thus would reduce impacts to existing habitat areas.

Currently, the majority of nearby residents are concentrated to the northwest of the Project Area, but the main beach access used is at Arnold Road, at the far eastern end of the Project Area. Public feedback indicates that most nearby residents do not go to Ormond Beach, but go to Hueneme Beach instead. Access is also possible to Ormond Beach by walking along the beach from Port Hueneme Beach. Figure 4-1 illustrates several opportunities to connect either existing or future planned bicycle paths or trails to the Project Area.

The Bubbling Springs Greenway proposed along the Hueneme Drain by the 2011 City of Oxnard Bicycle and Pedestrian Facilities Master Plan can be connected to the Project Area by providing an access point (bridge) over tšumaš Creek, linking the Port Hueneme neighborhoods and visitors to the pier to the Project Area. A formal bike path could be developed along tšumaš Creek to bring South Oxnard residents along J Street to the western edge of the Project Area. Both trails could provide safe bicycle access from local schools to the Project Area. The OLW, which includes a proposed bike path per the Oxnard and Ventura County Bicycle Master Plans, could be connected to the Project Area at TNC property along Hueneme Road. This would provide access to additional local South Oxnard neighborhood residents, in addition to providing larger regional access via the California Coastal Trail and trails from California State University Channel Islands (CSUCI). Focusing on providing trail access connections on the western edge of the Project Area, which is closest to developed existing neighborhoods, can increase visitation by local residents who are currently underserved by park and open space, and shift use away from the Arnold Road entrance.

PAO #2: Use existing public and private dirt roads or trails as proposed circulation routes through the Project Area.

Private trails are existing dirt roads for footpaths which are currently located on private property and not open to the public. Public trails are existing trails noted in planning documents and open to the public. The use of existing dirt roads or trails can minimize impacts to existing habitats and lower construction costs, since they are already existing and just need improvements.

Existing informal private trails located on private property could be easily formalized and utilized as public access features. For example, the existing trails along the OLW through TNC parcel contains habitat of interest to local birders and school science teachers. Impacts to habitat can be reduced by using existing trails along the creek, which are elevated above the surrounding lower wetland habitats, allowing views into the habitats and longer resistance to sea-level rise. Additional opportunities for trail alignments along existing features are illustrated in Figure 4-1.

The Port of Hueneme and Ventura County Railroad operates in the Project Area and traverses the Project Area. Any trails along existing railroad tracks would require fencing, and crossings would require at-grade crossings. Since these features are prominent aligning trails adjacent to them would concentrate existing uses of trails and rails and open up larger habitat areas for restoration.

Providing trail connections at existing paved roads provide opportunity for informal parking along road right-of-ways, for example along East McWane Blvd. Existing dirt roads leading from McWane Blvd. can provide the foundation for new formalized trails, birding overlooks, and interpretive or educational visitor amenities.

Existing official trails include the canal trail at the end of Arnold Road, which heads west along ODD #3 to the beach, and a small trail network between the Perkins Road parking lot and the OLW. These trails could be utilized and combined with existing informal trails on private property, along with new proposed trails, to form a more comprehensive and connected trail network.

PAO #3: Connect proposed paths to the beach at points that are closest to the beach to minimize distance through sensitive habitats.

Many of the existing wide beach and adjacent lowland wetland habitat areas provide important nesting and foraging habitat for various birds. By utilizing existing trails or berms to connect trails to the beach, a shorter distance of trail is required to travel through these habitat areas. A bridge across tšumaš Creek could link the Perkins Road parking area and existing informal trails to Hueneme beach, and visitors could then walk around the western edge of the lagoon to access the beach on the Project Area. Existing trails through TNC parcel can be formalized and connected to the beach at the center of the Project Area, providing birding opportunities along the way.

Trails leading through productive agricultural areas would need to be fenced or signed to encourage users to stay on the trail and reduce conflicts with agricultural activities. A trail providing access to the beach at the center of the Project Area, at the east end of the lagoon, would require consideration of existing sensitive bird habitat fencing, and would possibly require realignment of the fencing to accommodate the trail and provide habitat buffers.

PAO #4: Use adjacent existing creek channel corridors and green belts (i.e., Bubbling Springs Green Belt) to lead visitors from neighboring areas to the Project Area by providing trail connections in the Project Area.

Many of the existing adjacent drainages have proposed bike paths per community General Plans or Bicycle Master Plans (Port Hueneme, City of Oxnard, and County of Ventura). Utilizing these proposed trails along creeks and drainages or greenways would encourage walking and biking to the Project Area from adjacent neighborhoods.

As the OBRAP design is developed, the Project Partners can coordinate with local agencies to understand how they propose to align these trails so that trails within the Project Area can connect to them, creating low-impact access points. Alternative transportation grants could potentially be used to fund some of these trails or alignment studies.

PAO #5: Provide new and/or enhanced public entrances to the Project Area.

Several opportunities for new and enhanced entrances are discussed below and will be considered further and selected from for the development of alternatives. The existing Perkins Road entrance is discussed within the northwest entrance below. The existing Arnold Road entrance is discussed in PAC #5.

- *Northwest entrance could utilize existing parking lots at Hueneme beach and Perkins Road, and use the adjacent Bubbling Springs Drain and Green Belt to lead visitors to the Project Area.*

  The existing entrance at Perkins Road provides limited access opportunities to the lagoon, but does not provide access to the beach. The Perkins Road entrance could potentially be incorporated into a new enhanced northwest entrance that provides beach access. A trail from Perkins Road leading northwest to tšumaš Creek and a new bridge over tšumaš Creek could provide an access path to the beach (Figure 4-1). This northwest entrance would also connect to the Bubbling Springs Drain and Green Belt path. Enhancing the northwest entrance would require coordination with the VCWPD and the City of Port Hueneme for a tšumaš Creek bridge.

- *Hueneme Road entrance through TNC's property, which extends to Hueneme Road.*

  A new entrance to the Project Area could be created at East Hueneme Road. TNC's parcel extends to East Hueneme Road between the Ventura County Railroad and the OLW (Figure 4-1). The portion of TNC's parcel between East Hueneme Road, Ventura County Railroad, and the OLW could be used as an entrance with parking and other features. A pedestrian crossing over the OLW and a controlled railroad crossing could be installed to bring visitors to trails heading south through the Project Area. The OLW crossing could potentially use the existing railroad bridge/culvert, or a new pedestrian bridge could be constructed. The railroad crossing could potentially be a signaled at-grade crossing, similar to the signaled crossing at Hueneme Road, or an elevated over-crossing. Fencing could be installed at the entrance in conjunction with the railroad crossing to encourage visitors to use the crossing and discourage visitors from crossing the railroad in other locations.

- *East McWane Blvd. entrance.*

  Public and/or maintenance entrances to TNC parcel via East McWane Blvd. could be created either at the west end of East McWane Blvd. or through the agricultural field, once it is restored. These entrances would require crossing the Ventura County Railroad. A crossing would likely be required and fencing would likely be more complicated than at a Hueneme Road entrance. East McWane Blvd. entrances would also be farther and more remote from the South Oxnard community. The existing gate at the end of East McWane Blvd. could be used as an entrance for maintenance and/or emergency service vehicles to access trails on the west side of the railroad.

- *West McWane Blvd. entrance.*

  Public access and maintenance entrance to TNC parcel via West McWane Blvd. could be created on the West McWane Blvd. road, which is owned by the City of Oxnard. A gate currently exists between the West McWane Blvd. portion of the road which is paved and the undeveloped dirt portion of the road. An existing dirt road is located on the private TNC parcel which connects to this gate. There is also an existing dirt trail and double track dirt road on TNC property north of the Halaco properties which could be connected to West McWane Blvd. by use of boardwalks and/or a bridge.

PAO #6: Involve neighboring schools in stewardship programs.

Several local school teachers attended the first Public Meeting to provide input on the OBRAP. The input received indicated that there is strong interest from local science and environmental studies teachers to incorporate site visits and field studies into their class curriculum. The nearby CSUCI provides an opportunity to dovetail restoration studies and stewardship programs with local college student curriculum.

An outreach program could be developed to include local educators in the OBRAP design, so that trails and public access amenities can support school activities. In the long term, Project Partners could include long-term partnerships with local schools into their management programs.

PAO #7: Stimulate Ecotourism in Port Hueneme and Oxnard by providing a variety of activities for local residents and attracting tourists, which can drive opportunities for the local economy.

The pristine nature and abundant opportunities for birding is a natural draw to the Project Area. By simply providing safe, clean, secure, easy access to trails, and promoting the Project Area, it should become a draw for locals and tourists alike. Amenities such as boardwalks, bird overlooks, raised viewing areas, and safe nature trails will make accessing the site easier, thus promoting visitation. Local entrepreneurs can take advantage of this by providing guided hikes to birding sites, and inform visitors about the plants and birds, hydrology, ecology, and evolution of the site. Improving the real and perceived sense of safety at access points will be important to promoting tourism. Parking, entry features, and trail design should consider enhancing visitor experience of nature.

PAO #8: Inspire and inform a diverse community that is actively engaged in using, enjoying, and protecting Ormond Beach.

Providing improved visitor services such as safe parking areas or trail head entrances, interpretive elements, and preserved open space with ocean views and beach access could attract many visitors to the Project Area. By educating visitors, perhaps with informational kiosks or a visitor's center where informational presentations could be made or where school groups could gather to learn from site docents, a new generation and group of community members could be inspired to use and protect the Project Area. A docent program could engage the public through programs, walks, talks, or demonstrations, so that the public could learn about the rich history and ecology of the Project Area and be motivated to protect it. Local youth have already participated in, and should continue to be encouraged to engage in, restoration activities through the Oxnard City Corps and other similar programs (State grants may also facilitate these efforts).

This opportunity could be realized through a long-term management plan.

PAO #9: Extend the Oxnard, Camarillo, and Ventura Greenbelt to the Project Area.

The Feasibility Study (Aspen 2009) identifies extending the Oxnard, Camarillo, and Ventura Greenbelt as an opportunity for the OBRAP. In 1984, the City of Oxnard, City of Camarillo, and County of Ventura entered into an agreement establishing a greenbelt, defined as "an area consisting of prime agricultural or other open space land…which is preserved in agricultural or other open space uses." The Camarillo-Oxnard Greenbelt was established in an effort to conserve open space as a means of "providing community identity, definition, and character in keeping with the objective of controlling urban sprawl." The OBRAP Project Area could be included in an amended version of the Agreement between these agencies, which would further protect it from future development or urbanization. Since the City of Oxnard's 2030 General Plan includes a change in Sphere of Influence to cover agricultural lands east toward Arnold Road, those lands could potentially be included in the Camarillo-Oxnard Greenbelt. NBVC Point Mugu's contiguous habitat area combined with OBRAP would effectively create a contiguous open space area from the beach to the existing Oxnard-Camarillo Greenbelt.

PAO #10: Complete the Ormond Beach section of the California Coastal Trail.

The Feasibility Study (Aspen 2009) identifies creating a trail system to serve as the California Coastal Trail as an opportunity for the OBRAP.

PAO #11: Create bike trails within the Project Area that are incorporated into the City of Oxnard's Bicycle Facilities Master Plan.

The Feasibility Study (Aspen 2009) identifies creating bike trails within the Project Area and incorporating them into the City of Oxnard's Bicycle Facilities Master Plan as an opportunity for the OBRAP. This plan was completed in 2012, and the only relevant recommendation was extending a bike lane on Perkins Road to the Project Area.

PAO #12: Construct a future visitor center.

The Feasibility Study (Aspen 2009) identifies creating a visitor center and/or cultural center as an opportunity for the OBRAP. A visitor center could include natural and cultural interpretation and education programs for neighborhood schools and other visitors. It can also serve as community and cultural space for events and partnerships with educational institutions to host classes, screenings and other educational and recreational opportunities.

PAO #13: Provide public safety elements and access for fire department, security and law enforcement.

The Oxnard Fire Department recommended consideration of additional hydrants and fire roads to allow easier access for fire control. Roads should consider accessibility by police and private security companies. The design of safety elements (e.g., hydrants and water lines, security at trailheads compatible with habitat) would be resolved in the final design phase and are not addressed in this plan.

PAO #14: Address the scarcity of overnight accommodations for lower and middle-income individuals and families on the coast.

The State of California Coastal Conservancy in the draft document, Explore the Coast Overnight; (November 2018), identified barriers to coastal access including a lack of lower-cost accommodations. Project Partners can consider locations in or near the Ormond Beach Project Area for lower cost overnight accommodations (e.g., camping) that would be compatible with the restored ecosystem.

4.2.2 Public Access Constraints (PACs)

PAC #1: Public transportation options for visitors to the Project Area are limited.

Both research into existing public transportation networks and input gained from public outreach efforts (Public Meeting #1 and Survey results) show that public transportation to the Project Area is very limited. Residents who do not drive or do not have cars have a difficult time reaching the Project Area. Challenges include:

- Existing bus network does not reach all neighborhoods in Oxnard.
- Must take 2 or 3 buses to reach Ormond Beach.
- Bus stop at Perkins Road does not ultimately lead to beach access, only north side of the lagoon.
- Need more efficient transportation.

While this is a larger planning concern, which is not in the purview of the OBRAP, it would be advantageous to OBRAP's success to have easy public access to the Project Area. Future development and land use changes outlined in the Oxnard 2030 General Plan may result in future increased public transportation to the area as required in the General Plan. It is uncertain when this would be implemented. Design for the Project Area can consider facilities for future bus or shuttle route access and circulation to key visitor access points to the Project Area. Site planning should include outreach to public transportation providers.

PAC #2: Existing and potential new entrances to the Project Area are remote and should therefore consider safety and vagrancy issues.

As discussed in PAO #8, there is a real and perceived concern for safety due to the remote location of the Project Area. Current concerns regarding safety and security at existing access points and in more remote parts of the Project Area due to transient populations was a reason cited for not visiting the Project Area by some attendees at Public Meeting #1 and survey respondents. Potential improvements include eliminating trash and debris dumping at access points, and providing security, rangers, or police patrols to discourage vagrancy, camping, and illicit activities. Access points can also be designed to be open and promote visibility. An increase in visitation alone may discourage activities like dumping or camping, so that the access points would no longer be isolated.

PAC #3: Future sea-level rise could cause inundation of low elevation public access features.

Public access features at lower elevations may be inundated in the future with sea-level rise. Public access planning will therefore consider life spans for public access features and corresponding projections of sea-level rise. Public access features can be assessed to identify whether features should be built at higher elevations with an allowance for future sea-level rise or if features can be moved in the future as an adaptive management response to future sea level. Trails may require seasonal closures due to inundation during major storms or high tide events.

PAC #4: Options for Parking Lot expansion constrained at Arnold Road.

The existing head-in parking along the east side of Arnold Road will need to be removed to comply with Navy policy, which calls for a 20-foot unobstructed zone at the fence line for security purposes. The Project Partners could consider pursuing an exception with Navy command as allowed for in Navy policy, such as raising the existing fence to improve security and allowing the existing parking to remain, but it is highly unlikely to be granted since such exceptions are only intended for use in constrained areas. The Navy owns this land; the OBRAP cannot rely on Navy property to serve as a public parking area. Parallel parking may be made available on the west side of Arnold Road; however, opportunities to provide a parking area are constrained by the NBVC Point Mugu to the East and private property to the west side of Arnold Road. OBRAP alternatives consider reconfigured and alternative means of access via Arnold Road, including as an entrance for pedestrians, cyclists, and emergency vehicles. As discussed for PAC #5, the Arnold Road entry point is one of only two current beach access points and should also be considered with that in mind.

PAC #5: Limited parking, vehicular, and pedestrian (e.g., trail) access.

Currently there are two recognized public access points. The Arnold Road parking area, which has 20 parking stalls, and which does not comply with Navy regulations, is the only vehicular parking area which provides beach access. This parking lot is subject to flooding after heavy rains. The lot size does not always accommodate visitor demand (Walter Fuller, pers. Comm. September 21, 2016). The pedestrian access from the Arnold Road parking lot is limited to an old, degraded partially-paved road subject to flooding which extends to the sand, and a compacted dirt trail along a levee of ODD #3 leading to the dunes and beach. Neither of these pedestrian trails currently provides Americans with Disabilities Act (ADA) access. The Perkins Road parking lot, which provides 50 parking stalls, is the only other access point. It contains limited trails and a footbridge leading out to trails on an islet in the lagoon. There is no beach access here. There are no other public access locations or formal trails, which is a constraint to public access of the Project Area.

PAC #6: Physical barriers to pedestrian access such as channels and property line fences (as well as the Ventura County Railroad).

As discussed previously, the Ventura County Railroad spur runs through the Project Area from Hueneme Road to the OBGS. Public access across the railroad could possibly be provided at controlled crossings, such as a signaled at-grade crossing or an elevated over-crossing. Based on Ventura County Railroad's experience, an elevated over-crossing would need to be installed in conjunction with fencing along the railroad to prevent people from walking across the tracks instead of using the over-crossing. A crossing could potentially be installed in conjunction with a new entrance at Hueneme Road.

PAC #7: Public use disturbance of existing and newly restored sensitive species and their habitat or nesting areas, such as the western snowy plover and California least tern.

Protective measures for habitats and species, including western snowy plover and California least tern may constrain public access. A major goal of the OBRAP is to provide public access features that are compatible with and limit disturbance to sensitive habitats. There are a number of these habitats and associated species that will be evaluated when considering access features, such as the lagoon, listed species nesting sites, wetlands that become seasonally inundated and are impassable, and sections of coastal dunes that contain fragile plant associations, processes, and nesting sites. For example, locating trails on existing disturbed locations or on existing roads, berms, or trails around the perimeters of habitats can provide areas of contiguous habitats and concentrate uses into perimeter buffer areas, which are adjacent to other land uses, thus potentially limiting disturbance to wildlife.

PAC #8: Prominent industrial uses (e.g., the Ormond Beach Generating Station, its associated transmission lines, the Oxnard Wastewater Treatment Plant and the Halaco properties), which diminish visual quality and the public's perceived recreational/outdoor "experience."

These large-scale industrial facilities loom over the pristine wetland landscapes one can experience in the Project Area. The tall smoke stacks of the OBGS diminish the visual quality of the landscape and contrast starkly with sense of wild nature and open views afforded by the Project Area. The Halaco slag pile rises above the landscape, surrounded by a graffiti-clad fence, which reduces the visual quality and sense of pristine habitat one could otherwise experience at the lagoon. While these facilities are a reality of the Project Area, they do pose a challenge to public access experience by creating barriers to trail networks and diminishing the visual quality of the visitor's experience.

SECTION 5
Project Elements

The Project Alternatives are assembled from a set of ecological elements (habitat types) and public access elements. This section describes these elements to guide the reader's interpretation of the alternative design maps in Section 6.

5.1 Habitat Elements

The ecological elements are characterized according to the dominant vegetation community or habitat type (defined in Section 2.3.4), with typical or special-status species mentioned. The habitat types are intentionally broad in order to simplify the maps, and to acknowledge uncertainty in predicting the habitat outcomes at a finer resolution of detail. In reality, these habitats will grade into each other, and will likely move up and down slope across years where there are broad, relatively flat ecotones (a transition zone between two biological communities).

The potential habitat elements include:

5.1.1 Open Water

Open brackish water habitats are more or less permanently flooded areas that are too deep for emergent vegetation (wetland plants that project above the water surface, such as cattails). The lagoon and associated OLW would be the main open water feature. In general, where water salinities are low (less than 5 ppt), cattail can grow in water up to about 3 feet deep. In saltier water (generally 5 to 20 ppt), tule (*Schoenoplectus californicus*) can grow in water up to about 2 feet deep. Other factors also affect plant distribution, such as scouring and seasonal variations in water levels. Since most of the water on-site is brackish, almost all of the open water habitats (i.e. no emergent vegetation) are expected to be at least about 2 feet deep (the exception being the area of the lagoon on the beach where conditions other than depth likely impede emergent vegetation). Open water areas can support algae and aquatic plants such as sea lettuce (*Ulva lactuca* and *U. intestinalis*) and spiral ditch grass (*Ruppia cirrhosa*).

Open water habitat supports tidewater goby for all life stages. Many bird species forage in open water areas including California least tern, herons, egrets and waterfowl. As the sea level rises, open water areas will get deeper and expand throughout the Project Area.

5.1.2 Beach/Strand

The most seaward habitat on the Project Area is the beach. It consists mostly of marine intertidal wetland. Directly behind and landward edge of the beach is the strand, an important habitat and plant community. These habitats fluctuate with the seasons and between years, in response to seasonal wave climate and large wave events (causing erosion). The beach is generally unvegetated but the strand can support beach saltbush and red sand verbena, which play important roles in dune building.

Beach and strand habitats support invertebrates that are a food source for over-wintering and migrating shorebirds. Western snowy plovers forage here year-round, and can nest in coastal strand areas. Other special-status species include hairy-necked tiger beetles, globose dune beetles, and many kinds of birds. As the sea level rises, the beach and coastal strand habitats will migrate landward and upward and therefore persist.

5.1.3 Coastal Dunes

Inland of the strand are coastal dunes. Coastal dunes include large unvegetated areas of open sand with hummocks and dunes, which form when plants such as red sand verbena, pink sand verbena (*Abronia umbellata*) and beach bur trap blowing sand. Further back in the dunes where the sand is more stable, other dune species may be found such as beach evening primrose and beach morning glory (*Calystegia soldanella*). Most dune plants rely on long taproots to access moisture trapped deep in the dunes where a freshwater lens (a pocket of freshwater fed by percolating rainwater that remains separate from an underlying water table due to density) is found on top of the salty watertable (supported by the ocean). Further landward, shrubs such as coyote brush and coast goldenbush can establish a habitat often called back dune scrub.

Both western snowy plover and California least tern nest in coastal dunes, especially in areas with low vegetative cover. Other ground-nesting birds such as killdeer (*Charadrius vociferus*) and northern harrier (*Circus cyaneus*) can nest in coastal dune and back dune habitats. The silvery legless lizard (*Anniella pulchra*) is a burrowing reptile that lives primarily in dunes.

As the sea level rises and the beach and strand habitats retreat landward, the area of dunes in the Project Area will decrease. Eventually, with enough coastal retreat, the dunes may be eroded and also begin to migrate inland into wetland habitats.

5.1.4 Dune Swale Wetlands

A new habitat element not previously defined or mapped includes dune swale wetlands occur in coastal dunes where dry sand gets scoured away by wind, exposing moist sand associated with the dunes' freshwater lens. The wind is not able to move the wet sand, which supports a range of wetland plants, including arctic rush (*Juncus arcticus*), salt grass (*Distichlis spicata*), spiny rush, field sedge (*Carex praegracilis*) and sandbar willow (*Salix exigua*). There is very little dune swale wetland habitat in the Project Area now, but nearby areas such as McGrath State Beach still support dune swale wetlands that range in size from a few hundred square feet to many acres in size.

Dune swale wetlands add considerable habitat heterogeneity to the coastal dune system. They support denser and taller vegetation than other dune areas, which likely supports wildlife. The critically endangered Ventura marsh milk vetch (*Astragalus pycnostachyus* var. *lanosissimus*) could be introduced experimentally in dune swale wetlands at the Project Area. As the dune system narrows due to coastal retreat, dune swale wetlands might be lost. Dune swales constructed toward the back of the dunes would be expected to last longer.

Dune swale wetlands are not included as constructed features of the Proposed Design, but would be welcome elements if they evolve on the site.

5.1.5 Salt Panne

Salt panne habitats occur in shallow basins that are seasonally flooded and hypersaline. The source of the salt may be from saline surface water and/or groundwater, or from ocean water washing over the beach and dunes. In either case, the water then evaporates (as opposed to flowing off-site or percolating into the soil) and leaves an increasing amount of salt on the soil surface over time. The high salinity precludes all plants, though algae such as sea lettuce can occur seasonally. Salt pannes are a rare habitat type that contributes to habitat complexity (SCWRP 2018).

Salt panne habitats support many bird species, including nesting and/or foraging areas for American avocet (*Recurvirostra americana*), California least tern, western snowy plover, killdeer and black-necked stilt (*Himantopus mexicanus*). Western snowy plover fathers are consistently seen bringing recently fledged chicks to the salt panne habitat at the Arnold Road end of the Project Area to forage on the abundant brine flies (*Ephydridae* spp.). Salt panne habitat occurs in the lowest elevations at the Project Area and as the sea level rises, increasing groundwater levels will eventually lead to year-round ponding and eventual conversion of these areas to open water, salt or brackish marsh.

During the 19th century, 80 percent of salt panne habitats were lost in Southern California (SCWRP 2018). The Regional Strategy recommends an objective of protecting 100 percent of existing natural salt pannes and their supporting hydrological regime.

5.1.6 Salt Marsh

As described above, salt marsh habitats at Ormond Beach are non-tidal and have salinity levels high enough to exclude brackish species, but lower salinities and less ponding than occurs in salt panne areas. Salts from brackish ground or surface water and poor drainage off-site are probably important factors in sustaining salt marsh in other areas of the Project Area. Salt marsh plants do not occur in permanently flooded areas but they can tolerate some seasonal flooding. Salt marsh habits are dominated by pickleweed, salt grass and fleshy jaumea, which all have broad tolerance to different salinity and flooding regimes including hypersalinity (i.e., >40 ppt). Special status plants include Coulter's goldfields and salt marsh bird's beak. The non-tidal salt marsh habitats are unlikely to support a high diversity or abundance of bivalves, snails, crabs, or shrimp that are found in tidal salt marshes, and therefore the predators that depend on these food sources are not expected either.

Despite being non-tidal, the salt marsh habitats in the Project Area might be expected to support some salt marsh-dependent wildlife species, including Belding's savannah sparrow, documented in the Project Area, and wandering skipper (Panoquina errans), a butterfly. As the sea level rises, salt marsh habitats will be more strongly influenced by groundwater. This might convert some areas to salt panne and others to brackish marsh. Based on current modeling, there is no strong evidence that regular tidal influence will come in the future (a few decades) with increasing sea levels.

5.1.7 Brackish Marsh

Brackish marshes occur where water salinities are typically lower than seawater but have some amount of salt. Brackish marsh can occur in permanently or seasonally flooded areas and in areas that are not flooded but have a water table close to the surface. Flooding can be caused by groundwater rising above the soil surface, rainfall, or watershed inputs (i.e., the lagoon). Salts come from brackish groundwater or overwash from the ocean. The flooded areas of brackish marsh on the Project Area are typically dominated by tule and cattail. Species found in rarely flooded areas include saltmarsh bulrush, spiny rush, salt marsh baccharis (*Baccharis glutinosa*), and pickleweed.

Tule and cattail stands provide important nesting habitat for many species of birds, including red winged blackbird (*Agelaius phoeniceus*), marsh wren (*Cistothorus palustris*), common yellowthroat (*Geothlypis trichas*) and several species of rail. The endangered light-footed clapper rail (*Rallus longirostris levipes*) almost always nests in tidal salt marshes, but can occasionally nest in brackish marshes. As the sea level rises, brackish marsh will generally convert toward open water habitats.

As noted above, restoring wetland area, size, distribution, habitat diversity and condition are objectives in the Regional Strategy (SCWRP 2018).

5.1.8 Seasonal Wetlands

Seasonal wetlands might occur in depressions that pond water or on flats with clay soils that retain moisture and salt after rainfall. Saline-affected seasonal wetlands might support some of the same wildlife species as salt marsh and salt panne habitats. As the sea level rises, the seasonal wetlands will evolve in to other habitats. Depressional areas, where water could pool and evaporate, are expected to evolve toward salt marsh and salt panne or brackish marsh in the future. Non-depressional areas are expected to evolve toward salt marsh and brackish marsh in the future.

5.1.9 Wetland-Upland Transition

Wetland-upland transition habitats (also known as wetland-upland ecotones) occur at intermediate elevations between marsh habitats (salt and brackish) and uplands. Growing conditions in this zone are dynamic in space and time. Different characteristics of both adjacent habitats are expressed at different times in the transition zone. Rare flooding events can inundate plants with salty, brackish or fresh water. This can stress or kill most typical upland species. These flooding events can be followed by the heat and drought stress associated with upland habitats that make these elevations unsuitable for wetland species. The extreme events that affect the transition zone occur on impossible to predict time scales. There are several native species that are tolerant of the extremes found in the transition zone, including shrubs like Brewer's saltbush (*Atriplex lentiformis* ssp. *lentiformis*), horned sea blite, woolly sea blite, bush seepweed (*Suaeda nigra*), coyote brush, and coast goldenbush.

Wetland-upland transition habitat supports a similar range of wildlife compared to uplands and is especially important as a refugia for terrestrial species when water levels are high in adjacent wetland habitats. Wetland-upland transition habitat on the Project Area will be a crucial resource for upslope movement of wetland habitats as sea-level rise pushes existing resources out of their current locations and up slope.

The Regional Strategy recognizes the importance of such transition zones with four specific objectives focused on protecting and increasing wetland/upland transitions zones (SCWRP 2018).

5.1.10 Bioswales

Bioswales are constructed wetlands. As discussed under Restoration Opportunity #6 (Section 4.1.1), bioswales are an example of BMPs that can enhance water quality. Bioswales may be designed for different purposes, but depending on their size and location in catchment they can: (1) trap sediment, (2) retain stormwater that can then percolate and evaporate rather than flow in to habitat areas, and (3) help clean up contaminated water (allow sediments to settle, allow plants to take up excess nutrients, let microbes break down toxic compounds, etc.). If bioswales are planted with native plants such as cattail, tule and bulrush, and are well designed, they can provide valuable habitat for foraging and nesting birds and other wildlife. In some cases, especially where sediment is expected to be a problem, constructed wetlands may include a forebay that traps most of the sediment and can be cleaned out as needed without damaging vegetation in the rest of the wetland.

This habitat is not yet present at the Project Area but is proposed in Alternative 2. The proposed bioswales are all schematic at this design stage. Eventually, they would need to be engineered to perform adequately given the expected amount of runoff they would be designed to catch, and the potential pollutant loads they would be expected to affect (both runoff volumes/velocities and pollutant loads are currently unknown). As the sea level rises, the bioswale areas are expected to convert to other wetland types, such as brackish marsh, salt marsh, and perhaps salt panne.

5.1.11 Coastal Sage Scrub

Upland areas that would support coastal sage scrub community are expected at elevations above areas that flood, even if the flooded areas are very rarely inundated. The type of vegetation supported in upland areas will depend on several factors, with soil texture probably being the most important. If soils are relatively high in clay and poorly drained, they might be expected to support native grassland habitats dominated by perennial grasses such as purple needle grass (*Nassella pulchra*), California brome (*Bromus carinatus*), meadow barley (*Hordeum brachyantherum*), and blue wild rye (*Elymus glaucus*), with a mix of annual and small perennial broad leaved species such as California poppy (*Eschscholzia californica*), arroyo lupine (*Lupinus succulentus*), miniature lupine (L. bicolor) and deer weed (*Acmispon glaber*). Better-drained soils would likely support coastal sage scrub, with species such as California sagebrush (*Artemisia californica*), Brewers saltbush, coyote brush, California encelia (*Encelia californica*), California buckwheat (*Eriogonum fasciculatum*), coast goldenbush, sticky monkey flower (*Mimulus aurantiacus*), purple sage (*Salvia leucophylla*), and black sage (*S. mellifera*).

Uplands might be especially important to terrestrial wildlife species as refugia when water levels are extremely high in adjacent wetland and transition zone habitats. Upland habitat on the Project Area will be a crucial resource for upslope movement of wetland habitats as sea-level rise pushes existing resources out of their current locations and up slope.

5.2 Public Access Elements

The potential trail types and amenities included in the alternatives are described below.

5.2.1 Trails

Developed (Primary) Trails. are generally intended to accommodate larger groups, more active uses, and are designed for more intensive use. Developed trails would be constructed of class II base, decomposed granite, or improved and graded natural soil depending on their location and adjacent or projected future or seasonal hydrologic conditions. These trails could be sited in projected high-use areas, provide ADA access, room for school or tour groups, and can be multi-modal to serve both pedestrians and bikers, in addition to maintenance and emergency vehicles. Developed trails are approximately 10–12 feet wide with 1- to 2-foot shoulders, and may be site or California Coastal Trail sections. These trails are sufficient to provide emergency access for fire, law enforcement, private security, and rescue, as well as access for maintenance staff, and can be used to align any required utilities. Site amenity elements along developed trails could include boardwalks, bridges, turn-outs, overlooks with bird blinds, benches, viewpoints, and edge control (fencing or edging) in sensitive areas, signage (directional, interpretive), culverts or footbridges, limited wildlife-friendly lighting from bollards at trailheads for safety, and viewing platforms. The trail surface would be set at elevation of 12 feet NAVD88, except for Alternative 3 where they are proposed at elevation 15 feet NAVD88.

Rustic (Secondary) Trails are designed for access through habitats where an immersion in nature experience can be provided. Rustic trails are generally intended to accommodate two people walking side by side comfortably in areas where moderate use is anticipated. Rustic trails would be graded natural soil or class II base in wet areas. They are designed for pedestrian use only to serve activities such as walking and nature observation. They would be 4 to 6 feet wide with 2 feet clear of tall vegetation on perimeters. They may contain elements such as footbridges, boardwalks, overlooks, benches, viewpoints, turn-outs, and signage, and edge control at sensitive habitat areas. Trail elevations may vary to sit on native grade elevations or between elevation of 11 to 12 feet NAVD88.

Primitive (Tertiary) Trails are single-track, narrow earthen tread, with limited gravel or class II base only in wet areas, with mowed or cleared edges 1-foot wide maximum. Primitive trails are designed to provide solitude and a quiet nature experience in more sensitive wildlife and habitat areas with lower use. Many of these trails could be seasonal. They are designed to serve pedestrians only, focus on birding or other nature observation, slow nature-based activities, nature immersion, and could, for example, have benches or platforms for birding, or small trails leading to water's edge with overlooks.

Beach Trails provide access on the beach sand, or on the sensitive back dune areas via boardwalks. They are for pedestrian use only along the shore. Boardwalks could be used through the most active areas of the dune complex. The width is viable from the entire beach strand to 50- or 100-foot buffer areas near bird habitat fencing. Bird fencing may also be on beach sand and back dune areas, and is either symbolic bird fencing composed of metal posts and wire or cable, or exclusion fencing comprised of a mesh such as cintoflex to protect the most sensitive areas. If included as part of a beach trail, boardwalks would be 6 feet wide with occasional turnouts for wheel chair pull-outs or passing where applicable. Boardwalk sections of beach trails overlooking sensitive nesting bird areas could be shielded by bird blinds where necessary to minimize disturbance to nesting birds.

Bike or Multi-Modal Trails would either be Class I or Class II bike ways. Class II striped bike lanes are proposed on the edges of existing roads leading to the Project Area from adjacent neighborhoods and are envisioned to be spurs of the California Coastal Trail. The striping of Class II bike lanes would need to be coordinated with local jurisdictions. Class I bike paths leading through the Project Area are proposed only in limited areas, and would be made of Class II base, or striped two-way paths of pervious asphalt or concrete, wide enough for emergency responders or wildlife rescues. Class I bike paths may be combined with Primary trails, and may be bifurcated for more active and passive uses.

5.2.2 Site Amenities

Site amenities are features to enhance, guide, and complement the visitor experience. Common site amenities and how they may be incorporated in the Project Area are identified and described in **Table 5-1**. Amenities may be phased in over time as funding is procured and/or restoration plan components are implemented.

TABLE 5-1
SITE AMENITIES

Site Amenity	Description
Signage	**Tell people where to go, and educate them regarding their environment.**
Directional	Series of trail signs noting trail name for location and route identification on the Project Area. Each section of trail can be named after a bird, animal, or plant, and the name and icon of that element can universally identify the trails. This would make the directional signage and maps understandable by visitors who may speak many different languages. Text on directional signs should be multilingual. A color code system can be developed to denote trail usage, such as multi-modal (bike and pedestrian), pedestrian only, seasonal, rustic, etc.
Interpretive	Interpretive signage could be at trail heads and at certain overlooks. Each interpretive sign can tell the story of a particular topic related to the Project Area, such as endangered birds, how salt pannes form, what a salt marsh is, etc. These signs should be durable, UV resistant, contain ample clear graphics, and multilingual. If signs have numbers or QR codes, a smartphone app can be developed to provide additional audio information for visitors. This option could be developed in concert with or to support school curriculum in partnership with local grade schools, high schools, or colleges.

TABLE 5-1 (CONTINUED)
SITE AMENITIES

Site Amenity	Description
Signage (cont.)	
Access Control	Signs that encourage or discourage entry to certain areas. Access control signs can be posted on bird nesting fences along with interpretive signage explaining the life-cycle and limited habitat availability of those birds. Seasonal trails should all be posted with access control signs.
Symbolic Bird Fencing	T-bar posts with two strands of wire or cable between them. They provide a symbolic barrier between the trail and sensitive habitat areas but allow wildlife to pass through them. Symbolic fencing is good for lining trails which move through dunes as they do not impede the process of dune formation and sand migration while clearly defining the trail for visitors. Symbolic fences may also be used to define seasonal closures of trails; cable fences may have hooks which allow them to be open or closed to allow or prevent access due to nesting season, high water levels from inundation or high tides, etc.
Exclusionary Bird Fencing	T-bar posts with wire mesh between them. They provide a physical barrier between the trail and sensitive habitat areas. Birds and very small mammals may pass through them, but larger predators, dogs, and people cannot easily pass through them. Exclusionary fences may be used in the most sensitive seasonal nesting areas, areas with high visitorship, or as an adaptive management strategy to convert symbolic bird fencing in locations where visitors are not staying on trails.
Edge Control	**Keep visitors on trails**
Rails on boardwalks	Low symbolic edges on flat boardwalks, or guard-rail (42”) or railing (36”) height railing that prevent or signal that visitors need to stay on the trail. These may be for safety or to provide a steady surface for birding glasses.
Rustic Fencing	Rustic fencing such as lodgepole, split rail, or wood post and cable fences meant to restrict access to certain areas at more developed locations such as trailheads or locations where people cannot enter (i.e., active railroad tracks).
Agricultural Fencing	T-bar post or wood post with hog-wire mesh or horizontal cable to provide a physical barrier between a farm and trail.
Access Node	**Locations where the public can enter Ormond Beach**
Major Trailhead	Large parking lot (20–50+ stalls) that may include visitor services such as docents, security, restrooms, maps, for high-use areas
Minor Trailhead	Small parking area (2–15 stalls) or ADA-only parking (or no car parking), drop-off area, bike parking, interpretive signage only, community focused entries.
Visitor Services	
Visitor Center	A physical building with, for example, interpretive elements, books or goods for sale, docents to answer questions, security center. A portable visitor’s center could be made from an RV-type trailer and could be open to the public on weekends or during summer. Visitor Center can be geared to school groups, designed to support and provide research facilities for college/university involvement in long-term monitoring and data collection to inform adaptive management planning, serve as a hub to arrange ecotourism services, and to provide information regarding recent species sightings. It can also serve as community and cultural space for events and partnerships with educational institutions to host classes, screenings and other educational and recreational opportunities.
Visitor Kiosk	A portable trailer or small covered structure (posts only, no walls or doors) with information for visitors, such as trail conditions, recent species sightings, interpretive displays, fish guides, interactive displays. Visitor Kiosks may be staffed by docents during busy times or when school groups or tours are scheduled, but interpretive displays could be available at all times.
Restrooms	Restrooms could be included in a visitor center or kiosk. Initial restrooms could be portable trailer restrooms provided by a local waste management company; rental on these units typically includes service and can be very reasonably priced. Later phases could implement restrooms with sewer connections, water, and electrical at a visitor’s center or Major Trailhead. Restrooms would ideally be provided where groups stage and begin or end their visit.

TABLE 5-1 (CONTINUED)
SITE AMENITIES

Site Amenity	Description
Bike Services	
Bike Parking	Metal bike racks secured to the ground either by bolting to a concrete pad or bolting to below-ground footings in a decomposed granite or earthen parking area.
Bike Lockers	Large “boxes” where visitors, including regional Coastal Trail riders, can store and lock their bike and gear while visiting the Project Area.
Bike Service	Small pre-fab public bike repair stations that have tools, air, clamps, etc. to allow visitors to perform minor services such as pumping tires, fixing brakes, patching tires, or other minor repairs.
Trail Amenities	
Bridge	Bridges would be prefabricated drop-in structures supported by concrete abutments, pile, or other means. Bridge deck elevations should be set at an elevation of 15.0 to allow water passage below. Bridges are proposed at major water crossings (OLW).
Floating Boardwalk	A floating structure suspended over water to facilitate wildlife viewing. The deck elevation can raise and lower with tidal influence or hydrological cycles, and should be far enough above the water to allow passage of birds beneath.
Boardwalk	Wood or metal frame structures with recycled lumber decks, elevated above substrates such as seasonal or perennially wet land, shifting sands, or shallow water (pools, seasonal wetlands, flooded marsh, etc.). Boardwalk elevations to be at set at an approximate elevation of 13 feet. Boardwalks would be elevated high enough to allow bird and wildlife passage beneath, and discourage rodent nesting.
Overlook Platform	An overlook platform is a flat surface with benches and railings to support wildlife viewing, located so that trail circulation is not blocked.
Trash / Recycle	Trash and recycling receptacles designed to exclude foraging birds. These could be located at major and minor trailheads.
Picnic Tables	Both ADA and standard picnic tables for picnics or school group gatherings. No barbeques or open fires are envisioned in the Project Area for the protection of sensitive habitat and species. At least one table could have a shade structure or shade sails.
Benches	Benches can be used by visitors to rest, bird watch, or commune with nature. Benches should be rustic in style, durable, and could have recycled plastic lumber or ipe slats, and can be donor opportunities.
Overlook	Overlook may be an Overlook Platform, bump-out in a bridge or boardwalk, or raised earthen feature to provide visitors with views over the Project Area or into specific habitat areas. Due to the extremely flat nature of the Project Area, these elevated features could help visitors orient themselves on-site and take in views of vast natural habitats.
Bird Blinds	Structures that conceal humans from birds to promote high-quality bird viewing while minimizing disturbance to birds. Overlooks or Platforms may include bird blinds.

5.2.3 Design Considerations

Design Themes

Community input and goals developed by the Project Partners identify one of the most important characteristics of the Project Area is the sense of wild nature and solitude that it offers. Rather than proposing heavily developed access infrastructure with large architectural features, a more appropriate approach would be to provide more naturalistic integrated access features, compatible with a rustic, wild site.

Development of the public access alternatives by the Consultant Team took into consideration a set of design principles developed by True Nature to meet the Project’s goals and objectives.

Each design guidelines stems directly from a project goal (Section 3.2) and is meant to guide design decisions to meet project goals. Specific input received from the community is woven into these guidelines, which are:

1. *Habitats*: Create ability to experience multiple habitat types.
2. *Processes*: Create ability to observe natural processes.
3. *Processes*: Trails and access features should not interrupt or impede natural processes.
4. *Resilience*: Trails or boardwalks should be planned to accommodate sea-level rise and habitat migration.
5. *Connectivity*: Trails or access points should connect to existing or planned trail routes adjacent to the site to facilitate access by neighboring communities, including non-automobile forms of transportation for local residents.
6. *Coastal Trail*: Traverses site, is multi-modal, and should connect to the southeast and northwest planned Coastal Trail routes at Project Area boundaries.
7. *Recreation*: Enhance opportunities for passive recreation (e.g., bird watching, walking, bike riding, picnicking, beach enjoyment).
8. *Sensitive*: Trails and access features should be sited and aligned so as to minimize impacts to sensitive plants or wildlife by using buffers or avoiding sensitive areas. When competing ecological concerns overlap, elements should seek to minimize impacts.
9. *Community*: Encourage community involvement.
10. *Education*: Include interpretive elements and access for school groups and visitors.
11. *Sensitive*: Parking areas should be provided to discourage on-street parking and trespass over agricultural fields or though industrial areas; trails should be aligned to discourage trespass onto adjacent properties, and parking areas, trails, and public areas should ensure compatibility with security and safety criteria of the adjacent military installation.
12. *Amenities*: Provide public access amenities (trails, staging areas, interpretive signs, viewing areas, restrooms, shade structures, picnic tables, benches, trash cans, parking) for community members and visitors. The Visitor Center can also serve as community and cultural space for events and partnerships with educational institutions to host classes, screenings and other educational and recreational opportunities (Table 5-1).

Choice of Materials

In keeping with the nature-based goals and design character suggested for the Project Area, site amenities should blend with the natural surroundings and be sited in ways that support a positive visitor experience. It is suggested that colors be muted, natural tones, and materials balance natural look with longevity. An example would be recycled lumber which has a natural wood-grain pattern but is resistant to rot, important in a coastal site with multiple types of wetlands.

Seasonal Inundation and Sea Level Rise

Public access feature design and proposed location take SLR into consideration. Future SLR models were reviewed to understand likely impacts to the site. Primary trails are proposed at an elevation of 12.0 NAVD88 (or 15.0 NAVD88 for Alternative 3) to minimize the likelihood of flooding or inundation for approximately the next 50 to 75 years. Primary trails are proposed to be constructed of a sturdy compacted Class II base material which holds up during wet weather, even for emergency or security vehicular access. Bicycle and pedestrian use should not damage them when they are wet, such as during heavy storms or extreme high tides. Many proposed trail locations run through areas which are seasonally wet or which may become wetter with SLR. Boardwalks are proposed in those areas. The boardwalks would be constructed of a weather-resistant material, and can be designed to float, like boat docks, during the wet season and under future SLR scenarios. Rustic trails and Primitive trails, which are proposed with natural earthen surfaces, may require seasonal closure. Rustic trails may need to be surfaced with Class II base or other similar materials in the future should wetland levels rise and the trails become wetter. Boardwalks and bridges proposed for Rustic and Primitive trails were sited to anticipate areas of current or future inundation. Some of the Rustic and Primitive trails may need to be abandoned if the 2100 SLR model predictions become reality.

Public access amenities such as interpretive kiosks and docent stations are proposed to be semi-permanent, meaning they can be surface mounted and unbolted and relocated to higher elevations further inland on the Project Area as required should SLR occur faster than predicted, or high tide events prove to be too damaging to them. The main Visitor’s Center was proposed in Area 4 due to the current high elevation, and it would not require relocation under current SLR models. The proximity to roads and future planned neighborhoods was also taken under consideration.

Habitat and Species Considerations

Public access features such as trails, boardwalks, and overlooks were also sited to allow natural hydrologic function to occur, and were sited to be sensitive to habitat areas. In addition to accommodating SLR, boardwalks allow water to flow evenly across the Project Area, without providing barriers for migration of water, plants, and animals. Trail and boardwalk alignments were adjusted and refined to avoid sensitive plant populations and known bird nesting sites.

Boardwalks are proposed at an elevation above ground level which will allow species migration below them, and which will discourage rodent pests which can prey on eggs and hatchlings. Boardwalks also function to clearly define the trails and serve to keep people on them, limiting off-trail disturbance to wildlife and sensitive plant species. Boardwalks in dune areas allow some sand migration, and limit foot traffic onto sensitive dune plants and nesting birds.

Beach trails are proposed to have symbolic fencing aligning them. Since a beach trail exists on sand, which migrates and can obscure previous footprints which would help visitors find the trail, these symbolic fences serve to define the trail route and protect bird species nesting in the coastal dune environments. Additional exclusionary bird fencing will be added to as needed along the backdune boardwalks. Bird blinds are proposed along the back dune boardwalk adjacent to existing sensitive bird nesting sites for Western Snowy Plover and California Least Tern so that visitors may observe them or use the trail without disturbing the birds. Locations of exclusionary and symbolic bird fencing can be adjusted in the future as an adaptive management strategy to protect wildlife and define preferred access routes.

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SECTION 6
Description of Project Alternatives

The Restoration Plan includes three refined Project Alternatives, each of which provides a different range of outcomes related to the Project's overall goals and objectives and across a range of complexity related to hydromodification and earth moving. Each alternative seeks to restore natural ecosystem processes with a focus on self-sustaining habitats typical of coastal southern California wetland systems. This chapter:

- Describes three alternatives that are expected to provide a different range of ecological outcomes using varying intensities of landscape modification and management.
- Depicts a variety of public access trails and amenities for each alternative that is compatible with proposed restoration outcomes.
- Analyzes each alternative and compares how well each alternative meets Project goals and objectives using quantitative and qualitative criteria.
- Presents a preferred "hybrid" alternative that is composed of elements selected primarily from Alternatives 2 and 3 as recommended by the SAC and the Project Partners.

This Section 6.1 provides an overview of the three alternatives that were developed, analyzed and evaluated. Development of the alternatives is described in Section 6.1. Each of the three alternatives is described in detail, analyzed and evaluated in Section 6.3. The Preferred Alternative is described in Section 6.4.

The three alternatives are designed around three ecological themes. Alternative 1 focuses on restoring salt marsh (the "Salt Marsh Theme") (**Figure 6-1**), Alternative 2 focuses on restoring a wider diversity of habitats (the "Habitat Diversity Theme") (**Figure 6-2**), and Alternative 3 focuses on removing man-made barriers between habitats (the "Habitat Connectivity Theme") (**Figure 6-3**). The amount of modification and intervention increases from Alternative 1 (minimal intervention) through Alternative 3 (greater intervention).

Table 6-1 presents a comparison of major actions and outcomes among the three alternatives. Various public access improvements were developed concurrently and matched to each restoration alternative. These public access features are presented for each alternative concept design (Figures 6-1, 6-2, and 6-3) to show the interrelation between restored habitats and access elements. Public access elements are not restricted to the restoration alternative they are paired with in the tables and figures. Development of a Preferred Alternative may include combining of elements from among the restoration and public access alternatives.

6.1 Alternatives Development

Three alternatives were developed to meet project goals and objectives, based on our understanding of historical and existing site conditions, expected future conditions, and opportunities and constraints. The alternatives are consistent with the objectives of the Regional Strategy (SCWRP 2018). Surveys, modeling, and technical studies (as summarized in Section 2 and Section 6.3 and detailed in the appendices) were conducted to bolster understanding of present and future physical processes that may affect the feasibility and sustainability of ecosystem restoration.

6.1.1 Ecological Basis

Three restoration alternatives were developed and refined primarily to present a range of ecological outcomes to the Project Partners and SAC for consideration in the eventual development of the Preferred Alternative. The target habitats presented are appropriate for the Project Area within the context of what we know about historical conditions. There are still outstanding questions as to the types of interventions that might be needed to sustain some of the depicted habitats, due in part to data gaps. However, the target habitats presented are expected to be feasible within the context of the minimal, moderate and more intensive interventions that characterize the three alternatives. Habitat targets will be achieved by restoration of important physical and biological processes that have been altered.

Alternative 1 is configured to enhance existing habitats through limited intervention, with an emphasis on preservation of salt marsh and salt panne habitats. Alternative 1 recognizes that there are significant existing wetlands resources in the Project Area that can be improved through, enhancement, restoration and improved management. This alternative also provides a lower impact approach with less earth moving. Alterative 1 therefore has a “salt marsh theme” with minimal intervention and is described in Section 6.2.1.

Alternative 2 has a “diversity theme” with moderate intervention. Substantial intervention is proposed to expand a wide diversity of wetland habitats. The wetland types proposed are based on current conditions and are appropriate within the historic context of the region. A major action is the realignment of OLW to create extensive brackish wetlands. This alternative requires substantial earthwork to enhance, restore and create higher functioning habitats. Alternative 2 is described in Section 6.2.2.

Alternative 3 focuses on removing man-made barriers that fragment habitats throughout the site in order to re-create a more contiguous mosaic of habitats connected by broad ecotones. This alternative proposes the most earthwork, and the greatest changes. Hence the alternative has a “connectivity theme” with the greatest degree of intervention. A major action is the creation of a new lagoon connected to a re-routed OLW and with a new intermittently open mouth. The fill generated from the earthwork is used to expand upland and wetland-upland ecotone habitat. These higher areas will allow for wetland habitat transgression with sea-level rise. Alternative 3 is described in Section 6.2.3.

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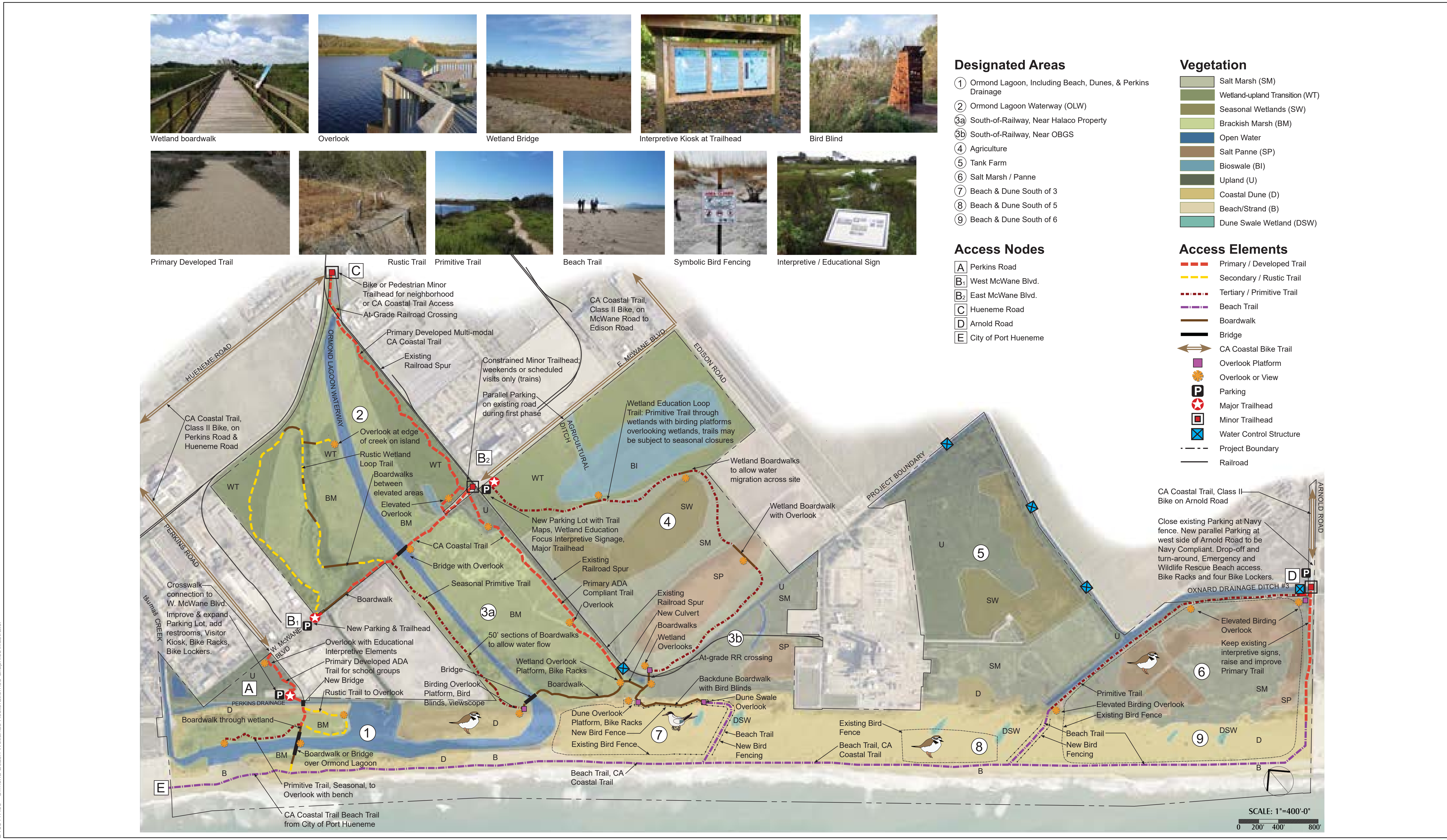
SOURCE: ESA, 2019

Ormond Beach Restoration and Public Access Plan

Figure 6-1
Alternative 1: Salt Marsh Theme, Light Intervention

ESA

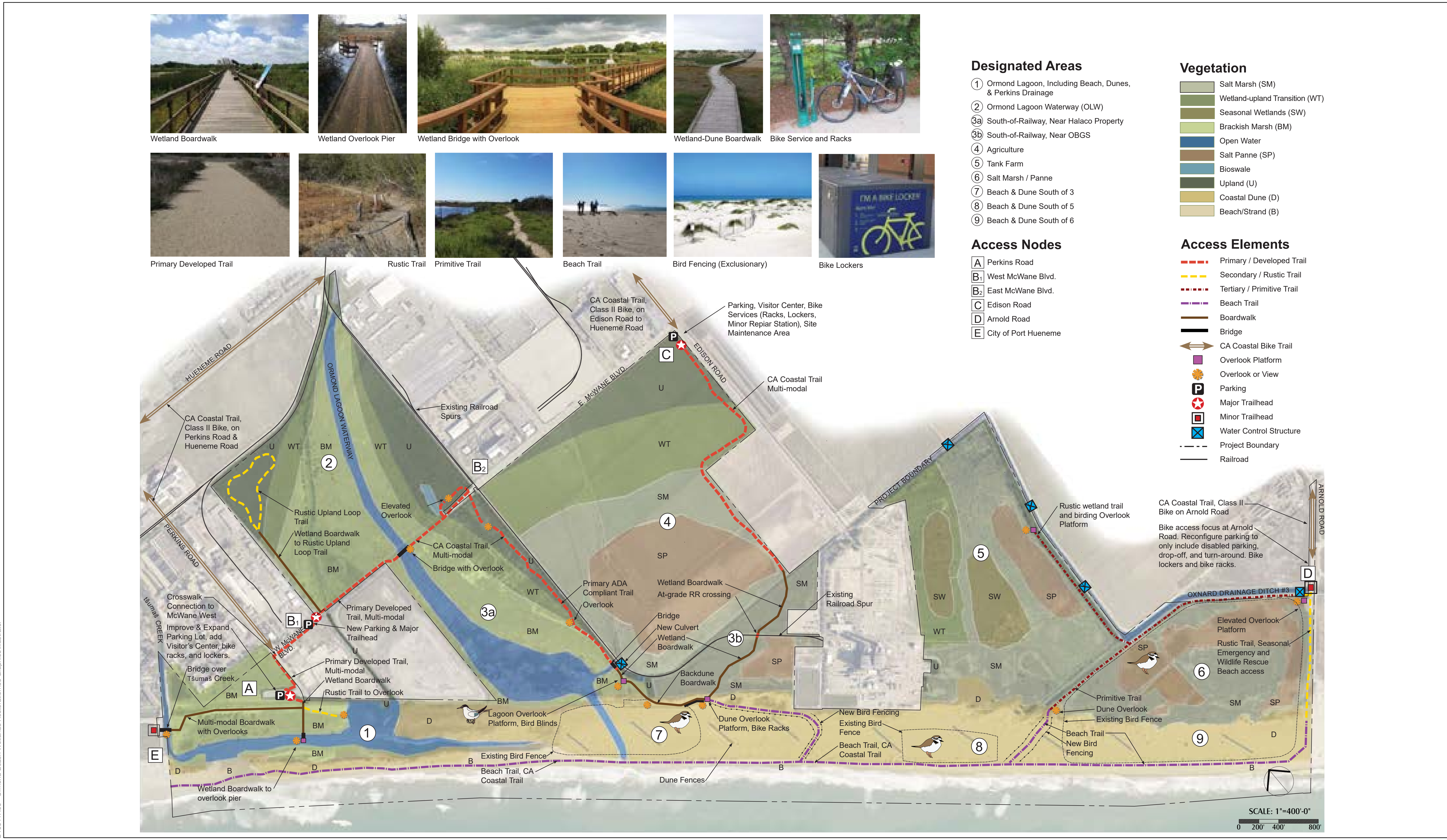


SOURCE: ESA, 2019

Ormond Beach Restoration and Public Access Plan

Figure 6-2
Alternative 2: Habitat Diversity Theme, Moderate Intervention

ESA



D160447.00 - Ormond Beach Wetlands Restoration\05 Graphics\Illustrator

SOURCE: ESA, 2019

Figure 6-3
Alternative 3: Habitat Connectivity Theme, Greater Intervention

ESA

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TABLE 6-1
OVERVIEW OF ALTERNATIVES WITH RESTORATION AND PUBLIC ACCESS ELEMENTS

Area	Design Element	**Alternative 1** **Salt Marsh Theme** Minimal Intervention	**Alternative 2** **Habitat Diversity** Moderate Intervention	**Alternative 3** **Habitat Connectivity** Greater Intervention
1	Restoration	• Weeding and planting in upland areas • Surface connection between lagoon and Area 3a blocked by fill configured and planted to form a stabilized dune • Lagoon volume may decrease slightly	• Weeding and planting in upland areas • Lagoon connection to OLW moved to the east of Halaco properties • Lagoon connection to marsh in Area 3a increases capacity and leads to less frequent manual breaching	• Convert upland areas to brackish marsh by grading • OLW diverted to second lagoon in Area 3a • Decreased inflows lead to less manual breaching of existing lagoon
	Public Access	• All primary trails at 12.0 elevation, rustic trails at 11.0-12.0 elevation where feasible, boardwalks at 13.0 • New bridge over tšumaš Creek • Primary trail on OLW “island”, primitive loop trail with footbridges and birding overlooks • Overlook pier/platform at OLW • Expand Perkins Road parking lot footprint, adding 24 spaces. • Visitor Services - ±120 SF docent kiosk with interpretive elements, security, wildlife-friendly lighting at Perkins	• All Primary trails at 12.0 elevation, rustic trails at 11.0 -12.0 elevation where feasible, boardwalks at 13.0, bridges at 15.0 • Boardwalk, floating boardwalk, or bridge over OLW from island to beach • Primitive seasonal trail to overlook at OLW • Rustic trail to overlook and boardwalks • New bridge between Perkins and OLW • Expand Perkins parking lot footprint, adding 24 spaces • Restrooms, interpretive kiosk, and docent station (±100 SF for school group focus) • Bike racks and bike lockers (rental) • Primary trail in wetlands north of Perkins Road parking leading to West McWane Blvd.	• All primary trails 15.0, rustic and primitive trails at 13.0 elevation, pier/boardwalks at 15.0 • Bridge over tšumaš Creek • Elevated boardwalk from tšumaš Creek bridge to Perkins parking lot • Elevated boardwalk to an overlook pier • Rustic trail to overlook at OLW • Primary developed multi-modal trail from Perkins across wetlands, leading to West McWane Blvd trailhead • Expand Perkins Parking Lot footprint, adding 50 spaces • Visitor’s Center (Future), bike racks, bike lockers, interpretive and educational signage, docent staff, security, lighting
2	Restoration	• Maintain brackish marsh west of OLW • Close culvert in eastern levee of OLW to enhance salinity, and rebuild southern section of OLW levee-berm to reduce freshwater flows from OLW to Area 3a via southern Area 2 • Enhance seasonal wetlands with weeding and planting • Enhance and restore upland areas with weeding and planting • Eliminate berms and ditch between Area 2 and 3a • Create bioswale to capture freshwater runoff from McWane Blvd to maintain higher salinity in salt marsh	• Re-align OLW and grade to allow engagement with floodplain and brackish marsh • Minor grading to create gently sloping brackish marsh plain along new channel • Balance cut-fill within the area by filling old channel and adding flood protection around edges of property • Create smooth transition between Areas 2 and 3a • Create bioswale to capture nutrients in runoff from McWane Blvd.	• Re-align OLW and grade to allow engagement with floodplain and brackish marsh • Fill old channel and add flood protection around edges of property • Place fill from newly excavated lagoon in 3a on edges of property to create upland habitats • Create smooth transition between Areas 2 and 3a • Create bioswale to capture nutrients in runoff from McWane Blvd.

TABLE 6-1 (CONTINUED)
OVERVIEW OF ALTERNATIVES WITH RESTORATION AND PUBLIC ACCESS ELEMENTS

Area	Design Element	Alternative 1 **Salt Marsh Theme** Minimal Intervention	Alternative 2 **Habitat Diversity** Moderate Intervention	Alternative 3 **Habitat Connectivity** Greater Intervention
2 (cont.)	Public Access	• New Parking at extended West McWane Blvd, parallel on road with ADA parking at end (±15 spaces) • New trailhead with primary developed trail, seasonal primitive trail loop, creek overlooks • Bridge over OLW and primary developed trail/ CA Coastal Trail to East McWane Blvd elevated overlook. • Constrained, scheduled, minor access point at East McWane Blvd (at-grade train crossing and frequent train parking on track)	• New Major trailhead with 25+ parking spaces and interpretive signage • New primary developed trail and boardwalk, CA Coastal Trail • Rustic wetland loop trail with boardwalks, creek overlook on island • Bridge over OLW with birding overlook • Elevated overlook near East McWane • Minor pedestrian and bike trailhead at Hueneme Road • Primary multi-modal trail at Hueneme Road (at-grade railroad crossing) to East McWane Blvd, CA Coastal Trail	• New Major trailhead with 25+ parking spaces and interpretive signage • New multi-modal primary developed trail and CA Coastal Trail • Elevated wetland boardwalk to rustic loop trail • Elevated overlook • Bridge over OLW with overlook • No access at East McWane Blvd.
3	Restoration	• Limit off-site surface drainage to retain salts, sustain and expand salt marsh and salt panne habitats • Eliminate berms and ditch between Areas 2 and 3a • Weeding and planting in upland areas • Expand existing small population of salt marsh bird's beak	• Re-align OLW and grade to allow engagement with floodplain and brackish marsh • Minor grading to create gently sloping brackish marsh plain along new channel • Let habitat naturally convert from salt marsh to brackish marsh • Establish additional Coulter's goldfield populations in other areas on-site by collecting seed and distributing in appropriate areas • Weeding and planting in upland areas • Water control structure (culvert) under the railroad	• Excavate new lagoon with open water habitats and an intermittently open (un-managed) mouth through the dunes to the ocean • Place excavated material in Area 2 and edges of Area 3A to protect neighbors from flooding • Revegetate as needed with upland, transition and brackish marsh species • Allow for future channel to connect the new lagoon to Area 4 as Area 4 becomes wetter with sea-level rise • Water control structure (culvert) under the railroad • Construct berm between Area 3a and 3b to prevent second lagoon from flooding Area 3b to maintain salt marsh there • Establish additional Coulter's goldfield populations in other areas on-site by collecting seed and distributing in appropriate areas

Table 6-1 (continued)
Overview of Alternatives with Restoration and Public Access Elements

Area	Design Element	**Alternative 1** **Salt Marsh Theme** Minimal Intervention	**Alternative 2** **Habitat Diversity** Moderate Intervention	**Alternative 3** **Habitat Connectivity** Greater Intervention
3 (cont.)	Public Access	• Primary Developed CA Coastal Trail from East McWane Blvd to beach though Area 3a • Wetland boardwalk behind back dunes • Wetland birding overlook	• Primary multi-modal trail, CA Coastal Trail • Overlook platforms • Wetland boardwalk behind back dunes • Birding overlook with platforms and viewing scope (into OLW Area 1) • Boardwalks through back dunes and wetlands • Beach overlook platform with bike racks • Back dune boardwalks with bird fencing	• Primary multi-modal trail, CA Coastal Trail • Overlook Platforms • Bridge over OLW/Agricultural ditch creek • Wetland boardwalks • Birding overlook platform with bird blinds • Backdune boardwalks • Elevated boardwalks through Area 3b • At-grade railroad crossing
4	Restoration	• Cease farming and do minor grading to eliminate roads, ditches and any tile drains • Assess need for soil amendments to create appropriate salt marsh soils (relatively high silt and clay content) • Fill in diagonal drainage ditch; capture inflows in bioswale located adjacent to McWane Blvd. • Plant salt marsh species below about 9 feet NAVD88 and consider irrigating with brackish water or saltwater • Establish transition zone habitat above about 9 feet NAVD88 with planting and weeding as needed	• Cease farming and excavate a series of shallow basins at increasing elevations from south to north • Water control structure (culvert) under the railroad to allow hydraulic connectivity between Areas 4 and 3 may be installed, to be determined. • Basins will undergo type changes as the sea level rises • Lower basin expected to support salt panne habitat at about 5 feet NAVD88 in the short term and evolve in to open water with moderate sea-level rise • Middle basin(s) expected to support seasonal saline-effected wetlands at about 7 feet NAVD88 and evolve in to salt marsh and salt panne with moderate sea-level rise • Upper basin(s) expected to support seasonal wetlands and act as a bioswale at about 9 feet NAVD88 and evolve in to salt marsh and salt panne with greater sea-level rise • Establish salt marsh (below about 9 feet NAVD88) and transition zone vegetation (above about 9 feet) around basins	• Cease farming and excavate a large shallow basin to about 5 feet NAVD88 to create a large salt panne • Place excavated material in the northern areas and revegetate with upland (above 11 feet NAVD88) and transition (between 9 and 11 feet NAVD88) species • Restore salt marsh around the salt panne between about 6 and 9 feet NAVD88 • Fill in the diagonal ditch between McWane Blvd and ODD # 3 and remove levees between Areas 3b and 4 • Water control structure (culvert) under the railroad to allow hydraulic connectivity between Areas 4 and 3, hydraulic criteria to be determined during design

TABLE 6-1 (CONTINUED)
OVERVIEW OF ALTERNATIVES WITH RESTORATION AND PUBLIC ACCESS ELEMENTS

Area	Design Element	**Alternative 1** **Salt Marsh Theme** Minimal Intervention	**Alternative 2** **Habitat Diversity** Moderate Intervention	**Alternative 3** **Habitat Connectivity** Greater Intervention
4 (cont.)	Public Access	• Major trailhead with new parking lot (±25 stalls, ADA stalls) • Interpretive signage • Farm exclusion fencing along rustic trail	• Parallel parking on East McWane for McWane east access (constrained, first phase) • Major trail head and parking lot (±25 spaces + ADA) with interpretive and educational exhibits, trail maps (future phase) • Wetland Education Loop Trail: primitive trail through wetlands with birding platforms, overlooks, boardwalks, observation nodes, subject to seasonal closures when flooded in major events (future phase), at grade railroad crossing to Area 3	• Major trailhead and ±50 stall parking lot at McWane Blvd and Edison Drive intersection (Future, high point of site) • Bike services for CA Coastal Trail riders, including racks, lockers, minor repair station. • New Community Wetland Center (future) • Multi-modal primary elevated trail, CA Coastal Trail
5	Restoration	• Modify culverts between Area 5 and ODD #3 to retain salts on-site and support more ponding and salt marsh and salt panne habitat, and to support existing Mugu hydrology; monitor to assure no polluted waters/sediments are impacting restoration sites. • Plant salt marsh below about 7.5 feet NAVD88 and transition species above 7.5 feet NAVD88 • Expect salt panne below about 5 feet NAVD88 • Consider irrigating with brackish water or saltwater	• Leave culverts between the northern part of Area 5 and ODD #3 as is to minimize changes to hydrology in the western arm of Mugu Lagoon • Expand salt marsh in southern portion of Area 5 by removing some roads/levees and building a berm eliminate drainage (and removal of salts) toward ODD #3 • Weeding and planting to restore saline seasonal wetlands where highly degraded wetlands currently occur • Weeding and planting to restore upland habitats where weedy uplands currently occur • Planting to restore salt marsh in south eastern area with possible brackish water/saltwater irrigation	• Eliminate culverts between Area 5 and ODD #3 (or reduce connectivity with berms, similar to Alternative 1) • Remove levees and fill the ditch of ODD #3 between Areas 5 and 6 (the dead end channel) to create continuous marsh plain • Remove all old roads and building pads • Create series of shallow basins at increasing elevation • Lowest basin expected to support salt panne in the near term at about 5 feet and open water habitats with moderate sea-level rise • Middle basin expected to support seasonal saline-effected wetlands at about 6 feet NAVD88 and evolve in to salt marsh and salt panne with moderate sea-level rise • Upper basin expected to support seasonal wetlands at about 8 feet NAVD88 and evolve in to salt marsh and salt panne with greater sea-level rise • Establish salt marsh (below about 7.5 feet NAVD88) and transition zone vegetation (above about 7.5 feet NAVD88) around basins
	Public Access	• No proposed access	• No proposed access	• Rustic trail to birding platform with wetland overlook • Opportunity for future connection to Edison Drive for loop trail

TABLE 6-1 (CONTINUED)
OVERVIEW OF ALTERNATIVES WITH RESTORATION AND PUBLIC ACCESS ELEMENTS

Area	Design Element	**Alternative 1** **Salt Marsh Theme** Minimal Intervention	**Alternative 2** **Habitat Diversity** Moderate Intervention	**Alternative 3** **Habitat Connectivity** Greater Intervention
6	Restoration	• Maintain salt panne and salt marsh habitats with some weeding and revegetation as needed on higher spots • Restore upland habitats along ODD #3 levee	• Maintain salt panne and salt marsh habitats with some weeding and revegetation as needed on higher spots • Restore upland habitats along ODD #3 levee	• Maintain salt panne and salt marsh habitats with some weeding and revegetation as needed on higher spots • Restore upland habitats along ODD #3 levee • Remove levees and fill the ditch of ODD #3 between Areas 5 and 6 (the dead end channel) to create continuous marsh plain (in coordination with Oxnard Drainage District No. 2)
	Public Access	• Arnold Road closed to public traffic; emergency, maintenance, and public works access only	• Close existing parking lot at Arnold Road abutting Navy fence (non-compliant) • Future parallel parking along west side of Arnold Road • Drop-off and turn-around at Arnold Road, Emergency access, bike racks and bike lockers (rentals) • Elevated birding overlooks to salt panne • Raise and improve primary trail to beach • Primitive trail along ODD #3 (formalize existing trail) • Birding overlook in back dunes	• CA Coastal trail Class II bike trail on Arnold Road (future) • Close existing Arnold parking, provide only ADA parking stalls, drop-off and turn-around space for cars • Bike focused trailhead with bike lockers and bike racks • Elevated wetland overlook • Primitive trail along ODD #3 to Area 5 and beach • Birding overlook in back dunes • Rustic seasonal trail from trailhead to beach
7, 8, 9	Restoration	• Weeding and planting to restore back dune scrub habitat and expand foredune scrub habitat • Excavate series of shallow depression between dune ridges and vegetate with dune swale wetland species • Conduct minimal management of the dunes at the southern end to facilitate occasional (+/decadal) wave overwash events	• Weeding and planting to restore back dune scrub habitat and expand foredune scrub habitat • Excavate series of shallow depression between dune ridges and vegetate with dune swale wetland species • Excavate new connection between OLW and the lagoon through the dunes	• Weeding and planting to restore back dune scrub habitat and expand foredune scrub habitat • Excavate series of shallow depression between dune ridges and vegetate with dune swale wetland species • Add sand fencing and seed native dune species to facilitate wind-driven sand capture and dune building
	Public Access	• Area 7: New bird fencing • Beach trail from Dunes Area 3a and beach in front of power plant • Area 8: Beach spur trail to elevated birding overlook in backdunes (for birding views into Area 6) • CA Coastal Trail along beach strand	• Area 7: New bird fencing • Beach trail from dunes Area 3a and beach in front of Area 3b • Area 8: Beach trail to Arnold primitive trail • CA Coastal Trail along beach strand	• Area 7: New bird fencing • Backdune boardwalk • Dune Overlook platform with bike racks • CA Coastal Trail along beach strand

6.1.2 Public Access

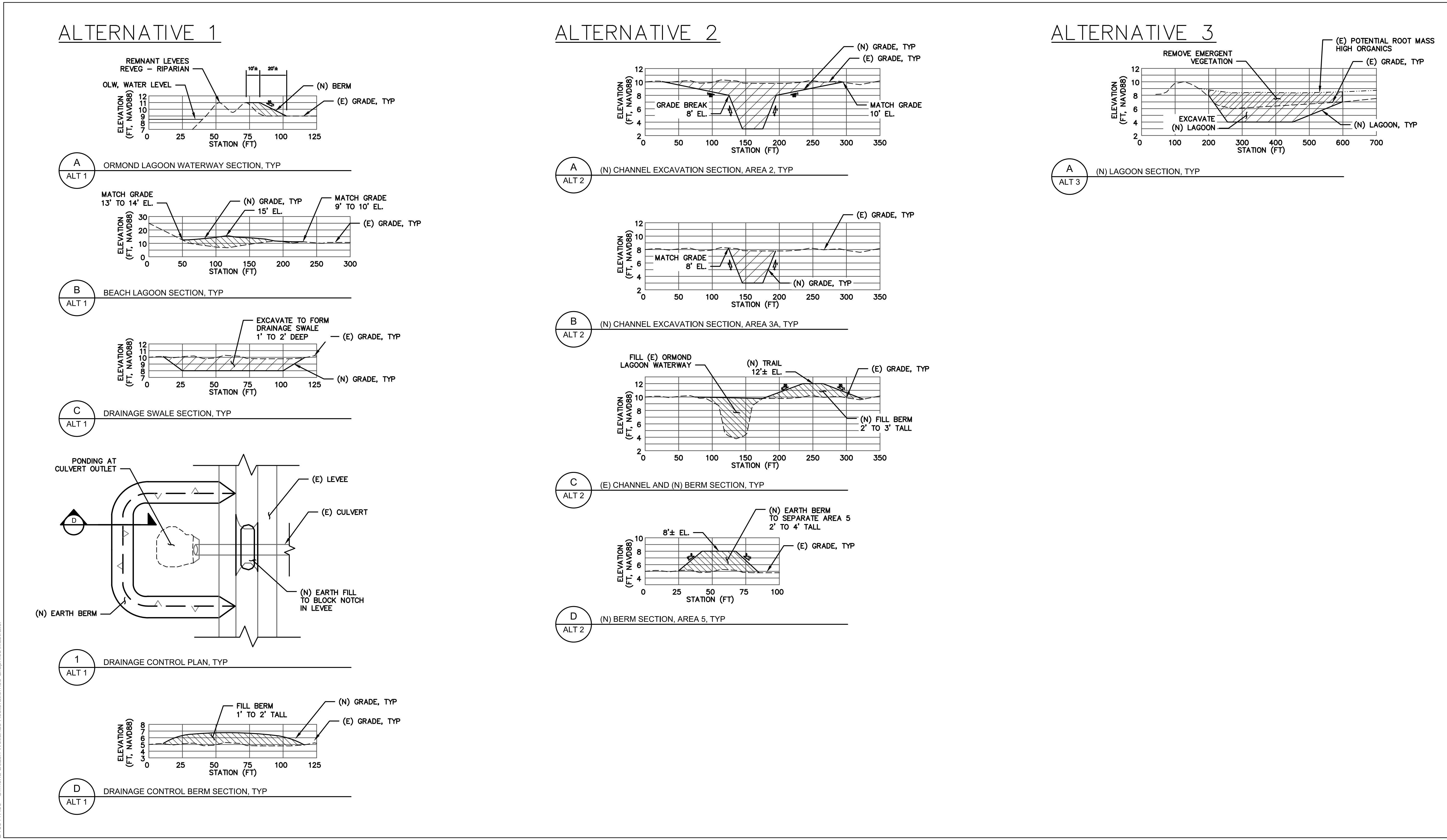
The three alternatives for public access were developed to meet project goals and objectives for public access (Section 3.2).

Information gained through public input also informed the character of the proposed access features in the alternatives, including areas the community is interested in visiting and the types of activities they would like to do. The Project Partners held a public meeting on June 21, 2017. In addition, the Project Partners gathered input from individual surveys conducted by the Central Coast Alliance United for a Sustainable Economy (CAUSE) (322 door-to-door in-person oral surveys with local South Oxnard residents, including Mixteco residents). One of the major themes that emerged at the public meeting was a desire to preserve the unique and rare coastal habitats found at Ormond Beach. Many community members expressed interest in viewing birds and other wildlife, connecting with nature, enjoying the beach, and facilitating use of the site for education by local schools. Survey results identified a desire for low-impact and free access activities or amenities such as picnic tables, beach access, walking paths, learning about nature, biking, and fishing. Multi-modal bicycle and walking paths with safe and easy neighborhood connections were commonly requested. The community also expressed desire for clean, safe, well-lit family-friendly experiences where children and adults alike could experience nature and relax.

In the design of public access for each alternative, the ecological restoration theme of the associated alternative was considered and built upon to develop an appropriate design approach. The types of habitat, the physical implications of the interventions proposed for the Project Area (hydrologic modifications leading to wetter environments, etc.), and the level of intervention was considered to develop the access plans so that the proposed access features are compatible with the proposed habitat and desired hydrologic conditions. Design of the public access elements also considered the potential to "mix and match" components of different alternatives into the Preferred Alternative.

6.2 Description of Alternatives

Alternatives 1, 2, and 3 are described in Sections 6.2.1, 6.2.2, and 6.2.3, and shown in Figures 6-1, 6-2, and 6-3, respectively. Table 6-1 provides a summary of restoration actions and public access improvements for each alternative, by area. More detail for each alternative is provided below, including restoration actions and estimated acreages by habitat type within each of the nine areas. Typical earthwork cross sections are provided in **Figure 6-4a** and **Figure 6-4b**. The locations of earthwork sections are shown in the plan views in **Figure 6-5** (Alternative 1), **Figure 6-6** (Alternative 2), and **Figure 6-7** (Alternative 3). These plan views also show the habitats used to initiate the habitat evolution modeling described in Section 6.3.1. The distribution of habitat areas for each alternative is quantified in **Figure 6-8**.



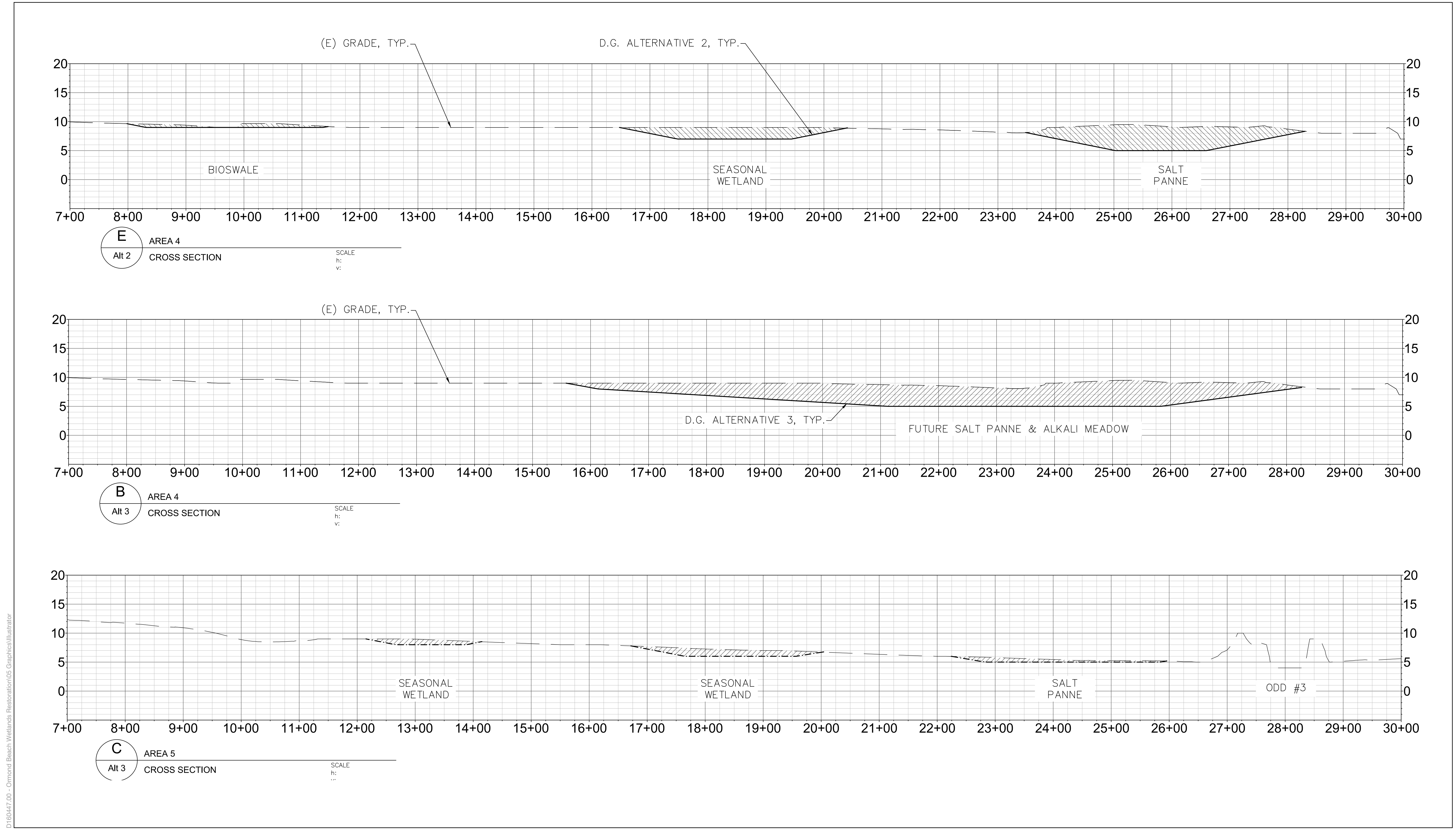
D160447.00 - Ormond Beach Wetlands Restoration\05 Graphics\Illustrator

SOURCE: ESA, 2019

Ormond Beach Restoration and Public Access Plan

Figure 6-4a
Cross Sections for Project Alternatives

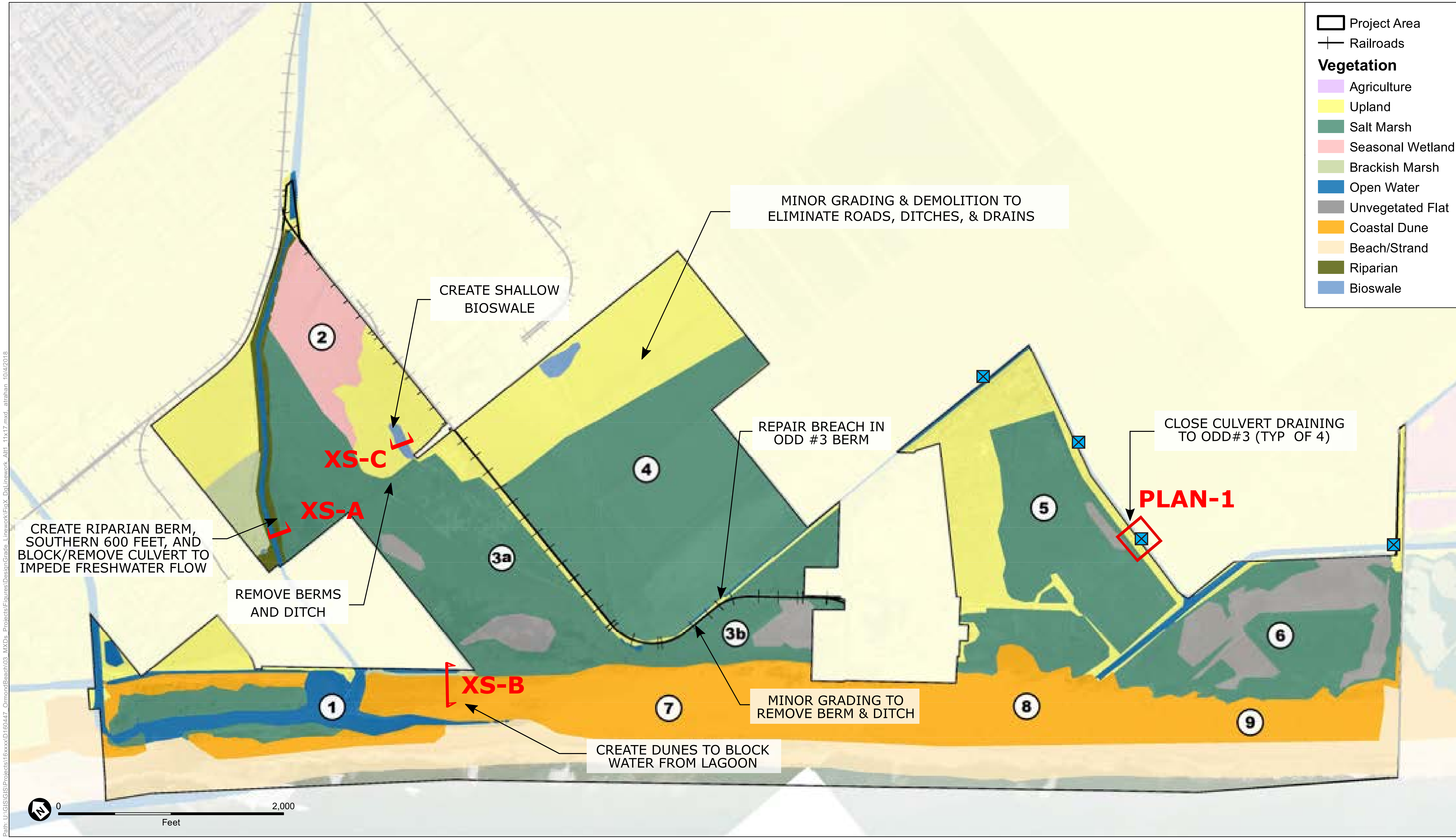
ESA



SOURCE: ESA, 2019

Figure 6-4b
Cross Sections for Project Alternatives

ESA

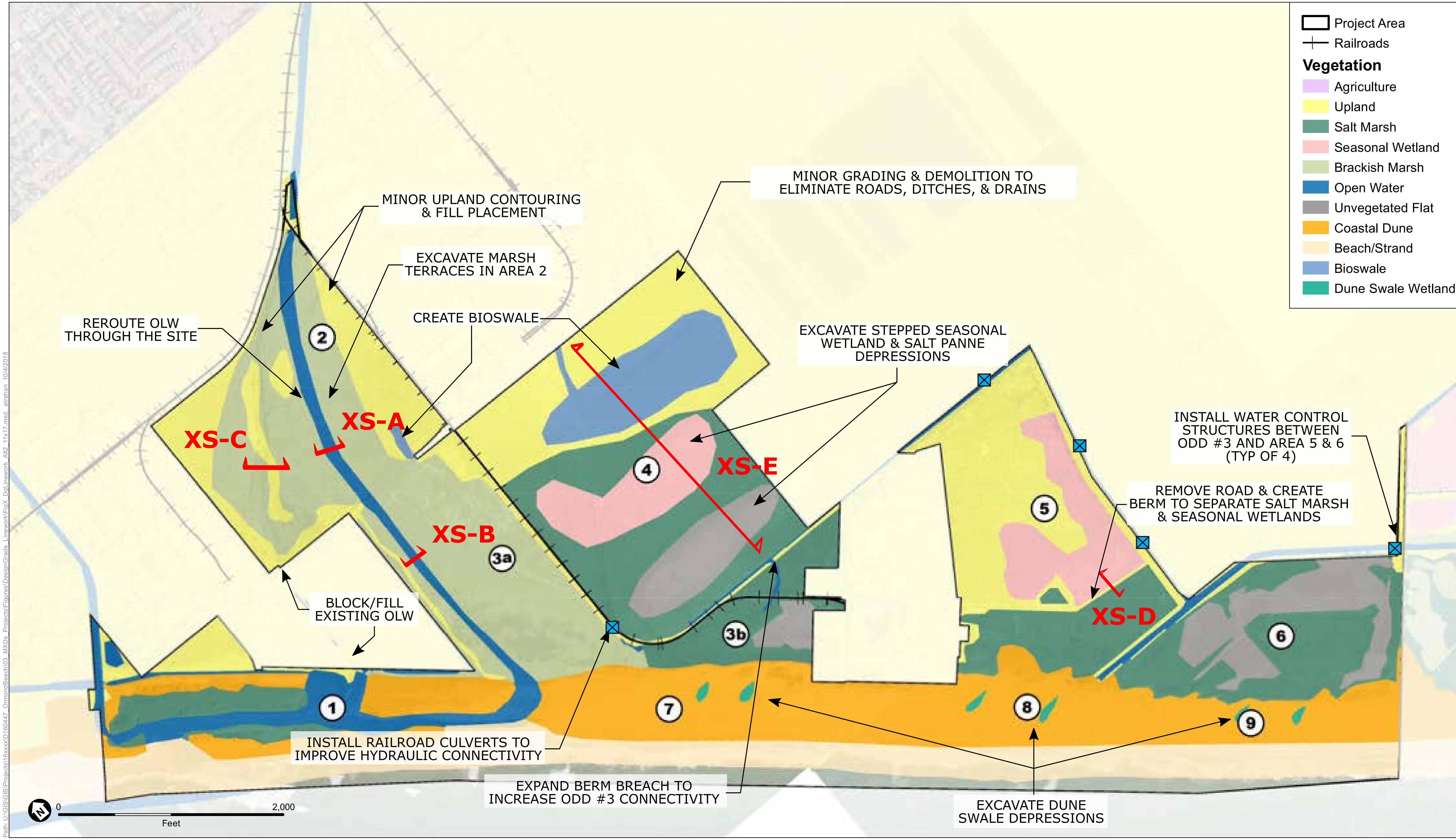


SOURCE: ESA (2017), CA Coastal Conservancy LiDAR (2011)

Ormond Beach Restoration and Public Access Plan

Figure 6-5
Alternative 1 Cross Section Locations

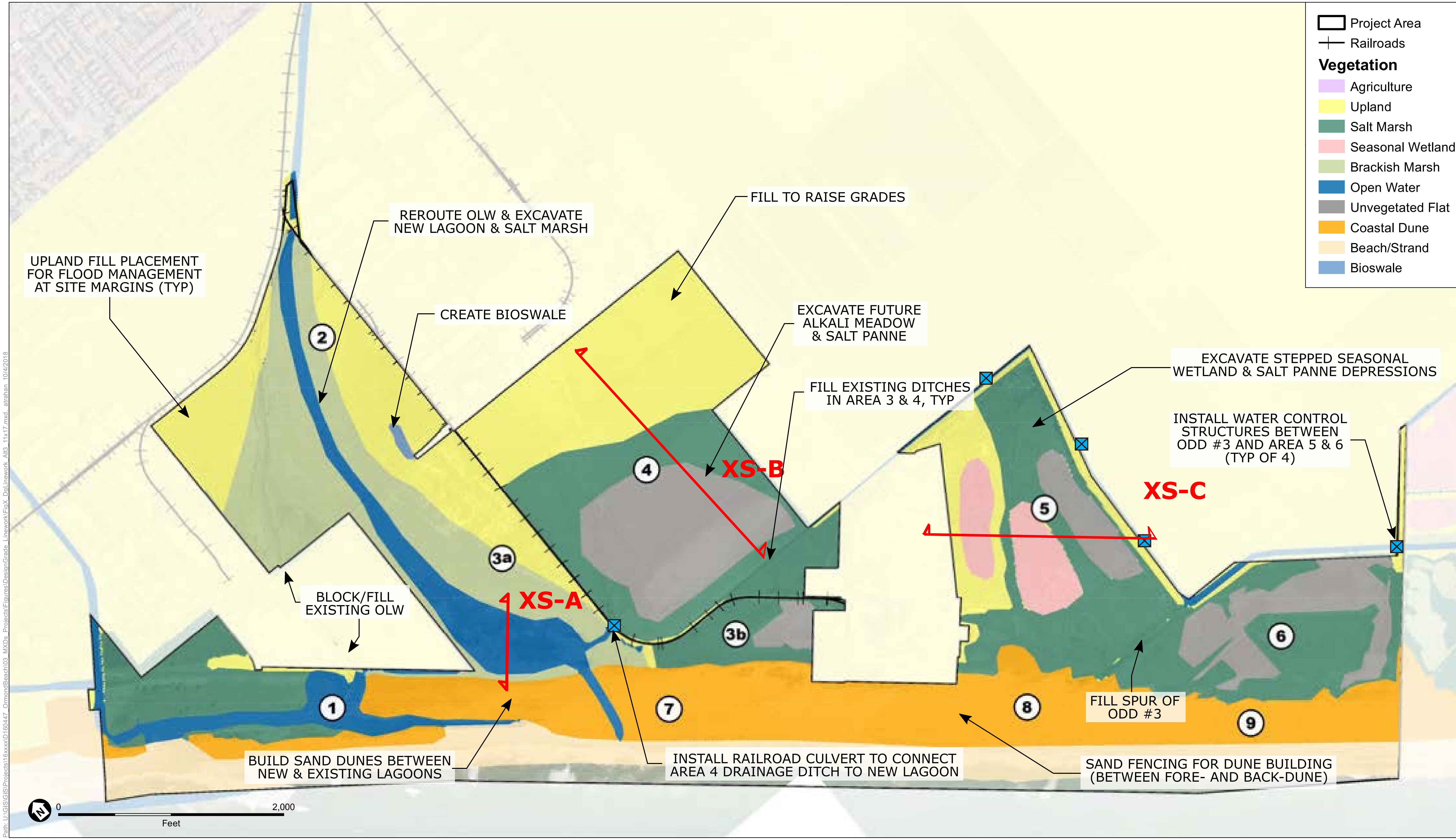
ESA



SOURCE: ESA (2017), CA Coastal Conservancy LiDAR (2011)

ESA

Figure 6-6
Alternative 2 Cross Section Locations



SOURCE: ESA (2017), CA Coastal Conservancy LiDAR (2011)

Ormond Beach Restoration and Public Access Plan

Figure 6-7
Alternative 3 Cross Section Locations

ESA

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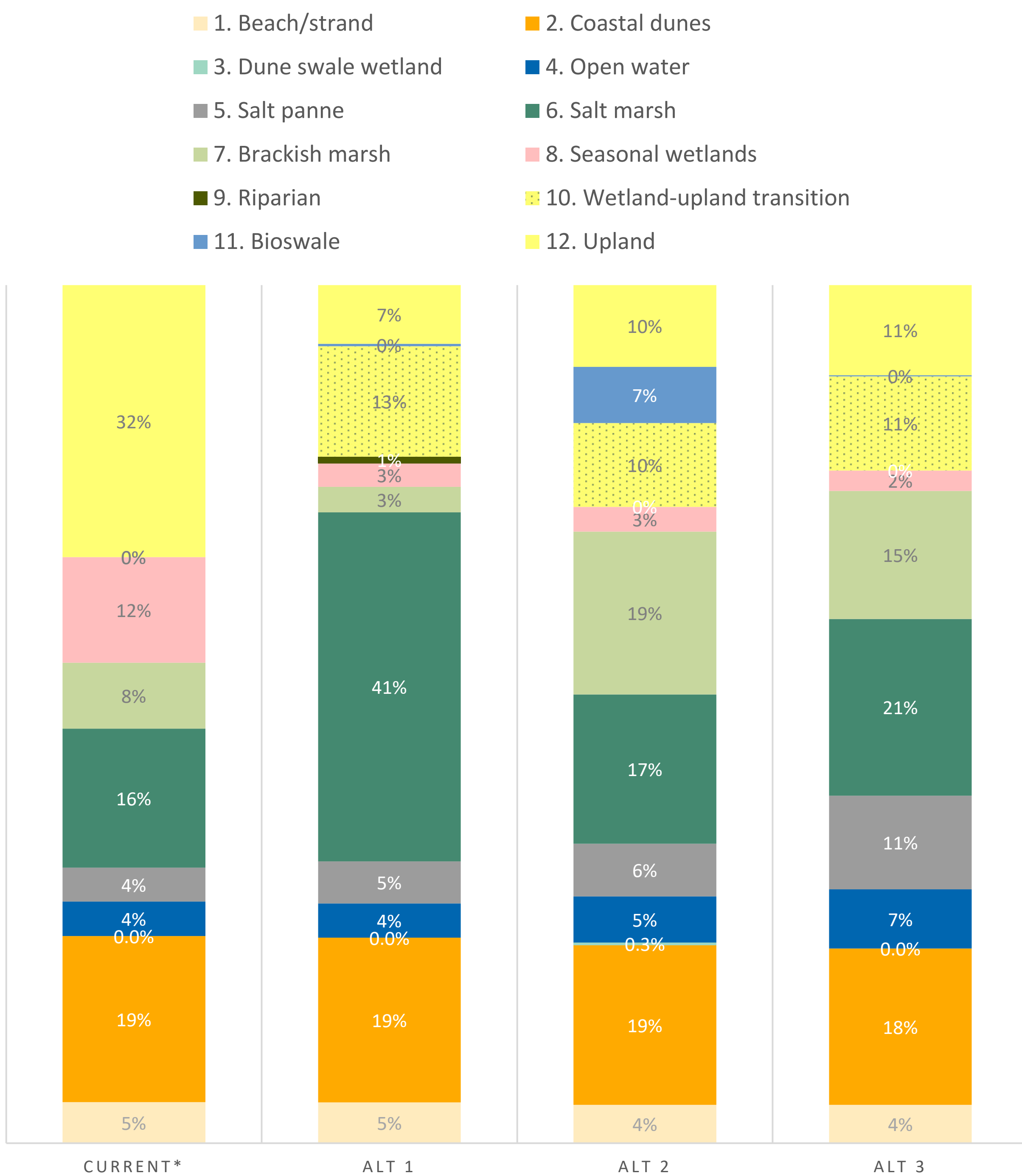


* Agricultural area (106 ac) and coyote brush scrub (30 ac) were grouped into "uplands". Willow scrub (<1 acre) was grouped with surrounding "seasonal wetlands".
* Wetland/Upland Transition is yellow in SLAMM figures and green in public access figures, so it is stippled in this figure.

D160447.00 - Ormond Beach Wetlands Restoration\05 Graphics\Illustrator

SOURCE: SFEI 2011, CRC 2018

Ormond Beach Restoration and Public Access Plan

Figure 6-8
Habitat Distribution by Alternative

ESA

6.2.1 Alternative 1

6.2.1.1 Overview

Alternative 1 emphasizes salt marsh and limited intervention (Figure 6-1).

Most of the Project Area was historically salt marsh habitat, but much of it has been lost due to soil disturbance and hydrologic alterations. This alternative seeks to restore salt marsh habitats through minor alterations to small channels, culverts and land forms with minimal earth moving. Local point source runoff will be directed to bioswales and away from core habitat areas to limit freshwater inputs and encourage retention or buildup of salts to support salt marsh and salt panne, instead of brackish and freshwater marsh. Resilience to sea-level rise is built into the design by preserving higher-elevation upland and transitional areas to accommodate up-slope migration of salt marsh (Areas 2 and 4) habitat. Existing high-value habitats in Areas 3b, 5, and 6 would be preserved. There would be minimal actions taken in the dunes.

The public access features proposed for Alternative 1 could be implemented with limited grading or other disturbance. This access alternative focuses on utilizing existing infrastructure (such as roads, trails, parking lots, etc.), largely preserving existing conditions. It provides three new entry points to the site and shifts the concentration of public use to the west. This alternative provides the least number of access points and trails, in effect preserving vast contiguous areas of the site for habitat. The trails and access elements can largely be implemented immediately, with options for phased boardwalks to accommodate sea-level rise and habitat migration in the future (i.e., wetland expansion inland).

6.2.1.2 Actions

Overview by Areas

The ecological restoration will consist mostly of enhancement, defined as improving existing habitats based on limited earthwork, planting and vegetation management.

More extensive grading is proposed for the areas north and south of the Halaco properties, to block surface water flow from OLW and Ormond Lagoon to the area north and east of the Halaco properties slag pile (primarily Area 3a).

The banks of OLW (Area 2) and the north banks of Ormond Lagoon (Area 1) will be mostly maintained as-is, and enhanced with some weeding and planting for riparian vegetation (depending on salinity) and brackish marsh, respectively. An exception entails modification east bank of OLW, where the southern 600 linear will be regraded on the landside of the eroded levee-berm to provide a contiguous berm crest: the purpose is to reduce fresh water supply to Area 3a via southern Area 2. Also, an existing culvert in this area will be plugged or removed for the same purpose (it is believed to be a conduit for freshwater “back-flowing” into Areas 2 and 3a). A cross section of this action is shown in Section A, Figure 6-4a. The upland areas will also be enhanced by weeding and planting, with limited to no earthwork, with the exception that some selective fine grading to enhance wetlands.

In Areas 3a and 3b, salt marsh and salt panne habitats will be enhanced. Special-status plants would be maintained, and potentially expanded or provided with inland expansion pathways via grading, planting and vegetation management actions.

The agricultural area (Area 4) will be taken out of agriculture and transitioned into wetland. Conceptually, the conversion from agriculture to natural area could progress from south to north, and occur in several steps associated with the existing site drainage divisions, or as part of a single effort. One or more drainage swale features would capture stormwater runoff from adjacent pavements, increase residence time, and facilitate breakdown of organics and cycling of nutrients prior to flows entering the perennial wetland areas.

Areas 5 and 6 will be enhanced as salt marsh and salt panne. Localized earthwork will be employed to reduce site drainage to ODD #3, and to enhance salt accumulation on the site. Continued salt input from the ocean, ditch backwater, and groundwater, together with evaporation, will increase salinity and thus maintain salt marsh and salt panne.

Weeding and planting of beach-dune Areas 7, 8, and 9 is included subject to funding for ongoing maintenance activities (such funding may not be available, or these actions may be accomplished by others). Special consideration to Area 9 (adjacent to Area 6) is recommended so that wave overtopping is maintained. Management activities could target plant management to limit high-dune relief that blocks wave run-up while maintaining low hummocks, similar to existing conditions, though these actions are not expected as part of this project.

More details on area-specific actions and expected outcomes is provided in **Table 6-2**.

Grading

Typical earthwork cross sections are provided in Figures 6-4a and 6.4b, with corresponding locations marked on the Alternative 1 Plan (Figure 6-5). Excavated soil will be reused beneficially on-site as practicable.

Earthwork will be limited to that needed to enhance existing habitats, and will include removal of legacy structures such as irrigation channels and pavement, flattening of banks, and localized creation of swales (shallow depressions). Grading will be limited and targeted with the goal of reducing freshwater inflows that are altering the marsh in Area 3a. Grading will reduce surface water flows into 3a but will not block groundwater and direct precipitation.

One exception is fill placement to block surface water flows from the OLW to the area near the Halaco properties and McWane corridor (southeastern Area 2 and northwestern Area 3a), and south of the Halaco properties, between Ormond Lagoon and Area 3a. This earthwork is expected to consist of fill in existing channels, mounded above existing elevations. Typical earthwork cross-sections A and B show the earthwork to block surface flow (cross sections are drawn in Figure 6-4a and located in the plan view in Figure 6-5). Cross-section A shows the placement of earth fill on the east side of OLW for a length of 600 feet, on the land side of the remnant levee, to form a barrier to surface flow; we anticipate that this new earth would be graded and planted to

TABLE 6-2
ALTERNATIVE 1 ACTIONS BY AREA

Area	Sub-area	Habitat Type	Actions/Expected Outcomes: Earth moving	Actions/Expected Outcomes: Vegetation	Actions/Expected Outcomes: Hydrology/Salinity	Projected changes with sea-level rise
1	1.1	Brackish marsh	None	Non-native species control	As-is	Conversion toward open water
	1.2	Open water	None	N/A	As-is	Lagoon will retreat landward
	1.3	Coastal dune	None	Non-native species control	N/A	Conversion to beach/strand as the shoreline retreats & marsh/open water as the lagoon migrates landward
	1.4	Upland	None	Non-native species control. Planting grassland & coastal sage scrub	N/A	Conversion toward salt marsh then brackish marsh as water table nears surface
	1.5	Beach/strand	Continued mouth management	None	As-is	Conversion to intertidal beach & surf zone
2	2.1	Salt marsh	• Minor grading to eliminate berms & ditch between Areas 2 & 3a • Restore berm along east bank, of OLW, southern 600 feet, to reduce overtopping and fresh water supply to salt marsh in 3a	• Tule marsh expected to convert to salt marsh with increasing salinity • Weed & plant as needed • Expect salt marsh up to about 9.5' contour	• Reduce surface connection to OLW by restoring berm crest, southern 600 feet east bank, and blocking existing culvert that is flowing “backwards” into Areas 2 and then 3a • Salinity should increase with decreased drainage • Sewer trunk line is dewatering the area & may preclude desired habitat conversion	Conversion to brackish marsh as water table reaches surface & eventually to open water as growing-season water depth exceeds about 2'
	2.2	Brackish marsh	None	Non-native species control & planting brackish marsh species to increase diversity	As-is	Conversion toward open water
	2.3	Riparian	None	• Eliminate non-native trees & shrubs • Control other non-natives • Plant willows & mulefat (depending on salinity)	Soil & groundwater salinity may be too high for riparian so suggest pilot plantings	Conversion to brackish marsh with increasing salinity
	2.4	Upland	None	Non-native species control, planting grassland & coastal sage scrub	N/A	Conversion toward brackish marsh as water table nears surface

TABLE 6-2 (CONTINUED)
ALTERNATIVE 1 ACTIONS BY AREA

Area	Sub-area	Habitat Type	Actions/Expected Outcomes			Projected changes with sea-level rise
			Earth moving	Vegetation	Hydrology/Salinity	
2 (cont.)	2.5	Seasonal wetland	None	• Control non-natives & plant salt-tolerant natives that tolerate wet winter & dry summer conditions • Consider introducing locally & regionally rare species such as *Salicornia depressa, Atriplex coulteri, A. pacifica, A. serenana var. davidsonii, Lasthenia glabrata ssp. coulteri, Suaeda calceoliformis, Astragalus pycnostachyus var. lanosissimus,* etc.	• Rare seasonal flooding primarily by rainfall • Saline groundwater generally below the rooting zone • Salts transported in to the rooting zone, generally pushed deeper & diluted in the winter with rainfall & closer to the surface & more concentrated in the summer	Conversion toward brackish marsh as water table nears surface
	2.6	Bioswale	• Create shallow basin of sufficient volume to capture dry-season runoff from McWane Blvd • Consider including forebay that traps sediment & can be cleaned out occasionally • Direct outflow toward seasonal wetland area	Plant with cattail & tule	• Basin will capture surface flows & allow plants to uptake water, nutrients & other pollutants • Encourage percolation with coarse soil & large area • Expect slightly brackish conditions	As the water table rises, water will percolate less efficiently & when the water table reaches the surface, the basin will begin to lose capacity
	2.7	Open water	None	Tule on the edges of the channel will remain	As-is	Water will get deeper & tule fringe will move up the banks
3a	3a.1	Salt marsh	• Minor grading to eliminate berms & ditch between Areas 2 & 3a • Minor grading to eliminate drainage to the lagoon by creating a berm to about 10ft NAVD88	• Let pickleweed & other salt marsh species recolonize areas as cattail & tule die of due to higher salinity soils over time • Consider options to expand salt marsh bird's beak population • Consider weeding in high marsh areas & replanting with rare salt-tolerant natives (see subarea 2.5 above for list)	• Lower areas will pond with rainfall but drainage off-site will be limited • Decreased off-site drainage should lead to increased salinity over time • The water level in the lagoon is probably driving groundwater elevations in this area	Rising groundwater will eventually lead to wetter & less salty year-round conditions & eventual conversion to brackish marsh & open water
	3a.2	Salt panne	None	None	• Ponding with rainfall but drainage off-site will be limited & salt concentrations should build up over time • Soils & surface water should eventually become hypersaline • The water level in the lagoon is probably driving groundwater elevations in this area	Rising groundwater will eventually lead to wetter year-round conditions & eventual conversion to brackish marsh & open water

TABLE 6-2 (CONTINUED)
ALTERNATIVE 1 ACTIONS BY AREA

Area	Sub-area	Habitat Type	Actions/Expected Outcomes			Projected changes with sea-level rise
			Earth moving	Vegetation	Hydrology/Salinity	
3a (cont.)	3a.3	Upland	None	Non-native species control & planting grassland & coastal sage scrub	N/A	Conversion toward salt marsh then brackish marsh as water table nears surface
3b	3b.1	Salt marsh	Minor grading to eliminate breach in berm that allows the site to drain to ODD #3	Some salt marsh may convert to salt panne as ponding increases & salts build up	• Expect salinity to rise over time with decreased drainage • Expect longer-duration ponding from rainfall • This area probably has less brackish groundwater influence from the lagoon & more salty groundwater influence from the ocean than Area 3a	Assuming limited influence on groundwater from the lagoon, rising salty groundwater from the ocean will cause conversion to salt panne & then open water
	3b.2	Salt panne	None	N/A	• Expect salinity to rise over time with decreased drainage • Expect longer-duration ponding from rainfall • This area probably has less brackish groundwater influence from the lagoon & more salty groundwater influence from the ocean than Area 3a	Assuming limited influence on groundwater from the lagoon, rising salty groundwater from the ocean will cause conversion to open water
	3b.3	Upland	Minor grading to eliminate breach in berm that allows the site to drain to ODD #3	Non-native species control & planting grassland & coastal sage scrub	N/A	Conversion toward salt marsh as the water table nears surface
	3b.4	Open water	None	Tule on the edges of the channel will remain	As-is	Water will get deeper & tule fringe will move up the banks
4	4.1	Salt marsh	• Minor grading to eliminate roads, ditches & any tile drains • Area could be a broad almost flat plain gently sloping southwest or could contain shallow basins & higher areas • Soil texture should be studied & appropriate amendments added (e.g., bentonite) to mimic salt marsh soil	• Area will need revegetation & possibly short-term weed control • Expect salt marsh below about 9 feet NAVD88 • Consider options such as irrigating with salt or brackish water to control weeds & favor salt marsh species • Dominant species would include *Salicornia pacifica, Distichlis spicata & Jaumea carnosa*	• The brackish water table is expected to be within a couple feet of the surface once ditches & drains are removed • If basins are excavated, the area might pond water also	Rising salty groundwater from the ocean will cause conversion to salt panne & then open water

TABLE 6-2 (CONTINUED)
ALTERNATIVE 1 ACTIONS BY AREA

Area	Sub-area	Habitat Type	Actions/Expected Outcomes: Earth moving	Actions/Expected Outcomes: Vegetation	Actions/Expected Outcomes: Hydrology/Salinity	Projected changes with sea-level rise
4 (cont.)	4.2	Wetland-upland transition	• Minor grading to eliminate roads, ditches & any tile drains • Area should be a broad almost flat plain gently sloping toward the salt marsh	• The area will need revegetation & probably short-term weed control • Expect transition zone above about 9 feet NAVD88 • Typical species would include shrubs that can tolerate some salinity & occasional flooding such as *Atriplex lentiformis, Suaeda calceoliformis, S. taxifolia* & *Isocoma menziesii*	• Very rare flooding for short durations with brackish water • Some buildup of salts in soil • Water table below the rooting zone	Conversion toward salt marsh as the water table nears the surface
	4.3	Bioswale	• Create shallow basin of sufficient volume to capture dry-season runoff from McWane Blvd • Consider including forebay that traps sediment & can be cleaned out occasionally	Plant with cattail & tule	• Basin will capture surface flows & allow plants to uptake water, nutrients & other pollutants • Encourage percolation with coarse soil & large area • Expect slightly brackish conditions	As the water table rises, water will percolate less efficiently & when the water table reaches the surface, the basin will begin to lose capacity
	4.4	Open water	None	None	As-is	Water will get deeper & tule fringe will move up the banks
5	5.1	Salt marsh	Close culverts draining the area to ODD #3	• No actions in existing salt marsh area • Plant new salt marsh with appropriate salt marsh species	• Salt marsh areas would pond with rainfall & retain salts (similar to other salt marsh habitats on-site) • Expect salt marsh between about 5 &7.5 feet NAVD88	Rising salty groundwater from the ocean will cause conversion to salt panne & then open water
	5.2	Salt panne	Salt panne habitat could be expanded by creating a low shallow basin	N/A	• Salt panne areas would pond with rainfall & retain salts (similar to other salt panne habitats on-site) • Expect salt panne below about 5 feet NAVD88	Rising salty groundwater from the ocean will cause conversion to open water

TABLE 6-2 (CONTINUED)
ALTERNATIVE 1 ACTIONS BY AREA

Area	Sub-area	Habitat Type	Actions/Expected Outcomes			Projected changes with sea-level rise
			Earth moving	Vegetation	Hydrology/Salinity	
5 (cont.)	5.3	Wetland-upland transition	None	• Eliminate iceplant & non-native trees • Expect transition zone above about 7.5 feet NAVD88 • Typical species would include shrubs that can tolerate some salinity & occasional flooding such as *Atriplex lentiformis, Suaeda calceoliformis, S. taxifolia & Isocoma menziesii*	• Very rare flooding for short durations with brackish water • Some buildup of salts in soil • Water table below the rooting zone	Rising salty groundwater from the ocean will cause conversion to salt marsh
	5.4	Upland	None	Non-native species control & planting coastal sage scrub	N/A	Rising water in ODD #3 will lead to conversion to brackish or salt marsh
	5.5	Open water	None	Tule on the edges of the channel will remain	As-is	Water will get deeper & tule fringe will move up the banks
6	6.1	Salt marsh	None	Non-native species control	As-is	• Conversion to salt panne & open water as groundwater level rises • Dunes will migrate landward & bury salt marsh
	6.2	Salt panne	None	None	As-is	Conversion to open water as groundwater level rises
	6.3	Upland	None	Non-native species control	N/A	Conversion to salt marsh habitat as groundwater level rises
	6.4	Open water	None	Tule on the edges of the channel will remain	As-is	Water will get deeper & tule fringe will move up the banks
7, 8, 9	7, 8, 9.1	Coastal dune	Optional occasional lowering of dune berm at southern end	• Optional planting of dune species • Maintain low cover at southern end to discourage dune building	Encourage rare (~decadal) overwash into Area 6 at southern end during large wave events	Conversion to strand & beach as the coast retreats
	7, 8, 9.2	Beach/strand	None	None	As-is	Conversion to intertidal & surf zone as the beach retreats

mimic a brackish-riparian channel berm. Cross-section B shows fill placement to block the channel-swale just south of the Halaco properties. We anticipate that this earth would be graded and planted to resemble a high-relief dune, with crest elevation between 10 and 15 feet NAVD88.

The grading to reduce surface water flows from Areas 1 and 2 to Area 3 is not expected to increase flooding along Ormond Lagoon and OLW based on modeling of lagoon hydrology (see Section 6.4 Alternative Evaluation and Appendix C).

Shallow drainage swales would be excavated to capture runoff from paved areas, as shown schematically in cross-section C.

More intensive earthwork is also targeted to mute the draining of the Area 5 and 6 to drainage ditches, including where deteriorating culverts and levee erosion have increased the drainage from the wetlands. Detailed Plan 1 and Section D on Figure 6-4a show the treatment at each of the four culverts between Areas 5 and 6 and the ODD #3. Earth would be used to reconstruct degraded levee crests and a berm would inhibit drainage from the sites. The berm would be low enough that the effect would be limited, but enough to pond water to depths up to 2 feet.

Infrastructure Modification

Existing infrastructure will be removed where it interferes with habitat establishment, adversely affects drainage or intersects desired grades. The primary infrastructure modification will be removal of drainage works in the agriculture parcel (Area 4).

An existing culvert that conveys water from OLW to the southeast portion of Area 2 will be removed and the levee locally regraded to block freshening of the brackish marsh in the vicinity.

A breach in the levee between Area 3b and the remnant drainage ditch (western extension of ODD #3) will be filled and locally regraded to inhibit drainage and enhance salt concentration via evaporation in the salt panne area.

The existing, deteriorating drainage culverts between Areas 5 and 6 and ODD #3 may be removed and replaced, along with grading, to increase area ponding and salt accumulation.

Public Access, Trails, and Site Amenities

The trails and amenities in Alternative 1 are focused near the existing western entry points; this alternative proposes additional trailheads at the western edge of the site in an effort to concentrate visitors near existing neighborhoods, public transportation routes, existing or proposed bike trails, and the Port Hueneme Beach (Figure 6-1 Alternative 1). Alternative 1 modifies the eastern parking lot and public entry point at Arnold Road, limiting entry for emergency, natural resource management, and security. Alternative 1 trails and public amenities would be site-wide and primarily based on existing roads and trails, resulting in larger amounts of contiguous habitat areas. A discussion of specific elements in each area follows.

The existing Perkins Road parking lot (Access Node A in Area 1) would be expanded to accommodate visitor services such as security, a docent kiosk, and interpretive elements by using fill soil obtained from grading activities to create more level area at the same grade as the existing parking lot. A bridge is proposed over tšumaš Creek, with a primary trail leading from Hueneme Beach Park to Perkins Road, and to an overlook platform at Ormond Lagoon. A small loop trail is proposed with primitive and rustic trails, foot-bridges, an overlook platform, and tranquil viewing areas with benches to offer visitors a peaceful nature experience.

A new trailhead is proposed at West McWane Blvd (Access Node B1) with parking on the existing road right-of-way owned by the City of Oxnard, which would be improved and reconfigured for this purpose. A new trail loop is proposed in the west side of Area 2, and a CA Coastal Trail primary route runs east-west to East McWane Blvd (Access Node B2, a constrained access point due to railway spur train parking). This East McWane Blvd primary trail heads south to the ocean from East McWane Blvd roughly following the railroad corridor through Area 3a, to a set of wetland boardwalks (which can be implemented in a future phase) and ultimately to a dune overlook platform with benches and bike racks located in Area 7. The trail heads east through Area 7 along the un-vegetated section of the dunes toward the power plant, and then connects to the Beach (California Coastal Trail). A new small parking area, which can be implemented in the future, is proposed at Edison Drive (Area 4, Access Node C). A rustic trail can be aligned to the edge of the existing agricultural fields (Area 4) with farm exclusion fencing and interpretive signage about the importance of local agriculture, sea-level rise, etc. The proposed trail may be kept in this alignment upon conversion of the agricultural area to habitat areas.

The public parking lot and public entry at Arnold Road (Area 6, Access Node D) would be closed, except for natural resource management, Navy maintenance, large mammal rescue, and emergency and security purposes consistent with Ormond Beach Ordinance. The public could continue to access Areas 6 and 9 from the beach. A small spur trail is proposed in the dunes between Areas 8 and 9 to provide a seasonal birding overlook to Areas 5 and 6.

6.2.1.3 Outcomes

Physical

Minor grading and modifications to culverts will change soil moisture and salinity dynamics in order to favor the expansion of salt marsh vegetation. Minor grading will provide more natural transitions between the wetland and upland areas. Over time, as sea levels rise, groundwater and ponding levels will also rise, and wetland habitats will migrate into upland areas. The project is not expected to affect the hydrology of adjacent lands.

Ecological/habitat

The expected habitat types and acres are compiled in **Table 6-3**, and shown in Figure 6-1. Figure 6-8 shows the expected acreage of post-project habitats, compared to existing conditions. Some existing habitats will be enhanced through planting of natives and controlling non-native vegetation. Limited earth moving will expand contiguous habitat areas and provide more natural transitions and ecotones.

This alternative would favor some salt marsh dependent wildlife, especially Belding's savannah sparrow. Existing populations of rare plants (Coulter's goldfields and salt marsh bird's beak) could be expanded to new areas and rare species adapted to non-tidal saline habitats might be introduced (e.g., Ventura marsh milk vetch).

TABLE 6-3
ALTERNATIVE 1: SALT MARSH THEME HABITAT PROJECTIONS

Habitat Type	Area (acres)								
	1	**2**	**3a**	**3b**	**4**	**5**	**6**	**7-9**	**TOTAL**
Beach/strand	12							19	31
Coastal dunes	24							102	126
Dune swale wetland									0
Open water	17	3	0	1		2	4		26
Salt panne			5	4		1	22		32
Salt marsh		23	53	20	88	51	33		268
Brackish marsh	14	6							19
Seasonal wetlands		18							18
Riparian		5							5
Wetland-upland transition		15			45	25			85
Bioswale		1			1				2
Upland	9	19	5	1		9	2		45
TOTAL	**76**	**89**	**64**	**25**	**135**	**87**	**60**	**121**	**658**

NOTE: Habitat estimates rounded to nearest acre. Habitat projections are post-construction under current sea level.
SOURCE: CRC

Public Access

Access is generally concentrated toward areas with existing roads, trails, and similar infrastructure. Access in the western portion of the Project Area is increased, with the addition of new parking, new entry via Perkins Road over tšumaš Creek around Ormond Lagoon and mid-beach, and several loop trails of varying size. Large areas of the site are also left as undisturbed habitat areas, particularly in the eastern Project Area. This alternative could be implemented immediately while funding is secured for greater interventions and bolder actions proposed by some of the other alternatives.

6.2.2 Alternative 2

6.2.2.1 Overview

Alternative 2 enhances and expands the range of existing habitats and modifies site hydrology (Figure 6-2).

The Project Area's large size and complex hydrology make it feasible to create and restore a wide range of wetland types. This alternative uses some earth moving and other moderate interventions to create a broader mosaic of wetland types on the site. The greater diversity of wetlands might be expected to support a wider array of species. Realignment of the OLW would significantly alter hydrological processes in Area 2 and 3a, increasing year-round inundation by brackish water. Resilience to sea-level rise is built in with some water control structures (Area 5) and by allowing wetland types to convert over time (Area 4). Existing high-value habitats in Areas 3b, 5, and 6 would be preserved. A series of dune swale wetlands would be excavated to increase biodiversity in the dunes. Upland areas will be restored, as will broad transitions between wetland and upland habitats. These transitional and upland areas will also provide space to accommodate wetland migration in response to sea-level rise.

The public access plan for Alternative 2 immerses the visitor in the ecology and diversity of Ormond Beach. Trail alignments showcase the diversity of wetland types wetlands and provide opportunities to see seasonal fluctuations in water levels and wildlife (bird) interactions with site. With the realignment of OLW and the increase in wetland areas and diversity, the access features focus on boardwalks, elevated structures, birding overlooks, and all-season trails graded at higher elevations or on elevated boardwalks. Bridges cross waterways with overlooks, and boardwalks wind through wetlands to increase visibility and access to the site. The public access features and amenities are distributed evenly across the site. Alternative 2 provides a multi-modal connection directly to the South Oxnard neighborhoods so that locals can easily walk or bike to visit the site. Direct beach access is provided at Perkins Road via a new floating boardwalk or bridge across Ormond Lagoon.

6.2.2.2 Actions

Overview by Areas

Site hydrology will be modified by way of earthwork and modification of surface water conveyance. The banks of OLW (Area 2) and the north banks of Ormond Lagoon (Area 1) will be graded and planted to expand wetlands and transition to upland. OLW will be routed through Area 3a and connected to the existing Ormond Lagoon on the eastern side of the lagoon. The new channel would bypass the Halaco properties in favor of a more natural channel and expanded wetlands within the project area. The existing OLW channel segment between the two Halaco properties would be blocked and potentially filled, pending coordination with EPA. The design includes an expansion of the Ormond Lagoon into Areas 7 and 3a. A pedestrian access bridge would be installed across this channel along McWane Blvd, from Perkins Street, and a trail would be constructed to the beach. We anticipate expansion of brackish marsh and open water habitats in Areas 2 and 3a. Flood waters would be partly diverted into the restoration area and the expanded lagoon, thereby incrementally lowering the water level in the lagoon and reducing flood risk and management effort. Routing flows through the wetlands is expected to remove nutrients and improve the lagoon water quality.

A series of shallow basins will be created in Area 4 at different elevations as the area transitions out of agriculture. The lowest basin would support salt panne habitat, and higher basins would be seasonal wetlands and/or bioswales. The higher basins would convert to salt panne habitat as the sea level rises.

Drainage from Area 4 in to ODD #3 will be reduced to retain more water on-site. Hydraulic connectivity between ODD #3 and Areas 3b, 5, and 6, will be maintained as they are. The existing connections include a mix of open culverts, culverts with gates, and breached berms. If further evaluation of these connections in the future indicates they are deteriorating, intervention may be needed to stabilize these connections. Intervention would likely consist of maintenance or reconstruction to maintain the existing hydrology, or modification in case hydrologic changes are desired including potentially removal of culverts.

The southern, seaward portion of Area 5 would be segregated from the rest of Area 5 by a low berm. This would limit drainage to ODD #3 and allow salts to concentrate in the soils, allowing for the expansion of salt marsh and salt panne habitats. North of the new berm existing upland and seasonal wetland habitats would be enhanced.

The beach (Areas 7, 8, and 9) will be enhanced by weeding and planting to restore back dune scrub habitat and expand foredune scrub habitat. In addition, several shallow depressions will be excavated between dune ridges and planted with dune swale wetland species.

More details on area–specific actions and expected outcomes are provided in **Table 6-4**.

Grading

Typical earthwork cross sections are provided in Figures 6-4a and 6.4b, with corresponding locations marked on the Alternative 2 Plan (Figure 6-6). Excavated soil will be reused beneficially on-site as practicable.

A new OLW channel will be excavated, and the existing lagoon expanded, resulting in significant earthwork. Much of the earth will be used to fill the existing OLW and to fill and block ODD #3. Excess earth will be placed to form uplands and for access trail elements. Surface water connectivity between Area 1 and 3a will be increased by excavation of a lagoon deep enough to support tidewater goby habitat. Cross-sections A and B show the new OLW channel through Areas 2 and 3, respectively. In Area 2, the existing grades are higher, and a wetland terrace is excavated above elevation 8 feet NAVD88 to provide for emergent marsh. An emergent marsh terrace is not included in Area 3a, where existing grades are lower. Both sections show the thalweg (low point) of the channel at elevation 3 feet NAVD88, which approximately matches the existing OLW. Section C shows the filled existing OLW, as well as additional fill to form a raised area. The raised area is shaped to resemble an abandoned natural river levee, and largely follows the existing remnant levees originally constructed as part of the OLW. This raised land will be planted with a riparian palette, and support a path for public access.

Area 4 will be excavated and graded to form shallow seasonally flooded basins. The elevations and depths of the basins will be designed to support different hydrology and salinity dynamics. The basins will be higher with distance northward, to allow for habitat conversion with sea level-rise.

Area 5 will be segregated into a salt marsh-panne area by a fill embankment (Section D), and the remainder of the site will be maintained at existing grades, or filled (existing uplands only) to balance cut and fill on-site. Upland habitat can accommodate wetland migration with future sea-level rise. Grading will occur in beach-dune Areas 7, 8, and 9 to form wetland swales and to provide limited access.

TABLE 6-4
ALTERNATIVE 2 ACTIONS BY AREA

Area	Sub-area	Habitat Type	Actions/Outcomes			Projected changes with sea-level rise
			Earth Moving	Vegetation	Hydrology/Salinity	
1	1.1	Brackish marsh	None	Non-native species control	As-is	Conversion toward open water
	1.2	Open water	None	N/A	As-is	Lagoon will retreat landward
	1.3	Coastal dune	• Minor excavation through dunes to enhance connection to re-aligned OLW	Non-native species control	N/A	Conversion to beach/ strand as the shoreline retreats & marsh/open water as the lagoon migrates landward
	1.4	Upland	Fill in old OLW	Non-native species control. Planting grassland & coastal sage scrub	N/A	Conversion toward salt marsh then brackish marsh as water table nears surface
	1.5	Beach/strand	Continued mouth management	None	None	Conversion to intertidal beach & surf zone
2	2.1	Brackish marsh	• OLW re-aligned & allowed to overtop its banks in high water conditions & flood the brackish marsh • Fill in old channel & remove most of the existing levees • Create a marsh plain that slopes gently toward the new channel to support riparian vegetation along channel levees • Topographic heterogeneity (e.g., depressions or higher areas) would support greater spatial vegetation diversity within the marsh	• Non-native species control as needed • Plant a wide diversity of brackish marsh species • Highest elevations within the marsh may get salty enough to support salt marsh species	• Brackish marsh would occur down to elevations that are regularly flooded to depths less than about 2 feet • Brackish marsh will occur up to elevations where the soil is saturated in the rooting zone during the growing season • Highest areas of the marsh might get salty enough to support salt marsh species where evaporation at the soil surface concentrates salts	Conversion toward open water
	2.2	Wetland-upland transition	• Minor contouring & possible location to spoil any excess material dredged during creation of the brackish marsh • Area should be a broad plain gently sloping toward the brackish marsh to the east • Highest areas at the edges of the property should be tall enough to protect neighbors from flooding	• The area will need revegetation & probably short-term weed control • Expect transition zone above about 11 feet NAVD88 • Typical species would include shrubs that can tolerate some salinity & occasional flooding such as *Atriplex lentiformis, Suaeda calceoliformis*, *S. taxifolia* & *Isocoma menziesii*	• Very rare flooding for short durations with brackish water • Some buildup of salts in soil • Water table below the rooting zone	Conversion toward salt marsh & then brackish marsh as the water table nears the surface

TABLE 6-4 (CONTINUED)
ALTERNATIVE 2 ACTIONS BY AREA

Area	Sub-area	Habitat Type	Actions/Outcomes: Earth Moving	Actions/Outcomes: Vegetation	Actions/Outcomes: Hydrology/Salinity	Projected changes with sea-level rise
2 (cont.)	2.3	Bioswale	• Create shallow basin of sufficient volume to capture dry-season runoff from McWane Blvd • Consider including forebay that traps sediment & can be cleaned out occasionally • Direct outflow toward seasonal wetland area	Plant with cattail & tule	• Basin will capture surface flows & allow plants to uptake water, nutrients & other pollutants • Encourage percolation with coarse soil & large area • Expect slightly brackish conditions	As the water table rises, water will percolate less efficiently; when the water table reaches the surface, the basin will begin to lose capacity
	2.4	Open water	A new channel will be excavated	N/A	Permanently flooded with brackish water	Water will get deeper
3a	3a.1	Brackish marsh	• OLW re-aligned & allowed to overtop its banks in high water conditions & flood the brackish marsh • Create a marsh plain that slopes gently toward the new channel with micro-topography to support wetland and riparian habitats (tbd) • Topographic heterogeneity (e.g., depressions or higher areas) would support greater spatial vegetation diversity within the marsh • New culvert(s) potentially with water control (e.g., gates) to allow adjustment of hydraulic connectivity across railway	• Non-native species control as needed • Plant a wide diversity of brackish marsh species • Highest elevations within the marsh may get salty enough to support salt marsh species	• Brackish marsh would occur down to elevations that are regularly flooded to depths less than about 2 feet • Brackish marsh will occur up to elevations where the soil is saturated in the rooting zone during the growing season • Highest areas of the marsh might get salty enough to support salt marsh species where evaporation at the soil surface concentrates salts • Culvert beneath railroad provides hydraulic connectivity to Area 4	Conversion toward open water
	3a.2	Open water	A new channel will be excavated	N/A	Permanently flooded with brackish water	Water will get deeper
	3a.3	Upland	• Existing upland areas will receive fill from excavated areas • Wetland-upland transition expected to be relatively steep	Non-native species control & planting grassland & coastal sage scrub	N/A	Conversion toward salt marsh & then brackish marsh as the water table nears the surface

TABLE 6-4 (CONTINUED)
ALTERNATIVE 2 ACTIONS BY AREA

Area	Sub-area	Habitat Type	Actions/Outcomes: Earth Moving	Actions/Outcomes: Vegetation	Actions/Outcomes: Hydrology/Salinity	Projected changes with sea-level rise
3b	3b.1	Salt marsh	Minor enhancement of berm breach & channel to increase connectivity to ODD #3	Weed control as needed	• Little change from current conditions • Hydrology would be more closely tied to that of ODD #3, mainly north of railroad tracks • Realignment of OLW in Area 3a might raise/freshen groundwater in this area & could lead to conversion to brackish marsh	Assuming limited influence on groundwater from the lagoon, rising salty groundwater from the ocean will cause conversion to salt panne & then open water
	3b.2	Salt panne	None	N/A	• Little change from current conditions • Realignment of OLW in Area 3a might raise/freshen groundwater in this area & could lead to conversion to brackish marsh	Assuming limited influence on groundwater from the lagoon, rising salty groundwater from the ocean will cause conversion to open water
	3b.3	Upland	None	Planting coastal sage scrub along railroad and berms	N/A	Conversion toward salt marsh as the water table nears surface
	3b.4	Open water	Lengthen existing channel off of ODD #3 toward railroad tracks	Expand existing bulrush on the edges of the channel	As-is	Water will get deeper & bulrush fringe will move up the banks
4	4.1	Salt marsh	• Minor grading to eliminate roads, ditches & any tile drains • Area could be a broad almost flat plain gently sloping southwest with two or more shallow basins at increasing elevations • Soil texture should be studied & appropriate amendments added (e.g., bentonite) to mimic salt marsh soil	• The area will need revegetation & possibly short-term weed control • Expect salt marsh below about 9 feet NAVD88 • Consider options such as irrigating with salt or brackish water to control weeds & favor salt marsh species • Dominant species would include pickleweed, salt grass & fleshy jaumea	• The brackish water table would presumably be within a couple feet of the surface once ditches & drains are removed • New location of OLW might raise the water table enough that wetlands establish above the estimated 9-foot NAVD88 contour & might lower salinities • Limiting off-site drainage would help keep salts on-site & favor salt marsh species	Rising groundwater will cause conversion to salt panne & then open water

TABLE 6-4 (CONTINUED)
ALTERNATIVE 2 ACTIONS BY AREA

Area	Sub-area	Habitat Type	Actions/Outcomes: Earth Moving	Actions/Outcomes: Vegetation	Actions/Outcomes: Hydrology/Salinity	Projected changes with sea-level rise
4 (cont.)	4.2	Salt panne	• Create a shallow basin • Soil may need to be amended with clay to encourage ponding • Water control structure(s) (culvert) under the railroad to allow hydraulic connectivity between Areas 4 and 3	N/A	• Salt panne areas would pond with rainfall & retain salts from evaporating groundwater (similar to other salt panne habitats on-site) • Expect salt panne below about 5 feet NAVD88 • water control structure to allow hydraulic connectivity across railway and adjust water balance and salt balance	The lowest of a series of stepped basins would convert to open water
	4.3	Seasonal wetland	• Create a shallow basin • Soil may need to be amended with clay to encourage ponding • Water control structure(s) (culvert) under the railroad to allow hydraulic connectivity between Areas 4 and 3	• Control non-natives & plant salt-tolerant natives that tolerate wet winter & dry summer conditions • Consider introducing locally & regionally rare species such as *Salicornia depressa, Atriplex coulteri, A. pacifica, A. serenana* var. *davidsonii, Lasthenia glabrata* ssp. *coulteri, Suaeda calceoliformis, Astragalus pycnostachyus* var. *lanosissimus,* etc.	• Rare seasonal flooding primarily by rainfall • Saline groundwater generally below the rooting zone • Salts transported in to the rooting zone, generally pushed deeper & diluted in the winter with rainfall & closer to the surface & more concentrated in the summer • water control structure to allow hydraulic connectivity across railway and adjust water balance	The middle of a series of stepped basins would convert to salt panne & eventually open water
	4.4	Wetland-upland transition	• Minor grading to eliminate roads, ditches & any tile drains • Area should be a broad almost flat plain gently sloping toward the salt marsh	• The area will need r-vegetation & probably short-term weed control • Expect transition zone above about 9 feet NAVD88 • Typical species would include shrubs that can tolerate some salinity & occasional flooding such as *Atriplex lentiformis, Suaeda calceoliformis, S. taxifolia & Isocoma menziesii*	• Very rare flooding for short durations with brackish water • Some buildup of salts in soil • Water table below the rooting zone • New location of OLW might raise the water table enough that wetlands establish above the estimated 9-foot NAVD88 contour	Conversion toward salt marsh as the water table nears the surface

TABLE 6-4 (CONTINUED)
ALTERNATIVE 2 ACTIONS BY AREA

Area	Sub-area	Habitat Type	Actions/Outcomes			Projected changes with sea-level rise
			Earth Moving	Vegetation	Hydrology/Salinity	
4 (cont.)	4.5	Bioswale	• Create a large shallow basin to capture dry & wet-season runoff from McWane Blvd • Consider including forebay that traps sediment & can be cleaned out occasionally	Plant with cattail & tule	• Basin will capture surface flows & allow plants to uptake water, nutrients & other pollutants • Encourage percolation with coarse soil & large area • Expect slightly brackish conditions	As the highest of a series of stepped basins, expect conversion to brackish marsh or, if inflows from the street are diverted elsewhere, salt marsh & then salt panne
	4.6	Open water	None	None	As-is	Water will get deeper & tule fringe will move up the banks
5	5.1	Salt marsh	• Remove some abandoned roads & create a berm to separate salt marsh from seasonal wetlands to the north • Optional basins could be created in new salt marsh area to support salt panne	• No actions in existing salt marsh area • Plant new salt marsh with appropriate salt marsh species	• Salt marsh areas would pond with rainfall & retain salts (similar to other salt marsh habitats on-site) • Expect salt marsh between about 5 &7.5 feet NAVD88	Rising salty groundwater from the ocean will cause conversion to salt panne & then open water
	5.2	Seasonal wetland	None	• Control non-natives & plant salt-tolerant natives that tolerate wet winter & dry summer conditions • Consider introducing locally & regionally rare species such as *Salicornia depressa, Atriplex coulteri, A. pacifica, A. serenana var. davidsonii, Lasthenia glabrata ssp. coulteri, Suaeda calceoliformis, Astragalus pycnostachyus var. lanosissimus,* etc.	• Maintain existing drainage of area to ODD #3 • Seasonally wet from rainfall & possibly water backing up from ODD #3 • Saline groundwater generally below the rooting zone • Salts transported in to the rooting zone, generally pushed deeper & diluted in the winter with rainfall & closer to the surface & more concentrated in the summer	Conversion toward brackish marsh as water table nears surface
	5.3	Upland	None	Non-native species control & planting coastal sage scrub	N/A	Rising water in ODD #3 &/or groundwater will lead to conversion to brackish or salt marsh
	5.4	Open water	None	Tule on the edges of the channel will remain	As-is	Water will get deeper & tule fringe will move up the banks

TABLE 6-4 (CONTINUED)
ALTERNATIVE 2 ACTIONS BY AREA

Area	Sub-area	Habitat Type	Actions/Outcomes			Projected changes with sea-level rise
			Earth Moving	Vegetation	Hydrology/Salinity	
6	6.1	Salt marsh	None	Non-native species control	As-is	• Conversion to salt panne & open water as groundwater level rises • Dunes will migrate landward & bury salt marsh
	6.2	Salt panne	None	None	As-is	Conversion to open water as groundwater level rises
	6.3	Upland	None	Non-native species control	N/A	Conversion to salt marsh habitat as groundwater level rises
	6.4	Open water	None	Tule on the edges of the channel will remain	As-is	Water will get deeper & tule fringe will move up the banks
7, 8, 9	7, 8, 9.1	Coastal dune	None	Dune planting could include reintroduction or introduction of rare, threatened & endangered endemic dune species	N/A	Conversion to strand & beach as the coast retreats
	7, 8, 9.2	Beach/strand	None	None	Occasional wave overwash at south end	Conversion to intertidal & surf zone as the beach retreats
	7,8,9.3	Open water	• Excavate new connection between re-aligned OLW and existing lagoon	N/A	The connection will designed to keep the two waterways connected and convey flood waters	As the beach retreats, the connection would eventually be lost and OLW would have its own mouth
	7,8,9.4	Dune swale wetland	• Excavate multiple depressions between the dune ridges • Depressions should be deep enough to expose damp sand	Plant dune swale species such as *Juncus arcticus, Distichlis spicata, Juncus acutus*, and *Carex praegracilis*	Depressions will intersect the capillary fringe above the dunes' freshwater lens	Conversion to dunes, strand & beach as the coast retreats

Infrastructure Modification

One or more culverts may be installed to provide the opportunity for hydraulic connectivity across the railway. The water and salt balance of the salt panne and seasonal wetlands for existing and future conditions will inform the design of culverts and whether they will be open or have gates to control and adjust water conveyance. Note that the culverts can be used to drain Area 4 to Area 3b, and allow flow from Areas 3b into 4 when water levels are high. Water control structures will be installed between the ODD #3 and Area 5, to modify and control the flow of water between the two areas. These structures and changes will be designed to be reversible, in case the changes have adverse effects on sensitive habitats at Ormond Beach or NBVC–Point Mugu. Irrigation and drainage systems in Area 4 will be removed. Finally, OLW will be blocked in the vicinity of the Halaco properties, and ideally filled, pending coordination with EPA.

Access, Trails, and Site Amenities

Alternative 2 provides a diverse visitor experience in which many habitat types can be experienced and appreciated. Trails are evenly distributed throughout the site and traverse through many of the newly created wetlands. This alterative provides a large amount of primitive and rustic trails, and may be expected to provide a more tranquil nature experience for visitors. Alternatives 1 and 3 largely keep trails to the perimeters or to areas which are adjacent to developed areas. Alternative 2 also creates the closest link with South Oxnard neighborhoods, providing direct access for walking and biking from Hueneme Road.

Alternative 2 (Figure 6-2, Area 1) provides direct beach access via a proposed primary ADA accessible trail and boardwalk system leading from the Perkins Road parking lot to a bridge or floating boardwalk crossing Ormond Lagoon (Access Node A). The floating boardwalk can be designed with sea-level rise in mind. A rustic trail loop leads from the new bridge at Perkins Road parking to the Ormond Lagoon island and a lagoon overlook platform, and connects back to the floating boardwalk. A primitive seasonal trail runs along the south side of the Ormond Lagoon island to an overlook. Boardwalks are proposed over wetlands on the OLW island. A new primary developed, Ormond Lagoon compliant trail weaves through the wetland north of the Perkins Road parking lot, designed specifically to accommodate school groups and provide educational opportunities for students. The trail terminates with an overlook platform. One can cross Perkins Road at this point to West McWane Blvd.

A new trailhead at West McWane Blvd (Access Node B1) is served by a new parking lot in the reconfigured West McWane Blvd right-of-way. The McWane Blvd east trailhead (Access Node B2, constrained by an at-grade railroad crossing and train parking) provides parking and trails leading west through Areas 2 and 3a over a new bridge crossing the realigned OLW. This primary, all-season trails adjoins a north-south primary spur of the CA Coastal Trail. This trail provides bicycle and pedestrian access at Hueneme Road (Access Node C), leading through restored habitats to a network of boardwalks between Areas 3a, 3b, and 7, where cyclists can secure their bikes and continue the adventure on foot. Several birding overlooks on platforms and boardwalks provide birding opportunities, and lead to a beach trail lined with bird fencing through the back dunes and to the beach at Area 7. A possible future seasonal loop is provided in Area 3a along the Halaco properties, which could be implemented after cleanup.

A wetland discovery loop can be implemented in the future in Area 4, with new primitive trails and boardwalks with birding platforms and overlooks providing views of the newly created wetlands and salt panne area. The new (future) parking lot proposed at the end of eastern McWane Blvd (Access Node B2) is sited conveniently for visitors to complete larger trail loops when the train is not parked on the tracks at the western end of East McWane Blvd.

The existing parking adjacent the Navy fence would be removed, and a smaller parallel parking area (Access Node D) along the west side of at Arnold Road, a drop-off area, and turn-around area would be provided, limiting the number of visitors to this sensitive area of the site (Area 6). Emergency, wildlife rescue, and maintenance beach access would still remain south of ODD #3 via Arnold Road. This would be enhanced and improved by elevating this section of primary trail so it is above the flood zone, and the existing interpretive signs could be retained. Elevated birding overlooks, oriented into Area 6 (and not into NBVC–Point Mugu), are provided off of a primitive trail which borders ODD #3 and leads to the beach. The CA Coastal Trail runs east west along the beach. The CA Coastal Trail runs east west along the beach, and connects to a future Class II bike path spur of the California Coastal Trail identified in the County of Ventura Local Coastal Plan.

6.2.2.3 Outcomes

Physical/Geomorphic

The hydrology of Areas 2 and 3a will be markedly changed due to the rerouting of the OLW. The capacity of Ormond Lagoon will be expanded to about twice its existing volume through connectivity to Area 3a. The lack of berms directly along the new OLW will allow for more regular inundation of the expanded floodplain wetlands. Flood management actions are expected to be unchanged or reduced owing to the reduced frequency of higher lagoon water levels during intermediate-flowrate conditions. The expansion of the lagoon will reduce the area of open sandy strand and dune. In Areas 4 and 5, grading and modification of culverts will be used to enhance hydrology and salinity dynamics to support salt marsh, salt panne, and seasonal wetland habitats.

The significant alterations to drainage channels raises the risk of effects (primarily flooding) on tributary areas of site. We anticipate that these changes will be neutral to beneficial, either causing no change in the areas surrounding the project or improving conveyance. However, analysis will likely be required to quantify the effects and inform stakeholders.

Ecological/habitat

The post-construction habitat types and acres are compiled in **Table 6-5**, and shown in Figure 6-8. The area of wetlands within the site will be increased overall. Salt marsh habitats in Areas 2 and 3a will be converted to brackish marsh or open water and existing open water will be converted to brackish marsh. Some uplands will be converted to brackish marsh while others will be maintained and restored. Riparian habitat along OLW will not be sustainable in Area 2 because the shallow groundwater is too brackish for most riparian vegetation species. Salt marsh and salt panne are expanded in Areas 4 and 5. Regionally rare dune swale wetlands would be excavated Areas 6-9. Areas 1 and 6 would remain largely unchanged.

TABLE 6-5
ALTERNATIVE 2: WETLAND DIVERSITY THEME HABITAT PROJECTIONS

Habitat Type	Area (acres)								
	1	**2**	**3a**	**3b**	**4**	**5**	**6**	**7-9**	**TOTAL**
Beach/strand	12							18	30
Coastal dunes	23							100	123
Dune swale wetland								2	2
Open water	18	6	4	1		2	4	2	36
Salt panne				4	15		22		40
Salt marsh				19	41	22	33		115
Brackish marsh	14	56	56						125
Seasonal wetlands					19				19
Riparian									0
Wetland-upland transition		27			37				64
Bioswale		1			23	20			43
Upland	10		5	1		44	2		63
TOTAL	**76**	**89**	**65**	**25**	**135**	**88**	**60**	**121**	**660**

NOTES: Habitat estimates rounded to nearest acre. Habitat estimates rounded to nearest acre. Habitat projections are post-construction under current sea level.

SOURCE: CRC

Expanded salt panne habitats could provide potential new nesting areas for California least tern and western snowy plover. Area 4 could support these functions as the sea level rises and converts existing salt panne areas to open water. The expanded lagoon will increase available tidewater goby and California least tern foraging habitat. An enlarged lagoon would generally benefit California least tern; however; this expanded design would eliminate their current (2017–2018) nesting colony in Area 7. The design's effect on nesting habitat in the dunes would need to be studied in more detail. Existing habitat for Belding's savannah sparrow would be eliminated in Area 3a but new salt marsh habitats in Areas 4 and 5 could support this species. The expansion of brackish marsh and open water would benefit a large suite of avian species, especially ducks and rails. The only existing population of Coulter's goldfields in the project area and a small population of salt marsh bird's beak in Area 3a would be eliminated. Restored saline habitats in Areas 4 and 5 and existing habitat in Area 6 might support new populations of these species. Regionally and globally rare species adapted to non-tidal saline habitats might be introduced (e.g., Ventura marsh milk vetch) in Areas 4 and 5 as well.

Public Access

A diverse array of access features is provided which generally improve access to the Project Area and beach, especially for neighboring communities. Numerous loop trails provide the public with the opportunity to experience every habitat type proposed, with ample opportunities to experience nature and view birds and other wildlife. The varied trails provide frequent visitors the opportunity to have a different experience with each visit.

6.2.3 Alternative 3

6.2.3.1 Overview

Alternative 3 emphasizes connectivity of habitat and restoration of historical processes (Figure 6-3).

The project area is currently highly fragmented by levees, channels, roads, railroads, and other industrial infrastructure. This alternative focuses on earth moving and manipulations to increase hydrologic and ecological connectivity within the site and between the site and neighboring habitats. A new lagoon would be excavated with its own intermittently open mouth to allow unmanaged connectivity with the ocean. All unnecessary berms and channels would be filled to create large swaths of contiguous habitat (Areas 5 and 6, Areas 3b and 4, Areas 3a and 2). Wetlands around Ormond Lagoon would be expanded landward to facilitate lagoon retreat with sea-level rise. Existing high-value habitats in Areas 3b, 5, and 6 would be preserved. Actions such as planting and/or installing sand fencing would be taken to facilitate continued dune building, which might protect the wetlands from sea-level rise. Excavated material would be used on-site to create more upland habitat to provide wetland to upland connectivity.

Alternative 3 supports more active use of the site with an interconnected network of multi-modal trails. Due to the expanded and projected higher elevations of wet areas and movement of waterways inland, public access features are primarily located on the periphery of the Project Area at higher elevations to support the enhanced hydrologic connectivity. Access points remain concentrated at McWane Blvd and Perkins and Arnold Roads. This alternative has the most amount of developed trails and boardwalks of all of the alternatives, creating year-round access and looped trail experiences for visitors. This alternative provides the strongest connection to the regional California Coastal Trail for cyclists. The more active trail types are focused to the west, while primitive trails are focused on the east for birding and quiet contemplation. These trails invite regional visitors using the California Coastal Trail by bike to traverse the Project Area and enjoy the coastal and natural environment. Extensive boardwalks and bridges provide views of seasonal fluctuations in water and thus bird species.

6.2.3.2 Actions

Overview by Areas

Upland areas to the north of the current lagoon in Area 1 would be excavated to expand brackish marsh habitat. The existing lagoon would no longer have a surface connection to the OLW.

OLW will be rerouted through Areas 2 and 3a to a new lagoon, and the existing OLW channel (the portion through the Halaco properties) would be blocked and filled pending coordination with EPA). Fill would be placed to separate the new lagoon (Area 3a) from the existing Ormond Lagoon (Area 1). The new lagoon would not be subject to flood management, and it will pond to higher levels, estimated to be 1 to 3 feet higher than Ormond Lagoon management elevation of 9 feet NAVD88. The new lagoon would provide many of the functions provided by historical lagoon habitats, once present between Hueneme and Mugu but since lost or severely reduced. The existing Ormond Lagoon would receive less water after diversion of the OLW to the new lagoon, resulting in a lower water level. As a result, estimates of the typical lagoon water level in Ormond

Lagoon would be about 1 foot lower. While this lower water level is expected to reduce flood potential, management of the mouth to prevent flooding will need to continue.

Salt marsh habitats in Areas 3b and 4 will be connected hydrologically and restored. Area 4 would be graded to create a large basin that will support salt panne habitat. Excavated soil would be placed in the northern part of Area 4 and would support upland and transition habitats. The drainage ditches in Areas 3b and 4 would be filled and hence water would no longer drain from the area as efficiently. Small culverts may be desired to create greater hydraulic connectivity under the railway within Area 3b.

Salt marsh and salt panne habitat will be restored in Area 5 and it will be connected to Area 6. Excavated soil would be placed in the northern part of Area 5 and would support upland and transition habitats. Additional shallow basins would be excavated in Area 5 at elevations that would allow them to convert from seasonal wetlands to salt panne habitat as the sea level rises. The ODD #3 would be disconnected from the site, and the spur between Areas 5 and 6 would be filled. Water control structures may be required to allow reconnection of Areas 5 and 6 to the ODD #3 if adverse effects develop in the Mugu wetlands or if the loss of flood water storage increases flood levels on adjacent lands.

Beach Areas 7, 8, and 9 will be enhanced by weeding and planting to restore back dune scrub habitat and expand foredune scrub habitat. Dune building will be facilitated in selected locations with sand fencing and seeding with native dune species to capture wind-driven sand.

Further detail on actions and expected outcomes by Area and habitat is provided in **Table 6-6**.

Grading

Alternative 3 proposes the greatest amount of earthwork and will result in a greater change in the landscape than the other alternatives. Typical earthwork cross sections are provided in Figure 6-4a and 6-4b, with corresponding locations marked on the Alternative 3 Plan (Figure 6-7). Excavated soil will be reused beneficially on-site as practicable.

The upland areas north of Ormond Lagoon in Area 1 will be excavated to a lower elevation to establish brackish marsh.

A second, new lagoon will be constructed in Area 3a, as depicted in cross-section A. The lagoon will be connected to the new OLW, similar to that depicted in cross-sections A and B for Alternative 2. An outlet channel will be excavated through the dunes and beach, to the shore. The excavation of the lagoon and outlet channel will extend down to elevation 4 feet NAVD88, which is similar to the elevation of the existing Ormond Lagoon.

Fill will be placed around the perimeter of Area 2 and Area 3a to form upland that will also serve a barrier between the higher lagoon water and adjacent land and infrastructure. Fill will also be placed between Areas 3a and 3b, to maintain the salt marsh and panne in 3b. Excavation will connect the agricultural ditch of other feature(s) in Area 4 to the lagoon in 3a, with a new culvert facility installed under the existing railway. The hydraulic criteria for this culvert have not been defined at this point in the project development. Actual configuration will depend on further understanding of the water salt balance.

TABLE 6-6
ALTERNATIVE 3 ACTIONS BY AREA

Area	Sub-area	Habitat Type	Actions/Outcomes			Projected Changes with sea-level rise
			Earth Moving	Vegetation	Hydrology/Salinity	
1	1.1	Brackish marsh	• Excavate upland areas down to marsh elevation • Use excavated material to fill existing landward channel to marsh elevation • Additional fill might be placed in Area 2 or exported off-site	• Non-native species control in existing marsh • Planting in newly excavated marsh • Marsh elevation range may adjust once OLW is no longer connected the lagoon if hydrology/salinity change	Without inflows/connection to OLW, hydrology & salinity may change but will likely stay in the brackish range	Conversion toward open water as lagoon migrates landward
	1.2	Open water	None	N/A	Without inflows/connection to OLW, water levels & salinity may change	Lagoon will retreat landward
	1.3	Coastal dune	None	Non-native species control	N/A	Conversion to beach/strand as the shoreline retreats & marsh/open water as the lagoon migrates landward
	1.4	Upland	Fill in old Perkins drain by lagoon	Non-native species control. Planting grassland & coastal sage scrub	N/A	Conversion toward salt marsh then brackish marsh as water table nears the surface
	1.5	Beach/strand	Continued mouth management	None	None	Conversion to intertidal beach & surf zone
2	2.1	Brackish marsh	• OLW re-aligned & allowed to overtop its banks in high water conditions & flood the brackish marsh • Fill in old channel & remove the existing levees • Create a marsh plain that slopes gently toward the new channel • Topographic heterogeneity (e.g., depressions or higher areas) would support greater spatial vegetation diversity within the marsh	• Non-native species control as needed • Plant a wide diversity of brackish marsh species • Highest elevations within the marsh may get salty enough to support salt marsh species	• Brackish marsh would occur down to elevations that are regularly flooded to depths less than about 2 feet • Brackish marsh will occur up to elevations where the soil is saturated in the rooting zone during the growing season • Highest areas of the marsh might get salty enough to support salt marsh species where evaporation at the soil surface concentrates salts	Conversion toward open water

TABLE 6-6 (CONTINUED)
ALTERNATIVE 3 ACTIONS BY AREA

Area	Sub-area	Habitat Type	Actions/Outcomes			Projected Changes with sea-level rise
			Earth Moving	**Vegetation**	**Hydrology/Salinity**	
2 (cont.)	2.2	Wetland-upland transition	• Fill material from new channel & lagoon placed in existing upland & seasonal wetland areas • Excavated soil may be saline • Saline soils would not support most transition species so leaching & soil amendments may be needed	• The area will need revegetation & probably short-term weed control • Expect transition zone above about 11 feet NAVD88 • Typical species would include shrubs that can tolerate some salinity & occasional flooding such as *Atriplex lentiformis, Suaeda calceoliformis, S. taxifolia & Isocoma menziesii*	• Very rare flooding for short durations with brackish water • Some buildup of salts in soil • Water table below the rooting zone	Conversion toward salt marsh & then brackish marsh as the water table nears the surface
	2.3	Upland	• Fill material from new channel & lagoon placed in existing upland & seasonal wetland areas • Highest areas at the edges of the property should be tall enough to protect neighbors from flooding • Excavated soil may be saline • Saline soils would not support most upland species so leaching & soil amendments may be needed • The slope created between the wetland to upland is expected to be fairly steep	Non-native species control & planting grassland & coastal sage scrub	N/A	Conversion toward transition zone & brackish marsh as occasional flooding occurs & the water table nears the surface
	2.4	Bioswale	• Create shallow basin of sufficient volume to capture dry-season runoff from McWane Blvd • Consider including forebay that traps sediment & can be cleaned out occasionally • Direct outflow toward seasonal wetland area	Plant with cattail & tule	• Basin will capture surface flows & allow plants to uptake water, nutrients & other pollutants • Encourage percolation with coarse soil & large area • Expect slightly brackish conditions	As the water table rises, water will percolate less efficiently; when the water table reaches the surface, the basin will begin to lose capacity
	2.5	Open water	A new channel will be excavated	N/A	Permanently flooded with brackish water	Water will get deeper

TABLE 6-6 (CONTINUED)
ALTERNATIVE 3 ACTIONS BY AREA

Area	Sub-area	Habitat Type	Actions/Outcomes			Projected Changes with sea-level rise
			Earth Moving	Vegetation	Hydrology/Salinity	
3a	3a.1	Brackish marsh	• OLW re-aligned & allowed to overtop its banks in high water conditions & flood the brackish marsh • Create a new lagoon with a large area of open water • Create a marsh plain that slopes gently toward the new channel & lagoon • Topographic heterogeneity (e.g., depressions or higher areas) would support greater spatial vegetation diversity within the marsh	• Non-native species control as needed • Plant a wide diversity of brackish marsh species • Highest elevations within the marsh may get salty enough to support salt marsh species	• Brackish marsh would occur down to elevations that are regularly flooded to depths less than about 2 feet • Brackish marsh will occur up to elevations where the soil is saturated in the rooting zone during the growing season • Highest areas of the marsh might get salty enough to support salt marsh species where evaporation at the soil surface concentrates salts	Conversion toward open water
	3a.2	Wetland-upland transition	• Fill material from new channel & lagoon placed in existing upland & salt marsh areas • Excavated soil may be saline • Saline soils would not support most transition species so leaching & soil amendments may be needed	• The area will need revegetation & probably short-term weed control • Expect transition zone above about 11 feet NAVD88 • Typical species would include shrubs that can tolerate some salinity & occasional flooding such as *Atriplex lentiformis, Suaeda calceoliformis, S. taxifolia & Isocoma menziesii*	• Very rare flooding for short durations with brackish water • Some buildup of salts in soil • Water table below the rooting zone	Conversion toward salt marsh & then brackish marsh as the water table nears the surface
	3a.3	Open water	A new channel & lagoon will be excavated	N/A	Permanently flooded with brackish water	Water will get deeper

TABLE 6-6 (CONTINUED)
ALTERNATIVE 3 ACTIONS BY AREA

Area	Sub-area	Habitat Type	Actions/Outcomes			Projected Changes with sea-level rise
			Earth Moving	Vegetation	Hydrology/Salinity	
3a (cont.)	3a.4	Upland	• Existing upland areas will receive fill from excavated areas • The slope created between the wetland to upland is expected to be fairly steep • Place fill strategically to protect neighbors and railroad from flooding • Excavated soil may be saline • Saline soils would not support most upland species so leaching & soil amendments may be needed	Non-native species control & planting grassland & coastal sage scrub	N/A	Conversion toward salt marsh & then brackish marsh as the water table nears the surface
3b	3b.1	Salt marsh	Removal of ODD #3 would allow restoration of salt marsh	Plant salt marsh species	• Little change from current conditions • Hydrology would no longer be influenced by ODD #3 • Filling of ODD #3 might raise the water table & lead to conversion of lowest areas of salt marsh to salt panne • Creation of lagoon in Area 3a might raise/freshen groundwater in this area & could lead to conversion to brackish marsh	Assuming limited influence on groundwater from the new lagoon, rising salty groundwater from the ocean will cause conversion to salt panne & then open water
	3b.2	Salt panne	None	N/A	• Little change from current conditions • Creation of lagoon in Area 3a might raise/freshen groundwater in this area & could lead to conversion to brackish marsh	Assuming limited influence on groundwater from the new lagoon, rising salty groundwater from the ocean will cause conversion to open water
	3b.3	Upland	None	Non-native species control & planting grassland & coastal sage scrub along railroad berm	N/A	Conversion toward salt marsh as the water table nears surface

TABLE 6-6 (CONTINUED)
ALTERNATIVE 3 ACTIONS BY AREA

Area	Sub-area	Habitat Type	Actions/Outcomes			Projected Changes with sea-level rise
			Earth Moving	Vegetation	Hydrology/Salinity	
4	4.1	Salt marsh	• Minor grading to eliminate roads, ditches & any tile drains • Area could be a broad almost flat plain gently sloping southwest • Soil texture should be studied & appropriate amendments added (e.g., bentonite) to mimic salt marsh soil • Water control structure and culvert under the railroad to allow managed hydraulic connectivity between Areas 4 and 3	• The area will need revegetation & possibly short-term weed control • Expect salt marsh below about 9 feet NAVD88 • Consider options such as irrigating with salt or brackish water to control weeds & favor salt marsh species • Dominant species would include pickleweed, salt grass & fleshy jaumea	• The brackish water table would presumably be within a couple feet of the surface once ditches & drains are removed • New lagoon in 3a might raise the water table enough that wetlands establish above the estimated 9-foot NAVD88 contour & might lower salinities • Limiting off-site drainage would help keep salts on-site & favor salt marsh species • a culvert with water control across the railway is included as a placeholder for subsequent analysis of need to discharge from Area 4 and potential for water supply from Area 3.	Rising groundwater will cause conversion to salt panne & then open water
	4.2	Salt panne	• Create a large shallow basin • Soil may need to be amended with clay to encourage ponding	N/A	• Salt panne areas would pond with rainfall & retain salts from evaporating groundwater (similar to other salt panne habitats on-site) • Expect salt panne below about 5 feet NAVD88	Conversion to open water as groundwater level rises
	4.3	Wetland-upland transition	• Spoil site for soil excavated in 3a • Area should be gently sloping toward the salt marsh	• The area will need revegetation & probably short-term weed control • Expect transition zone at about 11 feet NAVD88 • Typical species would include shrubs that can tolerate some salinity & occasional flooding such as *Atriplex lentiformis, Suaeda calceoliformis, S. taxifolia & Isocoma menziesii*	• Very rare flooding for short durations with brackish water • Some buildup of salts in soil • Water table below the rooting zone • New location of OLW might raise the water table enough that wetlands establish above the estimated 9-foot NAVD88 contour	Conversion toward salt marsh & then brackish marsh as the water table nears the surface

TABLE 6-6 (CONTINUED)
ALTERNATIVE 3 ACTIONS BY AREA

Area	Sub-area	Habitat Type	Actions/Outcomes: Earth Moving	Actions/Outcomes: Vegetation	Actions/Outcomes: Hydrology/Salinity	Projected Changes with sea-level rise
4 (cont.)	4.4	Upland	• Spoil site for soil excavated in 3a • The slope toward the transition zone may need to be fairly steep • Excavated soil may be saline • Saline soils would not support most upland species so leaching & soil amendments may be needed	Non-native species control & planting grassland & coastal sage scrub	N/A	Conversion toward transition zone & then salt marsh as flooding occurs & the water table nears the surface
5	5.1	Salt marsh	• Remove all the abandoned roads & create a broad salt marsh plain • Optional basins could be created in new salt marsh area to support salt panne	• No actions in existing salt marsh area • Plant new salt marsh with appropriate salt marsh species	• Salt marsh areas would pond with rainfall & retain salts from evaporating groundwater (similar to other salt marsh habitats on-site) • Expect salt marsh between about 5 & 7.5 feet NAVD88 • Block culverts to eliminate drainage of area to ODD #3	Rising salty groundwater from the ocean will cause conversion to salt panne & then open water
	5.2	Seasonal wetland	Shallow basins would be excavated at multiple elevations	• Control non-natives & plant salt-tolerant natives that tolerate wet winter & dry summer conditions in upper basin(s) • Consider introducing locally & regionally rare species such as *Salicornia depressa, Atriplex coulteri, A. pacifica, A. serenana var. davidsonii, Lasthenia glabrata* ssp. *coulteri, Suaeda calceoliformis, Astragalus pycnostachyus* var. *lanosissimus,* etc. • Lower basin would likely support salt marsh habitat	• Seasonally flooded from rainfall • Saline groundwater generally below the rooting zone • Salts transported in to the rooting zone, generally pushed deeper & diluted in the winter with rainfall & closer to the surface & more concentrated in the summer	Conversion toward salt marsh & salt panne as water table nears surface
	5.3	Upland	None	Non-native species control & planting coastal sage scrub	N/A	Rising water in ODD #3 &/or groundwater will lead to conversion to brackish or salt marsh
	5.4	Open water	None	Tule on the edges of the channel will remain	As-is	Water will get deeper & tule fringe will move up the banks

TABLE 6-6 (CONTINUED)
ALTERNATIVE 3 ACTIONS BY AREA

Area	Sub-area	Habitat Type	Actions/Outcomes			Projected Changes with sea-level rise
			Earth Moving	Vegetation	Hydrology/Salinity	
6	6.1	Salt marsh	• Remove levees & fill in the stub of ODD #3 between Areas 5 & 6 • Create contiguous salt marsh plain between Areas 5 & 6	• Non-native species control • Planting in new salt marsh areas	As-is	• Conversion to salt panne & open water as groundwater level rises • Dunes will migrate landward & bury salt marsh
	6.2	Salt panne	None	None	As-is	Conversion to open water as groundwater level rises
	6.3	Upland	None	Non-native species control	N/A	Conversion to salt marsh habitat as groundwater level rises
	6.4	Open water	None	Tule on the edges of the channel will remain	As-is	Water will get deeper & tule fringe will move up the banks
7, 8, 9	7, 8, 9.1	Coastal dune	Add sand fencing between fore & back dune ridges to encourage dune building	• Extensive planting between fore & back dune ridges to encourage natural dune building • Dune planting could include reintroduction or introduction of rare, threatened & endangered endemic dune species	N/A	• Conversion to strand & beach as the coast retreats • Additional sand in expanded dunes might slow rate of retreat
	7, 8, 9.2	Open water	• Create sand berm between existing lagoon and the mouth of the new lagoon • Excavate channel through dunes to create a mouth for the new lagoon	N/A	• Mouth of new lagoon would breech occasionally and receive wave overwash rarely • Mouth would be allowed to open and close naturally • A back beach swale may form naturally (as seen at the current lagoon)	As the beach retreats, there will be more opportunities for a back beach swale to form
	7, 8, 9.3	Beach/strand	None	None	Occasional wave overwash at south end	Conversion to intertidal & surf zone as the beach retreats

Earthwork on the beach in Areas 1 and 7 will be substantial. A raised area of vegetated dunes will be built with sand excavated from the new lagoon mouth channel. The new dune ridge will keep the two lagoon segregated. The anticipated geometry is similar to the dune fill shown in cross-section B for Alternative 1, but a large footprint is envisioned, to extend the barrier out to the existing elongated lagoon.

Area 4 will be excavated and graded to form one large, shallow basin to support salt panne habitat. Excavated material will be placed to raise the northern perimeter of Area 4. ODD #3 between Areas 3b and 4 will be eliminated to restore a flat, contiguous marsh plain and limit surface drainage from these areas.

A series of shallow basins and increasing elevations would be excavated in Area 5. The fill would be placed in existing upland areas. The stub of ODD #3 between Areas 5 and 6 would be eliminated to restore a contiguous marsh plain.

Dune formation will be encouraged via sand fences and planting, but grading of the sand dunes is not proposed except to form the boundary between the existing and new lagoon.

Infrastructure Modification

The new lagoon water level will result in water ponding higher than the existing lagoon, and hence may impact the railway between Areas 3a and 4. The potential for increased water levels farther upstream near Hueneme Road will be evaluated relative to the local flood thresholds. Modifications to the railway will be required sooner because site water levels will be higher sooner, due to the new lagoon. A culvert under the railway will be constructed to allow backwater from the new lagoon to fill the agricultural ditch in Area 4 and or to limit drainage in order to concentrate salts via evaporation, and to allow draining of Area 4 if needed: The hydraulic criteria for the culvert and potential water control elements (e.g., gate) have not been developed at this stage of design and would depend on an analysis of water and salt balance.

Filling the existing OLW in Area 2 and at the Halaco properties is required to form two lagoons (pending coordination with EPA). The existing Ormond Lagoon will have reduced water supply and water levels, but will still require beach excavation to prevent flooding.

Drainage ditches will be removed by filling. Connection to the ODD #3 will be accomplished by water control structures so that any adverse effects to downstream habitats and adjacent properties can be reversed and otherwise the hydrology can be adaptively managed. This modification is similar to Alternative 2, but the target hydrology is different.

Access, Trails, and Site Amenities

Alternative 3 (Figure 6-3) features more developed trails and boardwalks and opportunities for looped trail experiences, as well as a bicycle route traversing the site (as opposed to “out and back”). Although the trails are more developed and can accommodate more intensive usage, the alignments create contiguous habitat areas, thus contributing to less potential wildlife disturbance.

A new bridge at tšumaš Creek (Area 1, Access Node E) provides a multi-modal connection between the project area and Hueneme Beach, and the multi-modal boardwalk leading through the Ormond

Lagoon island connects to the Perkins Road trail. The improved and expanded parking lot at Perkins (Access Node A) can accommodate more visitors, who can then take the elevated boardwalk trail to the overlook at Ormond Lagoon, head to the Beach via the Hueneme Beach trail, or head east to the heart of the site through the West McWane Blvd trailhead (Access Node B1). A clearly signed and connected sidewalk or site trail is proposed between Perkins and West McWane to facilitate a larger loop trail experience. An elevated boardwalk leads from West McWane (Access Node B1) north to Area 2 and a rustic wetland loop trail. The primary multi-modal trail heads east across a new bridge with overlook at OLW (Area 2 and 3a). The trail continues west, and then south toward the beach via a multi-modal trail with overlooks (Area 3a). This trail then becomes a boardwalk through wetlands and back dunes, creating the opportunity for visitors to head north east to complete a large loop and head back to Hueneme Road along McWane Blvd (Area 4), or walk along the beach (Area 7 and 1) to return to the Perkins Road or McWane Blvd East trailhead.

A new trailhead access proposed at the corner of Edison Drive and East McWane Blvd (Area 4, Access Node C) is sited to accommodate both local and regional visitors, including cyclists. This node would have bike services, and due to its location, could be implemented either while the Area 4 agriculture is occurring or after conversion to wetland. A community visitor's center is envisioned to provide school groups and community groups with a place to gather and learn about the Project Area, and to facilitate community involvement in direct hands-on restoration activities such as planting, weeding, and monitoring. Maintenance facilities could be located here to facilitate volunteer inclusion, tool storage, and staging area for example.

This alternative focuses access to the western portion of the site while still providing limited access on primitive and rustic trails to the more sensitive eastern portion of the site. The existing Arnold Road parking lot (Access Node D) would be reconfigured to have only ADA parking sites, and a drop-off or turn-around area, and focus on bike parking for access. Bike racks and a limited number of bike lockers allow cyclists to secure their bikes or camping gear and explore Areas 5, 6, and 9 on foot. The filling of the ODD #3 (pending agreement with Oxnard Drainage District No. 2) allows an easy access through a new upland band proposed in Area 5, where visitors can view birds and habitats from a new overlook platform. This is the only alternative providing access within Area 5.

6.2.3.3 Outcomes

Physical/Geomorphic

A separate lagoon will be created in Areas 2, 3a and 7 that will be fed by the OLW, with a new mouth intermittently connecting it to the ocean. The new lagoon would have permanently flooded areas but water levels would vary with rainfall and with the opening and closing of the mouth. At current sea levels, the mouth would remain closed the majority of the time. Seawater ingress could occur during mouth-open conditions. Light rainfall events that do not deliver enough water to cause a breach of the beach berm would lead to high water levels (up to 3 feet higher than the maximum levels in the current lagoon). Overall, water levels in the lagoon will fluctuate between about 2 and 12 feet NAVD88. The existing Ormond Lagoon is expected to attain a lower water level (typically about a foot lower), based on the analysis in Section 6.4.1 Technical Studies (see Water Balance/Lagoon Inlet Modeling, including Figure 6-14). Substantial grading in Area 4 will create a shallow basin that will fill with rainwater, have very low percolation rates, and drain only when the basin is over full. This will facilitate a buildup of salts on and near the surface as water evaporates. Similar basins will be constructed in Area 5 at multiple elevations. The lowest will provide salt panne conditions at current sea levels and the higher basins will convert to salt panne conditions with sea-level rise.

Ecological/habitat

The overall shift in habitats in Alternative 3 is similar to Alternative 2. The post-construction habitat types and acres are compiled in **Table 6-7**, and shown in Figure 6-8. The area of wetlands within the site will be increased overall. Salt marsh habitats in Areas 2 and 3a will be converted to brackish marsh or open water, and existing open water will be converted to brackish marsh. Some uplands will be converted to brackish marsh while others will be maintained and restored. Riparian habitat along OLW in Area 2 will not be sustainable due to existing brackish ground water. Salt marsh and salt panne are expanded in Areas 4 and 5. There would be some conversion of dune habitat in Area 7; however, the affected area would remain valuable habitat. Dune topography would be increased and back dune areas would be more vegetated than they are currently.

TABLE 6-7
ALTERNATIVE 3: CONNECTIVITY THEME HABITAT PROJECTIONS

	Area (acres)								
Habitat Type	**1**	**2**	**3a**	**3b**	**4**	**5**	**6**	**7-9**	**TOTAL**
Beach/strand	12							18	30
Coastal dunes	18							102	120
Dune swale wetland									0
Salt panne				4	37	9	22		72
Salt marsh				19	39	43	34		136
Brackish marsh	30	42	28						99
Seasonal wetlands					16				16
Riparian									0
Open water	15	6	19			2	2	1	46
Wetland-upland transition		13	8		39	13			73
Bioswale		1							1
Upland	2	27	9	1	22	6	2		69
TOTAL	**77**	**89**	**64**	**24**	**137**	**88**	**60**	**121**	**660**

NOTE: Habitat estimates rounded to nearest acre. habitat projections are post-construction under current sea level.
SOURCE: CRC

New open water and brackish marsh habitats would support various species of ducks and rails as well as songbirds. Open water areas would provide foraging habitat for California least tern. However, the new mouth location would eliminate the currently active (2017–2018) nesting colony in Area 7 and could also affect a currently productive western snowy plover nesting area. The new lagoon could support a separate population of tidewater goby and therefore decrease the likelihood that the species might be extirpated from the Project Area if there were some major disturbance in one lagoon or the other. The existing lagoon would have lower water levels owing to the diversion of OLW, which could reduce habitat area (but may be offset by the gain in area with a second lagoon). Further analysis of the dynamics and net change in habitat area and quality of a two-lagoon system, and the potential effect on tidewater goby in the existing Ormond Lagoon and new lagoon is needed if this Alternative is advanced.

Existing habitat for Belding's savannah sparrow would be eliminated in Area 3a but new salt marsh habitats in Areas 4 and 5 could support this species. The only existing population of Coulter's goldfields in the project area and a small population of salt marsh bird's beak in Area 3a would be eliminated. Restored saline habitats in Areas 4 and 5 might support new populations these species. Regionally and globally rare species adapted to non-tidal saline habitats might be introduced (e.g., Ventura marsh milk vetch) in Areas 4 and 5 as well.

Public Access

This alternative balances access to each of the designated Project Areas while maintaining large contiguous, connected habitat areas. Due to the expanded and projected higher elevations of wet areas, and movement of waterways inland, public access features are primarily located on the periphery of the Project Area to support the hydrologic connectivity. Access points remain concentrated at McWane Blvd, Perkins Road, and Arnold Road. A number of large loop trails are created to support cycling and long nature hikes. The network of boardwalks clearly define walking paths and help encourage visitors to stay on the trails, while allowing hydrologic connectivity and wildlife movement to be unrestricted.

6.3 Alternatives Evaluation

The alternatives were analyzed using SLAMM habitat evolution modeling and the lagoon QCM for future performance, and then scored on the basis of how well they met the project objectives. The shore response to sea-level rise was modeled separately and superimposed on the SLAMM model outputs, and is explained in Appendix B – Shore Migration and Overtopping (Beach QCM). Future sea-level rise used for this study is explained in Appendix A – Sea-Level Rise. These analyses are addressed in detail for the no-project future conditions in Chapter 2 Site Conditions of this report. Please note that the lagoon QCM includes a water balance model and therefore accounts for water supply and the effects of modifying the Ormond Lagoon basin (Alternative 2) and a creating a new lagoon (Alternative 3). Chapter 7 Data Gaps and Uncertainties of this report addresses data gaps and uncertainties, including the need for hydrology data to better quantify water supply. However, based on available data and modeling, all three alternatives considered herein are considered feasible from a physical processes perspective.

6.3.1 Technical Studies

6.3.1.1 SLAMM Modeling

SLAMM was used to evaluate the habitat evolution of the proposed restoration alternatives. For each alternative, the ground elevations in the digital elevation model (DEM) were modified to represent the proposed grading and the initial habitat map was revised to reflect the target habitats. Then SLAMM was run using all the same configuration as for the No Project scenario, except for the altered DEMs and habitat maps. Differences from the No Project scenario and between the alternatives are summarized in the sections below. Additional details can be found in Appendix D – Wetlands Habitat Evolution Modeling (SLAMM).

Alternative 1

Since Alternative 1 proposes mostly enhancements to existing habitats and relatively mild grading, its initial conditions are very similar to existing conditions in the No Project scenario. Because of the similarity to No Project's initial conditions, the resulting habitat evolution is also similar to the No Project scenario. The habitats entered into the SLAMM model are shown in Figure 6-5.

At 2060 (**Figure 6-9**), with 2 feet of sea-level rise, the most prominent change is open water in Area 6. At 2080 (**Figure 6-10**), with 3 feet of sea-level rise, inundation spreads to a substantial fraction of the project area, and the reduced connectivity to ODD #3 results in larger open water and unvegetated areas in the western portion of Area 5. At 2100, the majority of the Project Area is inundated (see Appendix D – Wetlands Habitat Evolution Modeling (SLAMM)).

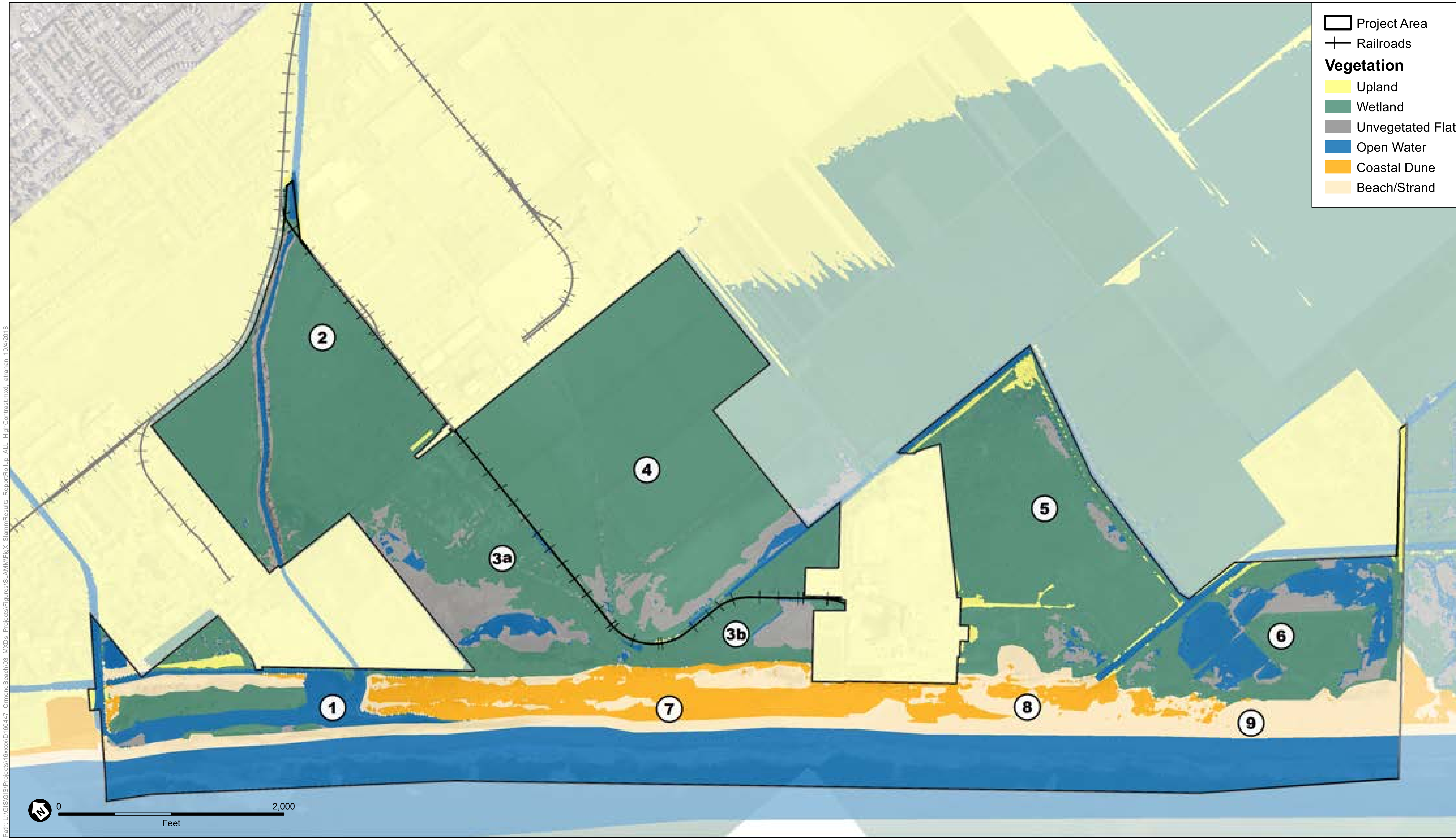
Alternative 2

The proposed grading in Alternative 2, notably the realignment of OLW in Areas 2 and 3a, and the wetland swales in Area 4, modify this alternative's initial habitat conditions.

At 2060 (**Figure 6-11**), with 2 feet of sea-level rise, the southern-most wetland swale in Area 4 become permanently inundated. Because of the better connectivity via the OLW realignment, Area 3a has more vegetated wetlands rather than the unvegetated flats predicted for this area for No Project and Alternative 1. The lower portion of the re-aligned channel also provides connectivity between OLW and the lagoon across a wider swath of Area 1.

At 2080 (**Figure 6-12**), with 3 feet of sea-level rise, inundation from OLW spills out across Area 3a, re-creating lagoonal conditions which would be displaced at the original Ormond Lagoon by beach transgression. In Area 4, the landward transgression of inundation progresses, deepening the water in the southern swale and activating the next swale north with permanent inundation. In Area 5, the proposed embankment will slow the encroachment of inundation in the northeast part of the site as compared to the No Project scenario.

At 2100, with almost 5 feet of sea-level rise, the majority of the Project Area is inundated, with slight variation in the inundation's distribution due to this alternative's proposed grading (Appendix D – Wetlands Habitat Evolution Modeling (SLAMM)).

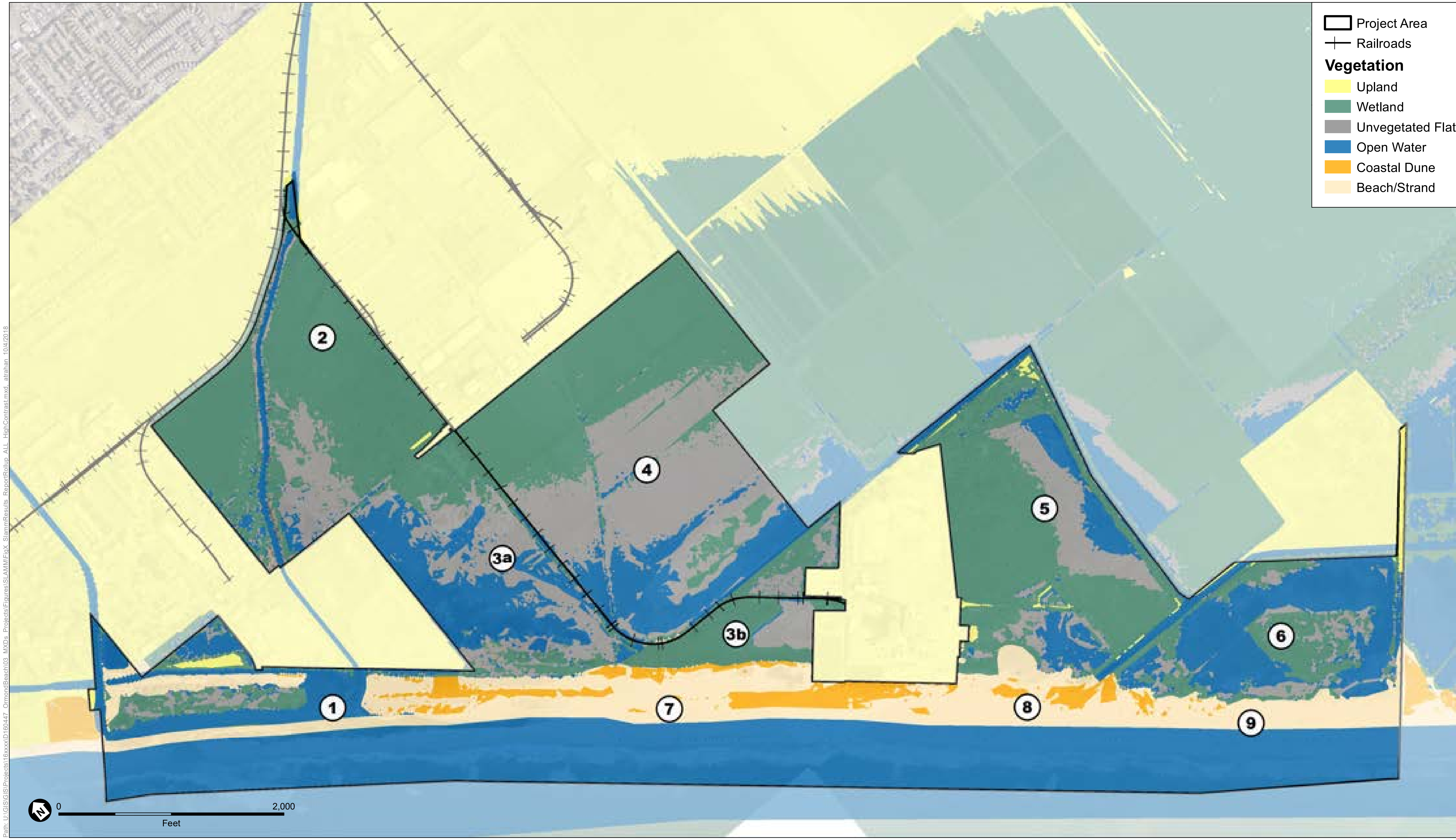


SOURCE: ESA (2017), CA Coastal Conservancy LiDAR (2011)

Ormond Beach Restoration and Public Access Plan

Figure 6-9
SLAMM Results with Beach Transgression
Alternative 1, 2060, +2.1 ft SLR

ESA



SOURCE: ESA (2017), CA Coastal Conservancy LiDAR (2011)

Ormond Beach Restoration and Public Access Plan

Figure 6-10
SLAMM Results with Beach Transgression
Alternative 1, 2080, +3.4 ft SLR

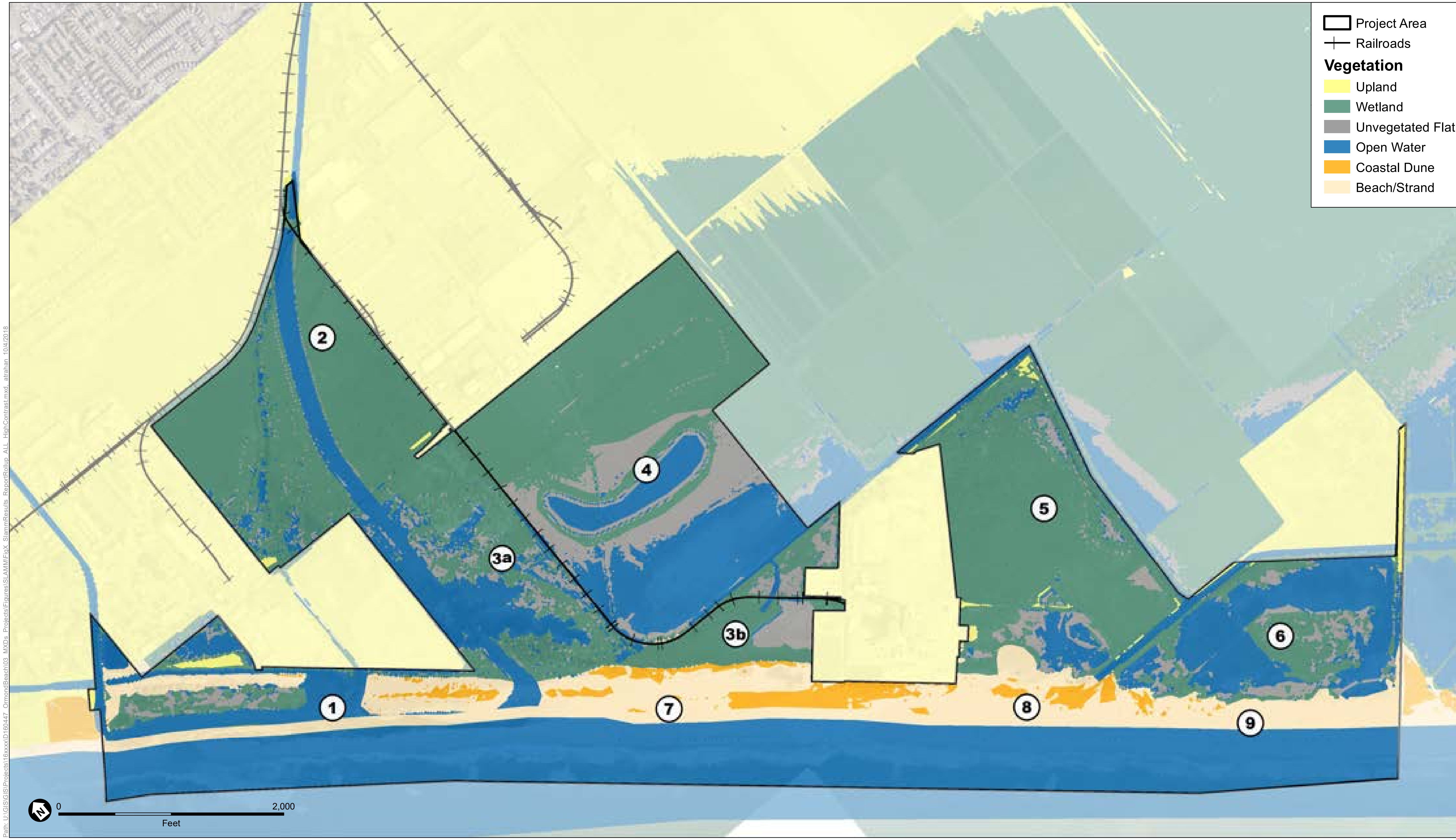
ESA

SOURCE: ESA (2017), CA Coastal Conservancy LiDAR (2011)

Ormond Beach Restoration and Public Access Plan

Figure 6-11
SLAMM Results with Beach Transgression
Alternative 2, 2060, +2.1 ft SLR

ESA



SOURCE: ESA (2017), CA Coastal Conservancy LiDAR (2011)

Ormond Beach Restoration and Public Access Plan

Figure 6-12
SLAMM Results with Beach Transgression
Alternative 2, 2080, +3.4 ft SLR

ESA

Alternative 3

Alternative 3 proposes more extensive grading to re-align OLW, excavate a lagoon at its downstream end, and create wetland depressions in Area 4 and Area 5.

At 2060 (**Figure 6-13**), with 2 feet of sea-level rise, all of major grading areas become inundated. Conditions are similar to Alternative 2, except the more extensive excavation increases the inundated extents.

At 2080 (**Figure 6-14**), with 3 feet of sea-level rise, the rising inundation spills out from the excavated areas onto adjacent properties. The combination of the grading and increased connectivity yields more contiguous wetlands across Area 3a and Area 4. Inundation in Area 5 is largest for this alternative.

At 2100, with almost 5 feet of sea-level rise, the majority of the Project Area is inundated, with slight variation in the inundation's distribution due to this alternative's proposed grading (Appendix D – Wetlands Habitat Evolution Modeling (SLAMM)).

6.3.1.2 Water Balance/Lagoon Inlet Modeling

In general, the Lagoon QCM model found that the alternatives that expanded the lagoon volume (Alternatives 2 and 3) tended to accumulate more water on the site (by prolonging seasonal lagoon mouth closure events and/or adding additional storage volume for ponded inflows) than maintaining open-mouth conditions during the wet season. Alternative 1 would likely provide the least additional wetted area and water volume, but would provide more brackish and saline habitat (see Section 2.4.3). With 3 feet of sea-level rise, the model generally predicted that the site would tend to be closed to tidal influence for longer periods of time for all alternatives, along with a shift toward higher average water levels and a greater amount of ponded brackish habitat.

Figure 6-15 condenses the modeled water levels for the various alternatives into probability density function (pdf) curves. These curves represent the relative number of times that lagoon water levels were predicted within certain bands of elevation. As an example, a pdf curve of oceanic tides would show high density of occurrences between mean lower low water (MLLW) and mean higher high water (MHHW). For Ormond Lagoon, water levels are typically much higher, so the pdf curves show a higher density above MHHW. The goal of this plot is to show subtle changes in water level between the alternatives. Figure 6-15 also shows pdf curves for wetted area and lagoon volume, which were calculated from the water levels by relating them to the hypsometry (volume vs elevation) relationships for each case.

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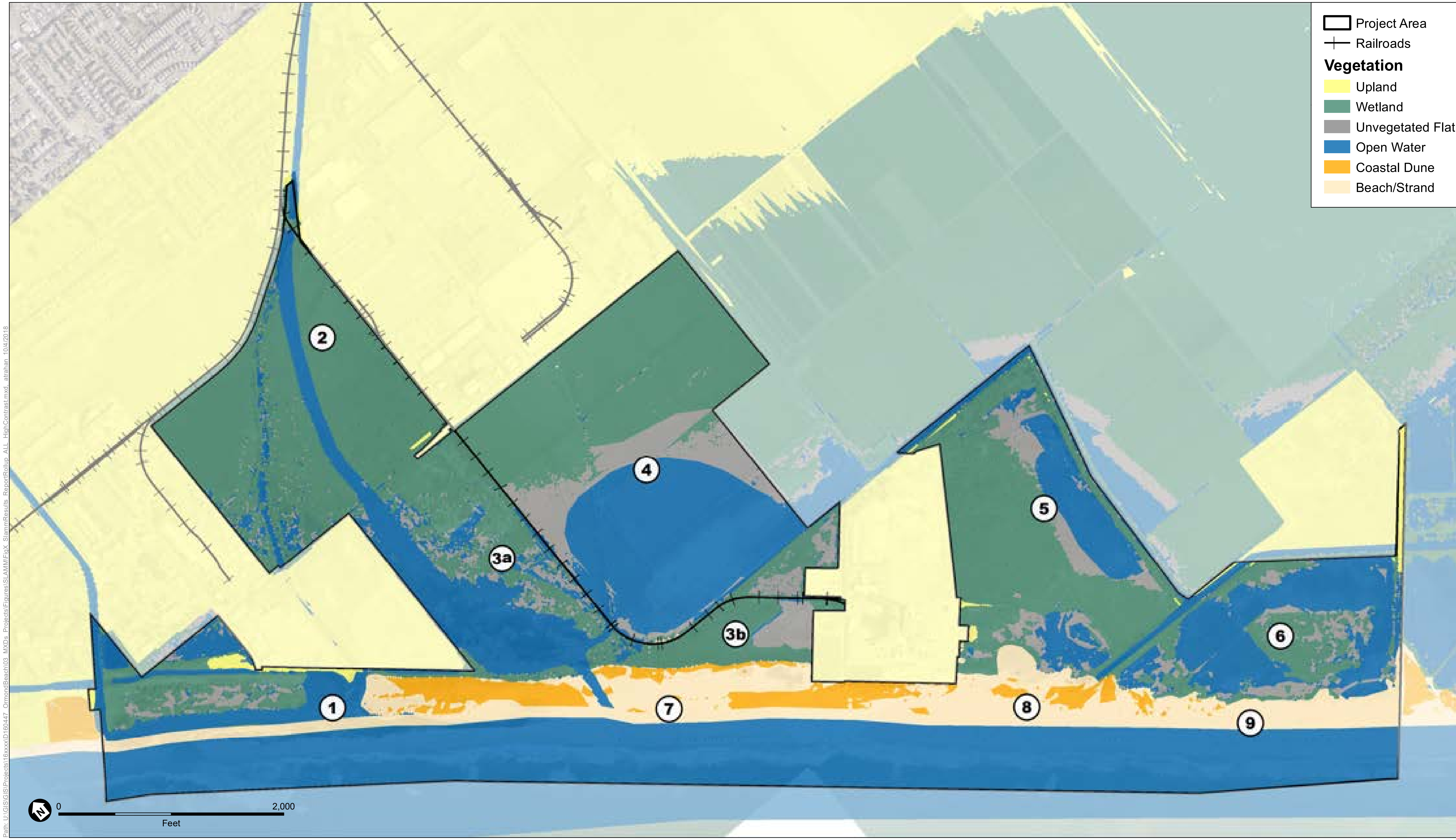
SOURCE: ESA (2017), CA Coastal Conservancy LiDAR (2011)

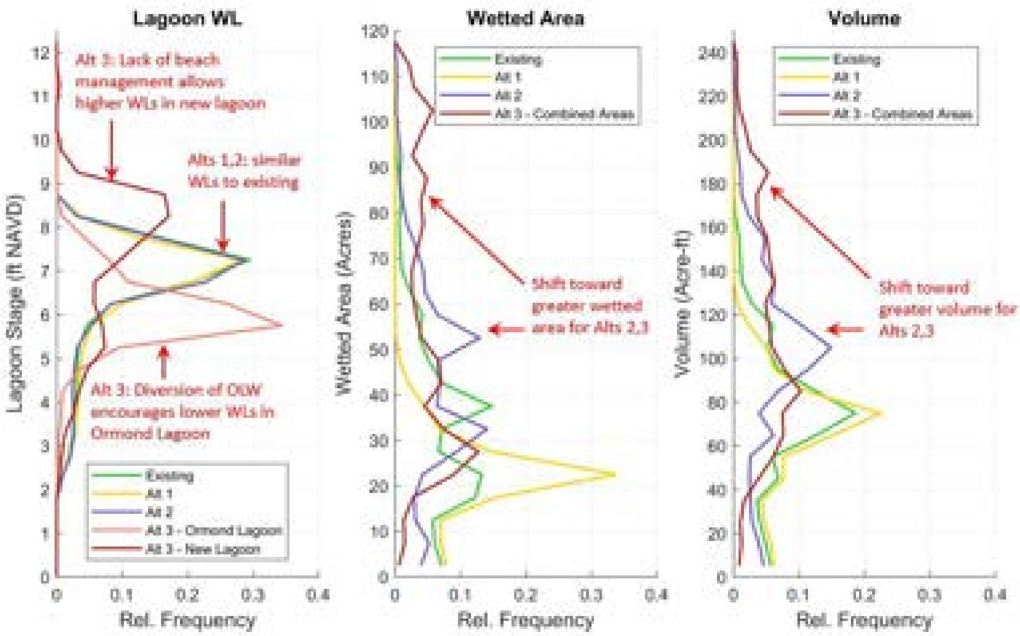
Figure 6-13
SLAMM Results with Beach Transgression
Alternative 3, 2060, +2.1 ft SLR

ESA



SOURCE: ESA (2017), CA Coastal Conservancy LiDAR (2011)

Figure 6-14
SLAMM Results with Beach Transgression
Alternative 3, 2080, +3.4 ft SLR



Ormond Beach Wetlands Restoration / D160447.00

SOURCE: ESA QCM model

Figure 6-15
Modeled Lagoon Stage (Water Level) (left), Area (middle), & Volume (right) Probability Distributions for 2007-2017.

Alternative 1

The lagoon model was setup to include a portion of 3a as part of the Ormond Lagoon basin to represent the existing hydraulic connectivity between the largely open water area on the beach Area 1 (this is what most people refer to as Ormond Lagoon) and the often flooded area in Area 3a (part of Ormond Lagoon hydraulically) which is freshening due to inundation during high lagoon levels. Alternative 1 is configured to block the surface water connection to Area 3a at the fresh-brackish area east of the Halaco properties, which is represented by a smaller Ormond Lagoon in the model. Since Alternative 1 would effectively reduce the volume of the lagoon (by isolating the ponded area east of the Halaco properties), the model showed that water levels would likely be slightly higher than in existing conditions during seasonal lagoon mouth closure events. The higher water levels would exist in the open water in Area 1, typically called Ormond Lagoon. The increased water level is attributed to a reducing backwater into Area 3a, essentially making a smaller lagoon, as there would be less storage capacity to hold the inflows. However, this higher water level would also cause the lagoon to breach earlier, as shown by the model. The earlier breaching would occur because the water level would rise higher and faster for a given inflow rate, and therefore would overflow and scour the beach, discharging to the ocean sooner than occurs with the existing, larger lagoon, and sooner than would occur with the other alternatives because it would take less time for inflows to pool and rise to the beach crest elevation and erode a new mouth. The predicted change in number of days of lagoon closure per year was a decrease of less than 1 percent, which is small relative to variations we expect to occur year to year. This means that under Alternative 1, the lagoon drained slightly earlier and more frequently than the other alternatives, and overall, the resulting surface area and volume of the lagoon were smaller throughout the modeled time period of 2007–2017 (Figure 6-15).

Alternative 2

Alternative 2 would enlarge Ormond Lagoon. This alternative was modeled by doubling the current Ormond Lagoon storage volume. Modeled water levels under Alternative 2 were similar to existing conditions, but the added lagoon volume east of the Halaco properties added a significant amount of wetted area and freshwater volume (Figures 6-15). Overall, the model predicted that the added wetland/lagoon areas constructed east of the Halaco properties would act more to store water entering the site than to change the seasonal mouth morphology. The model predicted a slight increase in closure duration (less than 1 percent) which is small relative to the variations we expect year to year.

Alternative 3

Modeling of Alternative 3 analyzed the impact of adding lagoon storage east of the Halaco properties, and blocking the surface water connection with the existing Ormond Lagoon. The model assumed flows from OLW to the new lagoon in the existing wetland area. The new lagoon was modeled separately from Ormond Lagoon. Alternative 3 resulted in the most marked changes in lagoon water levels and mouth closure frequency, and showed a similar effect as that of Alternative 2 with respect to increasing total lagoon wetted area and volume. The new lagoon under Alternative 3 was predicted to experience higher water levels than for Ormond Lagoon under existing conditions. This is a result of:

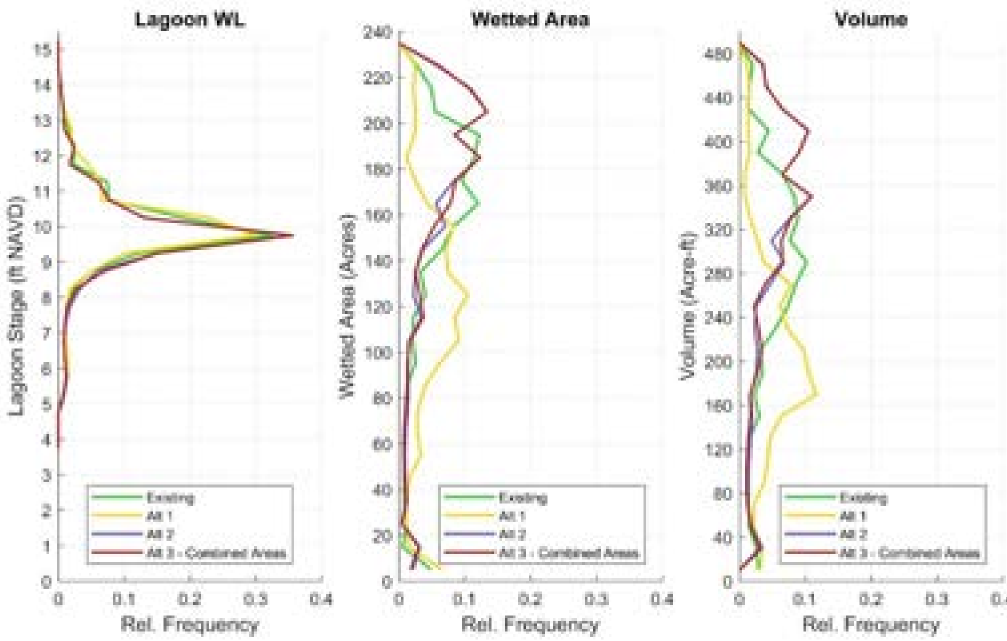
- Smaller storage capacity as compared to the capacity of the entire existing system,
- Reduced seepage toward the ocean given that the new lagoon would mostly be situated behind the dune line, rather than open to the beach, and
- Lack of beach management, allowing the beach crest to reach equilibrium levels of 9 to11 feet NAVD88 during seasonal lagoon mouth closures. This would allow higher water levels to occur in the new lagoon and hold more water behind the beach berm.

These modeled changes contributed to significant gains in water volume east of the Halaco properties, despite the fact that a portion of the inflows (from tšumaš Creek and Bubbling Springs) were directed to Ormond Lagoon. In contrast, the Ormond Lagoon experienced a reduction of 1 to 2 feet in water levels, since its storage capacity remained the same and the OLW would be diverted to the new lagoon. This is anticipated to have a net benefit on flood management in the bypassed portion of OLW and Ormond Lagoon, as it would delay ponding during floods and reduce the number of times that peak water levels would reach the grooming elevation. Water levels would be higher in Areas 3 however and may impact the railway. A flood-hydraulics assessment of Alternative 3 is needed as part of subsequent project development. Given these predicted changes in hydrology, we presume an ecological impact analysis is required for Alternative 3.

Despite the separation of inflows, when combined, the new lagoon and Ormond Lagoon segments are predicted to provide a net increase in overall brackish habitat in the system as indicated by the curves for wetted area and volume in Figure 6-15. The increase is similar in magnitude to Alternative 2.

Sea-level Rise

With 3 feet of sea-level rise, the model predicted that water levels would likely be similar across all alternatives, owing to the expansion of the lagoons into inland lowlands (**Figure 6-16**). The similar water levels result because the progressive (increasing with sea-level rise over time) inundation of back-barrier low-lying areas would eventually compensate for the reduction of lagoon on the beach from beach transgression, and eventually increase the lagoon volumes to exceed the existing and post-construction lagoon volumes. With 3 feet of sea-level rise, all alternatives experienced a shift toward longer seasonal closure events, rather than longer periods of open-mouth conditions. Note that Appendix C – Ormond Lagoon Hydrology and Morphology (Lagoon QCM) distinguishes models run with sea-level rise as “b” alternatives and alternatives without sea-level rise as “a” alternatives. The model set up varied somewhat for sea-level rise cases; details of the modeling conditions are presented in Appendix C.



Ormond Beach Wetlands Restoration / D160447.00

SOURCE: ESA QCM model

Figure 6-16
Modeled Lagoon Stage (Water Level) (left), Area (middle), & Volume (right) Probability Distributions for 2007–2017. With 3 feet of Sea-Level Rise

6.3.2 Comparative Evaluation

The three Project Alternatives were scored relative to existing conditions based on how well each meet the restoration objectives (**Table 6-8**), the public access objectives (**Table 6-9**).

The scoring protocol is:

= the alternative performance is equivalent to existing conditions

\+ the alternative is expected to perform better than existing conditions; multiple “+” symbols indicates higher performance

\- the alternative is expected to perform worse that existing conditions; multiple “-” indicates lower performance

Each sub-objective was qualitatively scored per above. Scoring can be achieved by comparing the number of "+" scores, which indicates positive outcomes, and noting the number of "-" scores, which indicates negative outcomes. The scoring indicates that the alternatives with more intervention are expected to provide greater ecological benefits (higher score relative to restoration objectives): Alternative 3 scores higher than 2 Alternative, and Alternative 2 scores higher than Alterative 1. Alternatives 2 and 3 have similar scores relative to access objectives, and scored higher than Alternative 1.

In addition to scoring performance relative objectives, the relative feasibility for implementation was comparatively evaluated (**Table 6-10**). Criteria considered include amount of earthwork, amount of disturbance of existing habitats and wetlands, complexity of new infrastructure, future water flows and water quality, permitting requirements, cost feasibility, dependency on other plans and projects, and ongoing maintenance and management requirements. Alternative 1 scored as the most relatively feasible, due to the minimal interventions inherent in this alternative. Alternative 3 scored the least relatively feasible, due to its more extensive earthwork and disturbance with a new second lagoon, and concomitant greater cost.

Note that the above "scoring" presumes equal weight is given to each sub-objective, and a change in weighting could change the overall assessment. Additional data to address data gaps and uncertainties may affect rankings, weightings, and judgments. Negatives may constitute "fatal-flaws" if, for example, impact to adjacent property or protected species cannot be mitigated by design or other action. Cost may also be a consideration. Hence, alternative selection is a judgment that requires the Project Partners decision.

6.3.3 OBRAP Science Advisory Committee

SCC and TNC convened five SAC meetings between 2016 and 2018 to review the priorities and desired outcomes for the OBRAP. Meetings in 2017 and 2018 discussed and reviewed options for restoration and public access alternatives. On the May 29, 2018, SAC meeting, the three alternatives presented in this section were reviewed and the SAC discussed several issues and recommendations related to technical feasibility; rare, sensitive, threatened, and endangered species and their habitats; and permitting considerations. The Project Partners considered this feedback in selecting the Preferred Alternative identified in Section 6.4.

Significant SAC recommendations are summarized below.

TABLE 6-8
COMPARATIVE EVALUATION OF ALTERNATIVES RELATIVE TO RESTORATION OBJECTIVES

Restoration Objective	Restoration Sub-objective	Metric	Criterion description	Alternative 1		Alternative 2		Alternative 3	
				Rank	Description	Rank	Description	Rank	Description
1. Restore diverse, interconnected native habitats that considers the historical, current, and future landscape context.	1.1 Enhance and restore habitats including: beach; dune; coastal lagoon; seasonally ponded saline wetland and salt flat; high marsh and wetland-upland transition zone; upland; and riparian	Habitat (acres) post-construction estimates	Habitat acres and diversity estimated for historical (SFEI), current (2017 mapping), and post-construction projections (acres) for total project area. (Figure 6-8) Habitats interconnected, with fewer barriers.	+ + + +	Native habitat increased, particularly salt marsh. See Table 6-3 for habitat acres. Diversity increased from current Interconnected – some improvement from current Historic	+ +++ + +	See Table 6-5 for habitat acres Diverse Interconnected Historic	+ ++ ++ ++	See Table 6-7 for habitat acres Diverse Interconnected Historic
	1.2 Enhance and restore habitat for Project Area special-status, rare, and extirpated species where feasible	Species-specific habitat acreage	Salt marsh bird's beak – protect existing and enhance suitable salt marsh habitat near existing patches. Manage for multiple patches on-site. Coulter's goldfields – salt marsh and salt panne California least tern – dune habitat in Areas 8 and 9 Western snowy plover – dunes and salt panne habitats in Areas 6, 8, 9 Tidewater goby – lagoon/open water Belding's Savannah sparrow - salt marsh, wetland-upland transition Ridgway's rail – tidal salt marsh with tall vegetation	++ ++ = = = + =	Salt marsh bird's beak – expands salt marsh that could support Coulter's goldfields – could expand to other salt marsh or salt panne areas California least tern – maintain existing habitat Western snowy plover – maintain existing habitat that will be lost with sea-level rise Tidewater goby – lagoon similar Belding's Savannah sparrow – enhance marsh habitat Ridgway's rail – no appropriate habitat	= - = + + + =	Salt marsh bird's beak loss in Area 3a, could expand elsewhere Coulter's goldfields loss in Area 3a, could expand elsewhere California least tern – current nesting colony lost; benefits of expanded lagoon for foraging Western snowy plover – will use the salt panne Tidewater goby – more channel less channelized, connected with marshplain, not through Halaco Belding's Savannah sparrow - enhance marsh habitat Ridgway's rail – no appropriate habitat	= - = ++ + + =	Salt marsh bird's beak loss in Area 3a, could expand elsewhere Coulter's goldfields loss in Area 3a, could expand elsewhere California least tern – current nesting colony lost; benefits of expanded lagoon for foraging. Western Snowy Plover – will use the new big salt panne Tidewater goby – new channel bypass Halaco, add 2nd lagoon, but both shallower and smaller, persistence uncertain Belding's Savannah sparrow - enhance marsh habitat Ridgway's rail – no appropriate habitat

TABLE 6-8 (CONTINUED)
COMPARATIVE EVALUATION OF ALTERNATIVES RELATIVE TO RESTORATION OBJECTIVES

Restoration Objective	Restoration Sub-objective	Metric	Criterion description	Alternative 1		Alternative 2		Alternative 3	
				Rank	Description	Rank	Description	Rank	Description
2. Restore physical and biological processes that sustain native habitats and ecosystems	2.1 Restore physical processes, such as hydrology, sediment dynamics, and water quality.	Geomorphology - channel location and form relative to marsh and lagoon Water quality Beach crest and lagoon mouth morphology	Linear feet of unconfined channel that can be hydrologically connected to its floodplain Reduction of pollutant levels (nutrients, sediment, pesticides, other urban runoff constituents). Lagoon mouth dynamics responsive to natural versus managed drivers	+ +	Lowest score, some light grading of channel Bioswale will reduce pollutants delivered to lagoon	+ + +	New OLW channel will (1) allow more hydrological connection between marshplain and channel, and (2) will improve downstream water quality by reducing flow through Halaco properties. Bioswale (greater extent) will reduce pollutants delivered to lagoon	+ + + ++	New OLW channel will (1) allow more hydrological connection between marshplain and channel, and (2) will improve downstream water quality by reducing flow through Halaco properties. Bioswale will reduce more pollutants delivered to lagoon New lagoon will function with its own mouth hydro-dynamics, increase hydrologic connectivity
	2.2 Restore biological processes, such as vegetation composition and structure and food web dynamics.	Vegetation Food web Geomorphology	"Composition" – native versus exotic species "Condition" – health and vigor Structure" – more natural pattern	+	Weed management and revegetation will enhance existing habitats	+ +	Weed management and revegetation will enhance existing habitats Reconfigure site to create conditions for expanded aquatic and wetland habitat	+ ++	Weed management and revegetation will enhance existing habitats Reconfigure site with new lagoon with ocean connection to create expanded aquatic and wetland habitat, enhanced tidal/freshwater mixing and access to wetland habitats

TABLE 6-8 (CONTINUED)
COMPARATIVE EVALUATION OF ALTERNATIVES RELATIVE TO RESTORATION OBJECTIVES

Restoration Objective	Restoration Sub-objective	Metric	Criterion description	Alternative 1		Alternative 2		Alternative 3	
				Rank	Description	Rank	Description	Rank	Description
2. Restore physical and biological processes that sustain native habitats and ecosystems (continued)	2.3 Allow for a mosaic of self-sustaining habitats that are **naturally dynamic**, which change and move over time in response to physical processes (e.g., inundation during storm events, wave over-washing, and dune migration and change driven by winds)	Vegetation distribution	Mosaic of viable minimum patch size, in suitable landscape assemblage.	= + + +	Maintain existing high-functioning wetland habitats Enhance habitat conditions with weeding and revegetation Enhance salt marsh conditions with blocking of freshwater/urban runoff flows Conduct minimal management of dunes at south end to facilitate episodic wave overwash events	+ ++ + +	Less dynamic with existing lagoon mouth. Realign OLW and grade to create engagement with floodplain and marsh Excavate to create dune/swale morphology and back dune wetland habitat Excavate new connection between OLW and Ormond Lagoon through the dunes	++ +++	Dynamic with unmanaged lagoon mouth More barriers have been removed, to allow dynamic processes and increased hydrologic connectivity, including tidal influence
	2.4 Create large areas of interconnected habitat with broad transition zones (i.e., ecotones)	Vegetation Topography	Transition zones that transgress upslope across +5 feet, +10 feet, and +15 feet elevation gradient	=	Establish transition zone habitat where elevations are above ~ 9 feet NAVD88	+	Reconfigure site to create 'ramped' series of basins that will facilitate wetland habitat transgression	++	Especially Area 4 Connecting uplands to wetlands in a more definitive way
	2.5 Provide and enhance ecological and hydrological connectivity within the site and with the site's watershed, the coast, and, if feasible, Mugu Lagoon	Hydrology Geomorphology	ODD #3 manipulations with water control structures and connections to Mugu Lagoon Removal of artificial barriers (berms) 2nd lagoon with connection to coast (Alt 3)	+	Remove berms and ditches between Areas 2 and 3a	+ ++ ++	Realign and reconfigure OLW to reconnect with floodplain and marsh Lagoon connection to Area 3 increases capacity and natural mouth breach events (reduced need for managed breaching) Excavate new connection between OLW and Ormond Lagoon through dunes	+ ++ +++	Realign and reconfigure OLW to reconnect with floodplain and marsh Fill ditches and remove artificial barriers (berms) to enhance connectivity within the site 2nd lagoon with connection to coast

TABLE 6-8 (CONTINUED)
COMPARATIVE EVALUATION OF ALTERNATIVES RELATIVE TO RESTORATION OBJECTIVES

Restoration Objective	Restoration Sub-objective	Metric	Criterion description	Alternative 1		Alternative 2		Alternative 3	
				Rank	Description	Rank	Description	Rank	Description
3. Restore an ecosystem that is naturally resilient (i.e., able to respond, recover, and adapt) to climate change and sea-level rise	3.1 Promote resiliency to projected future climate change, including accelerated sea-level rise, extreme coastal storms, precipitation variability and extremes (i.e., drought and flood cycles and magnitudes), saline groundwater intrusion, and temperature.		Existing habitat connected to transition zones that progress upslope. Continuous transgression area to maintain species use and allow upslope migration. A connected gradient across expected future elevation changes, based on visual interpretation of elevation patterns in SLAMM for +1, +3 and +5 feet SLR Findings: beach and dune system is already wide, so inherently protected. The big loss will be existing lagoon squeezed, existing panne more inundation become more like a lagoon. Therefore, Alts that create salt panne seasonal pond areas are configured to accommodate pannes with sea-level rise	=	Maintain and slight expansion of existing salt pane habitat See Table 6-2 for habitat acres	+	Creates greater area of salt panne habitat See Table 6-4 for habitat acres Creates diversity of habitats that can transition in response to sea-level rise Large bioswales in Area 4 capture freshwater high flows during extreme storm events predicted with global climate change	++	Creates greatest area of salt panne habitat See Table 6-6 for habitat acres Creates diversity of habitats that can transition in response to sea-level rise
	3.2 As the sea level rises, allow for dunes to migrate landward, wetland types to change within the site, and upland and transition zone habitats to convert to wetlands			=	Maintains 'elevation capital' with minimal grading	+ +	Expands lagoon. Creates tiered basins to accommodate wetland habitat transgression in Area 4.	++ +	Creates new lagoon. Creates tiered basins to accommodate wetland habitat transgression in Areas 4 and 5.
	3.3 Consider local and regional changes in species distributions due to climate change and the potential for assisted migration of imperiled species to or from the site	Vegetation Wildlife	Does the Alternative provide habitats that are especially at risk regionally?		See rating for Sub-objective 1.2		See rating for Sub-objective 1.2		See rating for Sub-objective 1.2

TABLE 6-8 (CONTINUED)
COMPARATIVE EVALUATION OF ALTERNATIVES RELATIVE TO RESTORATION OBJECTIVES

Restoration Objective	Restoration Sub-objective	Metric	Criterion description	Alternative 1		Alternative 2		Alternative 3	
				Rank	Description	Rank	Description	Rank	Description
3. Restore an ecosystem that is naturally resilient (i.e., able to respond, recover, and adapt) to climate change and sea-level rise. (continued)	3.4 Employ restoration as a nature-based climate change adaptation approach that provides co-benefits (such as reducing flood and erosion hazards) and promotes natural habitat as protection to developed areas ("green infrastructure") as an alternative to human-built structures such as concrete channels and seawalls ("grey infrastructure")		Number/acreage of habitat features that have capacity to function as stormwater basins (wetlands, basins, channels connected to waterways, sufficient area/topography to accommodate winter flooding) If compared to Existing conditions (with infrastructure like railroad). When model routes OLW and separates the channel… there is a flood benefit by increasing flood storage in the lagoon.	+	Create bioswale in Area 2	+ ++	Create bioswales in Areas 2 & 4 Greater capacity for floodwater with new OLW channel Lower water level in Ormond Lagoon	+ + -	Create bioswale in Area 2 Allows water levels to go higher upslope Lower water level in Ormond Lagoon but potentially more frequent flooding of railway.
4. Restore habitats that contribute to regional ecological wetland recovery goals.	4.1 Implement the WRP Regional Strategy goals and principles		WRP needs for salt pannes Also WRP emphasis on salt marsh over brackish/FW	+	Native wetland habitat increased, particularly salt marsh – minor increase in salt panne See Table 6-3 for habitat acres	+	Native wetland habitat increased- greater increase in salt panne See Table 6-5 for habitat acres	++	Greatest increase in salt panne, more salt marsh than Alt 2 See Table 6-7 for habitat acres
	4.2 Enhance the site's ecological function as a part of an interconnected system of wetland and upland habitats along the coast, the Pacific flyway, and inland (e.g., by enhancing wildlife corridors; conditions that support migrating birds; and connectivity with Mugu Lagoon, the Santa Monica Mountains, and Los Padres National Forest)		Hydrologic connectivity with Mugu Lagoon (via ODD #3) Wildlife corridors (not sure how to depict, except as sea-level rise wetland-upland transition areas) Which Alt has more open water (for migratory waterbirds on Flyway).	=	Maintains existing high-functioning nesting and forage habitats	+	Realign and reconfigure OLW to reconnect with floodplain and marsh	++ ++	More grading on OLW for lagoon and marsh Expect this to have higher water levels and larger amounts of desirable shallow water habitat for migratory shorebirds at new lagoon. Expect more flats between water and vegetated marsh (unless vegetation encroaches)

TABLE 6-8 (CONTINUED)
COMPARATIVE EVALUATION OF ALTERNATIVES RELATIVE TO RESTORATION OBJECTIVES

Restoration Objective	Restoration Sub-objective	Metric	Criterion description	Alternative 1		Alternative 2		Alternative 3	
				Rank	Description	Rank	Description	Rank	Description
4. Restore habitats that contribute to regional ecological wetland recovery goals. (continued)	4.3 Consider opportunities to accommodate certain coastal wetland habitats and species that have experienced disproportionate loss at local and regional scales		Lagoon and salt panne were more prevalent historically, and are contemporarily rarer. So we are considering this in design by looking to incorporate	+	Maintains and enhances existing wetland habitats; slight increase in salt panne habitat	+	Increased lagoonal and salt panne habitats over Alt 1	++	Greatest increase in salt panne, more salt marsh than Alt 2. Creates new lagoon and create increase in open water habitat

TABLE 6-9
COMPARATIVE EVALUATION OF ALTERNATIVES RELATIVE TO ACCESS OBJECTIVES

Access Objective	Access Sub-objective	Metric	Criterion description	Alternative 1		Alternative 2		Alternative 3	
				Rank	Description	Rank	Description	Rank	Description
1. Provide improved access features … consistent with preserving natural ecosystems and minimizing disruption to natural processes, habitats and associated species, and ecological functions.	1.1 Provide improved access features, such as staging areas, trails, interpretive signs, viewing opportunities, restrooms, shade structures, picnic tables, benches, trash cans, and safe parking consistent with preserving natural ecosystems and minimizing disruption to natural processes, habitats and associated species, and ecological functions (e.g., that do not conflict with sand dune formation and lagoon hydrology).	Trails do not block water migration or prevent habitat transgression Trails and amenities located at appropriate elevations	Processes: Trails and access features should not interrupt or impede natural processes Processes: Ability to observe natural processes (assumes they are preserved or improved if they are observable) Resilient: Trails or boardwalks planned for sea-level rise and habitat transgression Amenities: Provides public access amenities (trails, staging areas, interpretive signs, viewing areas, restrooms, shade structures, picnic tables, benches, trash cans, parking) for community members and visitors	+ + +	Least amount of boardwalk proposed to allow water/ plant migration (see 5) Least number of trails and habitats/ processes to view 18 Site Amenity Elements proposed	++ +++ +++	Medium number of sections of boardwalk and bridges proposed along elevated trails to allow water flow through site Most number of trails and habitat types/ processes to view 26 Site Amenity Elements proposed	+++ ++ ++	Most linear feet of boardwalk proposed to allow water flow; and reduce blockage; works in concert with habitat connectivity theme. Most contiguous habitat and hydrologic connectivity through boardwalks. Medium number of habitat types/processes to view 18 Site Amenity Elements proposed (though they are more robust than Alt 1)

TABLE 6-9 (CONTINUED)
COMPARATIVE EVALUATION OF ALTERNATIVES RELATIVE TO ACCESS OBJECTIVES

Access Objective	Access Sub-objective	Metric	Criterion description	Alternative 1		Alternative 2		Alternative 3	
				Rank	Description	Rank	Description	Rank	Description
2. Enhance opportunities for recreation, including walking/ hiking, wildlife viewing and bird watching, picnicking, fishing, and surfing	N/A	Number of access points, number of trails, number of overlooks, amenities, habitat types to view or access	Habitats: Ability to experience multiple habitat types Recreation: Enhances opportunities for recreation	+	Least number of trails, trails mostly through salt marsh, coastal dune, or coastal strand	+++	Highest number of trails through highest diversity of habitat types	++	Medium number of trails through diverse number of habitat types
3. Improve local community connectivity to Ormond Beach.	3.1 Connect regional and local bicycle and/or multi-use trails to the Ormond Beach trail networks	Number of trail heads and trailhead types (pedestrian, multi-modal, parking lots) and adjacency to neighborhoods.	Connectivity: Trails or access points connect to existing or planned trail routes adjacent to the site to facilitate access by neighboring communities	+	tšumaš Creek Greenway & Bubbling Springs trails, Hueneme Beach Park Pedestrian beach connection (seasonal) and pedestrian bridge connection (year-round). Coastal Trail alignment connects bus stop at Perkins and Hueneme Roads (pedestrian or bike) along Perkins Road to site.	+++	Highest number of access points closest to existing neighborhoods. Pedestrian beach connection to tšumaš Creek Greenway & Bubbling Springs at Hueneme Beach Park (seasonal). Coastal Trail alignment connects bus stop at Perkins and Hueneme Roads (pedestrian or bike) along Perkins Road to site. Multi-modal connection at Hueneme Road to neighborhoods. McWane Blvd & Arnold Road access points.	++	Multi-modal connection to tšumaš Creek Greenway & Bubbling Springs, Hueneme Beach Park. Coastal Trail alignment connects bus stop at Perkins and Hueneme Roads (pedestrian or bike) along Perkins Road to site. Edison Drive and Arnold Road access points.
	3.2 Provide directional and informational signs at local public transportation stops or entry points	Provide way-finding and interpretive signage	Connectivity: Way-finding signage proposed. Education: Includes interpretive elements and access for school groups and visitors.	+	All alternatives propose way-finding and interpretive signage	+	All alternatives propose way-finding and interpretive signage	+	All alternatives propose way-finding and interpretive signage

TABLE 6-9 (CONTINUED)
COMPARATIVE EVALUATION OF ALTERNATIVES RELATIVE TO ACCESS OBJECTIVES

Access Objective	Access Sub-objective	Metric	Criterion description	Alternative 1		Alternative 2		Alternative 3	
				Rank	Description	Rank	Description	Rank	Description
4. Identify the segment of the California Coastal Trail through Ormond Beach, with connections to the proposed trail alignment to the SE and NW	N/A		Coastal Trail: Traverses site and connects to the southeast and northwest planned routes at site.	+	Two bike routes from Hueneme Road to Perkins Road, Edison Drive to McWane Blvd, "out and back" access. Beach strand trail "out and back" only. One pedestrian loop from B1, through 3a to Area 7 dunes.	+++	Four bike route connections; two are "out and back" (Perkins A, Arnold Road D); three access points offer multi-modal trail loops through site. Six Pedestrian access points include bifurcated trails and loops. Coastal strand connected at both ends.	++	Four bike route connections; One is "out and back," three provide loop opportunities. Six pedestrian access points. Coastal strand connected at both ends.
5. Establish buffers to protect sensitive species while allowing visitors to view these habitats in a manner consistent with their protection (e.g., maintaining adequate distances between public access features and sensitive habitats and use of bird blinds).	N/A	100' buffer established from concentrated nesting sites based on data obtained from Audubon 2017. Trails sited away from seaside bird's beak mapped populations, etc.	Sensitive: Trails and access features are sited and aligned in a way which reduces impacts to sensitive plants or wildlife by utilizing buffers or avoiding sensitive areas. When competing ecological concerns overlap, elements seek to balance and minimize impacts. Habitats: Ability to experience multiple habitat types	+	Least amount of boardwalk proposed. Raised trail from B1 to B2 has the potential to limit habitat transgression with sea-level rise. Backdune trail is aligned through dunes, thus has the least amount of definition and highest potential for users to go "off trail" into bird nest areas.	++	Sections of boardwalk and bridges proposed along elevated trails to allow water flow through site. Perimeter trails sited to consider habitat transgression. Largest number of trails near backdunes, but they are sited with buffers, additional fencing proposed. No trails purposed in largest seaside bird's beak population.	+++	Many linear feet of boardwalk proposed to allow water flow; works in concert with habitat connectivity theme. Perimeter trails pulled back furthest to the perimeter to allow internal habitat transgression. Dune boardwalks sited with buffers. Boardwalk proposed near but not on largest seaside bird's beak population.
6. Ensure compatibility with and minimize disturbance to adjacent land uses	N/A		Sensitive: Parking areas provided to discourage on street parking and trespass over agricultural fields or though industrial areas; trails aligned to discourage trespass to adjacent properties.	+++	No access at Arnold Road reduces potential neighbor conflicts and trespass to Mugu. Lowest number of trails aligned adjacent to dis-similar land uses.	+	Provides the most access at Arnold Road, thus highest potential neighbor conflicts and trespass to Mugu. Highest number of trails aligned adjacent to dis-similar land uses.	++	Provides limited access at Arnold Road, thus moderate potential neighbor conflicts and trespass to Mugu. Medium number of trails aligned adjacent to dis-similar land uses.

TABLE 6-9 (CONTINUED)
COMPARATIVE EVALUATION OF ALTERNATIVES RELATIVE TO ACCESS OBJECTIVES

Access Objective	Access Sub-objective	Metric	Criterion description	Alternative 1		Alternative 2		Alternative 3	
				Rank	Description	Rank	Description	Rank	Description
7. Encourage community involvement and participation in restoration and/or management activities	N/A		Community: Encourages community involvement. Education: Includes interpretive elements and access for school groups and visitors.	+	Least number of amenities and lowest number of habitat types to view and learn about.	+++	The diversity of habitats provides the most opportunity for learning about them. The largest number of interpretive elements, overlooks, and opportunities for site engagement.	++	Proposes future location for community wetland center geared to including community in propagation and restoration planting efforts.

TABLE 6-10
COMPARATIVE EVALUATION OF ALTERNATIVES RELATIVE TO IMPLEMENTATION FEASIBILITY

Factor	Criterion description	Ranking	Alternative 1		Alternative 2		Alternative 3	
			Rank	Description	Rank	Description	Rank	Description
1. Amount of Earthwork	Based on amount of earthwork expected	1 = Extensive earthwork 3 = Minimal earthwork	3	Minor, localized earthwork	2	Rerouting OLW requires significant earthwork	1	New Lagoon requires extensive earthwork
2. Amount of disturbance of existing habitats and wetlands	Based on extent of existing habitats and wetlands that overlap with planned access infrastructure and earthwork	1 = Significant disturbance 3 = Minimal disturbance	3	Most wetlands maintained as-is	2	Significant disturbance in Area 2	1	Re-routing OLW and new lagoon changes Areas 2 and 3 significantly with some change to the lagoon in Area 1
3. Complexity of new infrastructure	Based on large built infrastructure, primarily bridges and over-water platforms	1 = Many/complex built features 3 = Few built features	3	Bridge over tšumaš Creek	1	Two bridges over OLW Overlook platforms Bridge over lagoon	2	Two bridges over OLW Overlook platform on lagoon
4. Future water flows in lagoon	Based on potential water supply concerns	1 = Lagoon inflows most altered 3 = Lagoon inflow minimally altered	3	No major rerouting of flow	2	Potential for low water levels with expanded lagoon system	1	Potential for low water levels in existing Ormond Lagoon with new lagoon
5. Future water quality in OLW and lagoon	Based on potential WQ issues	1 = All flow into lagoon(s) continues to flow past Halaco 3 = Lagoon inflow bypasses Halaco site	1	OLW still flows through Halaco properties into lagoon	3	Flow avoids Halaco properties	3	Flow avoids Halaco properties but reduced water supply to existing Ormond Lagoon may affect water quality
6. Permitting Requirements	Based on expected permitting challenges for earthwork and construction in wetland areas and sensitive habitats	1 = More extensive potential impacts to resources 3 = Limited impacts to resources	3	Limited earthwork in wetland areas Little infrastructure in habitat areas	2	Significant earthwork in wetland areas Complex infrastructure in wetland areas	1	Extensive earthwork in wetland areas Moderate infrastructure in wetland areas
7. Cost feasibility	Based on Ormond Beach Wetland Restoration Feasibility Study (Aspen 2009) Alternatives 1–3	1 = Higher costs 3 = Lower costs	3	Similar to 2009 Alternative 3 Enhance Existing Habitat	2	Less extensive than 2009 Alternative 2 Restore Seasonally Open Wetlands	1	Similar to 2009 Alternative 1 Create New Lagoon
8. Dependency on other plans and projects	Based on other projects whose outcomes affect this one (Halaco and TNC properties cleanup)	1 = Highly dependent on other plans or actions 3 = Not dependent on other actions	2	No other plans with major influence	2	Contingent on actions on Halaco properties	2	Contingent on actions on Halaco properties
9. Ongoing maintenance and management requirements	Based on level of maintenance for public access infrastructure and adaptive management requirements of target habitats	1 = Extensive maintenance, complex management 3 = Standard maintenance	3	No change due to project alternative	2	Extensive public access infrastructure Adaptive management of stepped habitats (Area 4)	2	Extensive public access infrastructure Adaptive management of stepped habitats (Areas 4 and 5)
Total Score		Low score = less feasible High score = more feasible	**25**	Greatest relative feasibility	**18**	Medium relative feasibility	**14**	Lowest relative feasibility

6.3.3.1 SAC General Recommendations for Restoration

- The restored area should be a self-sufficient ecosystem with minimal active management or maintenance (such as dredging, grading, or dune management).
- Rerouting Ormond Lagoon Waterway away from the Halaco properties is important to improve water quality and to support additional habitat with a more natural channel that would be subject to natural flooding and bank overtopping; therefore, consensus is that Alternatives 2 or 3 are preferred.
- With sea-level rise and other natural processes, Alternative 3 may well be the end point even without intervention; Alternative 2 is an intermediate-range solution that will not have the costs and impacts associated with Alternative 3.
- There is uncertainty whether the Oxnard Plain will drain enough water to Ormond to sustain two lagoons, especially as periods of drought may become more frequent and longer and water recycling is increased and water use is decreased in the communities upstream of the wetlands, which facilitates a leaning toward Alternative 2.
- Hydrologic connectivity between Areas 3a (wetlands on TNC/SCC properties to the west) and 4 (current agricultural area) is important; this needs further examination to ensure that if the OLW is re-aligned there will not be too much freshwater to support the desired salt marsh habitat.
- In general, salt marsh is favored over salt pannes, although salt pannes are a desired habitat type for protection and recovery from the WRP Regional Strategy; salt marsh, salt pannes, dunes, and dune swales are relatively rare in Southern California and should be emphasized; freshwater and brackish wetlands are more common.
- Heterogeneity is important in the face of uncertainty; larger patches of continuous habitat are favored over smaller less-resilient patches.
- Adaptive management, adaptive restoration and pilot projects can inform the final project design in the face of uncertainty; specifically, adjustments to the flows in ODD #3 should not negatively impact habitat or operations at NBVC–Point Mugu or for the channel's owners Oxnard Drainage District No. 2; features that may not take hold in the such as dune swale features from Alternative 3; err on the side of caution and phase implementation to learn how the system will respond; protect what is working well (e.g., non-tidal salt marsh).
- Facilitate habitat migration in response to sea-level rise, particularly allowing for increased salt marsh at Ormond Beach as salt marsh at Mugu Lagoon is lost; allow for beach and dune migration inland.
- Alternatives that consider grading or rerouting of the OLW have the potential to impact rare plants and wildlife habitat; careful consideration must be taken on how to minimize these impacts.

SAC General Recommendations for Public Access

- Consensus is that more perimeter trails are better; more multi-use trails will bring a different kind of users to the area and increase visitation/ecotourism.

- Minimize trails through the middle—the consensus is for a "natural experience" where habitat is not broken up by trails, where you do not see a lot of people in the middle, where wildlife can have more room to move.
- A family loop (i.e., short, easily accessible walking path) at Ormond Lagoon is a good idea, maybe also in Area 2 on the west side of OLW; include spur trails, bird blinds and overlooks for birding and views, and educational kiosks.
- Site security is important to protect natural resources, including sensitive habitats and tern and plover nesting and foraging areas; multi-use trails can be used by car security patrols, VAS, etc.; enforcement would be needed for seasonal trails.
- Install seasonal symbolic fences along dunes to keep people on the strand and away from sensitive habitats.
- Provide access at Arnold Road, but emphasis on western side of the Project Area will better serve the local community and spread out the concentration of visitors.
- Amenities for school children and multiple school buses is important.
- A bridge over tšumaš Creek and a bridge or floating dock over Ormond Lagoon as well as Lagoon Overlook will provide needed access to the beach for the local community (note: a solid bridge structure over Ormond Lagoon may be difficult to permit; a floating dock on piers may be easier to permit).
- A bike path starting at entry point C in Alternative 2 should be included with viewing nodes off the main line.
- Provide amenities and ease of access to the beach for local residents as described in the CAUSE survey results.

6.4 Preferred Alternative

The Project Partners have selected a Preferred Alternative that best meets their identified restoration and public access objectives. This Plan presents a Preferred Alternative and preliminary design (see Section 7 Preliminary Design of Preferred Alternative). The next phases of design will further develop the restoration and public access elements in the OBRAP Plan. Additional refinements are expected in response to environmental review, additional technical analysis, regulatory review and public comment.

The Preferred Alternative reflects the Project Partners' consideration of input from the Ormond Beach SAC and the public. The Project Partners also met with the following entities to discuss potential opportunities and constraints and inform development of the OBRAP:

- NBVC to discuss adjacent NBVC-Point Mugu.
- VCWPD, to discuss areas of VCWPD jurisdiction (including Ormond Lagoon Waterway, Ormond Lagoon, and tšumaš Creek).
- Port of Hueneme and Ventura County Railway (Port of Hueneme), to discuss the railroad line in the OBRAP area.

- Oxnard Drainage District No. 2, to discuss flows in ODD #3, which drains Areas 3 and 4 to Mugu Lagoon through NBVC.
- EPA to discuss Halaco Superfund Site.

6.4.1 Overview

The Preferred Alternative combines elements of Alternative 2 and Alternative 3 to enhance and expand the range of existing habitats while emphasizing connectivity with modified hydrology (**Figure 6-17** and Figure 7-1).

This alternative uses earth moving and other moderate interventions to create a broader mosaic of wetland types on the site. The greater diversity of wetlands might be expected to support a wider array of species. Realignment of the OLW would alter hydrological processes to Areas 2 and 3a, creating more extensive brackish wetlands and open water in the place of brackish salt marsh and upland. Resilience to sea-level rise is built in with some water control structures (Area 5) and by allowing wetland types to convert over time (Areas 4 and 5). Unnecessary berms and channels in the east of the Project Area (Areas 5 and 6) would be removed or modified to improve connectivity while preserving existing high-value habitats in the east of the site. A series of dune swale wetlands would be excavated to increase biodiversity in the dunes. Upland areas will be restored, as will broad transitions between wetland and upland habitats. These transitional and upland areas will also provide space to accommodate wetland migration in response to sea-level rise.

Evaluation of the Preferred Alternative for habitat can be derived from Section 6.3.2 Comparative Evaluation using Alternative 2 for all areas except using Alternative 3 for Areas 5 and 6. Evaluation of the Preferred Alternative for public access can be based primarily on Alternative 3.

6.4.2 Actions

6.4.2.1 Overview by Areas

Site hydrology will be modified by way of earthwork and modification of surface water conveyance. Higher elevation areas will be enhanced to form a gradient of habitat that transitions from wetlands to uplands and perimeter infrastructure. These transitional and upland areas will also provide space to accommodate wetland migration in response to sea-level rise.

The banks of OLW (Area 2) and the north banks of Ormond Lagoon (Area 1) will be graded and planted to expand wetlands and transition habitats. OLW will be routed through Area 3a and connected to the existing Ormond Lagoon on the eastern side of the lagoon. The new channel would bypass the Halaco properties in favor of a more natural channel and expanded wetlands within the project area. The existing OLW channel segment between the two Halaco parcels would be blocked and potentially filled, pending coordination with EPA. The design includes an expansion of the Ormond Lagoon into Areas 7 and 3a. A pedestrian access bridge would be installed across the newly aligned OLW connecting the east and west portions of McWane Blvd (Area 2, Access nodes B1 and B2), and a primary multi-modal trail would be constructed leading south through Area 3 to connect with boardwalks leading to the beach (Area 7). We anticipate expansion of brackish marsh in Areas 2 and 3a owing to brackish shallow groundwater, as measured in 2017 (6 – 16 ppt). Plants typically associated with riparian habitat may establish in some locations but we do not expect substantive riparian habitat. Additional analysis of potential vegetation and habitat based on soils and water-salt balance considerations may clarify the likely outcomes. Flood waters would be partly diverted into the restoration area and the expanded lagoon, thereby incrementally lowering the water level in the lagoon and reducing flood risk and management effort. Routing flows through the wetlands is expected to remove nutrients and improve the lagoon water quality.

A series of shallow basins will be created in Areas 4 at different elevations as the area transitions out of agriculture. The lowest basin would support salt panne habitat and higher basins would be seasonal wetlands and/or bioswales. The higher basins would convert to salt panne habitat as the sea level rises. One or more culverts under the railway may be added, based on a further evaluation of the desired hydraulic connectivity between Areas 4 and 3.

Hydraulic connectivity between ODD #3 and Areas 3b and 6 will be maintained as they are. Drainage from Area 5 to ODD #3 will be blocked or reduced in order to retain limited water supply and emphasize evaporation: Earth berms or other means will be used to block drainage rather than removal of the existing culverts and flap gates (similar to the Alterative 1 concept). If further evaluation of these connections in the future indicates they are deteriorating, intervention may be needed to stabilize these connections.

Salt marsh and salt panne habitat will be restored in Area 5 and it will be connected to Area 6. Excavated soil would be placed in the northern part of Area 5 and would support upland and transition habitats. Additional shallow basins would be excavated in Area 5 at elevations that would allow them to convert from seasonal wetlands to salt panne habitat as the sea level rises.

Drainage to ODD #3 from Area 5 and potentially Area 6 would be blocked or reduced, and the spur between Areas 5 and 6 would be filled. This would be the only modification to Area 6.

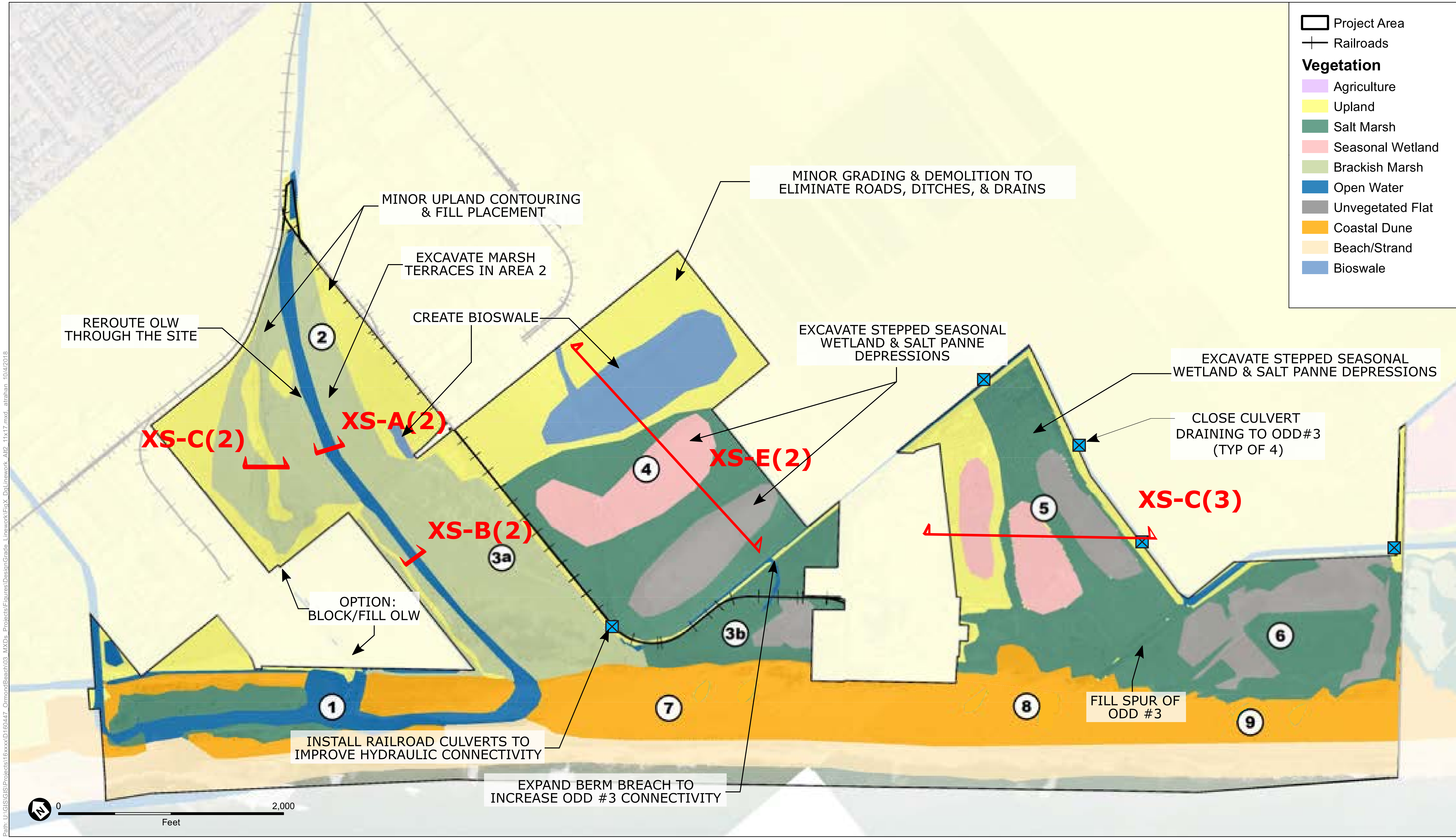
Beach Areas 7, 8, and 9 will be enhanced by weeding and planting to restore back dune scrub habitat and expand foredune scrub habitat. In addition, several shallow depressions will be excavated between dune ridges and planted with dune swale wetland species.

More details on area-specific actions and expected outcomes are provided in **Table 6-11**.

6.4.2.2 Grading

Typical earthwork cross sections are provided in Figures 6-4a and 6-4b, with corresponding locations marked on the Preferred Alternative Plan (Figure 6-17). Excavated soil will be reused beneficially on-site as practicable.

A new OLW channel will be excavated, and the existing lagoon expanded, resulting in significant earthwork excavation. Much of the earth will be used to fill the existing OLW and to fill and block ODD #3. Excess earth will be placed to form uplands and for access trail elements. Surface water connectivity between Area 1 and 3a will be increased by excavation of a lagoon deep enough to support tidewater goby habitat. Cross-sections A (Alt 2) and B (Alt 2) on Figure 6-4a show the new



SOURCE: ESA (2017), CA Coastal Conservancy LiDAR (2011)

Ormond Beach Restoration and Public Access Project

Figure 6-17
Preferred Alternative Cross Section Locations

ESA

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TABLE 6-11
PREFERRED ALTERNATIVE RESTORATION ACTIONS BY AREA

Area	Sub-area	Habitat Type	Actions/Outcomes: Earth Moving	Actions/Outcomes: Vegetation	Actions/Outcomes: Hydrology/Salinity	Projected changes with sea-level rise
1	1.1	Brackish marsh	None	Non-native species control	As-is	Conversion toward open water
	1.2	Open water	None	N/A	As-is	Lagoon will retreat landward
	1.3	Coastal dune	• Minor excavation through dunes to enhance connection to re-aligned OLW	Non-native species control	N/A	Conversion to beach/strand as the shoreline retreats & marsh/open water as the lagoon migrates landward
	1.4	Upland	Fill in existing OLW channel	Non-native species control; Planting grassland & coastal sage scrub	N/A	Conversion toward salt marsh then brackish marsh as water table nears surface
	1.5	Beach/strand	Continued mouth management	None	None	Conversion to intertidal beach & surf zone
2	2.1	Brackish marsh and Upland Transition	• OLW re-aligned & allowed to overtop its banks in high water conditions & flood the brackish marsh • Fill in existing channel & remove most of the existing levees • Create a marsh plain that slopes gently toward the new channel • Topographic heterogeneity (e.g., depressions or higher areas) would support greater spatial vegetation diversity within the marsh	• Non-native species control as needed • Plant a wide diversity of brackish marsh species • Highest elevations within the marsh may get salty enough to support salt marsh species	• Brackish marsh would occur down to elevations that are regularly flooded to depths less than about 2 feet • Brackish marsh will occur up to elevations where the soil is saturated in the rooting zone during the growing season • Highest areas of the marsh might get salty enough to support salt marsh species where evaporation at the soil surface concentrates salts	Conversion toward brackish marsh and then open water
	2.2	Wetland-upland transition	• Minor contouring & possible location to spoil any excess material dredged during creation of the brackish marsh • Area should be a broad plain gently sloping toward the brackish marsh to the east • Highest areas at the edges of the property should be tall enough to protect neighbors from flooding	• The area will need revegetation & probably short-term weed control • Expect transition zone above about 11 feet NAVD88 • Typical species would include shrubs that can tolerate some salinity & occasional flooding such as *Atriplex lentiformis*, *Suaeda calceoliformis*, *S. taxifolia* & *Isocoma menziesii*	• Very rare flooding for short durations with brackish water • Some buildup of salts in soil • Water table below the rooting zone	Conversion toward salt marsh & then brackish marsh as the water table nears the surface

TABLE 6-11 (CONTINUED)
PREFERRED ALTERNATIVE RESTORATION ACTIONS BY AREA

Area	Sub-area	Habitat Type	Actions/Outcomes			Projected changes with sea-level rise
			Earth Moving	Vegetation	Hydrology/Salinity	
2 (cont.)	2.3	Bioswale	• Create shallow basin of sufficient volume to capture dry-season runoff from McWane Blvd • Consider including forebay that traps sediment & can be cleaned out occasionally • Direct outflow toward seasonal wetland area	Plant with cattail & tule	• Basin will capture surface flows & allow plants to uptake water, nutrients & other pollutants • Encourage percolation with coarse soil & large area • Expect slightly brackish conditions	As the water table rises, water will percolate less efficiently; when the water table reaches the surface, the basin will begin to lose capacity
	2.4	Open water	A new channel will be excavated	N/A	Permanently flooded with brackish water	Water will get deeper
3a	3a.1	Brackish marsh	• OLW re-aligned & allowed to overtop its banks in high water conditions & flood the brackish marsh • Create a marsh plain that slopes gently toward the new channel • Topographic heterogeneity (e.g., depressions or higher areas) would support greater spatial vegetation diversity within the marsh	• Non-native species control as needed • Plant a wide diversity of brackish marsh species • Highest elevations within the marsh may get salty enough to support salt marsh species • Consider options to expand salt marsh bird's beak population • Consider weeding in high marsh areas & replanting with rare salt-tolerant natives (see subarea 2.5 above for list)	• Brackish marsh would occur down to elevations that are regularly flooded to depths less than about 2 feet • Brackish marsh will occur up to elevations where the soil is saturated in the rooting zone during the growing season • Highest areas of the marsh might get salty enough to support salt marsh species where evaporation at the soil surface concentrates salts	Conversion toward open water
	3a.2	Open water	A new channel will be excavated	N/A	Permanently flooded with brackish water	Water will get deeper
	3a.3	Upland	• Existing upland areas will receive fill from excavated areas • Wetland-upland transition expected to be steep	Non-native species control & planting grassland & coastal sage scrub	N/A	Conversion toward salt marsh & then brackish marsh as the water table nears the surface

TABLE 6-11 (CONTINUED)
PREFERRED ALTERNATIVE RESTORATION ACTIONS BY AREA

Area	Sub-area	Habitat Type	Actions/Outcomes: Earth Moving	Actions/Outcomes: Vegetation	Actions/Outcomes: Hydrology/Salinity	Projected changes with sea-level rise
3b	3b.1	Salt marsh	Minor enhancement of berm breach & channel to increase connectivity to ODD #3	Weed control as needed	• Little change from current conditions • Hydrology would be more closely tied to that of ODD #3, mainly north of railroad tracks • Realignment of OLW in Area 3a might raise/freshen groundwater in this area & could lead to conversion to brackish marsh	Assuming limited influence on groundwater from the lagoon, rising salty groundwater from the ocean will cause conversion to salt panne & then open water
	3b.2	Salt panne	None	N/A	• Little change from current conditions • Realignment of OLW in Area 3a might raise/freshen groundwater in this area & could lead to conversion to brackish marsh	Assuming limited influence on groundwater from the lagoon, rising salty groundwater from the ocean will cause conversion to open water
	3b.3	Upland	None	N/A	N/A	Conversion toward salt marsh as the water table nears surface
	3b.4	Open water	Lengthen existing channel off of ODD #3 toward railroad tracks	Expand existing bulrush on the edges of the channel	As-is	Water will get deeper & bulrush fringe will move up the banks
4	4.1	Salt marsh	• Minor grading to eliminate roads, ditches & any tile drains • Area could be a broad almost flat plain gently sloping southwest with two or more shallow basins at increasing elevations • Soil texture should be studied & appropriate amendments added (e.g., bentonite) to mimic salt marsh soil • Water control structure and culvert under the railroad to allow hydraulic connectivity between Areas 4 and 3.	• The area will need revegetation & possibly short-term weed control • Expect salt marsh below about 9 feet NAVD88 • Consider options such as irrigating with salt or brackish water to control weeds & favor salt marsh species; consider use of Calleguas Brine Line discharge • Dominant species would include pickleweed, salt grass & fleshy jaumea	• The brackish water table would presumably be within a couple feet of the surface once ditches & drains are removed • New location of OLW might raise the water table enough that wetlands establish above the estimated 9-foot NAVD88 contour & might lower salinities • Limiting off-site drainage would help keep salts on-site & favor salt marsh species • a culvert with water control across the railway is included as a placeholder for subsequent analysis of need to discharge from Area 4 and desire for water supply from Area 3.	Rising groundwater will cause conversion to salt panne & then open water

TABLE 6-11 (CONTINUED)
PREFERRED ALTERNATIVE RESTORATION ACTIONS BY AREA

Area	Sub-area	Habitat Type	Actions/Outcomes			Projected changes with sea-level rise
			Earth Moving	Vegetation	Hydrology/Salinity	
4 (cont.)	4.2	Salt panne	• Create a shallow basin • Soil may need to be amended with clay to encourage ponding	N/A	• Salt panne areas would pond with rainfall & retain salts from evaporating groundwater (similar to other salt panne habitats on-site) • Expect salt panne below about 5 feet NAVD88	The lowest of a series of stepped basins would convert to open water
	4.3	Seasonal wetland	• Create a shallow basin • Soil may need to be amended with clay to encourage ponding	• -Control non-natives & plant salt-tolerant natives that tolerate wet winter & dry summer conditions • Consider introducing locally & regionally rare species such as *Salicornia depressa*, *Atriplex coulteri*, *A. pacifica*, *A. serenana* var. *davidsonii*, *Lasthenia glabrata* ssp. *coulteri*, *Suaeda calceoliformis*, *Astragalus pycnostachyus* var. *lanosissimus*, etc.	• Rare seasonal flooding primarily by rainfall • Saline groundwater generally below the rooting zone • Salts transported in to the rooting zone, generally pushed deeper & diluted in the winter with rainfall & closer to the surface & more concentrated in the summer	The middle of a series of stepped basins would convert to salt panne & eventually open water
	4.4	Wetland-upland transition	• Minor grading to eliminate roads, ditches & any tile drains • Area should be a broad almost flat plain gently sloping toward the salt marsh	• The area will need revegetation & probably short-term weed control • Expect transition zone above about 9 feet NAVD88 • Typical species would include shrubs that can tolerate some salinity & occasional flooding such as *Atriplex lentiformis, Suaeda calceoliformis, S. taxifolia & Isocoma menziesii*	• Very rare flooding for short durations with brackish water • Some buildup of salts in soil • Water table below the rooting zone • New location of OLW might raise the water table enough that wetlands establish above the estimated 9-foot NAVD88 contour	Conversion toward salt marsh as the water table nears the surface
	4.5	Bioswale	• Create a large shallow basin to capture dry- & wet-season runoff from McWane Blvd • Consider including forebay that traps sediment & can be cleaned out occasionally	Plant with cattail & tule	• Basin will capture surface flows & allow plants to uptake water, nutrients & other pollutants • Encourage percolation with coarse soil & large area • Expect slightly brackish conditions	As the highest of a series of stepped basins, expect conversion to brackish marsh or, if inflows from the street are diverted elsewhere, salt marsh & then salt panne

TABLE 6-11 (CONTINUED)
PREFERRED ALTERNATIVE RESTORATION ACTIONS BY AREA

Area	Sub-area	Habitat Type	Actions/Outcomes			Projected changes with sea-level rise
			Earth Moving	Vegetation	Hydrology/Salinity	
4 (cont.)	4.6	Open water	None	None	As-is	Water will get deeper & tule fringe will move up the banks
5	5.1	Salt marsh	• Remove all the abandoned roads & create a broad salt marsh plain • Optional basins could be created in new salt marsh area to support salt panne	• No actions in existing salt marsh area • Plant new salt marsh with appropriate salt marsh species	• Salt marsh areas would pond with rainfall & retain salts from evaporating groundwater (similar to other salt marsh habitats on-site) • Expect salt marsh between about 5 & 7.5 feet NAVD88 • Block culverts to eliminate or reduce drainage of area to ODD #3	Rising salty groundwater from the ocean will cause conversion to salt panne & then open water
	5.2	Seasonal wetland	Shallow basins would be excavated at multiple elevations	• Control non-natives & plant salt-tolerant natives that tolerate wet winter & dry summer conditions in upper basin(s) • Consider introducing locally & regionally rare species such as *Salicornia depressa*, *Atriplex coulteri*, *A. pacifica*, *A. serenana* var. *davidsonii*, *Lasthenia glabrata* ssp. *coulteri*, *Suaeda calceoliformis*, *Astragalus pycnostachyus* var. *lanosissimus*, etc. • Lower basin would likely support salt marsh habitat	• Seasonally flooded from rainfall • Saline groundwater generally below the rooting zone • Salts transported in to the rooting zone, generally pushed deeper & diluted in the winter with rainfall & closer to the surface & more concentrated in the summer	Conversion toward salt marsh & salt panne as water table nears surface
	5.3	Upland	None	Non-native species control & planting coastal sage scrub	N/A	Rising water in ODD #3 &/or groundwater will lead to conversion to brackish or salt marsh
	5.4	Open water	None	Tule on the edges of the channel will remain	As-is	Water will get deeper & tule fringe will move up the banks

TABLE 6-11 (CONTINUED)
PREFERRED ALTERNATIVE RESTORATION ACTIONS BY AREA

Area	Sub-area	Habitat Type	Actions/Outcomes			Projected changes with sea-level rise
			Earth Moving	Vegetation	Hydrology/Salinity	
6	6.1	Salt marsh	• Remove levees & fill in the stub of ODD #3 between Areas 5 & 6 • Create contiguous salt marsh plain between Areas 5 & 6	• Non-native species control • Planting in new salt marsh areas	As-is	• Conversion to salt panne & open water as groundwater level rises • Dunes will migrate landward & bury salt marsh
	6.2	Salt panne	None	None	As-is	Conversion to open water as groundwater level rises
	6.3	Upland	None	Non-native species control	N/A	Conversion to salt marsh habitat as groundwater level rises
	6.4	Open water	None	Tule on the edges of the channel will remain	As-is	Water will get deeper & tule fringe will move up the banks
7, 8, 9	7, 8, 9.1	Coastal dune	Add sand fencing between fore & back dune ridges to encourage dune building	• Extensive planting between fore & back dune ridges to encourage natural dune building • Dune planting could include reintroduction or introduction of rare, threatened & endangered endemic dune species	N/A	Conversion to strand & beach as the coast retreats
	7, 8, 9.2	Beach/strand	None	None	Occasional wave overwash at south end	Conversion to intertidal & surf zone as the beach retreats
	7,8,9.3	Open water	• Excavate new connection between re-aligned OLW and existing lagoon	N/A	The connection will designed to keep the two waterways connected and convey flood waters	As the beach retreats, the connection would eventually be lost and OLW would have its own mouth

OLW channel through Areas 2 and 3, respectively. In Area 2, the existing grades are higher, and a wetland terrace is excavated above elevation 8 feet NAVD88 to provide for emergent marsh. An emergent marsh terrace is not included in Area 3a, where existing grades are lower. Both sections show the thalweg (low point) of the channel at elevation 3 feet NAVD88, which approximately matches the existing OLW. Section C shows the filled existing OLW, as well as additional fill to form a raised area. The raised area is shaped to resemble an abandoned natural river levee, and largely follows the existing remnant levees originally constructed as part of the OLW. This raised land will be planted with a riparian palette, and support a path for public access.

Area 4 will be excavated and graded to form shallow seasonally flooded basins. The elevations and depths of the basins will be designed to support different hydrology and salinity dynamics. The basins will be higher with distance northward, to allow for habitat conversion with sea-level rise.

A series of shallow basins and increasing elevations would be excavated in Area 5, as shown by Section C (Alt 3) on Figure 6-4b. The fill would be placed in existing upland areas. The stub of ODD #3 between Areas 5 and 6 would be eliminated to restore a contiguous marsh plain.

Grading will occur in beach-dune Areas 7, 8, and 9 to form wetland swales and to provide limited access.

6.4.2.3 Infrastructure Modification

Irrigation and drainage systems in Area 4 will be removed. A culvert with water control across the railway is included as a placeholder for subsequent analysis of need to discharge from Area 4 and desire for water supply to Area 3. Earth berms or other method will be used to block or reduce drainage from Area 5 to ODD #3 via the existing culverts: The conceptual design for the blockages is similar to that detailed for Alternative 1. Similar actions may be taken at Areas 6 at the existing culvert to ODD #3. The intent is to leave the existing culverts in place to provide the capacity to adapt the restoration. Finally, OLW will be blocked in the vicinity of the Halaco properties, and ideally filled, pending coordination with EPA.

6.4.2.4 Access, Trails, and Site Amenities

The Preferred Alternative (Figure 6-17, **Table 6-12**, and Figure 7-1, Section 7 Preliminary Design) combines the public access components from Alternative 3, with a few components from Alternative 2, including the bridge or boardwalk at Ormond Lagoon and the Minor Trailhead and primary trail at Hueneme Blvd. The resulting plan highlights primary trail connections and reduces the number of rustic and primitive trails. This creates a trail network which arranges trails largely to the perimeter of the Project Area, leaving contiguous internal habitat areas. This approach is reinforced by the additional trails in Area 5. Because of the numerous habitat types and the way they are distributed, this configuration allows visitors to experience and appreciate many habitats while minimizing human disturbance with the perimeter trails. A multi-modal primary trail connection at Hueneme Road facilitates access for residents of South Oxnard to enjoy Ormond Beach. Small spur trails leading to overlooks provides a nature immersion experience and the solitude many community members say they treasure about Ormond Beach.

TABLE 6-12
PREFERRED ALTERNATIVE RESTORATION AND PUBLIC ACCESS ELEMENTS BY AREA

Area	Design Element	Preferred Alternative
1	Restoration	• Weeding and planting in upland areas • Lagoon connection to OLW moved to the east of Halaco properties • Lagoon connection to marsh in Area 3a increases capacity and leads to less frequent manual breaching
	Public Access	• All Primary trails at 12.0 elevation, rustic trails at 11.0 -12.0 elevation where feasible, boardwalks at 13.0, bridges at 15.0 • Bridge over tšumaš Creek • Bridge or boardwalk over Ormond Lagoon from island to beach • Boardwalk to overlook at Ormond Lagoon • Rustic trail to overlook • New bridge between Perkins and Ormond Lagoon • Expand Perkins Parking Lot footprint, adding 24 spaces • Restrooms, interpretive kiosk and docent station (±1,000 SF for school group focus), which can be relocated to accommodate sea-level rise (SLR) • Bike racks and bike lockers (rental) • Primary trail in wetlands north of Perkins Road parking leading to West McWane Blvd.
2	Restoration	• Re-align OLW and grade to allow engagement with floodplain and brackish marsh • Grading to create gently sloping brackish marsh plain along new channel • Balance cut-fill within the area by filling old channel and adding flood protection around edges of property • Create smooth transition between Areas 2 and 3a • Create bioswale to capture nutrients in runoff from McWane Blvd.
	Public Access	• New Major trailhead with 25+ parking spaces at West McWane Blvd. • Interpretive signage • New primary developed CA Coastal Trail heading east • Elevated wetland boardwalk to rustic loop trail • Bridge over OLW with birding overlook • Elevated overlook near East McWane Blvd. • Minor pedestrian and bike trailhead at Hueneme Road • Primary multi-modal trail at Hueneme Road (at-grade railroad crossing) to East McWane Blvd, CA Coastal Trail
3	Restoration	• Re-align OLW and grade to allow engagement with floodplain and brackish marsh • Minor grading to create gently sloping brackish marsh plain along new channel • Let habitat naturally convert from salt marsh to brackish marsh • Establish additional Coulter's goldfield populations in other areas on the Project Area by collecting seed and distributing in appropriate areas • Weeding and planting in upland areas • Water control structure (culvert) under the railroad

TABLE 6-12 (CONTINUED)
PREFERRED ALTERNATIVE RESTORATION AND PUBLIC ACCESS ELEMENTS BY AREA

Area	Design Element	Preferred Alternative
3 (cont.)	Public Access	• Primary multi-modal trail, CA Coastal Trail in north 3a • Overlook platforms • Bridge over OLW/agricultural ditch creek • Wetland boardwalks • Birding overlook platform with bird blinds • Elevated boardwalks through wetlands and dunes Areas 3a and 3b • At-grade railroad crossing
4	Restoration	• Cease farming and excavate a series of shallow basins at increasing elevations from south to north • Water control structure (culvert) under the railroad • Basins will undergo type changes as the sea level rises • Lower basin expected to support salt panne habitat at about 5 feet NAVD88[1] in the short term and evolve in to open water with moderate sea-level rise • Middle basin(s) expected to support seasonal saline-affected wetlands at about 7 feet NAVD88 and evolve in to salt marsh and salt panne with moderate sea-level rise • Upper basin(s) expected to support seasonal wetlands and act as a bioswale at about 9 feet NAVD88 and evolve in to salt marsh and salt panne with greater sea-level rise • Establish salt marsh (below about 9 feet NAVD88) and transition zone vegetation (above about 9 feet) around basins
	Public Access	• Major trailhead and ±50 stall parking lot at East McWane Blvd and Edison Drive intersection (Future, high point of site) (could be moved south on Edison Drive to former Metropolitan Water District parcel recently acquired by TNC). • Bike services for CA Coastal Trail riders, including racks, lockers, minor repair station. • Visitor Center. The Visitor Center can also serve as community and cultural space for events and partnerships with educational institutions to host classes, screenings and other educational and recreational opportunities (see Table 5-1). • Multi-modal primary elevated trail at 12 feet NAVD88, CA Coastal Trail
5	Restoration	• Block or reduce drainage through culverts between Area 5 and Oxnard Drainage Ditch (ODD)#3 • Remove levees and fill the ditch of ODD #3 between Areas 5 and 6 (the dead end channel) to create continuous marsh plain • Remove all old roads and building pads • Create series of shallow basins at increasing elevation • Lowest basin expected to support salt panne in the near term at about 5 feet and open water habitats with moderate sea-level rise • Middle basin expected to support seasonal saline-affected wetlands at about 6 feet NAVD88 and evolve into salt marsh and salt panne with moderate sea-level rise • Upper basin expected to support seasonal wetlands at about 8 feet NAVD88 and evolve in to salt marsh and salt panne with greater sea-level rise • Establish salt marsh (below about 7.5 feet NAVD88) and transition zone vegetation (above about 7.5 feet NAVD88) around basins
	Public Access	• Rustic trail to birding platform with wetland overlook

TABLE 6-12 (CONTINUED)
PREFERRED ALTERNATIVE RESTORATION AND PUBLIC ACCESS ELEMENTS BY AREA

Area	Design Element	Preferred Alternative
6	Restoration	• Maintain salt panne and salt marsh habitats with some weeding and revegetation as needed on higher spots • Restore upland habitats along ODD #3 levee • Remove levees and fill the ditch of ODD #3 between Areas 5 and 6 (the dead end channel) to create continuous marsh plain (in coordination with Oxnard Drainage District No. 2)
	Public Access	• CA Coastal trail Class II bike trail on Arnold Road per County of Ventura Local Coastal Plan • Reconfigure Arnold parking for drop-off/turnaround only and ADA parking, Bike focused trailhead with bike lockers and bike racks • Elevated wetland overlook • Primitive trail along ODD #3 to Area 5 and beach or along rustic trail to Area 6 and Beach • Birding overlook in back dunes • Rustic seasonal trail from trailhead to beach (closed during nesting season or if inundated in winter)
7, 8, 9	Restoration	• Weeding and planting to restore back dune scrub habitat and expand foredune scrub habitat • Add sand fencing and seed native dune species to facilitate wind-driven sand capture and dune building
	Public Access	• Area 7: New and existing bird fencing • Area 7-9: Continue to maintain CA Coastal Trail along beach strand (includes Area 1) • Area 7: Primitive beach strand trail connects to backdune boardwalks in Area 3a and Area 3b • Area 8: Beach strand trail connects to Arnold primitive trail, dune overlook area • Area 9: Beach strand trail connects to Rustic trail at Arnold Road

NOTE:
1 All elevations are in North American Vertical Datum of 1988 (NAVD88)

The Preferred Alternative (Figure 7-1, Area 1) provides direct beach access via a proposed primary ADA accessible trail and boardwalk system leading from the Perkins Road parking lot to a bridge or floating boardwalk crossing Ormond Lagoon (Access Node A). The bridge or floating boardwalk can be designed with sea-level rise in mind. An ADA compliant multi-modal boardwalk trail loop connects a new bridge at tšumaš Creek (Access Node E), the new Perkins Road Parking (Access Node A) bridge to the Ormond Lagoon island, and the floating boardwalk over Ormond Lagoon to create a small, easily traversed trail system. A rustic trail runs along the east side of the Ormond Lagoon island to an overlook to provide a quiet nature and birding experience. The floating boardwalk (or pile-supported, to be determined) and tšumaš Creek bridge can also provide a beach loop by traversing the California Coastal Trail and Port Hueneme Beach Park along the beach. The existing Perkins Road parking lot (Access Node A in Area 1) would be expanded to accommodate visitor services such as security, a docent kiosk, and interpretive elements. A primary trail with a wetland overlook heads north to West McWane Blvd.

A new trailhead is proposed at West McWane Blvd (Access Node B1) near Perkins Road, with parking on the existing road right-of-way owned by the City of Oxnard, which would be improved and reconfigured for this purpose. A new trail loop is proposed in the west side of Area 2, and a primary route runs east-west to East McWane Blvd (Access Node B2, a constrained access point due to railway spur train parking). This primary, all-season trail adjoins a north-south primary spur of the California Coastal Trail. This trail provides bicycle and pedestrian access at Hueneme Road (Access Node C) to residents of South Oxnard and users of the California Coastal Trail bike path, leading along the edge of restored habitats to a network of boardwalks between Areas 3a, 3b, and 7, where cyclists can secure their bikes and continue the adventure on foot. Several birding overlooks on platforms and boardwalks provide birding opportunities, and lead to a beach trail lined with bird fencing through the back dunes and to the beach at Area 7. Bird blinds would be installed where necessary to minimize disturbance to nesting California least tern colonies.

A new trailhead access proposed off Edison Drive at the intersection with East McWane Blvd or farther seaward (Area 4, Access Node F) is sited. This node would have bike services, and due to its location, could be implemented either while the Area 4 agriculture is occurring or after conversion to wetland. A visitor center is envisioned to provide school groups and community groups with a place to gather and learn about the Project Area, and to facilitate community involvement in direct hands-on restoration activities such as planting, weeding, and monitoring. It can also serve as community and cultural space for events and partnerships with educational institutions to host classes, screenings and other educational and recreational opportunities.
A loop trail is created via multi-modal trails around the north and east side of Area 4, which connects to the multi-modal trail in Area 3a and the boardwalks in Area 3b.

Backdune boardwalks are proposed along area 7. The boardwalks would have bird blinds to allow visitors to observe birds without disturbing nesting birds such as Western snowy plover and California least tern. The boardwalks would be elevated to allow wildlife to safely pass below, and configured and maintained such that they will not provide refuge for nest predators. The existing exclusionary fencing would be augmented with additional exclusionary fencing offset from the boardwalk. New symbolic bird fencing will line the boardwalk past the bike lock and dune overlook platform, and line the beach trail leading to the coastal strand. The California Coastal Trail runs east –west along beach. The existing bird fencing in area 8 will remain.

The existing Arnold Road parking lot (Access Node D) would be reconfigured for ADA parking, limited parallel parking along the west side of Arnold Road, and a drop-off or turn-around area. Bike racks and a limited number of bike lockers would be provided to allow cyclists to secure their bikes or camping gear and explore Areas 5, 6, and 9 on foot. A rustic seasonal trail leading from Arnold road to the beach will follow the current alignment, providing pedestrian and emergency access to the beach. This section of trail would require seasonal closure based on winter rain patterns and inundation. The filling of the ODD #3 (pending agreement with Oxnard Drainage District No. 2) allows an easy access through a new upland band proposed in Area 5, where visitors can view birds and habitats from a new overlook platform. A primitive trail continues west from the Arnold Road trailhead past area 5 to a dune overlook which provides views of the salt panne, salt marsh, dunes, and beach. This section of rustic trail from Arnold Road to areas 5 and 8 can be closed during nesting season to limit disturbance to birds. A beach trail lined with symbolic fencing leads from the wetland overlook to the beach, allowing visitors to make a loop back to Arnold Road or explore the western portion of the Project Area.

6.4.3 Outcomes

6.4.3.1 Physical/Geomorphic

The hydrology of Areas 2 and 3a will be markedly changed due to the rerouting of the OLW. The capacity of Ormond Lagoon will be expanded to about twice its existing volume through connectivity to Area 3a. The lack of berms directly along the new OLW will allow for more regular inundation of the expanded floodplain wetlands. Flood management actions are expected to be unchanged or reduced owing to the reduced frequency of higher lagoon water levels during intermediate-flowrate conditions. The expansion of the lagoon will reduce the area of open sandy strand and dune. In Areas 4 and 5, grading and modification of culverts will be used to enhance hydrology and salinity dynamics to support salt marsh, salt panne, and seasonal wetland habitats. Physical processes and landscapes at the site will be restored and designed to allow habitat transgression with sea-level rise.

The significant alterations to drainage channels raises the risk of effects (primarily flooding) on tributary areas of site. We anticipate that these changes will be neutral to beneficial, either causing no change in the areas surrounding the project or improving conveyance. However, analysis will likely be required to quantify the effects and inform stakeholders.

6.4.3.2 Ecological/habitat

The post-construction habitat types and acres are compiled in **Table 6-13**. The area of wetlands within the site will be increased overall. Salt marsh habitats in Areas 2 and 3a will be converted to brackish marsh or open water and existing open water will be converted to brackish marsh. Some uplands will be converted to brackish marsh while others will be maintained and restored. Salt marsh and salt panne are expanded in Areas 4 and 5. Regionally rare dune swale wetlands would be excavated in Areas 6–9. Areas 1 and 6 would remain largely unchanged.

TABLE 6-13
PREFERRED ALTERNATIVE HABITAT PROJECTIONS

	Area (acres)								
Habitat Type	**1**	**2**	**3a**	**3b**	**4**	**5**	**6**	**7-9**	**TOTAL**
Beach/strand	12							18	30
Coastal dunes	23							100	123
Dune swale wetland								2	2
Open water	18	6	4	1		2	4	2	36
Salt panne				4	15		22		40
Salt marsh				19	41	22	33		115
Brackish marsh	14	56	56						125
Seasonal wetlands					19				19
Riparian									0
Wetland-upland transition		27			37				64
Bioswale		1			23	20			43
Upland	10		5	1		44	2		63
TOTAL	**76**	**89**	**65**	**25**	**135**	**88**	**60**	**121**	**660**

NOTES: Habitat estimates rounded to nearest acre. Habitat estimates rounded to nearest acre. Habitat projections are post-construction under current sea level.

SOURCE: CRC

Expanded salt panne habitats could provide potential new nesting areas for California least tern and western snowy plover. Area 4 and 5 could support these functions as the sea level rises and converts existing salt panne areas to open water. The expanded lagoon will increase available tidewater goby and California least tern foraging habitat. An enlarged lagoon would generally benefit California least tern; however, this expanded design would eliminate their current (2017–2018) nesting colony in Area 7. The designs effect on nesting habitat in the dunes would need to be studied in more detail. Existing habitat for Belding's savannah sparrow would be eliminated in Area 3a but new salt marsh habitats in Areas 4 and 5 could support this species. The expansion of brackish marsh and open water would benefit a large suite of avian species, especially ducks and rails. The only existing population of Coulter's goldfields in the project area and a small population of salt marsh bird's beak in Area 3a would be eliminated. Restored saline habitats in Areas 4 and 5 and existing habitat in Area 6 might support new populations of these species. Regionally and globally rare species adapted to non-tidal saline habitats might be introduced (e.g., Ventura marsh milk vetch) in Areas 4 and 5 as well.

6.4.3.3 Public Access

A diverse array of access features is provided which generally improve access to the Project Area and beach, especially for neighboring communities. Numerous loop trails provide the public with the opportunity to experience every habitat type proposed, with ample opportunities to experience nature and view birds and other wildlife. The varied trails provide frequent visitors the opportunity to have a different experience with each visit. Enhanced visitor services provide opportunity for community involvement and environmental education. Visitors using the California Coastal Trail by bicycle have services and opportunities to explore the wetlands and relax on the beach. The network of boardwalks clearly define walking paths and help encourage visitors to stay on the trails, while allowing hydrologic connectivity and wildlife movement to be unrestricted.

6.5 Refinements to Preferred Alternative

The Preferred Alternative was refined in consideration of public input and preliminary engineering design. The refinements are included in the Preferred Alternative and described in Section 7 Preliminary Design of Preferred Alternative. A list of refinements is provided below for convenience and clarity.

1. The public access features in Area 7 (Central Area, coastal dunes) were modified to better protect bird habitat. Specifically, the trail, bird blinds and other features were refined to be mostly hidden below the dune crest, the trail was configured for pedestrians only (no bicycles), and the trail was relocated to avoid nesting areas. Bird fencing and trails shown in this Plan are subject to revision and adaptive management in response to bird presence.
2. Public Access Node F was relocated farther south along Edison Drive to be closer to trails and existing habitat. Note that the precise location is subject to refinement.
3. Construction of new dune swale wetlands previously considered for areas 7, 8 and 9 were deleted owing to concerns about maintenance of these habitats.

Section 7 Preliminary Design of the Preferred Alternative includes additional details such as elevations and dimensions of excavated features, earthwork balance and stockpiling, consideration of utilities modifications along McWane Blvd, and refinement of the extents of boardwalks, and the primary, secondary and tertiary trail types. Allowances are made for undefined elements such as the Visitor Center programed for Access Node F.

SECTION 7
Preliminary Design of Preferred Alternative

This section describes the Preliminary Design of the OBRAP Plan. This description is consistent with the Preferred Alternative described in Section 6.4, but provides additional detail and refinement of proposed project elements.

7.1 Preliminary Design Drawings and Opinion of Probable Costs

The Preliminary Design is depicted in **Figure 7-1** and detailed in preliminary design drawings (Appendix G). **Table 7-1** lists the preliminary drawings.

The drawing sheets are number sequentially, and also have an ID that indicates the content (General [G-], Civil [C-] and Landscaping [L-]). The General sheets address all construction. Civil sheets address site work which is in this case primarily earthwork (i.e. "grading"). The Landscaping sheets address public access facilities, planting and erosion control. As the design progresses, additional drawings will be required to show civil, landscaping and erosion control details, and structural drawings for public access structures.

For design and phasing purposes, the site is subdivided into the following three geographic segments:

- Western Segment (Areas 1, 2 and 3a)
- Central Segment (Areas 3b, 4 and 7)
- Eastern Segment (Areas 5, 6, 8 and 9)

TABLE 7-1
LIST OF PRELIMINARY DESIGN DRAWINGS (SEE APPENDIX G)

Number	ID	Title	Description of Contents
1	G-1	Title Sheet	Vicinity and location map, and list of drawings
2	G-2	Note, Abbreviations & Legend	
3	G-3	Existing Conditions	Identifies designated areas, property ownership and existing grades
3	C-1	Site Overview	Overview of target habitat types, grading limits and public access improvements and sheet key plan
4	C-2	Grading Plan - Western	Proposed grading contours for cut and fill, major drainage modifications and staging areas
5	C-3	Grading Plan – Central	
6	C-4	Grading Plan – Eastern	
7	C-5	Grading Sections	Typical sections of key design elements
8	L-1	Planting and Access Plan - Western	Revegetation and vegetation enhancement zones, and public access improvements, including access nodes, trails, bridges and other features
9	L-2	Planting and Access Plan – Central	
10	L-3	Planting and Access Plan – Eastern	
11	L-4	Planting Lists	Planting lists for revegetation & vegetation enhancements
12	L-5	Trails Details	Typical sections for primary, secondary and tertiary trails

Estimates of construction quantities and costs are summarized in **Table 7-2**,[11] with the complete estimate in **Table 7-3**. The line items are organized to address the major elements of anticipated work and the estimated construction costs include associated, or ancillary, elements. For example, surveying, grade checking, clearing and grubbing, stockpiling, and compaction are included in the earthwork costs per unit cubic yard. Similarly, soil treatments to support vegetation (e.g., topsoil placement and amendments) are accounted for in the unit costs per acre estimates for revegetation and vegetation enhancement. Cost for each structural element includes structural earthwork (special excavation and backfill requirements) and other incidentals.

TABLE 7-2
PRELIMINARY OPINION OF PROBABLE COSTS - SUMMARY

Description	Cost			
	Whole Project	Western	Central	Eastern
General and Site Preparation	$ 9,442,000	$ 4,576,000	$ 3,558,000	$ 1,308,000
Earthwork	$ 3,794,000	$ 1,198,000	$ 2,158,000	$ 435,000
Revegetation (Earthwork Locations)	$ 17,167,000	$ 2,742,000	$ 8,470,000	$ 5,955,000
Vegetation Enhancement	$ 13,956,000	$ 5,940,000	$ 4,110,000	$ 3,906,000
Erosion Control	$ 590,000	$ 466,000	$ 101,000	$ 23,000
Public Access	$ 32,041,000	$ 19,388,000	$ 11,770,000	$ 882,000
Utilities, Channel & Storm Drain Structures	$ 3,941,000	$ 1,360,000	$ 2,440,000	$ 141,000
TOTAL (before CONTINGENCY)	$ 80,929,000	$ 35,670,000	$ 32,607,000	$ 12,650,000
TOTAL with CONTINGENCY	$ 113,300,000	$ 49,938,000	$ 45,649,000	$ 17,711,000

11 Please note that in providing opinions of probable construction costs, ESA has no control over the actual costs at the time of construction. The actual cost of construction may be impacted by the availability of construction equipment and crews and fluctuation of supply prices at the time the work is bid. ESA makes no warranty, expressed or implied, as to the accuracy of such opinions as compared to bids or actual costs. These estimates are subject to refinement and revisions as the design is developed in future stages of the project.

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SOURCE: ESRI 7/19/2016, City of Oxnard, Ventura County

Ormond Beach Restoration and Public Access Plan

Figure 7-1
Preferred Alternative and Preliminary Design of the Ormond Beach Restoration and Public Access Project

ESA

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TABLE 7-3
PRELIMINARY OPINION OF PROBABLE COSTS - DETAILED*

Bid Item	Description	Quantity: Whole Project	Quantity: Western	Quantity: Central	Quantity: Eastern	Unit	Unit Cost	Cost: Whole Project	Cost: Western	Cost: Central	Cost: Eastern
	General and Site Preparation							$ 9,442,000	$ 4,576,000	$ 3,558,000	$ 1,308,000
1	Mobilization/Demobilization	3	1	1	1	LS	8%	$ 5,719,000	$ 2,488,000	$ 2,324,000	$ 907,000
2	Environmental Protection (SWPPP, etc.)	1	1	1	1	LS	1%	$ 715,000	$ 311,000	$ 290,000	$ 113,000
3	Clearing and Grubbing, include minor demolition/ removal	190	51	119	20	ACRE	$3,040	$ 578,000	$ 155,000	$ 362,000	$ 61,000
4	Miscellaneous Demolition and Disposal	1	1	1	1	LS	2%	$ 1,430,000	$ 622,000	$ 581,000	$ 227,000
5	Water Control and Diversion OLW	1	1	0	0	LS	$ 1,000,000	$ 1,000,000	$ 1,000,000	-	-
	Earthwork							$ 3,794,000	$ 1,198,000	$ 2,158,000	$ 435,000
6	Dry Soil Excavation and Placement	234,000	40,900	159,000	34,200	CY	9.80	$ 2,293,000	$ 401,000	$ 1,558,000	$ 335,000
7	Wet Soil Excavation and Placement	58,000	57,800	0	0	CY	13.80	$ 800,000	$ 798,000	-	-
8	Excess Earth Stockpile	175,000	0	150,000	25,000	CY	4.00	$ 700,000	-	$ 600,000	$ 100,000
	Revegetation (Earthwork Locations)	213				ACRE	$ 74,000	$ 17,167,000	$ 2,742,000	$ 8,470,000	$ 5,955,000
9	Salt Marsh	68	0	25	43	ACRE	$ 70,000	$ 4,747,000	$ 18,000	$ 1,728,000	$ 3,001,000
10	Wetland-Upland Transition	28	4	20	4	ACRE	$ 87,000	$ 2,394,000	$ 354,000	$ 1,702,000	$ 338,000
11	Seasonal Weltand	13	0	0	13	ACRE	$ 115,000	$ 1,534,000	-	-	$ 1,534,000
12	Brackish Marsh	12	12	0	0	ACRE	$ 50,000	$ 616,000	$ 608,000	$ 8,000	-
13	Bioswale	23	1	22	0	ACRE	$ 62,000	$ 1,415,000	$ 70,000	$ 1,345,000	-
14	Coastal Sage Scrub	63	17	36	11	ACRE	$ 97,000	$ 6,102,000	$ 1,605,000	$ 3,478,000	$ 1,019,000
15	Native Ornamental	1	1	0	0	ACRE	$ 97,000	$ 111,000	$ 87,000	$ 10,000	$ 15,000
16	Salt Panne	25	0	20	5	ACRE	$ 10,000	$ 248,000	-	$ 199,000	$ 49,000
	Vegetation Enhancement	318				ACRE	$ 44,000	$ 13,956,000	$ 5,940,000	$ 4,110,000	$ 3,906,000
17	Salt Marsh	61	0	19	41	ACRE	$ 30,000	$ 1,831,000	$ 4,000	$ 584,000	$ 1,243,000
18	Wetland-Upland Transition	53	45	0	8	ACRE	$ 38,000	$ 2,017,000	$ 1,713,000	$ 5,000	$ 299,000
19	Seasonal Wetland	0	0	0	0	ACRE	$ 47,000	-	-	-	-
20	Brackish Marsh	69	55	14	0	ACRE	$ 20,000	$ 1,375,000	$ 1,092,000	$ 283,000	-
21	Coastal Sage Scrub	28	26	0	2	ACRE	$ 66,000	$ 1,833,000	$ 1,710,000	$ 3,000	$ 120,000
22	Coastal Dune	107	22	50	35	ACRE	$ 64,200	$ 6,901,000	$ 1,421,000	$ 3,235,000	$ 2,244,000
	Erosion Control							$ 590,000	$ 466,000	$ 101,000	$ 23,000
23	Hydroseed/Hydromulch	33	8	24	1	ACRE	$ 3,000	$ 100,000	$ 26,000	$ 71,000	$ 3,000
24	Coir Wattles	5	2	2	1	ACRE	$ 18,000	$ 83,000	$ 33,000	$ 30,000	$ 20,000
25	Erosion Control Fabric	5	4.7	0.0	0.0	ACRE	$ 87,100	$ 407,000	$ 407,000	-	-
	Public Access							$ 32,041,000	$ 19,388,000	$ 11,770,000	$ 882,000
26	Primary Trail (paved)	15,100	8,000	5,600	1,500	LF	$ 102	$ 1,540,000	$ 816,000	$ 571,000	$ 153,000
27	Secondary Trail (aggregate)	3,200	2,100	0	1,100	LF	$ 36.00	$ 115,000	$ 75,000	-	$ 40,000
28	Tertiary Trail (dirt)	4,500	0	0	4,500	LF	$ 6.00	$ 27,000	-	-	$ 27,000
29	Wetland/Wetland-Dune Boardwalk	8,300	5,400	2,900	0	LF	$ 2,100	$ 17,430,000	$ 11,340,000	$ 6,090,000	-
30	Overlook Platform	16	9	4	3	EACH	$ 110,000	$ 1,760,000	$ 990,000	$ 440,000	$ 330,000
31	Bird Blind	6	2	1	3	EACH	$ 90,000	$ 540,000	$ 180,000	$ 90,000	$ 270,000
32	Node A	1	1	0	0	EACH	$ 147,400	$ 147,000	$ 147,000	-	-
33	Node B1	1	1	0	0	EACH	$ 83,400	$ 83,000	$ 83,000	-	-
34	Node B2	1	1	0	0	EACH	$ 10,000	$ 10,000	$ 10,000	-	-
35	Node C	1	1	0	0	EACH	$ 10,000	$ 10,000	$ 10,000	-	-
36	Node D	1	0	0	1	EACH	$ 48,100	$ 48,000	-	-	$ 48,000
37	Node E	1	1	0	0	EACH	$ 10,000	$ 10,000	$ 10,000	-	-
38	Node F	1	0	1	0	EACH	$ 2,115,000	$ 2,115,000	-	$ 2,115,000	-
39	Tsumas Creek Bridge	1	1	0	0	EACH	$ 720,000	$ 720,000	$ 720,000	-	-
40	Perkins Drainage Bridge	1	1	0	0	EACH	$ 540,000	$ 540,000	$ 540,000	-	-
41	OL Bridge	1	1	0	0	EACH	$ 1,800,000	$ 1,800,000	$ 1,800,000	-	-
42	OLW Bridge	1	1	0	0	EACH	$ 2,160,000	$ 2,160,000	$ 2,160,000	-	-
43	Wetland Bridge	2	0	2	0	EACH	$ 720,000	$ 1,440,000	-	$ 1,440,000	-
44	New Railway Crossing, At-grade	1	0	1	0	EACH	$ 1,000,000	$ 1,000,000	-	$ 1,000,000	-
45	Pedestrian Gates at existing Railway Crossing	2	2	0	0	EACH	$ 253,000	$ 506,000	$ 506,000	-	-
46	Bird Fencing	3,840	0	2,400	1,440	LF	$ 10.00	$ 38,000	-	$ 24,000	$ 14,000
	Utilities, Channel & Storm Drain Structures							$ 3,941,000	$ 1,360,000	$ 2,440,000	$ 141,000
47	Utilities at McWane	1	1	0	0	EACH	$ 600,000	$ 600,000	$ 600,000	-	-
48	Temporary Construction Bridge - OLW	1	1	0	0	EACH	$ 720,000	$ 720,000	$ 720,000	-	-
49	Temporary Channel Crossings	6	2	2	2	EACH	$ 20,000	$ 120,000	$ 40,000	$ 40,000	$ 40,000
50	Culverts Under Railway Crossing	1	0	1	0	EACH	$ 2,400,000	$ 2,400,000	-	$ 2,400,000	-
51	Modify Existing Drains	4	0	0	4	EACH	$ 25,200	$ 101,000	-	-	$ 101,000
	TOTAL (before CONTINGENCY)							$ 80,929,000	$ 35,670,000	$ 32,607,000	$ 12,650,000
	Construction Contingency	30%	1	1	1	%	30%	$ 24,278,000	$ 10,701,000	$ 9,782,000	$ 3,795,000
	Bid Contingency	10%	1	1	1	%	10%	$ 8,093,000	$ 3,567,000	$ 3,261,000	$ 1,265,000
	TOTAL with CONTINGENCY							$ 113,300,000	$ 49,938,000	$ 45,640,000	$ 17,711,000

TABLE 7-3 (CONTINUED)
PRELIMINARY OPINION OF PROBABLE COSTS - DETAILED*

NOTES:

* These are engineer's estimates of likely cost estimates at the preliminary stage of design and are considered to be approximately -30% to +50% accurate. A 30% contingency is included to account for project uncertainties (such as final design, permitting restrictions) and an additional 10% contingency for future bidding climate (strong construction economy can reduce competition and increase bids). These estimates are subject to refinement and revisions as the design is developed in future stages of the project. This table does not include estimated project costs for permitting, design, construction administration, monitoring and/or ongoing maintenance except the vegetation enhancement is expected to extend over several years, minimum, to be determined. Estimated costs are presented in 2020 dollars, and would need to be adjusted to account for price escalation for implementation in future years.

Please note that in providing opinions of probable construction costs, ESA and their consultant team have no control over the actual costs at the time of construction. The actual cost of construction may be impacted by the availability of construction equipment and crews and fluctuation of supply prices at the time the work is bid. ESA makes no warranty, expressed or implied, as to the accuracy of such opinions as compared to bids or actual costs.

These estimated costs are for budgeting purposes, and subject to refinement as the design is progressed to a level appropriate for construction. Consequently, a contingency is included to allow for additional costs that may emerge as the project progresses through design and approvals. A design contingency of 30% is selected. Design uncertainties are addressed in Section 7.7 Design Uncertainties. In addition, a bid contingency of 10% is included to allow for higher bids which may be received when construction contractors are near capacity.

The estimated construction cost for the entire project is about $113 Million with contingencies and about $81 Million without contingencies. Construction costs are roughly split with approximately half for Public Access elements and the other half for Habitat Restoration. The Eastern Segment of the project accounts for less than 20% of the total project costs, while the Central and Western Segments each account for about 40%.

We envision that earthwork can be balanced within two project segments (Western and Eastern). However, the Central segment has a large surplus of excavated earth requiring design refinements, as described in Section 7.6.2. Transfer of materials between areas can be accomplished by truck on McWane Blvd and via haul roads likely to coincide with proposed public access trails.

7.2 Description of Preliminary Design Elements

The OBRAP preliminary design consists of Restoration and Public Access elements. Restoration is first discussed in Section 7.2.1 by the basic elements of earthwork, flow modifications, erosion control, revegetation and vegetation enhancement. Access elements consist of parking, trails and pedestrian structures, as well as hardscape and native ornamental planting, and ancillary elements (e.g. bike racks). Access elements are described in terms of access nodes and tributary trail networks in Section7.2.2.

7.2.1 Restoration Elements

The main elements of habitat restoration actions are described in general below by the major elements of earthwork, flow modifications, erosion control, revegetation and vegetation enhancement. This discussion is followed by a description of each target habitat and proposed planting palette. More detail is then provided for each area by project segment (Western, Central and Eastern) in Sections 7.3 through 7.5.

7.2.1.1 Earthwork

Earthwork is shown in Grading Plans (Drawings C-2, 3 and 4) for the Western, Central and Eastern segments, respectively. The grading plans show the limits of earth excavation and fill placement. Within these limits there will also be removal of built assets (demolition), vegetation and debris (clearing and grubbing). The drawings show the “mass grading”, sometimes referred to as “rough grading”, and the associated “neat lines” depicting final grades. Future design progression will likely include “fine grading” to provide additional topographic variability typical of natural habitats.

Soil treatments to support vegetation, such as over-excavation and backfill with select materials, earth compaction to reduce permeability and soil amendments, are addressed under revegetation by below. There will also be minor earthwork associated with culvert installation and public access structures.

Construction access to the Western Area will require coordination with the Port of Hueneme rail crossing at East McWane Blvd, where a construction staging area will be located in Area 2, at Access Node B2. Additional construction staging areas are provided for the Western Area, located in Area 1 on the west side of OLW (Access Node B1) and at the end of Perkins Road (Access Node A). Bridge construction at Access Node E will require staging on the west side of the tšumaš Creek.

The portion of Area 2 between Perkins Road and the new OLW location will benefit from temporary construction crossings of both the old and new OLW channels, likely in the vicinity of the McWane Blvd right-of-way. Construction equipment in this access way will require controlled pathways to traverse utility lines, both buried and overhead.

Construction access for the Central Area will be at Access Node F, near the intersection of Edison Drive and East McWane Blvd. If agriculture is still active, the construction access will be in the vicinity of the MWD parcel, to be determined.

Construction access for the Eastern Area will be via Arnold Road at Access Node D.

7.2.1.2 Flow Modifications

The project includes new culverts and grading modifications to achieve desired hydrologic conditions.

The only proposed water control structure of significance will be the proposed culverts under the Port of Hueneme railway hydraulically connecting Areas 4 and 3a. As described in Section 7.4.4, this structure will consist of reinforced concrete box culverts, covered with a structural slab to accommodate railcar loads. Other hydraulic structures associated with minor storm drainage incidental to public access facilities, and will be detailed under a future phase. In addition, minor grading will be performed along the ODD#3 drainage system to increase hydraulic connectivity to Area 3b (Central) and decrease hydraulic connectivity with Areas 5 and 6 (Eastern).

Extensive earthwork-based hydraulic modification entails rerouting Ormond Lagoon Waterway (OLW) through areas 2 and 3a to Ormond Lagoon (OL). In addition, large drainage bioswales are proposed in Area 2 (Western) and Area 4 (Central).

7.2.1.3 Erosion Control

On completion of restoration activities, erosion control measures and best management practices (BMPs) will be implemented to limit erosion and prevent sediment runoff to receiving waters. Revegetation alone may be adequate to provide erosion control in some areas, depending on erosion potential and anticipated speed of vegetation establishment. More intensive erosion control may be employed on more erosion-prone areas, such as steeper slopes and stream banks. Four levels of erosion control measures are expected based on anticipated erosion risks:

Level 1: Low Erosion Risk: For all emergent wetland areas, revegetation alone is sufficient for erosion control and no additional measures are required.

Level 2: Moderate Erosion Risk: Upland areas with low height and mild slopes may take time for vegetation establishment, and therefore will be treated with hydromulch and/or seeded with native grasses or if needed, sterile non-native seed (e.g. sterile wheat).

Level 3: High Erosion Risk: Newly-disturbed cut and fill slopes will be treated with hydroseeding and coir wattles to help reduce rilling and surface erosion.

Level 4: Higher Erosion risk: The banks of the new OLW and any other steep slopes in the vicinity of swales, berms and hydraulic structures will be treated with hydroseeding, wattles and biodegradable erosion control fabric. Erosion control measures will need to be selected to withstand expected flow depths and velocities.

7.2.1.4 Revegetation

Active planting will occur to revegetate newly graded areas and/or areas of proposed habitat conversion. Native plant species will be selected to be appropriate for the target habitats, as described in Section 7.2.1.6 below.

Revegetation will include fine grading to result in the desired surface soil characteristics, including development of micro-topography (small scale grade changes). Soil treatments may be employed where necessary to adjust permeability, acidity, nutrients and texture typical of native conditions supporting the target habitats. Temporary irrigation will be desired to support establishment of upland, transitional and native ornamental landscape elements in the vicinity of public access facilities, and possibly to address saline/hypersaline soil conditions.

7.2.1.5 Vegetation Enhancement

Vegetation enhancement may also occur where needed to improve the quality of existing habitat. Enhancement actions include selective planting, invasive species control and temporary irrigation in select habitats.

Vegetation enhancement could occur during the restoration construction, and continue as part of subsequent maintenance and adaptive management. Ideally, vegetation management activities could be initiated as part of site management and stewardship prior to restoration construction as well. Consequently, a moderate level of vegetation enhancement is assumed and “allowed for” in the restoration preliminary design.

7.2.1.6 Target Habitats

The project proposes to restore to the site a mosaic of native wetland and upland habitats. The types and names of target habitats have varied over time as the project has evolved. As a result, the range of habitats and nomenclature for these has also varied across documents prepared in project development. This preliminary design presents the habitats targeted for restoration and/or enhancement with the project. In order to clarify the relationship of habitats and names presented in this chapter with those described in prior chapters and project documents, the table below presents a "crosswalk" of habitats described in the Ormond Beach Restoration and Public Access Project, Preliminary Restoration Plan (ESA et al. 2019), the Ormond Beach Wetlands Conceptual Revegetation Plan (CRC 2020), appended hereto as Appendix H, and in the Preliminary Design described herein.

Preferred Alternative (Preliminary Restoration Plan)	Conceptual Revegetation Plan	Preliminary Design
Open Water	Open Water	Open Water
Salt Marsh	Salt Marsh	Salt Marsh
Seasonal Wetland	Saline-affected Seasonal Wetlands	Seasonal Wetland
Brackish Marsh	Fresh/Brackish Marsh	Brackish Marsh
	Brackish/Salt Marsh	
Wetland-Upland Transition	Wetland-Upland Transition	Wetland-Upland Transition
Salt Panne	Salt Flats	Salt Panne
Bioswale	-	Bioswale
Upland	Coastal Sage Scrub	Coastal Sage Scrub
Coastal Dune	Foredune Scrub	Coastal Dune
	Back Dune Scrub	
Beach/Strand	-	Beach/Strand
Dune Swale Wetlands	Dune Swale Wetlands	-*
-	-	Native Ornamental**

NOTES:
* eliminated per client request
** new upland habitat type added for design native plant landscaping at public entry/gathering areas

Native Plant Communities

The proposed project will expand wetland habitats at the site and restore existing degraded wetland, transition, and upland habitats. The restored site could support brackish marsh, salt marsh, open water, foredune and dune scrub, saline-affected seasonal wetlands, coastal sage scrub, and a range of transitional habitats. The exact distribution of these habitats will depend strongly on the post-restoration hydrology, especially as it relates to water levels (or depths) and salinity. Given the uncertainties associated with the trajectory of site hydrology following restoration, the plant communities and their distribution across the site within and adjacent to areas within the proposed restoration grading limit may or may not evolve as currently anticipated and shown in the preliminary design drawings (Appendix G). Additional information to be gathered in order to address some of these uncertainties will inform further habitat design development. The anticipated plant communities to be enhanced and/or restored with the project are described briefly below. Additional detail is provided in Appendix H.

Salt Marsh

Salt marsh habitats occur both in tidal and non-tidal wetlands with salinities similar to or higher than ocean water. Salt marsh habitats currently occur in Areas 3b, 5, and 6. These existing salt marsh areas could be enhanced to increase floral diversity. New salt marsh habitats may be restored and/or created in Areas 1, 3a, and 5. Species anticipated to be established in restored and enhanced salt marsh habitats include:

Species	Common Name
Arthrocnemum subterminale	Parish's Glasswort
Cressa truxillensis	Alkali weed
Distichlis spicata	Salt grass
Extriplex californica	California saltbush
Frankenia salina	Alkali heath
Jaumea carnosa	Fleshy jaumea
Juncus acutus	Spiny rush
Lasthenia glabrata ssp. Coulteri	Salt marsh goldfields
Limonium californicum	Sea lavender
Malvella leprosa	Alkali mallow
Monanthochloe littoralis	Shore grass
Salicornia pacifica	Pickleweed
Suaeda taxifolia	Wooly seablite
Triglochin concinna	Arrow weed

Brackish Marsh

Brackish marsh describes the types of wetlands that occur in lower salinities are between 0.5 parts per thousand (ppt) and 30 ppt. There are two subtypes of brackish marsh anticipated at the site depending on salinity, "fresh/brackish marsh" and "brackish salt marsh." "Fresh/brackish marsh" (with salinities of .5 - 5 ppt) would be expected in Area 2 and northern parts of Area 3a. Species established within the fresh/brackish marsh subtype would include:

Species	Common Name
Anemopsis californicus	Yerba mansa
Bolboschoenus robustus	Robust bulrush
Elymus triticoides	Alkali rye grass
Equisetum hymale	Scouring rush
Euthamia occidentalis	Western goldenrod
Juncus balticus	Baltic rush
Juncus textilis	Basket rush
Schoenoplectus californicus	Tule
Typha domingensis	Southern cattail
Typha latifolia	Broadleaf cattail

“Brackish/salt marsh” would be expected in Areas 1 and southern parts of Area 3a where there is more influence from the ocean (due to wave overwash or shallow saline ground water). This habitat will intergrade with the fresh/brackish marsh subtype and share many of the same plant species but will also support more saline adapted species. Anticipated species constituents include:

Species	Common Name
Baccharis glutinosa	Salt marsh baccharis
Bolboschoenus maritimus	Saltmarsh bulrush
Distichlis spicata	Salt grass
Frankenia salina	Alkali heath
Jaumea carnosa	Fleshy jaumea
Juncus acutus	Spiny rush
Salicornia pacifica	Pickleweed
Schoenoplectus californicus	Tule

Seasonal Wetland

Seasonal wetlands habitat is currently found in Areas 2, 4, and 5. Seasonal wetlands might occur in depressions that pond water or on flats with clay soils that retain moisture and salt after rainfall. Species for revegetation and enhancement of seasonal wetlands include:

Species	Common Name
Arthrocnemum subterminale	Parish’s Glasswort
Cressa truxillensis	Alkali weed
Distichlis spicata	Salt grass
Frankenia salina	Alkali heath
Lasthenia glabrata ssp. coulteri	Salt marsh goldfields
Malvella leprosa	Alkali mallow
Salicornia pacifica	Pickleweed
Suaeda taxifolia	Wooly seablite

Wetland to Upland Transition

Wetland-upland transition habitats occur at intermediate elevations between marsh habitats (salt and brackish) and uplands in Areas 1, 2, 3a, 4, and 5. Growing conditions in this zone are dynamic in space and time, and characteristics of both adjacent habitats are expressed. There are several locally native species that are tolerant of the extremes flooding and drought conditions found in the transition zone, including:

Species	Common Name
Arthrocnemum subterminale	Parish's glasswort
Atriplex lentiformis	Quail bush
Cressa truxillensis	Alkali weed
Distichlis litoralis	Shoregrasas
Distichlis spicata	salt grass
Isocoma menziesii	Coast goldenbush

Coastal Sage Scrub

The upland areas of the site are expected to support coastal sage scrub habitat. Coastal sage scrub habitats are found in parts of Areas 1, 2, 3a, 5, and 6, though overall diversity tends to be very low. Additional coastal sage scrub may be created and/or restored in all of these areas as well as in parts of Area 4. Species selected for revegetation and enhancement of coastal sage scrub habitat include:

Species	Common Name
Artemisia californica	California sagebrush
Atriplex lentiformis	Big saltbush
Baccharis pilularis	Coyote brush
Encelia californica	California encelia
Eriogonum fasciculatum	California buckwheat
Eschscholzia californica	California poppy
Isocoma menziesii	Coast goldenbush
Lupinus succulentus	Arroyo lupine
Mimulus aurantiacus	Sticky monkey flower
Salvia leucophylla	Purple sage
Salvia mellifera	Black sage
Suaeda taxifolia	Woolly seablite

Coastal Dune

Coastal sand dunes include foredune scrub, the more stressful zone closer to the ocean, and backdunes, which are the more landward dune areas not subject to direct impacts from waves. Both of these habitats are found extensively in Areas 1, 7, 8 and 9. Restoration efforts in these areas will focus on increasing floral diversity. Species selected for enhancement of this habitat include:

Species	Common Name
Foredunes	
Abronia maritima	Red sand verbena
Ambrosia chamissonis	Beach bur
Atriplex leucophylla	Beach saltbush

Species	Common Name
Back dunes	
Abronia maritima	Red sand verbena
Abronia umbellate	Pink sand verbena
Acmispon glaber	Deerweed
Ambrosia chamissonis	Beach bur
Calystegia soldanella	Beach morning glory
Camissoniopsis cheiranthifolia	Beach evening primrose
Ericameria ericoides	Mock heather
Lupinus arboreus	Bush lupine

Salt Panne

Unvegetated hyperhaline salt pannes are an important component of the salt marsh habitats at the site, though they do not support vascular plants. They currently occur in Areas 3b, 5 and 6. Additional salt flats may be restored and/or created in Areas 4 and 5. Restoration actions for this habitat type would consist primarily of fine grading, placement of select soils/backfill and compaction.

Open Water

Open brackish water habitats are more or less permanently flooded areas that are too deep for emergent vegetation (wetland plants that project above the water surface, such as cattails). The lagoon and associated OLW are the main open water features of the site. Open water areas can support algae and aquatic plants such as sea lettuce and spiral ditch grass. Open water habitat supports tidewater goby for all life stages. Many bird species forage in open water areas including California least tern, herons, egrets and waterfowl. As the sea level rises, open water areas will get deeper and expand throughout the project area.

Beach/Strand

The most seaward habitat on the project area is the beach. This habitat consists mostly of marine intertidal wetland. Directly behind the landward edge of the beach is the coastal strand. Beach and coastal strand is habitat currently found in Areas 1, 7, 8, and 9. The extents and boundaries between these habitats fluctuate with the seasons and between years, in response to seasonal wave climate and large wave events (causing erosion). These habitats are generally unvegetated but are important habitats that support invertebrates that are a food source for over-wintering and migrating shorebirds, including western snowy plovers, which forage here year-round, and can nest in coastal strand areas. No active revegetation or enhancement actions are proposed in these habitat areas.

Constructed Native Habitats

Two ‘anthropomorphic’ habitat types are proposed for installation with the restoration project: bioswales to enhance water quality and “native ornamental” landscape areas to enhance public access nodes.

Bioswale

Bioswales are constructed wetlands. Bioswales may be designed for different purposes, but depending on their size and location in catchment they can: (1) trap sediment, (2) retain stormwater that can then percolate and evaporate rather than flow in to habitat areas, and (3) help remove contaminants (allow sediments to settle, allow plants to take up excess nutrients, let microbes break down toxic compounds, etc.). If bioswales are planted with native plants such as cattail, tule and bulrush, and are well designed, they can provide valuable habitat for foraging and nesting birds and other wildlife. A small bioswale feature is proposed in Area 2, with a much larger bioswale anticipated for Area 4. The proposed bioswales are all schematic at this design stage. These features will need to be engineered to perform adequately based upon expected runoff volumes/velocities and pollutant loads, both of which are currently unknown. As the sea level rises, the bioswale areas are expected to convert to other wetland types, such as brackish marsh, salt marsh, and perhaps salt panne. Native plant species anticipated to be selected for vegetation of constructed bioswale habitats include:

Species	Common Name
Anemopsis californicus	Yerba mansa
Carex praegracilis	Field sedge
Distichlis spicata	Salt grass
Elymus triticoides	Creeping wild rye
Hordeum brachyantherum ssp. brachyantherum	California barley
Schoenoplectus californicus	Tule
Typha domingensis	Southern cattail
Typha latifolia	Broadleaf cattail

Native Ornamental

Landscaping installations may be desirable at public access nodes where hardscape, parking, and/or visitor facilities (e.g. kiosk, visitor center) are planned. Any such landscaping should be limited to locally appropriate native plants (no horticultural cultivars) with low soil moisture requirements and of groundcover or low mounding habit to preserve visibility around these developed areas. It is anticipated that these plants would be selected from local species of the coastal sage scrub plant community including:

Species	Common Name
Artemisia californica	California sagebrush
Baccharis pilularis	Coyote brush
Dudleya caespitosa	Coast dudleya
Dudleya lanceolata	Southern California dudleya
Dudleya pulverulenta	Chalk dudleya
Encelia californica	California encelia
Eriogonum fasciculatum	California buckwheat
Eriogonum cinereum	Asheyleaf buckwheat

Species	Common Name
Eschscholzia californica	California poppy
Isocoma menziesii	Coast goldenbush
Lupinus succulentus	Arroyo lupine
Mimulus aurantiacus	Sticky monkey flower
Salvia apiana	White sage
Salvia leucophylla	Purple sage
Salvia mellifera	Black sage

7.2.2 Public Access Elements

The preliminary public access design would create a trail network which locates trails largely along the perimeter of the project area, maximizing areas of contiguous habitat. This configuration would allow visitors to experience and appreciate the mosaic of various habitats while minimizing human disturbance. A multi-modal primary trail connection at Hueneme Road would facilitates access for residents of South Oxnard to enjoy Ormond Beach. Small spur trails leading to overlooks would provide a nature immersion experience and the solitude that many community members say they treasure about Ormond Beach.

The project preliminary design includes seven public access nodes labeled (A, B1, B2, C, D, E and F on Figure 7-1). The access nodes include a range of amenities from major (such as visitor center and parking) to minor (trailhead without parking) and bike rack. Proposed amenities for each access node, consistent with Section 5.2.2, are as summarized in **Table 7-4**. As shown on Figure 7-1, Access Node F is re-located on Edison Drive south of McWane Blvd to have access closer to the coast: The precise location depends on future planning and design.

TABLE 7-4
PUBLIC ACCESS AMENITIES

Access Amenities	A	B1	B2	C	D	E	F
Parking Lot - Major Trailhead	1	1					1
Parking Lot - Minor Trailhead					1		
Visitor Center							1
Visitor Kiosk	1						
Educational Interpretive Sign	2	1			2		3
Trailhead Sign Post	1	1	1	1	1	1	1
Bike Rack	3				3		5
Bike Locker	2				3		3
Bike Service	1				1		1

Site amenities would include boardwalks, bridges, overlooks with bird blinds, benches, viewpoints, edge control (fencing or edging) in sensitive areas, signage (directional, interpretive), and viewing platforms. Major public access structures throughout the site include:

- One railway pedestrian crossing between areas 4 and 3a;
- Six pedestrian bridges crossing Ormond Lagoon Waterway, Ormond Lagoon, tšumaš Creek, Perkins Drainage Channel, and two wetlands areas;
- A temporary construction access bridge across the existing Ormond Lagoon Waterway
- Modifications of existing utilities in the McWane right-of-way;
- Fifteen overlooks/overlook platforms; and,
- Six bird blind platforms.
- Two at-grade railway crossings at existing paved areas that as currently designed entail crossing gates (no other structures)

Current design assumptions for the major public access elements are summarized below. These elements, as well as associated utility modifications and connections, will be further designed and detailed under a future phase.

Pedestrian bridges are assumed to be pre-fabricated steel structures The paving surface and architecture of each bridge will be determined based on further design development. We assume that the bridges will free-span crossings up to 100 feet wide; longer spans will include intermediate supports. Bridge supports will be founded on reinforced concrete piles, either driven or cast in place.

Boardwalks, viewing platforms and bird blinds are assumed to be timber, likely preservative treated but potentially redwood or other rot- and insect- resistant structural species. Synthetic products may also be used instead of timber, along with architectural design. The foundations will likely be steel or concrete piles in order to limit maintenance and avoid water-contact with preservative treated timber. The preliminary design includes 8,300 linear feet of boardwalk, including a range of geometries based on height and terrain. For estimating purposes, timber decking and frames on concrete posts were assumed, with boardwalk widths matching the widths of connecting trails. Platforms adjacent to Primary Trails will be ADA-accessible. Boardwalks may be ADA accessible, to be determined. A high unit cost was assumed to allow for boardwalks that cross wetlands and dunes, including railings and stairs/ramps where needed.

Public access trails, consistent with the descriptions in Section 5.2.1 entail three levels of service:

- **Primary Trails:** Developed, ADA accessible and multi-modal with paving consisting of gravel, decomposed granite, asphalt concrete or reinforced Portland cement concrete. Dimensions are 10 to 12 feet wide plus 1- to 2-foot shoulders. Target finished grade is a nominal +12’ NAVD, requiring compacted earth fill in many locations. While there is a range of trail treatments to be detailed in design, the preliminary cost estimate assumes 12-foot-wide decomposed granite paving (3-inches thick) over 6 inches of aggregate base, confined by 2”x6” redwood headers.

- **Secondary Trails:** Rustic bare natural soils, or compacted aggregate base in wet areas, 4 to 6 feet wide plus 2-foot shoulders. Target finished grade depends on location but ideally +11’ to +12’ NAVD. The preliminary design uses a 6-foot wide compacted gravel trail as the basis for cost estimation.
- **Tertiary Trails:** Primitive bare-earth trails 4 to 6 feet wide with 1-foot shoulders of trimmed vegetation. The preliminary design presumes a 4-foot wide compacted bare-earth trail. Beach trails have no treatment other than fencing to mark the trail and protect sensitive wildlife.

Trails along the beach do not entail any construction are not specifically marked, located or described.

At the time of this Preliminary Design there remains a range of options and opportunities for refinement of the substantial design elements. We anticipate revisions based on further public engagement, response to potential future land use changes/acquisitions, and further assessment of the balance between access and protection of natural resources, in particular protected plant species and habitats for protected animals.

7.3 Western Segment

The Western segment includes Areas 1, 2 and 3a. The design emphasis is to maintain and expand lagoon, brackish marsh and transition/upland habitats and provide space to accommodate wetland migration with sea-level rise. Proposed actions, as shown on the grading plan (Sheet C-2) and the access and planting plan (sheet L-1), include:

- Re-route Ormond Lagoon Waterway (OLW) to the east of the Halaco industrial site, through Area 3a, to Ormond Lagoon (OL).
- Block existing OLW with earthen fill.
- Excavate for bioswale to buffer runoff from railway McWane Blvd.
- Revegetate graded areas and enhance existing habitats.
- Expand public access, including trails and amenities connecting the four access nodes in this area at tšumaš Creek (Node E), the existing parking area (Node A), West McWane Blvd near Perkins Road (Node B1) and East McWane Blvd (Node B2).

7.3.1 Earthwork Design Basis and Criteria

The following preliminary design criteria for earthwork elements were used:

- New OLW channel low point set to match existing channel and lagoon depths:
  - upstream, match OLW, estimated to be +4’ NAVD
  - downstream, match OL bottom, estimated to be +3’ NAVD

- New OLW channel cross-sectional shape is designed to restore more natural function (no flood control levees), lower flood risk and provide a flood plain terrace emergent wetland vegetation:
  - Area of low flow channel is about 230 sf (increased from existing area of approximately 200 sf)
  - Includes flatter side slopes at 4:1 (horizontal:vertical)
  - Flood plain, marsh terrace added to eastern bank, where grades above +8' NAVD
  - Terrace elevations selected to be between +8 and +9' NAVD based on typical OL water levels, with continued County management, with very flat slope of about 100:1 (horizontal:vertical)
  - Bank of terrace above +9' to have a steeper slope, in range of 3:1 to 5:1, to match proposed grade (existing or new)
- Fill the bypassed reach of the existing OLW:
  - Fill to existing grade at banks, which is about +10' NAVD.
  - Add berm in area 2 to inhibit recapture of the flow into the old channel, landscape for habitat and aesthetics, plant and potentially use for access and viewing area.
  - Berm crest elevation is currently shown as +12' NAVD, but fill extents and final grades may be adjusted to balance earthwork on site.
- Excavate linear depression to form bioswale accepting runoff from McWayne and railway:
  - An excavated area of about 0.3 acres and approximately 1-foot deep was selected as a placeholder, or allowance, pending an analysis of rainfall runoff.

7.3.2 Erosion Control

Erosion control in the Western segment is summarized in **Table 7-5**:

TABLE 7-5
EROSION CONTROL FOR WESTERN SEGMENT

Level	Location	Comments
1. Revegetation sufficient	All other areas	Channel bottom, emergent wetland areas, flat to gently sloped topography
2. Hydroseed	Fill areas with sloping grades	where revegetation sufficient but planting not scheduled to occur immediately following completion of earth work
3. Add coir wattles on slopes	Mounded fill in area 2, Bioswale in area 2	Locations with slopes 3:1 or steeper more than a few feet vertically
4. Erosion control fabric (and potentially coir wattles)	OLW	Low flow channel banks, lower and upper portions of flood terrace; coir wattles only above typical water levels

7.3.3 Property, Infrastructure, Flood Risk

- **Flood risk:** The modification (rerouting) of OLW shall not increase flood risk to developed areas, relative to the no-project baseline, and as determined by the Ventura County Watershed

Protection District (VCWPD). This risk is in terms of both the elevation and extent of surface flood waters at developed areas as well as the lagoon mouth management activities.

- **Habitat impact:** The modification (rerouting) of OLW shall not adversely affect lagoon habitat, including in particular goby and any other protected species, as determined by the State and Federal resource protection agencies, such as the U.S. Fish and Wildlife Service and the California Department of Fish and Wildlife.

- **Contamination Risk:**
  - The restoration shall not increase the mobility and extent of contaminants associated with the Halaco Superfund Site, as determined by the County Health Department, Regional Water Quality Control Board and in compliance with EPA cleanup project.
  - Sediment sampling and testing of proposed excavation areas is recommended to assess contamination to confirm ability to beneficially reuse excavated materials on site, agronomy properties to assess vegetation establishment opportunities and constraints, and engineering properties for select material reuse in access pathway construction.
  - Abandoned Landfill: The Ventura County Environmental Division (Division) has identified a closed, inactive, pre-regulation solid waste facility “Oxnard 1962 (SWIS# 56-CR-0032) located at Perkins Road and Ormond beach Wildlife, Oxnard”.[12] The Division has requested review of the project elements that entail uses of the landfill area including any structures within 1000 feet. A Phase 1 investigation, possibly followed by a Phase 2 investigation, are needed to assess whether the OBRAP results in uses or structures that trigger additional actions such as project revisions or landfill closure or maintenance measures. Further consultation is required with the Division, which is the Local Enforcement agency (LEA), along with the Regional Water Quality Control Board, local air district and local land use authority.

- **Utilities and Infrastructure:** The McWane Blvd corridor is not used and not accessible by public automobiles in much of the restoration area, and is bisected by the existing and proposed OLW. However, it is apparent that multiple utilities exist in the roadway corridor, including overhead electrical and telecommunications and underground water. Restoration design will need to avoid adverse effects to these services and or coordinate with utility agencies to modify the utilities. Further, the design will need to consider the conditions of existing easements, such as whether vehicular access for maintenance is included.
  - A temporary bridge across the existing OLW is included to provide construction access. This bridge will be coordinated with utilities modifications which may be required or desired along the McWane right-of-way. At present, there exists water including fire hydrants, sanitary sewer, electrical, communications and storm drain utilities.
  - A new public access bridge will be constructed across the new OLW along the McWane corridor. We assume that buried utilities (water and wastewater[13]) can be routed in new pipes suspended in the new pedestrian bridge. We assume that up to 4 electrical and communications poles will be replaced to accommodate the new OLW.[14]

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[12] Ventura County 2019. County of Ventura Resource Management Agency, County of Ventura Environmental Health Division Comments on Ormond Beach Preliminary Restoration Plan.

[13] Assumes that the wastewater line is a pressure line: If a gravity line is located above the proposed new OLW grades, a pump station and pressure line may be required.

[14] Access to the power poles and lines may require a boardwalk or other facility, to be determined in consultation with utility agencies.

– Additional public access structures are addressed in the Public Access section below.

7.3.4 Revegetation and Enhancement

Areas disturbed by grading for relocation of OLW will be revegetated, and all other existing habitat areas will receive vegetation enhancements. Revegetation actions are summarized in **Table 7-6**, and enhancement actions are presented in **Table 7-7**.

TABLE 7-6
REVEGETATION ACTIONS FOR WESTERN SEGMENT

Habitat	Fine grading	Select soil fill / backfill	Soil Amendment	Compaction	Planting	Seeding	Temporary Irrigation
Brackish Marsh	X				X	X	
Coastal Sage Scrub	X				X	X	X
Wetland-Upland Transition	X	X	X		X	X	X
Bioswale	X	X			X	X	
Native Ornamental	X	X	X		X	X	X

TABLE 7-7
VEGETATION ENHANCEMENT FOR WESTERN SEGMENT

Habitat	Weeding	Planting	Seeding	Temporary Irrigation
Brackish Marsh	X	X	X	
Coastal Sage Scrub	X	X	X	X
Coastal Dune	X	X	X	X
Salt Marsh	X	X	X	
Wetland-Upland Transition	X	X	X	X

An existing area of brackish and seasonal wetlands in the southwest portion of area 2 is expected to be impacted by reduced groundwater and surface water levels resulting from the re-routing of OLW. Therefore, wetland-upland transition habitat is targeted for this area pending design refinements.

7.3.5 Public Access

Direct beach access would be provided via a proposed primary ADA accessible trail and boardwalk system leading from the Perkins Road parking lot to a bridge or floating boardwalk crossing Ormond Lagoon (Access Node A). The bridge or floating boardwalk will be designed with sea-level rise in mind. An ADA compliant multi-modal boardwalk trail loop would connect a new bridge at tšumaš Creek (Access Node E), the new Perkins Road Parking (Access Node A) bridge to the Ormond Lagoon island, and the floating boardwalk over Ormond Lagoon to create a small, easily traversed trail system. A rustic trail would run along the east side of the Ormond

Lagoon island to an overlook to provide a quiet nature and birding experience. A bridge across Ormond Lagoon (or potentially a floating boardwalk (to be determined) and tšumaš Creek bridge can also provide a beach loop by traversing the California Coastal Trail and Port Hueneme Beach Park along the beach. The existing Perkins Road parking lot (Access Node A in Area 1) would be expanded to accommodate visitor services such as security, a docent kiosk, and interpretive elements. A primary trail with a wetland overlook heads north to West McWane Blvd.

A new trailhead is proposed at West McWane Blvd (Access Node B1) near Perkins Road, with parking on the existing road right-of-way owned by the City of Oxnard, which would be improved and reconfigured for this purpose. A new trail loop is proposed in the west side of Area 2, and a primary route would run east-west to East McWane Blvd (Access Node B2, a constrained access point due to railway spur train parking). This primary, all-season trail would adjoin a north-south primary spur of the California Coastal Trail. This trail would provide bicycle and pedestrian access at Hueneme Road (Access Node C) to residents of South Oxnard and users of the California Coastal Trail bike path, leading through restored habitats to a network of boardwalks between Areas 3a, 3b, and 7 in the Central segment. Bridges and major access structures are summarized in the following **Table 7-8**.

TABLE 7-8
PUBLIC ACCESS STRUCTURES FOR WESTERN SEGMENT

Item	Area(s)	Closest Access Node(s)	Description
Bridge - Perkins Drain	1	A	Replace existing bridge at end of Perkins to lagoon island
Bridge - Ormond Lagoon	1	A	Access to beach from Perkins
Bridge - tšumaš Creek	1	E	Access from west, to lagoon island and remainder of site
Bridge – Ormond Lagoon Waterway	2	B1, B2	Connect pedestrian trail across OLW along McWane ROW
Railway Crossing	2	B2	Gated railway crossing at McWane
Railway Crossing	2	C	Gated railway crossing at OLW culvert
Eleven Viewing Platform	1,2,3a	A, B1, B2	Raised timber structures or on fill with aggregate surface
Two Bird Blinds	2,3a	B1, B2	Screening structure added to Viewing Platforms

7.3.6 Opinion of Probable Construction Costs

The following **Table 7-9** provides a summary of estimated construction quantities and costs for the Western segment, based on the descriptions above and preliminary design drawings (Sheets C-2 and L-1 in Appendix G). As currently designed, the Western segment costs approximately $50M including the contingencies. These costs are subject to refinement as the design is progressed as described in the next section.

TABLE 7-9
PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COSTS FOR WESTERN SEGMENT

Bid Item	Description	Quantity Western	Unit	Unit Cost	Cost Western
	General and Site Preparation				$ 4,576,000
1	Mobilization/Demobilization	1	LS	8%	$ 2,488,000
2	Environmental Protection (SWPPP, etc.)	1	LS	1%	$ 311,000
3	Clearing and Grubbing, include minor demolition/ removal	51	ACRE	$3,040	$ 155,000
4	Miscellaneous Demolition and Disposal	1	LS	2%	$ 622,000
5	Water Control and Diversion OLW	1	LS	$ 1,000,000	$ 1,000,000
	Earthwork				$ 1,198,000
6	Dry Soil Excavation and Placement	40,900	CY	9.80	$ 401,000
7	Wet Soil Excavation and Placement	57,800	CY	13.80	$ 798,000
8	Excess Earth Stockpile	0	CY	4.00	-
	Revegetation (Earthwork Locations)		ACRE	$ 74,000	$ 2,742,000
9	Salt Marsh	0	ACRE	$ 70,000	$ 18,000
10	Wetland-Upland Transition	4	ACRE	$ 87,000	$ 354,000
11	Seasonal Weltand	0	ACRE	$ 115,000	-
12	Brackish Marsh	12	ACRE	$ 50,000	$ 608,000
13	Bioswale	1	ACRE	$ 62,000	$ 70,000
14	Coastal Sage Scrub	17	ACRE	$ 97,000	$ 1,605,000
15	Native Ornamental	1	ACRE	$ 97,000	$ 87,000
16	Salt Panne	0	ACRE	$ 10,000	-
	Vegetation Enhancement		ACRE	$ 44,000	$ 5,940,000
17	Salt Marsh	0	ACRE	$ 30,000	$ 4,000
18	Wetland-Upland Transition	45	ACRE	$ 38,000	$ 1,713,000
19	Seasonal Wetland	0	ACRE	$ 47,000	-
20	Brackish Marsh	55	ACRE	$ 20,000	$ 1,092,000
21	Coastal Sage Scrub	26	ACRE	$ 66,000	$ 1,710,000
22	Coastal Dune	22	ACRE	$ 64,200	$ 1,422,000
	Erosion Control				$ 466,000
23	Hydroseed/Hydromulch	9	ACRE	$ 3,000	$ 26,000
24	Coir Wattles	2	ACRE	$ 18,000	$ 33,000
25	Erosion Control Fabric	4.7	ACRE	$ 87,100	$ 407,000
	Public Access				$ 19,388,000
26	Primary Trail (paved)	8,000	LF	$ 102	$ 816,000
27	Secondary Trail (aggregate)	2,100	LF	$ 36.00	$ 76,000
28	Tertiary Trail (dirt)	0	LF	$ 6.00	-
29	Wetland/Wetland-Dune Boardwalk	5,400	LF	$ 2,100	$ 11,340,000
30	Overlook Platform	9	EACH	$ 110,000	$ 990,000
31	Bird Blind	2	EACH	$ 90,000	$ 180,000
32	Node A	1	EACH	$ 147,400	$ 147,000
33	Node B1	1	EACH	$ 83,400	$ 83,000
34	Node B2	1	EACH	$ 10,000	$ 10,000
35	Node C	1	EACH	$ 10,000	$ 10,000
36	Node D	0	EACH	$ 48,100	-
37	Node E	1	EACH	$ 10,000	$ 10,000
38	Node F	0	EACH	$ 2,115,000	-
39	Tsumas Creek Bridge	1	EACH	$ 720,000	$ 720,000
40	Perkins Drainage Bridge	1	EACH	$ 540,000	$ 540,000
41	OL Bridge	1	EACH	$ 1,800,000	$ 1,800,000
42	OLW Bridge	1	EACH	$ 2,160,000	$ 2,160,000
43	Wetland Bridge	0	EACH	$ 720,000	-
44	New Railway Crossing, At-grade	0	EACH	$ 1,000,000	-
45	Pedestrian Gates at existing Railway Crossing	2	EACH	$ 253,000	$ 506,000
46	Bird Fencing	0	LF	$ 10.00	-
	Utilities, Channel & Storm Drain Structures				$ 1,360,000
47	Utilities at McWane	1	EACH	$ 600,000	$ 600,000
48	Temporary Construction Bridge - OLW	1	EACH	$ 720,000	$ 720,000
49	Temporary Channel Crossings	2	EACH	$ 20,000	$ 40,000
50	Culverts Under Railway Crossing	0	EACH	$ 2,400,000	-
51	Modify Existing Drains	0	EACH	$ 25,200	-
	TOTAL (before CONTINGENCY)				$ 35,670,000
	Construction Contingency	1	%	30%	$ 10,701,000
	Bid Contingency	1	%	10%	$ 3,567,000
	TOTAL with CONTINGENCY				$ 49,938,000

7.3.7 Anticipated Subsequent Design Actions

The following design analyses and refinements are anticipated during future design phases:

- Hydrodynamic modeling of flood hydraulics for OLW and refinement of waterway dimensions.
- Modeling of lagoon response to restoration and sea-level rise, and effects on existing habitat and flood management, and potentially addressing risk with formation of second lagoon mouth.
- Adjust grading and revegetation extent based on post-remediation conditions (implemented by others).
- Assess desired vegetation at berm blocking OLW to confirm whether salinity is low enough to support riparian vegetation.
- Assess desired elevation of OLW floodplain terrace to support brackish and saline emergent wetland plants.
- Verify existing grade elevations in Area 3a where obscured by vegetation and inundation, especially in vicinity of new OLW
- Grading of new OLW across beach in Areas 3a and 1, and transition into existing OL.
- Sizing and design of the bioswale in Area 2, including rainfall-runoff analysis.
- Assess utilities crossing site, thought to be primarily in the McWane corridor, in terms of access easements as well as desired fire hydrant, power and lighting. Coordinate with all utility owners.
- Sediment sampling and testing in the areas of proposed earthwork to assess (a) contamination, (b) engineering properties to confirm suitability for beneficially reusing excavated materials on site, and (c) agronomy properties to assess vegetation establishment opportunities and constraints.
- Survey of existing conditions and property boundary, including easements.

7.4 Central Segment

The Central segment includes Areas 3b, 4 and 7. The emphasis for this segment is to maintain and expand salt marsh and panne, and add seasonal wetland basins at higher elevations that will convert to saltier wetlands with sea-level rise. Proposed actions, as shown on the grading plan (Sheet C-3) and the access and planting plan (sheet L-2), include:

- Excavate three large, shallow basins to create seasonal wetlands. The excavated bed elevation is different in each basin, in order to create a range of hydrology and habitat that would evolve in response to increased inundation due to sea-level rise.
- Install culverts under the existing railway to provide hydraulic connectivity between Areas 3b and 4.
- Lower the remnant dike on the bank of ODD#3 to increase hydraulic connectivity with Area 3b.
- Place excess fill to raise grades in areas with elevations associated with upland and wetland-upland transition habitats.

- Convert the existing agricultural fields to native wetland habitats through vegetation clearing and replanting.
- Perform vegetation enhancements for all other existing habitats.
- Expand public access, including trails and amenities interconnected with the new access nodes at the corner of Edison Drive and East McWane Blvd (Node F), where a visitor center is envisioned.

7.4.1 Earthwork Design Basis and Criteria

The following preliminary design criteria for earthwork elements were used:

- Low wetlands basin in Area 4 (salt panne): bed elevation of 7’ NAVD based on existing salt panne elevations in Area 3b.
- Mid wetlands basin in Area 4 (seasonal wetland): bed elevation of 7’ NAVD to achieve seasonal ponding from local rainfall runoff and shallow ground water daylight during wet season.
- High wetlands basin in Area 4 (bioswale and seasonal wetland): elevation bed of elevation 9’ NAVD fed by agricultural and roadway runoff that would otherwise enter the restoration area, as well as direct rainfall and local runoff.
- Assume structural excavation and backfill will be needed for new culverts under existing railway between Areas 3b and 4. The culverts have not yet been sized, but for estimating purposes we have assumed six 3-foot diameter culverts.
- Only minor earthwork needed to remove high ground along bank of ODD#3.

7.4.2 Erosion Control

Erosion control in the Central segment is summarized in **Table 7-10**:

TABLE 7-10
EROSION CONTROL FOR CENTRAL SEGMENT

Level		Location	Comments
1	Revegetation sufficient	All other areas	Seasonal wetland depressions
2	Hydroseed/Drill Seed	Fill areas with sloping grades less than 3:1	Where revegetation sufficient but planting not scheduled to occur immediately following completion of earth work
3	Add coir wattles on slopes	Swale banks	Locations with slopes 3:1 or steeper more than a few feet vertically
4	Erosion control fabric (and potentially coir wattles)	None	

7.4.3 Property, Infrastructure, Flood Risk

- **Property:** The restoration in Area 4 will displace existing agriculture and may be phased to extend the agricultural production, especially in the area closest to McWane Blvd where grades are higher and there is local irrigation water supply. Land use and ownership changes are anticipated in the MWD and OBGS properties but actions associated with these parcels, if any, are not included in the restoration design.

- **Flood Risk:** The project shall not increase flood risk to railway relative to existing conditions (no-project) with sea-level rise. The restoration design does not include any changes to hydrology that would increase flood risk. Culverts under the railway will increase connectivity between Areas 3b and 4 to allow backwater from 3b into 4 and allow runoff from 4 into 3 without overtopping of railway. Water management may be accomplished with gates subject to further design development of local site hydrology and desired management.
- **Habitat Impact:** Site grading shall be refined to avoid special status plant species that exist on the site unless other actions are approved.
- **Contamination Risk:** Sediment sampling and testing in the agricultural area is recommended to assess (a) contamination to confirm ability to beneficially reuse excavated materials on site, (b) agronomy properties to assess vegetation establishment opportunities and constraints, and (c) engineering properties for select material reuse in access pathway construction.
- **Utilities and Infrastructure:**
  - Conversion of the site from agriculture will entail demolition and removal of water supply and drainage facilities.
  - A water control structure is proposed to increase hydraulic connectivity across the railway between areas 4 and 3, as discussed above.
  - A railway pedestrian crossing, at grade, is proposed between areas 4 and 3.
  - A railway pedestrian crossing structure is not expected to be needed at McWane because the existing road already crosses the railway.

7.4.4 Revegetation and Enhancement

In Area 4, the existing agricultural field will be converted to native habitats so the entire area (including cleared areas outside the grading limits) will be revegetated. The remaining portions of the Central Project (essentially Areas 3b and 7) will receive vegetation enhancements. Revegetation actions are summarized in **Table 7-11**, and enhancement actions are presented in **Table 7-12**.

TABLE 7-11
REVEGETATION ACTIONS FOR CENTRAL SEGMENT

Habitat	Fine grading	Select soil fill / backfill	Soil Amendment	Compaction	Planting	Seeding	Temporary Irrigation
Salt Marsh	X				X	X	
Coastal Sage Scrub	X				X	X	X
Seasonal Wetland	X			X	X	X	
Wetland-Upland Transition	X	X	X		X	X	X
Bioswale	X	X		X	X	X	
Salt Panne	X	X		X			
Native Ornamental	X	X	X		X	X	X

TABLE 7-12
VEGETATION ENHANCEMENT FOR CENTRAL SEGMENT

Habitat	Weeding	Planting	Seeding	Temporary Irrigation
Brackish Marsh	X	X	X	
Salt Marsh	X	X	X	
Coastal Sage Scrub	X	X	X	
Coastal Dune	X	X	X	
Wetland-Upland Transition	X	X	X	X

7.4.5 Public Access

Expanded public access includes a new trailhead access at Node F. The location of Node F was changed from the corner of Edison and East McWane to a location farther south along Edison in order to be closer to the coast: The location of Node F will be determined as the project progresses. A visitor center is envisioned to provide school groups and community groups with a place to gather and learn about the area, and to facilitate community involvement in hands-on restoration activities. It can also serve as a community and cultural space for events and partnerships with educational institutions to host classes, screenings and other educational and recreational opportunities. A loop trail is created via multi-modal trails around the north and east side of Area 4, which connects to the multi-modal trail in Area 3a and the boardwalks in Area 3b. This node would have bike services, and due to its location, could be implemented either while the Area 4 agriculture is occurring or after conversion to wetland.

Cyclists using the California Coastal Trail bike path could secure their bikes and continue the adventure on foot to Area 7. Several birding blinds on overlooks and overlook platforms and boardwalks would provide birding opportunities, and lead to a beach trail lined with bird fencing through the back dunes and to the beach. Bird blinds would be installed where necessary to minimize disturbance to nesting California least tern colonies.

Backdune boardwalks are proposed along Area 7. The boardwalks would have bird blinds to allow visitors to observe birds without disturbing nesting birds such as western snowy plover and California least tern. The boardwalks would be elevated to allow wildlife to safely pass below, and configured and maintained such that they would not provide refuge for nest predators. The existing exclusionary fencing would be augmented with additional exclusionary fencing offset from the boardwalk. New symbolic bird fencing would line the boardwalk past the bike facilities and dune overlook platform, and line the beach trail leading to the coastal strand. The California Coastal Trail runs east –west along beach in this area.

Bridges and major access structures are summarized in the following **Table 7-13**.

Based on comments on the preliminary Preferred Alternative additional consideration was focused on the access across Area 3 to the dunes and beach to address concerns about potential adverse effects to bird nesting areas. The following modifications/additions have been made to the preliminary Preferred Alternative: The proposed boardwalk location is on the north side of the

TABLE 7-13
PUBLIC ACCESS STRUCTURES FOR CENTRAL SEGMENT

Item	Area(s)	Closest Access Node(s)	Description
Two Small Bridges	3	B2, F	Pedestrian access across wetlands, deeper areas
Railway Crossing	3b	F	New at grade crossing with gates, concrete structure
Two Viewing Platform	3a,7	B2,F	Raised timber structures or on fill with aggregate surface
Two Bird Blinds	3a,7	B2,F	Viewing Platform with screening structure

dunes, at an elevation below nesting level and obscured from view, but above and south of the salt marsh and salt panne areas. The boardwalk will rise in elevation with distance south along the dune slope, and end at a timber observation platform with bird blinds. The boardwalk and platform will be founded on reinforced concrete piles in order to traverse the terrain with limited effect on existing grades and vegetation. A primitive (tertiary) unimproved trail with bird fencing will extend from the platform, across the dune field to the shore. The location of this trail was shifted southward to avoid the most recently occupied nesting areas to the west and east. **Figure 7-2** provides photographs of the proposed boardwalk route and observation platform with bird-blind. Further analysis and refinement of this access and amenities is anticipated given the potential conflicts with coastal resources while recognizing the limits to public access to the shore. Mitigating actions such as seasonal closures and beach trail adjustments may be considered, along with signs listing restrictions and interpretative information.

Figure 7-2
Photographs in Vicinity of Area 3-7 Beach Access and Bird Observation Platform
Clockwise from upper left: (a) View from Area 3 wetlands along approximate boardwalk path across wetlands to dune. (b) View from dunes back to start of boardwalk in wetlands Area 3 (note, picture taken during dry season, but area ponds during wet season). (c) View to south showing elevation difference between dune crest, wetlands to north (left) and nesting area to south (right). Bardwalk will be between wetlands and dune crest, hidden from nesting area. (d) Anticipated view of nesting area from observation platform through bird blinds. [Photographs March 30, 2020 Bob Battalio ESA.]

7.4.6 Opinion of Probable Costs

The following **Table 7-14** provides a summary of estimated construction quantities and costs for the Central segment based on the descriptions above and preliminary design drawings (Sheets C-3 and L-2 of Appendix G). As currently designed, the Central segment costs approximately $45.6M including contingencies. These costs are subject to refinement as the design is progressed as described in the next section.

7.4.7 Anticipated Subsequent Design Actions

The following design analyses and refinements are anticipated during future design phases:

- Hydrologic data collection for surface and shallow groundwater hydrology to inform the design of wetland basins, culverts and minor excavation at ODD#3 bank.
- Investigate hydrology and soils of Area 3b salt pannes to inform Area 4 basin design.
- Investigate existing vegetation and correlate with elevation, inundation, existing site soils, shallow groundwater hydrology and salinity to inform vegetation establishment and management.
- Investigate existing infrastructure in Area 4 to assess scope of demolition.
- Engage Port of Hueneme to assess requirements for new culverts across existing railway.
- Investigate utilities to support public access facilities.
- Survey and mapping of existing conditions and property boundary, including easements.

7.5 Eastern Segment

The Eastern segment generally includes Areas 5, 6, 8 and 9. The design emphasis is to maintain and expand salt marsh and salt panne, and add seasonal wetland basins at higher elevations that will convert to saltier wetlands with sea-level rise. Proposed actions, as shown on the grading plan (Sheet C-4) and the access and planting plan (sheet L-3), include:

- Excavate three shallow basins to form a series of seasonal wetlands with a range of elevations, hydrology and habitat in Area 5.
- Connect salt marsh Areas 5 and 6 by removing the roadway in Area 5, and dike separating Areas 5 and 6.
- Fill ODD#3 channel spur in Area 6 and convert to salt marsh.
- Increase water retention in Areas 5 and 6 by placing fill to form a sill and threshold for drainage into existing drainage culverts under the perimeter dikes to ODD#3 drainage ditch.
- Use excess excavated soil to raise grades in areas with elevations associated with upland and wetland-upland transition habitats.
- Revegetate the graded portions of Area 5, and enhance vegetation in all other locations.
- Enhance public access, including reconfiguring the existing Arnold Road parking lot (Node D) and adding bicycle racks and lockers.

TABLE 7-14
OPINION OF PROBABLE CONSTRUCTION COSTS FOR CENTRAL SEGMENT

Bid Item	Description	Quantity Central	Unit	Unit Cost	Cost Central
	General and Site Preparation				$ 3,558,000
1	Mobilization/Demobilization	1	LS	8%	$ 2,324,000
2	Environmental Protection (SWPPP, etc.)	1	LS	1%	$ 290,000
3	Clearing and Grubbing, include minor demolition/ removal	119	ACRE	$3,040	$ 362,000
4	Miscellaneous Demolition and Disposal	1	LS	2%	$ 581,000
5	Water Control and Diversion OLW	0	LS	$ 1,000,000	-
	Earthwork				$ 2,158,000
6	Dry Soil Excavation and Placement	159,000	CY	9.80	$ 1,558,000
7	Wet Soil Excavation and Placement	0	CY	13.80	-
8	Excess Earth Stockpile	150,000	CY	4.00	$ 600,000
	Revegetation (Earthwork Locations)		ACRE	$ 74,000	$ 8,470,000
9	Salt Marsh	25	ACRE	$ 70,000	$ 1,728,000
10	Wetland-Upland Transition	20	ACRE	$ 87,000	$ 1,702,000
11	Seasonal Weltand	0	ACRE	$ 115,000	-
12	Brackish Marsh	0	ACRE	$ 50,000	$ 8,000
13	Bioswale	22	ACRE	$ 62,000	$ 1,345,000
14	Coastal Sage Scrub	36	ACRE	$ 97,000	$ 3,478,000
15	Native Ornamental	0	ACRE	$ 97,000	$ 10,000
16	Salt Panne	20	ACRE	$ 10,000	$ 199,000
	Vegetation Enhancement		ACRE	$ 44,000	$ 4,110,000
17	Salt Marsh	19	ACRE	$ 30,000	$ 584,000
18	Wetland-Upland Transition	0	ACRE	$ 38,000	$ 5,000
19	Seasonal Wetland	0	ACRE	$ 47,000	-
20	Brackish Marsh	14	ACRE	$ 20,000	$ 283,000
21	Coastal Sage Scrub	0	ACRE	$ 66,000	$ 3,000
22	Coastal Dune	50	ACRE	$ 64,200	$ 3,235,000
	Erosion Control				$ 101,000
23	Hydroseed/Hydromulch	24	ACRE	$ 3,000	$ 71,000
24	Coir Wattles	2	ACRE	$ 18,000	$ 30,000
25	Erosion Control Fabric	0.0	ACRE	$ 87,100	-
	Public Access				$ 11,770,000
26	Primary Trail (paved)	5,600	LF	$ 102	$ 571,000
27	Secondary Trail (aggregate)	0	LF	$ 36.00	-
28	Tertiary Trail (dirt)	0	LF	$ 6.00	-
29	Wetland/Wetland-Dune Boardwalk	2,900	LF	$ 2,100	$ 6,090,000
30	Overlook Platform	4	EACH	$ 110,000	$ 440,000
31	Bird Blind	1	EACH	$ 90,000	$ 90,000
32	Node A	0	EACH	$ 147,400	-
33	Node B1	0	EACH	$ 83,400	-
34	Node B2	0	EACH	$ 10,000	-
35	Node C	0	EACH	$ 10,000	-
36	Node D	0	EACH	$ 48,100	-
37	Node E	0	EACH	$ 10,000	-
38	Node F	1	EACH	$ 2,115,000	$ 2,115,000
39	Tsumas Creek Bridge	0	EACH	$ 720,000	-
40	Perkins Drainage Bridge	0	EACH	$ 540,000	-
41	OL Bridge	0	EACH	$ 1,800,000	-
42	OLW Bridge	0	EACH	$ 2,160,000	-
43	Wetland Bridge	2	EACH	$ 720,000	$ 1,440,000
44	New Railway Crossing, At-grade	1	EACH	$ 1,000,000	$ 1,000,000
45	Pedestrian Gates at existing Railway Crossing	0	EACH	$ 253,000	-
46	Bird Fencing	2,400	LF	$ 10.00	$ 24,000
	Utilities, Channel & Storm Drain Structures				$ 2,440,000
47	Utilities at McWane	0	EACH	$ 600,000	-
48	Temporary Construction Bridge - OLW	0	EACH	$ 720,000	-
49	Temporary Channel Crossings	2	EACH	$ 20,000	$ 40,000
50	Culverts Under Railway Crossing	1	EACH	$ 2,400,000	$ 2,400,000
51	Modify Existing Drains	0	EACH	$ 25,200	-
	TOTAL (before CONTINGENCY)				$ 32,607,000
	Construction Contingency	1	%	30%	$ 9,782,000
	Bid Contingency	1	%	10%	$ 3,261,000
	TOTAL with CONTINGENCY				$ 45,649,000

7.5.1 Earthwork Design Basis and Criteria

The following preliminary design criteria for earthwork elements were used:

- Low basin in Area 5 (salt panne): bed elevation of 5’ NAVD based on existing salt panne elevations in Area 6.
- Mid basin in Area 5 (seasonal wetlands): bed elevation of 6’ NAVD to achieve seasonal ponding from local rainfall runoff and shallow ground water daylight during wet season.
- High basin in Area 5 (seasonal wetland): elevation bed elevation 8’ NAVD to be fed by direct rainfall and local runoff.
- Grade berms around culverts with crest height at elevation +7’ NAVD to limit retain water below this elevation.
- Fill ODD#3 and remove roads and dikes to match adjacent salt marsh elevations.

7.5.2 Erosion Control

Erosion control in the Eastern segment is summarized in **Table 7-15**:

TABLE 7-15
EROSION CONTROL FOR EASTERN SEGMENT

Level		Location	Comments
1	Revegetation sufficient	All other areas	Seasonal wetland depressions
2	Hydroseed	Fill areas with sloping grades	where revegetation sufficient but planting not scheduled to occur immediately following completion of earth work
3	Add coir wattles on slopes	Swale banks and earth berms	Earth berms at water control structures require erosion control to prevent scour prior to vegetation establishment
4	Erosion control fabric (and potentially coir wattles)	Berms	Potentially desired at berms near existing water control structures

7.5.3 Property, Infrastructure, Flood Risk

- **Property:** Restoration in Areas 5 and 6 will need to be coordinated with the adjacent Naval Base Mugu for safety and security reasons.
- **Habitat Impact**: Site grading shall be refined to avoid special status plant species that exist on the site unless other actions are approved.
- **Contamination Risk**: Sediment sampling and testing in Area 5 is recommended to (a) assess contamination to confirm ability to beneficially reuse excavated materials on site, (b) agronomy properties to assess vegetation establishment opportunities and constraints, and (c) engineering properties for select material reuse in access pathway construction.

- **Utilities and Infrastructure:**
  - *Water and Sediment Management*: Earth berms will be constructed to limit drainage from Areas 5 and 6 to the ODD#3 flood control and drainage channel, in order to improve hydrology for existing and restored wetlands. Surface water and groundwater will need to be managed during construction to avoid adverse effects to water quality and habitat, including wetlands farther east in Naval Base Mugu.
  - *Abandoned Landfill*: The Ventura County Environmental Health Division[15] (Division) states that a closed, inactive, pre-regulation solid waste facility " Arnold Road Dump (SWIS# 56-CR-0056) is located at the end of Arnold Road and the Pacific Ocean". The Division has requested review of the project elements that entail uses of the landfill area including any structures within 1000 feet. A Phase 1 investigation, possibly followed by a Phase 2 investigation, are needed to assess whether the OBRAP results in uses or structures that trigger additional actions such as project revisions or landfill closure or maintenance measures. Further consultation with the Division, which is the Local Enforcement agency (LEA) is required, along with the Regional Water Quality Control Board, local air district and local land use authority.
- **Flood Risk:** Modifications at the existing culverts that drain the site to ODD#3 are not expected to increase flood risk, as these reduce surface runoff to the ODD#3 during typical wet conditions. During flood conditions, water will still drain to ODD#3 by overtopping the low earth berms at the existing storm drain inlets. Backwater during floods through the leaky tide gates and over the existing earth berm will still be possible. Monitoring and adaptive management will allow adjustments if unanticipated adverse effects occur.

7.5.4 Revegetation and Enhancements

Areas disturbed by grading of the wetland basins in Area 5 will be revegetated, and all other existing habitat areas will receive vegetation enhancements. Revegetation actions are summarized in **Table 7-16**, and enhancement actions are presented in **Table 7-17**.

TABLE 7-16
REVEGETATION ACTIONS IN EASTERN SEGMENT

Habitat	Fine grading	Select soil fill / backfill	Soil Amendment	Compaction	Planting	Seeding	Temporary Irrigation
Salt Marsh					X	X	
Coastal Sage Scrub	X				X	X	X
Seasonal Wetland	X	X		X	X	X	
Wetland-Upland Transition	X	X	X	X	X	X	X
Salt Panne		X		X			
Native Ornamental	X	X	X		X	X	X

15 Ventura County 2019. County of Ventura Resource Management Agency, *County of Ventura Environmental Health Division Comments on Ormond Beach Preliminary Restoration Plan.*

TABLE 7-17
VEGETATION ENHANCEMENT FOR EASTERN SEGMENT

Habitat	Weeding	Planting	Seeding	Temporary Irrigation
Salt Marsh	X	X	X	
Coastal Sage Scrub	X	X	X	X
Coastal Dune	X	X	X	X
Wetland-Upland Transition	X	X	X	X
Salt Panne	X			

7.5.5 Public Access

The existing Arnold Road parking lot (Access Node D) would be reconfigured for ADA parking, limited parallel parking along the west side of Arnold Road, and a drop-off or turn-around area. Bike racks and a limited number of bike lockers would be provided to allow cyclists to secure their bikes or camping gear and explore areas 5, 6, and 9 on foot. A rustic seasonal trail leading from Arnold Road to the beach would follow the current alignment, providing pedestrian and emergency access to the beach. This section of trail would require seasonal closure based on winter rain patterns and inundation. The filling of the ODD #3 (pending agreement with Oxnard Drainage District No. 2) would allow an easy access through a new upland band proposed in area 5, where visitors could view birds and habitats from an overlook platform with bird blinds. A primitive trail would continue west from the Arnold Road trailhead past Area 5 to a dune overlook which would provide views of the salt panne, salt marsh, dunes, and beach. This section of rustic trail from Arnold Road to Areas 5 and 8 could be closed during nesting season to limit disturbance to birds. A beach trail lined with symbolic fencing would lead from the wetland overlook to the beach, allowing visitors to make a loop back to Arnold Road or continue west to explore the Central and Western segments. The existing bird fencing in Area 8 would remain.

Table 7-18 summarizes the public access structures in the Eastern segment.

TABLE 7-18
PUBLIC ACCESS STRUCTURES FOR EASTERN SEGMENT

Item	Area(s)	Closest Access Node(s)	Description
Three Viewing Platforms with Bird Blinds	5,6,8,9	D	Raised timber structures or on fill with aggregate surface, and screening structure

7.5.6 Opinion of Probable Construction Costs

The following **Table 7-19** provides a summary of estimated construction quantities and costs for the eastern segment, based on the descriptions above and preliminary design drawings (Sheets C-4 and L-3 of Appendix G). As currently designed, the Central segment costs approximately $17.7M including contingencies. These costs are subject to refinement as the design is progressed as described in the next section.

TABLE 7-19
OPINION OF PROBABLE CONSTRUCTION COSTS FOR EASTERN SEGMENT

Bid Item	Description	Quantity Eastern	Unit	Unit Cost	Cost Eastern
	General and Site Preparation				$ 1,308,000
1	Mobilization/Demobilization	1	LS	8%	$ 907,000
2	Environmental Protection (SWPPP, etc.)	1	LS	1%	$ 113,000
3	Clearing and Grubbing, include minor demolition/ removal	20	ACRE	$3,040	$ 61,000
4	Miscellaneous Demolition and Disposal	1	LS	2%	$ 227,000
5	Water Control and Diversion OLW	0	LS	$ 1,000,000	-
	Earthwork				$ 435,000
6	Dry Soil Excavation and Placement	34,200	CY	9.80	$ 335,000
7	Wet Soil Excavation and Placement	0	CY	13.80	-
8	Excess Earth Stockpile	25,000	CY	4.00	$ 100,000
	Revegetation (Earthwork Locations)		ACRE	$ 74,000	$ 5,955,000
9	Salt Marsh	43	ACRE	$ 70,000	$ 3,001,000
10	Wetland-Upland Transition	4	ACRE	$ 87,000	$ 338,000
11	Seasonal Weltand	13	ACRE	$ 115,000	$ 1,534,000
12	Brackish Marsh	0	ACRE	$ 50,000	-
13	Bioswale	0	ACRE	$ 62,000	-
14	Coastal Sage Scrub	11	ACRE	$ 97,000	$ 1,019,000
15	Native Ornamental	0	ACRE	$ 97,000	$ 15,000
16	Salt Panne	5	ACRE	$ 10,000	$ 49,000
	Vegetation Enhancement		ACRE	$ 44,000	$ 3,906,000
17	Salt Marsh	41	ACRE	$ 30,000	$ 1,243,000
18	Wetland-Upland Transition	8	ACRE	$ 38,000	$ 299,000
19	Seasonal Wetland	0	ACRE	$ 47,000	-
20	Brackish Marsh	0	ACRE	$ 20,000	-
21	Coastal Sage Scrub	2	ACRE	$ 66,000	$ 120,000
22	Coastal Dune	35	ACRE	$ 64,200	$ 2,244,000
	Erosion Control				$ 23,000
23	Hydroseed/Hydromulch	1	ACRE	$ 3,000	$ 3,000
24	Coir Wattles	1	ACRE	$ 18,000	$ 20,000
25	Erosion Control Fabric	0.0	ACRE	$ 87,100	-
	Public Access				$ 882,000
26	Primary Trail (paved)	1,500	LF	$ 102	$ 153,000
27	Secondary Trail (aggregate)	1,100	LF	$ 36.00	$ 40,000
28	Tertiary Trail (dirt)	4,500	LF	$ 6.00	$ 27,000
29	Wetland/Wetland-Dune Boardwalk	0	LF	$ 2,100	-
30	Overlook Platform	3	EACH	$ 110,000	$ 330,000
31	Bird Blind	3	EACH	$ 90,000	$ 270,000
32	Node A	0	EACH	$ 147,400	-
33	Node B1	0	EACH	$ 83,400	-
34	Node B2	0	EACH	$ 10,000	-
35	Node C	0	EACH	$ 10,000	-
36	Node D	1	EACH	$ 48,100	$ 48,000
37	Node E	0	EACH	$ 10,000	-
38	Node F	0	EACH	$ 2,115,000	-
39	Tsumas Creek Bridge	0	EACH	$ 720,000	-
40	Perkins Drainage Bridge	0	EACH	$ 540,000	-
41	OL Bridge	0	EACH	$ 1,800,000	-
42	OLW Bridge	0	EACH	$ 2,160,000	-
43	Wetland Bridge	0	EACH	$ 720,000	-
44	New Railway Crossing, At-grade	0	EACH	$ 1,000,000	-
45	Pedestrian Gates at existing Railway Crossing	0	EACH	$ 253,000	-
46	Bird Fencing	1,440	LF	$ 10.00	$ 14,000
	Utilities, Channel & Storm Drain Structures				$ 141,000
47	Utilities at McWane	0	EACH	$ 600,000	-
48	Temporary Construction Bridge - OLW	0	EACH	$ 720,000	-
49	Temporary Channel Crossings	2	EACH	$ 20,000	$ 40,000
50	Culverts Under Railway Crossing	0	EACH	$ 2,400,000	-
51	Modify Existing Drains	4	EACH	$ 25,200	$ 101,000
	TOTAL (before CONTINGENCY)				$ 12,650,000
	Construction Contingency	1	%	30%	$ 3,795,000
	Bid Contingency	1	%	10%	$ 1,265,000
	TOTAL with CONTINGENCY				$ 17,711,000

7.5.7 Anticipated Subsequent Design Actions

The following design analyses and refinements are anticipated during future design phases:

- Surface and shallow groundwater hydrology to inform designs of basins and earth berms to reduce drainage to culverts and ODD#3. Characterize existing water control structures and ODD#3 as component of the hydrology analysis.
- Area 6 salt panne hydrology and soils investigation to inform Area 5 basin designs.
- Investigate existing vegetation and correlate with elevation, inundation, existing site soils, shallow groundwater hydrology and salinity in order to inform vegetation establishment and management.
- Sediment sampling and testing in the areas of proposed earthwork to assess (a) contamination, (b) engineering properties to confirm ability to beneficially reuse excavated materials on site, and (c) agronomy properties to assess vegetation establishment opportunities and constraints.
- Survey and mapping of existing conditions and property boundaries, including easements.
- Investigate location of recorded landfill and assess work-offset requirements and other implications.

7.6 Construction Phasing

Implementation of the project will likely be phased given the scale, changing adjacent land uses and other factors. The various considerations that will inform construction phasing are discussed as follows:

- Phased construction by project area;
- Phased construction to balance earthwork;
- Phasing associated with water management;
- Phased vegetation enhancement and overall site management; and,
- Early enhancement of public access.

7.6.1 Phasing by Project Area

The following factors are likely to influence phasing of restoration construction.

- Remediation of project Area 3a adjacent to the Halaco industrial super fund site is prerequisite to restoration of the western area. Clearance from EPA, County Health Department and Water Quality Control Board anticipated to be attained prior to restoration in the western area.
- Cessation of agriculture is required prior to restoration in Area 4. As an option, the lower one or two basins and associated restoration may be accomplished with agriculture on the remaining areas subject to additional investigation. In particular, the extent of subsurface drains on site and their function with remaining agriculture and the effect on restoration need to be assess prior to partial restoration.

- Restoration of the Western, Central and Eastern segments can be constructed independently, in sequence, or all at once.
- Construction costs may be lower if the construction in one contract

Based on the above, we identify the following two phasing scenarios for consideration:

- Construct the three segments in sequence, as three separate construction contracts in the following suggested order: (1) Eastern (2) Central (3) Western.
- Construct the entire project under one construction contract, which may occur over one to three years.

Under either scenario, construction of a portion of the Central segment may be deferred to allow continued agriculture use in Area 4.

7.6.2 Phasing to Balance Earthwork

The preliminary estimates of earthwork volume are summarized in the following **Table 7-20** by project segment and in total. Excavation volumes are based on neat-lines and bank[16] volumes. Estimated volumes for filling the OLW and ODD#3 channels were increased by 50% to account for various losses (from compaction, consolidation, settlement, stockpiling, rehandling, etc.). Volume adjustments for trail embankments and other public access fill areas were not applied.

TABLE 7-20
ESTIMATED EARTHWORK VOLUMES

Earthwork Element	Earthwork Volumes (Cubic Yards)							
	Western Segment		Central Segment		Eastern Segment		Total	
	Cut	Fill	Cut	Fill	Cut	Fill	Cut	Fill
Public Access Trails	600	7,600		11,200			600	18,800
Ormond Lagoon Waterway - dry	40,300	18,000					40,300	18,000
Ormond Lagoon Waterway - wet	57,800	65,900					57,800	65,900
AREA 4			159,000				159,000	0
AREA 5					34,200	10,300	34,200	10,300
TOTALS	98,700	91,500	159,000	11,200	34,200	10,300	291,900	113,000
NET Earthwork Volume (rounded)	7,000		148,000		24,000		179,000	

The overall project has a net earthwork imbalance of about 180,000 cubic yards. Off haul and disposal is not desirable and is currently not included in estimated costs. Most of the excess excavation is generated from wetland depressions in Area 4 of the Central segment (157,000 cubic yards), and secondly from wetland depressions in Area 5 of the Eastern segment

16 Neat lines refer to the design grades without consideration of earthwork tolerances and volume changes that result from compaction, bulking, distributed "losses" during handling and stockpiling, clearing and grubbing. Bank volume refers to the existing "in situ" volume measured between existing and proposed finished grades, without inclusion of overexcavation and subgrade preparation.

(34,000 cubic yards). Supplemental onsite fill locations that could be used balance the earthwork are shown on **Figure 7-3** and described below.

- Future filling of the OLW channel offsite in the Halaco reach requires about 30,000 cubic yards. This material would most likely be generated in the Central segment and require temporary stockpiling.
- Raising grades along the perimeter of Area 2 two to three feet would accommodate 85,000 to 125,000 cubic yards. While this area is already relatively high (elevations +10 to +11 feet NAVD), higher grades could accommodate wetland migration with sea-level rise and potentially reduce flood potential to adjacent industrial facilities.
- Raising grades in the northern portion of Area 4 one to two feet can accommodate approximately 35,000 to 70,000 cubic yards, would be consistent with the revegetation and future wetland migration.
- Raising grades by approximately one foot in the 10-acre area in the north portion of Area 5 (see Figure 7-3) would accommodate approximately 15,000 cubic yards. However, this parcel should be investigated further. This parcel requires investigation to confirm that it is not wetland or other protected habitat.

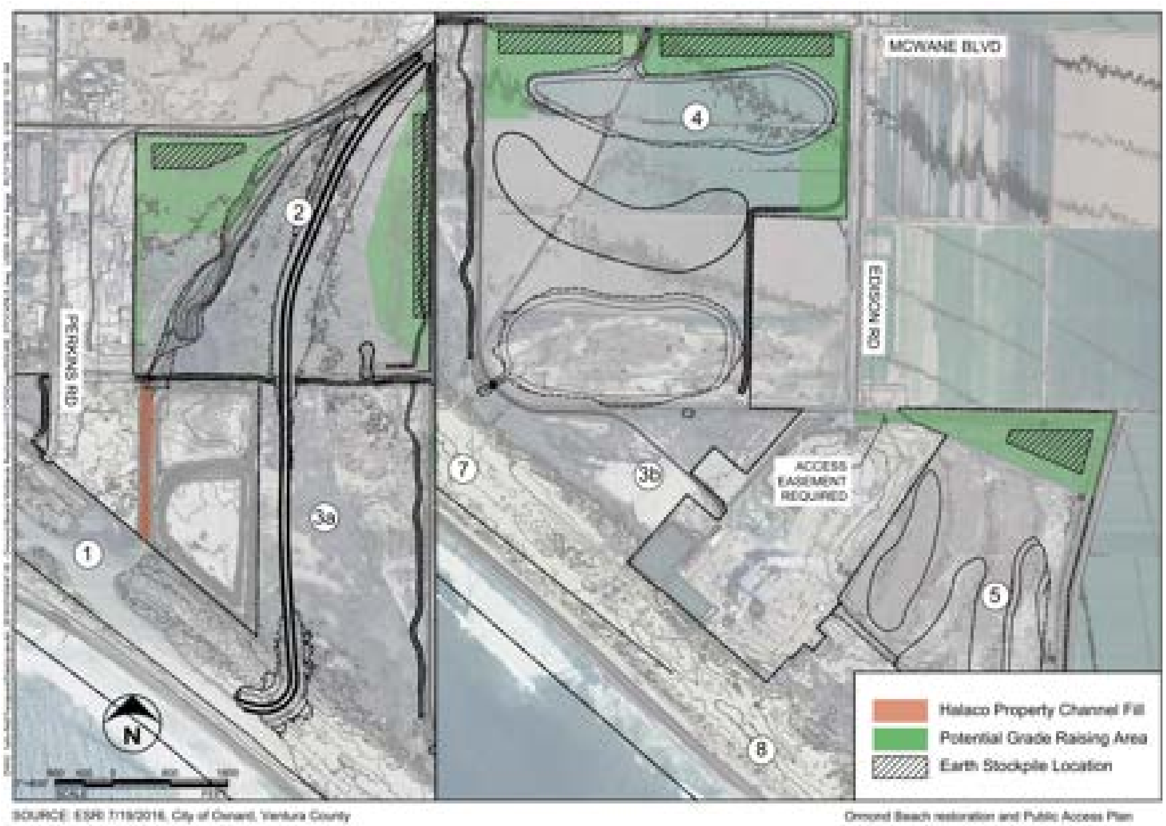

Figure 7-3
Potential Fill and Stockpile Locations

Three potential stockpile areas for temporary staging of excess material are shown on Figure 7-3:

- Stockpiling in Area 2 of 3 to 6 feet can accommodate 25,000 to 50,000 cubic yards.
- Stockpiling in Area 4 of 3 to 6 feet can accommodate 25,000 to 50,000 cubic yards.
- In addition, the northern portion of Area 5 is likely an option for temporary stockpiling. The stockpile site would require truck access from the end of Edison Road, and easements across power plant and or drainage district property (see green shaded area beyond project limits, Figure 7-3).

If onsite fill placement is not feasible or desirable, other options to achieve onsite balance may include:

- Placement in future potential expansion areas (see Section 2.6 Potential Future Expansion) that may benefit from earth fill.
- Reducing excavation of wetland depressions.
- Raising the elevation of parking areas at access nodes.

In addition, given the potential flood hazards in the Ormond Beach area, we anticipate that excess earth could be of interest for fill offsite by others.

7.6.3 Phasing for Water Management

Re-routing of Ormond Lagoon Waterway (OLW) will require consideration of water management, including effects to ecology, flooding and sediment delivery. We anticipate phased excavation that maintains water supply to Ormond Lagoon in order to maintain water levels and quality characteristics within a target range. It may be beneficial to defer filling of the existing OLW until vegetation in the new channel is established sufficiently to limit excess sediment delivery during flood discharges. Water management associated with filling the ODD#3 spur in the Eastern segment is not expected to pose special challenges.

7.6.4 Phased Vegetation Enhancement and Overall Site Management

Vegetation enhancement may be phased over several years rather than being associated with discrete construction contracts.

7.6.5 Early Enhancement of Public Access

While public access improvements are typically completed after earthwork and other site work, some public access improvements may be implemented prior to completion of the entire project. In particular, interpretive and educational signs could be installed at existing and any interim access facilities at any time.

We assume that Arnold Road facilities would be maintained at their present level until increased public access is provided elsewhere. Trails and access structures, particularly those located outside of earthwork areas, that are possibilities for early implementation include:

- In Area 1 of the Western segment:
  - Bridges at Perkins, tšumaš and Ormond Lagoon; and,
  - Trails and boardwalks near Perkins parking lot and Ormond Lagoon.
- In Area 3b, in the proximity of the Ormond Generating Station and informal parking area near the end or Edison road;
  - Railway crossing;
  - Boardwalk through Area 3b to dunes;
  - Observation platform, bird blinds at dunes; and,
  - Trail with fencing across dunes.
- An access node off Edison Road, vicinity of Nodes F or B2 and trails through Areas 4 and 3b may be practical with existing land uses.
- Access to the west side or Area 2 via McWane (presently dead-ends at a locked gate) may be practical.

7.7 Design Uncertainties

Data Gaps and Restoration Uncertainties are addressed in Section 8 Data Gaps and Uncertainties of this Plan. The following are required prior to completion of design:

- **Design criteria for plant establishment:** Data collection and analysis are required to identify site preparation necessary to establish plants and habitats. An analysis of existing soil characteristics, surface and groundwater hydrology including salinity, elevation and plant communities is required. The sampling, testing and analysis should be accomplished for each of the three areas based on observations that similar plant communities inhabit different elevations in different areas, presumably owing to variations in soils and hydrology.
- **Contamination:** Soil sampling and bulk sediment chemistry analysis are recommended for all earthwork areas, in order to confirm sediment quality is acceptable for restoration actions. In addition, a Phase 1 assessment of potential site contamination is recommended for areas 5 (former fuel storage) and 6 (possible old landfill).
- **Soils Characterization:** Soil sampling and testing is recommended for all earthwork areas in order to characterize engineering and agronomy properties to inform beneficial reuse of excavated soils.
- **Landfills:** The Ventura County Environmental Health Division (Division) states that two closed, inactive, pre-regulation solid waste facilities may exist within 1000 feet of OBRAP project elements. Investigation as to the location of these potential landfills is recommended.
- **Halaco Cleanup:** The timing of the clean-up of the Halaco Super Fund site by EPA is not known but affects OBRAP implementation.

- **Flood Hydraulics:** Data collection and modeling of flood flows is required for design and approval of the proposed modifications to the Ormond Lagoon Waterway.
- **Lagoon Response:** Further analysis of the response of Ormond Lagoon to the proposed restoration is required to confirm or refine the design in terms of no adverse effects to food management and ecology.
- **Water and Salt Balance:** Water and salt balance analyses are required to refine the geometries of the seasonal wetland basins in areas 4 and 5.
- **Property and Easements:** A boundary survey and easement research is required prior to construction. In particular, utility and access easements need to be researched and mapped by a licensed land surveyor.
- **Elevation Survey:** Additional land elevation surveys need to be completed to help interpret available LIDAR data and develop a base map for construction. The base map may benefit from additional LIDAR or photogrammetric mapping. Survey control benchmarks can be established to support construction. Ground survey is desired to correct LIDAR-based mapping where water and emergent wetland vegetation obscure solid ground.
- **Area 4:** Desk top and field investigation (trenching, pot-hole investigation) to ascertain scale and extent of tile drains and other agricultural support elements that will need to be demolished.
- **Unassessed Area:** The northerly 10 acres of area 5 in the Eastern segment has not been investigated because access is not available. Access and assessment is recommended to facilitate restoration, access and or earth stockpiling.
- **Railway Encroachment:** Engage Port of Hueneme to assess requirements for new culverts across existing railway.
- **Public Access Utilities:** Investigate and design utilities to support public access facilities.
- **Public Access Programing:** Refine public access based on additional consideration of public desires balanced with protection of natural resources, funding and phasing. Potential future expansion of the project area could result in opportunities for improved public access.

7.8 Design Progression

This Plan presents a Preferred Alternative and preliminary design. The OBRAP will be further refined and additional opportunities for public review during the next phases of design development, environmental review, and regulatory approval are expected. Therefore, if the project proceeds, the Preferred Alternative will be refined through the subsequent phases of design development in response to environmental review, additional technical analysis, regulatory review and public comment Additional technical studies are needed to refine the project description prior to initiating environmental review, in compliance with the California Environmental Quality Act.

The following next steps specifically address the next phases of design development and are envisioned to progress the preliminary design through CEQA, permitting and final design to implementation:

1. Develop habitat planting criteria based on data collection.
2. Conduct flood hydraulics analysis and water/salt balance modeling.
3. Conduct Phase 1 and Phase 2 (if needed) assessments of potential historical landfill near end of Arnold Road (Eastern Segment). Continue to coordinate with EPA Halaco Super Fund site clean up to ascertain construction phasing and extents.
4. Update project description for environmental review.
5. Develop base map (property boundaries, easements, utilities, topography, survey control).
6. Perform soil sampling and testing for contaminants, engineering properties and agronomic characteristics within earthwork excavation areas.
7. Initiate biological assessment(s), wetland delineation and biological surveys.
8. Perform additional public outreach and engagement.
9. Engage regulatory agencies to receive early input and permit requirements.
10. Advance design of construction documents to a level to secure regulatory permits
11. Apply for and obtain regulatory permits.
12. Incorporate permit conditions into the construction documents.
13. Identify construction phasing and contracting framework.
14. Complete construction documents necessary to initiate bidding and construction.
15. Initiate bidding/construction phases.

In the above design progression, the environmental review of the project will occur starting coincident with Step (4) Updated Project Description. Permit applications will be submitted following the environmental review phase and around the time of step (10). Step (14) will not be accomplished until the permits are essentially attained, when permit conditions are known.

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SECTION 8
Data Gaps and Adaptive Management

The OBRAP alternatives and preliminary design in this Plan were developed and evaluated using the best available data on current and historical conditions, projected future conditions, local and regional needs, and opportunities and constraints. The data came from existing sources (Aspen 2009, Beller et al. 2011) and new studies conducted for this effort in 2017, including a general assessment of biological status and needs, collection of hydrologic and topographic data, modeling of water balance and lagoon inlet morphology, and assessment of sea-level rise resiliency. However, important data gaps remain. There are also uncertainties regarding processes, future conditions and expected project outcomes. In general estuaries and coasts face uncertainties on two fronts: altered flows and contaminants from urban and agricultural watersheds, and rising sea levels (Zedler 2016). Furthermore, precise outcomes of restoration actions can be unpredictable (McDonald et al. 2016, Zedler 2016). We seek to differentiate between *data gaps*, which can be addressed by data collection and analyses, and *uncertainties*, which are more effectively addressed via “adaptive management” and “adaptive restoration” (as defined by Zedler 2016 and described below and in Section 7.4). In practice, the distinction between data gaps and uncertainties is not discrete, especially in highly variable natural systems where it is rarely feasible to have enough data to eliminate uncertainty for some important parameters, even with significant data collection.

The Project Area provides opportunities to employ “adaptive management” and “adaptive restoration” to reduce uncertainties through phased restoration. Adaptive management provides a science-based decision-making framework for deliberate learning (Williams et al. 2009). It is an iterative approach that uses targeted studies, monitoring, and assessments to evaluate progress toward Project objectives and make adjustments in the course of implementing the project to help assure those objectives are met. This is more systematic than a trial-and-error approach. Monitoring data collected early in the project’s implementation is used to assess progress, reduce uncertainty, and adjust actions as-needed to achieve project goals. This knowledge is also shared to improve long-term management and future projects (Williams et al. 2009; Zedler 2016). Adaptive restoration is a process of “learning while restoring” using field experiments of selected approaches (Zedler 2016). The goal is to achieve on-the-ground ecological goals, fill data gaps and reduce uncertainty, while also improving strategies for future restoration.

The Project Area supports a mosaic of habitats with a complex history of disturbance, including high-functioning habitats, areas in various states of recovery from severe disturbance, and areas that are not currently managed for habitat (the agricultural lease area). High-functioning areas should be studied to inform design of target habitats elsewhere. These areas, in addition to other high-functioning habitats elsewhere on the coast, should also serve as reference sites for evaluating the performance of restoration projects. Recovering areas could be used to implement small-scale restoration pilot projects or experiments that test various techniques and hypotheses, using an "adaptive restoration" approach. The lessons learned through monitoring existing habitats and small-scale implementation projects would then be "scaled up" when restoration occurs, for example, on the agricultural parcel or potential future adjacent lands (e.g., the sod farm, Halaco properties, or the power plant site), giving those large, complex, and expensive projects a greater likelihood of achieving their goals.

This section identifies: (1) data gaps and how to address them, (2) key uncertainties about how potential alternatives and design may perform, (3) status of data gaps identified in the Feasibility Study (Aspen 2009), and (4) a framework for incorporating adaptive management and adaptive restoration as plans are refined and on-the-ground projects begin.

8.1 Data Gaps

Gaps in information regarding current site conditions, physical and biological processes, management practices, existing infrastructure and CEQA-specific needs will need to be addressed in order to facilitate refinement of the alternatives, development of the preferred alternative, and CEQA review. We recommend the following additional field data collection and analysis:

- Hydrology monitoring
  - Stream gaging in the main waterways that provide runoff and/or drain the Project Area, such as OLW, ODD #3, and other creeks entering the site. Stream gauging was accomplished historically, but not presently, and the site shows signs of changing conditions.
  - Surface water level recording in Ormond Lagoon. While the County monitors water levels, they do not store the data.
  - Salinity (seasonal dynamics).
  - Effects of neighbors discharging to and withdrawing from ODD #3.
  - Project site hydraulic connectivity with ODD #3.
- Groundwater monitoring
  - Water levels and salinity data collection through a range of seasons and throughout the site confirm general pattern of slope (flow) in shallow groundwater.
- Monitor seasonal patterns in surface water ponding.
- Soils testing
  - Surface texture and texture at depth where grading is proposed.
  - Presence of perching layer-hard pan depth/presence for salt panne, compare existing salt marsh areas to agricultural and tank farm areas (Areas 4, 5, and 6).
  - Soil salinity to assess suitability for upland restoration in spoil areas.
- Water quality monitoring
  - Nutrients, sediment, and agricultural and urban runoff constituents.

- Contaminants
  - Arnold Road dump location and degree of contaminants in Areas 6 and 9.
  - Assess areas of potential contamination which may exist due to prior land uses (Aspen 2009).
  - Water quality in OLW and ODD #3 and surface flow into Area 4.
- Agricultural drainage and water management practices
  - Documentation of inflows/outflows, salinities, culverts, tile drains, and other water management practices, to understand contributions to surface and groundwater levels.
  - Irrigation and drainage facilities in Area 4, which are likely to be removed and would affect restoration design.
- Topographic data collection in areas where LiDAR data accuracy is not adequate, to characterize habitat distribution relative to elevation and to supply data necessary to design public access features.
- Vegetation mapping (high resolution) and monitoring of target habitats and species.
- Wetland assessment (not a full delineation) to map areas that are under potential state and federal jurisdiction as wetlands or waters.
- Photo documentation and seasonal and inter-annual measurements of the beach crest and lagoon mouth morphology.
- Property boundary survey and easements.
  - Locations and tolerances of buried infrastructure.
  - Property lines.
- Cultural resources survey.

8.2 Restoration Uncertainties

Some data gaps are straightforward to fill, while others will remain sources of uncertainty even with years of monitoring. For the latter type, it will be important to acquire sufficient data to provide support for refining plans, conducting environmental review and permitting, finalizing design, and guiding implementation. New data will also likely reveal further data gaps and uncertainties that could affect projected outcomes. Virtually all restoration projects must be built with some degree of uncertainty. Decreasing uncertainty through a combination of adaptive management and adaptive restoration (Section 7.4) will give the project the best chance of meeting its goals and objectives in a timely and cost-effective manner. The implementation of a phased restoration may be the preferred way to move forward in light of continuing uncertainty.

Uncertainties regarding site conditions and processes that can determine habitat development and potential ecological responses are identified so that monitoring and/or management actions may be targeted to inform expected outcomes of restoration actions. This will guide project planning and design development of future project phases, as well as inform mid-course corrections, interim site management and post construction adaptive management actions.

Some key uncertainties for understanding the range of outcomes that may be expected from Project implementation are listed below.

Physical and Hydrological

- Sea-Level Rise – The actual rate at which sea-level rise will occur is unknowable. After +3 feet sea-level rise (approximately mid-century by current predictions), the site will be largely inundated. How high do upland habitats need to be to persist with sea-level rise? Will groundwater or surface water or some combination of both be the main drivers of habitat changes with sea-level rise? How will sea-level rise drive land use and management changes on neighboring parcels and will they be compatible with restoration at the site?

- Hydrology – Relationships between surface water, groundwater, and tidally-influenced groundwater, as well as dune hydrology are complex, variable, and not likely to be fully quantified. Monitoring results of current conditions will be complicated by ever-changing land alterations and practices by neighbors (e.g., culverts, sewer line, drainage ditches, agricultural pumping practices, sewer line, vegetation management). The hydrologic connections between channels and surrounding lands will need to be better understood in order to design and predict hydrologic processes and ecological outcomes (i.e., what kind of wetland may be supported).

  - What is the effect of the existing leaky wastewater trunk line near Ormond Lagoon Waterway north of Halaco properties on groundwater and what are future implications?

  - The water/salt balance can be better understood via data collection and analysis, but responses may still differ from expectations owing to the multi-variate processes and uncertain future conditions. Can restoration actions reverse the 'freshening' trend and enhance salinity to support saline wetland habitats over brackish wetlands (to what degree is trajectory controlled by surface water versus groundwater – how do these conditions intergrade across the site?

  - Existing hydrology of ODD #3 and effects on restoration site, and effects of project on ODD #3 hydrology and tributary areas.

  - Quantify flowrates in OLW and water balance in Ormond Lagoon in order to assess effects of proposed restoration actions and in particular check to see if there is sufficient water supply to support habitat with expanded lagoon basin volumes.

- Soils – The available data indicate correlations between soil texture (e.g., amount of sand, silt, and clay) and other area-specific parameters (groundwater elevation, salinity). Data collection and analysis can better characterize the existing conditions, and responses to changes in drivers (water level, salinity) during the data collection period. However, uncertainties are likely to remain and adaptive management to respond to future conditions should be contemplated.

- Water Quality and Soil Contamination – Does contamination affect habitats, plants and animals at the site? Coordinate with other projects and programs in the area. How will the Project be impacted by the EPA Halaco Superfund Site cleanup? How can the Project be coordinated with the EPA Halaco Superfund Site cleanup?

- Beach/Dune Morphology – What lagoon-dune shape will occur and persist? How will the beach and dunes respond with climate change and sea-level rise? To what degree will the dunes transgress inland? What is the impact of beach nourishment activities, will these continue, and will the practice affect shore response to sea-level rise?

- Lagoon Dynamics – The lagoon hydrology and beach face/mouth closure relationship is partially documented for Ormond Lagoon. Will the mouth management for flood control change? Will flowrates to the lagoon change?
  - Will the lagoon blow out at a different location under Alternative 2?
  - Is there enough dry-season flow (now and in the future as urban and agricultural runoff is likely to decline) to support two lagoons under Alternative 3?
  - How will changes in water conservation and reuse in the upper watershed change water levels in the lagoon over the next 20 years?

Biological

- What is minimum sustainable patch size for each target habitat?
- Salt marsh bird's beak - Can we create habitat for the population to migrate with sea-level rise? Pollinators (bees) need upland or transition zone areas for nesting. While uplands and transition zones are part of restored landscape, sea-level rise could squeeze them out. How much freshwater influence is needed for seed germination?
- Coulter's goldfields – If the existing population is extirpated in due to rerouting of OLW (Alternatives 2 and 3), how and where can new populations be established elsewhere in the Project Area?
- Western snowy plover and California least tern – Will nesting be impacted by expanded lagoon (Alternative 2) or construction of a second lagoon (Alternative 3)? Will the trail and boardwalk setbacks effectively buffer nesting tern colonies and nesting shorebirds from disturbance attributable to humans using trails and boardwalks? Will predators use public access features and increase predation losses of eggs and chicks?
- Tidewater goby – Will gobies persist in the existing lagoon and/or colonize the new lagoon (Alternative 3)? Will non-native fish invade new habitat and cause decline of gobies? Will water quality conditions in lagoon(s) continue to be suitable for gobies? Will contaminants from watershed runoff and Halaco properties affect gobies in restored habitat?
- Ridgway's rail – Will new habitats increase the expansion of Ridgway's rail from Mugu Lagoon?
- Invasive plants – Will weeds overtake restored areas? What planting practices and control measures are most effective?

Stakeholder and Regulatory

In addition to the physical, hydrological, and ecological uncertainties, there are questions related to local land and water use and regulations.

- Sewer line interactions with groundwater hydrology – How might the sewer line be changed in the future, and how would that affect local hydrology, salinity, and resulting wetland type in Area 2 and 3a on TNC property? How will the Project affect the existing sewer line infrastructure?

- Railway – What are the Port's long-term plans for the railway in the face of sea-level rise? How would restoration elements to improve hydrologic connectivity (e.g., culverts under railroad) affect drainage and hydrological regime in this area? How will wetlands respond?
- Future agriculture – How will a change or cessation of farming alter irrigation water pumping and drainage through the removal of tiles drains (if they exist), and how would that affect local resultant surface water and groundwater hydrology?
- Land acquisition – What adjoining parcels are most suitable for preserving options for upland migration of the full gradient of habitats? Which parcels may be available for future acquisition and incorporation into the OBRAP (e.g., sod farm, generating station property, Halaco Properties)?
- Permitting for wetland and special-status species – What avoidance and mitigation requirements will there be for potential impacts from construction and long-term restored habitat trajectory? Will short-term impacts on salt marsh bird's beak from habitat construction require plantings to mitigate?
- Vector risk- Will there be increased risks from mosquitoes at restored areas?
- What is EPA's remediation plan for the Halaco Superfund Site at TNC and City of Oxnard properties? What is EPA's funding and timeline? How can these dovetail with OBRAP implementation on TNC and City property?

8.3 Feasibility Study Recommended Activities

The earlier Feasibility Study (Aspen 2009) recommended activities and studies to inform project development (**Table 8-1**). Some of the short-term studies were undertaken as part of this effort, but many are either highly focused research projects, or will be more relevant for later phases after a Preferred Alternative is selected and environmental document preparation commences. We have added a column to this table to indicate current status of those recommended activities.

A list of priority studies recommended to support design is provided in **Table 8-2**. This list is informed by recent analysis leading to and including evaluation of alternatives, and is intended to support refinement of the Project Description and scoping of the environmental review. The list in Table 8-2 is based upon:

- Data Gaps (Section 8.1) and Uncertainties (Section 8.2)
- Data Gaps from the prior Feasibility Study (Section 8.3, Table 8-1) pertinent to project design and environmental review: Specifically, those included from Table 8-1 are:
  - Biological Resources
  - Environmental Resources and Physical Processes
- Studies desired to initiate CEQA and listed in Table 8-1 under:
  - Regulatory Processes
  - Economics

TABLE 8-1
SUMMARY OF RECOMMENDATIONS TO FILL PROJECT DATA GAPS (2009 FEASIBILITY STUDY)

Recommendation	Description	Project Phase	Priority in 2009	Status in 2018
Short-Term Recommendations				
Biological Resources				
Prepare Species-Specific Pre-Restoration Studies	Implement studies to understand biological attributes and relationships, refine species-specific restoration techniques, and develop success criteria for specific habitats and species. • Belding's savannah sparrow surveys • Pollinator study for salt marsh bird's beak • Wandering skipper studies • Salt marsh goldfields studies • Surveys for globose dune beetles, ciliate dune beetles, and silvery legless lizards • Determine distribution of *Juncus acutus* • Survey for three common salt marsh snail species • Survey for staphylinid beetles • Monitor New Zealand mudsnails and evaluate eradication methods • Survey small mammal populations • Experimental studies of habitat parameters of salt marsh goldfields and salt marsh bird's beak • Restoration experiments to understand design and implementation of wetland transition and upland habitat restoration	Prior to refinement and optimization of the conceptual alternatives	Critical to Advanta-geous	Not initiated.
Prepare Analysis of Environmentally Sensitive Habitat Areas (ESHAs)	Identify ESHAs in the project area	Prior to refinement and optimization of the conceptual alternatives	High	Initiated (City of Oxnard)
Prepare Essential Fish Habitat (EFH) Analysis	Identify EFH within the project area including analysis of tidewater goby habitat	Prior to refinement and optimization of the conceptual alternatives	Critical	Not initiated. EFH is for marine fish species, not applicable to goby. Intermittently open lagoon may provide limited nursery habitat.
Environmental Resources and Physical Processes				
Prepare Ecological Gaps Analysis	Identify gaps in the regional ecological functions of the project area to maximize opportunities that support weak or mission functions.	Prior to refinement and optimization of the conceptual alternatives	High	Initiated (ESA)
Complete Cross Sections	Complete two-dimensional cross sections of each of the project's conceptual alternatives in order to evaluate and compare alternatives	Prior to refinement and optimization of the conceptual alternatives	Critical	Completed (ESA)
Complete Regional Littoral Sediment Budget Analysis	Prepare a sediment budget analysis from Port Hueneme to Point Mugu to improve current predictions for inlet resistance to closure, thereby increasing the level of confidence in creating sustainable habitats for some of the project's alternatives.	Prior to refinement and optimization of the conceptual alternatives	Critical to High	No longer applicable because the project does not include a tidal inlet

TABLE 8-1 (CONTINUED)
SUMMARY OF RECOMMENDATIONS TO FILL PROJECT DATA GAPS (2009 FEASIBILITY STUDY)

Recommendation	Description	Project Phase	Priority in 2009	Status in 2018
***Environmental Resources and Physical Processes* (cont.)**				
Complete Nearshore Wave Monitoring	Develop monitoring program to assess local nearshore wave patterns to further refine and improve predictions for inlet stability and resistance to closure, which would improve the degree of confidence in developing long-term, viable wetland habitats.	Prior to refinement and optimization of the conceptual alternatives	Critical to High	No longer applicable
Complete Morphological Modeling of Inlet	Morphological modeling for conceptual alternatives that involve an inlet, in terms of location, migration, ebb and flood shoals bathymetry, and influence on their respective lagoon's tidal range, would help refine decisions related to the need for, and geometry of, jetties. The modeling would also assist with the development of site grading plans and infrastructure protection requirements.	Prior to refinement and optimization of the conceptual alternatives	Critical	No longer applicable
Prepare Agricultural Drainage Study	Assess the project area's agricultural drainage connectivity, discharge and conveyance capacity. The study should include assessment of subsurface drains and limiting culvert capacity of the duck club property to ensure that the water supply needed for the project is sufficient.	Prior to refinement and optimization of the conceptual alternatives	Critical	Not initiated
Prepare Sea-Level Rise and Coastal Flood Inundation Study	Predict changes to the project area's coastline in response to anticipated sea-level rise and assess the project area's coastal flood inundation zones as they relate to sea-level rise. The results of the Study would be useful for land acquisition strategies, as well as establishment of final engineering and design plans as well as grading plans.	Prior to or during refinement and optimization of the conceptual alternatives	Critical	Completed (ESA and TNC CRV)
Prepare Groundwater Study	The groundwater study would assess the hydraulic conductivity and groundwater flow rates in the project area's semi-perched surface aquifer and examine the connectivity between semi-perched and deep aquifers to assess potential salinity intrusion. Identification of the potential location of seeps and springs fed from shallow groundwater sources for each alternative also is important for potential establishment of brackish marsh habitat and non-tidal palustrine marshes on the margins of estuary.	Prior to preparation of the project's environmental review document	Critical	Initiated
Prepare a Subsidence Feasibility Analysis	Assess of the feasibility and costs of pumping groundwater to cause managed subsidence of the project area to reduce the need for excavation and provide a water source for the project. If this analysis concludes that managed subsidence is a viable option for one or more alternatives, it would likely lessen project implementation costs due to reduced excavation costs.	Prior to or during refinement and optimization of the conceptual alternatives	Critical	No longer applicable
Complete Water Quality Monitoring and Sampling Program	The program would ensure that the quality of the water sources required for the long-term sustainability of the project is adequate. The program should include a wide range of sampling locations and be undertaken over multiple seasons.	Initiated prior to or during refinement and optimization of the conceptual alternatives	Critical	Not initiated.

TABLE 8-1 (CONTINUED)
SUMMARY OF RECOMMENDATIONS TO FILL PROJECT DATA GAPS (2009 FEASIBILITY STUDY)

Recommendation	Description	Project Phase	Priority in 2009	Status in 2018
***Environmental Resources and Physical Processes* (cont.)**				
Prepare Ecological Risk Analysis	Analysis would further evaluate the historic and existing contaminant sources within and surrounding the project area to determine: (1) the volume of excavated soil that could be reused on-site versus the volume of excavated soil that would need to be transported and disposed of off-site; and (2) the potential effects of these contaminant sources on the habitats created. The archived soil samples that were collected during the project's Site-Wide Soil/Surface Water Investigation are recommended for this analysis.	Prior to or during refinement and optimization of the conceptual alternatives	Critical	Not initiated
Integrate Public Access and Recreation Plans into Project Design Plans	Integrate the "Access Vision Plan" into the conceptual alternatives that have been developed for the project. The process would require careful consideration of the project's habitat restoration goals and objectives versus public access and use and the restrictions that may be necessary for habitat protection.	During refinement and optimization of the conceptual alternatives	Critical	Completed (ESA)
Regulatory Processes				
Identify Proposed Project	Establish which alternative is the "proposed project" for completion of the environmental review and decision making process.	Prior to preparation of the project's environmental review document	Critical	Not initiated
Identify and Coordinate with the Federal Lead Agency	Verify that the project's environmental review requires consideration under NEPA and that the USACE will act at the federal Lead Agency.	Prior to preparation of the project's environmental review document	Critical	Not initiated
Initiate Public and Involvement and Participation Program	Facilitate the public's understanding, acceptance and support of the project. This program would also assist with the early resolution of possible issues of concern and controversy that could hinder the environmental review process.	Prior to preparation of the project's environmental review document	Very High	Initiated
Initiate Informal Agency Consultations	Facilitate the project's regulatory permit acquisition process and ensure that agency concerns are appropriately addressed in the project's environmental review document.	Prior to preparation of the project's environmental review document	Very High	Not initiated
Complete Formal Wetland Delineation	A formal wetland delineation of the project area is needed to support regulatory permitting with federal agencies including the USACE and USFWS, and State agencies including the CDFG and CCC.	Prior to preparation of the project's environmental review document	Critical	Not initiated
Complete Cultural Resources Phase I or Phase II Investigation	Ascertain if significant cultural resources would be affected by project implementation so that a Section 106 consultation process can be initiated as soon as possible.	Prior to preparation of the project's environmental review document	Very High	Not initiated
Complete Environmental Review and Permit Acquisition Processes	Ensure that all regulatory review processes and approvals are complete prior to project implementation. Some permits may not be issued until final design is complete.	Initiate during the preparation of the project's environmental review document	Critical	Not initiated
Prepare Wetland Restoration Management and Monitoring Plan	The Management and Monitoring Plan (MAMP) will guide all future phases of the project once the proposed project has been established.	Complete draft plan prior to preparation of the project's environmental review document	Critical	Initiated (ESA)

TABLE 8-1 (CONTINUED)
SUMMARY OF RECOMMENDATIONS TO FILL PROJECT DATA GAPS (2009 FEASIBILITY STUDY)

Recommendation	Description	Project Phase	Priority in 2009	Status in 2018
Economics				
Complete Cost Feasibility Analysis	Complete a detailed cost feasibility analysis of the project's refined and optimized alternatives to determine if any of them are too costly to pursue. This analysis would help "pare down" those alternatives that were ultimately considered infeasible, and would provide information for pursuit of potential funding sources.	Prior to preparation of the project's environmental review document	Critical	Not initiated
Assess Funding Potential Under the Calleguas Creek In-Lieu Fee Program	Ascertain if the project is a candidate for funding under the in-lieu fee program for Calleguas Creek	Prior to or during preparation of the project's environmental review document	Very High	Unknown
Complete Carbon Sequestering Analysis	Estimate and compare carbon sequestration potential of the project's refined and optimized alternatives (tidal marsh vegetation). Partial project funding may be available from the sale of carbon credits for carbon sequestered as a result of project implementation.	During (as part of) preparation of the project's environmental review document	High	Initiated (ESA and TNC CRV)
Long-Term Recommendations				
Biological Resources				
Develop and Implement Seed Collection Program	Program would collect seed on-site and the propagate plant materials for long-term use within the project area. Implementation of the program would help maintain local genotype and may be the only viable method of providing the required plantings necessary for full restoration.	Initiate soon after the approved project has been identified and all properties for project implementation have been secured.	Very High	Not initiated
Environmental Resources and Physical Processes				
Implement Wetland Restoration Management and Monitoring Plan	Implementation of the Wetland Restoration Management and Monitoring Plan will be the primary mechanism for the project's short- and long-term success. Regular evaluation and revision to the MAMP will help achieve a long-term management strategy that is flexible and adaptive to resource/issue specific site conditions as they evolve.	Implement as first task of any pre-construction activities. Evaluate and revise every 5 years or as warranted by the Project Area conditions	Critical	Not initiated
Regulatory Processes				
Develop and Implement Permit Compliance Plan	The Compliance Plan is to ensure that all conditions of the project's regulatory permits and approvals are implemented, including any required reporting.	Development of the Plan's organization and structure should begin during the project's regulatory permit acquisition process and completed immediately upon receipt of all of the project's regulatory permits and approvals	Very High	Not initiated
Economics				
Develop Long-Term Funding Program	Develop and implement a strategy that would ensure a funding source (or sources) for the project's long-term management and monitoring	The program should be developed and implemented as soon as the approved project is established and the properties necessary for its implementation are secured	Critical	Initiated

SOURCE: Aspen 2009

TABLE 8-2
LIST OF PRIORITY STUDIES

Priority	Study	Comments
1.	Hydrology: Surface and Groundwater Characterization	This study addresses the Hydrology Surface and Groundwater characterization identified in Section 7.1, including data collection. Install instrumentation to record water levels and salinity at selected locations. Extend the data collection period to include periods of rainfall and elevated water runoff and water levels, including flooding of the site and discharge from the Ormond Lagoon. Include a time-lapse camera to record Ormond Lagoon mouth conditions (open, closed, or intermediate) so that lagoon response to drainage and ocean hydrology is better understood. Establish a stream gauge station on Ormond Lagoon Waterway (OLW) to better characterize flowrates as a function of water level: Coordinate with the Ventura County Watershed Protection District for location and other parameters. A minimum period for the data collection period is 1 year; however, an ongoing program is recommended to both inform restoration as well as site management.
2.	Vegetation Conceptual Model	This study addresses soil conditions for plant establishment and habitat enhancement/creation as well as partially addressing Surveying and Vegetation Mapping identified in Section 7.1. Conceptual model of habitats will be developed to inform restoration design and assessment of effects/ effectiveness of candidate restoration actions. The conceptual model should look for correlations of surface elevation, soils, groundwater and vegetation overall and by area, with the aim of identifying restoration actions (e.g., change surface elevation, soils and or inundation) to affect vegetation and hence habitat. The analysis should include degraded areas in order to diagnose causes and hence conditions to avoid and correct during restoration. Field data collection is necessary to characterize soils and map vegetation. Soil cores will be analyzed in a laboratory for texture, salinity and chemistry. Vegetation mapping will be improved generally but in particular in the vicinity of other data collection (soil, groundwater, elevations). An adaptive data collection and test-plot program should be considered.
3.	Soil and water quality	This study addresses the contamination and water quality unknowns identified in Section 7.1. A soil and water quality sampling and testing program is recommended to confirm or refine the proposed restoration project description. A sampling and testing plan will be developed based on a summary of available data and information, and consideration of the limits of earthwork and water sources. Depending on the results, additional sampling and testing may be desired. We envision a Phase 1 Environmental Site Assessment followed by a Phase II Assessment for the areas potentially disturbed by the project and alternatives. This work should utilize information available from the EPA in the vicinity of the Halaco parcels, and other available information for the rest of the site.
4.	Revised Project Description	A project Description is needed for the Environmental Review, as indicated in Table 7-1 under Regulatory Processes. Include cost information per Table 7-2 Economics, need for cost feasibility analysis. Develop a project description with sufficient detail and specificity to support environmental review. The preliminary project description will be refined based on the results of the technical studies including 1, 2 and 3 listed above.

TABLE 8-2 (CONTINUED)
LIST OF PRIORITY STUDIES

Priority	Study	Comments
5.	Agricultural drainage and water management Topographic data collection in areas where LiDAR data accuracy is not adequate, to characterize habitat distribution relative to elevation Vegetation mapping (high resolution) and monitoring of target habitats and species Photo documentation and seasonal and inter-annual measurements of the beach crest and lagoon mouth morphology Property boundary survey and easements. Locations and tolerances of buried infrastructure Property lines Cultural resources survey	Priority 5 is assigned to the remaining items in the Data Gaps list in Section 8.1.
6.	Wetland Assessment / Wetland Delineation	A wetland delineation is typically needed for the EIR, as indicated in Table 7-1 under Regulatory Processes. Given the size of the site and extent of wetlands, and the nature of the project (ecological enhancement), we recommend considering an assessment instead of a more formal wetland delineation. The level of detail in the wetland Delineation / Assessment for the EIR and for subsequent permitting should be evaluated. This information may be generated before starting the EIR, and used to establish the baseline.
7.	Biological Resources	This Biological Resources Study would satisfy a need for the CEQA process and the data needs “biological Resources” in Table 7-1. A biological resources technical report is desired for the EIR, and may need to be initiated prior to the EIR in order to complete species surveys at the appropriate time of the year. We anticipate that the some of the information may be available from agencies that monitor species activities. This work should be accomplished just before the EIR as part of the baseline. Additional species surveys may be needed.
8.	Biological Assessments	Biological assessment(s) for USFW and possibly NMFS may be integrated with the CEQA analysis. Strategic planning for the Biological Assessment(s) is recommended early on in the EIR process, with a strategic consideration of future Biological Opinion(s) for endangered species.
9.	Flood Hazard	An assessment of project effects (including alternatives) on flooding will be required during the EIR. Subsequent certification of no-rise in flood level or a flood Map Revision may be required in subsequent design and permitting.

The list of studies and priorities should be updated as new information is generated and needs are reassessed. A new priority action is to coordinate the OBRAP with the WRP Restoration Project List. The SCWRP will be updating its list of restoration projects that are in alignment with the 2018 Regional Strategy Update. Projects that are not currently on the list must complete a project application. This action is not listed in Table 8-2 because it is a not a OBRAP study.

8.4 Adaptive Management and Adaptive Restoration

The Project will use an adaptive management approach and will apply adaptive restoration where appropriate and feasible. The large size of the Project Area, the need for phasing of restoration implementation in different areas over time, and the inherent uncertainty related to existing and future conditions make this an ideal site for employing a combined adaptive approach. Early phases could be installed on relatively small scales. The results of early phases would increase understanding of the site and allow for refinement of plans for subsequent phases. For instance, early projects could be located in disturbed areas where there are opportunities to provide ecological lift with only minor manipulations to hydrology with revegetation. Planting experiments could assess which species perform best at different elevations, with different types of soil amendments. Vegetation responses should be compared to data collected on important physical drivers such as soil salinity and hydrology to inform plausible predictions of which species will perform best under different conditions. Experimental dune swales and flow alterations in ODD #3 are also examples of testing and refining methodologies using targeted studies and monitoring over time. This type of small-scale testing and monitoring would allow refinement of restoration actions to support a range of target habitats as large-scale project phases are implemented.

Ideally, adaptive restoration uses controlled, manipulative field experiments that employ a range of approaches (i.e., treatments) in replicated areas (Zedler 2016). Monitoring and statistical analyses can then be applied to assess potential differences in outcomes between the different approaches. The most effective approaches can then be applied on larger scales, in future phases and/or in other areas. For example, at Tijuana Estuary a field test of alternative planting methods found better growth of seedlings planted in tight clusters, near creeks and with soil amendments (O'Brien and Zedler 2006).

Adaptive management/restoration will be especially useful at the Ormond Beach site, where hydrologic, salinity, and soil conditions vary widely both spatially and temporally, and are, at present, only partially understood. Expanded baseline monitoring will document conditions and improve understanding of how proposed manipulations associated with restoration actions can lead to support for target ecosystem functions. Nevertheless, it is expected that even with more data and modeling, there will remain considerable uncertainty as to what plant species will occur at what elevations in different areas of the site. Climate change and sea-level rise will add further complexity.

Learning from past experience is another tool in the adaptive management structure. For instance, the Navy has been implementing wetland and marsh restoration at the adjacent NBVC–Point Mugu for many years. Working with their ecologists to share "lessons learned" can inform restoration methodologies at Ormond Beach. Similarly, efforts under way at the Tijuana Estuary National Estuarine Research Reserve in San Diego County and at Devereux Slough in Santa Barbara County can inform restoration goals and practices at Ormond.

This process of structured learning and decision making is a critical component of successful restoration. Structured learning requires a clear understanding of how monitoring data will be used to make management decisions and achieve objectives. For example, Zedler and Callaway

(2000) applied progress-based perspectives to successful wetland restoration, focused on understanding problems at a particular site by identifying cause–effect mechanisms. They recommend experimentation and the evaluation of ecosystem resiliency to unplanned disturbances as the best means to measure restoration success.

As project elements are designed and implemented in future phases, the baseline conditions of the site will change. Long-term data sets characterizing physical and biological drivers will be critical to long-term planning and management of the site, particularly due to the sites' sensitivity to sea-level rise. Continuous monitoring of surface water and groundwater elevations and salinities, establishing permanent transects through restored and existing high-functioning habitats to assess vegetation changes over time, and building on existing data sets of bird use at the site would be extremely advantageous. Ongoing monitoring of the early-phase restoration /pilot projects is indicated in an adaptive restoration approach. Such long-term data sets and monitoring can be implemented through success monitoring associated with grant implementation, citizen science and university undergraduate and graduate studies.

Site-specific knowledge about outcomes of restoration actions targeted to specific species or habitats will greatly increase implementation efficiency and likelihood of success for future restoration efforts in the Project Area as well as among other coastal locations. Documentation of large-scale changes at the site can inform coastal restoration and conservation approaches along the California coast and beyond.

An adaptive management framework for the Project will be developed further after the design of the Preferred Alternative is fleshed out, with involvement from the SAC. The framework will identify metrics to track progress in meeting OBRAP objectives and evaluate effectiveness of restoration actions, and outline a process to guide management decisions. Management of the restoration site should include opportunities for mid-course corrections as mistakes and/or unexpected benefits are realized. This applies to both ecosystem and public access outcomes.

Ultimately, a monitoring and adaptive management plan (MAMP) will be prepared once the Project has reached a more advanced design and has commenced preparation of environmental documents. The final MAMP will address these uncertainties and other objective-based performance questions in a phased, adaptive approach. Issues that require more in-depth analysis may be referred to separate focused investigations.

SECTION 9
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SECTION 10
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Appendix A
Historical Conditions

APPENDIX A
Historical Conditions

1. Introduction

Understanding historical landscape patterns, their physical and ecological characteristics, the dynamic processes that shape the landscape, and the effect of human alterations is an important step in determining appropriate goals and opportunities for restoration and conservation. Historical ecology focuses on the interactions between people and the environment over long periods of time. This report focuses on aspects of the historical ecology of the Ormond Beach area to inform the Ormond Beach Restoration and Public Access (OBRAP) planning process.

The San Francisco Estuary Institute (SFEI) presents an excellent and detailed analysis of the historical ecology of the Ventura coast using the earliest maps, photographs, and historical accounts (Beller et al. 2011). Their analysis focuses on what our coastal wetlands and associated habitats might have looked like in the mid to late 19^{th} century and how they changed in to the early 20th century. These early sources are our best chance at understanding our natural landscapes as they existed before the wholesale changes that have occurred over the last 150 years.

However, humans (Native Americans and early European settlers) were already having dramatic impacts on California's landscapes prior to the earliest maps and photographs and modifications to natural features have continued until recent times. Just as importantly, California's coastal ecosystems are naturally dynamic and are constantly responding to, and recovering from, rare extreme natural events and, in more recent times, man-made alterations. This report augments the SFEI analysis with additional references and assesses changes that have occurred from the early 20^{th} century up until recent times.

2. Natural Dynamics

Southern California's landscapes have never been fixed. They respond in dramatic ways to natural forces including droughts, floods, geologic shifts (uplift or subsidence), tsunamis, and large wave events. The coast between the Ventura River and Point Mugu is a vast delta formed by the Santa Clara River, and to a lesser extent the Ventura River and Calleguas Creek. These rivers, especially the Santa Clara, have shifted course over the last several hundred years in response to natural forces (Beller et al. 2011). Estuaries formed at these shifting river mouths, a process repeated over thousands of years. The result was a dynamic complex of coastal wetlands that were intermittently connected to rivers and the ocean. Based on maps made in the 1850s

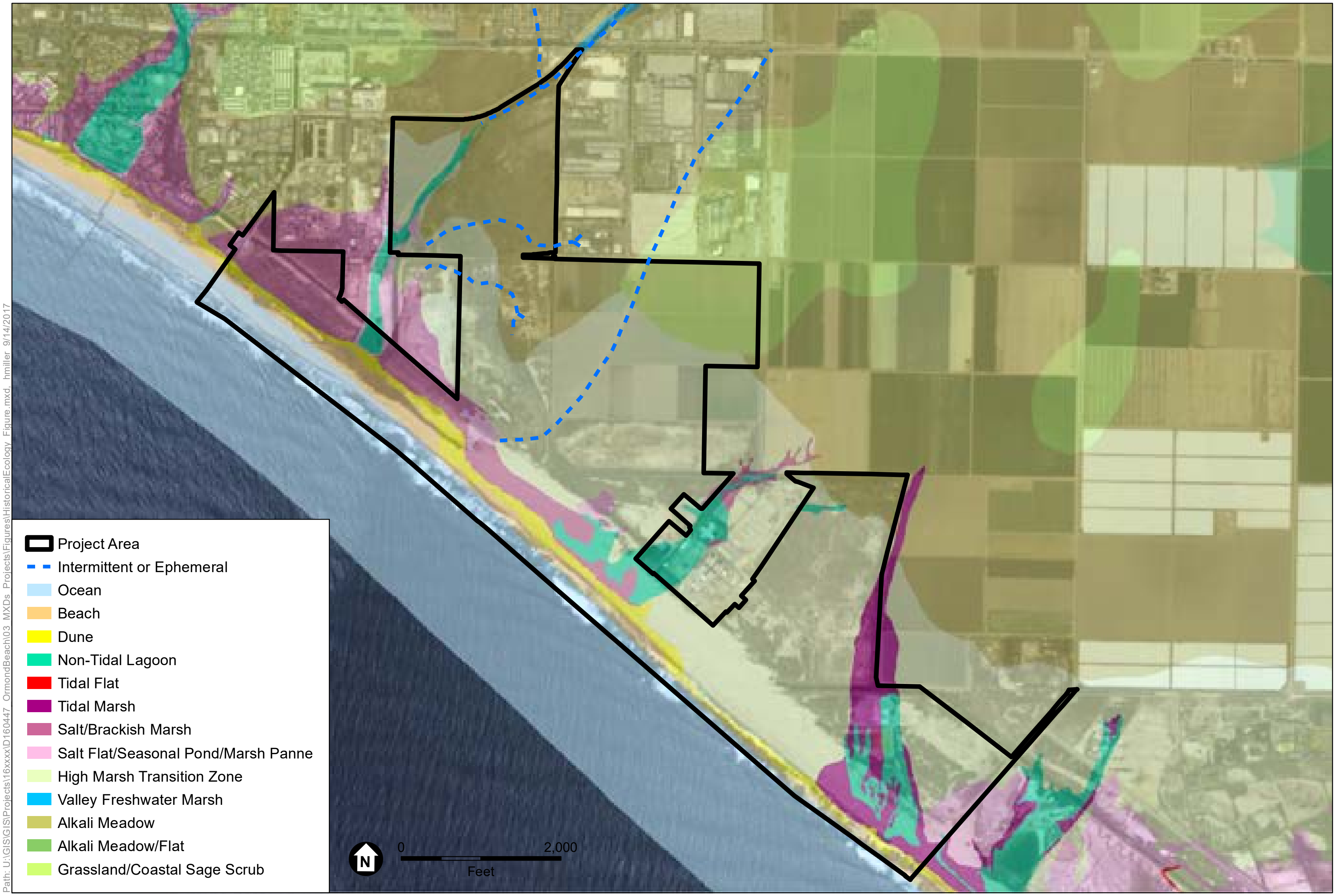
(**Figures A-1 and A-2**), Beller et al. (2011) estimated there were over 2,600 acres of open water, marsh, and transition habitats between (but not including) the current mouth of the Santa Clara River and Mugu Lagoon. These coastal wetlands functioned differently when they were connected to riverine inputs compared to periods when river mouths shifted elsewhere. Evidence suggests that the Santa Clara River may have moved to its current location as recently as 1812. Prior to this time the mouth was probably located near present day Port Hueneme with previous channels and estuaries more or less at the current location of the Ormond Lagoon (Beller et al. 2011).

Seven wetland areas with open water were mapped in the 1850s between Point Hueneme and Mugu Lagoon (Figure A-2). These probably represent historic mouths of the Santa Clara River. Early maps and other historical sources suggest that most of these wetlands were hydrologically connected to each other (at least in wet years), saline (brackish to hypersaline), and generally non-tidal (Beller et al. 2011). The source of salt was probably wave over-wash of the beach/dunes during winter storms. The wetlands in the vicinity of the Beach likely only connected to the tidal Mugu Lagoon in very wet years (presumably draining to the Mugu Lagoon). The lagoon just east of Hueneme (Figures A-1 and A-2) was noted in the late 1800s to have perennial fresh-to-brackish water and was fed by springs (Beller et al. 2011). Surface or sub-surface flows from the springs may have influenced the wetland areas further east as well. In general, though, these eastern wetland areas were probably intermittently flooded by rainfall or wave over-wash events as they tended to be referred to either as ponds or salt flats at various times.

3. Early Human Influences

Humans probably arrived in Southern California about 13,000 years ago (though recent evidence suggests the date may be closer to 130,000 years ago (Holen et al. 2017)) near the end of the Pleistocene Epoch. About 11,000 years ago, the diverse Pleistocene megafauna that had characterized much of California for over a million years was extinct. The loss of these huge grazers likely caused major shifts in plant communities. Over the next several millennia, early human societies manipulated landscapes with fire (intentionally or otherwise), moved species around (intentionally or otherwise), and employed various forms of agriculture.

By the time the first Europeans arrived in California in the early 16th century, the landscape looked very different. The Portola Expedition of 1769, one of the first overland explorations of Southern California, provided some accounts of what the landscapes looked like and how the Native Americans lived in relation to the land before European settlers arrived. The expedition passed through the Ventura area twice, but they reported little related to the natural landscapes. They found a large town of natives established near the mouth of the Ventura River. When they left Ventura heading north, Fray Juan Crespi wrote: "*At the start we crossed the river, which gave us some trouble on account of the stones and the large amount of water which ran above them*." (Bolton 1927). The observation of so much water is noteworthy since it was mid-August. Today, it would be rare for there to be significant natural flow in the Ventura River near the coast in August. The coastal wetlands of Ventura County probably experienced different hydrologic conditions before human modifications to streams, rivers, and shallow groundwater modifications began in the early 1800s.



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Source: ESRI 7/19/2016, San Francisco Estuary Institute, Ventura County,

Ormond Beach Wetlands Restoration

Figure A-1
Project Area Historic Ecology
in the Early 1800s

ESA

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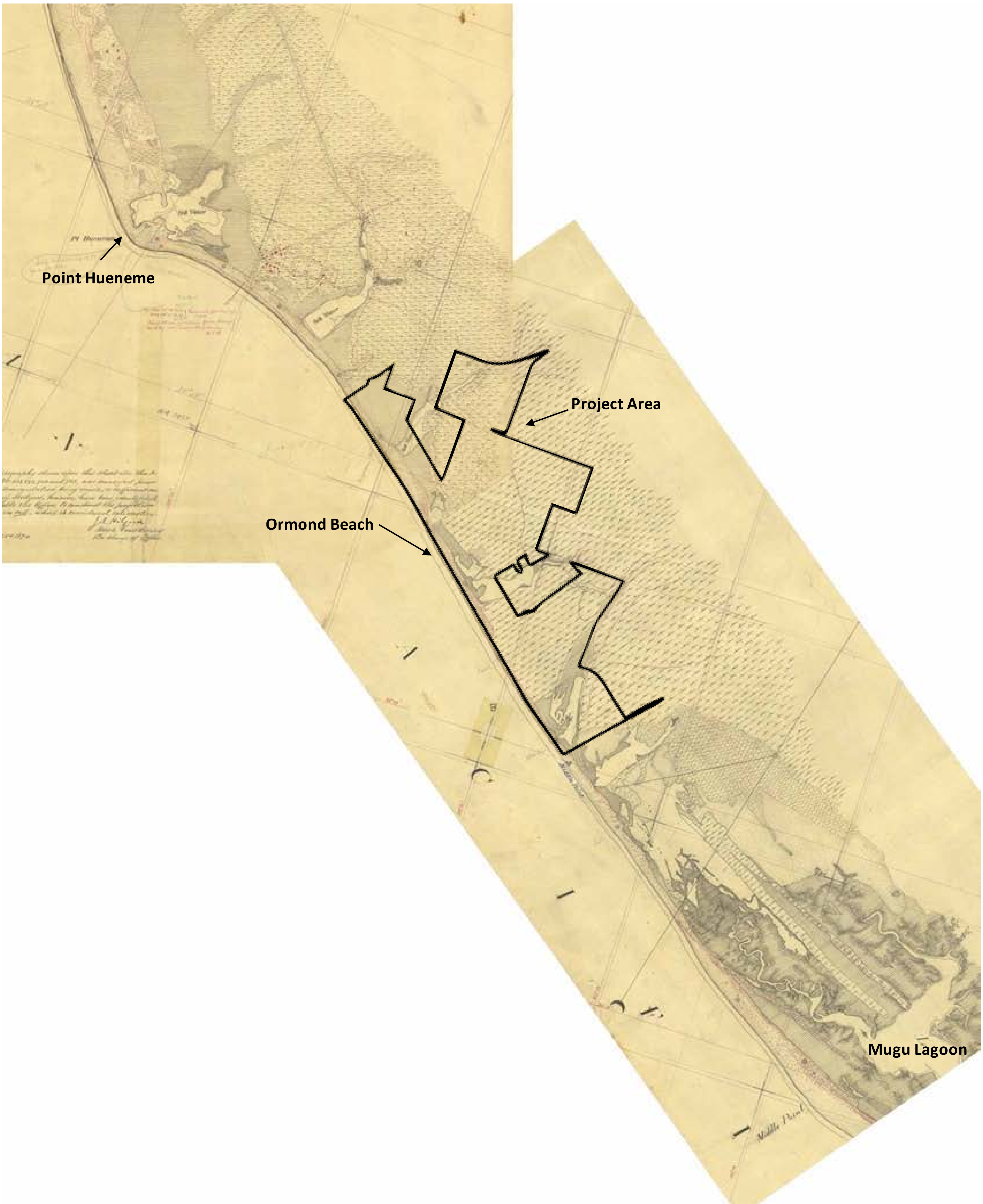

SOURCE: U.S. Coast Survey Maps of California

Ormond Beach Wetlands Restoration

Figure A-2
1855/57 Coast Survey T-Sheets

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4. The Spanish and Mexican Ranchos (1780s–1860s)

Spanish colonists soon followed the Portola Expedition, establishing a mission at Ventura in 1782. The missionaries brought an end to most of the traditional hunting, gathering, and agricultural practices of the Native American societies in the region. The natural landscapes of Southern California would undergo huge changes again. The Spanish introduced many plants (intentionally and unintentionally) and livestock to California. Agriculture expanded using Native American labor, and ranching became the backbone of the new economy.

The Mission San Buenaventura brought the first European-style agriculture to the area along with cattle and sheep. At its height, the mission's herd included 23,000 cattle and 12,000 sheep, which ranged throughout the Oxnard Plain and surrounding hills (San Buenaventura Research Associates 2014). All California missions were secularized in 1833, and their lands seized by the Mexican government and subsequently granted to Mexican citizens. The settlers primarily raised cattle, which grazed throughout the landscape and had devastating impacts on natural communities. During droughts, cattle and sheep would eat almost anything that was green, leaving vast tracts of land totally unvegetated. During this period plants introduced from Europe became invasive in their new setting. By the early 1800s invasive plants such as black mustard (*Brassica nigra*) dominated huge tracts of land throughout Southern California (Minnich 2008).

The profound impact of grazing on the habitats and natural processes was exacerbated during extreme natural events. In the winter of 1861-62 a storm battered California for several weeks straight, causing catastrophic flooding (Dettinger and Ingram 2013, Ingram 2013). The Ventura area reportedly received rain for 60 straight days (Mason 1883) during this atmospheric river event. Mason (1883) described conditions in Ventura thus: *"...so many land-slides happened that the face of the country was materially changed. In certain localities half of the land was moved a greater or less distance.*" This epic event delivered huge amounts of sediment into coastal wetlands and probably led to lasting changes to landforms and habitat distributions.

5. Farming, Hydrological Modifications, and Industrial Uses (1860s–Present)

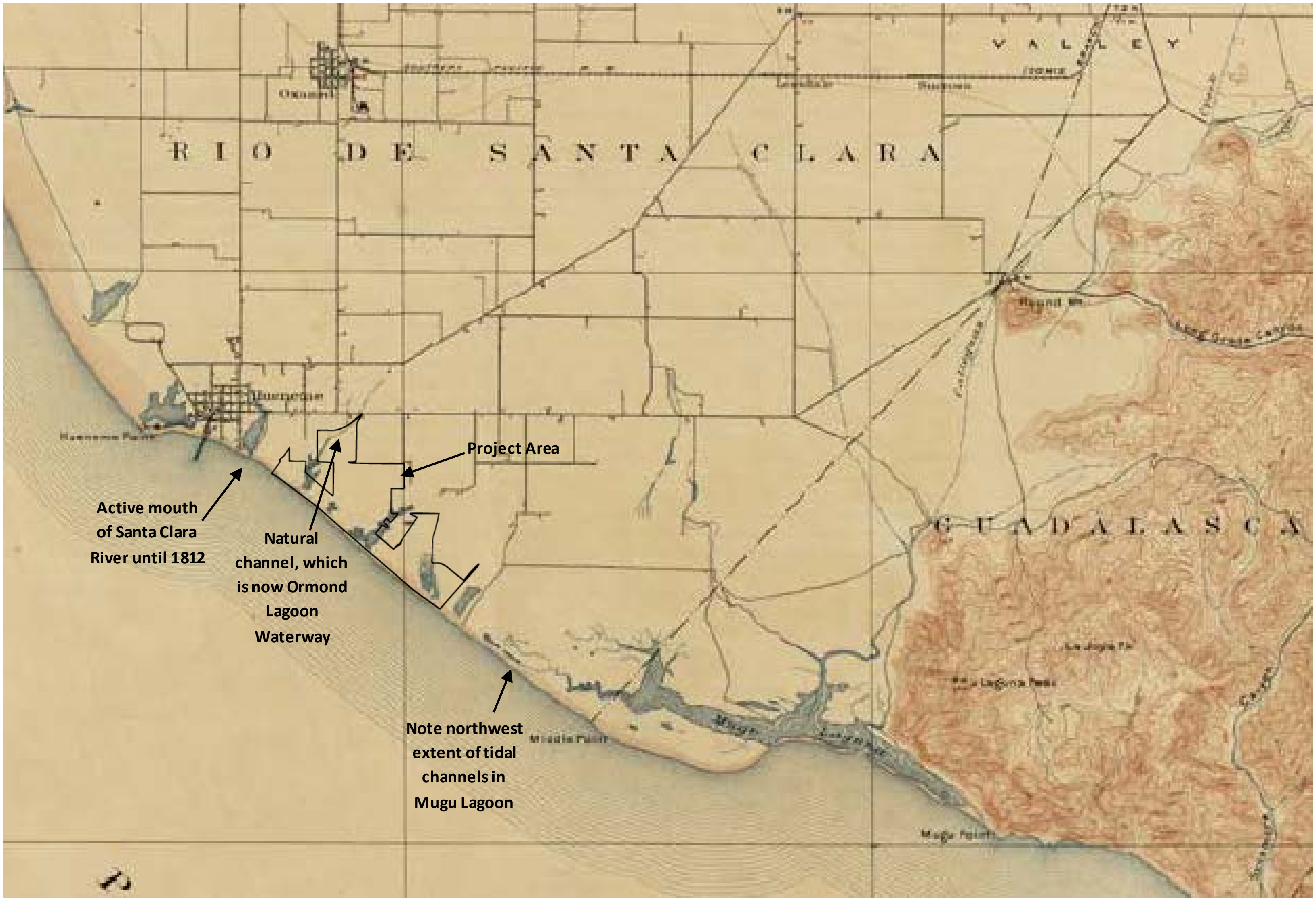
Following the devastating drought of 1863–64, in which the majority of cattle starved to death, the Southern California economy shifted from ranching towards farming (Troxell 1957), especially in areas with fertile soil and a water source for irrigation. Rapid conversion began on the Oxnard Plain in 1868, and by the early 1870s most of the plain was being farmed (Storke 1891).

The expansion of farming increased demand for more reliable sources of water, which led to hydromodification of the area. In 1871, the Santa Clara Irrigation Company was formed and dug a 12-mile-long canal (plus side branches) from the Santa Clara River to lands of an old rancho. This canal is not seen on early maps but followed what is, today, Rose Avenue from El Rio to Hueneme (San Buenaventura Research Associates 2014). As early as 1871, farmers on the Oxnard Plain started digging wells 125 to 150 feet deep that produced artesian flows. One well was said to be sufficient to irrigate 160 acres of grain (Storke 1891). A well dug by T.R. Bard in 1871 near Hueneme produced so much water that a ditch was dug to carry away the excess (Storke 1891). By the early 20th century, however, pumps were needed on most wells (San Buenaventura Research Associates 2014) as the aquifer was depleted.

The digging of ditches to control the movement of water continued as farming spread throughout the area. Tile drains were installed to drain salty marshland starting in 1901 (San Buenaventura Research Associates 2014) north of Hueneme (**Figure A-3**). South of Point Hueneme, agriculture had crept close to the coast by 1929, although the various lagoons in this area were still relatively intact (**Figure A-4**). The 1943 topographic map (**Figure A-5**) shows a ditch, referred to as Old Oxnard Drain or East Hueneme Drain, that leads from Bubbling Springs to Mugu Lagoon. This ditch can also be seen in an aerial oblique photo from 1942 (**Figure A-6**) and in the 1945 aerial (**Figure A-7**). The series of wetlands seen on earlier maps (Figure A-3) and aerial photos (Figure A-4) between Hueneme Point and Mugu Lagoon started to disappear and shrink during this time, drained by the ditch. The most dramatic conversion was to the permanently flooded lagoon south of Point Hueneme (Figure A-4), which is essentially gone by 1945 (Figure A-7). Remnants of the other wetlands can still be seen in 1945, although agriculture continued to take over more former wetlands (Figure A-7). While the central part of the East Hueneme Drain is gone today, the Ormond Beach Wetlands and the surrounding landscape are still bisected by numerous ditches, designed to deliver or remove water from various areas. Some of these ditches continue to affect the hydrology of the wetlands that remain.

Other significant hydromodifications in the area were done for the sake of duck hunting. The Ventura County Game Preserve Association was founded in 1908 and purchased between 1,200 and 2,500 acres of marshland near Mugu Lagoon and managed it for duck hunting (San Buenaventura Research Associates 2014). In 1929, the Point Mugu Game Preserve Association formed and developed 132 acres of ponds managed for duck hunting. The development of the duck ponds involved dividing up marshlands with berms, managing water levels with pumps and valves, and introducing species such as wild rice to attract different types of fowl. By 1945, a large area of duck ponds is evident north of Mugu Lagoon (Figure A-7). More duck ponds were established after 1945 northwest of Arnold Road **(Figure A-8**) on what is now California State Coastal Conservancy (SCC) property. It is not known how long these areas were managed for hunting, but many of the berms can still be seen today in the wetlands that remain.

Establishment of the Naval Air Station Point Mugu (now operated as the Naval Base Ventura County Point Mugu [NBVC]) also altered drainage and tidal exchange. Runway construction started in 1941. An agricultural drainage ditch (Oxnard Drainage Ditch #3) now drains east under Arnold Road, through the NBVC, and through a series of culverts under the NBVC runway and two roads, to Mugu Lagoon. This has impeded drainage to Mugu Lagoon and reduced and muted tidal exchange north of the runway.



SOURCE: United States Geological Survey (USGS)

Ormond Beach Wetlands Restoration

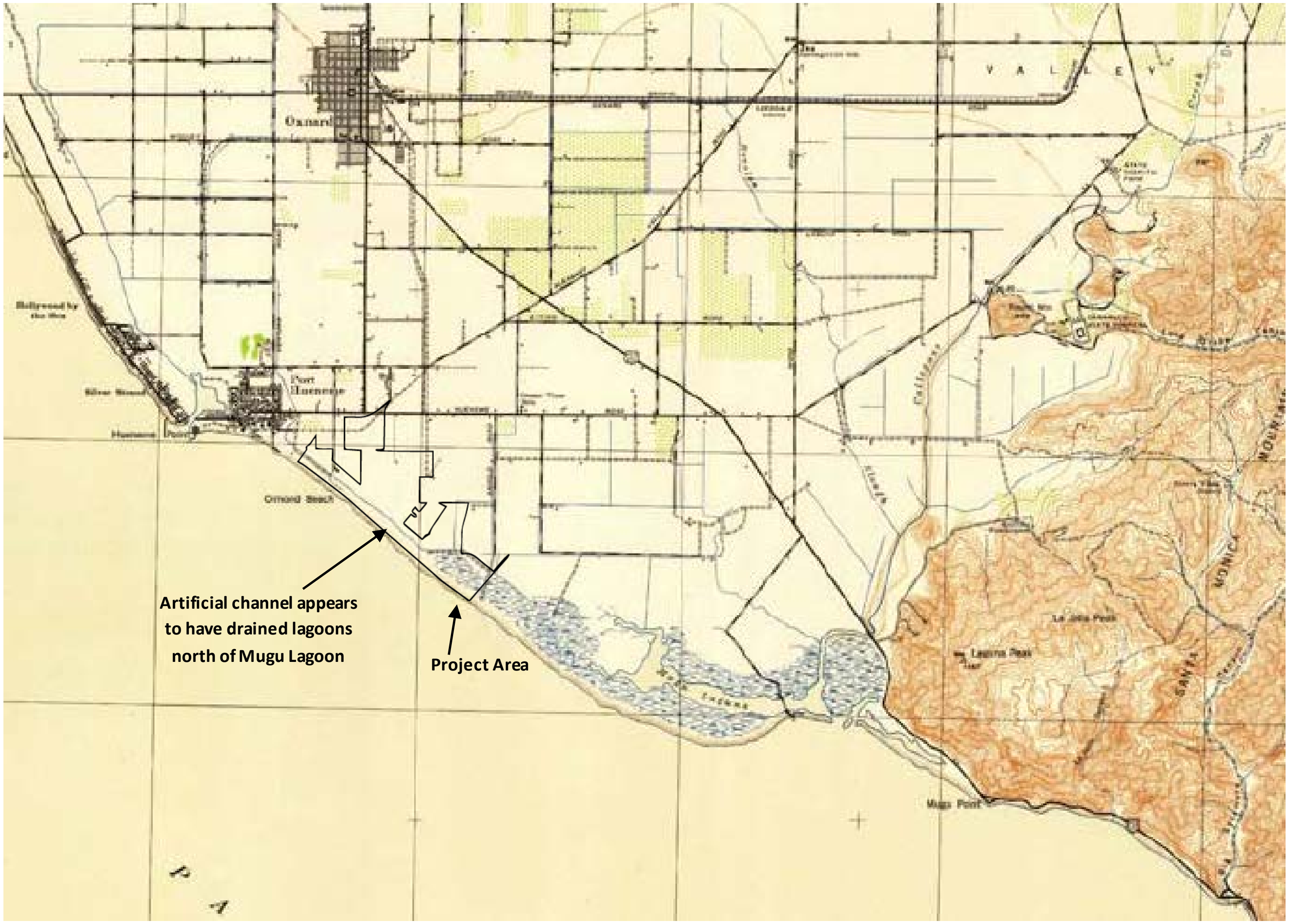
Figure A-3
1901 US Coast and Geodetic Survey Map, Hueneme Quad

SOURCE: UCSB Maps and Imagery

Ormond Beach Wetlands Restoration

Figure A-4
1929 Aerial Photo

ESA Coastal Restoration Consultants



SOURCE: United States Geological Survey (USGS)

Ormond Beach Wetlands Restoration

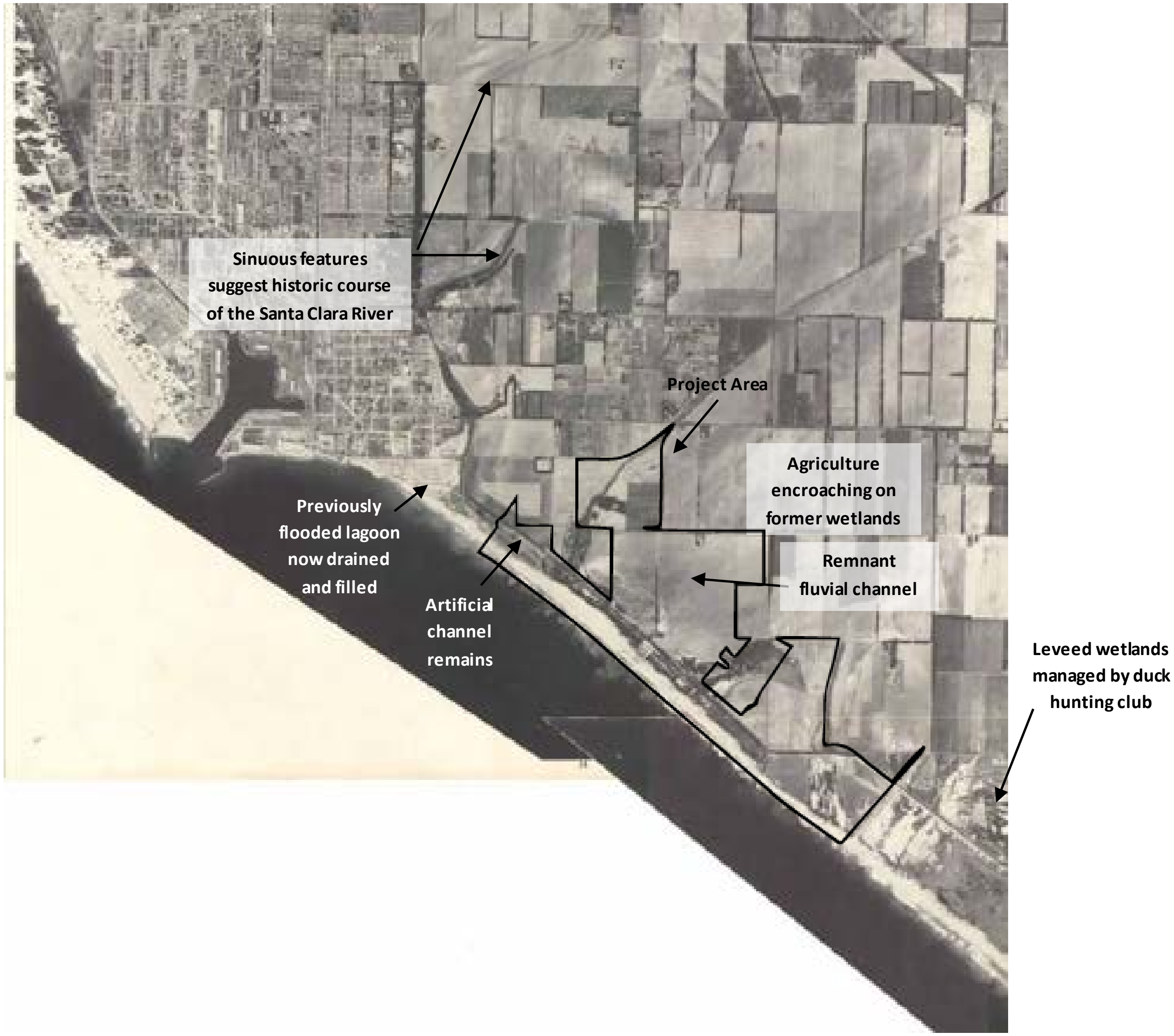
Figure A-5
1943 USGS Topographic Map, Hueneme Quad

SOURCE: http://seabeemagazine.navylive.dodlive.mil/

Ormond Beach Wetlands Restoration

Figure A-6
1942 Aerial Oblique Photo

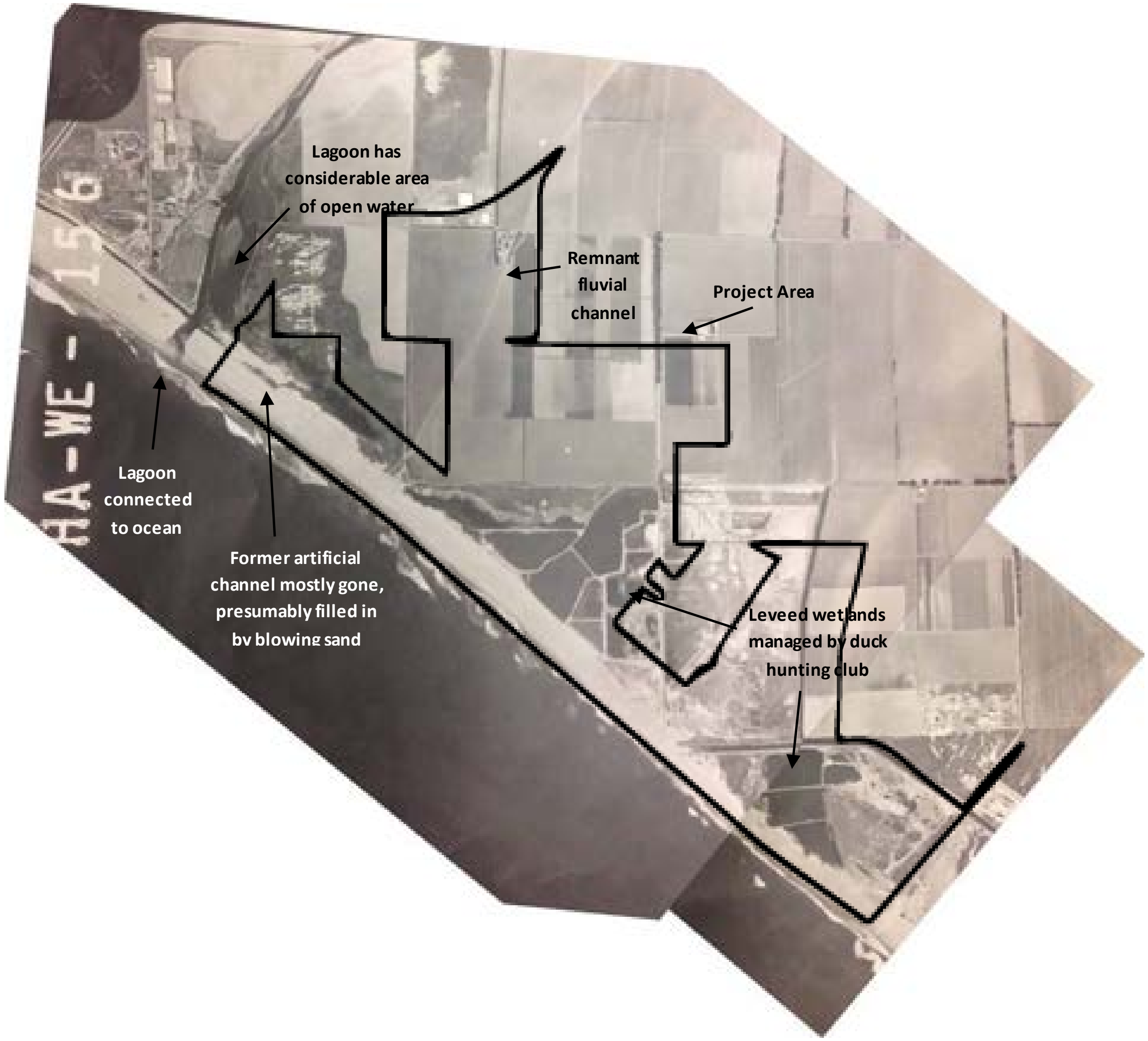
ESA Coastal Restoration Consultants



SOURCE: UCSB Maps and Imagery

Ormond Beach Wetlands Restoration

Figure A-7
1945 Aerial Photo



SOURCE: UCSB Maps and Imagery

Ormond Beach Wetlands Restoration

Figure A-8
1964 Aerial Photo

ESA Coastal Restoration Consultants

Another driver in the loss of wetlands in the project area was a rapid episode of coastal retreat that occurred after the Port of Hueneme was built in 1940. The jetties that protect the mouth of the port essentially stopped all down-shore transport of sand immediately following construction. Almost all of the sand moving down-coast to the project area from the northwest was trapped north of the new jetty, or diverted by the jetty to an offshore canyon, where it was lost to littoral processes (Herron and Harris 1966). While this made for a virtually maintenance-free harbor mouth, the effects down-coast were dramatic. By the mid-1960s the sand-starved beach and dune system in the project area retreated landward about 150 feet (**Figure A-9**). The beach and dune system did not get noticeably narrower between 1929 and 1964, it simply moved inland (Figure A-9). Over 100 acres of wetland were converted to dune and beach habitat during this time. In the mid-1960s, construction began on Channel Island Harbor just north of Port Hueneme. Sand supply to the project area changed in two important ways as a result. First, when Channel Island Harbor was dredged, much of the sand was discharged south of Port Hueneme, which delivered a one-time pulse of sand to the beach. Second, the harbor's northern jetty, which acts as a huge sand trap, is now regularly dredged and the sand is moved down-coast to Port Hueneme Beach, which is just south of the entrance to Port Hueneme (**Figure A-10**). The long-term result at Ormond Beach is a beach and dune system that has advanced seaward to its approximate pre-harbor condition. The back of the dunes has mostly stayed static, resulting in a beach and dune system that is approximately twice as wide as it was in 1929 and 1945 (Figure A-9).

The 1960s and 1970s also brought two major industrial developments that impacted what remained of Ormond Beach. The Halaco Engineering Company operated a metal smelter from 1965 to 2004 on an 11-acre parcel (**Figure A-11a**). The operation filled in much of the lagoon system with contaminated waste during its 40 years of operation. The facility directly discharged waste into the waterways from 1965 to 1970, and in 1970, Halaco began pumping waste to unlined settling ponds on an adjacent 26-acre parcel. Halaco ceased all operations in 2004, and the EPA estimates that more than 700,000 cubic yards of waste remain on site.

South of the Halaco Property, the Ormond Beach Generating Station (OBGS) was built on one of the remaining large wetlands, which was probably being managed for duck hunting at that time (**Figure A-11b**). The OBGS includes a once-through-cooling (OTC) power plant and adjacent tank farm. The tank farm was removed sometime in the late 1990s and this area is currently a mosaic of wetland and upland habitats with a mix of native and non-native plants. The OBGS bisected the shore-parallel backshore drainage channel, creating a drainage divide. As a result, water runoff northwest of the power plant flows northwest toward the Lagoon, while runoff southeast of the power plant flows southeast toward Mugu Lagoon. The OBGS is still operating in 2020, but is expected to be decommissioned within the next couple years and eventually dismantled.

The beach and dune habitats in the Beach area underwent severe degradation from vehicles during the last half of the 20^{th} century. The beach was open to vehicles until sometime in the 1980s and was a popular spot for riding off highway vehicles. Vehicles destroyed almost all of the vegetation in some areas. As a result, dune-building processes were disrupted and the former dunes and hummocks turned into an essentially flat landscape (**Figure A-12a**). Arnold Road, at the southeastern end of the project area, was a primary vehicle access point. Early aerial photos showed well-developed dune vegetation in this area (Figures A-4 and A-7). By 1964 (Figure A-8), there seemed to be considerably less vegetation. The earliest available aerial oblique photo shows a few dunes in 1972, which were already destabilized by erosion moving down coast from Hueneme harbor due to the jetties, and active roads through the salt marsh areas (**Figure A-12**). By 2002, access to vehicles had been cut off and the dunes were beginning to recover. One of the major effects of the flattened dunes is also obvious in the 2002 photo, which shows evidence of a wave overwash event that would have delivered significant amounts of salt water to the wetlands.

The County of Ventura modified the local drainage for flood control purposes and to facilitate development in the area. tšumaš Creek, which was previously called the J-Street Drain, is a concrete-lined channel constructed in the 1950s-1960s, and recently widened and renovated. When constructed, the shore was farther landward than today (see above discussion on the effects of Hueneme Harbor), and the mouth of the lagoon was breached to allow drainage as needed (communication with the Ventura County Watershed Protection District [VCWPD], 2017). In 1992, the mechanical breaching was halted by environmental restrictions owing to concerns about impacts to fish and birds. Subsequently, the lagoon expanded and several flood events occurred. Following a large flood event in 2010, the County has been allowed to manage flood risk by a permitted "beach grooming" activity. Prior to large storm events (but no more frequently than three times per year) the berm separating the lagoon from the ocean is graded lower near the lagoon, so that as flood waters from the storm move downstream, the berm breaches naturally at a lower level and then drains, before waters can rise and flood the developed areas along Perkins Road.

The Project Partners began acquiring and protecting wetlands and uplands in the Ormond Beach area in 2002, with plans implement large-scale ecological restoration. Even though 630 acres of land is protected, hydromodification from past actions and ongoing management changes on adjacent properties are still driving changes in the ecological communities. The most dramatic change is occurring southeast of the Halaco Property, landward of the dunes, on the Nature Conservancy (TNC) property. In 2002, this area was dominated by salt marsh vegetation with areas of salt flats (**Figure A-13a**). This area was connected to the Lagoon by a small channel, which would have delivered salty water to this area, at least rarely. By 2006, the same channel was filled with cattail (*Typha* spp.) (**Figure A-13b**) and the saltmarsh/salt flat area was being invaded by brackish marsh species (probably alkali bulrush, *Bolboschoenus maritimus*), suggesting brackish lagoon water was no longer flowing through the channel or reaching the site. This may be due to the channel being filled with sediment (blowing sand) or by changing management of water levels in the Lagoon. By 2013, the isolated former saltmarsh/salt flat area was dominated by freshwater marsh species (tule, *Schoenoplectus californicus,* and cattails) (**Figure A-14**). This relatively rapid conversion of salt marsh habitat to fresh/brackish habitat is not uncommon in Southern California salt marshes that lose their connection to the ocean and/or receive increased freshwater runoff from human sources. By 2017, about 20 acres of fresh/brackish marsh were mapped where there was only salt marsh and salt flat just 15 years prior. The Lagoon hydrology and morphology will be evaluated further for the OBRAP process to further assess the drivers for the observed marsh conversion.

SOURCE: Google Earth 2017

Ormond Beach Wetlands Restoration

Figure A-9
Current and Historic Beach Limits

ESA

Coastal Restoration Consultants

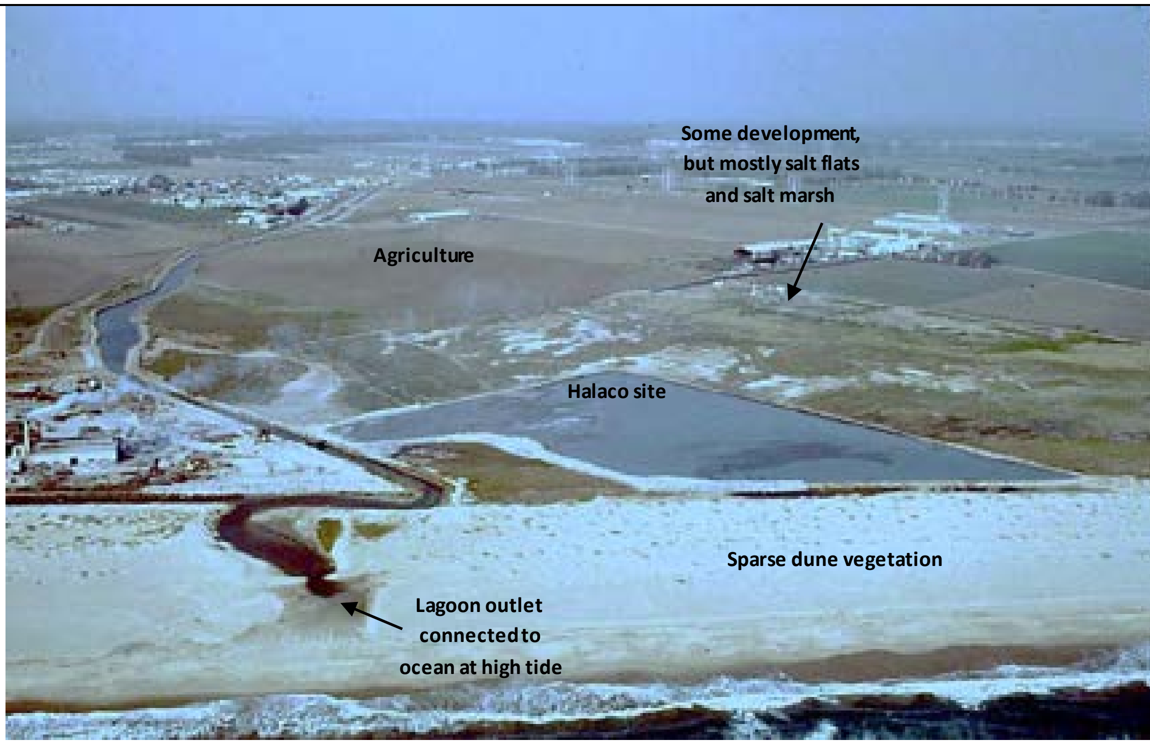
a

b

SOURCE: Google Earth 2017

Ormond Beach Wetlands Restoration

Figure A-10
2014 and 2015 Beach Widths



a

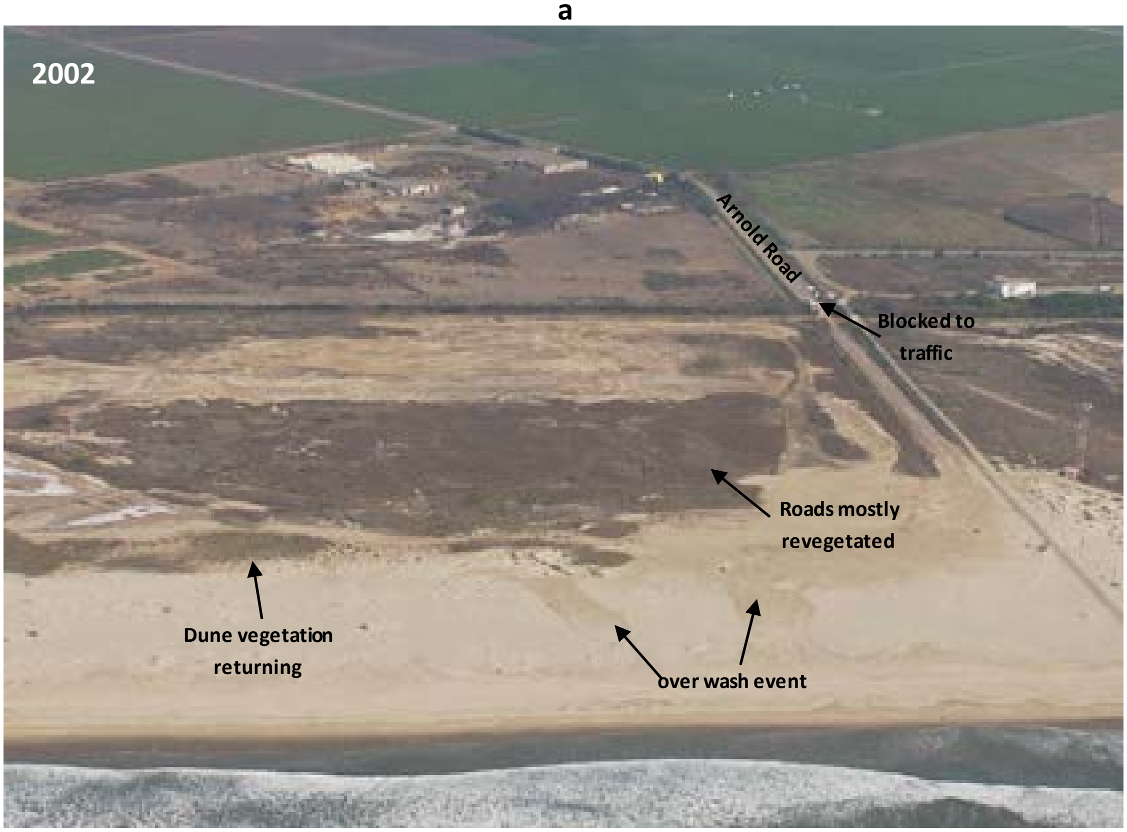
b

SOURCE: California Coastal Records Project

Ormond Beach Wetlands Restoration

Figure A-11
1972 Aerial Oblique Photos

a

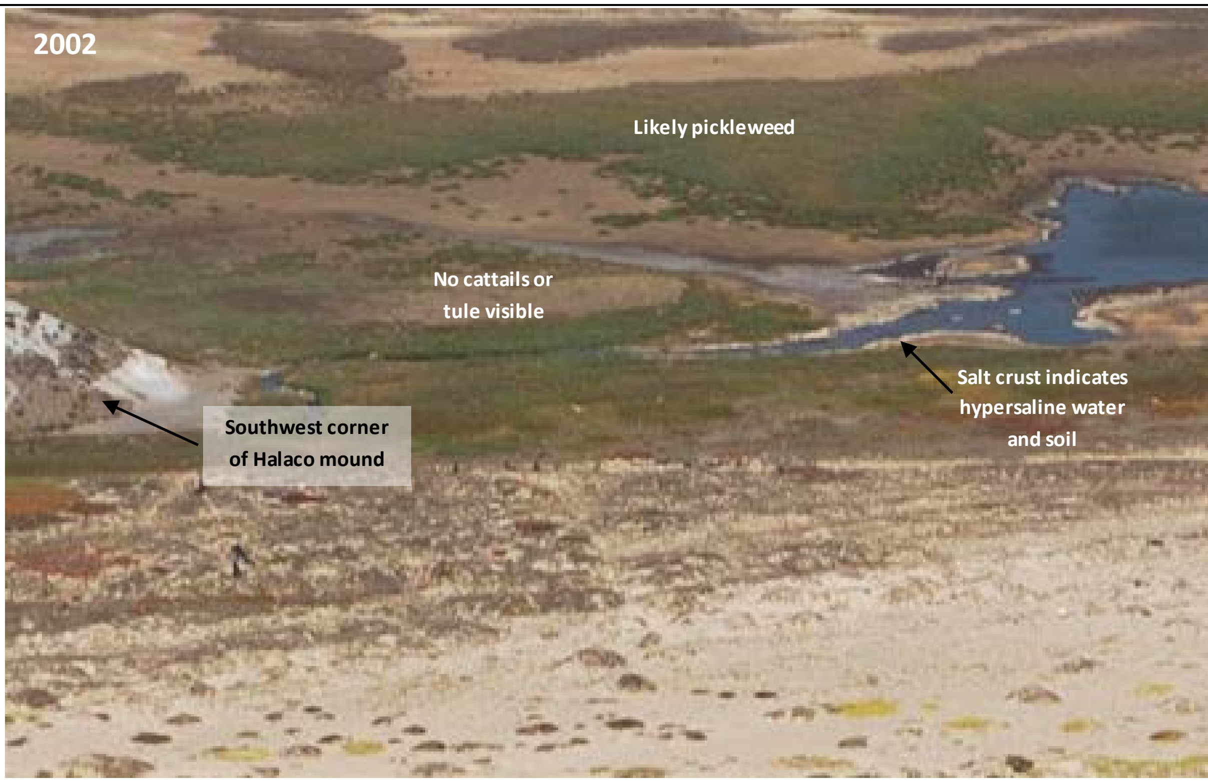


b

SOURCE: California Coastal Records Project

Ormond Beach Wetlands Restoration

Figure A-12
1972 and 2002 Aerial Oblique Photo Comparison



a

b

SOURCE: California Coastal Records Project

Ormond Beach Wetlands Restoration

Figure A-13
2002 and 2006 Aerial Oblique Photo Comparison,
Southern TNC Parcel

SOURCE: California Coastal Records Project

Coastal Restoration Consultants

Ormond Beach Wetlands Restoration

Figure A-14
2013 Aerial Oblique Photo,
Southern TNC Parcel

6. Implications for Restoration

The Ormond Beach area once supported a large complex of wetlands that were formed by the mouth of the Santa Clara River as it moved course over the Oxnard Plain over thousands of years. Historic river mouth locations supported lagoons, surrounded by other types of wetlands and transitional habitats. Where there were year-round freshwater inflows, lagoons were permanently flooded and naturally breached and therefore may have had intermittent tidal influence. Prior to the runway construction at the NBVC, wetlands closer to Mugu Lagoon probably had some tidal exchange in very wet years. Lagoons with only wet-season freshwater inputs were flooded after rains and then dried to salty flats. These seasonal lagoons were probably rarely inundated with salt water when storms or large wave events overwashed the dunes. Small remnants of permanently flooded lagoon, seasonal lagoon, and other wetlands persist within the project area but with significantly altered hydrology.

Some wetland-upland transition and upland habitats remain as well, but almost all are on landforms that have been altered over the years (e.g., berms, levees, abandoned crop land or development). Beach and dune habitats migrated landward in the middle of the 20th century, converting over 100 acres of wetlands to dunes. The current beach and dune system is nearly twice as wide as it was in the mid-1940s. In addition to physical alteration, invasive plant species have fundamentally altered the structure and composition of some habitats. In summary, the Ormond Beach site is still a beach-dune-wetland system, but greatly reduced, degraded, and modified. Yet despite the impacts over the last 250 years, important remnant habitats remain, along with opportunities for ecological restoration.

While historical ecology can inform the underlying processes that formed a landscape and its ecological conditions, restoration goals must also consider existing and anticipated future conditions. Restoring ecological functioning will require working within the constraints of the site. Habitat features will not necessarily be replaced in the exact location where they appear in historical maps or photos. Rather, the OBRAP project seeks to re-establish many of the physical and ecological processes that supported the diverse wetland and upland habitats once present at the site. This holds the most promise to restore self-sustaining ecological communities that are resilient to changing conditions and dynamic in space and time.

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Appendix B
Additional Information on Existing Conditions and Future No Project Conditions

APPENDIX B
Additional Existing Conditions and Future No Project Conditions

This appendix provides information from 2017 field surveys and other sources to describe existing conditions and to develop an understanding of the physical processes that shape the landscape, hydrology, soils, vegetation communities and species that inhabit the Ormond Beach area. This appendix also assesses future conditions without restoration (i.e., future without project conditions), based on available information.

2017 Field Surveys

ESA conducted field surveys at the Ormond Beach Restoration and Public Access Project Area (Project Area, **Figure B-1**) from May 30 through December 14, 2017. The surveys included water level gage installation, soil sampling, and topography and bathymetry surveys. ESA also surveyed vegetation elevations in coordination with CRC. Survey point locations are indicated in **Figure B-2**.

Topography and Bathymetry

ESA conducted a survey of the project area June 5 through 7, 2017 using Real Time Kinematic (RTK) GPS equipment. The survey was referenced to the NAVD88 vertical datum and California State Plane Zone 5, NAD83 horizontal datum and tied into the Leica SmartNet system. The purpose of the survey was to groundtruth the SCC CA California Coastal Light Detection and Ranging (LiDAR) dataset. Between 2009 and 2011, the SCC collected LiDAR elevation data along the entire California coast (**Figure B-3**).

The survey extent included the lagoon, beach, channels, marsh, and salt panne areas. Transects up to approximately 2,500 feet in distance were taken by the marsh and lagoon areas. Along-shore and cross-shore transects were taken along the beach. Excluding points surveyed on the beach, since LiDAR elevations collected for that area are seasonally variable, elevations from the LiDAR dataset are approximately 0.8 feet higher than those collected in the ESA survey, which is likely due to the LiDAR capturing the top of vegetation and/or the benchmarks used for each survey.

SOURCE: ESRI 7/19/2016, City of Oxnard, Ventura County

Ormond Beach Restoration and Public Access Plan

Figure B-1
Project Area and Site Areas

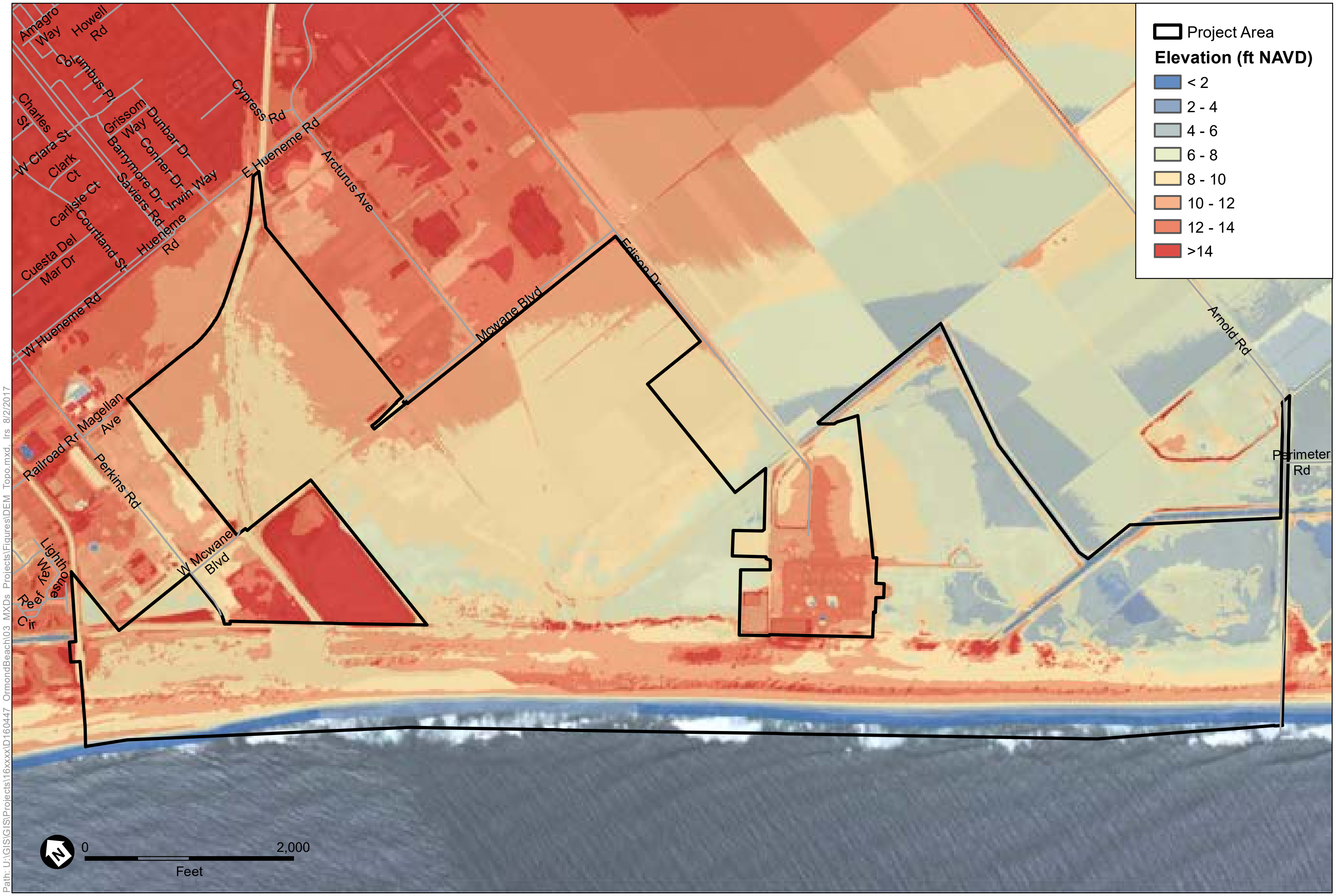
ESA

SOURCE: ESRI, City of Oxnard, Ventura County

Ormond Beach Restoration and Public Access Plan

Figure B-2
Water Level and Groundwater Guage Locations, and Survey Transects

ESA



SOURCE: ESRI, SCC 2011

Ormond Beach Wetlands Restoration

Figure B-3

Site Topography

ESA

Nine cross-shore transects on Ormond Beach were taken along the project site (**Figure B-4**). The beach transects measure between 200 feet and 400 feet in length and capture the foreshore and berm feature. The data show an increase in berm height from the north to the center of the lagoon, then a decrease in height near where the lagoon breaches to the south end of the lagoon (**Figure B-5**). Further south along the beach, the berm rises again. Across the project site, the berm crest ranges between 9.4 feet and 16.1 feet NAVD88. Marsh transects were also collected in the survey.

Water Levels

Pressure gages were installed to measure surface and groundwater elevations at six sites. Gages were installed on June 1, 2017 and monitored levels through December 14, 2017 at the sites shown in Figure B-2. **Figure B-6** shows water level time series from each of the gages. Due to the timing of the installation, these preliminary measurements are indicative of closed-mouth lagoon conditions and seasonally low water tables. Surface and groundwater sites near the Ormond Lagoon Waterway and the Ormond Lagoon have experienced a slow seasonal decline in water level through late July, punctuated by a high water level event in late June that may have been caused by wave overwash into the lagoon. At the salt panne near Arnold Rd (Area 6), surface water elevations in the Oxnard Drainage Ditch #3 have been stable, while groundwater levels appear to have fluctuated with the spring-neap tidal cycle.

Soil Sampling

Investigative soil test pits were dug in the Arnold Road salt pannes on June 1, 2017 for the purpose of investigating locations for shallow groundwater monitoring well installations. Pits were dug in two locations on opposite sides of the salt panne complex (**Figure B-7**). Site A was originally selected on the basis of proximity to existing plover nests (as far as possible), ease of access from the road, and representation of the surrounding area. At the time of digging, the area surrounding Site A was fully dried out, so an alternative test pit was deemed necessary near an area still ponded. Site B was selected near an area of ponded water and revealed a different set of soil types and stratification.

A thin surface layer of salty crust and lack of standing water were observed over the eastern salt panne area. For Site A, a layer of sandy clay was found two inches below the top salt layer and can be seen in (**Figure B-8**). The layer extended down 2.8 feet and was notably moist, although not entirely saturated. Drilling further, a very dense, moist clay lens of approximately 0.8 feet appeared at 1.1 feet NAVD. Immediately after punching through the clay lens, groundwater began to rise in the test pit due to the change in hydraulic head pressure as the clay was acting as a confining layer. Within 30 minutes of breaching the clay lens, the water level rose 2.3 feet, and within two hours, the water level had risen another foot. This potentially means that surface water at the site is forced to evaporate rather than infiltrate deeper into the profile, due to the clay layer.

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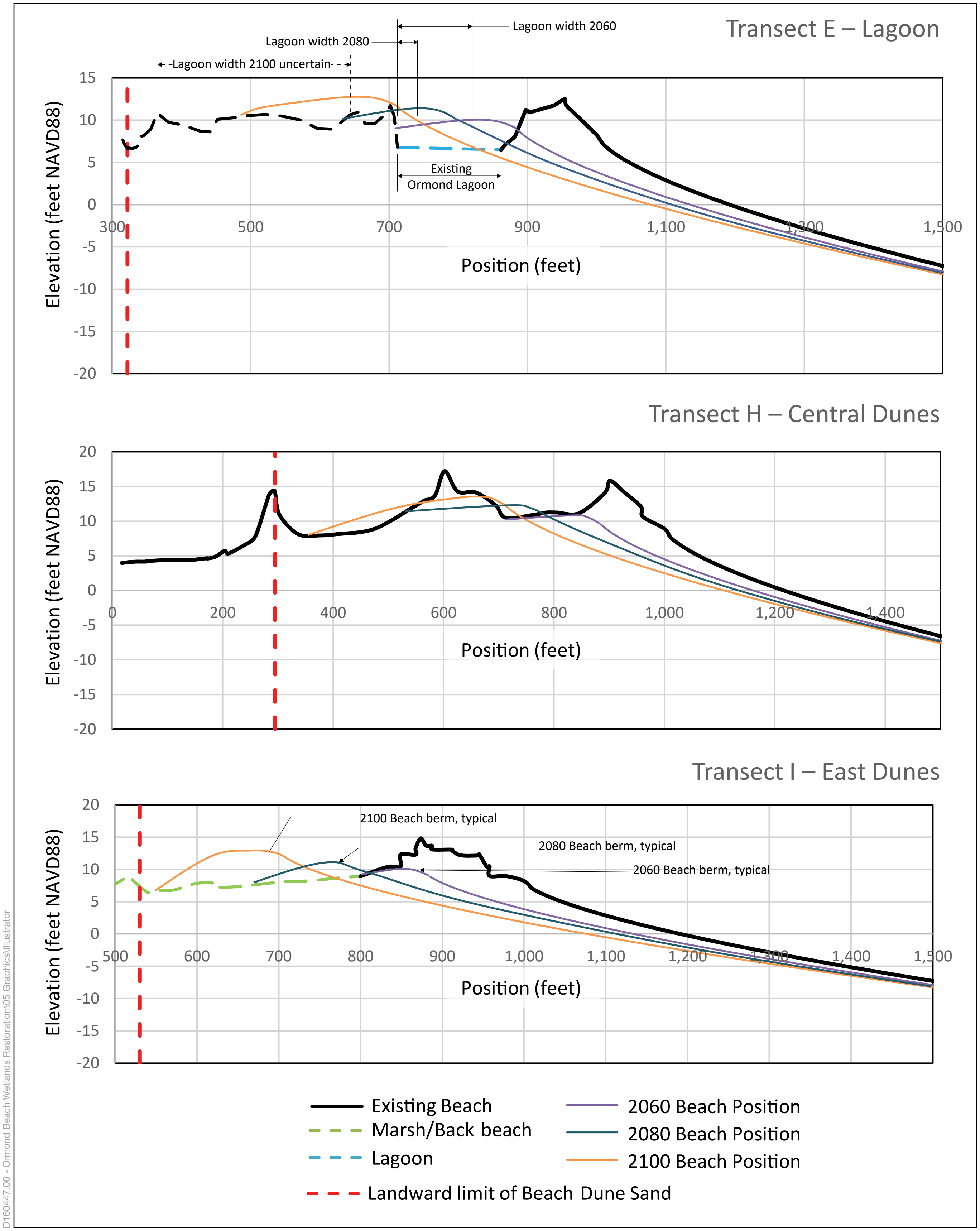
SOURCE: ESA Survey (6/2017)

Ormond Beach Restoration and Public Access Plan

Figure B-4
Beach Transects Locations

ESA

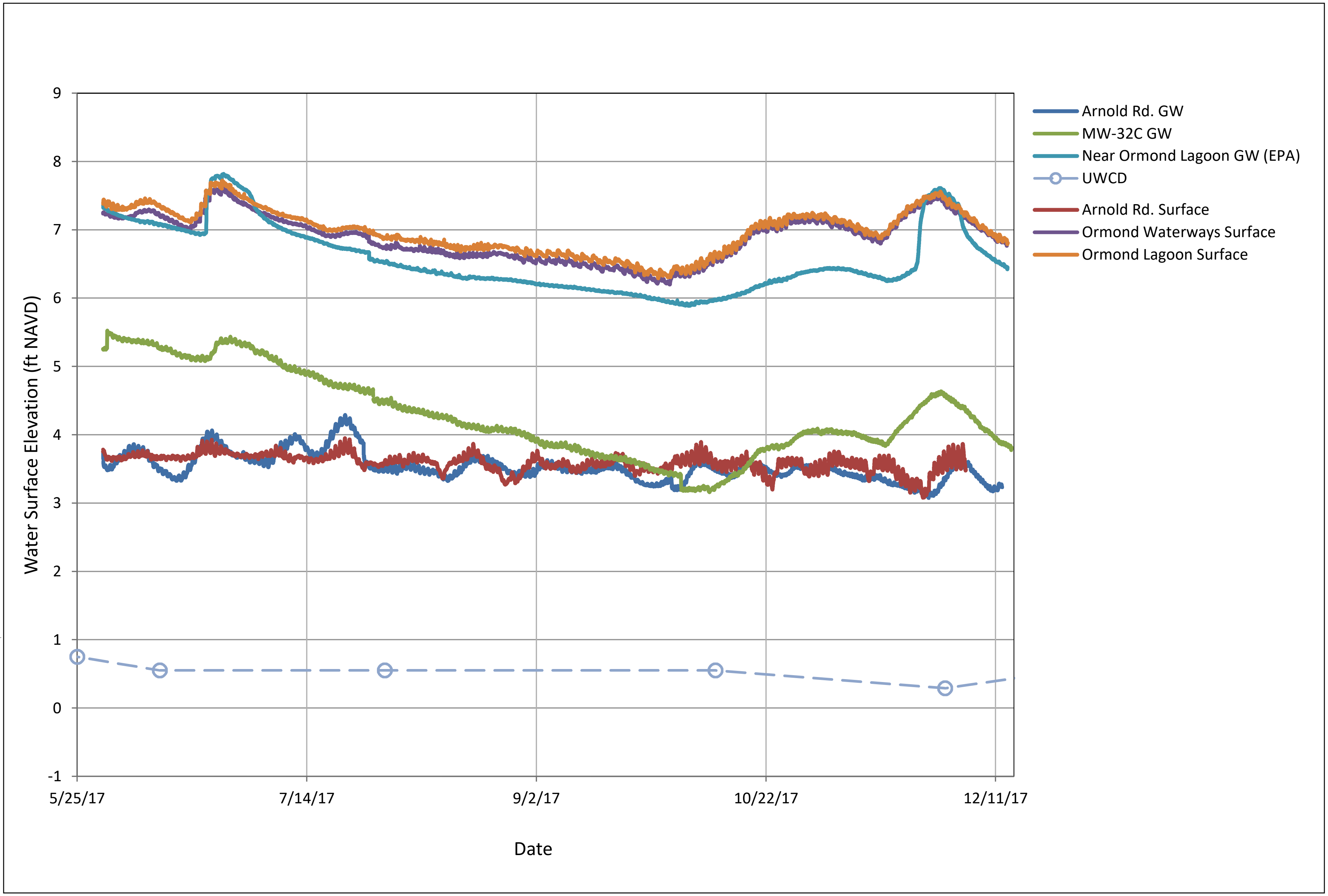


SOURCE: ESA, 2017

NOTE: Transect E (top) is located at western beach strand Area 1 at Ormond Lagoon; Transect H is located at central beach strand 7 near backshore Area 3 and Transect I is located at eastern beach strand Area 9 near backshore Area 6.

Figure B-5
Beach Transect Elevations

ESA



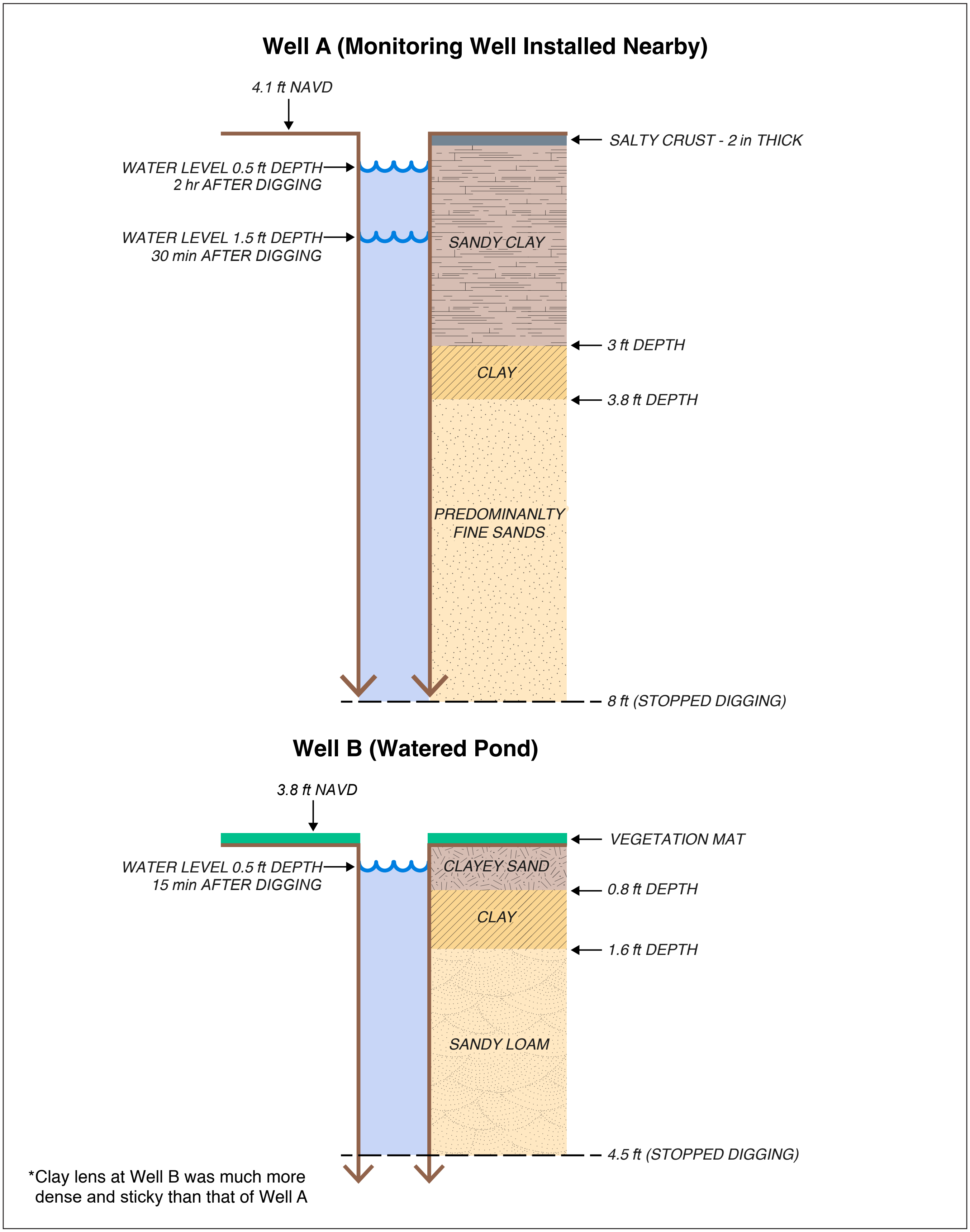
SOURCE: ESA Water Level Gauges UWCD Groundwater Well

Figure B-6
Water Levels

SOURCE: Google Earth Imagery

Ormond Beach Wetland Restoration

Figure B-7
Groundwater Monitoring Soil Test Locations



SOURCE: ESA, 2017

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Figure B-8

Groundwater Monitoring Well Soil Observations

ESA

The test pit for Site B was chosen near the edge of a large area of standing water in the northwestern area of the salt panne complex. Beneath a thin layer of matted vegetation, the top of the profile consisted of 0.8 feet of clayey sand that was moist, but not saturated (Figure B-8). Similar to Area A, a 0.8-foot-thick clay lens was discovered below this. The top of the lens, however, was found to be at an elevation of 3 feet NAVD, nearly 2 feet higher than the layer in Area A. After breaching the lens and arriving at the next layer of sandy loam, water immediately began to well up again. After 15 minutes, the water level had risen 1.1 feet, a similar rate to that of Site A. The higher elevation of the clay layer in Site B means less volume in the soil above the layer for water to pond. This may be why ponded water was visible near the test pit. Alternatively, there may be greater connectivity with the water table in the western area of the site or a breach in the clay layer may have led to the ponding.

Vegetation Elevations

ESA surveyed marsh plant elevations in coordination with CRC on June 7, 2017. Elevations of vegetation transitions, salt marsh bird's beak occurrences, and coulter's goldfield occurrences were collected. Figure B-2 shows the location of the surveyed data.

Table B-1 presents the elevation statistics for each plant species or habitat type by basin.

TABLE B-1
VEGETATION ELEVATIONS AT ORMOND BEACH

Vegetation Type	Location	Elevation Range (ft NAVD88)	Average Elevation (ft NAVD88)
Salt Marsh Bird's Beak	Area 6 - South SCC Salt Panne and Marsh	5.3 – 8.0	6.4
	Area 3b - Southeast TNC/SCC Marsh	5.7 – 7.1	6.4
	Area 3a - Southwest TNC Marsh	7.5	7.5
Coulter's Goldfields	Area 3a - Southwest TNC Marsh	8.1 – 9.6	8.9
Marsh to Upland Transition	Area 5 - South SCC Salt Panne and Marsh	4.5 – 6.4	5.3

Existing Conditions - Physical Processes

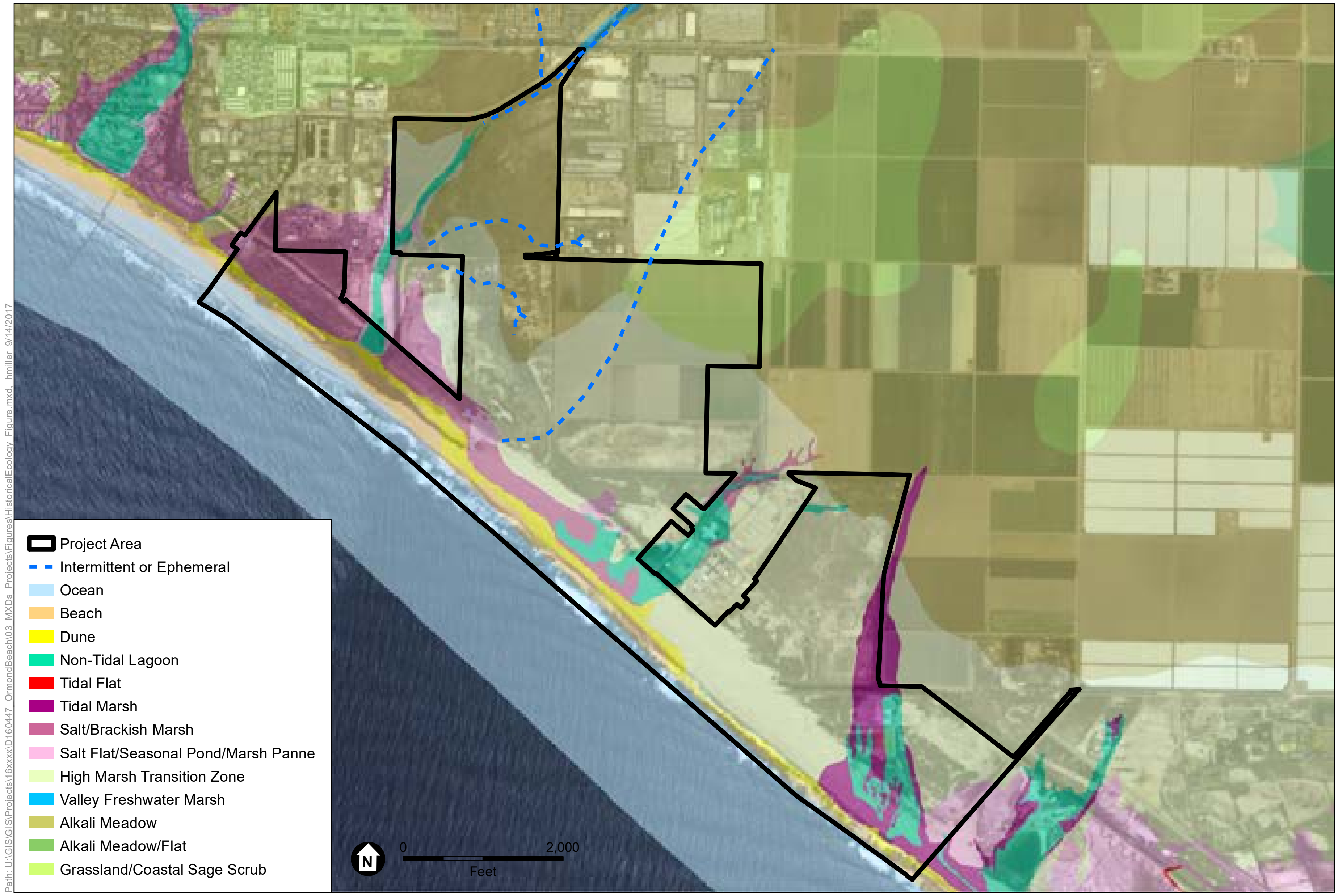
The Project Area is located on the oceanside of the Oxnard Plain, a large alluvial plain created by the deposition of sediment eroded from the surrounding mountains (**Figure B-9**). The major regional drainage channels are the Ventura and Santa Clara Rivers and Calleguas Creek. The extent of the sediment plain is limited and the shore orientation is controlled by the Hueneme and Mugu submarine canyons, which affect ocean waves and wave-driven sand transport (Herron and Harris 1966). The sandy shore is built by waves and winds, forming a ridge of sand dunes that inhibits drainage of rainfall to the ocean. **Figure B-10** shows the historical wetlands that existed behind this littoral (coastal) ridge of dunes, including lagoons and back-dune wetlands (Beller et al. 2016). Development has significantly modified the drainages to and from the site, and the extent of wetlands.

SOURCE: ESRI

Ormond Beach Wetlands Restoration

Figure B-9
Southern California Bight

ESA



Source: ESRI 7/19/2016, San Francisco Estuary Institute, Ventura County,

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Figure B-10
Project Area Historic Ecology in the Early 1800s

ESA

Watershed Processes

The Project Area is located in a Mediterranean climate zone and experiences mild, wet winters and warm, dry summers. The Project Area receives an average total annual precipitation of 17 inches, with the most rainfall occurring in January and February (Aspen 2009). Measurements from Oxnard Airport (WRCC 2017) and the offshore National Data Buoy Center buoy at Anacapa Passage show that winds predominantly arrive from the west year-round (HDR 2008a). Average maximum temperatures in the summer (Jun-Aug) reach 75.0° Fahrenheit while average minimum temperatures in the winter (Dec-Feb) are around 44.7° Fahrenheit (WRCC 2017). Evaporation exceeds seasonal precipitation at the site (Philip William and Associates [PWA] 2007).

Freshwater Flow

The Ormond Lagoon Waterway (OLW), tšumaš Creek, and the Hueneme Drain (via the Hueneme Pump Station), are the main sources of freshwater runoff to the Lagoon. Seasonally wetted areas in the TNC parcel (Area 3a) receive freshwater via overflow from the Lagoon, and wetted areas in the SCC parcel arrive from drainage ditches draining agricultural lands east of the OLW. In general, freshwater runoff reaches the Lagoon much more quickly than it would have under historical conditions due to channelization (URS 2005, HDR 2008a). Typical and event discharges along the three major drainages are summarized in **Table B-2**.

TABLE B-2
FLOWS IN THE ORMOND LAGOON WATERWAY, TŠUMAŠ CREEK, AND HUENEME DRAINS

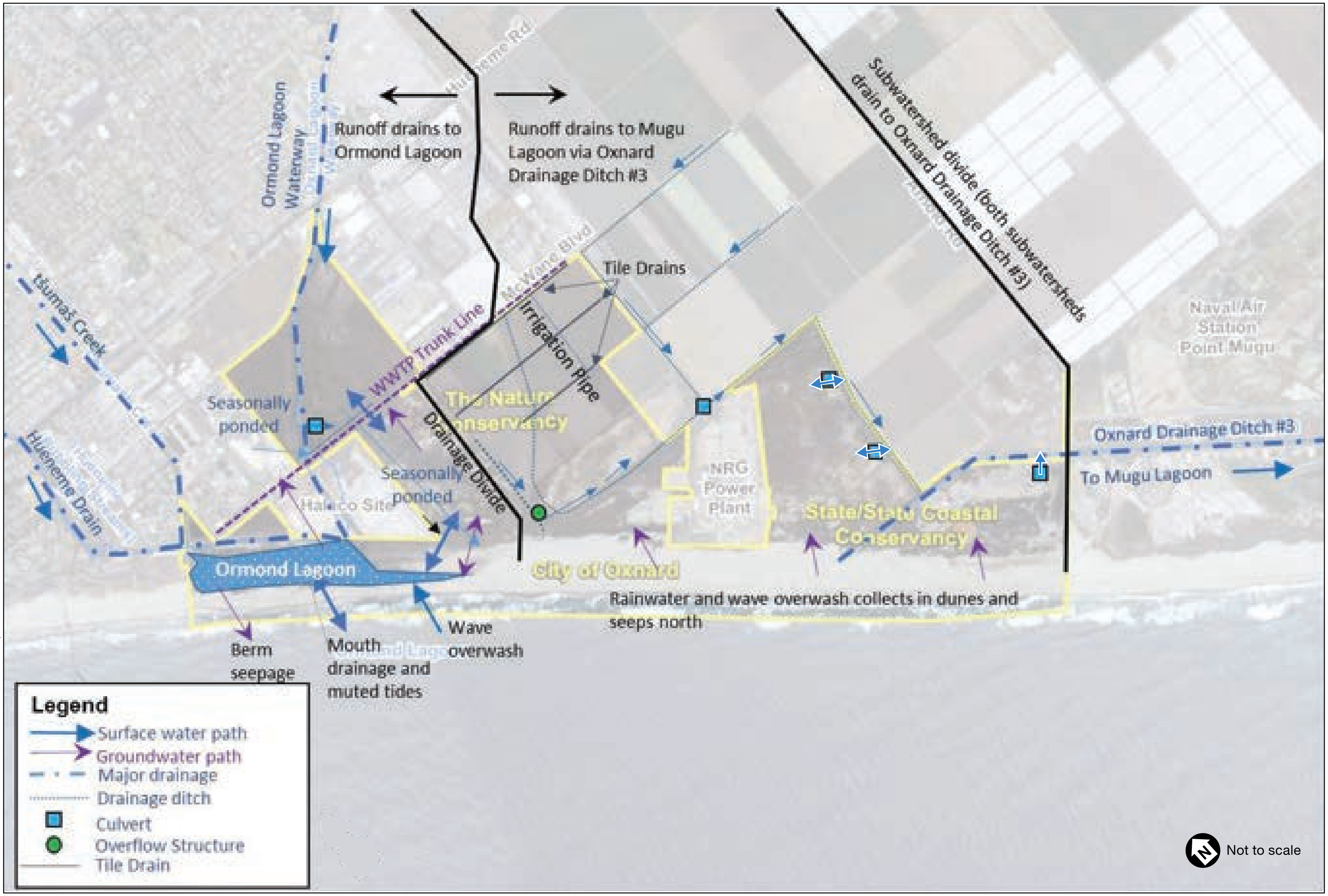
	Typical (CFS)	10-year (CFS)	50-year (CFS)
Ormond Lagoon Waterway	7-8	2,798	4,115
tšumaš Creek	1-2	1,049	1,542
Hueneme Drain	1-2	251	369

NOTE: CFS = Cubic feet per second

SOURCE: PWA 2007, based on information provided by Impact Sciences (1996) and Kennedy/Jenks Consultants (1999)

Hydrologic Connections Between Sub-Areas

Although most of the available freshwater runoff is routed to the Lagoon or to Oxnard Drainage Ditch #3 (ODD #3), ponding behind the beach berm prior to mouth breaching allows surface water to transfer to the TNC Area. This is illustrated schematically in **Figure B-11** and described in detail by CH2M Hill 2008. When the lagoon drains, water is trapped in the TNC Area 3a as seasonal ponds. After the rainfall event recedes, the mouth may remain open for several weeks, at which time muted tides may enter the lagoon from the ocean (CH2M Hill 2008). However, tide levels in the lagoon tend to be several feet lower than water levels during closed-mouth conditions, meaning that the TNC Area 3a, and parts of the tšumaš Creek and OLW, are hydrologically disconnected from the lagoon when the mouth is open. Farther east, the leaky flap gate connecting Mugu Lagoon to the ODD #3 communicates muted tides to the pickleweed marsh, open water, and salt panne areas east of the SCC parcel (PWA 2007).



SOURCE: ESRI 7/19/2016, PWA (2007), CH2M Hill (2008, 2012), HDR (2008a)

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Figure B-11
Schematic of Surface and Groundwater Flow Paths through the Project Area

ESA

Fluvial Sediment Supply

Sediment delivery to the Project Area via the three primary drainages is thought to be small due to urbanization and the fact that the wetlands are cut off from the sediment load of the drainage and flood control channels. HDR (2008b) estimated the total combined delivery from tšumaš Creek, Hueneme Drain, and OLW at less than 400 cubic yards per year (59 percent sand, 26 percent silt, 15 percent clay). Among these three pathways, 95 percent of the sediment load comes from the OLW.

The much larger sediment sources to Coastal Ventura County, the Ventura and Santa Clara Rivers, both discharge sediment into the tidal waters farther north of the Beach. Calleguas Creek supplies a significant amount to nearby beaches, but the predominant eastward littoral drift prevents this from reaching the site (Herron and Harris 1966). Much of the delivery by these sources occurs during brief, episodic discharge events, with 50 percent of the suspended sediment discharge occurring during only 0.1 percent of the time (Warrick and Milliman 2003). Willis and Griggs (2002) have estimated that the Santa Clara River and Ventura River discharge approximately 1.63 and 0.215 million cubic yards of sand and gravel per year, respectively. However, El Niño/Southern Oscillation (ENSO) climate patterns produce variations on multi-decadal time scales (Inman and Jenkins 1999), with ENSO years generally resulting in higher rates of precipitation and sediment delivery to the ocean. Larger variations occur on an inter-annual basis due to exceptionally dry years or large, infrequent flooding events (PWA 2007).

Fluvial Flood Hydrology and Hazards

Most flooding at the site occurs as a result of water collecting in the Lagoon during rainfall events, prior to the mouth breaching and draining of water to the ocean. When the lagoon mouth is closed, ponded water backs up into the OLW and tšumaš Creek, and typically spills east and north into the TNC Area 3a (EPA 2008, CH2M Hill 2012). On January 18, 2010 large swell waves built a high beach berm and complicated these actions, causing trapped runoff to flood the WWTP, International Paper plant, and Hueneme Road, leading to a mouth breach under an emergency permit from the CCC (Ventura County Watershed Protection District [VCWPD] 2010). Following this event, the County has been allowed to manage flood risk by a permitted “beach grooming” activity. Prior to large storm events (but no more frequently than three times per year) the berm separating the lagoon from the ocean is graded lower near the lagoon, so that as flood waters from the storm move downstream, the berm breaches naturally at a lower level and then drains, before waters can rise and flood the developed areas along Perkins Road (VCWPD 2016, 2017).

Farther east, high rainfall on agricultural lands draining to the ODD #3 can at times overwhelm the series of drainage ditches in the area. In 2017, roughly 4.2 inches of rainfall were recorded between February 17th and 18th, causing the Arnold Road drainage ditch to fill beyond capacity and flood across Arnold Road at the turn in Arnold Road adjacent to the Agromin parcel (personal communication with K. Krause).

Fluvial flooding at the site has been modeled by Tetra Tech (2005), URS (2005), and HDR (2008a). The HDR effort took into account beach management and movable bed conditions while modeling the 2-, 10-, 50-, and 100-year recurrence interval floods.

Coastal Processes

The Project Area is located within the Southern California Bight, an area that includes several offshore islands, submarine canyons, and a narrow continental shelf (Figure B-9). The site is subject to multiple coastal processes, including tides, waves, and littoral drift. These processes are described in more detail below.

Ocean Tides

Continuous oceanic tide level measurements are available from NOAA north of the site at Santa Barbara and south of the site at Santa Monica. Tidal datums are similar at each site, suggesting that these are representative of tides adjacent to the Beach. The tidal datums for the 1983–2001 epoch and observed extreme water levels at both gages are summarized in **Table B-3**, and referenced to the North American Vertical Datum of 1988 (NAVD88).

TABLE B-3
OCEANIC TIDAL DATUMS AT SANTA MONICA AND SANTA BARBARA

Tidal Datum	Santa Monica, CA (NOAA #9410840[1]) ft. NAVD88	Santa Barbara (NOAA #9411340[2]) ft. NAVD88
Maximum Observed	8.31[1]	7.54[2]
Mean Higher High Water (MHHW)	5.24	5.31
Mean High Water (MHW)	4.50	4.55
Mean Tide Level (MTL)	2.62	2.72
Mean Sea Level (MSL)	2.59	2.70
Mean Low Water (MLW)	0.73	0.89
Mean Lower Low Water (MLLW)	-0.20	-0.09

NOTES:
1 Observed 11/30/1982 7:54
2 Observed 12/13/2012 16:36

Waves

In addition to oceanic tides, wave conditions have a major influence on the Project Area, both by shaping the Beach, which forms the barrier between the ocean and Project Area and by influencing nearshore water levels and directly contributing ocean water to the lagoon during wave overwash events. Wave conditions near the site are heavily influenced by the regional

1 NOAA website tides and currents, last visited August 19 2020 https://tidesandcurrents.noaa.gov/datums.html?id=9410840

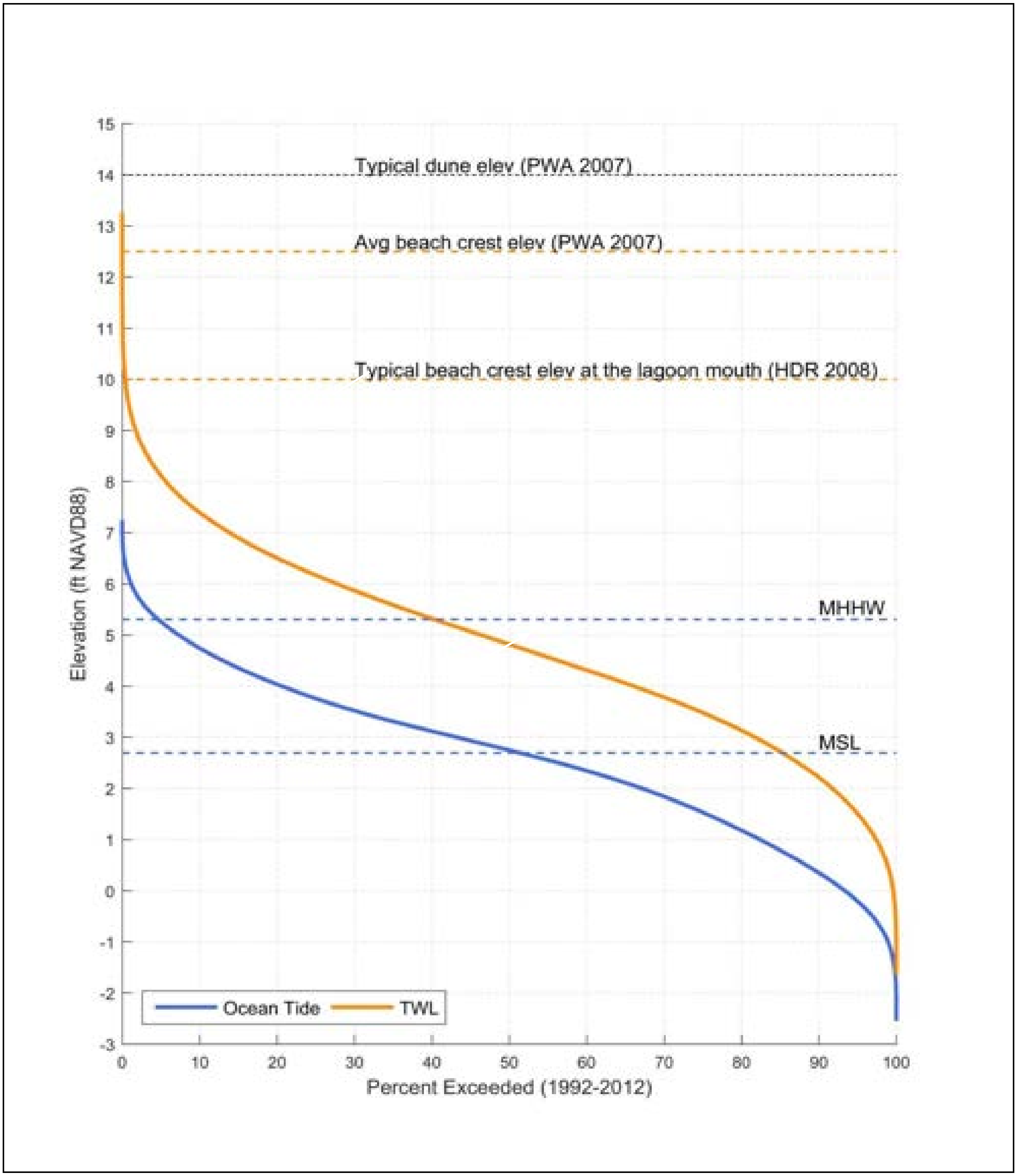
2 NOAA website tides and currents, last visited August 19 2020 https://tidesandcurrents.noaa.gov/datums.html?id=9411340

setting. Major coastal features that affect the local wave climate are Point Conception, the northern chain of the Santa Barbara Channel Islands and, to a lesser extent, the two submarine canyons that bound the coastal edge of the greater Ormond Beach area (Figure B-9). In general, this stretch of coastline is subject to energetic winter waves and more calm conditions during the summer months (Moffatt and Nichol 1986, PWA 2007). The area is also exposed to elevated breaking waves during swells from the southern hemisphere during spring, summer, and fall months, and occasionally from tropical storms off the Mexico coast in the fall. The bathymetry around Mugu Canyon amplifies these waves along the shore around Arnold Road and Mugu Lagoon.

Wave exposure at the Beach is primarily limited to two directional sectors: one from the west that lies within the Santa Barbara Channel; and a second that lies to the south between Anacapa Island and Point Mugu (Herron and Harris 1966; Moffatt and Nichol 1986). PWA (2007) and HDR (2008a) have characterized offshore wave conditions by assessing directional wave buoy data available from the Coastal Data Information Program (CDIP). In general, waves at the Anacapa Buoy (15 miles west of the Project Area) are nearly unidirectional and westerly due to sheltering by the northern chain of the Santa Barbara Channel Islands and Point Conception, whereas waves recorded at the decommissioned Point Dume buoy (16 miles southeast of the Project Area) are more broadly distributed and show exposure from the west to south, although the largest and most frequent waves arrived from due west. The largest waves are observed during the winter months, with a steady decline in wave height through the summer months and the smallest waves recorded from July to October (PWA 2007; HDR 2008a).

In 2012, ESA PWA (2013) developed nearshore wave predictions as part of TNC’s Ventura Coastal Resilience project (TNC 2016). These were used in concert with beach topography information to develop time series of total water level (ocean tide + wave runup on the beach) from 1992 to 2012 at the site. Nearshore wave conditions are also available from CDIP at 10 meter depths along the Ventura coastline, from a series of monitoring and prediction points located at 100 meter intervals along the coast. These were developed using a similar methodology (see O’Reilly and Guza 1993).

Figure B-12 summarizes the TWL estimates developed by ESA PWA (2013), and shows how these compare against important tidal datums and observed beach and lagoon conditions. Typical beach crest elevations of 10–12.5 feet NAVD88 correspond to TWL levels that are exceeded for one percent of the time from 1992 to 2012. Beach crest elevations of 14 feet NAVD88 are higher than predicted TWL levels. This discrepancy may result from additional sand accumulation due to aeolian transport (PWA 2007, HDR 2008a). Also, the wave exposure and TWL elevations may increase with distance south from Hueneme to Mugu Lagoon, resulting in a higher beach berm elevation.



SOURCE: ESA PWA (2013) nearshore wave and TWL estimates, NOAA ocean tide data at Santa Barbara

Ormond Beach Wetlands Restoration

Figure B-12
Ocean Tide and Total Water Level

Littoral Drift

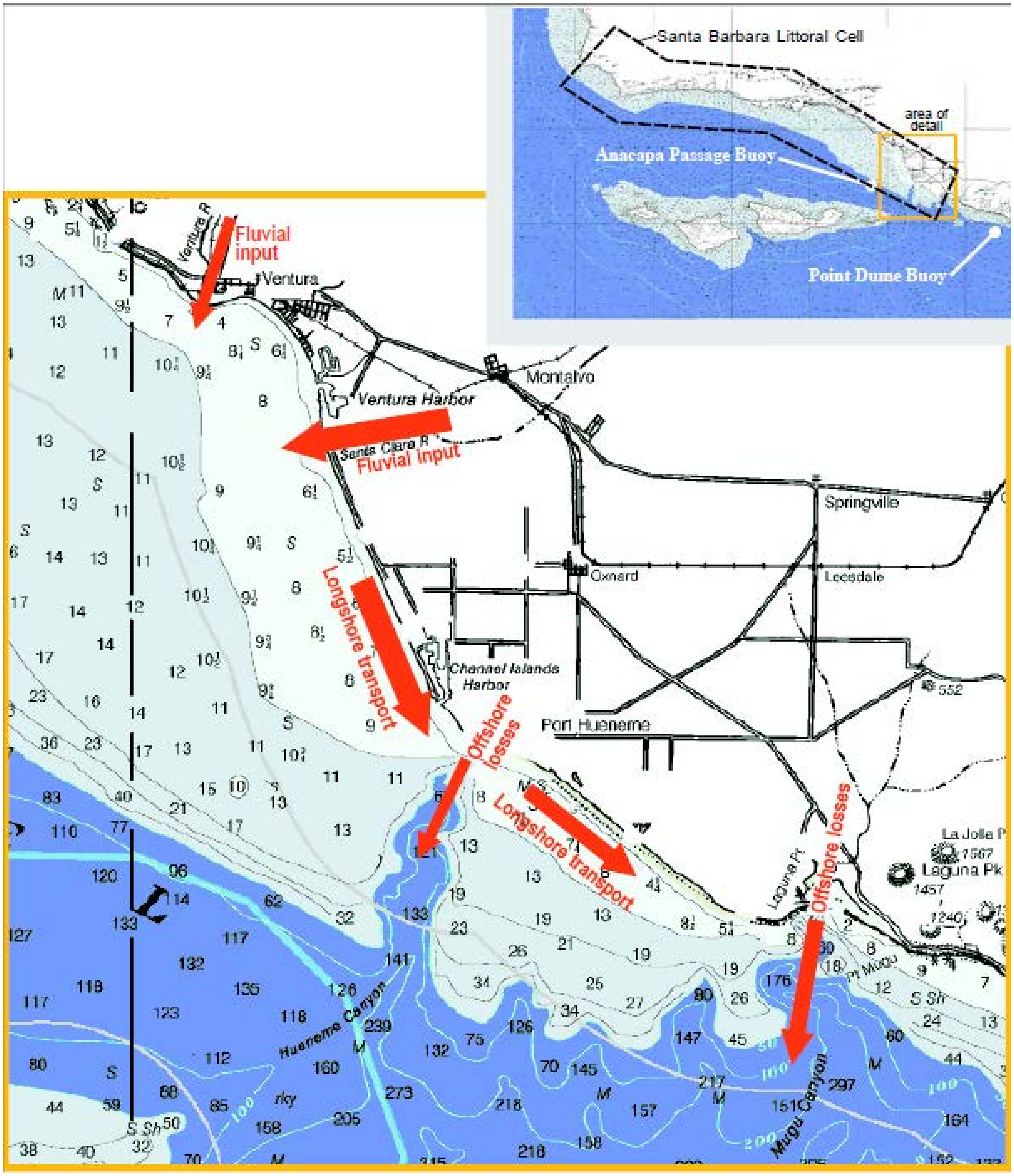
Following construction of the Hueneme and Channel Islands Harbors, sediment supplied by the Santa Clara and Ventura Rivers traversed a series of artificial sand bypasses before arriving at the site and maintaining the Beach (Herron and Harris 1966). Owing to the east-west shoreline orientation and the primarily westerly wave conditions, littoral sediment transport is almost exclusively eastward towards Point Mugu (**Figure B-13**). In the 10 years following construction of the Port Hueneme jetties in 1940, observations of 600 feet of shoreline accretion north of Hueneme suggest a net longshore transport of roughly 1.2 million cubic yards per year in the vicinity of the Project Area (Harris and Heron 1966, Moffatt and Nichol 1986). Most of this supply is thought to have naturally bypassed Point Hueneme historically, as observations of local shoreline changes between 1856 and 1940 suggest a stable shoreline between Point Hueneme and Point Mugu (Herron and Harris 1966).

While the site was historically within the Santa Barbara littoral cell, the jetties that maintain a permanent opening at the Port of Hueneme essentially create an artificial boundary to the littoral cell, and sand supplied to the Beach has become dependent on the biennial mechanical bypassing project managed by the USACE (Moffatt and Nichol 1986, PWA 2007). This project delivers sand dredged from Channel Islands and Port Hueneme harbors to the beach west of the Beach, immediately east of the eastern Port Hueneme jetty. Bypassing occurs approximately every 2 years depending on the severity of the shoaling in the sand trap and budgetary requirements (Moffatt and Nichol 1986; Brady et al., 2012). Dredged sand is bypassed with a hydraulic dredge and graded with heavy equipment, typically until the crest has an elevation of approximately 12 feet MLLW (~12 feet NAVD88), and a width of at least 300 feet (Moffatt and Nichol 1986; USACE 2012). The total amount of bypassed sediment varies, but has declined somewhat from the estimated historical rate of 1.2 million cubic yards per year, as summarized in **Table B-4**:

TABLE B-4
SEDIMENT BYPASSING HISTORY AT ORMOND BEACH

Year	Dredge Volume
1960 - 1987	1,200,000[1]
1984 - 1993	750,000[2]
1994 - 2002	850,000[3]
2001	1,235,950[4]
2003	2,062,695[4]
2005	2,168,115[4]
2007	1,171,035[4]
2009	2,884,040[4]
2011	968,530[4]

NOTES:
1 Wiegel 1994
2 Impact Sciences 1996
3 PWA 2007
4 USACE, LA District



SOURCE: PWA (2007)

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Figure B-13
Regional Littoral System

ESA

Coastal Flood Hydrology and Erosion Hazards

The Project Area is susceptible to flooding due to ocean conditions, primarily when high ocean levels and high wave runup coincide to result in overtopping of the beaches and dunes by wave uprush pulses (ESA PWA 2013). Beach and dune erosion can also occur during these elevated ocean conditions, resulting in temporarily narrow beaches and dune erosion. Projections of coastal hazards for existing and future conditions were developed to inform coastal planning and maps are publically available via the TNC Coastal Resilience website[3] and the USGS CoSMoS website[4]. Wave overwash also transports sand to backshore areas and is an important physical process that affects shore morphology. Additional information about coastal hazards is provided in Section 2.3.

Watershed-Coastal Interface

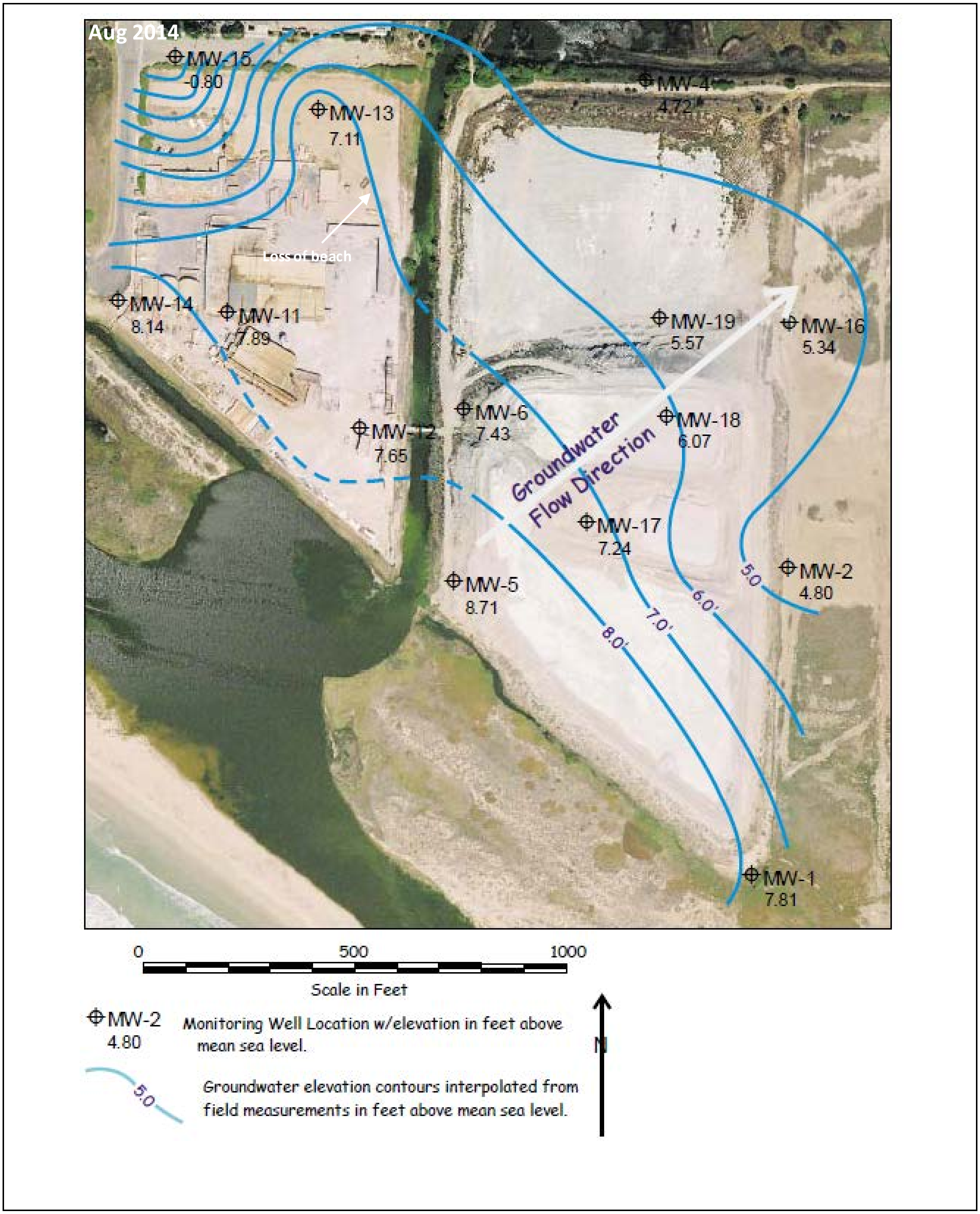
The Project Area is at the interface of watershed and coastal processes. In particular, the Lagoon is a dynamic system that fluctuates based on rainfall and runoff, waves, and sediment transport.

Natural Lagoon Dynamics

Water levels in the Lagoon respond to the balance of water inflows and outflows, which is dictated by the seasonal hydrology and by the condition of the lagoon mouth. When the mouth is open, it typically acts as a drainage outlet (Behrens et al. 2015), but tidal exchange through the mouth can lead to limited tidal fluctuations in the lagoon (CH2M Hill 2008). Waves deposit sediment in the mouth, which can either be removed by tidal and freshwater currents (effectively maintaining the opening), or can lead to blocking (closure) of the mouth, effectively separating the lagoon from the ocean (PWA 2007). When the mouth is closed, watershed runoff, groundwater flows, occasional wave overwash, and direct precipitation collect in the lagoon, causing water levels to rise. Since the lagoon is situated at a high elevation relative to ocean tides, this trapped water experiences a persistent head gradient between the lagoon and ocean, causing flows to seep through the beach toward the ocean (beach/berm seepage). As shown by CH2M Hill (2008, 2012), a persistent head gradient toward the WWTP trunk line to the north also causes upland-directed seepage from the lagoon (**Figures B-14**). Seepage and evapotranspiration allow water to leave the lagoon, and can be stronger than the combined inflows for extended periods of time (PWA 2007).

In a given year, winter flood events with more than 0.5 inches of rain are thought to be sufficient to raise water levels to the level of the beach crest, leading to scouring of beach sediments and opening of the mouth, allowing flood flows to drain to the ocean (Su 2007). The actual water level needed to breach the lagoon depends on how high waves have built the beach crest, which usually varies from 8–10 feet (PWA 2007; HDR 2008a). After the initial flood subsides, the mouth may remain open for some time, allowing lagoon water levels to fluctuate with the tides until waves eventually close the mouth again. Historically, the lagoon, which was located west of

3 http://maps.coastalresilience.org/california/ last visited, August, 2017
4 https://www.sciencebase.gov/catalog/item/57b125bbe4b0fc09fab0ce4b last visited August 2017



SOURCE: CH2M Hill (2008)

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Figure B-14
Groundwater Elevation Contours in June 2006, During a Period of Lagoon Mouth Closure

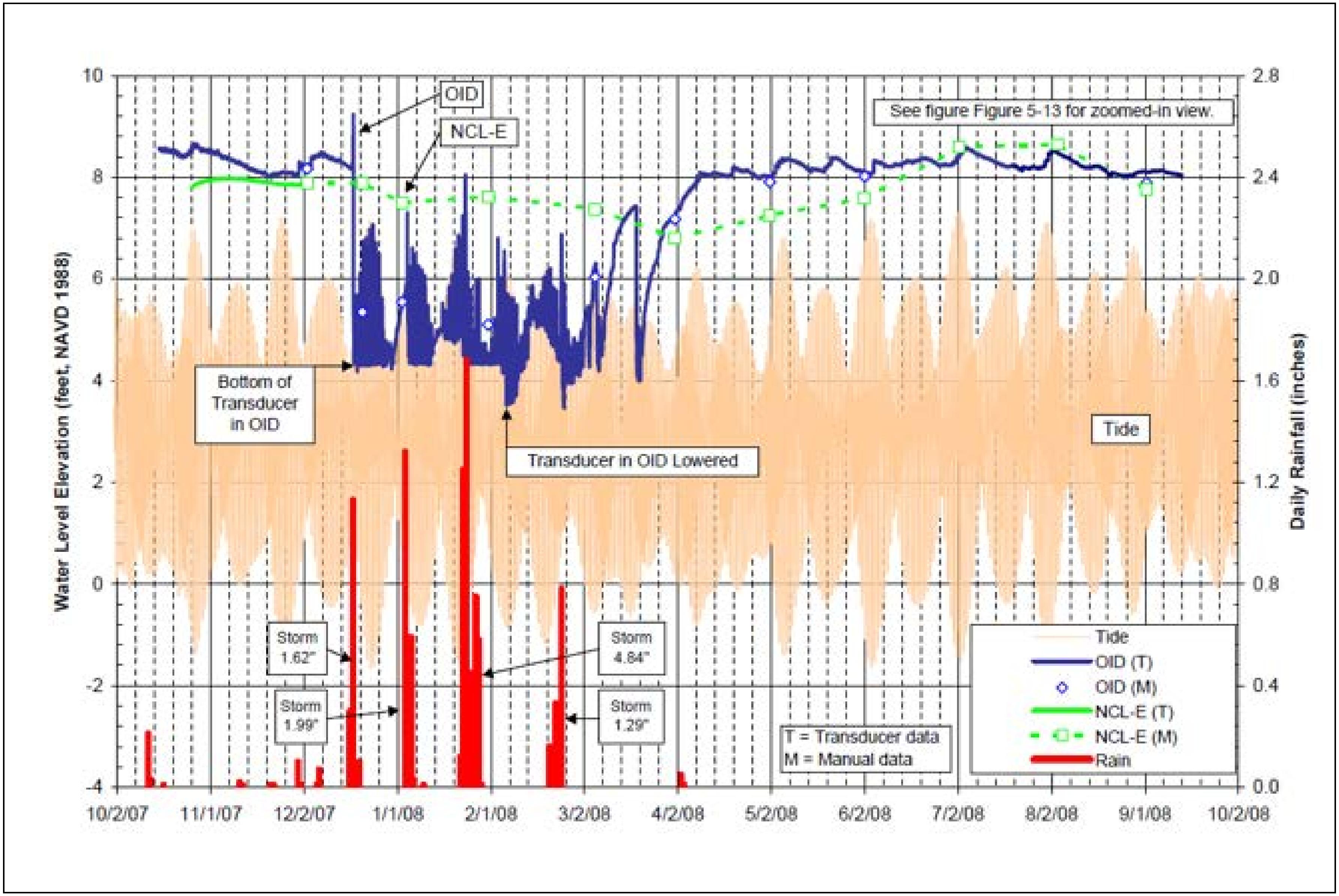
the existing location (see Section 2.1) may have had a tidal prism of 120 acre-feet, which may have allowed tidal currents large enough to keep the mouth open for extended periods of time regardless of watershed runoff conditions (PWA 2007). In its present state, the lagoon has less than 20 acre-feet of tidal prism, so mouth condition is largely dependent on watershed runoff events (HDR 2008a).

Compared to a typical oceanic tide range of 5–7 feet (see Table B-3), tidal water levels in the lagoon during open mouth conditions are on the order of 1–3 feet. This is typical for very small coastal lagoons, and these constrained flows through the mouth may produce a diurnal (i.e., once-a-day) fluctuation of water within the lagoon if ocean water only fills the site during higher high tides (PWA 2007).

The lagoon varies in size throughout the year, which makes continuous water level measurement a challenge. However, surface water data collected as part of the Halaco Site remediation provide an illustration of the seasonal variability of the site. Water levels are also currently being measured in the lagoon as part of the present study. **Figure B-15** illustrates how water levels fluctuated in the Lagoon from October 2007 to September 2008, showing several important features:

- The mouth was closed until December 18, 2007, when approximately 1.6 inches of rainfall increased the lagoon water level from 8 to 9 feet NAVD88 over several hours.
- A series of rainstorms in January and February maintained an open mouth, as indicated by lagoon tides (measured in the OLW) fluctuating between 3.5 and 7 feet NAVD88.
- The lagoon underwent a series of short closure and breach events in early March, before experiencing seasonal closure on March 20th.
- The smooth rise of the water level through early April is an indication that net inflows were sufficient to fill the lagoon, but not to reach the beach berm crest and re-open the mouth.
- From mid-April through September, the mouth reached an equilibrium of 8-8.5 feet NAVD88.
- Punctuations in the water level coincide with high spring tide events throughout summer, which is an indication that wave overwash was likely entering the lagoon during extremely high tides and contributing saltwater to the lagoon (ESA PWA 2015).

The VCWPD also maintained a tide gage in the Ormond Lagoon Waterway (formerly called the Oxnard Industrial Drain and referred to as “OID” in the source document) from 2002 to 2005. This record shows a series of closure and breaching events (see HDR 2008a), but this was not referenced to a vertical datum. Water levels have also been collected manually since 2008 by referencing a tide staff at the site (CH2M Hill 2012). While these do not provide enough resolution to understand tidal fluctuations at the site, they generally show that water levels during periods of seasonal mouth closure range from 6.5 to 9.5 feet NAVD88.



SOURCE: CH2M Hill (2008)

NOTE:

OID = Oxnard Industrial Drain (now referred to as Ormond Lagoon Waterway)

NCL = The Nature Conservancy Land

Tide = Oceanic tide measured at Santa Monica

Ormond Beach Wetlands Restoration

Figure B-15

Surface Water Level Measurements in Ormond Lagoon and TNC Parcel from October 2007 to September 2008

Lagoon Mouth Management

From the early 1960s until 1992, the mouth of the Lagoon was breached periodically to drain the lagoon and prevent flooding of upland areas. This was performed by the VCWPD (formerly the Ventura County Flood Control District) with heavy equipment by digging a small pilot channel in the beach and allowing the lagoon to begin spilling toward the ocean. After the practice was discontinued in 1992, flooding has remained a concern, as rainfall events coinciding with closed-lagoon mouth conditions can cause high water levels to build in the hours before the mouth naturally breaches and drains the lagoon.

HDR (2008a, b) explored the impacts of emergency breaches and of lowering the beach berm elevation prior to the arrival of the rainfall event. They found that

- For typical beach conditions without beach management, peak water levels within the lagoon could reach 11.5 feet and 12.1 feet NAVD88 during the 2-year and 100-year recurrence fluvial flood events, respectively.
- Overtopping of the beach occurs prior to the peak of the hydrograph for a 100-year event.
- Lowering a 50 meter (~160 ft.) segment of the beach to 7 feet NAVD88 could lower peak flood levels at the lagoon for a 2-year event to 8.5 feet NAVD88.
- Creating an emergency breach at tšumaš Creek prior to the 2-year storm event could reduce the peak elevations at the lagoon during a 2-year event to 7.9 feet NAVD88.
- Creating an emergency breach at tšumaš Creek prior to the 100-year storm event could reduce the peak elevations at the lagoon during a 100-year event to 10.8 feet NAVD88.

The VCWPD mitigates flooding by lowering (grooming) the beach crest for a 100-foot-wide segment of the beach to a specified level allowed by the Beach Elevation Management Program (BEMP) established under the Coastal Development Permit 4-12-051 (6.5 feet NGVD29, or 8.9 feet NAVD88, CCC 2013) or 0.5 feet above lagoon water level whichever is higher), up to three times per year (HDR 2012) VCWPD actively monitors beach elevations and forecasts precipitation and stream levels to determine if beach grooming is required. Maintenance activities under the permit have been documented for fiscal years 2015–2017. Post-grooming reports highlight how rapidly beach elevations can increase after grooming when breaching does not occur immediately (VCWPD 2017). Forecasting includes the following considerations:

- Minor flooding around the Lagoon for stages of 9.4-10.9 ft. NAVD88
- Flooding begins to impact Oxnard WWTP and International Paper plant at stages of 10.9-11.4 ft. NAVD88
- Major impact to Oxnard WWTP, International Paper plant, and Hueneme Road for stages above 11.4 ft. NAVD88.

Existing Conditions - Biological Processes

This section summarizes the physical drivers that support and shape the distribution and abundance of biological resources at the site. This analysis builds an understanding of how the current habitats and populations are functioning and changing, and informs the development and assessment of restoration alternatives. The findings will also support future studies that will be needed as part of the permitting and CEQA process.

Habitat Types

The habitats that establish on site are largely driven by salinity levels (**Figure B-16**). High soil salinities or a regular influx of salt water will create salt marsh or salt panne habitats. Fresher soils and waters lead to freshwater marsh. Areas in between become brackish marsh. Changes in soil salinity, through leaching or increased tidal inputs, will change the types of habitat that establish on the site. Salinity monitoring conducted in the spring of 2017 is discussed below, followed by the current understanding of the biological processes that regulate salt marsh and saline seasonal wetlands. The trend of salt marsh conversion to brackish/freshwater marsh is discussed after.

Project Area Salinity

Shallow basins retain rainwater and can pond for several months in wet years. When ponded, these areas are used by waterfowl and shore birds. A wide range of salinities was documented in different basins in the spring of 2017 (**Figure B-17**). In general, ponds got saltier as water levels dropped (suggesting evaporation was an important driver in the dropping water level). There was also a trend of increasing salinity from west (TNC parcel), where salinities ranged from 6 ppt to 16 ppt between March and late May, to the east (SCC parcel), which ranged from 20 ppt to 81 ppt over the same timeframe. Areas near the power plant were sampled less frequently, but ranged from about 5 ppt in March to 37 ppt in early June.

These salinity patterns are consistent with the existing habitats. The TNC parcel has large areas of tule and cattail, neither of which tolerates high salinities. The lower parts of the SCC salt panne and marsh basin are unvegetated and there is a salt crust on the soil surface when dry. The areas near the power plant are mostly pickleweed, with small areas of salt marsh bulrush and tule starting to get established.

Salt Marsh

All of the salt marsh habitat on site is currently non-tidal. Only the SCC salt panne and marsh basin (Area 6) (Figure B-17) still receives direct seawater influence in the form of occasional wave overwash events. Salt marsh species persist in other areas presumably due to high-salinity soils that exclude other species. The high-salinity soils are an indicator of an historic connection to the ocean.

Brackish Marsh

Brackish marshes form where fresh surface water and salt water meet, or where groundwater reaches the surface and mixes with tidewater. Extraction of groundwater for agricultural and municipal uses, along with channelization of streams and rivers, has lowered the water table near the site. The lower groundwater will limit opportunities to restore brackish marsh in these areas.

Saline Seasonal Wetlands

Seasonal wetlands occur on the TNC parcel next to agricultural land in Area 4. These areas pond water for very short periods of time, maybe only in wet years. The Areas 3a and 4 (near the railroad) are hydrologically connected to the lagoon, but only during periods of high water, so when the lagoon drains, water is trapped in these areas as seasonal ponds. Some of these wetlands may also be supported by high groundwater. Wetlands that rely on rainfall for their hydrology, even if salty now, will eventually evolve into freshwater habitats as salts are either leached out of the soil or removed from the site in runoff. Maintaining and restoring saltwater-dominated habitats is desirable at the site in order to maintain and increase biodiversity of coastal wetland-dependent species.

It is not clear what the main hydrologic drivers of this habitat are across the project site. Soils are almost certainly saline and appear to be better drained than most of the salt marsh areas on site. During field surveys, there was no ponding in most of these areas. The water table may be very close to the surface (and perhaps brackish) in these areas. Further study is warranted to understand these hydrological patterns.

Seasonally wetted areas are created elsewhere in the site by muted tidal connection to Mugu Lagoon via the ODD #3 (Area 5 on SCC parcel), direct exposure to rainfall, interaction with the local groundwater table, or local wave overwash create seasonally wetted areas. As an example, the wetted salt pannes on the SCC parcel (Area 5), may be fed by a combination of groundwater interaction and wave overwash.

Uplands

Uplands and upland-wetland transition habitats exist in parts of the project site and are important components of the overall ecological potential. These include the agricultural lands on the TNC parcel (Area 4) and the former tank farm area on the SCC parcel (Area 5). This potential includes high-water refuge for wetlands species and space for wetland migration with sea-level rise.

Plants and Wildlife

Understanding the physical and biological processes of a system is key to understanding how plants and animals will establish and use a site. The plants and animals that live within Southern California’s estuaries have evolved over many thousands of years to tolerate, and even take advantage of, the highly dynamic nature of these systems. This section considers how plants and animals function within the habitats created by those processes.

SOURCE: ESA (2017), CA Coastal Conservancy LiDAR (2011)
NOTE: Based on field mapping of site in Spring 2017. Minimum mapping unit was approximately one acre in most cases, so some small habitat features are not shown.

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Figure B-16
Existing Habitats

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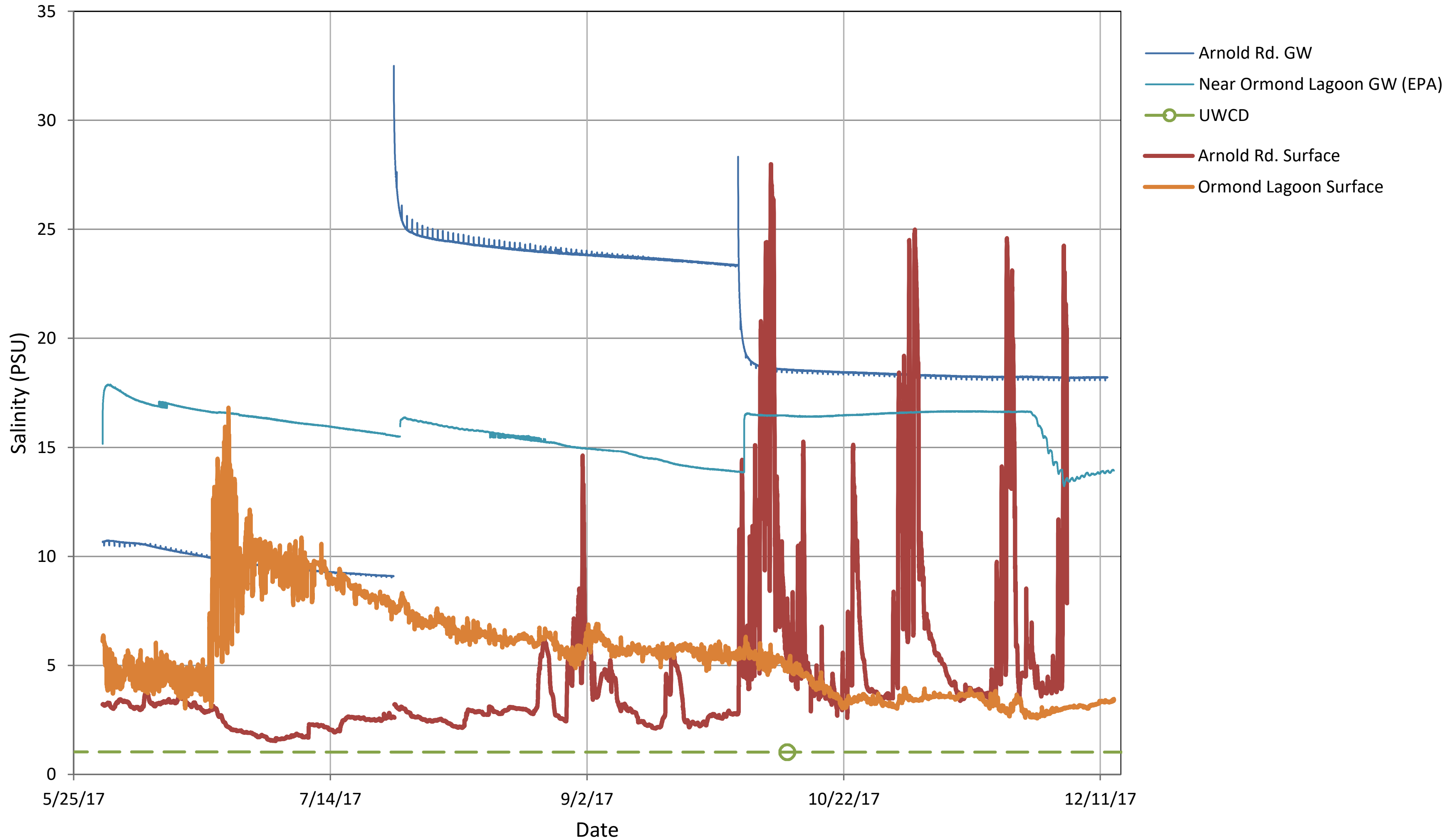

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SOURCE: ESA Water Level Gauges UWCD Groundwater Well

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Figure B-17
Salinity

ESA

Special Status Plant Species

Salt Marsh Bird's Beak

Salt marsh bird's beak tends to establish in areas of low salt marsh cover, often on the edges between bare ground and vegetation. Comparing mapping efforts at the site over time suggests this species has a high degree of small-scale site fidelity within the wetland complex (i.e., it tends to be found in the same location year after year). The species is threatened by the conversion of salt marsh to brackish marsh that is occurring at the site.

The mean elevations of salt marsh bird's beak vary by about a foot among the three wetland basins, based on surveys conducted in June 2017. The lowest distribution (mean 5.8 feet NAVD88, range 5.3 to 6.5 feet), for plants in the SCC salt panne and marsh basin, was nearly identical to the elevation distribution of salt marsh bird's beak in the muted tidal estuary at Carpinteria in 2017 (upper limit at Carpinteria 6.4 feet) (Page, Doheny, Hoesterey, Johnson, Hubbard, and Shroeter, *unpublished data*). The mean elevations for the other two basins surveyed at Ormond Beach were 6.4 feet NAVD88 (range 5.3 to 6.5 feet) and 6.8 feet NAVD88 (range 6.0 to 8.0 feet). These values are similar to the median reported by Zedler (2000) for fully tidal systems.

Coulter's Goldfields

Coulter's goldfields tends to establish on salty soils in areas where there is little or no plant cover. It is an annual plant that usually grows in wetlands (salt marsh, playas, vernal pools) but is occasionally found in non-wetlands. In salt marshes, Coulter's goldfields is found on the edges of salt pannes (unvegetated flats with salty soils) or in vernal basins (shallow pools that form in the cool season) (Zedler 2000). The population size of Coulter's goldfields varies strongly with soil moisture and salinity between years (Noe 1999). The population is large and presumed stable, however, the eventual leaching of salts out of soils will open up its current habitat to other species that might eventually out-compete it.

Coulter's goldfields occurred at elevations between 8.1 and 9.6 feet NAVD88, with an average elevation of 8.9 feet. This average distribution was more than 2 feet higher than in the fully tidal estuary at Carpinteria salt marsh in Santa Barbara County in 2017 (Page, Doheny, Hoesterey, Johnson, Hubbard, and Shroeter, *unpublished data*). The distribution is also 1.3 feet higher than the median elevation reported by Zedler (2000)

Elevated distributions are expected for coastal wetland plants in systems like Ormond Beach that do not get regular tidal exchange and that are not influenced by groundwater controlled by tidal processes. Since the system is perched above mean sea level, inundation, soil saturation, and high soil salinity limit plant distributions to elevations higher than those expected under fully tidal systems. These physical conditions will be important factors to consider in developing approaches to conserving these species under climate change scenarios and in restoration alternatives.

Sea Blite

Sea blite[5] is a succulent-leaved perennial shrub of the goosefoot family (Chenopodiaceae). Plants that appear to be *Suaeda taxifolia* occur at the site along the path in the southern portion of the SCC salt panne and marsh basin (Area 6), and in a large patch in the southwest TNC marsh parcel (Area 3a). Wooly sea blite grows in saline habitat at the margins of salt marshes and coastal dunes and bluffs (California Native Plant Society 2018).

Spiny Rush

Spiny rush (*Juncus acutus* ssp. *Leopoldii)* establishes on the edge of salt marshes, under moderately high salinities without inundation. This species was observed in 2017 scattered throughout the wetlands on SCC property (Areas 3b, 5, and 6). This survey indicates the species is expanding at the site since the Feasibility Study (Aspen 2009), which may be a result of the conversion of salt marsh to brackish marsh.

Red Sand Verbena

Red sand verbena establishes in dune habitat and fills an important role in dune building. This survey indicates the species is expanding at the site since the Feasibility Study (2009).

Birds

California Least Tern

The California Least Tern (*Sterna antillarium* ssp. *browni*) nests on the bare sand near the lagoon. The adults forage for fish in the lagoon and nearshore waters (Hartley 2017). This species was regularly observed flying over the site and diving for fish in open water habitats throughout the site during all of the field visits in 2017. As of late June 2017, there were more than two-dozen nests established on bare sand near the lagoon. VAS surveys (2003-2018) indicate a high concentration of nesting on the beach south of the lagoon on City property in Area 7 (Cynthia Hartley, VAS, personal communication to Kim True, August 29, 2018).

Western Snowy Plover

The Western Snowy Plover (*Charadrius alexandrius* spp. *nivosus*) inhabits the beach, dunes, and salt panne on the SCC parcel (Areas. In 2017, nests were dispersed over the entire 2-mile length of Ormond Beach (Hartley 2017). Chicks and fledglings were either at the salt panne to the south or near the lagoon (Hartley 2017). VAS surveys (2003-2018) in Area 7 indicate a high concentration of nesting on the beach south of the lagoon on City property, and extending south to SCC property in front of the OBGS (C. Hartley, VAS, personal communication to K. True, August 29, 2018).

5 Two special-status sea blites were previously documented on the site by others: woolly sea blite (*Suaeda taxifolia*) and California sea blite (*Suaeda californica*). However, *Suaeda taxifolia* is highly variable in appearance, and *Sueda californica* is now known to occur only north of Point Conception (USFWS 2010). Therefore, *Sueda californica* is not likely to be present on-site.

Belding's Savannah Sparrow

Belding's Savannah Sparrow (*Passerculus sandwichensis beldingi*) nests in pickleweed in coastal salt marshes. The conversion of salt marsh to brackish marsh is a threat to the species on site. Salt marsh areas that have converted to brackish marsh (cattail and tule) will generally not support nesting for this species.

Ridgway's Rail

Rallus longirostris levipes) nest in tidal salt marshes, preferring tall intertidal cordgrass (*Spartina foliosa*) where it builds a floating nest. Nesting in muted tidal or non-tidal areas of tidal marshes has been documented at Mugu Lagoon and Carpinteria Salt Marsh in spiny rush (*Juncus acutus*) and saltmarsh bulrush (*Bolboschoenus maritimus*). It is unlikely that the habitats in the Project Area can support breeding of the Ridgway's Rail due to the lack of important prey species (crabs and mollusks) that are found in tidal systems. Ridgway's rails are known to nest in non-tidal areas of tidal systems, but breeding in non-tidal systems is probably very rare (USFWS 2009).

Fish

The fish community of the Lagoon is shaped by the dynamics of mouth closure, salinity gradients, and physical habitat structure. Water levels in the Lagoon respond to the balance of water inflows and outflows, which is dictated by seasonal hydrology and by the condition of the lagoon mouth (Section 2.2.3). In general, when the mouth is open, marine fish species can enter to use the estuary for spawning or rearing habitat. Topsmelt and striped mullet have been documented in the Lagoon (Cardno 2017). However, access for marine fishes is likely limited since the Lagoon is perched at a higher elevation and has only minimal tidal connection.

Salinity gradients are strong drivers for estuarine fish assemblages (Allen et al. 2006). Estuarine fish species tolerate a wide range of salinity and temperature. When the mouth is closed but the lagoon is still receiving freshwater inflow, salinity will decrease. This can favor fish species adapted to lower salinities. Salinity measured in the Lagoon (mouth closed) was 1.7 ppt to 2.6 ppt (October 2015), 12.3 ppt to12.7 ppt (April 2016), and 6.9 ppt to 12.9 ppt (October 2016) (Cardno 2015b, 2016a, 2016b). Several non-native species in the Lagoon and tšumaš Creek are typical of brackish to freshwater conditions, including mosquitofish, sailfin molly, and Mississippi silverside. These species are competitors with the endangered tidewater goby. The long-jawed mudsucker , another native goby, preys on tidewater goby and can eliminate them in small closed lagoons (Brenton Spies, UCLA, *personal communication*).

Contaminants that impair water quality are a concern, as noted earlier in Section 2.2.1.2. Fish kills have occurred in the Project Area. On July 20, 2015, thousands of dead fish were observed in the tšumaš creek (formerly J Street Drain) following a large storm (CDFW 2015). Two live tidewater gobies were rescued, and no dead gobies were observed. Necropsy of dead fish revealed high levels of bifenthrin, a pyrethroid insecticide, present in gills and liver. The likely source was urban and agricultural runoff.

Tidewater Goby

The tidewater goby is uniquely adapted to low-salinity estuaries and lagoons, such as found at the Lagoon. The Project Area encompasses tidewater goby critical habitat unit *VEN-3 J Street Drain-Ormond Lagoon* (USFWS 2013). Attributes of critical habitat (USFWS 2013), include a seasonally closed lagoon, shallow low-salinity waters, still-to-slow-moving water, areas of sand and silt substrate for the construction of burrows for reproduction, and submerged and emergent aquatic vegetation, such as pondweed (*Ruppia maritima, Potamogeton pectinatus*), bulrush (*Scirpus* spp.), and cattail (*Typha latifolia*). Of particular importance is the presence of the 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. In general, backwater areas or off-channel marsh habitat provide valuable low-flow refugia and foraging habitat (Swenson 1999).

The Lagoon provides many of these critical habitat elements, in particular a closed lagoon, low salinity waters, suitable substrate, and pondweed. However, the presence of non-native fishes is a concern. Increasing the frequency of tidal exchange, while still maintaining seasonal lagoon closure would increase salinity levels and fluctuations, which could reduce the freshwater species.

As discussed previously, VCWPD grooms the berm between the lagoon and the ocean to allow for natural breaching of the lagoon berm during storm events. The approach of tying berm grooming to storm events is designed to protect tidewater goby populations; in response to pre-storm environmental cues, the fish will move upstream and thereby minimize the likelihood of being washed out to sea when the berm breaches (C. Dellith, U.S. Fish and Wildlife Service, personal communication to L. Riege, TNC, October 5, 2017).

Future Conditions

This section provides an initial summary of available information and assessment of future conditions without restoration (i.e., future without project conditions). This assessment of future conditions will be refined as part of developing and evaluating restoration alternatives.

Future Physical Conditions

Future conditions at the Project Area have been considered in a number of studies led by the Pacific Institute and TNC. These have incorporated regional projections of sea level rise, future watershed conditions, regional shoreline geology, and built infrastructure constraints to consider future coastal and fluvial flooding conditions, and storm erosion. Related studies examined economic tradeoffs of future management actions at the site, as well as future marsh accretion in the nearby Mugu Lagoon.

In 2009, Philip William and Associates (PWA) was funded by the Ocean Protection Council (OPC) to provide a technical hazards analysis in support of the Pacific Institute report on the “Impacts of Sea Level Rise to the California Coast” (Pacific Institute 2009). PWA projected future coastal flooding hazards for the entire state based on a review of existing FEMA hazard maps. PWA also projected future coastal erosion hazard areas for the northern and central California coastline, but did not include Ventura County at that time. This study led to the development of a methodology for assessing coastal erosion (Revell et al. 2011), but was constrained by a lack of data in parts of the State, including the Ventura coast. The Pacific Institute (2009) used information from this study to evaluate potential socio-economic impacts of sea level rise.

The Coastal Resilience Ventura project led by TNC built on this prior work, improving and adding to the methods of the Pacific Institute (2009) study and applying them to the Ventura study area with higher resolution local data to analyze the coastal hazards associated with sea level rise (Section 4.1). This work led to projections of future coastal hazards that were suitable to supporting local planning processes, as well as a series of decision-support tools intended to aid conservation, planning, and policymaking. Hazard zones were developed at three planning horizons (2030, 2060, and 2100) based on guidance from the steering committee.

The sections below summarize some of the main findings from the Pacific Institute and TNC studies. For more information on the technical details, refer to PWA (2009), and ESA PWA (2013 and 2014).

Sea Level Rise

ESA PWA (2013) assessed future sea level rise based on guidance from the National Research Council (NRC 2012) and the U.S. Army Corps of Engineers (USACE 2011). These studies considered the outputs from global circulation models (GCMs), to produce local sea level rise estimates based on a range of future carbon emissions scenarios. The USACE medium curve was selected as the low curve by ESA PWA because it is the lowest of all the USACE and NRC projections that incorporates future increases in the rate of sea level rise. The high and medium curves were based on the high and middle range of models discussed in the NRC 2012 report. All curves include an adjustment for local vertical land motion using the Santa Monica tide station (NOAA #9410840). **Table B-5** summarizes the sea level rise rates.

TABLE B-5
SEA LEVEL RISE PROJECTIONS, RELATIVE TO 2010

Year	Low SLR	Medium SLR	High SLR
2030	6 cm (2.3 inches)	13 cm (5.2 inches)	20 cm (8.0 inches)
2060	19 cm (7.4 inches)	41 cm (16.1 inches)	64 cm (25.3 inches)
2100	44 cm (17.1 inches)	93 cm (36.5 inches)	148 cm (58.1 inches)

NOTE: SLR = sea level rise
SOURCE: ESA PWA 2013

Watershed Runoff Conditions

ESA PWA (2013) also assessed regional climate change impacts on watershed runoff, looking at potential changes to the 100-year recurrence interval flood on the Ventura and Santa Clara Rivers. The impact of rising coastal water levels from sea level rise was also considered. Although runoff to the Ormond Beach Project Area was not modeled, relative changes to the Ventura and Santa Clara Rivers is assumed to provide a useful proxy for regional change.

To model future runoff conditions, ESA PWA (2013) relied on prior work by Cayan et al. (2012), who regionalized broad scale GCM data and identified the models that most reliably capture the climate phenomena in California. Future hydrology projections for Ventura County were obtained from the Coupled Model Intercomparison Project database for daily runoff and baseflow, which are available to the public through an online database (http://gdodcp.ucllnl.org/downscaled_cmip3_projections/). ESA PWA (2013) performed a fluvial flood hazard analysis using a combination of these downscaled climate projections, hydraulic modeling, and floodplain inundation mapping to evaluate the impact of climate change on fluvial flooding. Results for the Santa Clara and are shown in Table 9 of ESA PWA 2013. Generally, for a medium-high emissions scenario these show an increase of 11-23 percent in the peak flows for the 100-year recurrence flood, versus a 4-14 percent decrease for a low emissions scenario. Although the watershed for the Project Area is largely urban, these results give a sense of the direction of change in peak runoff conditions for future climate scenarios.

Coastal Flooding

ESA PWA (2013) mapped coastal flooding under several future cases. These included:

- Rising tide inundation zones: considering only inundation from oceanic tides
- Coastal storm wave impact area: considering the zones where water could potentially rush inland due to waves breaking at the coast
- Coastal storm flood hazard zones: flooding caused by storm waves rushing inland and by ocean storm characteristics such as storm surge (a rise in the ocean water level caused by waves and pressure changes during a storm)
- Combined storm flood hazard zones: combining the above terms and fluvial storm flooding into a single comprehensive, combined storm flood hazard area.

Figure B-18 shows the predicted flooding extents under present day, 2030, 2060, and 2100 conditions under tidal conditions. **Figure B-19** shows future flooding under storm conditions These conditions show the expected extents of inundation if the existing infrastructure, drainage pathways, and topography remain the same in the future. These changes do not consider changes to position of the beach, dunes, or other habitat over time. A separate study by ESA PWA (2014) examines changes to wetland and adjacent ecotone habitat in and adjacent to Mugu Lagoon.

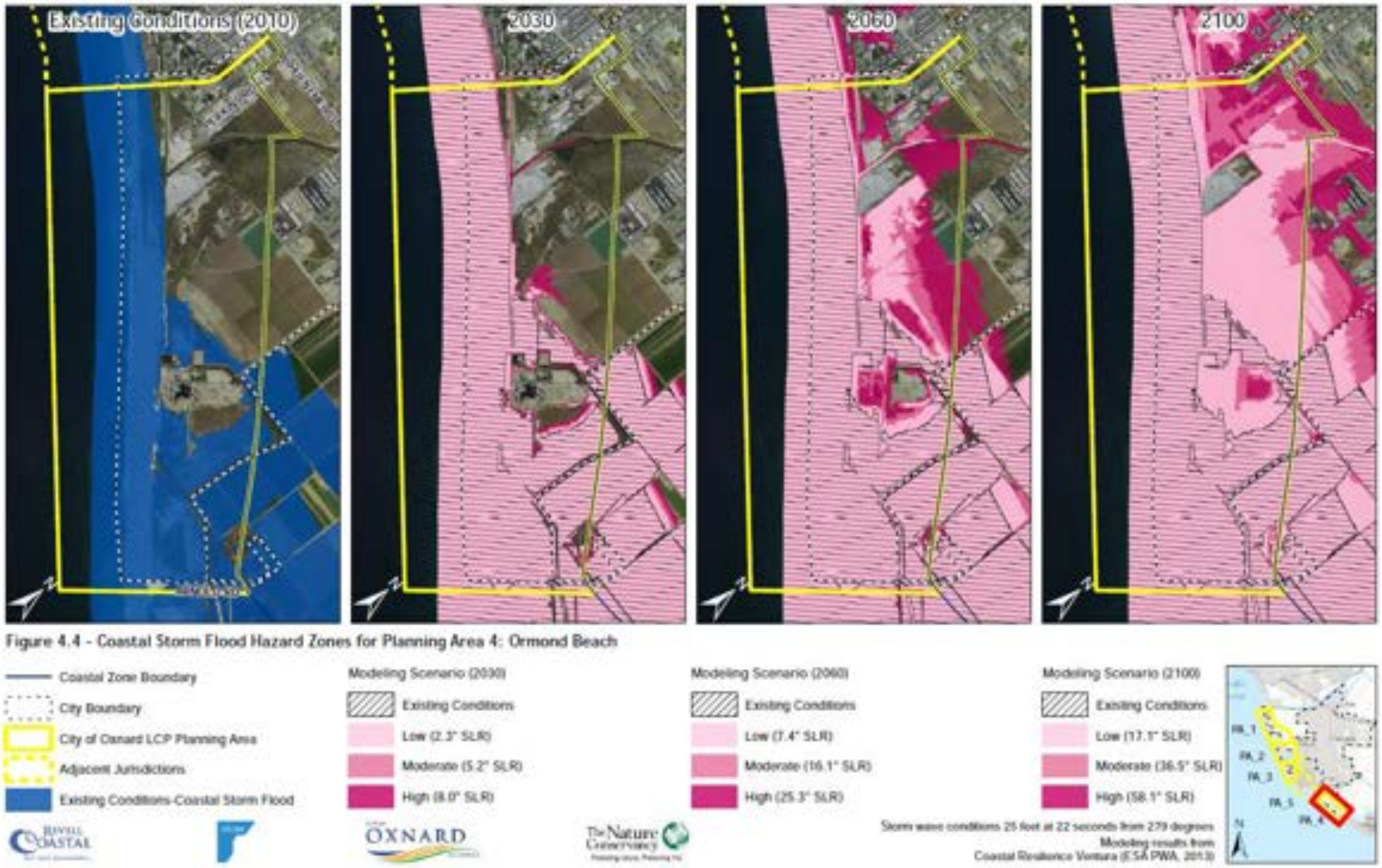
Coastal Erosion and Beach Adjustment

Under future sea level rise conditions, the Project Area will undergo a series of hydrologic changes as the beach responds geomorphically to the rising water levels. The Beach will likely respond to rising oceanic water levels by migrating inland (transgressing), and shifting upward. Depending on the rate of transgression, the existing dune system may be eroded, since higher oceanic water levels would mean that existing dunes would be exposed to waves on a more frequent basis. If the future lagoon and wetland system are allowed to migrate inland, the hydrology may remain similar in the future, although the groundwater table will likely shift upward along with the rising tides.

SOURCE: ESA PWA 2013

Ormond Beach Wetlands Restoration

Figure B-18
Future Monthly Tidal Inundation Hazard Zones



SOURCE: ESA PWA 2013

Ormond Beach Wetlands Restoration

Figure B-19
Future Coastal Storm Flood Hazard Zones

If the lagoon remains in place due to existing property constraints, the beach will likely erode over time, potentially eliminating the lagoon and wetlands (HDR 2008, ESA PWA 2015). ESA PWA (2015) performed an analysis to examine how the beach width could adjust over time.

Lagoon Mouth Dynamics

The effects of sea level rise on intermittent lagoons, such as the Lagoon, depends on the future response of the beach, and on changes to runoff patterns and locations of infrastructure and roadways that constrain the back edge of the lagoon. If the beach transgresses inland and existing roadways and infrastructure remain in place, the lagoon could reduce in size over time, since it would have no room to move inland, which would reduce flows through the mouth over time. In general, the maximum height of the beach berm at the mouth will rise at a one-to-one ratio with sea level rise (assuming sufficient sand supply), meaning the maximum water level in the marsh will rise proportionately. Depending on the rate of future sedimentation (either from delivery of inorganic sediments to the lagoon or from decay of organic material), this rise in maximum water level could increase tidal prism in the lagoon (if sea level rise outpaces deposition) or remain comparable (if sea level rise is comparable to deposition rates). A larger tidal prism could lead to longer periods of open conditions (PWA 2007). Since the Project Area currently receives very little sediment each year, this future deposition rate will likely depend on organic deposition rates within areas of restored marsh. Modeling of these future mouth dynamics will be completed as part of the Ormond Beach Restoration and Public Access Plan.

Future Biological Conditions

Current Trends

The most obvious current trend at the site is conversion of salt marsh and salt flat habitat to brackish and freshwater marsh habitats. This is driven by decreased influence of sea water on the site over the last few decades as the dunes have grown wider and taller (limiting wave overwash). The growth of the Ormond Lagoon since the suppression of mechanical breaching (1992) has also likely increased the extent of fresh water effects, whereas the “beach grooming” (also known as breach priming) that has been practiced following a 2010 flood event (VCWPD 2010, 2016, 2017) seemingly is less impactful that the historic mechanical breaching. This has led to a situation where rainfall and runoff from the local watershed have become more important drivers of hydrology and salinity for the western portion of the site. Unless seawater influence on the site is increased, more and more of the current salt marsh habitats is expected to convert to tule and cattail marsh, which is not as high a regional wetlands priority as salt marsh (WRP 2018).

Much of the north TNC marsh (Area 2) and the north SCC marsh (Area 5) are in the process of recovery from severe disturbance. Both areas support wetland habitats and native salt marsh species to a limited extent. Neither area has salt water influence, though, and it is expected that if rainfall continues to be the primary hydrologic driver, these areas will become less saline and non-native invasive species will come to dominate. Without restorative actions, these areas are unlikely to recover to high functioning wetland habitat on their own.

The salt marsh and panne habitat are persisting in the southeastern area (Area 6), likely because of wave overwash, less rainfall runoff, and resulting salt concentrations. The wave overwash is attributed to the narrower and lower dune field geometry in this location. Historical maps show that the relatively narrower beach and dune field in this area is natural. However, it appears that the dunes were destabilized by erosion following the Hueneme Harbor construction, resulting in very low dunes which allow greater wave overtopping and foster higher salinity levels in the wetlands.

Long-Term Changes Due to Sea Level Rise

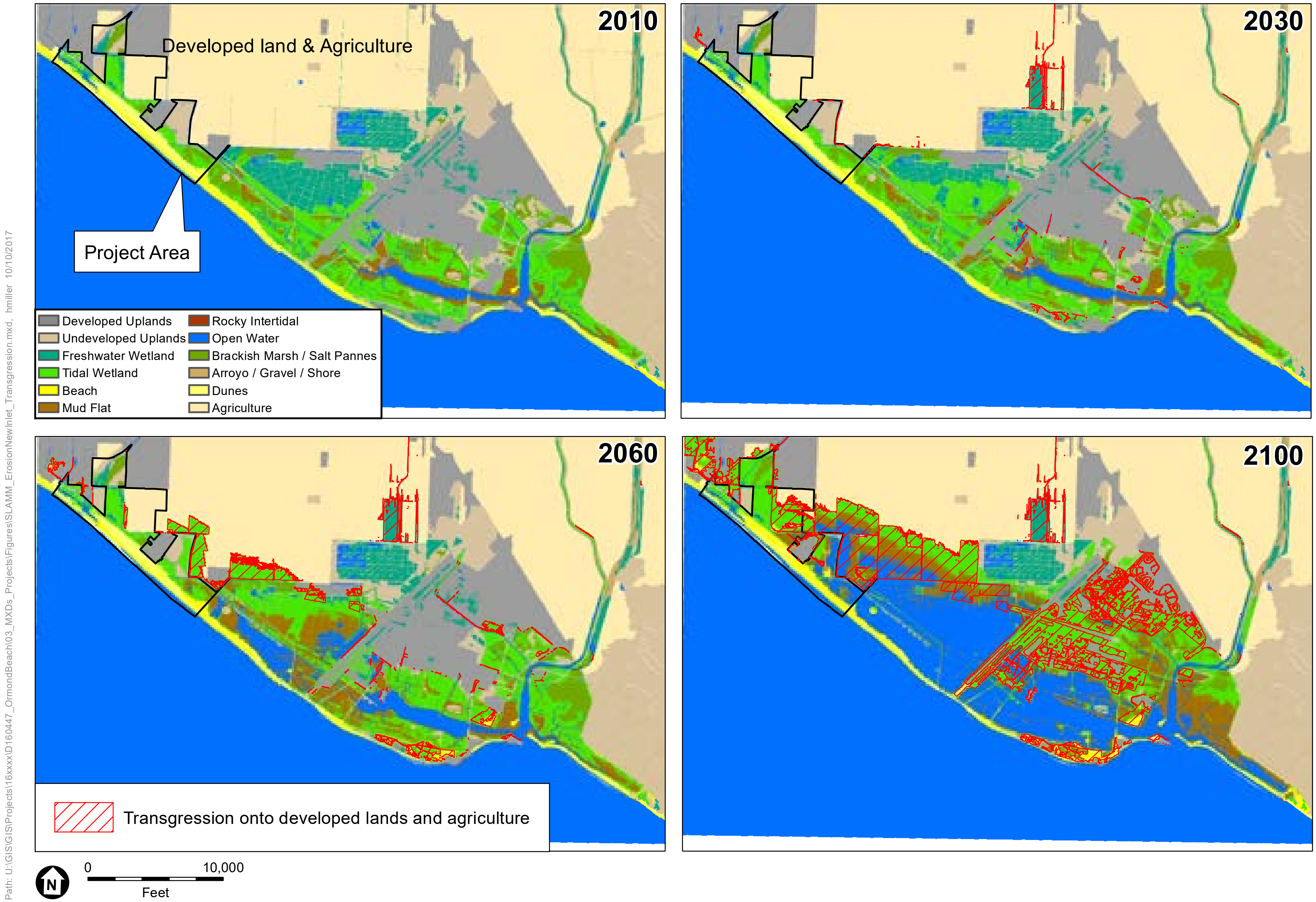
Sea level rise is expected to affect the beach and dunes, as well as groundwater levels, and in-turn affect the hydrology and salinity of the wetlands. Prior studies provide insight into the effects of sea-level rise on wetland hydrology and habitat changes. Much of the prior work was accomplished recently (2014) as part of the Coastal Resilience Ventura program lead by TNC and partners. This section outlines some of those projected changes to provide background. Site evolution is assessed in more detail as part of the OBRAP technical studies (Appendices C, D, E and F).

Prior SLAMM Projections

As part of TNC's Coastal Resilience Ventura project, ESA PWA (2014) modeled habitat evolution with sea level rise along the Ventura coastline for different management scenarios. ESA PWA used the EPA's Sea Level Affecting Marshes Model (SLAMM) to look at the effects of sea-level rise, accretion and erosion, and freshwater inflow on different coastal habitats. The Coastal Resilience online tool[6] shows future conditions for the Project Area with sea level rise. SLAMM, which is based on U.S. Atlantic Coast embayments, required modification to apply to Ventura coastlines. ESA PWA made modifications to improve the accuracy of projecting habitat change within the Mugu Lagoon. These modifications included using California wetland habitat types and accounting for tidal muting within Mugu Lagoon. At the time of the study, SLAMM could not accurately represent intermittently-open lagoon and backbarrier systems such as Ormond Lagoon and the backbarrier salt marsh and pannes at Ormond Beach. More recently, ESA has teamed with Warren Pinnacle Consulting (WPC) and TNC to improve SLAMM to better represent back-barrier wetlands with perched hydrology (water levels higher than ocean tides) (WPC 2016). This is an important improvement because backbarrier habitat in west coast systems is less dependent on tides than in east coast systems (WPC 2016). This ongoing work will allow refinement of future projections as part of the OBRAP process, but the results presented here are based on prior work that used the older version of SLAMM (ESA PWA 2014; Environs and ESA PWA, 2015).

Figures B-20 and B-21 show the existing (2010) habitat zones for the Project Area and projections for 2030, 2060, and 2100 based on a 'high' sea level rise case of 58.1 inches (4.8 ft.) by 2100 (NRC 2012). Both cases also consider a low sedimentation rate, and the potential for marsh to transgress upland into existing agricultural and developed areas (if marsh transgression/restoration is allowed). Figure B-20 shows projected conditions assuming a new tidal inlet erodes west of the base runway (which could be analogous to improving tidal connectivity between Ormond Beach and Mugu Lagoon), whereas projections in Figure B-21 assume no new inlet. The model showed progressive

6 http://maps.coastalresilience.org/california/#



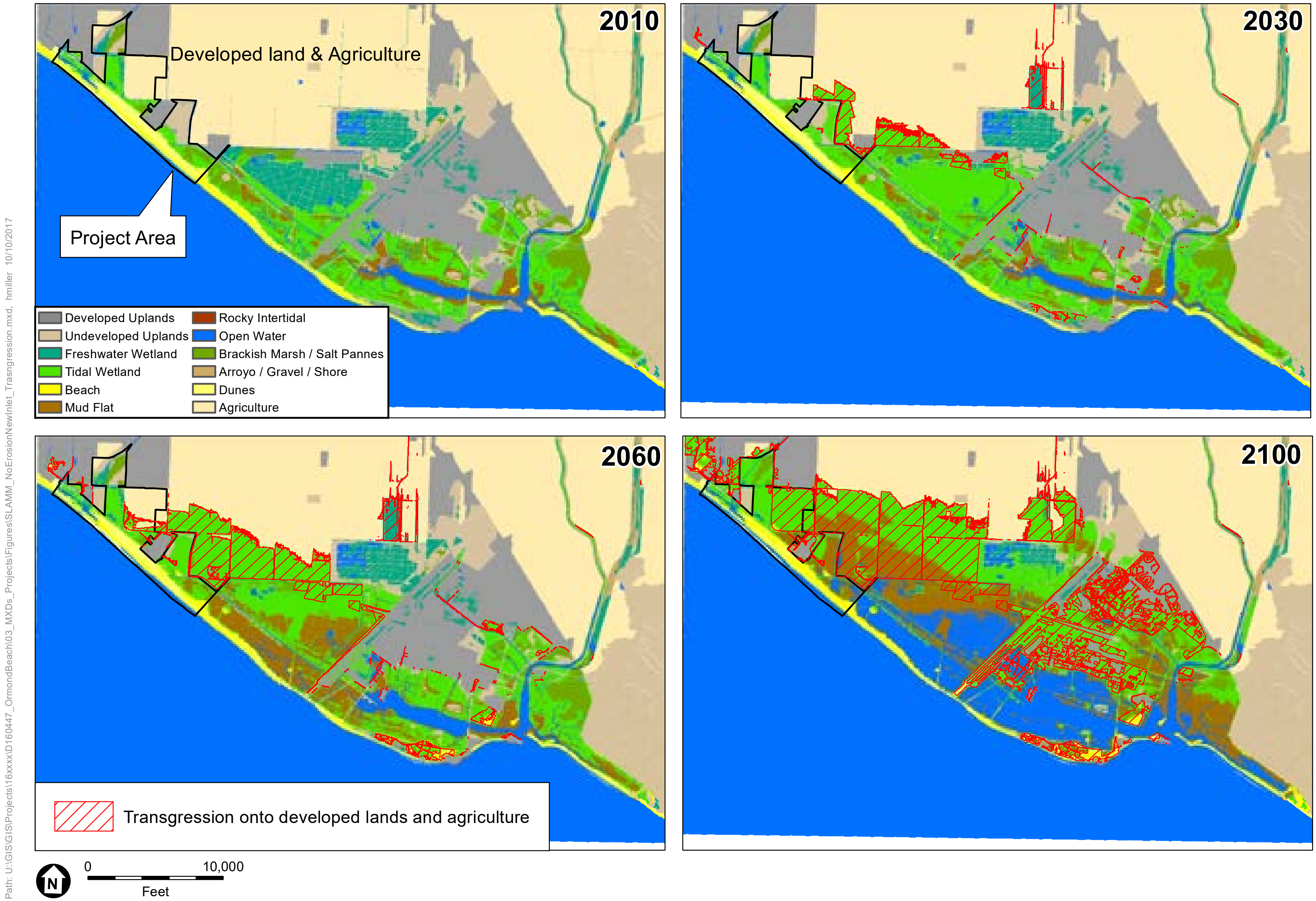
SOURCE:ESA PWA 2014

Ormond Beach Restoration and Public Access Plan

Figure B-20

SLAMM Results: High SLR, Low Accretion, Erosion of New Inlet, Allow Marshes to Transgress

ESA



SOURCE:ESA PWA 2014

Ormond Beach Restoration and Public Access Plan

Figure B-21

SLAMM Results: High SLR, Low Accretion, No Erosion of New Inlet, Allow Marshes to Transgress

ESA

drowning, or conversion of existing salt marsh habitat to mudflat, and mudflat conversion to open water. This is more pronounced for the case without erosion of a new inlet west of the base runway. These results indicate that existing salt marsh habitat are vulnerable to sea-level rise. The existing salt marsh could be largely lost in the future without adaptation measures such as restoring marsh/allowing for marsh transgression onto existing agricultural and upland areas. These results and findings led to the investigation of adaptation scenarios described in the following section.

Several of the aspects of this previous modeling will be revised as part of the OBRAP process in order to assess habitat evolution and resiliency with sea-level rise specifically at Ormond Beach. In particular, the response of the Ormond Beach dune and beach system to sea level rise will be examined in more detail (see the additional discussion in the Shoreline Response and Salinity of Backbarrier Wetted Areas section below). It is also important to note that the persistence of marsh habitat in the Project Area will depend on whether marsh habitats can transgress inland. Lack of transgression space would constrain marsh, mudflat, and open water areas, including the Lagoon, as the beach moves inland, most notably in Area 1 and around the Halaco Superfund Site. Fortunately, there is room for marsh migration on the uplands at the TNC property on agricultural lands (Area 4) and the SCC property on former tank farm land (Area 5).

Economic Analysis of Nature-Based Adaptation to Climate Change for Ventura County

Beach and wetland changes were also analyzed as part of an analysis of the economics of sea level rise adaptation scenarios (Environs and ESA PWA 2015). Two responses (adaptation strategies) to sea level rise were modeled: One response favors engineered solutions, and is referred to as the Engineering Based Adaptation, or EBA, while the other is called the Nature Based Adaptation strategy, or NBA. The work builds on the prior forecasting and mapping of climate change-induced hazards along with projections of wetlands responses developed for TNC by ESA (ESA PWA 2013, 2014). Additional shore response analysis was employed to support the economics assessment, which included accounting for ecological value. Areas of different habitats were modeled over time, driven by sea-level rise and adaptation actions (e.g. allow erosion, or construct a wall or dune).

Beach modeling was conducted through a simple “two-line” shore model, which tracked the position of the high tide shore (roughly 5.5 feet NAVD) and the backshore line where the beach meets the dunes, development, or other “backshore” feature. The difference between these two locations is called the “dry sand beach width”. The scenario that allowed for dune erosion is most pertinent to the OBRAP, and the results are summarized here. For the Ormond Beach sub-area, the beach in front of the Ormond Beach Generating Station was selected for analysis. This location had a dry beach width of 590 feet based on topography measured with LiDAR in November 2009 (NOAA 2012). ESA PWA estimated the minimum natural beach width to be about 400 feet (120 meters). Conceptually, once the dry beach width narrows to the minimum natural beach width, waves reach the dunes, resulting in erosion. ESA PWA computed the shore erosion rate to change from 0.4 feet per year in 2010 to 4.5 feet per year by 2100, owing to accelerating sea-level rise. This resulted in the erosion of about 260 feet of dune (total dry width reduced from 1079 to 814 feet). The projected erosion does not penetrate through the dunes in this location.

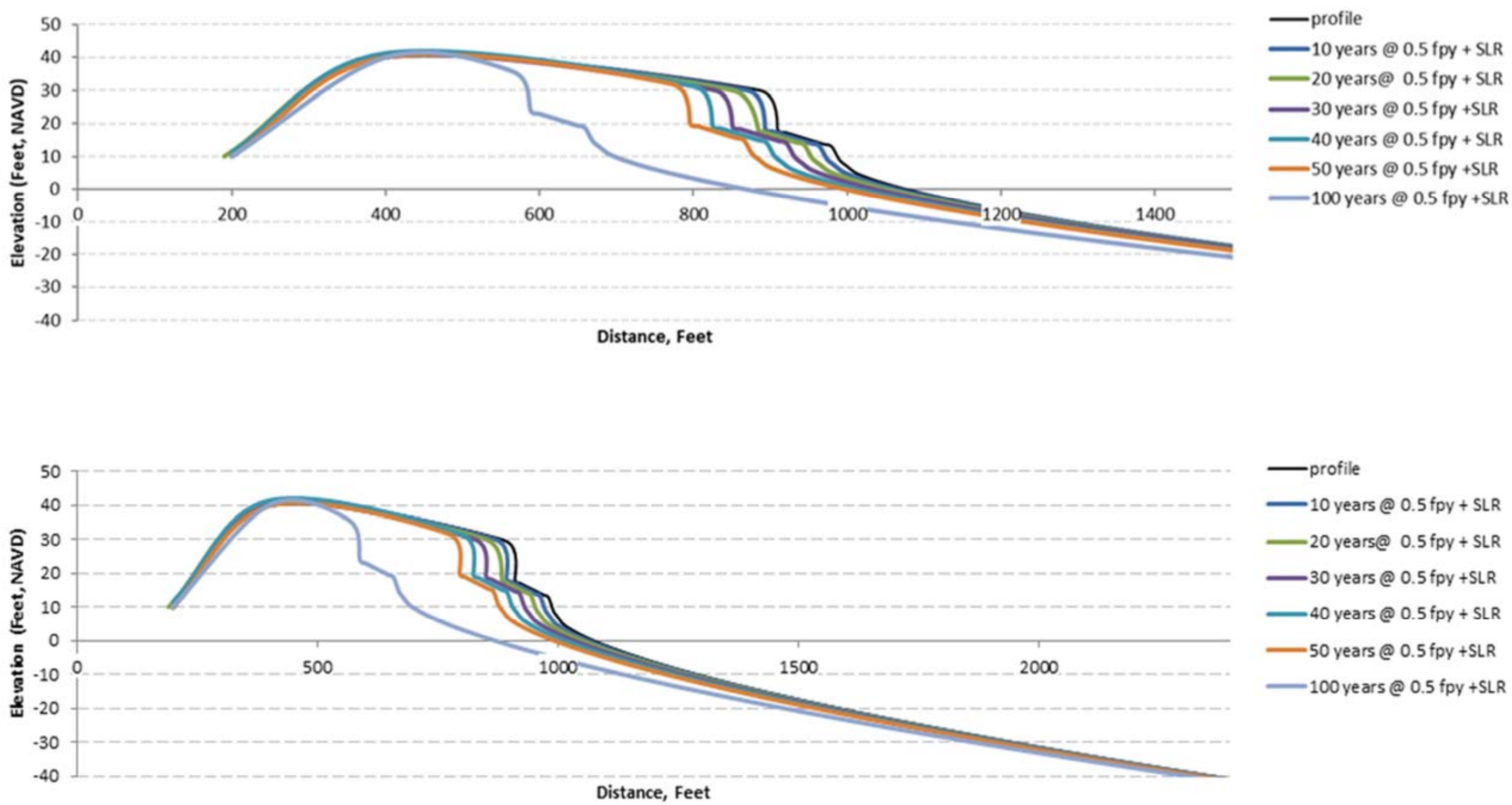
The Environs and ESA PWA study (2015) used similar analyses to estimate shore changes throughout Ventura County from 2010 to 2100 for three scenarios: Baseline (no action), NBA and EBA. The results indicated that the area of Ventura County's beaches will decrease from 800 acres to 530 acres by 2100, or to 270 acres, if coastal armoring is employed. Ormond Beach provides a large portion of the remaining beach area.

Shoreline Response and Salinity of Backbarrier Wetted Areas

Apart from changes in hydrology, salinity conditions at the site could change as a result of rising sea level. The Lagoon and the south SCC salt panne and marsh currently experience seawater influence, but water levels do not vary regularly with the tides as in a fully or intermittently tidal system. The existing dunes that back much of the Beach along the Project Area (see Figure B-20) influence the amount of salt entering ponded areas from wave overwash, so future salinity will depend on the persistence of coastal dunes. Other wetland areas may see increased saltwater influence (wave overwash or saline groundwater), which might help sustain salt marsh habitat that is otherwise converting to brackish or freshwater marsh. Hence, the future beach and dune geometry and associated future wave overwash may affect the wetlands.

Sea level rise will result in waves breaking at higher elevations, which will cause the sandy shore to change geometry. This "geomorphic response" can be approximated by presuming that the wave exposure and tidal conditions are the same except for a higher sea level. **Figure B-22** illustrates this concept of shore change driven by sea level for a sandy dune shore profile constructed to be representative of California conditions using geomorphic guidance such as an equilibrium beach profile (Dean, 1990). Figure B-22 shows the results using an ambient shore erosion rate (historic rate due to sediment supply issues) of 0.5 feet per year and a relatively high sea level rise scenario consistent with USACE guidance derived from the NRC 2012 report. The profile includes a beach between 15 and 18 feet NAVD, and a dune that rises to 40 feet NAVD.

The top panel of Figure B-22 focuses on the upper part of the profile while the lower panel includes the surf-zone out to about -40 feet NAVD. Note that the shore migrates landward and up, but is presumed to maintain its conceptual "equilibrium" shape. This shape is representative of a highly dynamic system, which can be thought of as an envelope of profiles around each "average" profile plotted in Figure B-22. The output predicts that about 400 feet of dune will be eroded by the shore recession. Therefore, it can be postulated that any dune field less than 400 feet in landward extent could be degraded over time by shore response to sea-level rise. Removal of dunes will allow greater wave overtopping, which will result in increased ocean water supply and salt supply to the wetlands. A review of dune field dimensions indicates that the eastern portion of the Project Area will likely have increased ocean effects (water and salt), whereas the central portion will be able to maintain dunes. This approximate analysis will be refined for the OBRAP process, but provides insight to future conditions.



Note: Shore profile response to sea-level rise is shown for a sandy beach and dune system that has an ambient erosion rate of 0.5 feet per year (fpy) and sea-level rise of 5.7 feet over 100 years. The colored lines are the shore profile in 10-year time steps for the first 50 years plus a shore at 100 years into the future. The upper plot is a “close up” of the upper elevations and the lower plot shows more of the offshore surf zone down to elevation -40’ NAVD.

ESA

Figure B-22
Shore Profile Response to Sea Level Rise

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Appendix C
Sea-Level Rise

APPENDIX C
Sea Level Rise Policy and Guidance

This appendix summarizes existing federal and state policy and guidance related to sea-level rise planning and describe current sea-level rise projections relevant to Ventura County from various data sources.

Federal

FEMA provides Flood Insurance Rate Maps (FIRM) as part of the National Flood Insurance Program (NFIP), which show coastal and fluvial flood hazards. The maps do not consider future sea-level rise or erosion and only evaluate existing hazards. Additionally, FEMA maps do not present flooding information related to extreme events with a lower probability than the 1% chance of occurrence.

State

As per Executive Order S-13-08 issued by Governor Schwarzenegger, the California Ocean Protection Council (OPC) released a statewide guidance document in 2010 to assist state agencies with incorporating sea-level rise into planning decisions. The subsequent update (OPC 2013) was informed by *Sea Level Rise for the Coasts of California, Oregon, and Washington* by the National Research Council (NRC 2012), which provided new projections of future SLR. An update to the OPC guidance is expected in early 2018 and is outlined in Section 3.3.

The California Coastal Commission (CCC) issued SLR policy guidance in 2015 (CCC 2015). The document outlines a methodology for addressing SLR and adaptation planning in Local Coastal Programs (LCPs) and Coastal Development Permits (CDPs) using “best available science” and specifies climate change scenarios relevant to local risk and vulnerability assessments. The framework for addressing SLR in CDP applications is summarized as follows (CCC 2015, p. 20):

1. Establish the projected sea-level rise range for the proposed project’s planning horizon using the best available science, which is currently the 2012 NRC report.
2. Determine how physical impacts from sea-level rise may constrain the project site, including erosion, structural and geologic stability, flooding, and inundation.

3. Determine how the project may impact coastal resources, considering the influence of future sea-level rise upon the landscape as well as potential impacts of sea-level rise adaptation strategies that may be used over the lifetime of the project
4. Identify alternatives to avoid resource impacts and minimize risks throughout the expected life of the development.
5. Finalize project design and submit CDP application.

Both OPC (2013) and CCC (2015) recommend considering a range of scenarios which represent low, medium and high rates of climate change (OPC 2013; CCC 2015), as caused by greenhouse gas emissions and estimates of future rates of ice sheet loss. Scenario-based analysis helps elucidate extent and severity of impacts caused by different amounts of climate change. Recent studies of current greenhouse gas emissions and projections of future loss of ice sheet indicate that the low scenario probably underrepresents future SLR (Rahmstorf et al. 2012; Horton et al. 2014). Also, note that even if SLR does not increase as fast as projected for the High scenario, SLR is projected to continue beyond 2100 under all scenarios. The assumptions that form the basis for the NRC (2012) scenarios are as follows:

Low Scenario – The low scenario assumes population growth that peaks mid-century, high economic growth, and assumes a global economic shift to less energy-intensive industries, significant reduction in fossil fuel use, and development of clean technologies.

Medium Scenario – The medium scenario assumes population growth that peaks mid-century, high economic growth, and development of more efficient technologies, but also assumes that energy would be derived from a balance of sources, thereby reducing greenhouse gas emissions.

High Scenario – The high scenario assumes population growth that peaks mid-century, high economic growth, and development of more efficient technologies. The associated energy demands would be met primarily with fossil-fuel intensive sources.

2018 SLR Guidance Update

The California Natural Resource Agency and Ocean Protection Council released a draft (OPC 2017) and final (OPC 2018) 2018 guidance update to the 2013 State of California guidance document (OPC 2013). The guidance update provides a synthesis of the best available science on SLR in CA, a step-by-step approach for state agencies and local governments to evaluate SLR projections, and preferred coastal adaptation strategies. The key scientific basis for this update was developed by the working group of the California Ocean Protection Council Science Advisory Team (OPC-SAT) titled *Rising Seas in California: An Update on Sea-Level Rise Science* (Griggs et al. 2017). SLR scenarios were selected for the OBRAP prior to the OPC 2018 and CCC 2018 updates were finalized. However, the OBRAP scenarios are generally consistent with the 2018 updates owing to use of the draft guidance update (OPC 2017) and consideration of the science update document (Griggs et. al. 2017). References to the earlier guidance documents (OPC 2017, CCC 2015, and OPC 2013) and science document (NRC 2012) are made for context.

The 2018 guidance update includes the following key changes and additions to the OPC 2013 guidance:

- **For years before 2050, SLR projections are provided only for the high emissions scenario (RCP 8.5).** The world is currently on the RCP 8.5 trajectory, and differences in SLR projections under different scenarios are minor before 2050.
- **Includes new "extreme" SLR projections associated with rapid melting of the West Antarctic ice sheet.**
- **Shifts from scenario-based (deterministic) projections to probabilistic projections of SLR.** The guidance update recommends a range of probabilistic projections for decision makers to select given their acceptable level of risk aversion for a given project.
- **Provides estimated probabilities of when a particular SLR amount will occur.** In addition to SLR projections that are tied to risk acceptability, updated guidance provides information on the likelihood that sea-level rise will meet or exceed a specific height (1 foot increments from 1 to 10 feet) over various timescales.

The guidance update includes significant advances in the scientific understanding of SLR. Compared to the ***scenario-based*** SLR projections in the 2013 version of state guidance, the updated guidance incorporates ***probabilistic*** sea-level rise projections, which associate a likelihood of occurrence (or probability) with various sea-level rise heights and rates into the future and are directly tied to a range of emissions scenarios (described below). Using probabilistic sea-level rise projections is currently the most appropriate scientific approach for policy setting in California, providing decision makers with increased understanding of potential sea-level rise impacts and consequences. The guidance update also includes an extreme SLR scenario that is based on rapid melting of the West Antarctic ice sheet.

The guidance update also provides a range of probabilistic projections of SLR that are based on two Intergovernmental Panel on Climate Change (IPCC) emissions scenarios called representative concentration pathways (RCPs[1]), as well as a non-probabilistic projection associated with rapid West Antarctic ice sheet mass loss. These three climate scenarios are explained below:

- **RCP 2.6 *Scenario* –** This scenario corresponds closely to the aspirational goals of the 2015 Paris Agreement, which calls for limiting mean global warming to 2 degrees Celsius and achieving net-zero greenhouse gas emissions in the second half of the century. This scenario is considered very challenging to achieve, and is analogous to the Low scenario in NRC (2012).
- **RCP 8.5 *Scenario* –** This scenario is consistent with a future where there are no significant global efforts to limit or reduce emissions. This emission scenario is consistent with that used to develop the High SLR scenario in NRC (2012) but the 50th percentile is closer to the Mid SLR rate and amount in NRC (2012).

1 Named for the associated radiative forcing (heat trapping capacity of the atmosphere) level in 2100 relative to pre-industrial levels.

- **H++ *Scenario*** – This extreme scenario was proposed by the Ocean Protection Council Science Advisory Team in response to recent scientific studies that have projected higher rates of SLR due to the possibility of more rapid melting of ice sheets.

Because differences in SLR projections under the various emissions scenarios are minor before 2050, the update only provides RCP 8.5 projections of SLR up to 2050. **State-recommended projections for use in low, medium-high and extreme risk aversion decisions are outlined by red boxes in Table C-1**.

TABLE C-1
PROJECTED SEA-LEVEL RISE IN FEET (OPC 2017; 2018)

		Probabilistic Projections (in feet) (based on Kopp et al. 2014)					H++ scenario (Sweet et al. 2017) *Single scenario
		Median *50% probability sea-level rise meets or exceeds…*	Likely range *67% probability sea-level rise is between…*		1-in-20 chance *5% probability sea-level rise meets or exceeds…*	1-in-200 chance *0.5% probability sea-level rise meets or exceeds…*	
				Low-risk Aversion		Medium - High risk Aversion	Extreme-risk Aversion
High emissions	2030	0.6	0.5 -	0.7	0.8	1	1.2
	2040	0.9	0.7 -	1.1	1.2	1.6	2.0
	2050	1.2	0.9 -	1.5	1.7	2.3	3.1
Low emissions	2060	1.3	1.0 -	1.7	2	2.8	
High emissions	2060	1.5	1.2 -	1.9	2.2	3.1	4.3
Low emissions	2070	1.6	1.2 -	2	2.4	3.5	
High emissions	2070	1.9	1.4 -	2.4	2.9	4	5.6
Low emissions	2080	1.8	1.4 -	2.4	2.9	4.4	
High emissions	2080	2.3	1.7 -	2.9	3.5	5.1	7.2
Low emissions	2090	2.1	1.5 -	2.7	3.4	5.3	
High emissions	2090	2.7	2.0 -	3.5	4.3	6.2	8.9
Low emissions	2100	2.3	1.7 -	3.1	3.9	6.3	
High emissions	2100	3.1	2.3 -	4.1	5.1	7.6	10.9
Low emissions	2110	2.5	1.9 -	3.3	4.2	7.1	
High emissions	2110	3.3	2.6 -	4.3	5.2	8	12.7
Low emissions	2120	2.7	2.0 -	3.7	4.8	8.2	
High emissions	2120	3.7	2.9 -	4.9	6.1	9.4	15.0
Low emissions	2130	3	2.1 -	4	5.3	9.4	
High emissions	2130	4.2	3.1 -	5.5	6.9	10.9	17.4
Low emissions	2140	3.2	2.3 -	4.4	5.9	10.7	
High emissions	2140	4.6	3.4 -	6.2	7.8	12.5	20.1
Low emissions	2150	3.4	2.3 -	4.8	6.6	12.1	
High emissions	2150	5	3.7 -	6.8	8.7	14.1	23.0

The State suggests using a risk-adverse approach for sea-level rise planning when evaluating projects with a long life span, limited adaptive capacity, and/or medium to high consequences of inundation. In these scenarios, the medium-high sea-level rise projections should be used across the range of emission scenarios. The State further recommends incorporating the H++ scenario in planning and adaptation strategies for projects that could result in threats to public health and safety, natural resources and critical infrastructure such as large power plants, wastewater treatment, and toxic storage sites.

The H++ projection is a single scenario and does not have an associated likelihood of occurrence as do the probabilistic projections. Probabilistic projections are with respect to a baseline of the year 2000, or more specifically the average relative sea level over 1991 - 2009.

SLR Projections for Ventura

The National Research Council (NRC) performed an analysis of SLR for the coasts of California, Oregon, and Washington (NRC 2012), which was used by the State of California including the CCC's SLR Policy Guidance (CCC 2015, updated 2018). The report evaluates each major contributing component to global sea-level rise and combines these contributions to provide values of sea-level rise at various planning horizons for the West Coast. The report also discusses regional and local contributions to sea-level rise. Four regional sea-level rise estimates are reported for the West Coast. The values for Los Angeles (the closest station to San Diego for which data are available) are reported in **Table C-2**. These values include an estimate for vertical land motion of -1.5 mm/year ± 1.3 mm/year, which NRC uses for all of California south of Cape Mendocino and refers to as the "San Andreas" region. Note that these sea-level rise projections do not account for any local effects of subsidence in the Ventura region; data or evidence of local subsidence is not available or known.

TABLE C-2
NRC 2012 SEA-LEVEL RISE PROJECTIONS[1]

Projection	2030	2050	2100
Low-range	2 in	5 in	17 in (1.4 ft)
Mid-range	6 in	11 in	37 in (3.1 ft)
High-Range	12 in	24 in	66 in (5.5 ft)

NOTE:
1 Inches and feet of sea-level rise since 2000

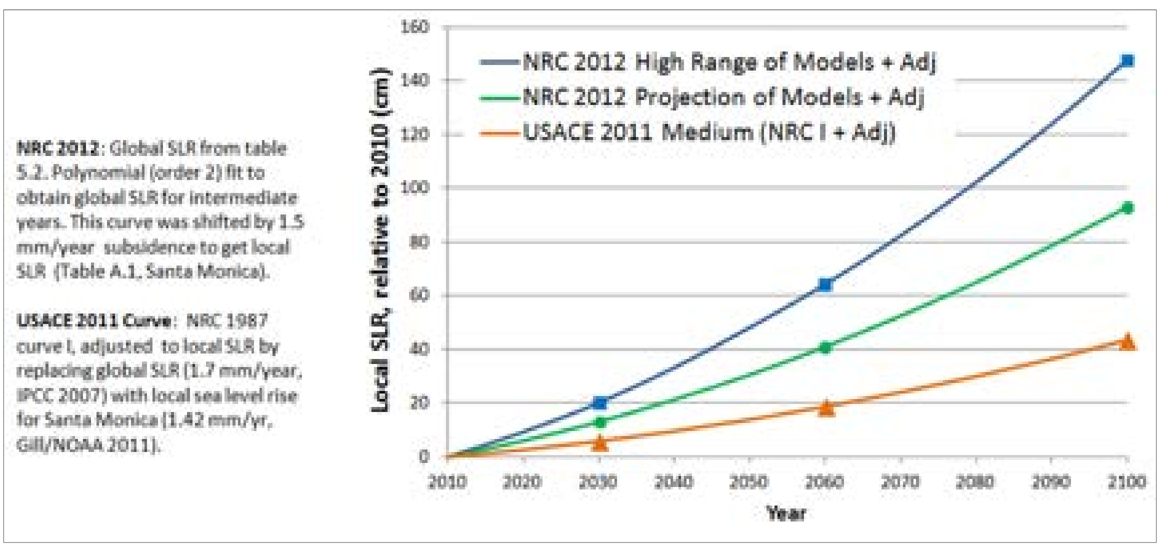
The 2100 estimates reflect the range in greenhouse gas emission scenarios, with low emissions resulting in 17 inches of sea-level rise and high emissions resulting in 66 inches. To date, emissions have been tracking on the high scenario (Flint and Flint 2012). Assuming continuation of the high emissions trajectory, the higher range of sea-level rise projections would apply.

The State of California and The Nature Conservancy funded an analysis of sea-level rise hazards for Ventura County as part of a program called Coastal Resilience Ventura (CRV). **Table C-3** provides the sea-level rise values used in that study, which were also derived from NRC 2012 and U.S. Army Corps of Engineers (USACE, 2011) guidance. The sea level rise scenarios used in this project are based on recent National Research Council (NRC, 2012). The State of California guidance on sea-level rise in effect at the time (OPC, 2010) prescribed the use of 55 inches of rise by 2100, the CRV study attempted to combine federal and scientific guidance in anticipation of revised guidance expected to be issued by the state shortly after the completion of this study (ESA PWA, 2013). Hence the CRV values are generally consistent with the existing guidance and are generally consistent with the subsequent OPC (2013) and CCC (2015, updated 2018), and tailored to Ventura County. The USACE medium curve was selected as the low curve because it is the lowest of all the USACE and NRC projections that incorporates future increases in the rate of sea-level rise. The high and medium curves are based on the high and middle range of models discussed in the NRC 2012 report. All curves include an adjustment for local vertical land motion using the Santa Monica tide station (NOAA #9410840). The sea-level rise at each planning horizon is shown in **Table C-3** and marked in **Figure C-1**.

TABLE C-3
CRV SEA-LEVEL RISE PROJECTIONS[1]

Projection	2030	2060	2100
Low-range	2.3 in	7.4 in	17.1 in (1.4 ft)
Mid-range	5.2 in	16.1 in	36.5 in (3.1 ft)
High-Range	8.0 in	25.3 in	58.1 in (4.8 ft)

NOTE:
1 Inches and feet of sea-level rise since 2000



Ormond Beach Restoration and Public Access Plan

Figure C-1
Sea Level Rise Scenarios (Local SLR, relative to 2010)

SLR Projections for OBRAP

The sea-level rise scenarios selected for the OBRAP are a subset of the Ventura County Coastal Resilience Ventura, specifically the mid-century (2060) and end-of-century (2100) Medium and High values (see Table C-3 and Figure C-1). Use of these values will be consistent with the coastal planning underway in Ventura County and the City of Oxnard, who are using the CRV program products.

A comparison of these values with draft updated California Guidance (OPC, 2017, finalized 2018) is provided in **Figures C-2 and C-3**. Figure C-2 shows that the selected values from CRV are similar to those low-risk aversion and medium-high risk aversion developed from the draft guidance update. The OPC (2017, finalized 2018) and CRV (2013) values are plotted in Figure C-3 for comparison.

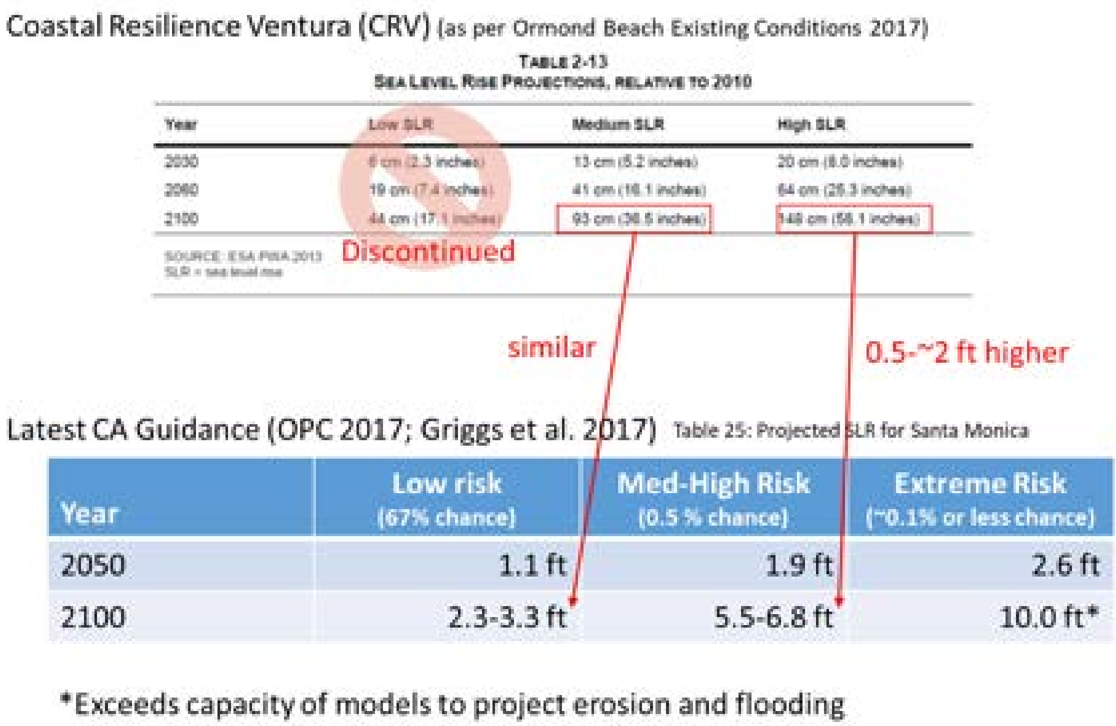


TABLE 2-13
SEA LEVEL RISE PROJECTIONS, RELATIVE TO 2010

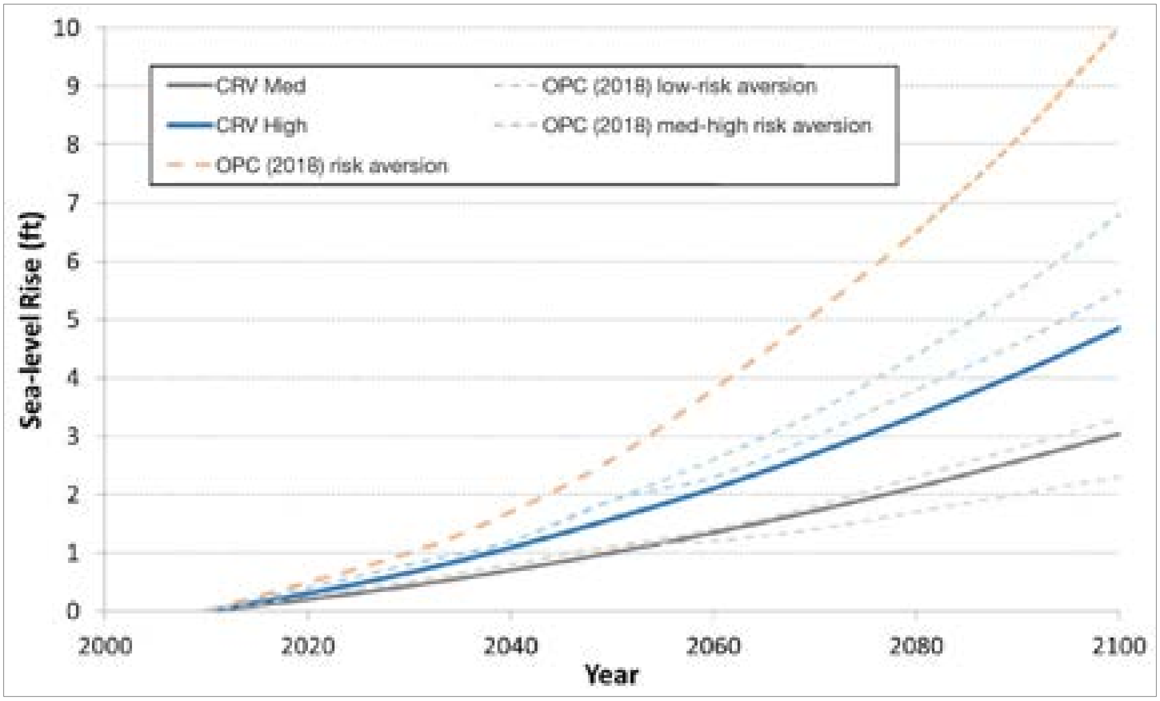
Year	Low SLR	Medium SLR	High SLR
2030	6 cm (2.3 inches)	13 cm (5.2 inches)	20 cm (8.0 inches)
2060	19 cm (7.4 inches)	41 cm (16.1 inches)	64 cm (25.3 inches)
2100	44 cm (17.1 inches)	93 cm (36.5 inches)	148 cm (58.1 inches)

SOURCE: ESA PWA 2013
SLR = sea level rise

Year	Low risk (67% chance)	Med-High Risk (0.5 % chance)	Extreme Risk (~0.1% or less chance)
2050	1.1 ft	1.9 ft	2.6 ft
2100	2.3-3.3 ft	5.5-6.8 ft	10.0 ft*

Ormond Beach Restoration and Public Access Plan

Figure C-2
Comparison of CRV (2013) and OPC (2017) SLR Scenario Tables



Ormond Beach Restoration and Public Access Plan

Figure C-3
Comparison of CRV (2013) and OPC (2017) SLR Scenario Graphs

Appendix D

Shore Migration and Overtopping (Beach QCM)

APPENDIX D
Shore Migration and Wave Overtopping

Introduction

The Ormond Beach Restoration and Public Access Project (OBRAP) project area crosses several coastal habitats, from open beach, to dune, to various types of back-dune marsh and wetland. While habitat modeling examines the effect of changing water levels on the wetlands behind the beach and dunes, it generally overlooks the erosion and transgression of the beach. Ormond beach is expected to transgress inland with rising sea level, as waves propelled by higher water levels push the beach up and inland.

In addition, a critical feature of the wetlands behind the beach and dunes is their salinity, and this is driven by the balance of freshwater from the inland side and saltwater from the coast. Coastal saltwater tends to reach the inboard side of the dunes through groundwater seepage (saltwater intrusion) and by wave overtopping, the latter of which is expected to increase nonlinearly with sea level rise, as higher water levels bring larger waves farther inland during more of the year.

Methods

Shore Migration Methods

Long-term erosion is common on the California coast, and the rate varies along over 800 miles between the Mexican border and the Oregon border. The United States Geologic Survey (USGS) has recorded the location of the coast at irregular intervals for several decades, and this can be used to estimate the long-term erosion rate in different portions of the coast. According to these coastlines, the average trend at Ormond beach is actually one of accretion (beach building); however, this is a regional outlier, and there are local physical processes that are believed to have obscured the actual long-term trend at the beach. Ormond beach has a high annual longshore transport volume (on the order of 800,000 cubic yards of sand moving along the coast each year, Herron and Harris 1966), which travels from northwest to southeast. After the construction of Port Hueneme, much of that transport was disrupted or blocked, rapidly eroding the regional coastline around Ormond beach. Now, about every two years, sand is pumped past the port to offset this erosion. This means that the coast southeast of Port Hueneme (i.e. the Ormond project site) fluctuates a great deal between these sand deposition projects, and the infrequent USGS shoreline measurements are scattered and do not capture an actual annual trend in shore position. In light of this, the average accretion rate was eschewed and the regional erosion rate of 0.5 feet per year was used for the Ormond beach project site.

In addition to the long-term erosion already underway at the site, sea-level rise is expected to drive inland transgression of the beach. This is likely to happen more quickly than wind can rebuild the dunes, meaning that the beach will eat into the existing dunes until it cuts through to the wetlands behind them. Beach transgression with changing sea levels is a common process, and is often modeled using the Bruun method (USACE 2006), which estimates the movement of the beach and dune face up and inland as the sand is eroded from the existing beach face and deposited offshore. The Bruun method migrates an equilibrium beach profile inland based on a representative shore slope. Based on survey and bathymetric data, this slope was determined to be 1:55 in the Ormond beach region. According to the Bruun method, when sea level rises, the beach will rise vertically an equal amount, and it will move inland that distance multiplied by the slope. For example, for one foot of sea-level rise, the beach would move up one foot and inland 55 feet.

The Bruun method assumes that the beach has enough time to reach equilibrium as sea level rises, which is a reasonable assumption for the beach itself, but the dunes behind the beach berm tend to develop and adapt more slowly. As such, they were assumed stationary, as the transgressing beach steadily eroded its way into them. For each analyzed transect (E, H, and I in **Figure D-1**), the representative dune slope was measured from the survey transect, and that was used to connect the berm of the transgressing beach to the existing dune profile. Each time the beach transgressed inland, segments of the dune outboard of the beach berm were removed, and the berm was connected to the closest inland survey point with a line at the representative dune slope. This representative slope varies between transects, but is generally within the range of 10:1 to 20:1 (horizontal to vertical). As the berm erodes through the back side of the dunes, this method generated unrealistic profiles, so they were smoothed into a typical 100-foot back beach area, using a shape consistent with sand transport associated with wave overwash.

This level of beach analysis is not included in the habitat model used in this study (SLAMM), but it was considered important to account for erosion and transgression in analyzing the OBRAP alternatives. To do this, the beach berm positions from each transect were connected at three time horizons, and areas offshore of this line were assumed to be open water. Then, the 100-foot band inland of the beach berm line was assumed to convert to beach/coastal strand to account for the back-beach area. These two regions were overlain on the SLAMM results to represent the coastal processes not captured in the habitat model.

Wave Overtopping Methods

Significant overtopping generally occurs in stormy high-water events, leading to ponded saltwater trapped behind the dunes. These effects are expected to be negligible in the west portion of the site, where lagoon processes dominate, but in the central and east portion of the site (areas 3a, 3b, 5, and 6 in **Figure D-2**), ponding from overtopping events is considered a major source of salt. To assess changes in operational conditions, each of these areas were analyzed for ponded water resulting from overtopping during conditions expected at least once per year.

Ormond Beach Restoration and Public Access Plan

Figure D-1
Beach transects E, H and I were used to represent beach strand areas 1, 7 and 9, respectively

SOURCE: ESA 2018, SCC 2011

Ormond Beach Restoration and Public Access Plan

Figure D-2
Ormond Beach Overtopping and Ponding Regions of Interest

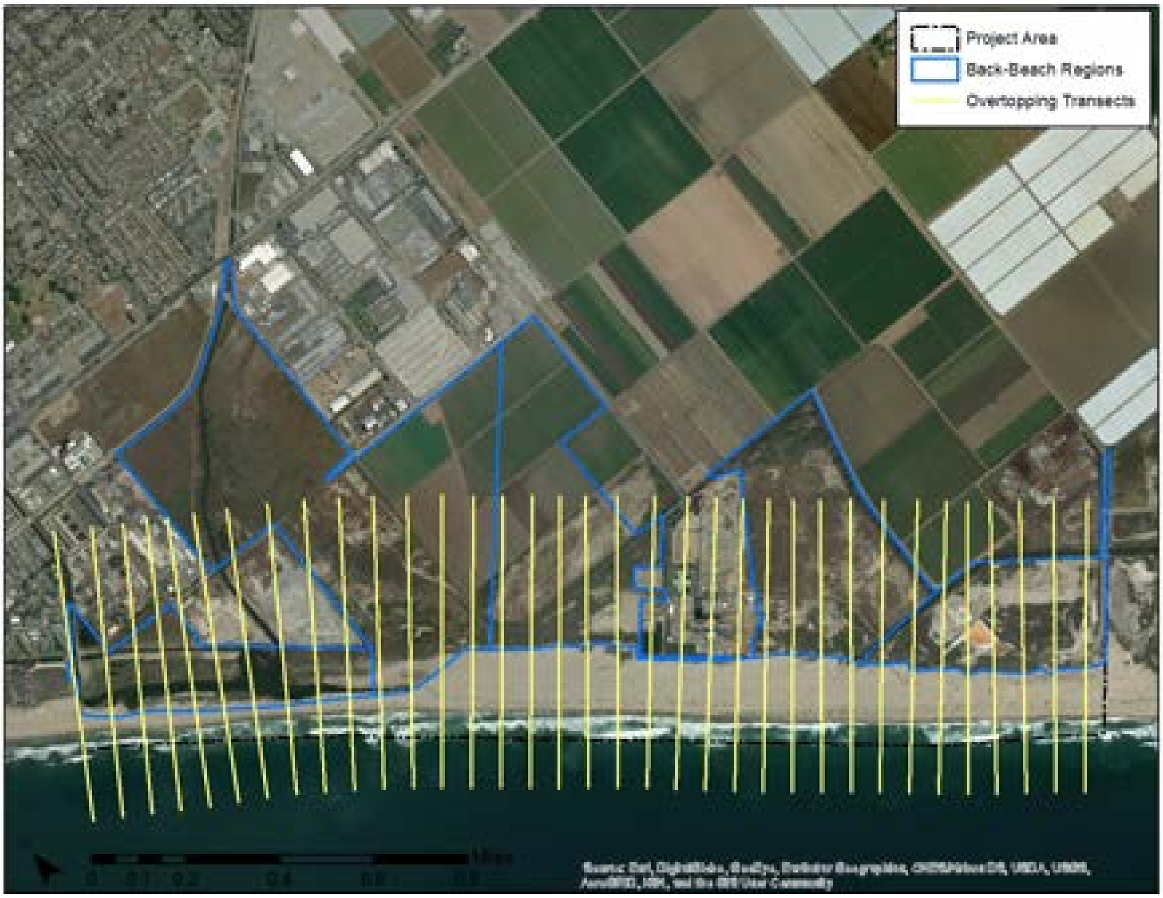
Overtopping volumes were calculated in the same manner as in the Coastal Resilience Ventura (CRV) study (ESA PWA 2013) for consistency. Water levels and wave conditions for a period of approximately 20 years were provided by NOAA, and these were used to generate a rough estimate of the 2% runup elevation using the Stockdon method for natural beaches. While this method is not entirely accurate for long-period waves arriving on beaches with steep backshore profiles (i.e. west-coast, dune-backed beaches), it is considered a reasonable approximation for this level of analysis. As in CRV, overtopping rates were calculated for each record in the 20-year time series based on the European overtopping manual (Pullen et al. 2007), which provides an estimate of overtopping rate (cubic meter per second per linear meter of coast) as a function of crest elevation, water level, runup elevation, and surf similarity parameter (the ratio of the beach slope to the wave slope). From these, annual maximum overtopping rates were identified, and the smallest of these – the maximum overtopping rate reached at least once during each year in the record – was selected to represent annual storm overtopping conditions. It was assumed that this event would last four hours, rising from no overtopping to peak overtopping in two hours, then declining back to zero; integrating over this period gave an overtopping volume per linear meter of beach.

The described analysis was performed on thirty-five cross-shore transects (**Figure D-3**) along the Ormond coastline. These were extracted from LiDAR (SCC 2010) at 120-meter intervals as part of CRV (ESA PWA 2013). The slopes and dune crests on each profile were identified and used in the analysis described above. Nearshore wave conditions at these transects were determined by transformation of waves recorded by NOAA[1] and CDIP[2] at their Santa Barbara offshore buoy. This analysis was performed for CRV, and details can be found in the report from that study. The overtopping analysis, applied to these inputs, resulted in a set of overtopping volumes per linear-meter along the Ormond coast, which was integrated by multiplying by the transect spacing (120 meters) to yield a total volume of water crossing each transect during a large storm event occurring at least once per year. Each transect was linked to a backshore area, resulting in an estimate of the total volume captured by each area. This volume of overtopped water was converted to ponding elevation based on the minimum elevation in the area and a hypsometric curve (elevation vs. volume) generated from the topography for each ponding region (Figure D-2).

Upon inspection of site topography, a few modifications were made to the raw overtopping volumes. First, the overtopping method estimates the volume crossing the first coastal barrier and does not account for additional rows of dunes or an extensive back beach. Since the project is primarily concerned with saltwater reaching and ponding in the wetland areas behind the back beach, a reduction factor of 0.1 was used to account for the backshore distance separating overtopping water from the wetlands of interest (on the order of 700-1000 feet under existing conditions). The beach transgression and dune erosion analysis performed as part of this study indicates that the beach is apt to recede on the order of 300 feet by the end of the century, greatly diminishing the backshore buffer between the ocean and the wetlands. To account for this, the reduction factor was weakened linearly to 0.5 by 2100.

1 National Oceanic and Atmospheric Administration, National Data Buoy Center, https://www.ndbc.noaa.gov/. Accessed March 2019.

2 Coastal Data Information Program, http://cdip.ucsd.edu/. Accessed March 2019.



SOURCE: ESA 2018

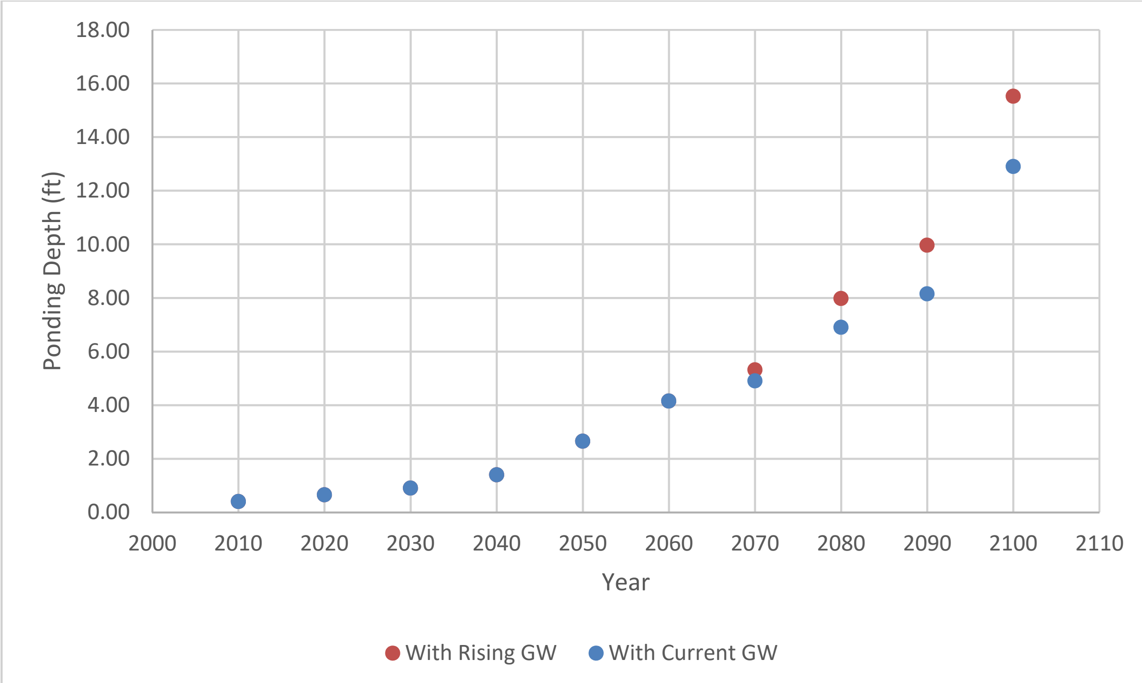
Ormond Beach Restoration and Public Access Plan

Figure D-3
Ormond Beach Overtopping Transects and Ponding Regions

Second, the central region of the project area – Area 5 – has a wider beach than the east and west ends of the project area. In this area, the beach is backed by two rows of dunes, separated by a shallow swale, before descending into wetlands. To account for this wide backshore, the reduction factors were intensified, beginning at 0.05 and weakening to 0.25 by 2100.

Third, there is a tall set of dunes at the inland edge of Ormond Beach in front of Area 3, but this dune ridge only covers half the coastline contributing overtopping water to Area 3. To account for this, the transects crossing the high dune ridge were not included when summing the overtopping volumes entering Area 3.

Finally, Area 6 is relatively low-lying with a high groundwater table. The area is expected to see an increase in ponded surface water as the groundwater table rises with sea level rise. To account for this, once sea level rises above the current groundwater depth (2 feet), the difference was added to the ponding elevation calculated in the overtopping analysis. The resulting difference can be seen in **Figure D-4**, though this effect only begins after mid-century, at which point high sea levels and beach transgression may have introduced new physical processes that dominate those analyzed in this study.



SOURCE: ESA 2018

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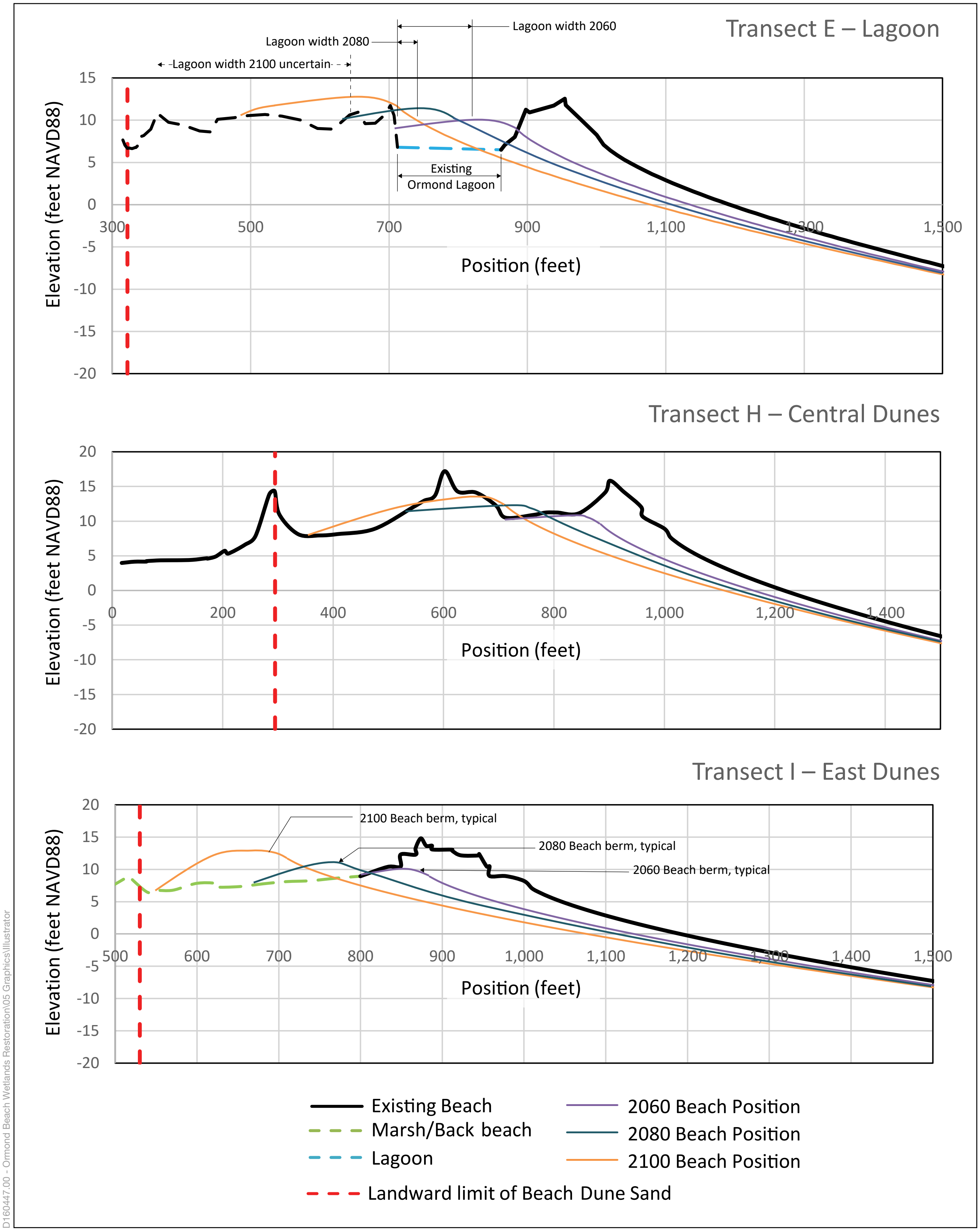
Figure D-4
Ponding Depth in Area 6,
With and Without Rising Groundwater

Results

Shore Migration Results

Cross sections for the shore migration transects from Figure D-1 are presented in **Figure D-5**. These three transects represent the dunes in front of Ormond Lagoon (Transect E), the dunes in the center of the beach (Transect H), and the dunes in the east of the beach (Transect I). Including both long-term erosion and beach transgression with sea-level rise, these transects are expected to move inland approximately 300 feet each, with different effects in different parts of the beach.

At each of these three locations, the shore geometry is shown in black in Figure D-5. For example, in the top schematic in Figure D-5, the black solid line is based on a survey of ground elevations (beach transect I), the black dashed line is derived from LiDAR, and the blue dashed line is the water surface of Ormond Lagoon at the time of the LiDAR data collection. The vertical red dashed line corresponds to the landward edge of the beach-dune strand and corresponds to the red line in Figure D-1. The horizontal position is a scale in feet with a “zero” location inland of the changes. The width of the existing lagoon is depicted by the blue dashed line. Note that the vertical scale is exaggerated to clarify the relief. Future shore geometries are shown in other colors, per the figure legend. As sea level rises, the wave-shaped seaward face of the profile responds rapidly by migration, while landward elevations are held steady.



SOURCE: ESA, 2017

NOTE: Transect E (top) is located at western beach strand Area 1 at Ormond Lagoon; Transect H is located at central beach strand 7 near backshore Area 3 and Transect I is located at eastern beach strand Area 9 near backshore Area 6.

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Figure D-5
Beach Transect Elevations

ESA

Note that at Transect E, the waves overtop the beach and reach the lagoon, and hence this "overwash" area also migrates with the seaward beach. At Transect E the existing Ormond Lagoon is impacted by shore migration. Note that the lagoon width decreases in 2030 and approaches zero in 2060. By 2100 the beach migrates inland of the existing dune and the extent of lagoon is difficult to predict. Transect E indicates that the lagoon (at least its east end) will be pinched by rising sea level by mid-century; without erosion, the east end will have closed by late-century; and by end-of-century, this half of the lagoon will have basically disappeared. This profile modeling neglects scouring of the backshore, which may happen during breaching events with rapid drainage and high OLW discharge. Therefore, the resulting lagoon footprint may be larger than implied by the beach migration modeling. Also, large expanses of low-elevation areas in Area 3b and 3a are likely to pond during high beach levels, indicating that the lagoon may "shift" location to the north and east.

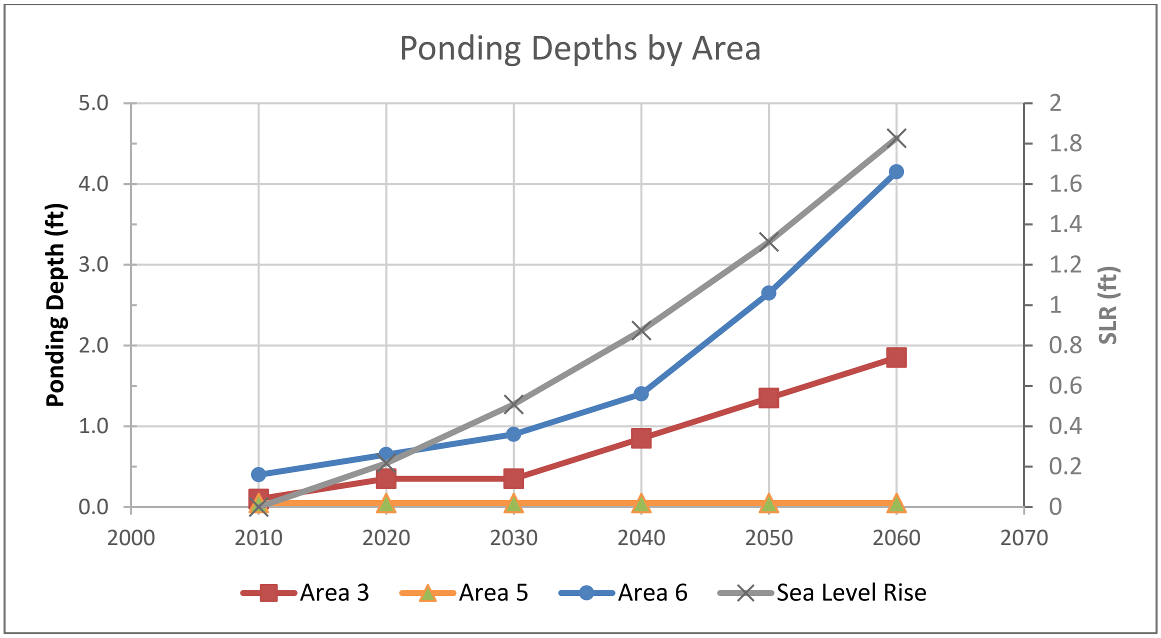
Transect H indicates that the first row of dunes will erode by mid-century, exposing flat plover habitat between the two dune rows; this area will be steadily eroded through late-century; and entirely gone by end-of century, leaving the second dune ridge exposed. At Transect H, waves are not predicted to overtop the dunes sufficiently to cause the sand deposition in the lee of the dunes, resulting in a reduction of the width of the dune field.

Transect I indicates that the east dunes will be eroded by mid-century, leaving a berm and back-beach transgressing into the salt panne currently behind the dunes; and this process will continue basically unimpeded through late-century and end-of-century.

Wave Overtopping Results

The wave overtopping analysis led to an estimate of ponding elevation for a relatively common storm ("operational conditions") in Areas 3, 5, and 6, as presented in **Figure D-6**. Area 3 shows a slow but steady increase into mid-century, thanks to the large wetland area that lies behind the gap in the high dune ridge there. Area 5 shows no increase through mid-century due to its second line of dunes, which block most of the overtopping volume until sea levels are even higher and the first row of dunes has eroded, later in the century. Area 6 shows an exponential increase in ponding depth, rising from approximately 0.5 feet to over 4.0 feet by mid-century, even before rising groundwater begins to raise the ponding elevation even more quickly.

In this analysis, the areas were assumed to be separate behind the dunes, which is not the case once water reaches higher elevations. This behavior could be harnessed in Areas 5 and 6, where one (Area 6) fills rapidly and the other (Area 5) is relatively resilient to increased overtopping from sea-level rise. The berm and ditch separating the two areas could be flattened to allow water to spread between the two more readily, reducing the nonlinear rise in ponding depth in Area 6 and making Area 5 wetter, promoting certain wetland habitats.



SOURCE: ESA 2018

Ormond Beach Restoration and Public Access Plan

Figure D-6
Ponding Depth in Areas 3, 5, and 6 Compared with SLR (right axis)

References

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Appendix E
Ormond Lagoon Hydrology and Morphology (Lagoon QCM)

APPENDIX E
Lagoon Quantified Conceptual Model

This appendix summarizes modeling of Ormond Lagoon and surrounding areas using a quantified conceptual model (QCM) of Ormond Lagoon's water balance. As described in the main body of the report, the project involves developing restoration concepts to enhance critical habitats, sustainability, and public value of Ormond Lagoon and surrounding areas that are managed by the state Coastal Conservancy, the City of Oxnard, and The Nature Conservancy. Ormond Lagoon is a heavily modified back-barrier lagoon-wetland system at the mouth of an urbanized watershed. Much of the historic Ormond Lagoon and surrounding wetlands have been converted to other uses, while upstream urban and agricultural development has increased the intensity of storm flows (see ESA 2017). The QCM provides an understanding of how Ormond Lagoon's morphology and hydrology could evolve, under the influence of future climate change and the proposed conceptual restoration actions. Interpretation of Ormond Lagoon's evolution can then inform how restoration may affect focal species' future habitat.

Section 1 summarizes the conceptual model lagoon conditions that inform the QCM. Additional details about the site can be found in the Existing Conditions report by ESA (2017). Sections 2 and 3 describe the model approach and data sources, respectively. Section 4 describes the preliminary results, and Section 5 discusses some of the uncertainties resulting from data gaps and future evolution of the site.

1. Conceptual Model of Site Conditions

The Ormond Lagoon is a perched system (see classification of Jacobs et al. 2010) that collects water from the Ormond Lagoon Waterway (OLW), tšumaš Creek, and Bubbling Springs (also called Hueneme Drain). After pooling in Ormond Lagoon, this water drains to the Pacific Ocean over and through a heightened beach berm that typically prevents tides from having a strong influence in Ormond Lagoon. Although the mouth of Ormond Lagoon is groomed prior to significant storms to facilitate natural breaching to alleviate flooding, waves elevate the mouth near or above high tides by delivering more sand than can be removed by stream inputs. The coastal sediment supply and beach morphology is heavily influenced by U.S. Army Corps of Engineers (USACE) dredging and beach nourishment activities west of the site, which involve mechanically bypassing the Port of Hueneme and placing of this sand updrift of Ormond Lagoon approximately every two years (see ESA 2017).

Under present conditions, Ormond Lagoon spills water out to the ocean during the winter months, when runoff from local municipal and agricultural runoff is highest. Flows from the watershed are concentrated into a series of drainage channels, which cause flood flows to rapidly arrive at Ormond Lagoon during rainfall events, and to rapidly tail off after rainfall ceases. The OLW provides the majority of the runoff to Ormond Lagoon, with smaller amounts arriving from tšumaš Creek and Bubbling Springs. The local groundwater table is influenced by the accumulation of runoff in Ormond Lagoon and by the nearby trunk line for the Oxnard Wastewater Treatment Plant (OWWTP). Because Ormond Lagoon's water surface is perched, water seeps from Ormond Lagoon as groundwater toward the ocean through the sandy beach, northward toward the sewer trunk line and the seasonally ponded area located immediately east of the Halaco Site (ESA 2017).

Even when the mouth is open to the ocean, Ormond Lagoon receives relatively little tidal action, owing to its high elevation on the beach (beach elevations vary around +8 to +12 feet NAVD along Ormond Beach (ESA 2017)). When runoff declines in the spring, wave action closes the mouth seasonally, usually for periods of at least 4-6 months. During these closure periods, residual runoff ponds in the closed Ormond Lagoon, but balances with seepage and evaporative losses, giving relatively stable water levels of about 8-8.5 feet NAVD in the dry season. In drier years, such as 2017, evaporation and seepage may overmatch runoff, leading to a lowering of water levels throughout the dry season, to as low as 6.5 feet NAVD (ESA 2017). Flooding can result when high runoff is initially trapped behind the beach berm during a wet season rainfall event. This occurred on January 18th, 2010, leading to flooding of many of the local roadways and the OWWTP (VCWPD 2010). Following guidance from HDR (2011), the Ventura County Water Protection District (VCWPD) has managed the beach to prevent further flooding events by lowering a portion the beach crest to an elevation of 8.9 feet NAVD88 when a series of water level, beach, and predicted precipitation triggers are met. This allows the mouth to breach at a lower elevation before flooding occurs during the initial flood pulse.

The available brackish habitat in Ormond Lagoon and surrounding areas is mostly governed by the state of the mouth. When it is closed, trapped runoff provides highest water levels, greatest surface area, and greatest volume. When the mouth breaches, Ormond Lagoon drains and tends to have lower water levels and saltier conditions. The existing hydrology and habitat of the system are described in more detail by ESA (2007; 2017).

2. Lagoon Modeling Approach

To provide an understanding of how the Ormond Lagoon would respond to future changes, ESA developed a quantified conceptual model (QCM) for the site, which predicts lagoon mouth morphology and the resulting water levels of the lagoon. The current QCM approach is an adapted and refined version of earlier approaches for tidal conditions from Crissy Field Lagoon (Battalio et al. 2006) and for fluvial conditions for the Carmel River (Rich and Keller 2013), and builds on lessons learned from both approaches. In recent years, ESA has further developed the QCM as a more complete tool to assess systems with both tidal and fluvial characteristics

(Behrens et al. 2015). It has been used most recently by ESA at Pescadero Creek (ESA 2017) in northern California, and at Los Peñasquitos Lagoon (ESA 2016) and Devereux Slough (ESA 2015), in southern California.

The QCM approach is centered on a water budget for the lagoon, which is coupled with a sediment budget for the lagoon mouth. The model is based on two core concepts:

- All water flows entering and leaving the lagoon should balance.
- The net erosion/sedimentation of the inlet channel results from a balance of erosive (fluvial and tidal) and constructive/deconstructive (wave) processes.

The model uses time series of nearshore waves and tides, watershed runoff, and evapotranspiration data as boundary conditions. Using these as forcing conditions with the lagoon's topography, the model dynamically simulates time series of lagoon water levels, along with inlet, beach, and lagoon state. With each time step, the net inflows or outflows to the system are estimated, along with the net sedimentation or erosion in the mouth. The flow terms vary depending on whether the mouth of the lagoon is open or closed. During closed conditions, inflows are based on watershed runoff, wave overwash into the lagoon, and while outflows are based from beach berm seepage and evapotranspiration. For more information on how the model resolves different processes, refer to Behrens et al. (2015).

As the model steps forward in time, it continuously transitions the mouth through tidal, perched, and closed conditions. When deposition in the inlet bed exceeds erosion, the bed rises vertically, eventually perching above most tidal elevations and closing. Mouth closure occurs in the model when sediment fills the bed higher than lagoon water levels. Breaching occurs in the model when the lagoon fills from accumulation of either watershed runoff or wave overwash, and water levels overtop the beach berm crest, eroding a new lagoon mouth.

Model accuracy is tested by comparing modeled lagoon water level time series against observed water levels, and by comparing the timing and length of inlet closure events to those of historical records. Closure time series and lagoon water level time series usually provide a good indication of which processes are dominating the system at a given time, such as runoff during floods, or powerful waves prior to closure. Thus, reproducing these time series is taken to mean that the dominant processes are meaningfully represented.

3. Data Sources

Input data for the QCM were obtained from a variety of publically available sources and field data collected by ESA and others. **Table E-1** summarizes the data sources for the model.

TABLE E-1
SOURCES OF HYDROLOGY, CLIMATE, AND TOPOGRAPHIC DATA AT THE PROJECT SITE

Parameter	Source/Location	Availability
Coastal Hydrology		
Offshore Waves	CDIP Harvest Buoy (#071)	1995-present
Nearshore Wave Estimates	ESA (2012)	1992-2012
	CDIP MOP	2000-present
Tide Stage	NOAA Santa Monica Gage (#9413450)	1985-present
Watershed Runoff, Local Climate, and Lagoon Hydrology		
Runoff	VCWPD gage 790	Peak flows 2002-2015, peak daily flows 2002-2005
	USGS Calleguas Creek Gauge (#11106550)	1996-2016
Evapotranspiration	CIMIS #156 (Oxnard)	2001-present
Rainfall	VCWPD gage 17C - Oxnard Sewer Plan	2004-present
	CIMIS #156 (Oxnard)	2001-present
Lagoon Stage	VCWPD (unreferenced OID gage)	2002-2005
	CH2M Hill (2011)	2007-2009
	VCWPD (OID staff gage referenced to NAVD)	2008-2013
	ESA (2018)	June 2017 – December 2017
Groundwater	CH2M Hill (2008)	2006-2012
Morphology		
Beach Topography	Coastal Frontiers: RTK GPS	March 2008
	State Coastal Conservancy LiDAR DEM	2011
	ESA: RTK GPS	2017
Lagoon Topography	HDR: RTK GPS	March 2008

3.1 Coastal Conditions

Hourly wave height, period, and direction near the Ormond Lagoon mouth were obtained from nearshore transformed wave data provided by the Coastal Data Information Program (CDIP) California Coastal Wave Monitoring and Prediction System (O'Reilly et al. 2016) at the CDIP model output point number VE254. VE254 is located approximately 2,000 feet offshore of Ormond Lagoon in approximately 33 ft of water. Model data were downloaded from January 2000 to November 2017. The wave data are a driver of beach elevation, which contributes to establishing the water levels in Ormond Lagoon, and influences the state of Ormond Lagoon (i.e., open, closed, perched overflow, etc.).

These nearshore wave predictions were compared against predictions from ESA PWA (2012), generated as part of the Coastal Resilience Ventura (CRV) project, and were generally found to correlate well. These prior predictions were based on a similar modeling approach that provided wave information from 1992-2012 at the site.

Hourly ocean water level data were obtained from NOAA's Santa Monica Tide Gage Station (NOAA #9413450) from 2005 to 2017. The Santa Monica Station is located approximately 35 miles from the Ormond Lagoon mouth. All data was downloaded in the North American Vertical Datum of 1988.

3.2 Lagoon Hydrology

The hydrology of Ormond Lagoon is summarized in detail by ESA (2017). This includes a description of the watershed conditions, and flows from the three main tributaries to the site.

Only limited observations of inflows to Ormond Lagoon are available. The VCWPD has maintained a gauge approximately 2 miles upstream of Ormond Lagoon that records high flow events. This gauge only captures flows above 50 cubic feet per second (cfs), and was in place from 2002 to 2015. As described in ESA (2017) and HDR (2008), several groups have scaled watershed inflows for the purpose of modeling flood conditions, but these do not provide a complete picture of the seasonal hydrograph or summer/fall base flows, which is critical information for understanding lagoon conditions when the mouth is closed during the dry season. A nearby gauge on Calleguas Creek upstream of Mugu Lagoon (see Table 1) was operated until 2016, and likely provides representative agricultural and municipal runoff conditions.

Runoff to Ormond Lagoon was scaled using information from the VCWPD gauge, the nearby Calleguas Creek gauge (USGS #11106550), and information from prior reports (PWA 2007). Calleguas Creek flows were scaled to the site using a ratio of drainage areas. Flood flows measured on the VCWPD gauge upstream of the site were also scaled to Ormond Lagoon by accounting for the ratio of drainage areas above the gauge and Ormond Lagoon, respectively. The scaled flood flows from both gauges were then compared, and the scaled Calleguas flows were adjusted to fit the scaled VCWPD flood peaks. Lastly, base flows were augmented by adding approximately 2 cubic feet per second to account for consistent urban runoff. Neither of the gauges used to develop this synthetic record had measurements in 2017.

Evaporation and precipitation data were obtained from Oxnard and Camarillo California Irrigation Management Information System (CIMIS) stations (Station #156 and #152, respectively). These stations were assumed to be representative of the rainfall and evaporation in the drainages upstream from Ormond Lagoon. Data were downloaded from the Oxnard Station from January 2002 to May 2016. After May 2016, data from the nearby Camarillo CIMIS Station #152 was appended to the Oxnard record.

Ormond Lagoon water levels collected from 2007 to 2017 were used to calibrate the model and test its accuracy. From October 2007 to September 2009, water level data were collected continuously with a logger by CH2M Hill as part of an EPA study of the Halaco Site (CH2M Hill 2011). Although continuous measurements ended in 2009, spot measurements were taken every two weeks from 2009 to 2011 using a staff gauge at the site referenced to the NAVD88 datum (CH2M Hill 2012). ESA deployed several continuous water level loggers in June through December 2017.

3.3 Beach and Lagoon Morphology

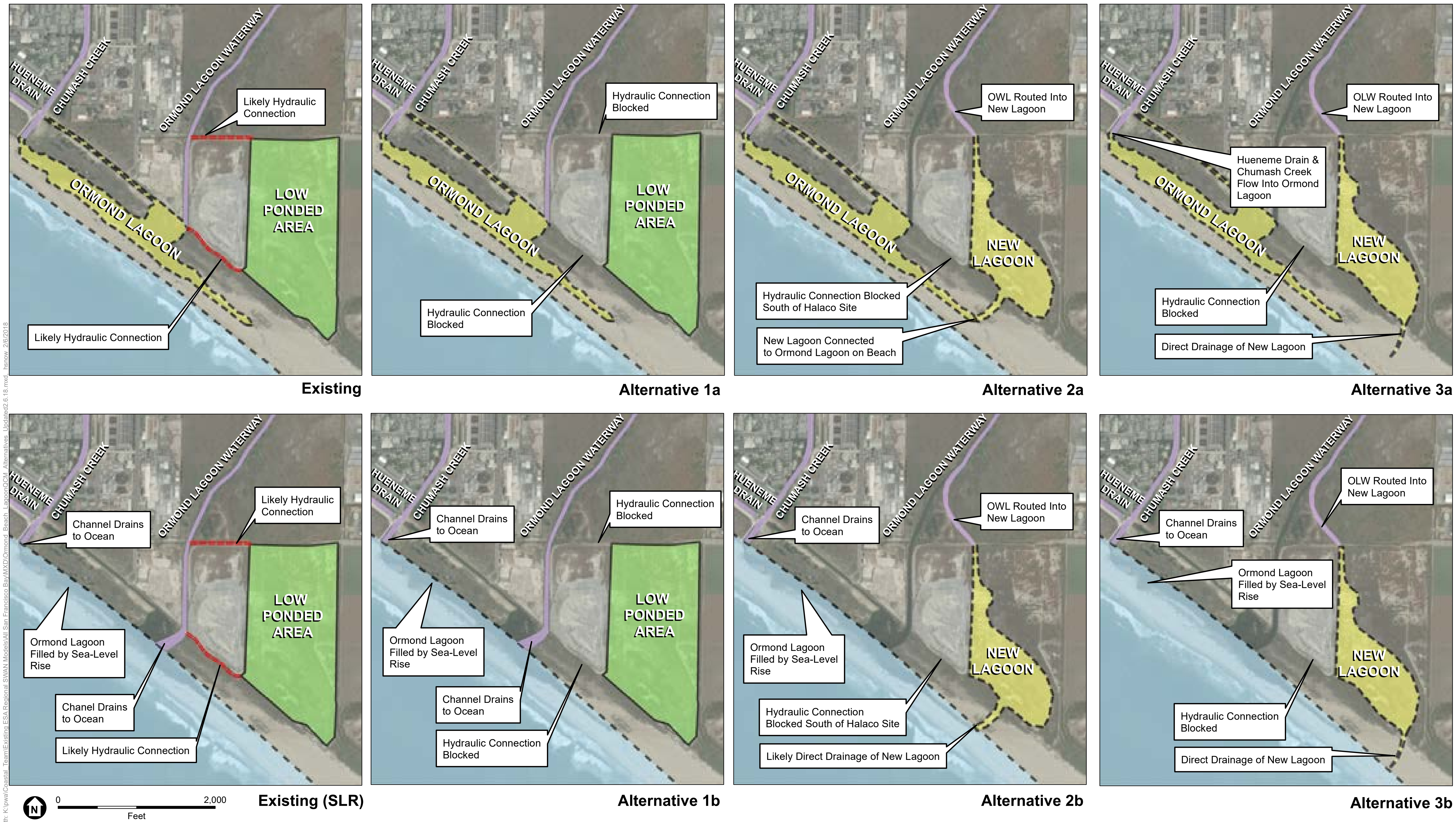
ESA compiled topographic data sources at Ormond Lagoon to create a ground surface elevation basemap. The basemap was used to build a stage-storage curve for Ormond Lagoon. A survey by Coastal Frontiers in 2008 provided elevations on the beach and in Ormond Lagoon. This field data was supplemented with 2009-2011 California Coastal Conservancy LiDAR in upland areas. Elevations within channels draining to Ormond Lagoon were approximated based on the Coastal Frontiers data. Note that the OLW was dredged after the 2008 Coastal Frontiers survey and the increased depth is not represented in the basemap. Additionally, Ormond Lagoon has likely accumulated sand over the past several years of extended drought in California, and thus, volumes in the stage-storage curve may overestimate present Ormond Lagoon storage. ESA also collected several transects of Ormond Lagoon and beach in the summer of 2017, and these were used to check for any changes in lagoon bed elevation between 2008 and 2017. A comparison of the transects showed that the southern arm of Ormond Lagoon which was not fronted by vegetation had partially filled-in with up to approximately 4 feet of sand between 2008 and 2017. This sand was likely deposited by wave overwash and had not scoured out during the low-flow drought years. Survey data from 2017 in other parts of Ormond Lagoon is too limited to make a comparison with the 2008 data.

4. Model Results

ESA ran the QCM from October, 2007 to October, 2017, a period that includes a range of wet and dry years, and a high overlap of available data sets for testing the model. Although the wave and tide data extend back further, the measured water levels are restricted to more recent years. To explore how future changes could influence the behavior of Ormond Lagoon, we ran the same 2007-2017 time series with 3 feet of SLR and with several restoration and management options. These initial restoration/management options are intended to inform the assessment of the restoration alternatives.

The modeled alternatives are summarized in **Table E-2** and shown graphically in **Figure E-1**. Alternatives 0 (existing conditions) through 3 were modeled with and without SLR. The Alternatives were given the suffix label "a" when sea-level rise (SLR) was not added, and the label "b" when 3 feet of SLR was included. The calibration run did not include SLR.

The conceptual restoration alternatives are introduced here for context, but are described in more detail in the main body of the report. Alternative 1 involved isolating the existing brackish habitat immediately east of the Halaco properties. Alternatives 2 and 3 include the creation of a new water system (called "New Lagoon" as it is modeled as a separate body in this lagoon model) in this area (see conceptual depiction in Figures 1). For this analysis, the New Lagoon was considered to be roughly the same volume as the portion of the existing Ormond Lagoon in front of the dune line. For Alternative 2, the New Lagoon (the re-routed OLW and surrounding floodplain) is assumed to be connected hydraulically to the OLW and to the existing Ormond Lagoon. Conversely, the New Lagoon and Ormond Lagoon are disconnected under Alternative 3



SOURCE:

Ormond Beach Restoration and Public Access Project

Figure E-1
Lagoon QCM Alternatives
Alternatives 1 through 3

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TABLE E-2
ORMOND LAGOON QCM SCENARIOS

Alternatives	Alt. Description	SLR	Hydrology	Beach Management
Calibration	Existing conditions without beach grooming	0'	Existing conditions	No beach grooming
0a	Existing conditions (do nothing)	0'	Existing conditions	Beach grooming to 8.9'
0b	Existing conditions (do nothing), include SLR	3'	Existing conditions	Partial loss of Ormond Lagoon due to SLR, no beach grooming
1a	Block hydraulic connection between Ormond Lagoon and ponded area east of Halaco slag pile	0'	OWL is disconnected from ponded area, Ormond Lagoon is disconnected from ponded area	Beach grooming to 8.9'
1b	Block hydraulic connection between Ormond Lagoon and ponded area east of slag pile, include SLR	3'	OWL is disconnected from ponded area (Area 3a), Ormond Lagoon is disconnected from ponded area	Partial loss of Ormond Lagoon due to SLR, no beach grooming
2a	Relocate OLW to area east of slag pile, connect to Ormond Lagoon	0'	Ormond Lagoon is hydraulically connected to OLW floodplain	Beach grooming to 8.9'
2b	Relocate OLW to ponded area east of slag pile, connect to Ormond Lagoon, include SLR	3'	Ormond Lagoon is hydraulically connected to OLW floodplain	Partial loss of Ormond Lagoon due to SLR, no beach grooming
3a	Create New Lagoon in ponded area east of slag pile, separate from Ormond Lagoon	0'	OWL is rerouted into New Lagoon. New Lagoon and OWL are blocked from Ormond Lagoon. New Lagoon discharges to ocean southeast of slag pile.	No beach grooming in front of New Lagoon. Beach grooming to 8.9' in front of Ormond Lagoon.
3b	Create New Lagoon in ponded area east of slag pile, separate from Ormond Lagoon, include SLR	3'	OWL is rerouted into New Lagoon. New Lagoon and OWL are blocked from Ormond Lagoon. New Lagoon discharges to ocean southeast of slag pile.	Partial loss of Ormond Lagoon due to SLR, no beach grooming

and were modeled separately with the New Lagoon receiving 80% of the original streamflow and the old Ormond Lagoon receiving the remaining 20% of the flow, to account for diversion of the OLW. Under Alternative 3, we assumed that the New Lagoon will drain directly to the ocean via a new unmanaged ephemeral lagoon outlet (mouth) and will not pond onto the beach between the beach berm and the dune line. The implications of this assumption are discussed later in Section 5.

For the sea level rise "b" cases, we assumed that part of the existing Ormond Lagoon will be filled in by sand as the beach transgresses landward, as described in the main report. For Ormond Lagoon, we predict that the majority of Ormond Lagoon in front of the dune line would be lost under 3 feet of sea level rise, representing a loss of 20-40% of the overall lagoon system storage.

To represent the influence of the current beach grooming practice, we applied a cap of 8.9 feet NAVD for beach berm growth for the "a" Alternatives, effectively assuming that VCWPD would breach the mouth if water levels ever reached this elevation. This means that if Ormond Lagoon water levels fill to 8.9 feet NAVD during a closure event, the model assumes the beach crest is instantaneously excavated to 8.9 feet, allowing Ormond Lagoon waters to spill over the beach and erode a new mouth. We assumed that the current beach grooming policy would no longer be relevant under 3 feet of sea level rise, and thus, the "b" cases did not include a beach height cap. The 3a alternative also does not include grooming in front of the New Lagoon.

4.1 Existing Conditions – Model Calibration

To train the model, we tested (1) predictions of water levels in the lagoon and (2) predictions of mouth closure and breach timing. We use the period from October 2007 to October 2011 to match water levels in the lagoon, and the mouth closure record interpreted from water level time series.

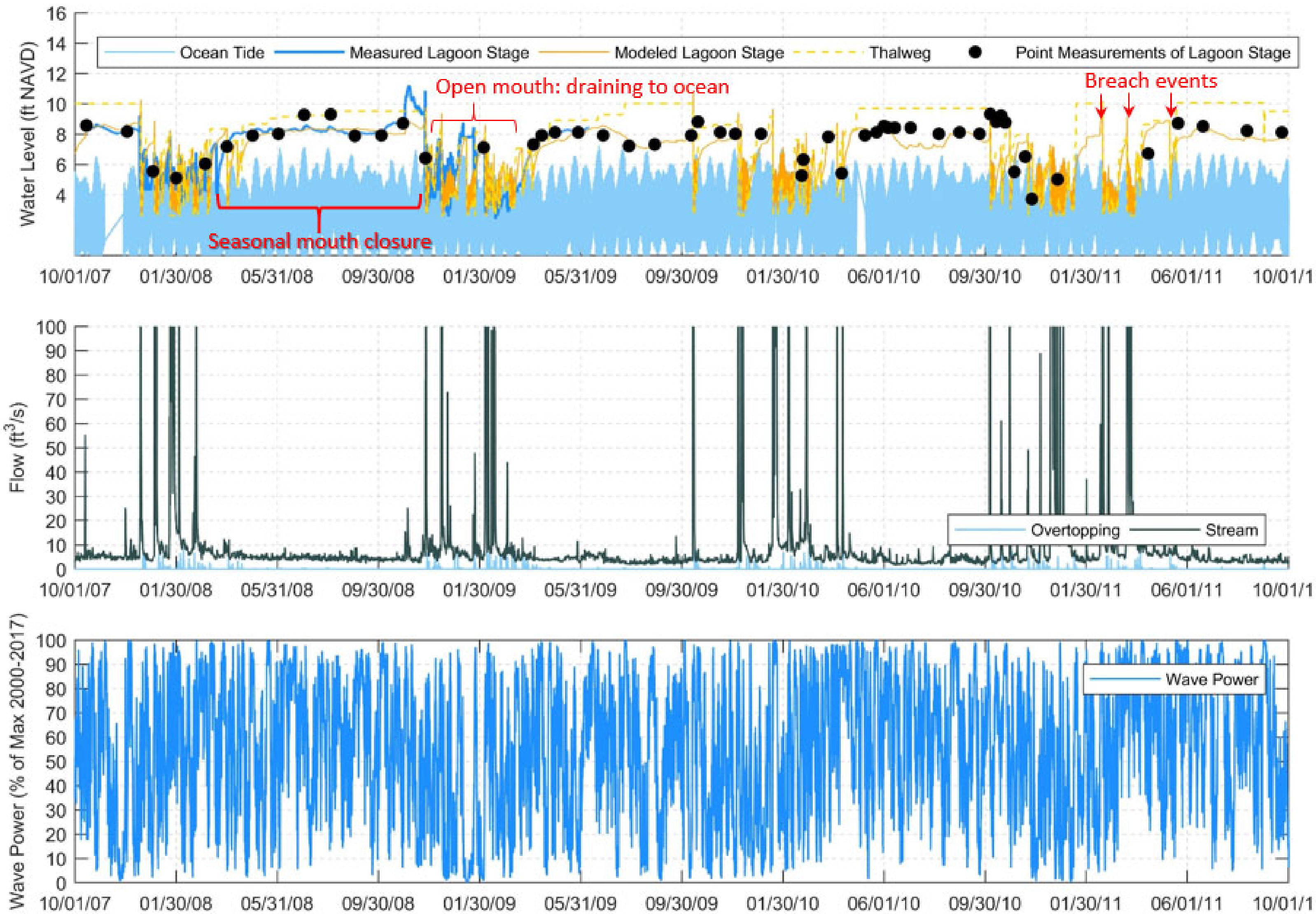
Figures E-2 and E-3 show how the model calibration run compares against the lagoon water level data from October 2007 to October 2011. Although the exact timing of the closure and breaching events are not always captured, the model reproduces a number of important aspects, such as (1) periods of mouth scour during high watershed runoff, (2) mouth closure during high wave events, (3) stabilization of the water level at 8-9 ft NAVD during seasonal closure events, and (4) natural mouth breaching during floods.

Given the complexity of Ormond Lagoon and other similar estuaries, the QCM is best used to reproduce the seasonality of the closures and the expected distribution of water levels in the lagoon, and not the exact timing of closure or breach events. Overall, the model performs well in reproducing the water level exceedance (Figure E-3) in the lagoon and the percentage of days closed (**Figure E-4**). The model correctly predicts the seasonality of closure, although it tended to overpredict mouth closure in late winter and fall. Since the model was driven by a synthetic inflow time series, and water level observations were limited, it is likely that it could be improved significantly as more data are collected.

4.2 Impact of Restoration Alternatives

Table E-2 outlines the conceptual alternatives, and lists the ways that they were represented in the model. The restoration alternative "a" cases are representative of existing sea level, while the "b" cases represent future sea levels, and an absence of mouth management. **Figures E-5 through E-8** provide a summary of model results that highlight the predicted water levels in the lagoon, the changes in the seasonal mouth closure pattern, and the expected changes in the wetted area and volume. These characterize the hydrology of the system, while the SLAMM model described in the main body of the report addresses specific habitat responses.

Figure E-5 shows a time series of modeled water level in the lagoon for each of the alternatives, without SLR (upper panel) and with 3' of SLR (lower panel). For the third alternative, water levels are indicated both for the Ormond Lagoon area, fed by tšumaš Creek and Bubbling Springs, and for the New Lagoon area fed by a redirected OLW. Figure E-6 illustrates the seasonal closure pattern for each of the alternatives, in terms of number of days of mouth closure

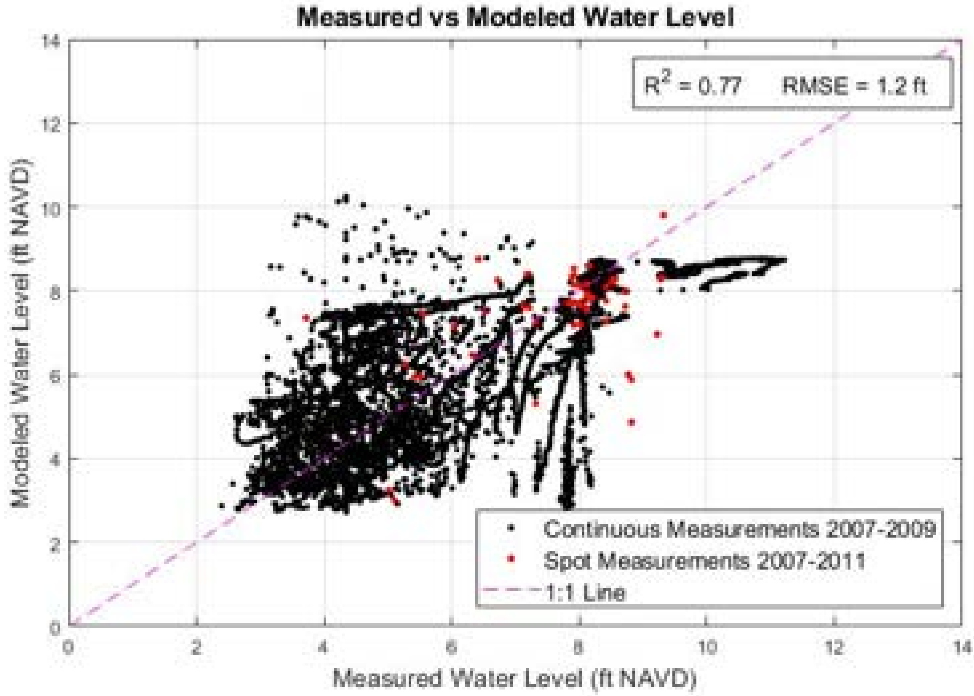


Ormond Beach Wetlands Restoration / D160447.00

SOURCE: ESA

Figure E-2

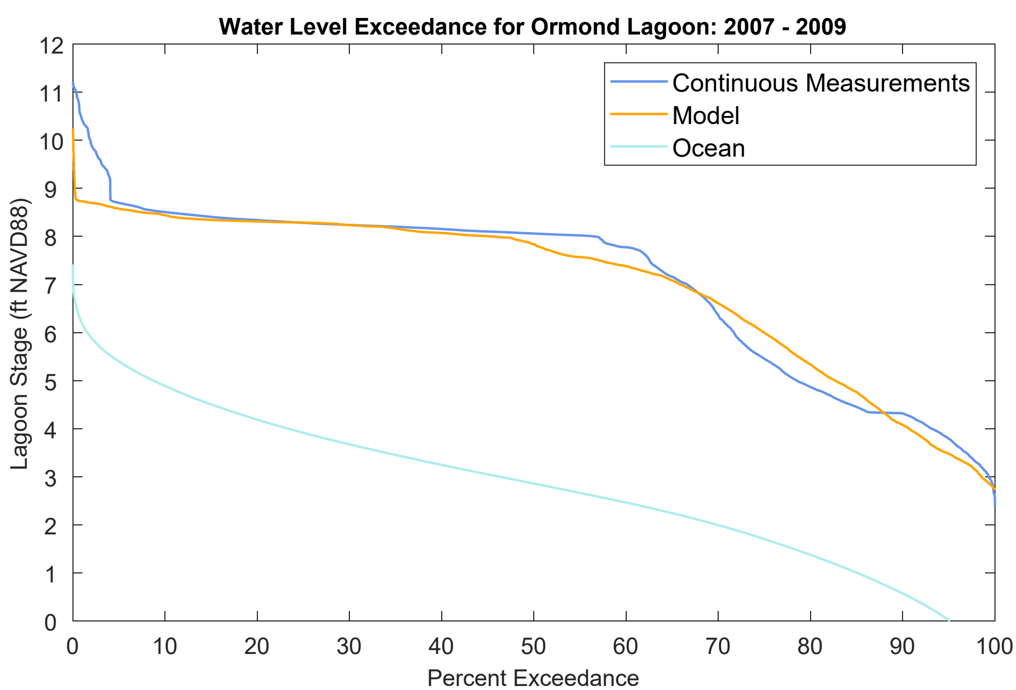
Comparison of **(top)** modeled and observed water levels in Ormond Lagoon, **(middle)** synthetic time series of runoff and predicted wave overwash, and **(bottom)** nearshore wave power.



Ormond Beach Wetlands Restoration / D160447.00

SOURCE: ESA

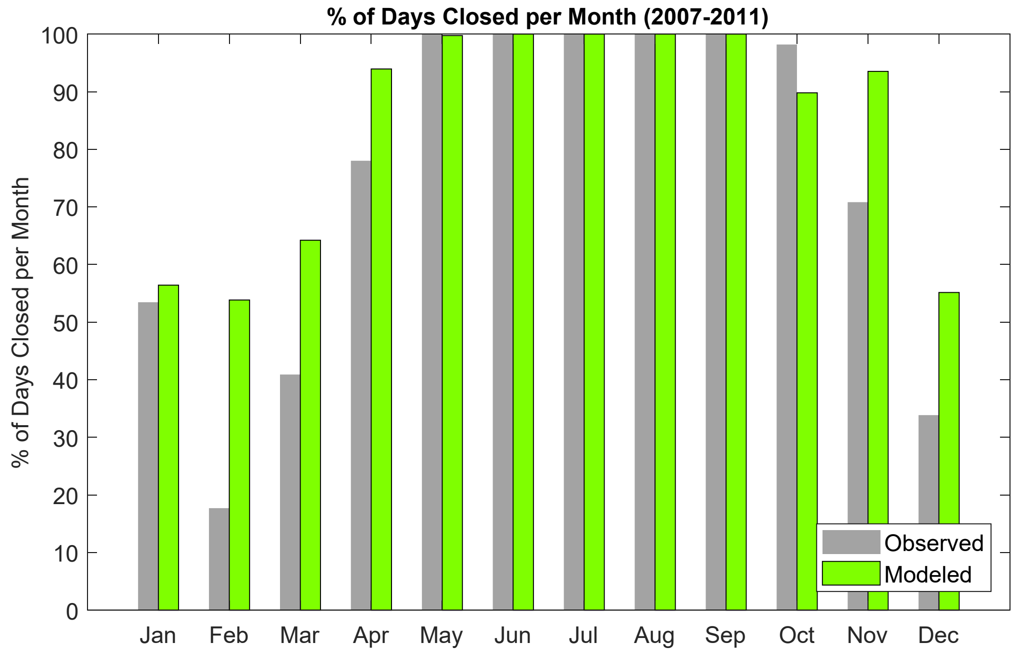
Figure E-3
Comparison of modeled and observed water levels in Ormond Lagoon from 2007 to 2009.



Ormond Beach Wetlands Restoration / D160447.00

SOURCE: ESA QCM model. Water level observations provided by CH2M Hill (2012)

Figure E-4
Comparison of modeled and observed water level exceedance in Ormond Lagoon from 2007 to 2009.



SOURCE: ESA

Ormond Beach Wetlands Restoration / D160447.00

Figure E-5
Comparison of modeled vs observed percentage of days closed per month

for each month of the year over the period from 2007 to 2017. The seasonal closure pattern is apparent in each of the curves from the dip in the number of closure days in winter months (during higher flow conditions) and higher number of closure days in the drier months (when runoff is low and the mouth is more likely to be blocked by sand from wave action).

Figure E-8 condenses the water level time series from Figure E-6 into probability density function (pdf) curves. These curves represent the relative number of times that lagoon water levels were predicted within certain bands of elevation. As an example, a pdf curve of oceanic tides would show high density of occurrences between mean lower low water (MLLW) and mean higher high water (MHHW). For Ormond Lagoon, water levels are typically much higher, so the pdf curves show a higher density above MHHW. The goal of this plot is to show subtle changes in water level between the alternatives more clearly than a time series alone could reveal. Figure E-8 also shows pdf curves for wetted area and lagoon volume, which were calculated from the water levels by relating them to the hypsometry (volume vs elevation) relationships for each case. Figure E-9 is similar to Figure E-8 but illustrates the SLR scenarios.

Alternative 1a was the only alternative to reduce the volume of Ormond Lagoon, since it isolated the ponded area east of the Halaco site. Compared to existing conditions, this alternative resulted in slightly higher water levels during seasonal closure (Figure E-6), but this caused Ormond Lagoon to breach earlier relative to existing conditions (Figure E-7). This meant that Ormond Lagoon drained earlier and more frequently than the other alternatives. Overall, the effects on water levels were small, although the isolation of part of Ormond Lagoon meant that wetted area and water volume were reduced (Figure E-8).

Alternative 2a resulted in slightly lower water levels than for existing conditions, but the added lagoon volume east of the Halaco site added a significant amount of wetted area and volume (Figures E-6 and E-8). Since oceanic tides have a small presence under existing conditions, the added volume had only a small impact on maintaining a longer opening, and relatively larger impact on impounding more water behind the beach during seasonal closure events. In systems that are much lower in elevation, adding volume within the tidal range can increase tidal currents in the mouth and make it harder for waves to deposit sediment and close the mouth (e.g. Behrens et al. 2015). In this case, the impact of the grading was predicted to have a relatively small impact on mouth conditions (Figure E-7).

Alternative 3a had the most marked impact on lagoon water levels and mouth closure, and had a similar effect as Alternative 2a with respect to increasing wetted area and volume. The New Lagoon under Alternative 3a was predicted to experience higher water levels than for Ormond Lagoon under existing conditions. This is a result of:

- Smaller storage capacity of inflows when compare to the capacity of the entire existing system,
- Reduced seepage toward the ocean given that the New Lagoon would mostly be situated behind the dune line, rather than on the beach, and
- Lack of beach management, allowing the beach crest to reach equilibrium levels of 9-11 feet NAVD during seasonal closures. This would allow the New Lagoon to hold more water behind the beach berm.

These changes contributed to significant gains in water volume east of the Halaco site, despite the fact that a portion of the inflows (Chumash Creek and Bubbling Springs) were directed to Ormond Lagoon. In contrast, the Ormond Lagoon experienced a reduction of 1-2 feet in water levels, since its storage capacity remained the same and the OLW would be diverted to the New Lagoon. This is anticipated to have a net benefit on flood management, as it delayed ponding during floods and reduced the number of times that peak water levels reached the grooming elevation of 8.9 ft NAVD (Figure E-6).

Despite the separation of inflows, when combined, the New Lagoon and Ormond Lagoon segments are predicted to provide a net increase in overall brackish habitat in the system as indicated by the curves for wetted area and volume in Figure E-8. The increase is similar in magnitude to Alternative 2a. The model also predicted significant changes in mouth closure duration. Despite the assumed continuation of beach grooming by VCWPD in front of Ormond Lagoon in the future, the reduced inflow to Ormond Lagoon meant that closure events lasted significantly longer on average (Figure E-7).

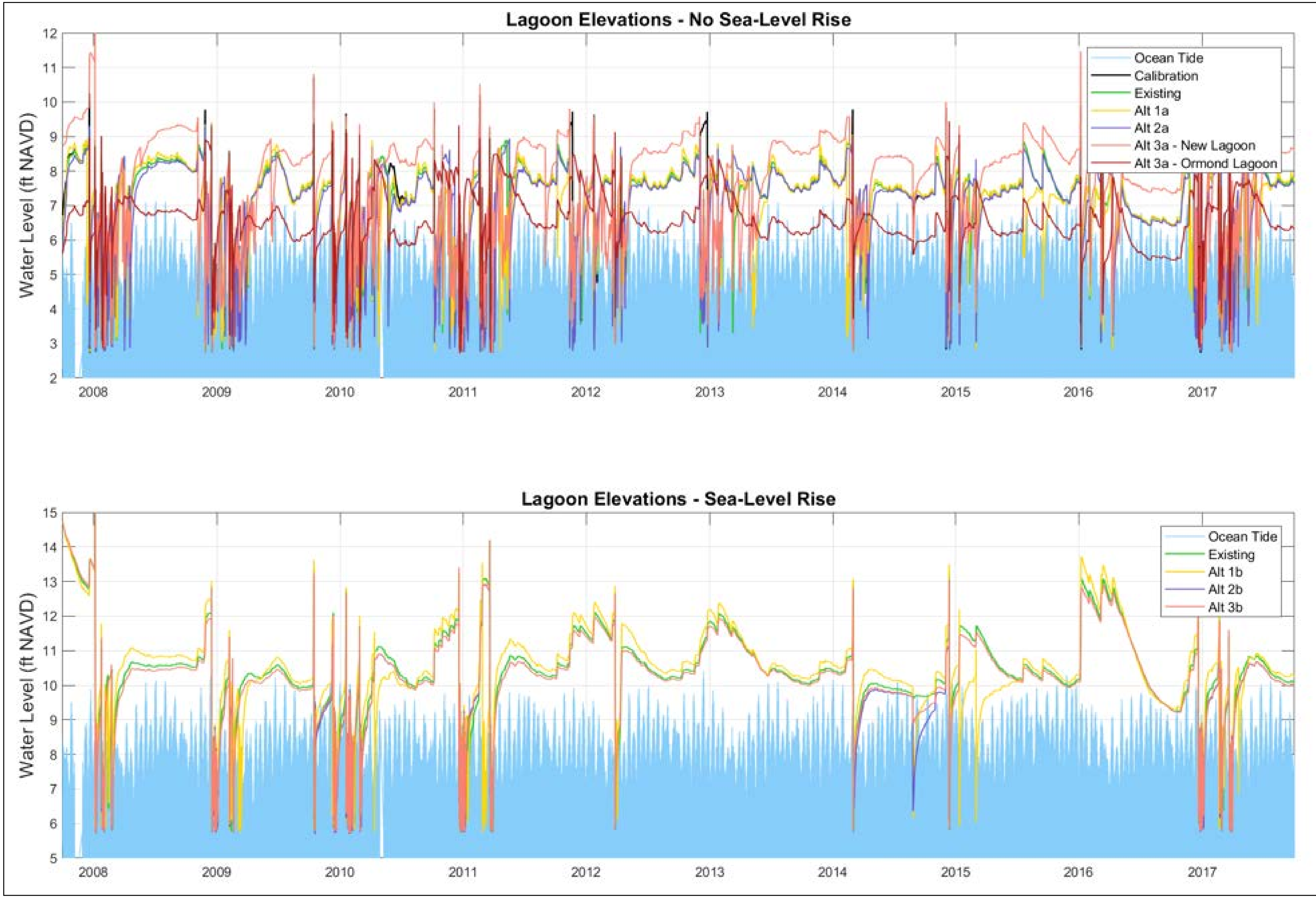


Figure E-6

Alternatives Timeseries

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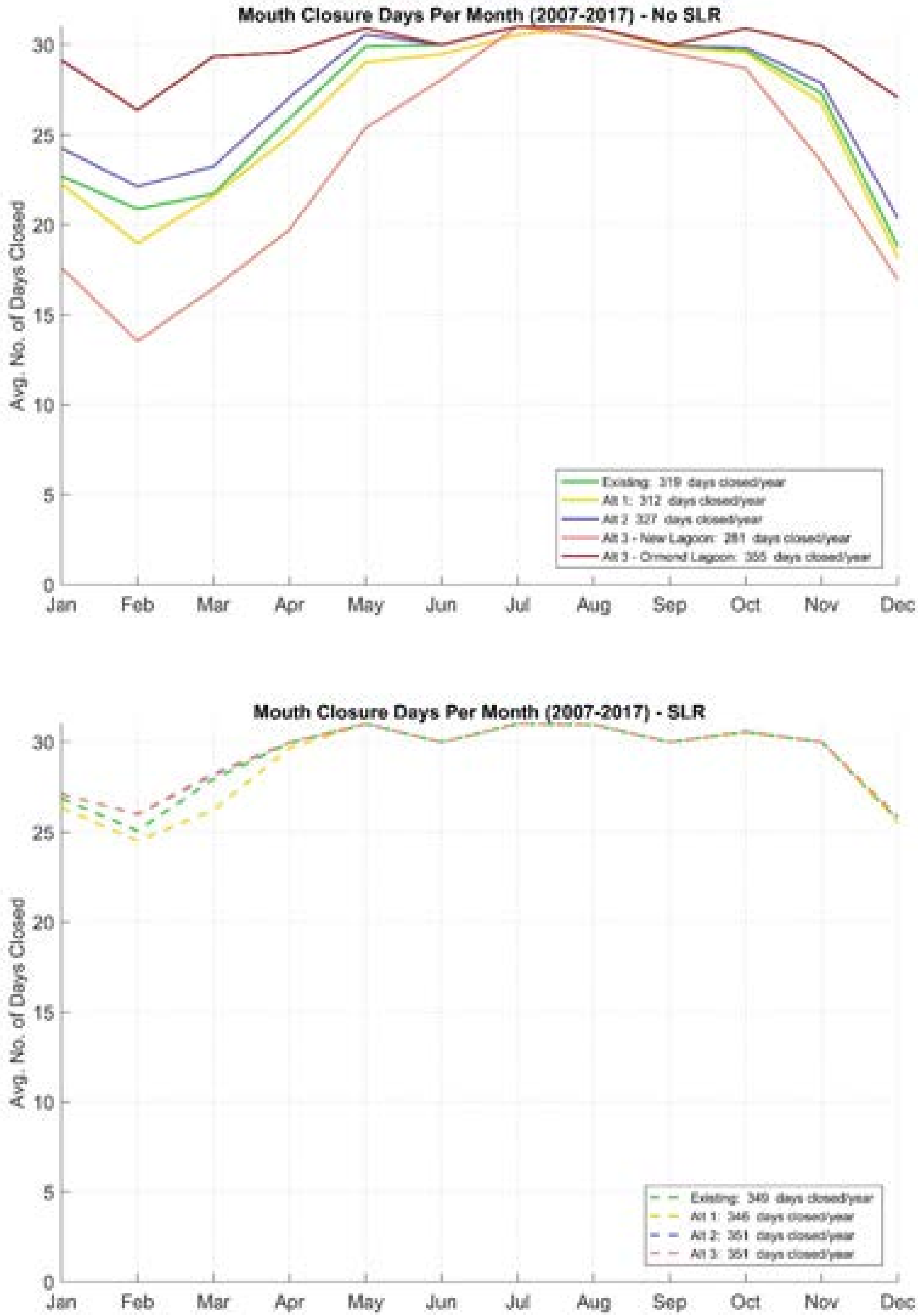

SOURCE: ESA QCM Model

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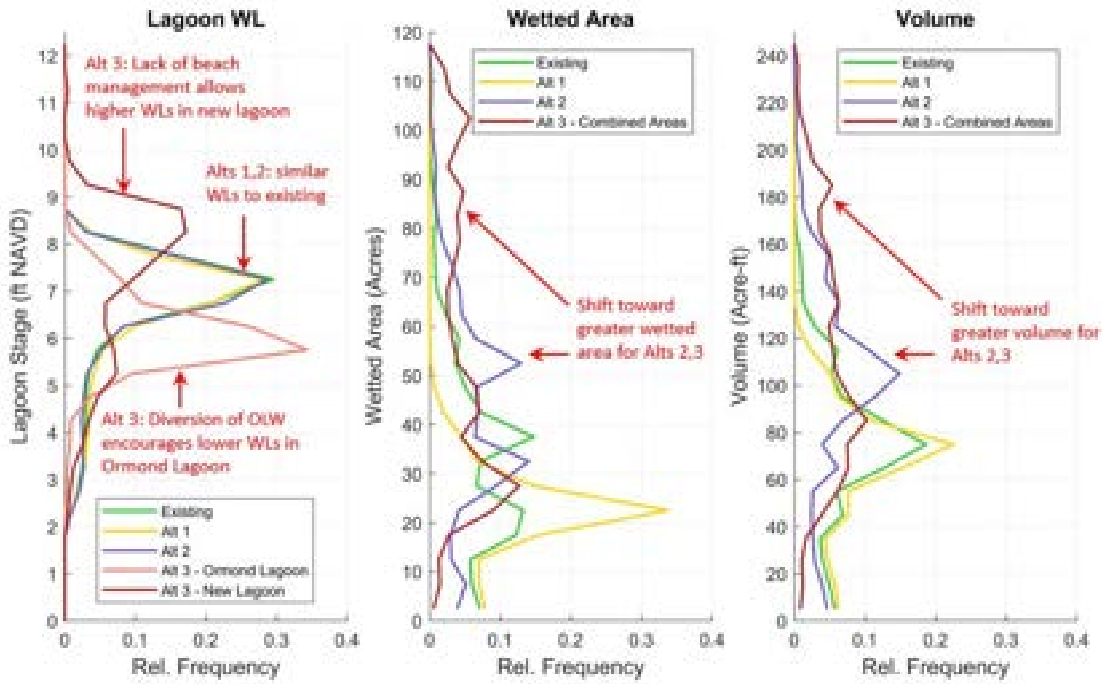
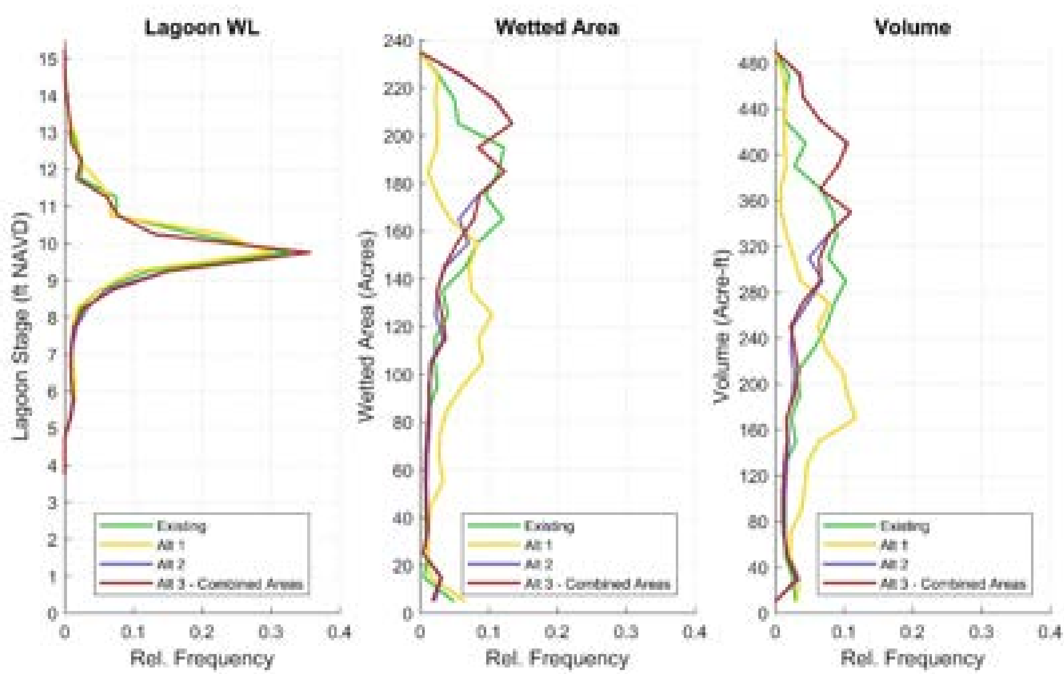
Figure E-7
Lagoon Mouth Closures in Days per Month
No Sea-Level Rise (top) and 3' of Sea-Level Rise (bottom)



SOURCE: ESA QCM model

Ormond Beach Restoration and Public Access Plan

Figure E-8
Modeled Lagoon Stage (Water Level) (left), Area (middle), & Volume (right) Probability Distributions for 2007-2017.



SOURCE: ESA QCM model

Ormond Beach Restoration and Public Access Plan

Figure E-9
Modeled Lagoon Stage (Water Level) (left), Area (middle), & Volume (right) Probability Distributions for 2007-2017. With 3 feet of Sea level Rise

4.3 Impact of Sea Level Rise

Under the sea level rise scenarios (“b” alternatives), water levels are very similar across the alternatives. This is likely because the elevated water levels will fill low areas behind the dune line. The capacity of these areas to store water is higher than the relatively small area of the Ormond Lagoon that would be lost to beach transgression inland. Therefore, the differences in storage capacity between the cases are small relative to the total storage capacity. Figure 7 (bottom) shows that for the SLR cases, the mouth is closed on the majority of the days each month. A similar seasonal pattern with winter and spring breaches is still observed with sea level rise, although the pattern is less pronounced. These results imply that the increase in the extent of inundated areas behind the dune line would contribute more to impoundment of water than to maintaining an open mouth. As SLR increases water levels above 3’, more frequent open-mouth conditions may result: This response was predicted for Devereux Slough in Santa Barbara County, for high levels of SLR (ESA 2016). For Ormond Beach area, the very low topography would not constrain the water surface at these higher sea-levels, and a more detailed analysis of the basin hydrology is required to provide meaningful projections.

4.4 Conclusions

In the short- to mid-term time horizon, Alternative 3 provides the greatest wetted area and volume for tidewater goby habitat. Although Alternative 3 can cause elevated water levels in the New Lagoon (which potentially poses a flooding risk), the fraction of time in which water levels are above 10 feet NAVD is small. If Alternative 3 were to be pursued, flooding risks to nearby areas should be assessed. Also note that Alternative 3 is sensitive to input assumptions and thus the results for Alternative 3 include more uncertainty than the other Alternatives. Alternative 2 was found to have a comparable increase in water volume, although water levels were constrained by continued beach management, limiting the allowable gain of lagoon habitat. Alternative 1, provided the least lagoon elevation and area (habitat), but would likely be simpler to implement and would preserve more brackish/saline habitats than the other alternatives.

As sea level rises, the differences between the Alternatives becomes less significant. With 3 feet of sea level rise, Alternative 3 has a smaller advantage over existing conditions in the amount of wetted area and volume provided. However, it is assumed that construction of this alternative would allow formation of critical backbarrier lagoon habitat, that could then transition and adjust inland with SLR, rather than being squeezed and constrained against infrastructure behind the beach. Also, Alternative 3 is more consistent with future conditions with higher sea levels for all of the Alternatives because the proposed New Lagoon location is where a lagoon is predicted to form at higher sea level.

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5. Uncertainties and Restoration Implications

5.1 Data Gaps and model uncertainty

While the model was able to reproduce seasonal mouth closure conditions and water levels, the short span and limited geographic scope of some of the available data contributed to some of its uncertainty. Model calibration relied heavily on data collected from 2007 to 2011 since this period had the greatest overlap of different data sets required for testing the model. Although this period of time included relatively dry and wet years, year-to-year variability in the California climate is often very high, and 4-5 years of data cannot describe the full breadth of hydrologic conditions that might be expected in the future, with or without restoration.

While data collection by the EPA, CH2M Hill, and others was intensive, and has done much to illustrate the function of the system, there are several data gaps that impacted this modeling study:

- Runoff data into Ormond Lagoon were unavailable. A synthetic record was developed from nearby gauges to attempt to approximate the seasonality if runoff (described in Section 3), but the uncertainty of this synthetic time series is unknown without data to compare against. No runoff data were available from either of these nearby gauges for 2017.

- No water level records were taken in Ormond Lagoon from 2012 to 2016.

- Records of mouth closure periods have not been kept, except for the dates of beach management actions. Timing of mouth closure events was interpreted from water level time series.

- The impact of biennial beach nourishment activities from the USACE, is thought to impact beach growth at the site, but seasonal and inter-annual measurements of the beach crest are not available.

- Groundwater interactions between area 3a and areas to the east are uncertain, which implications all alternatives. Area 3a is thought to have a groundwater connection to OLW and Ormond Lagoon (CH2M Hill 2012), but its connectivity to areas immediately to the east, including the ODD#3 is less certain. Ground water is affected by the existing waste water system, which is connected to the groundwater via pipeline leaks (CH2M Hill, 2012), but the existing and future implications to groundwater are not adequately understood.

Future refinement efforts of the restoration design would benefit greatly from additional data collection that would address these gaps. The goal of this data collection would be to gather information in a wider range of hydrologic conditions than were observed from 2007 to 2011. In particular, water level data collected in Ormond Lagoon and in area 3a would be relatively cost-effective and provide a much broader understanding of how Ormond Lagoon and outlying ponded areas respond to the driest and wettest of years. Runoff measurement near Ormond Lagoon would also provide a large benefit to the restoration design. Since the existing Ormond Lagoon rarely experiences ocean tides, we found that the seasonal runoff pattern has relatively high importance in governing the morphology of Ormond Lagoon mouth and the resulting water levels. This is consistent with other lagoons that whose topography lies mostly above the tide range, including Scott Creek in central California (ESA 2016) and at Aliso Creek, north of San Diego (ESA year).

5.2 Uncertainties in Site Evolution

For all alternatives, we assumed that beach transgression with sea level rise will impact the available volume on the beach, as the beach begins to squeeze Ormond Lagoon against the hard line of infrastructure immediately landward. Unlike the beach crest fronting Ormond Lagoon, we have assumed that the dune line would be more resilient and would front the Lagoon constructed in area 3a as part of Alternatives 2 and 3.

We have assumed that the New Lagoon created under Alternative 3 would mostly be comprised of the ponded areas behind the dune line, and would have an ephemeral connection to the ocean via a New Lagoon mouth channel on the beach. For simplicity, we assumed that the channel connecting the New Lagoon to the ocean on the beach would not expand to form a seasonally ponded area of its own on the beach (similar to the ponded area that makes up the existing Ormond Lagoon). At several other sites in California, this condition is true, but it requires that vegetation or other environmental constraints prevent the channel from migrating along the beach. The proposed grading for Alterative 3 includes dune creation to inhibit connection to the existing Ormond Lagoon, but pooling along the beach to the east is possible and even likely, and should be considered in reviewing alternatives effects and effectiveness.

While we did not explicitly model this case, the expected result of this lagoon formation on the beach would be:

- A gradual increase in wetted area and volume available (beyond those already predicted for Alternative 3), and
- An increase in seepage losses from the New Lagoon, potentially resulting in lower water levels

6. List of Preparers

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Appendix F

Wetlands Habitat Evolution Modeling (SLAMM)

APPENDIX F
Wetlands Habitat Evolution Modeling

Introduction

As sea level rises, the beach and wetland habitats at Ormond beach are expected to change due to increasing inundation and geomorphic migration inland. To project habitat changes at the site due to sea-level rise, this study employed the Sea Level Affecting Marshes Model (SLAMM). SLAMM, written and maintained by Warren Pinnacle Consulting, Inc., is a program that simulates wetland conversion and shoreline change due to sea-level rise (WPC 2016). It was developed in the 1980s and has been adapted and updated since, leading to the most recent version 6.7, which includes updates specific to California estuaries and lagoons. In general, SLAMM uses ground elevation and slope, along with an initial habitat map and a sea-level rise curve, to estimate the conversion and migration of habitat areas over large time steps (on the order of years to decades).

For this study, habitat changes under future conditions through 2100 were modeled for the No-Project case and for each of the three alternatives.

Methods

This study was performed with SLAMM version 6.7 because it is the latest iteration of the software and includes some features developed for California estuaries and perched lagoon systems (WPC 2016). Earlier versions of SLAMM were developed for sites and ecosystems on the east coast of the United States, and as such they did not capture the suite of California estuarine habitats and their relationship to perched lagoon hydrology. The latest version includes a separate set of habitat classifications and conversion functions tailored to California. SLAMM v6.7 also introduces a perched lagoon model, which allows estuarine water levels behind a coastal barrier beach to be perched above the ocean water level and to experience a muted tidal range. Lagoon perching is represented by a parameter, beta, and two physical benchmarks, mean tide level and the barrier beach crest elevation. Beta is multiplied by the difference between the barrier beach crest elevation and the mean tide level to represent the perched water level (WPC 2016).

The Coastal Resilience Ventura (CRV) project applied SLAMM v6.2 beta to the stretch of shoreline including both Ormond Beach and Mugu Lagoon to the southeast (ESA PWA 2014). The CRV project was intended as a regional-scale assessment of coastal wetland habitat vulnerability to sea-level rise, whereas the current study is intended as guidance for designing the Ormond Beach restoration. As such, the inputs to these two versions of SLAMM are similar, but not identical. Overall, the findings from the two studies are similar, particularly in that Ormond Beach will begin to experience significant increase in inundation after two feet of sea-level rise that escalates to affect nearly all the Project Area as sea-level rise approaches five feet.

The key inputs for ground elevations, habitat extents, and sea-level rise for this study's SLAMM model are as follows:

- **Ground elevation** - Over the OBRAP project site, a digital elevation model (DEM) at 1-meter resolution was taken from the SCC California Coastal LiDAR dataset (SCC 2011). Portions of this DEM were updated based on surveying and site observations to correct for LiDAR bias in densely vegetated areas. Outside the project area, the topography from CRV was deemed sufficient, and the two datasets were spliced together to provide a single DEM covering the model domain. The elevation bands can be seen in **Figure F-1**, with the two data source regions outlined. This merged DEM was sampled at 5-meter resolution to serve as input to SLAMM.

- **Existing habitats map** - As part of the OBRAP existing conditions report, habitat surveys were performed at the site, identifying different types of beach, wetland, and upland habitats in the area based on salinity, elevation, existing plant and animal communities, and access to water (ESA 2017, Figure 2-28). The SLAMM California habitat categories for each of these regions were identified to create the SLAMM existing habitats input file. For parts of the model domain outside the surveyed project area, the habitat map from CRV was converted to California categories as indicated by the cross-walk in **Table F-1**. This merged existing habitats map is presented in **Figure F-2**.

- **Sea-level rise** - For this study, the CRV 'High SLR' sea-level rise curve was used. This curve is based on guidance from the National Research Council (NRC 2012) and the US Army Corps of Engineers (USACE 2011) and projects sea-level rise of 4.8 feet at 2100. This elevation was selected based on reviews of prior work and consideration of California guidance and Ventura County planning, as described in more detail in Appendix A.

SLAMM allows the user to define subareas with different hydrologic parameters, and two of these were defined for this model: the Ormond Lagoon Subarea and the Arnold Road Subarea (as outlined in Figure F-2). The Ormond Lagoon Subarea was defined to capture the effects of perched Ormond Lagoon water levels on habitat conversion in the west, and the Arnold Road Subarea was defied to capture the effects of rising groundwater levels on habitat conversion in the east. The rest of the domain includes developed areas, which are assumed to have unchanged land use from their current development, and the exposed beach and dune areas, which directly experience the open ocean tides and waves. The hydrology of each subarea was characterized with a local definition of mean tide level, tide range, and berm crest and beta-parameter. These parameters are summarized in **Table F-2** and described in the following paragraphs.

The part of the domain not contained in either subarea is exposed to the open ocean, so it experiences the full oceanic tidal range (5.4 ft). The mean tide level applied to the model from the open ocean was based on published tidal datums at the NOAA's Santa Barbara gage #9411340. This area has a small perching factor applied via the lagoon module to account for groundwater higher than sea level, which is described in more detail in the description of Arnold Road Subarea below.

TABLE F-1
SLAMM TRADITIONAL TO CALIFORNIA HABITAT CATEGORY CROSS-WALK

Traditional Name	Trad. Code	CA Name	CA Code
Developed Dry Land	1	Developed Dry Land	101
Undeveloped Dry Land	2	Undeveloped Dry Land	102
Swamp *	3		
Cypress Swamp *	4		
Inland-Fresh Marsh	5	Freshwater Marsh	108
Tidal-Fresh Marsh	6	Tidal Fresh Marsh	114
Trans. Salt Marsh	7	Irreg.-Flooded Marsh	115
Regularly-Flooded Marsh	8	Regularly-flooded Marsh	120
Mangrove *	9		
Estuarine Beach	10	Ocean Beach	119
Tidal Flat	11	Tidal Flat and Salt Panne	122
Ocean Beach	12	Ocean Beach	119
Ocean Flat	13	Tidal Flat and Salt Panne	122
Rocky Intertidal	14	Rocky Intertidal	121
Inland Open Water	15	Inland Open Water	106
Riverine Tidal	16	Riverine Tidal	124
Estuarine Open Water	17	Estuarine Open Water	126
Tidal Creek	18	Tidal Channel	125
Open Ocean	19	Open Ocean	127
Irreg.-Flooded Marsh	20	Irreg.-Flooded Marsh	115
Inland Shore	22	Inland Shore	107
Tidal Swamp	23	Tidal Fresh Marsh	114
Flooded Developed Dry Land	25	Flooded Developed	128
		Dunes **	111

NOTES:
* These Traditional Categories to not apply to the California Coast, so they were not mapped.
** There was not a direct cognate in the Traditional Categories. CRV used “Flooded Forest” for this category, but the two are not consistently comparable.

TABLE F-2
DOMAIN HYDRAULIC PARAMETERS

	Model Domain Outside of Subareas	Ormond Lagoon Subarea	Arnold Road Subarea
Mean Tide Level (ft NAVD88)	2.6	2.6	2.6
GT Great Diurnal Tide Range (ft)	5.4	0.3	0.3
Lagoon Beach Crest Elev. (ft, NAVD88)	9.6	9.6	9.6
Lagoon Beta Parameter (-)	0.082	0.5	0.082

The Ormond Lagoon Subarea includes parts of Area 1, the existing lagoon and surrounding beach and marsh areas; Area 2, upstream on the Ormond Lagoon Waterway; and Area 3a, the wetland area potentially connecting the two; and Area 4, the land inland of the existing railroad embankment. These are hydraulically connected via by Ormond Lagoon Waterway, the channel along the south edge of the Halaco site, and the similar ground surface elevations. Tides in the lagoon are damped, and the representative tide range of 0.3 ft was selected based on results from water level observations and the lagoon QCM (Appendix C. Based on water level gauges deployed from June-December 2017 as part of the OBRAP field work, the minimum dry season water level in Ormond Lagoon is expected to be 6.5 feet NAVD. This is about 3.5 feet higher than oceanic mean tide level, so the beach crest elevation and lagoon beta parameter were set to representative values that result in this 6.5-foot NAVD perched elevation.

The Arnold Road Subarea includes the western portion of the OBRAP project area, comprising Area 3b, between the railroad embankment and the beach; Area 5, east of the power plant; and Area 6, the salt panne area at the end of Arnold Road that is between Oxnard Drainage Ditch #3 and the dunes. These areas are lower-lying and exposed to a shallow groundwater table, as indicated by water level gauges deployed from June-December 2017. These observations indicated that the groundwater in this area varied from 3.2 to 4.3 ft NAVD, and had a representative value of 3.7 ft NAVD, slightly higher than oceanic mean tide level. This slight elevation above oceanic mean tide was likely due to the regional groundwater gradient sloping down to the ocean. The groundwater observations exhibit muted fluctuations at periods corresponding to the daily and spring-neap tidal cycle, confirming the groundwater's connectivity to the ocean. To represent this ocean-connected groundwater, the Arnold Road sub area was modeled as a lagoon with a very small beta parameter. A beta parameter of 0.082 raises the water levels by about 0.7 feet under current conditions, aligning with field observations, such as the surface water in ODD #3. For current conditions, this water level is below the surface in most of the subarea, but with sea-level rise, it will rise above the ground surface and become a groundwater-sourced lagoon. The SLAMM tide range parameter was set to be consistent with the tidal fluctuations observed in the groundwater, 0.3 ft.

Using the hydraulic conditions in each subarea, SLAMM begins with the initial-conditions habitats (input) and steps forward in time by raising sea level and calculating changes to the topography – both horizontal recession by erosion, and vertical growth by accretion. Based on the elevation and slope of each cell, SLAMM calculates the new inundation frequency for that cell. SLAMM includes a set of conversion pathways – for example, leading from Irregularly-Flooded Marsh to Regularly-Flooded Marsh, to Tidal Flat/Salt Panne, to Estuarine Open Water – and as the inundation frequency of each cell changes, it shifts toward wetter or drier habitat categories (though wetter is far more frequent as sea level rises). For cells not directly connected to the ocean, SLAMM also considers saturation, assuming groundwater rises with sea level, allowing fresher wetlands to move into upland areas, even if they are not directly inundated.

SLAMM was developed to primarily to examine the effect of changing water levels in estuarine wetlands, and as such, it does not consider coastal processes affecting the beach and dunes themselves. Sea-level rise will cause landward transgression of water levels and waves, which, in turn, will cause erosion and shift the shoreline itself further inland. These processes were addressed outside SLAMM, and then applied to the SLAMM results. It was assumed that the beach could freely transgress inland and upwards according to the Brunn rule, while the dunes would erode permanently as sea-level rise outpaces aeolian dune formation. This methodology is described in more detail in Appendix B. The result was a new beach berm location, representing the inland extent of SLAMM's open ocean habitat category at each time horizon, and a new back beach extending 100 feet behind that line. These two habitat areas were overlain on the SLAMM habitat results, representing the inland transgression of the beach overtaking other potential habitats with rising sea level.

Results

1.1 No-Project

The SLAMM results for the No-Project case are presented in **Figure F-3**, **Figure F-4**, and **Figure F-5** at three future time horizons.

At 2060 (Figure F-3), projected sea-level rise is about two feet (2.1 ft). In the western side of the project area, water is still generally confined to existing waterways, and the beach is beginning to pinch off the east end of the lagoon, but Ormond Lagoon is generally still intact. In Area 6, on the east end of the project area, much of the salt panne at the end of Arnold Road has converted to open water, with the higher area around that converting from marsh to salt panne and the existing marsh shrinking slightly. Across the site, more saline and wetter influence is projected to move upslope, potentially shifting nearly all the uplands towards brackish wetlands. This is consistent with the project area's existing vegetation distribution (ESA 2017, Figure 2-28), which includes saline wetlands at elevations up to about 10 ft NAVD. With two feet of sea-level rise, the band of potential saline influence is likely to also shift upwards by two feet, to 12 ft NAVD. Nearly all the project area's ground surface falls below 12 ft NAVD (Figure F-1).

At 2080 (Figure F-4), projected sea-level rise is about three feet (3.4 ft). In the west, the marsh in Area 3a has mostly converted to open water, and is anticipated to have perched water levels that function similar to and somewhat connected to Ormond Lagoon. The surrounding areas have converted to a single class containing both unvegetated salt panne and tidal flat. These habitats are primarily differentiated by evaporation and hydraulic connectivity, process for which SLAMM does not account. Since SLAMM habitats are based on only elevation and tidal range, the model does not differentiate between tidal flat and salt panne and instead groups them together into a single category. While the figures in this appendix use more habitat distinctions and refer to those areas as "salt panne," they are generalized as "unvegetated flats" when the habitat areas are summarized into fewer categories for the main report. The beach has transgressed far enough inland to overrun the east side of the lagoon. The low-lying portions Area 2 near Ormond Lagoon Waterway have also converted to salt marsh and begun to show patches of permanent open water. Open water, salt panne, and salt marsh have begun to migrate into Area 4 from the west, and the lower area closer to the ocean is permanently ponded. The eastward extent of this open water, which is attributed to perched lagoon conditions, may be limited by the available freshwater volume and not spread out quite as far as shown, except during wet season runoff evens. In the east, the existing salt panne in Area 6 has been squeezed to the margins of a growing pool of open-water there, which likely acts as a lagoon supplied by a combination of groundwater, channels from Mugu Lagoon, and increasingly frequent wave overwash.

At 2100 (Figure F-5), projected sea-level rise is nearly 5 feet (4.8 ft). By this time, most of the project area is permanently inundated by open water. Groundwater's connectivity to the ocean provides an effectively unlimited water supply to support groundwater inundating the project area in the lower areas, including Areas 5 and 6, and progressing as far west as Area 3b. However, in the western portion of the project area, while the site is expected to be very wet by end-of-century, this figure may overstate the actual inundation. SLAMM does not account for limited water supply, whereas in reality as the western area inundates from Ormond Lagoon and its waterways, more volume would be required to raise the water surface as the water spreads over a wide area. SLAMM assumes that there is enough water to fill any potential space below the inundating water level, thereby likely overestimating inundation in Areas 2, 3a, and 4. Although the western inundation is likely overestimated for 4.8 ft of sea-level rise, higher amounts of sea-level rise, which are projected as possibilities for the end of the 21st century or into the 22nd century, would eventually result in conditions similar to inundation extent in Figure F-5 as the continued increase in groundwater augments the inundation from the watershed and lagoon perching.

1.2 Proposed Restoration Alternatives

SLAMM was also used to evaluate the habitat evolution of the proposed restoration alternatives. For each alternative, described in Section 6 of the preliminary restoration plan, the ground elevations in the DEM were modified to represent the proposed grading and the initial habitat map was revised to reflect the target habitats. Then SLAMM was run for each alternative using all the same configuration as for the No Project scenario, except for the altered DEMs and habitat maps. Unless otherwise stated, the alternatives' habitat evolution in Areas 6-9 are roughly similar to the No Project scenario. Differences from the No Project scenario and between the alternatives are summarized in the sections below.

The alternatives propose a range of management for the dunes, such as vegetation management, grading swales, and dune building. These types of management are not resolved by the approach for coastal erosion (Appendix B) that was applied to the SLAMM results, so projections for beach and dune erosion are mapped the same in all alternatives as for the No-Project scenario.

1.2.1 Alternative 1

Since Alternative 1 proposes mostly enhancements to existing habitats and relatively mild grading, its initial conditions (**Figure F-6**) are very similar to existing conditions in the No Project scenario. Because of the similarity to No Project's initial conditions, the resulting habitat evolution is also similar to the No Project scenario.

At 2060 (**Figure F-7**), with two feet of sea-level rise, the most prominent change is open water in Area 6.

At 2080 (**Figure F-8**), with three feet of sea-level rise, inundation spreads to a substantial fraction of the project area, and the reduced connectivity to ODD #3 results in larger open water and unvegetated in the western portion of Area 5.

At 2100 (**Figure F-9**), the majority of the site is inundated.

1.2.2 Alternative 2

The proposed grading in Alternative 2, notably the re-alignment of Ormond Lagoon Waterway in Areas 2 and 3a, and the wetland swales in Area 4, modify this alternative's the initial habitat conditions (**Figure F-10**).

At 2060 (**Figure F-11**), with two feet of sea-level rise, the southern-most wetland swale in Area 4 become permanently inundated. Because of the better connectivity via the Waterway's re-alignment, Area 3a has more vegetated wetlands rather than the unvegetated flats predicted for this area for No Project and Alternative 1. The lower portion of the re-aligned channel also provides connectivity between the Waterway and the Lagoon across a wider swath of Area 1.

At 2080 (**Figure F-12**), with three feet of sea-level rise, inundation from the Ormond Lagoon Waterway spills out across Area 3a, re-creating lagoonal conditions which would be displaced at the original Ormond Lagoon by beach transgression. In Area 4, the landward transgression of inundation progresses, deepening the water in the southern swale and activating the next swale north with permanent inundation. In Area 5, the proposed embankment will slow the encroachment of inundation in the northeast part of the site as compared to the No Project scenario.

At 2100 (**Figure F-13**), with almost five feet of sea-level rise, the majority of the site is inundated, with slight variation in the inundation's distribution due to this alternative's proposed grading.

1.2.3 Alternative 3

Alternative 3 proposes more extensive grading to re-align the Ormond Lagoon Waterway, excavate a lagoon at its downstream end, and create wetland depressions in Area 4 and Area 5. These proposed actions result in the initial habitat conditions shown in **Figure F-14**.

At 2060 (**Figure F-15**), with two feet of sea-level rise, all of major grading areas become inundated. Conditions are similar to Alternative 2, except the more extensive excavation increases the inundated extents.

At 2080 (**Figure F-16**), with three feet of sea-level rise, the rising inundation spills out from the excavated areas onto adjacent properties. The combination of the grading and increased connectivity yields more contiguous wetlands across Area 3a and Area 4. Inundation in Area 5 is largest for this alternative.

At 2100 (**Figure F-17**), with almost five feet of sea-level rise, the majority of the site is inundated, with slight variation in the inundation's distribution due to this alternative's proposed grading.

Discussion

SLAMM's predictions of habitat evolution are based on simplifying assumptions and only consider ground surface elevations, sea-level rise, representative water levels, and proximity to preceding habitats. Habitat evolution depends on a broader range of physical processes, including watershed hydrology, evapotranspiration, ground surface slope, groundwater, soils, and salinity. There is not enough available data to fully characterize the project area and watershed conditions that determine these processes. Even if sufficient existing data were available, full deterministic modeling of the processes over nearly a century is not feasible. In spite of these limitations, SLAMM's general trends in projected habitat evolution provide an indication of future site condition for the designated sea-level rise thresholds, even if the thresholds do not arrive exactly at the assumed decade.

Ground survey transects suggest LiDAR elevations may be high by a half a foot to a foot (e.g., southern part of Area 3a, central portion of Area 6) due to the LiDAR observing the vegetation canopy rather than the ground surface. In these areas, inundation would occur sooner than predicted by SLAMM.

The mapped open water areas are based on minimum observed elevations within the project site in 2017. During extended droughts, evaporation and limited watershed could lower these water levels. However, with anticipated wet season precipitation, inflow from the watershed, increased groundwater, and wave overwash, higher water levels and greater extent of inundated area are likely for portions of non-drought years.

Since the focus of this study is restoration, SLAMM was configured so as to not map inundation in the developed areas west and north of Areas 1, 2, 3a, and 4, as well as the power plant. These developed areas are vulnerable to coastal flood and erosion hazards, as evaluated in ESA PWA (2013) and in the County's hazard assessment. As sea-level rise exceeds about two feet, coastal flooding hazard begins to impinge upon developed areas at the southern end of Perkins Road. With five feet of sea-level rise, coastal flood risk extends further northward, extending across McWane Boulevard. As flood management planning for these areas progresses, it can be coordinated with the restoration project.

As the site, its environs, and climate evolve, adaptive management should be supplemented with hydrologic, hydraulic, and geomorphic modeling informed with additional data.

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State Coastal Conservancy (SCC). 2011. California Coastal Conservancy Coastal Lidar Project. Available: https://coast.noaa.gov/dataviewer.

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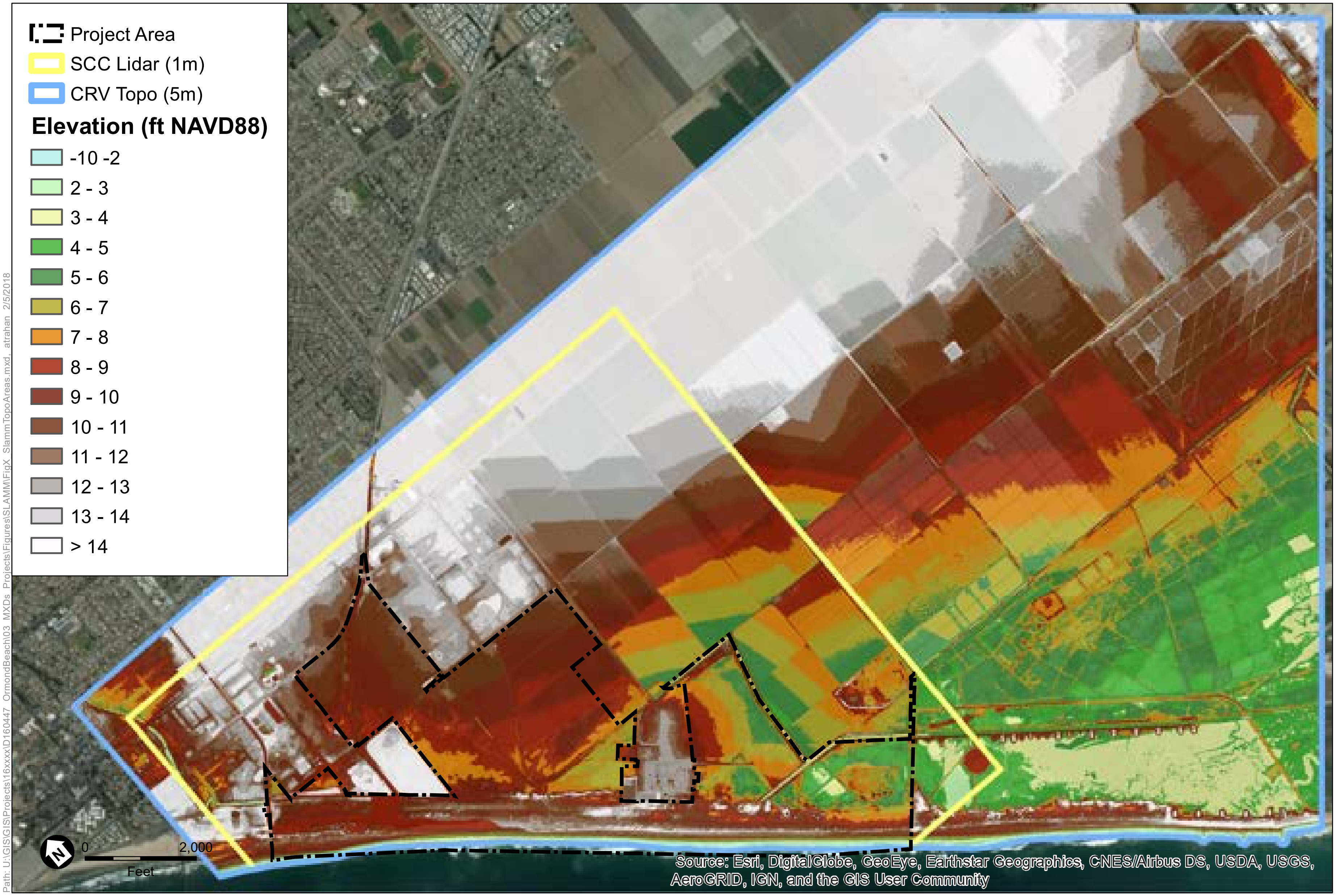
National Research Council (NRC). 2012. Sea-Level Rise for the Coasts of California, Oregon, and Washington: Past, Present, and Future. National Academy Press: Washington, D.C.

U.S. Army Corps of Engineers (USACE). 2011. Sea-Level Change Considerations for Civil Works Programs. Engineering Circular 1165-2-212.

Warren Pinnacle Consulting, Inc. (WPC). 2016. SLAMM 6.7 Technical Documentation Sea Level Affecting Marshes Model, Version 6.7 beta.

Figures



SOURCE: SCC 2011, ESA PWA 2014, ESA 2017

Ormond Beach Restoration and Public Access Plan

Figure F-1
Site Topography and Data Sources

ESA

SOURCE: ESA (2017), CA Coastal Conservancy LiDAR (2011)

Ormond Beach Restoration and Public Access Project

Figure F-2
SLAMM Results wtih Beach Transgression
Existing Conditions, Current-Day

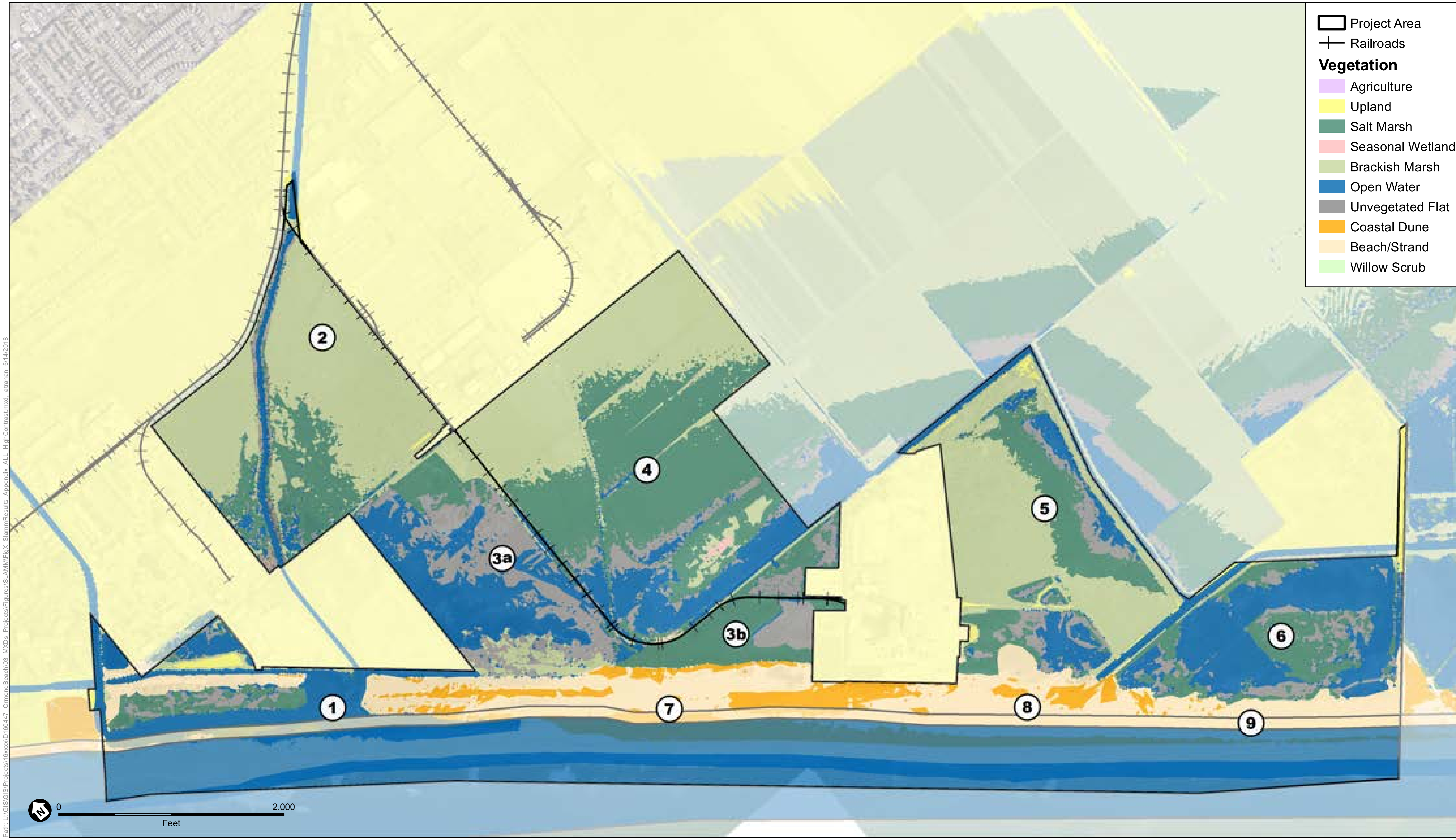
ESA

SOURCE: ESA (2017), CA Coastal Conservancy LiDAR (2011)

Ormond Beach Restoration and Public Access Project

Figure F-3
SLAMM Results wtih Beach Transgression
Existing Conditions, 2060 +2.1 ft SLR

ESA

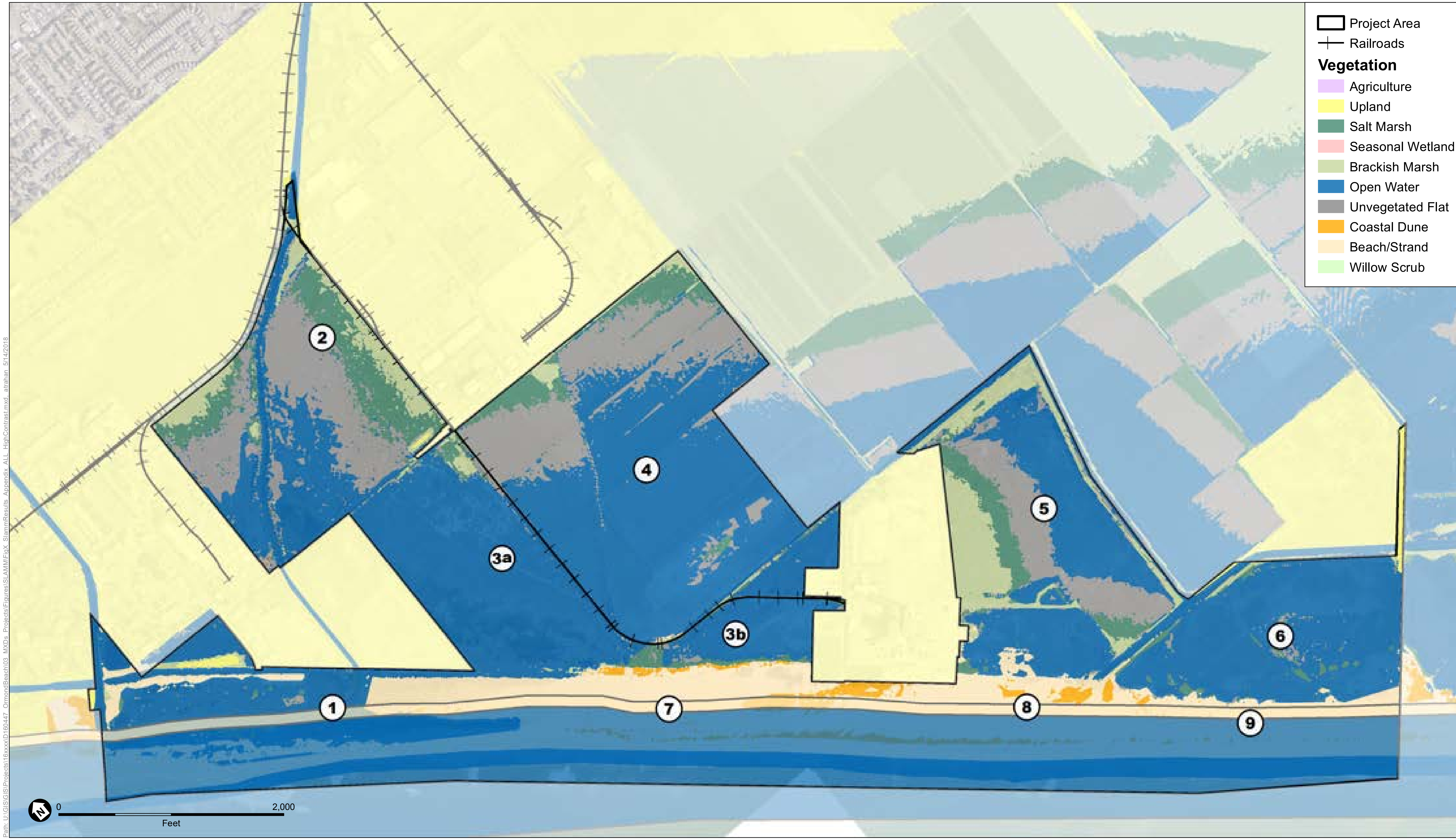


SOURCE: ESA (2017), CA Coastal Conservancy LiDAR (2011)

Ormond Beach Restoration and Public Access Project

Figure F-4
SLAMM Results wtih Beach Transgression
Existing Conditions, 2080 +3.4 ft SLR

ESA

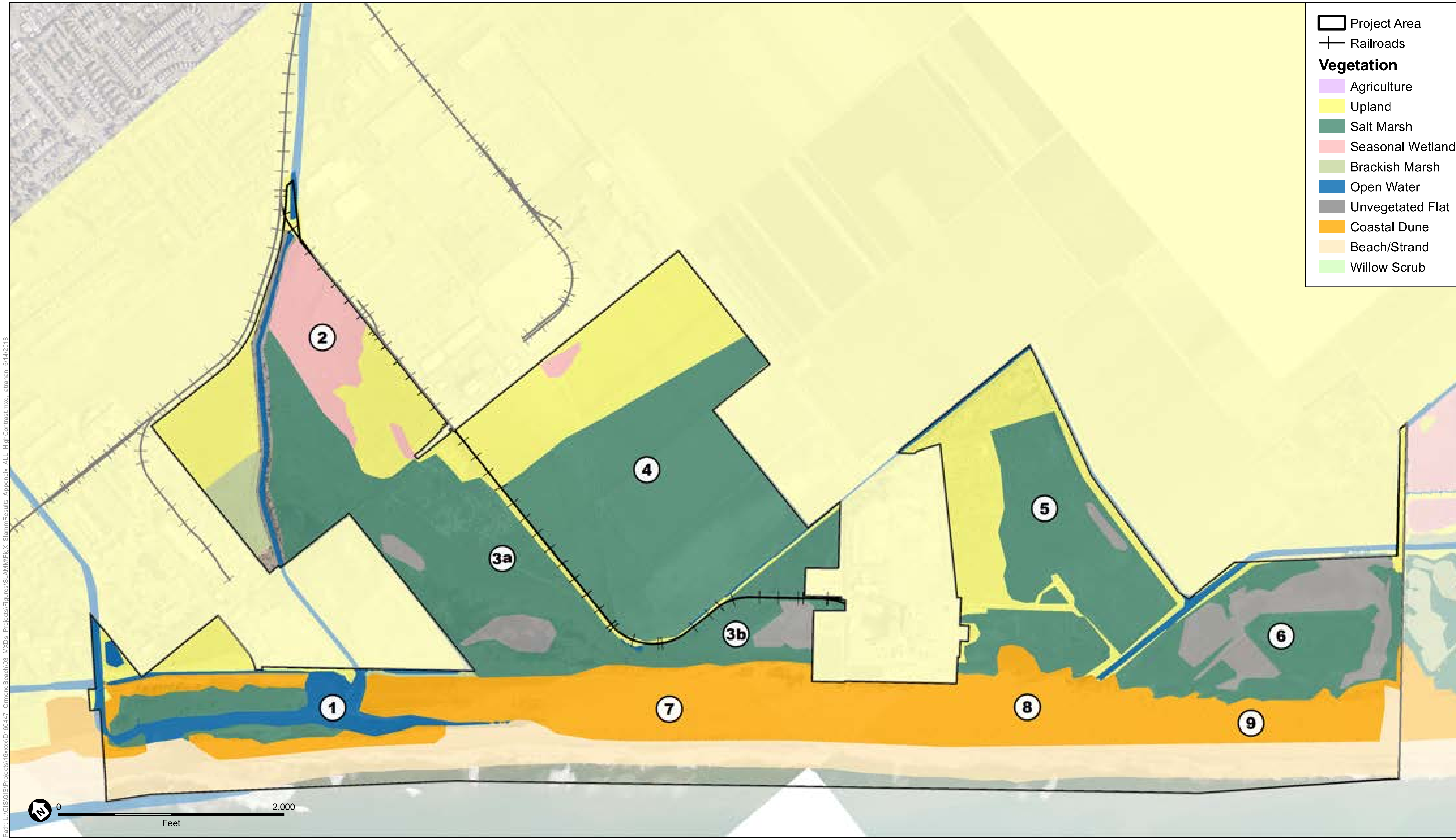


SOURCE: ESA (2017), CA Coastal Conservancy LiDAR (2011)

Ormond Beach Restoration and Public Access Project

Figure F-5
SLAMM Results wtih Beach Transgression
Existing Conditions, 2100 +4.8 ft SLR

ESA



SOURCE: ESA (2017), CA Coastal Conservancy LiDAR (2011)

Ormond Beach Restoration and Public Access Project

Figure F-6
SLAMM Results wtih Beach Transgression
Alternative 1, Current-Day

ESA

SOURCE: ESA (2017), CA Coastal Conservancy LiDAR (2011)

Ormond Beach Restoration and Public Access Project

Figure F-7
SLAMM Results wtih Beach Transgression
Alternative 1, 2060 +2.1 ft SLR

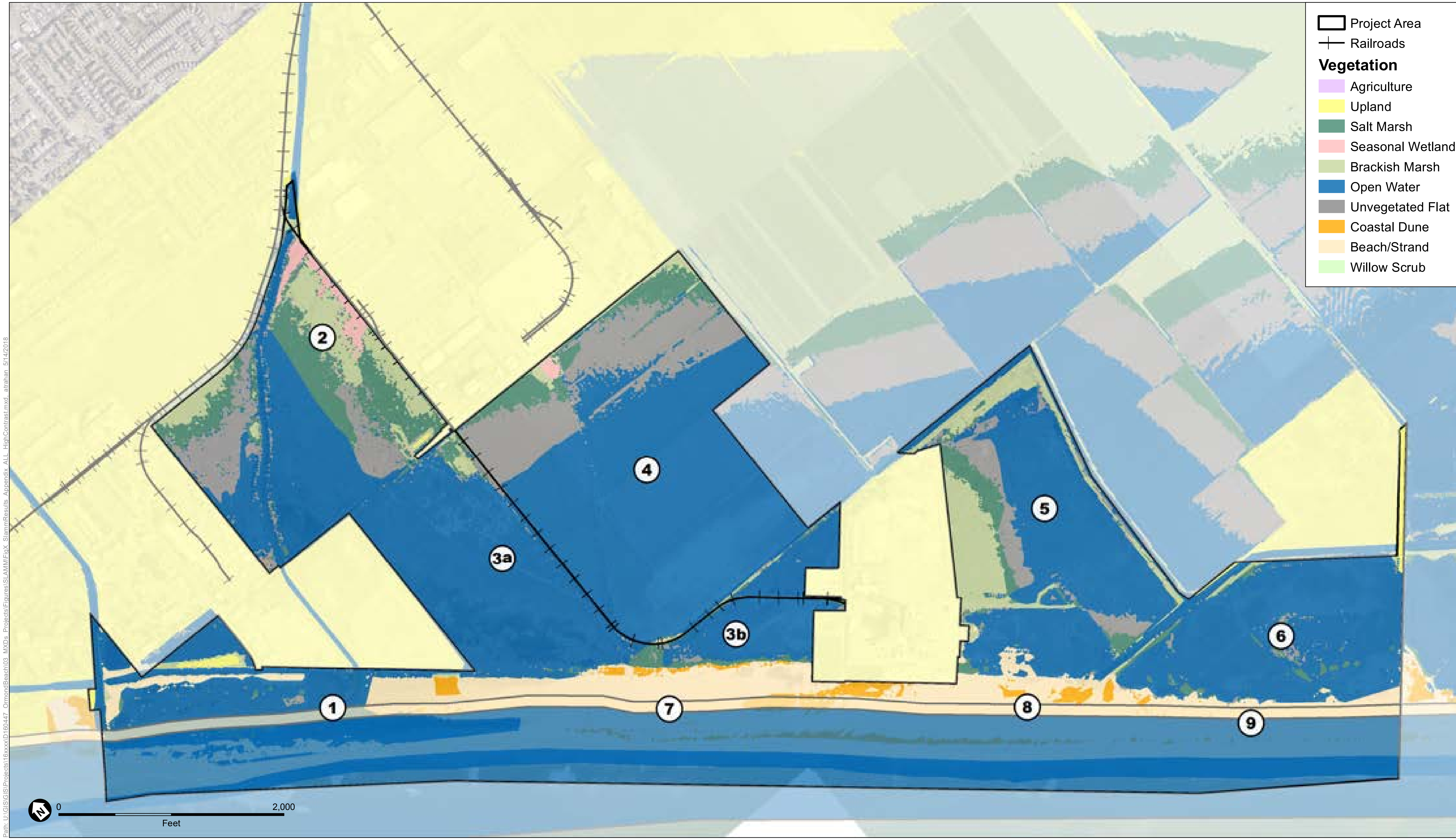
ESA

SOURCE: ESA (2017), CA Coastal Conservancy LiDAR (2011)

Ormond Beach Restoration and Public Access Project

Figure F-8
SLAMM Results wtih Beach Transgression
Alternative 1, 2080 +3.4 ft SLR

ESA



SOURCE: ESA (2017), CA Coastal Conservancy LiDAR (2011)

Ormond Beach Restoration and Public Access Project

Figure F-9
SLAMM Results wtih Beach Transgression
Alternative 1, 2100 +4.8 ft SLR

ESA

SOURCE: ESA (2017), CA Coastal Conservancy LiDAR (2011)

Ormond Beach Restoration and Public Access Project

Figure F-10
SLAMM Results wtih Beach Transgression
Alternative 2, Current-Day

ESA

SOURCE: ESA (2017), CA Coastal Conservancy LiDAR (2011)

Ormond Beach Restoration and Public Access Project

Figure F-11
SLAMM Results wtih Beach Transgression
Alternative 2, 2060 +2.1 ft SLR

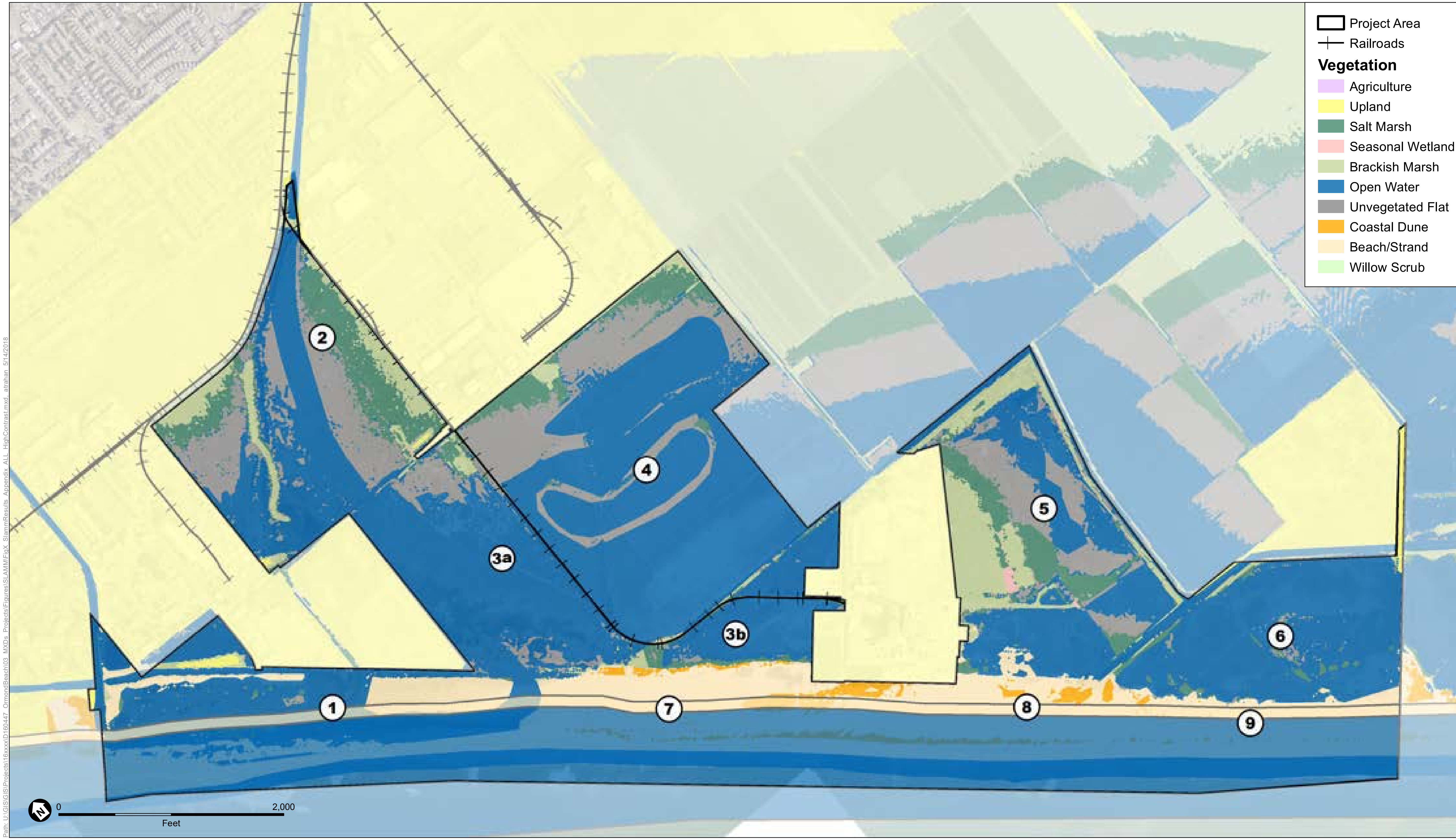
ESA

SOURCE: ESA (2017), CA Coastal Conservancy LiDAR (2011)

Ormond Beach Restoration and Public Access Project

Figure F-12
SLAMM Results wtih Beach Transgression
Alternative 2, 2080 +3.4 ft SLR

ESA



SOURCE: ESA (2017), CA Coastal Conservancy LiDAR (2011)

Ormond Beach Restoration and Public Access Project

Figure F-13
SLAMM Results wtih Beach Transgression
Alternative 2, 2100 +4.8 ft SLR

ESA

SOURCE: ESA (2017), CA Coastal Conservancy LiDAR (2011)

Ormond Beach Restoration and Public Access Project

Figure F-14
SLAMM Results wtih Beach Transgression
Alternative 3, Current-Day

ESA

SOURCE: ESA (2017), CA Coastal Conservancy LiDAR (2011)

Ormond Beach Restoration and Public Access Project

Figure F-15
SLAMM Results wtih Beach Transgression
Alternative 3, 2060 +2.1 ft SLR

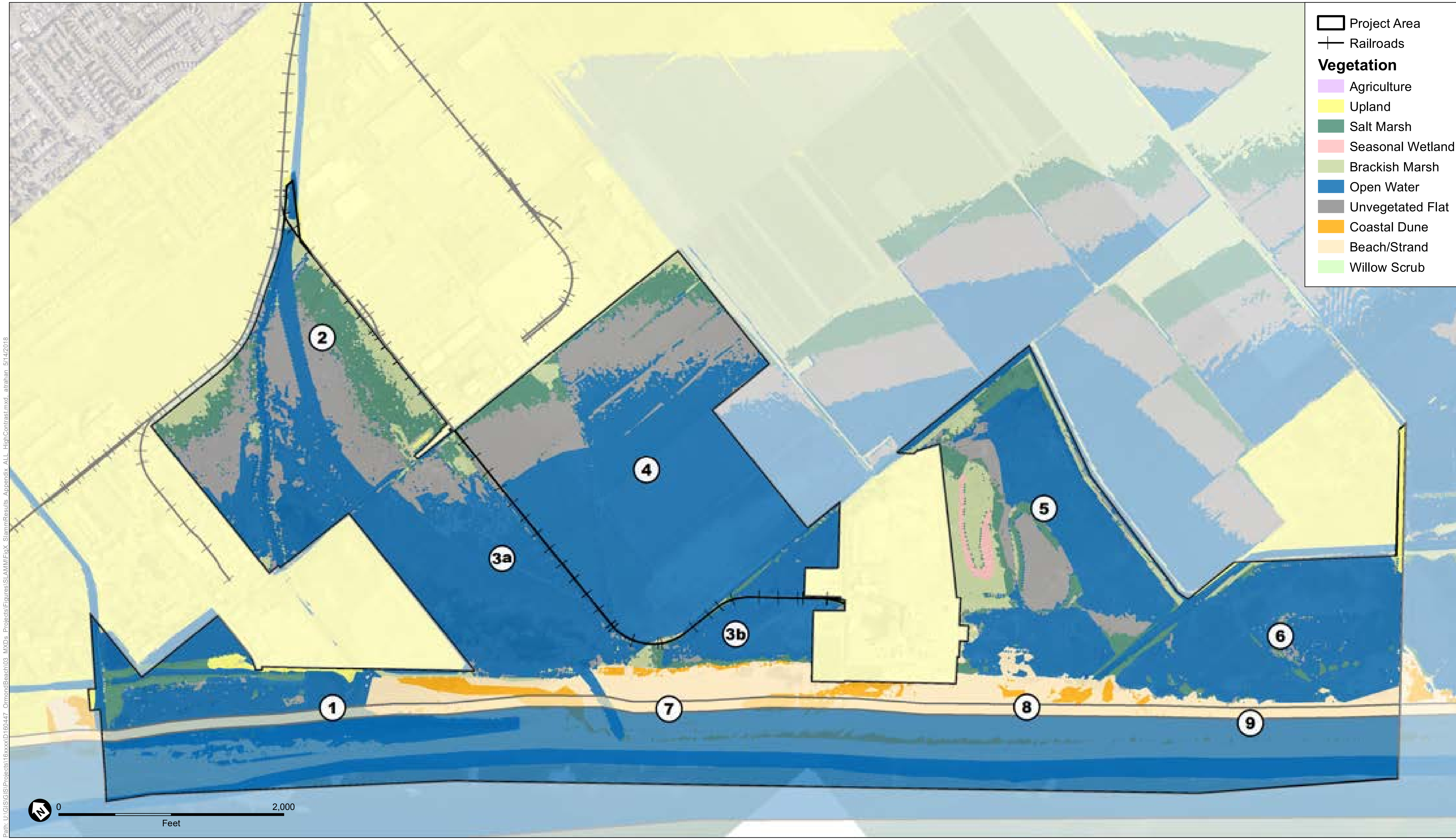
ESA

SOURCE: ESA (2017), CA Coastal Conservancy LiDAR (2011)

Ormond Beach Restoration and Public Access Project

Figure F-16
SLAMM Results wtih Beach Transgression
Alternative 3, 2080 +3.4 ft SLR

ESA



SOURCE: ESA (2017), CA Coastal Conservancy LiDAR (2011)

Ormond Beach Restoration and Public Access Project

Figure F-17
SLAMM Results wtih Beach Transgression
Alternative 3, 2100 +4.8 ft SLR

ESA

Appendix G
Preliminary Design Drawings

PRELIMINARY SUBMITTAL
NOT FOR CONSTRUCTION

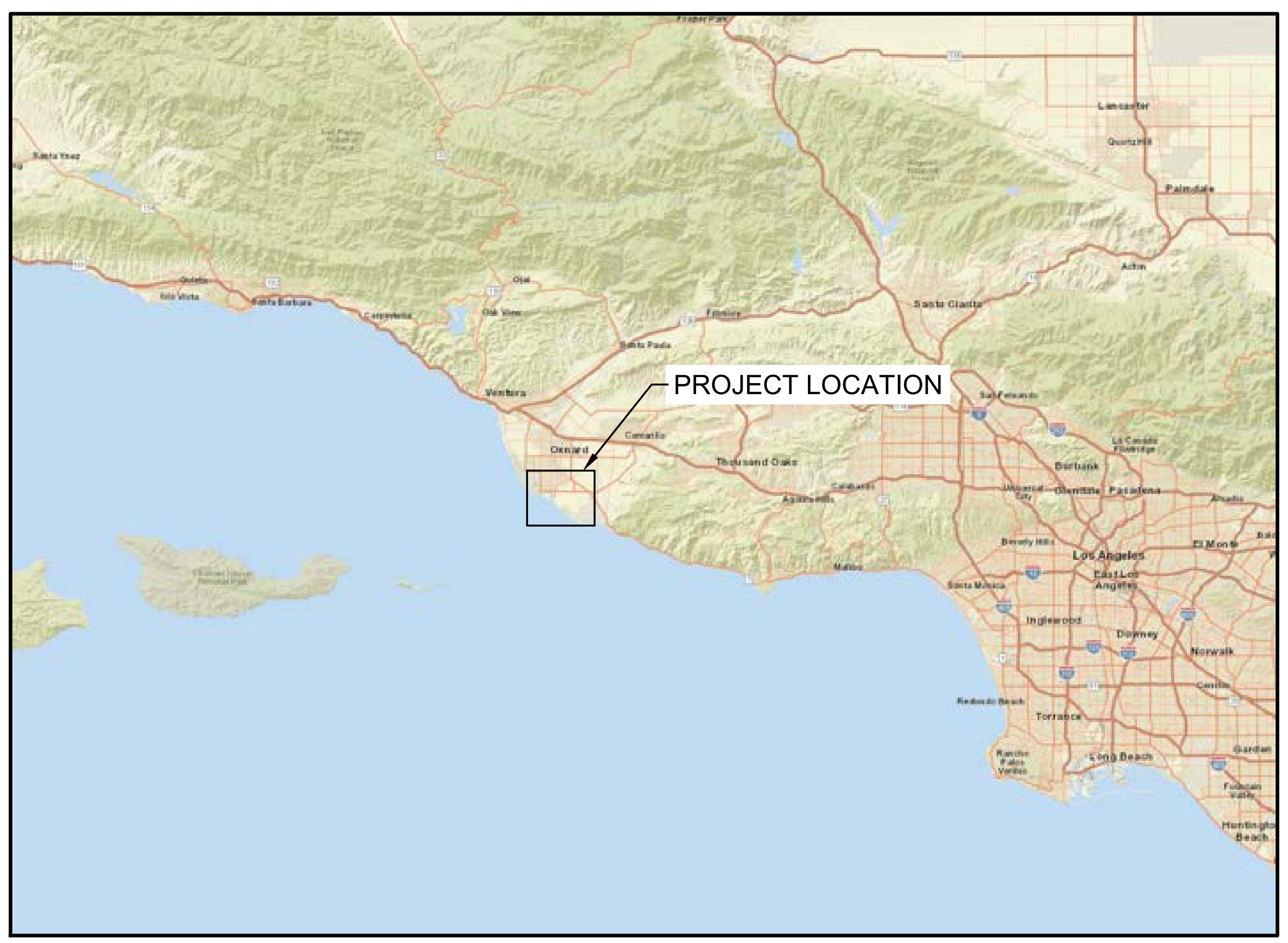
ORMOND BEACH RESTORATION AND PUBLIC ACCESS PROJECT

CALIFORNIA STATE COASTAL CONSERVANCY, THE NATURE CONSERVANCY AND CITY OF OXNARD

Coastal Conservancy

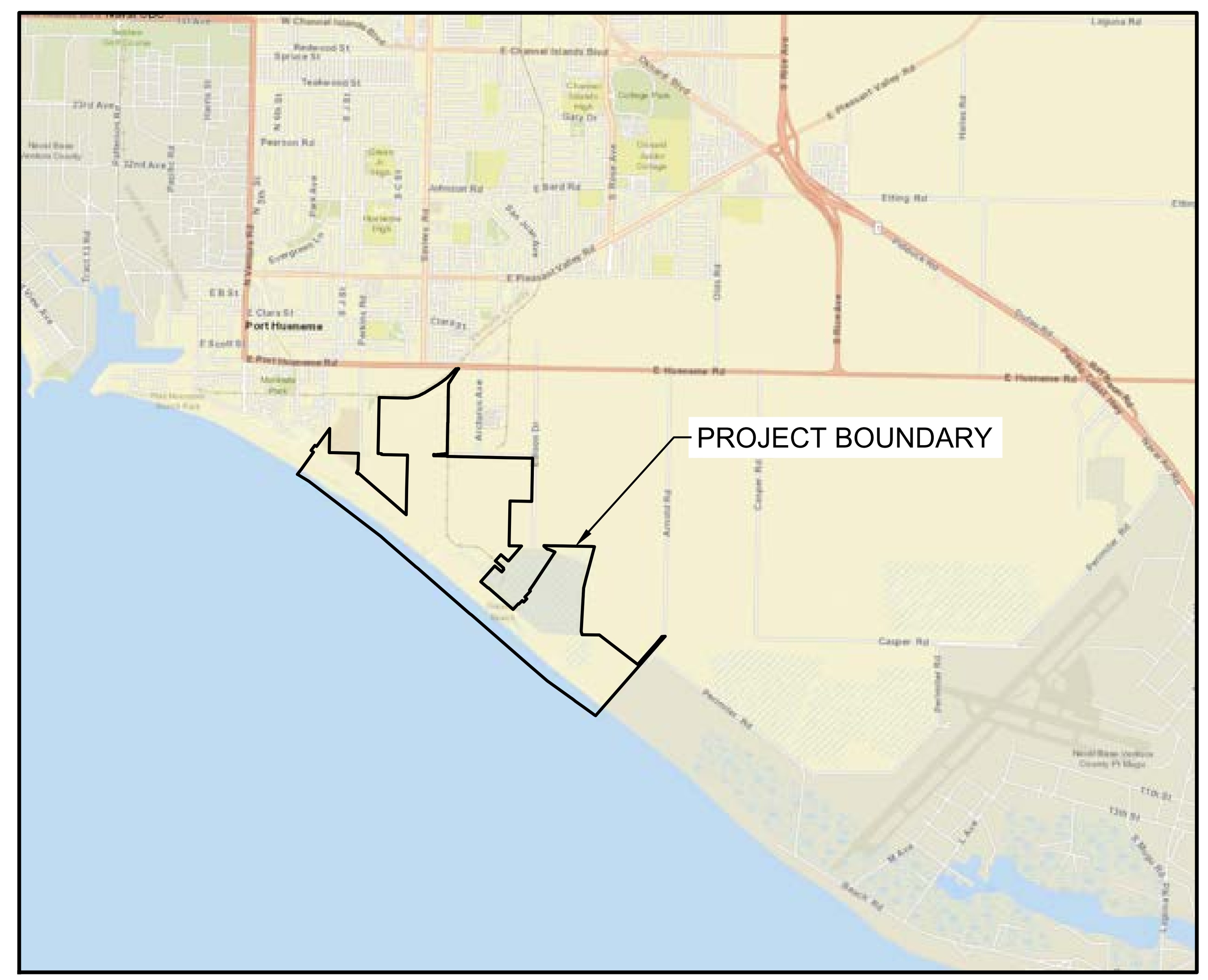
The Nature Conservancy
Protecting nature. Preserving life.

CITY OF OXNARD CALIFORNIA



VICINITY MAP

NOT TO SCALE



LOCATION MAP

NOT TO SCALE

SHEET LIST TABLE

Sheet Number	Sheet ID	Sheet Title
1	G-1	TITLE SHEET
2	G-2	NOTES, ABBREVIATIONS & LEGEND
3	G-3	EXISTING CONDITIONS
4	C-1	PROJECT OVERVIEW
5	C-2	GRADING PLAN - WESTERN
6	C-3	GRADING PLAN - CENTRAL
7	C-4	GRADING PLAN - EASTERN
8	C-5	GRADING SECTIONS
9	L-1	PLANTING & ACCESS PLAN - WESTERN
10	L-2	PLANTING & ACCESS PLAN - CENTRAL
11	L-3	PLANTING & ACCESS PLAN - EASTERN
12	L-4	PLANTING LISTS
13	L-5	TRAILS DETAILS

DATUMS

VERTICAL: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)
UNITS: FEET

HORIZONTAL: NORTH AMERICAN DATUM OF 1983
PROJECTION: CALIFORNIA STATE PLANE ZONE 5 FEET

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ESA
550 KEARNY STREET,
SUITE 800
SAN FRANCISCO, CA 94108
OFFICE - 415.896.5900
WWW.ESASSOC.COM

STAMP
PRELIMINARY
-
NOT FOR
CONSTRUCTION

CONSULTANT
TRUE NATURE
Coastal Restoration Consultants

PROJECT NAME:
ORMOND BEACH RESTORATION AND PUBLIC ACCESS PROJECT
OXNARD, CA

REVISIONS

#	DATE	DESCRIPTION

DESIGNED	RB, KT, EPK
DRAWN	JJ, AI, IS
CHECKED	AB, RB, EPK
IN CHARGE	ROBERT T. BATTALIO PE C41765
PROJECT NUMBER	D160447.00
ISSUE DATE	MM/DD/YY

SCALE IS AS SHOWN WHEN PLOTTED TO FULL SIZE (22"x34")

PHASE
PRELIM CONSTRUCTION DOCUMENTATION

SHEET TITLE
TITLE SHEET

SHEET NUMBER
G-1

SHEET 1 OF 13

PRELIMINARY SUBMITTAL
NOT FOR CONSTRUCTION

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ABBREVIATIONS

APPROX	APPROXIMATE
B	BEACH/STRAND
BM	BRACKISH MARSH
BI	BIOSWALE
D	COASTAL DUNES
DSW	DUNE SWALE WETLAND
EL	ELEVATION
EX	EXISTING
EG	EXISTING GRADE
FG	FINISHED GRADE
MHHW	MEAN HIGHER HIGH WATER
MLLW	MEAN LOWER LOW WATER
N	NEW
NAD83	NORTH AMERICAN DATUM OF 1983
NAVD88	NORTH AMERICAN VERTICAL DATUM OF 1988
NBVC	NAVAL BASE VENTURA COUNTY
OBRAP	ORMOND BEACH RESTORATION AND PUBLIC ACCESS PROJECT
ODD	OXNARD DRAINAGE DITCH
OLW	ORMOND LAGOON WATERWAY
PIP	PROTECT IN PLACE
SM	SALT MARSH
SP	SALT PANNE
SW	SEASONAL WETLAND
TYP	TYPICAL
U	UPLANDS
WSE	WATER SURFACE ELEVATION
WT	WETLAND-UPLAND TRANSITION

LEGEND

	EXISTING	PROPOSED
WORK LIMIT	N/A	
PROPERTY LIMIT		N/A
FENCE	X	X
RAILROAD TRACKS		N/A
MATCH LINE	N/A	
GRADE BREAK	N/A	
MAJOR CONTOUR	5	5
MINOR CONTOUR	4	4
TOP OF BANK	N/A	
TOE OF BANK	N/A	
FLOWLINE		
GROUND (SECTION/PROFILE)		
OVERHEAD POWER LINE	OH OH	N/A
POTABLE WATER LINE	W W	N/A
SANITARY SEWER LINE	SS SS	N/A
UNDERGROUND OIL LINE	U U	N/A
EXCAVATION (SECTION/PROFILE)	N/A	
FILL (SECTION/PROFILE)	N/A	
BRACKISH MARSH REVEGETATION	N/A	
BRACKISH MARSH ENHANCEMENT	N/A	
SALT MARSH REVEGETATION	N/A	
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COASTAL SAGE SCRUB REVEGETATION	N/A	
COASTAL SAGE SCRUB ENHANCEMENT	N/A	
COASTAL DUNE ENHANCEMENT	N/A	
SEASONAL WETLAND REVEGETATION	N/A	
WETLAND-UPLAND TRANSITION REVEGETATION	N/A	
WETLAND-UPLAND TRANSITION ENHANCEMENT	N/A	
BIOSWALE	N/A	
OPEN WATER	N/A	
NEW SALT PANNE	N/A	
EXISTING SALT PANNE	N/A	
NATIVE ORNAMENTAL	N/A	
BEACH/STRAND	N/A	
PRIMARY TRAIL	N/A	
SECONDARY TRAIL	N/A	
TERTIARY TRAIL	N/A	
BEACH TRAIL	N/A	
BOARDWALK	N/A	
BRIDGE	N/A	
BIRD FENCE - EXISTING	N/A	
BIRD FENCE - PROPOSED	N/A	
ACCESS NODE	N/A	A
OVERLOOK PLATFORM	N/A	
CONSTRUCTION FENCE	N/A	
STAGING AREA	N/A	

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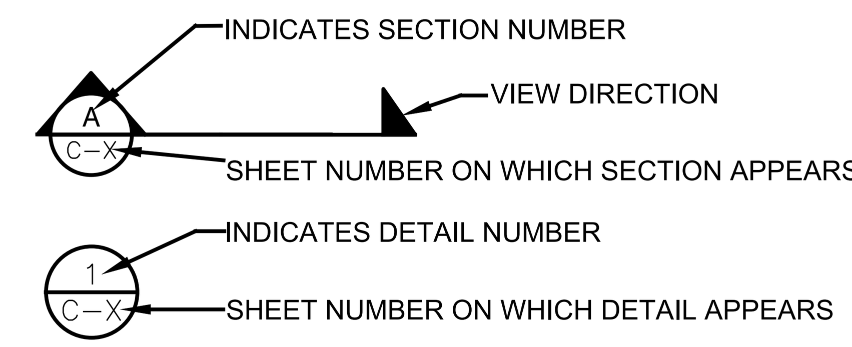


TITLE DATUM

OCEANIC TIDAL DATUMS AT SANTA MONICA AND SANTA BARBARA

TIDAL DATUM	SANTA MONICA, CA (NOAA #9410840) FT NAVD88	SANTA BARBARA (NOAA #9411340) FT NAVD88
MAXIMUM OBSERVED	8.31[1]	7.54[2]
MEAN HIGHER HIGH WATER (MHHW)	5.24	5.31
MEAN HIGH WATER (MHW)	4.50	4.55
MEAN TIDE LEVEL (MTL)	2.62	2.72
MEAN SEA LEVEL (MSL)	2.59	2.70
MEAN LOW WATER (MLW)	0.73	0.89
MEAN LOWER LOW WATER (MLLW)	-0.20	-0.09

1. OBSERVED 11/30/1982 7:54
2. OBSERVED 12/13/2012 16:36

GENERAL NOTES

1. TOPOGRAPHIC CONTOURS BASED ON CA COASTAL CONSERVANCY LIDAR (2011) AUGMENTED BY LAND SURVEY BY ESA (2017).
2. PROPERTY LINE LOCATIONS ARE APPROXIMATE, EASEMENTS NOT SHOWN.
3. UTILITY LOCATIONS ARE APPROXIMATE AND ALL UTILITIES ARE NOT SHOWN.
4. TIDAL DATUMS FOR NOAA 1983–2001 EPOCH

ESA
550 KEARNY STREET,
SUITE 800
SAN FRANCISCO, CA 94108
OFFICE - 415.896.5900
WWW.ESASSOC.COM

STAMP

PRELIMINARY
-
NOT FOR CONSTRUCTION

CONSULTANT

TRUE NATURE

Coastal Restoration Consultants

PROJECT NAME:

ORMOND BEACH RESTORATION AND PUBLIC ACCESS PROJECT

OXNARD, CA

REVISIONS

#	DATE	DESCRIPTION

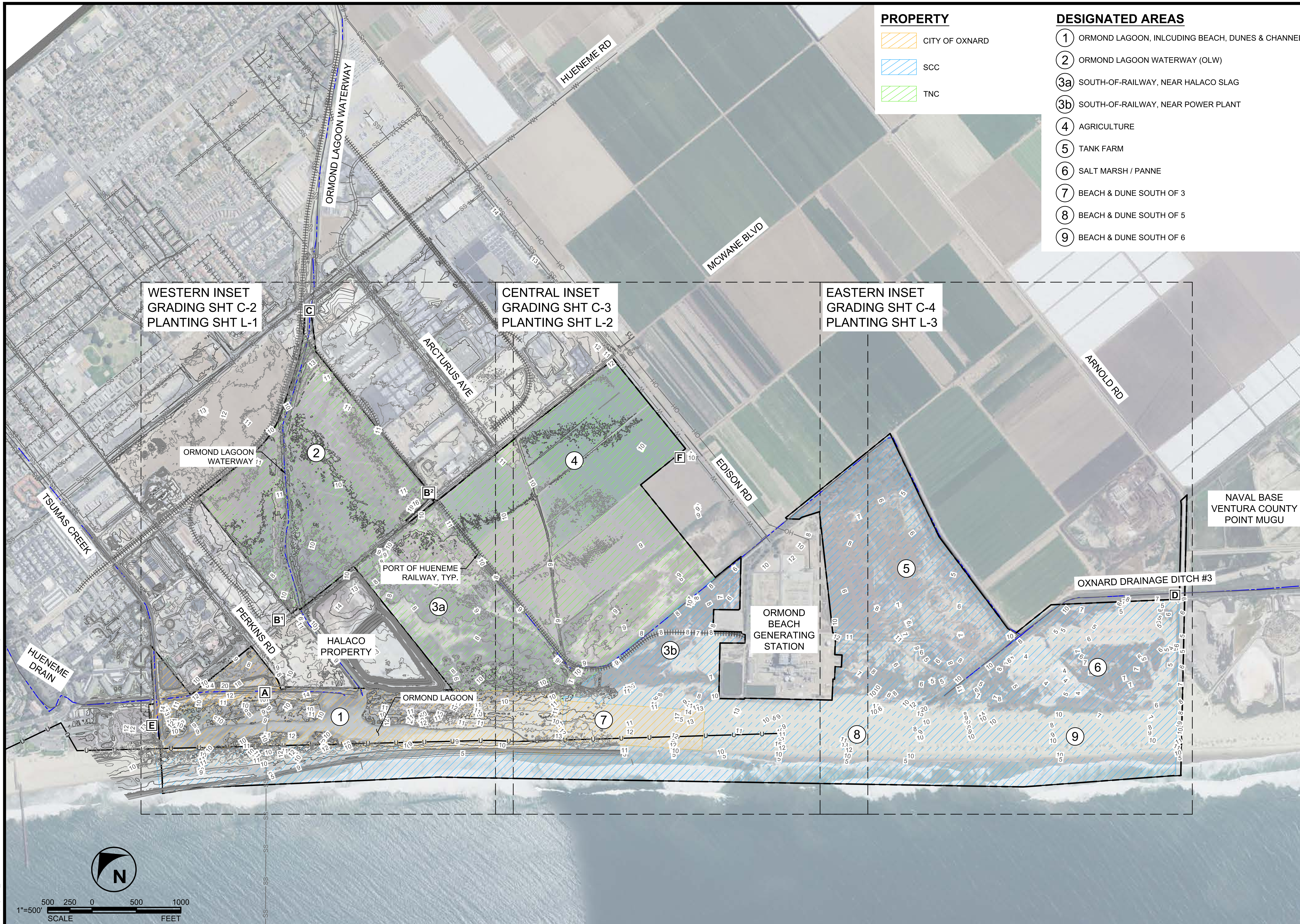
DESIGNED	RB, KT, EPK
DRAWN	JJ, AI, IS
CHECKED	AB, RB, EPK
IN CHARGE	ROBERT T. BATTALIO PE C41765
PROJECT NUMBER	D160447.00
ISSUE DATE	MM/DD/YY

SCALE IS AS SHOWN WHEN PLOTTED TO FULL SIZE (22"x34")
|— 1" —|

PHASE
PRELIM CONSTRUCTION DOCUMENTATION

SHEET TITLE
NOTES, ABBREVIATIONS & LEGEND

SHEET NUMBER
G-2



PROPERTY

- CITY OF OXNARD
- SCC
- TNC

DESIGNATED AREAS

1. ORMOND LAGOON, INLCUDING BEACH, DUNES & CHANNEL
2. ORMOND LAGOON WATERWAY (OLW)
3a. SOUTH-OF-RAILWAY, NEAR HALACO SLAG
3b. SOUTH-OF-RAILWAY, NEAR POWER PLANT
4. AGRICULTURE
5. TANK FARM
6. SALT MARSH / PANNE
7. BEACH & DUNE SOUTH OF 3
8. BEACH & DUNE SOUTH OF 5
9. BEACH & DUNE SOUTH OF 6

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CONSULTANT
TRUE NATURE
Coastal Restoration Consultants

PROJECT NAME:
ORMOND BEACH RESTORATION AND PUBLIC ACCESS PROJECT
OXNARD, CA

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PHASE
PRELIM CONSTRUCTION DOCUMENTATION

SHEET TITLE
EXISTING CONDITIONS

SHEET NUMBER
G-3

SHEET 3 OF 13

FILE: K:\projects_2016\D160447.00 - Ormond Beach Wetlands Restoration\10 CAD\Dwgs\OVERVIEW.dwg PLOT DATE: 8/19/2020 3:41:02 PM PLOTTED BY: AMBER INGGS

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PHASE
PRELIM CONSTRUCTION DOCUMENTATION

SHEET TITLE

PROJECT OVERVIEW

SHEET NUMBER

C-1

SHEET 4 OF 13

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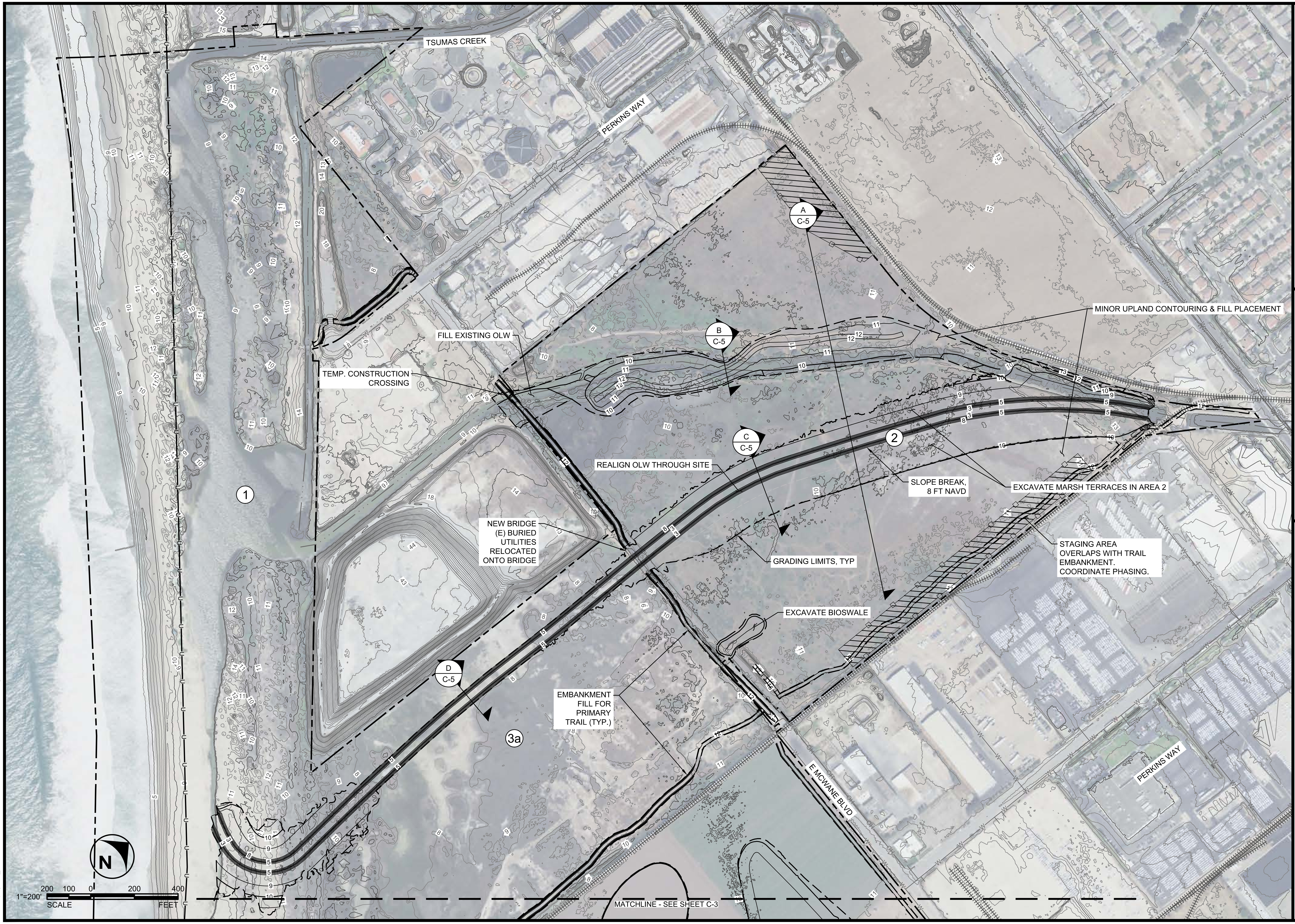

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1"

PHASE

PRELIM CONSTRUCTION DOCUMENTATION

SHEET TITLE

GRADING PLAN - WESTERN

SHEET NUMBER

C-2

SHEET 5 OF 13

PRELIMINARY SUBMITTAL
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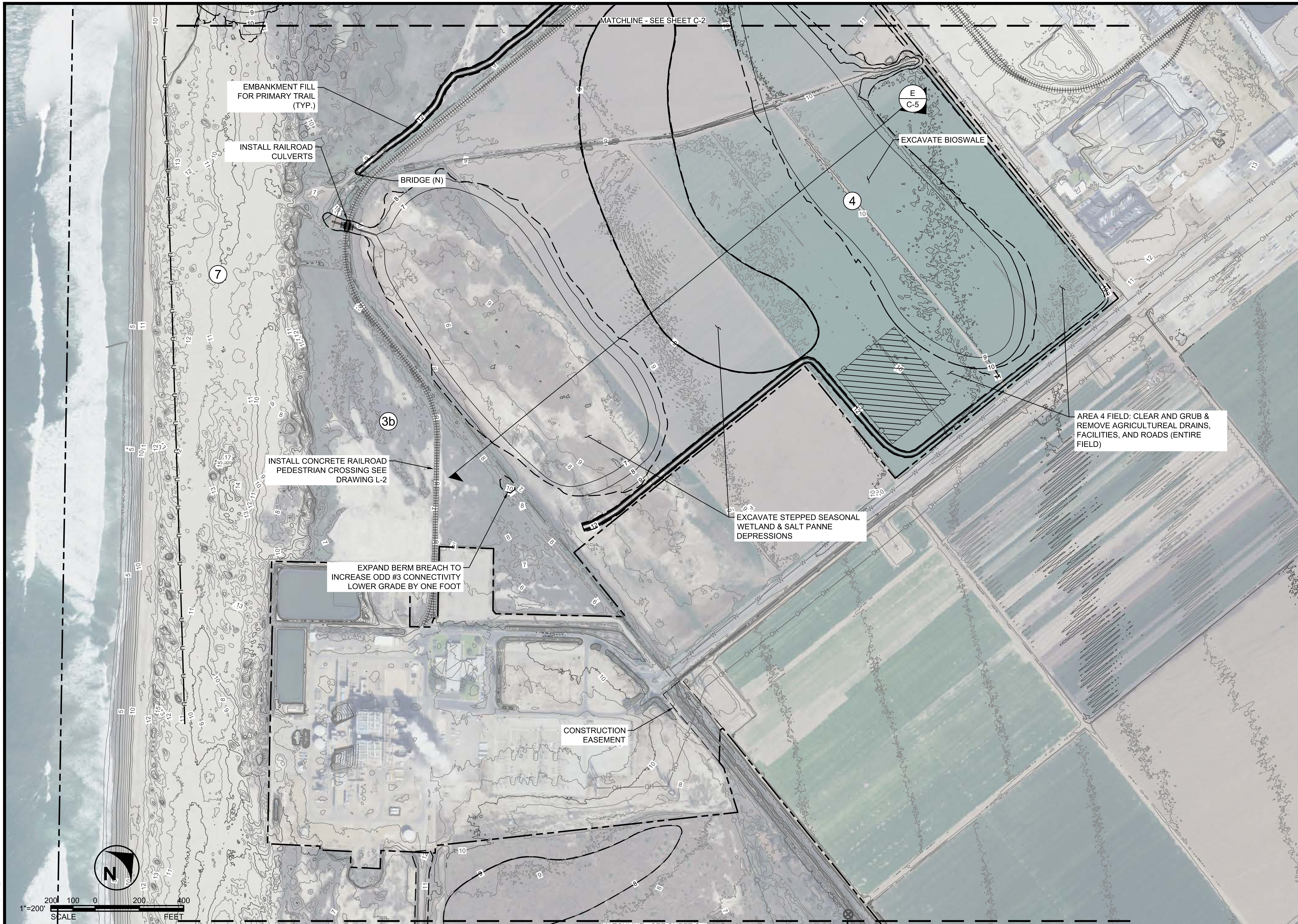

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PHASE

PRELIM CONSTRUCTION DOCUMENTATION

SHEET TITLE

GRADING PLAN - CENTRAL

SHEET NUMBER

C-3

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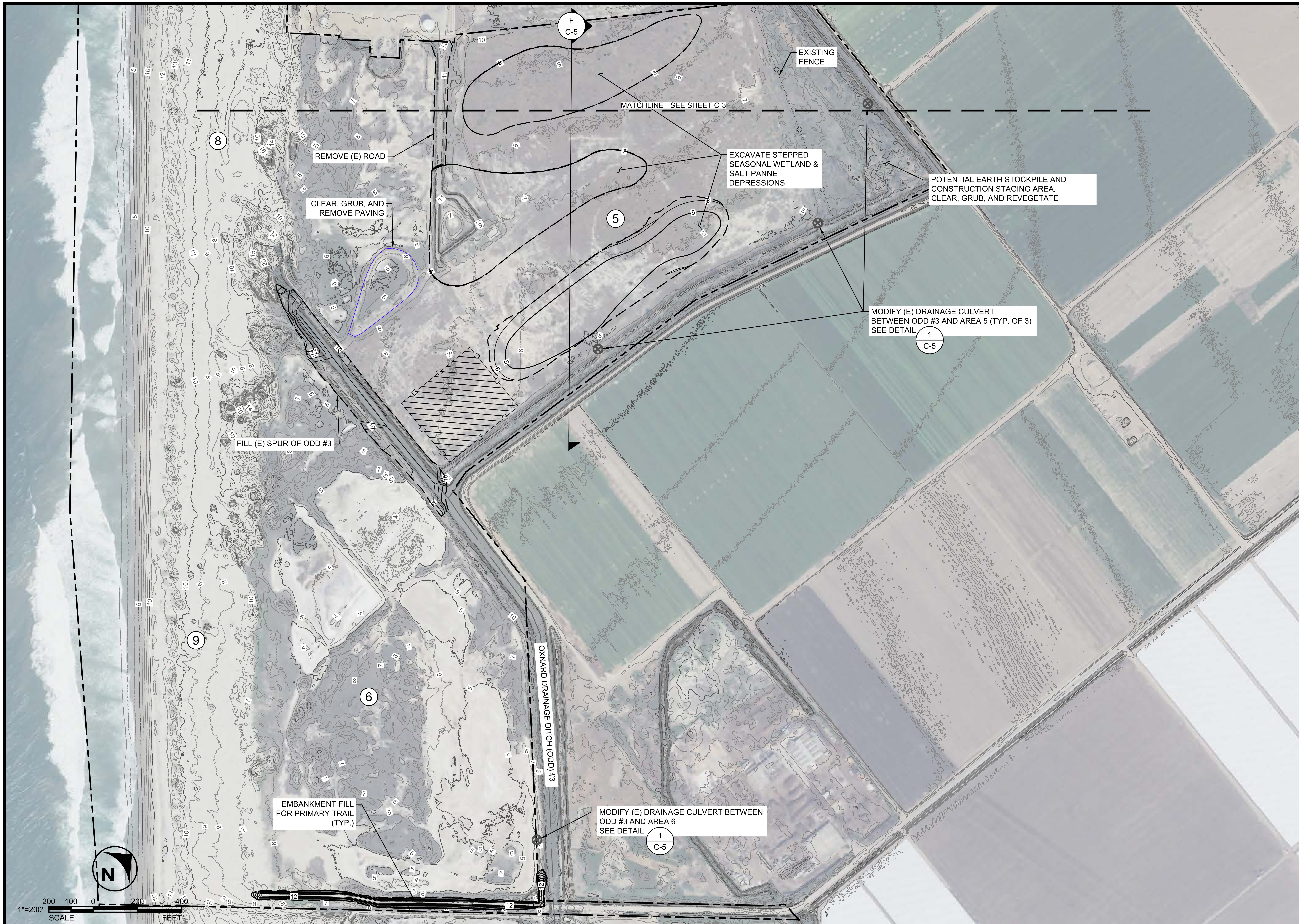

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PHASE
PRELIM CONSTRUCTION DOCUMENTATION

SHEET TITLE

GRADING PLAN - EASTERN

SHEET NUMBER

C-4

SHEET 7 OF 13

FILE: K:\projects_2016\D160447.00 - Ormond Beach Wetlands Restoration\10 CAD\Dwgs\GRADING.dwg PLOT DATE: 3/23/2021 2:12:45 PM PLOTTED BY: AMBER INGGS

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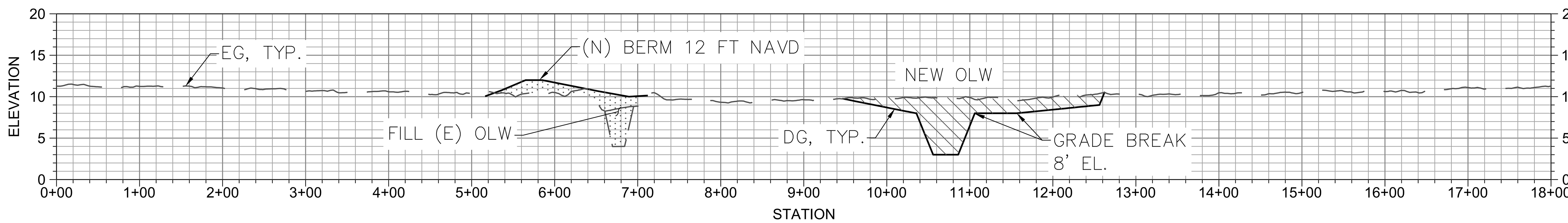
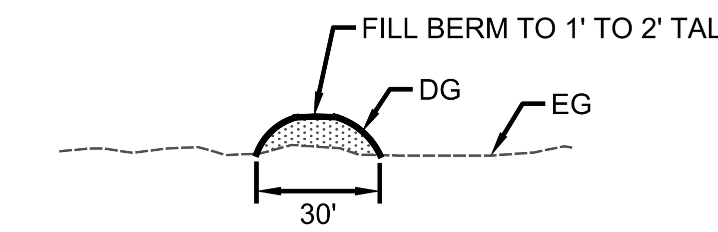
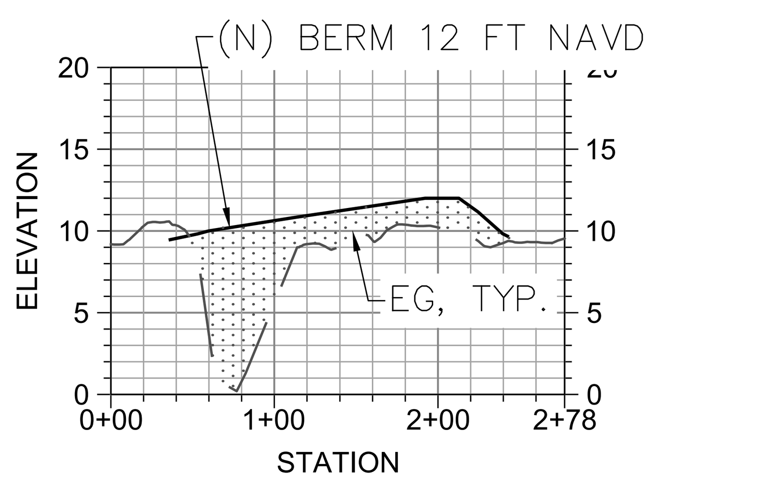


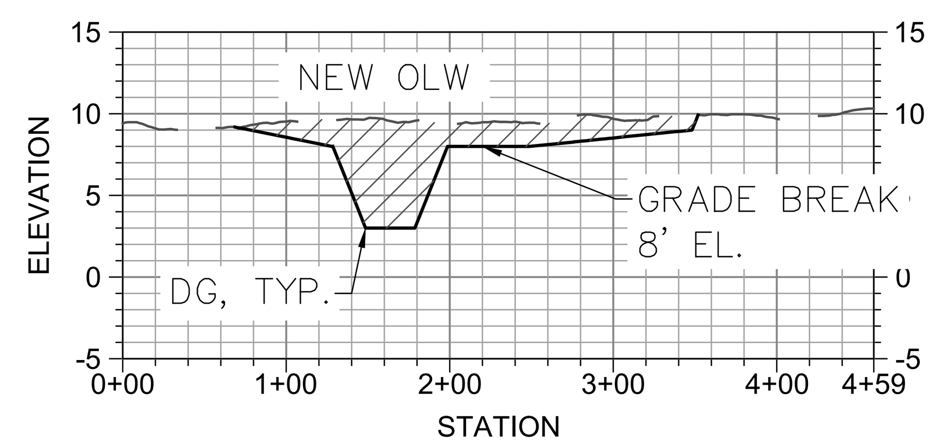
A / C-2 **AREA 2 - OLW REALIGNMENT**
SECTION
SCALE:
H: 1" = 100'
V: 1" = 10'



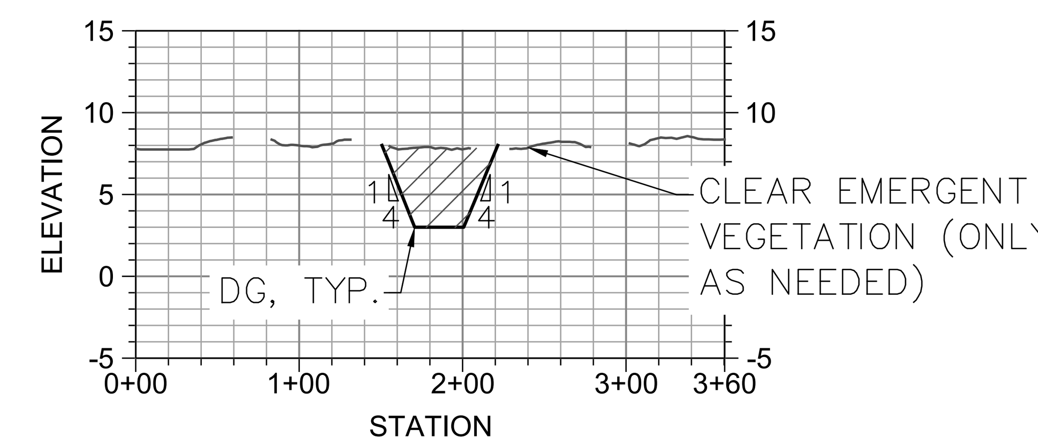
G / - **DRAINAGE CONTROL BERM**
TYPICAL SECTION
SCALE:
H: 1" = 40'
V: 1" = 8'



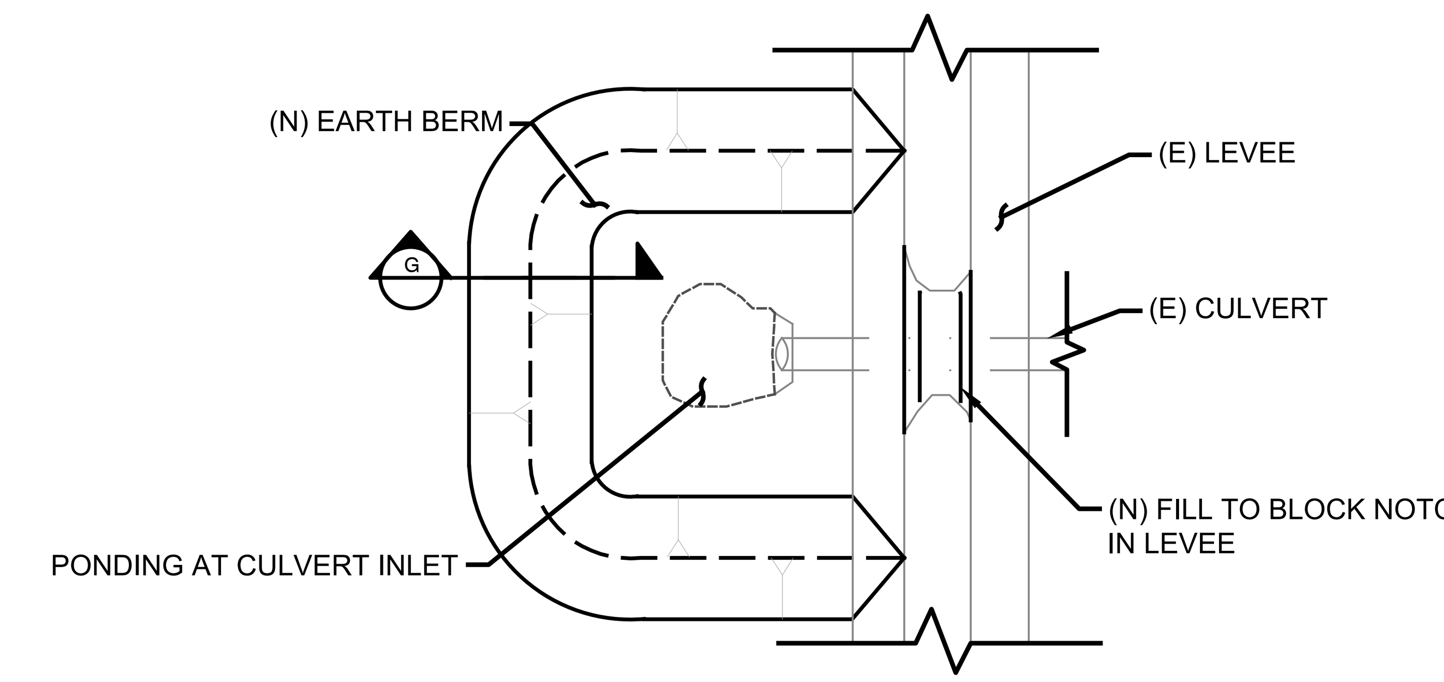
B / C-2 **AREA 2 - OLW WATERWAY FILL**
SECTION
SCALE:
H: 1" = 100'
v: 1" = 10'



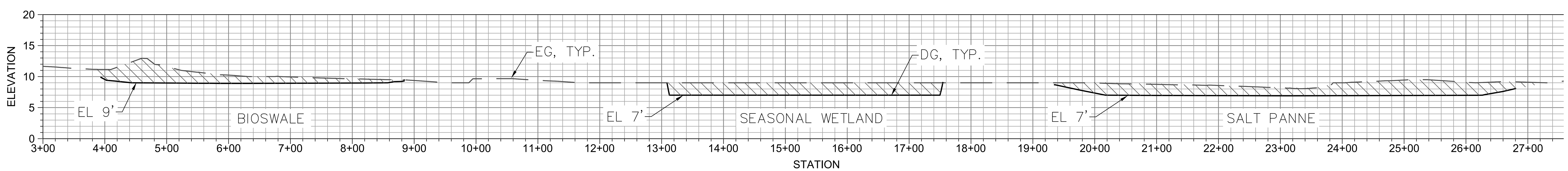
C / C-2 **AREA 2 - NEW OLW**
SECTION
SCALE:
H: 1" = 100'
v: 1" = 10'



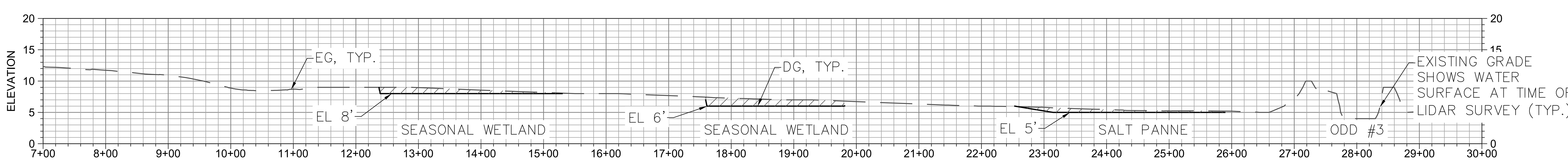
D / C-2 **AREA 3A - (N) OLW CHANNEL**
TYPICAL SECTION
SCALE:
H: 1" = 100'
V: 1" = 10'



1 / C-4 **MODIFICATIONS AT ODD #3**
PLAN
SCALE: 1" = 40'



E / C-3 **AREA 4 - DEPRESSIONS**
SECTION
SCALE:
H: 1" = 100'
V: 1" = 10'



F / C-4 **AREA 5 - DEPRESSIONS**
SECTION
SCALE:
H: 1" = 100'
v: 1" = 10'

FILE: K:\projects_2016\D160447.00 - Ormond Beach Wetlands Restoration\10 CAD\Dwgs\GRADING SECN DETL.dwg PLOT DATE: 8/14/2020 6:28:29 PM PLOTTED BY: AMBER INGGS

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|— 1" —|

PHASE
PRELIM CONSTRUCTION DOCUMENTATION

SHEET TITLE
GRADING SECTIONS

SHEET NUMBER
C-5

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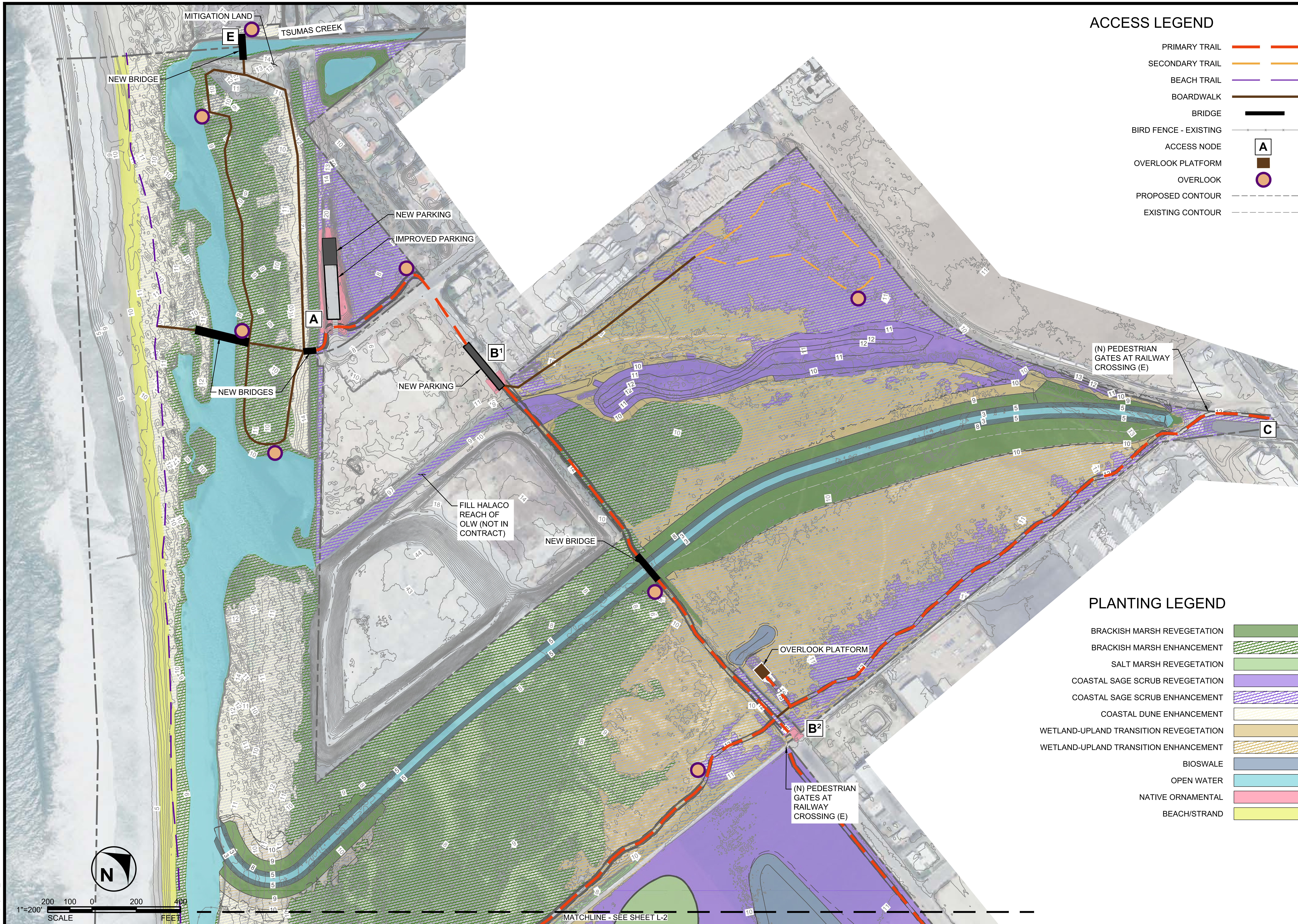

FILE: K:\projects_2016\D160447.00 - Ormond Beach Wetlands Restoration\10 CAD\Dwgs\PLANTING AND ACCESS.dwg PLOT DATE: 3/23/2021 11:15:35 AM PLOTTED BY: AMBER INGGS

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PHASE
PRELIM CONSTRUCTION DOCUMENTATION

SHEET TITLE
PLANTING & ACCESS PLAN - WESTERN

SHEET NUMBER
L-1

PRELIMINARY SUBMITTAL
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ACCESS LEGEND

- PRIMARY TRAIL
- BEACH TRAIL
- BOARDWALK
- BRIDGE
- BIRD FENCE - EXISTING
- BIRD FENCE - PROPOSED
- ACCESS NODE (A)
- OVERLOOK PLATFORM
- OVERLOOK
- PROPOSED CONTOUR
- EXISTING CONTOUR

PLANTING LEGEND

- BRACKISH MARSH REVEGETATION
- BRACKISH MARSH ENHANCEMENT
- SALT MARSH REVEGETATION
- SALT MARSH ENHANCEMENT
- COASTAL SAGE SCRUB REVEGETATION
- COASTAL SAGE SCRUB ENHANCEMENT
- COASTAL DUNE ENHANCEMENT
- SEASONAL WETLAND REVEGETATION
- WETLAND-UPLAND TRANSITION REVEGETATION
- WETLAND-UPLAND TRANSITION ENHANCEMENT
- BIOSWALE
- OPEN WATER
- CONSTRUCTED SALT PANNE
- SALT PANNE ENHANCEMENT
- NATIVE ORNAMENTAL
- BEACH/STRAND

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PHASE
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SHEET TITLE
PLANTING & ACCESS PLAN - CENTRAL

SHEET NUMBER
L-2

SHEET 10 OF 13

FILE: K:\projects_2016\D160447.00 - Ormond Beach Wetlands Restoration\10 CAD\Dwgs\PLANTING AND ACCESS.dwg PLOT DATE: 3/23/2021 11:25:53 AM PLOTTED BY: AMBER INGGS

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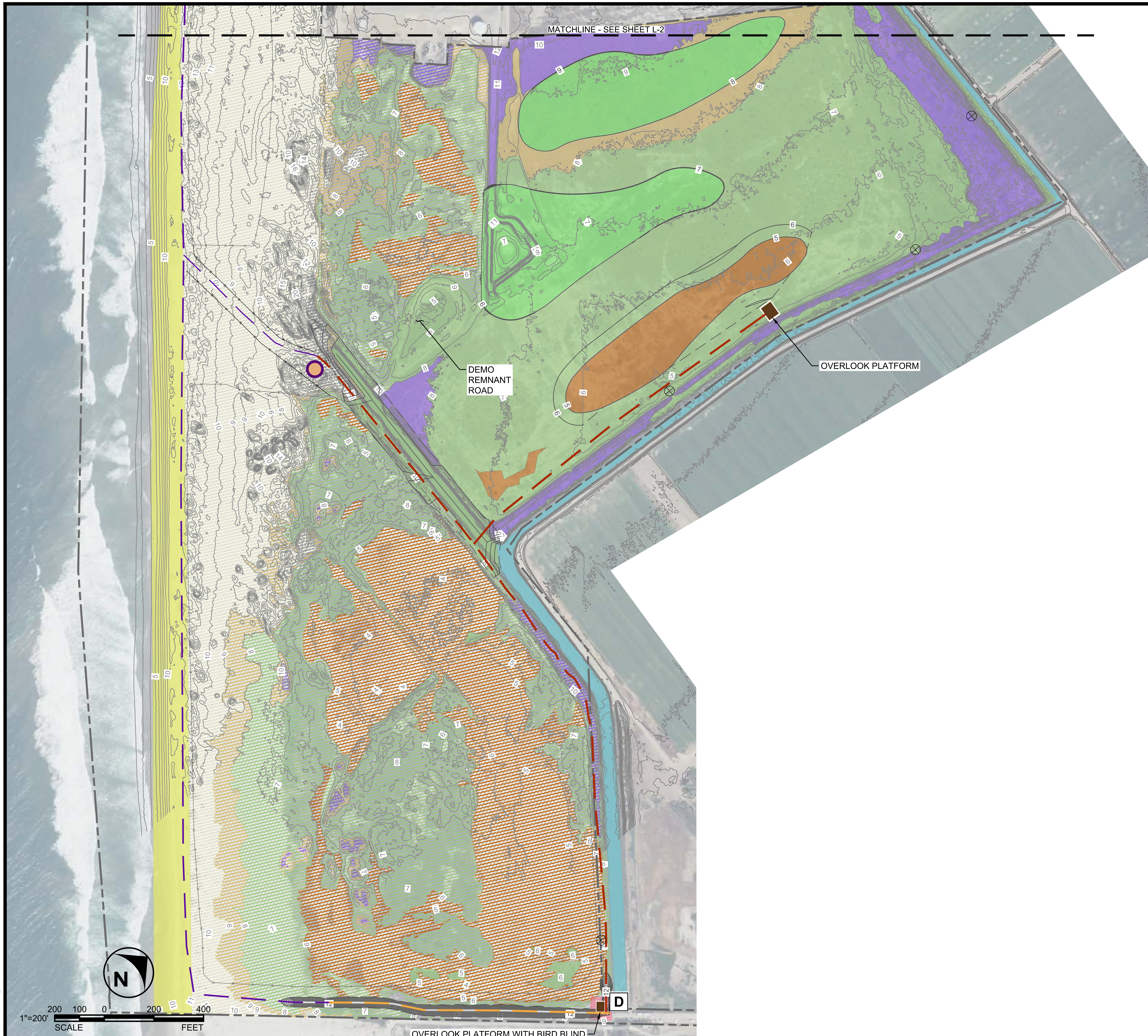

ACCESS LEGEND

- SECONDARY TRAIL
- TERTIARY TRAIL
- BEACH TRAIL
- BIRD FENCE - EXISTING
- BIRD FENCE - PROPOSED
- ACCESS NODE (A)
- OVERLOOK PLATFORM
- OVERLOOK
- PROPOSED CONTOUR
- EXISTING CONTOUR

PLANTING LEGEND

- SALT MARSH REVEGETATION
- SALT MARSH ENHANCEMENT
- COASTAL SAGE SCRUB REVEGETATION
- COASTAL SAGE SCRUB ENHANCEMENT
- COASTAL DUNE ENHANCEMENT
- SEASONAL WETLAND REVEGETATION
- WETLAND-UPLAND TRANSITION REVEGETATION
- WETLAND-UPLAND TRANSITION ENHANCEMENT
- OPEN WATER
- CONSTRUCTED SALT PANNE
- SALT PANNE ENHANCEMENT
- NATIVE ORNAMENTAL
- BEACH/STRAND

FILE: K:\projects_2016\D160447.00 - Ormond Beach Wetlands Restoration\10 CAD\Dwgs\PLANTING AND ACCESS.dwg PLOT DATE: 3/23/2021 11:34:34 AM PLOTTED BY: AMBER INGGS

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PHASE
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SHEET TITLE

PLANTING & ACCESS PLAN - EASTERN

SHEET NUMBER
L-3

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Salt Marsh

Species	Common Name
Arthrocnemum subterminale	Parish's glasswort
Cressa truxillensis	Alkali weed
Distichlis spicata	Salt grass
Extriplex californica	California saltbush
Frankenia salina	Alkali heath
Jaumea carnosa	Fleshy jaumea
Juncus acutus	Spiny rush
Lasthenia glabrata ssp. coulteri	Salt marsh goldfields
Limonium californicum	Sea lavender
Malvella leprosa	Alkali mallow
Distichlis littoralis	Shore grass
Salicornia pacifica	Pickleweed
Suaeda taxifolia	Wooly seablite
Triglochin concinna	Arrow weed

Brackish Marsh

Species	Common Name
Fresh/Brackish Marsh	
Anemopsis californicus	Yerba mansa
Bolboschoenus robustus	Robust bulrush
Elymus triticoides	Alkali rye grass
Equisetum hymale	Scouring rush
Euthamia occidentalis	Western goldenrod
Juncus balticus	Baltic rush
Juncus textilis	Basket rush
Schoenoplectus californicus	Tule
Typha domingensis	Southern cattail
Typha latifolia	Broadleaf cattail
Brackish/Salt Marsh	
Baccharis glutinosa	Salt marsh baccharis
Bolboschoenus maritimus	Saltmarsh bulrush
Distichlis spicata	Salt grass
Frankenia salina	Alkali heath
Jaumea carnosa	Fleshy jaumea
Juncus acutus	Spiny rush
Salicornia pacifica	Pickleweed
Schoenoplectus californicus	Tule

Coastal Dune

Species	Common Name
Foredunes	
Abronia maritima	Red sand verbena
Ambrosia chamissonis	Beach bur
Atriplex leucophylla	Beach saltbush
Back dunes	
Abronia maritima	Red sand verbena
Abronia umbellata	Pink sand verbena
Acmispon glaber	Deerweed
Ambrosia chamissonis	Beach bur
Calystegia soldanella	Beach morning glory
Camissoniopsis cheiranthifolia	Beach evening primrose
Ericameria ericoides	Mock heather
Lupinus arboreus	Bush lupine

Wetland - Upland Transition

Species	Common Name
Arthrocnemum subterminale	Parish's glasswort
Atriplex lentiformis	quail bush
Cressa truxillensis	alkali weed
Distichlis litoralis	shoregrasas
Distichlis spicata	salt grass
Isocoma menziesii	Coast goldenbush

Bioswale

Species	Common Name
Anemopsis californicus	Yerba mansa
Carex praegracilis	field sedgeedge
Distichlis spicata	Salt grass
Elymus triticoides	creeping wild rye
Hordeum brachyantherum ssp. brachyantherum	California barley
Schoenoplectus californicus	Tule
Typha domingensis	Southern cattail
Typha latifolia	Broadleaf cattail

Native Ornamental

Species	Common Name
Artemisia californica	California sagebrush
Baccharis pilularis	Coyote brush
Dudleya caespitosa	Coast dudleya
Dudleya lanceolata	Southern California dudleya
Dudleya pulverulenta	Chalk dudleya
Encelia californica	California encelia
Eriogonum fasciculatum	California buckwheat
Eriogonum cinereum	Asheyleaf buckwheat
Eschscholzia californica	California poppy
Isocoma menziesii	Coast goldenbush
Lupinus succulentus	Arroyo lupine
Mimulus aurantiacus	Sticky monkey flower
Salvia apiana	White sage
Salvia leucophylla	Purple sage
Salvia mellifera	Black sage

Seasonal Wetland

Species	Common Name
Arthrocnemum subterminale	Parish's Glasswort
Cressa truxillensis	Alkali weed
Distichlis spicata	Salt grass
Frankenia salina	Alkali heath
Lasthenia glabrata ssp. coulteri	Salt marsh goldfields
Malvella leprosa	Alkali mallow
Salicornia pacifica	Pickleweed
Suaeda taxifolia	Wooly seablite

Coastal Sage Scrub

Species	Common Name
Artemisia californica	California sagebrush
Atriplex lentiformis	Big saltbush
Baccharis pilularis	Coyote brush
Encelia californica	California encelia
Eriogonum fasciculatum	California buckwheat
Eschscholzia californica	California poppy
Isocoma menziesii	Coast goldenbush
Lupinus succulentus	Arroyo lupine
Mimulus aurantiacus	Sticky monkey flower
Salvia leucophylla	Purple sage
Salvia mellifera	Black sage
Suaeda taxifolia	Woolly seablite

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|— 1" —|

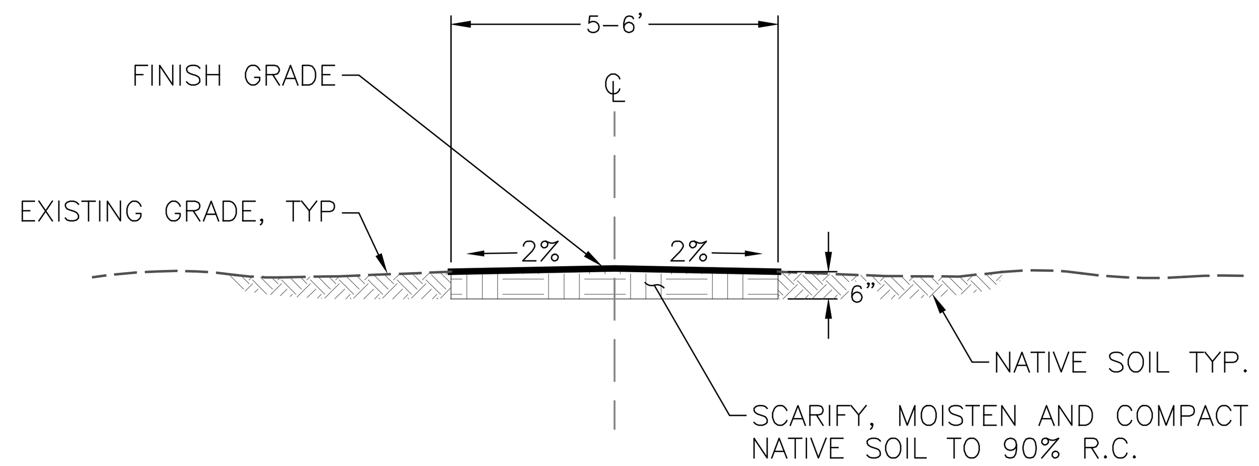
PHASE
PRELIM CONSTRUCTION DOCUMENTATION

SHEET SCALE: NOT TO SCALE

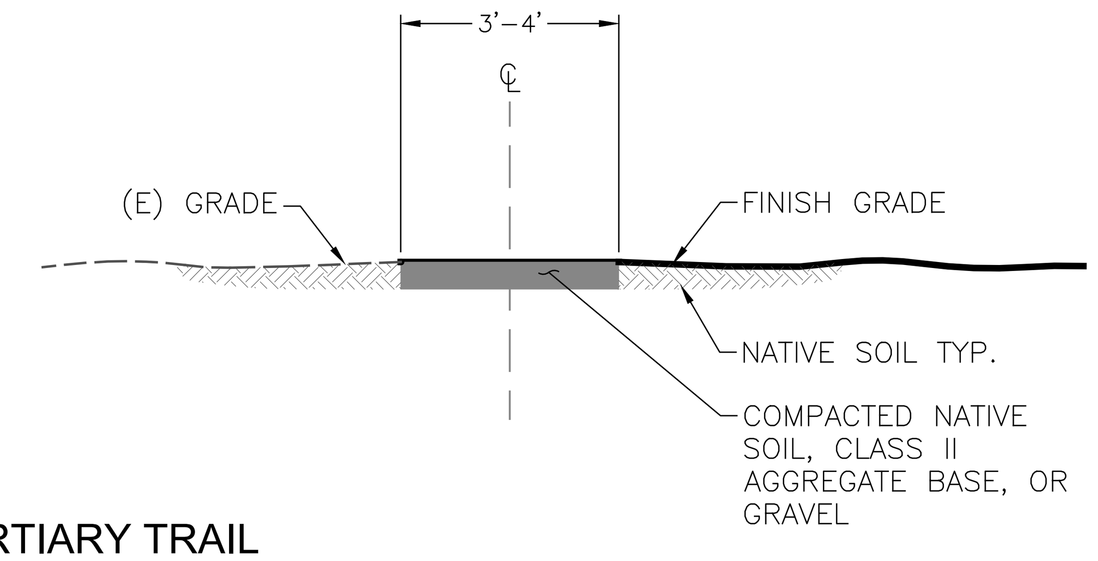
PLANTING LISTS

SHEET NUMBER
L-4

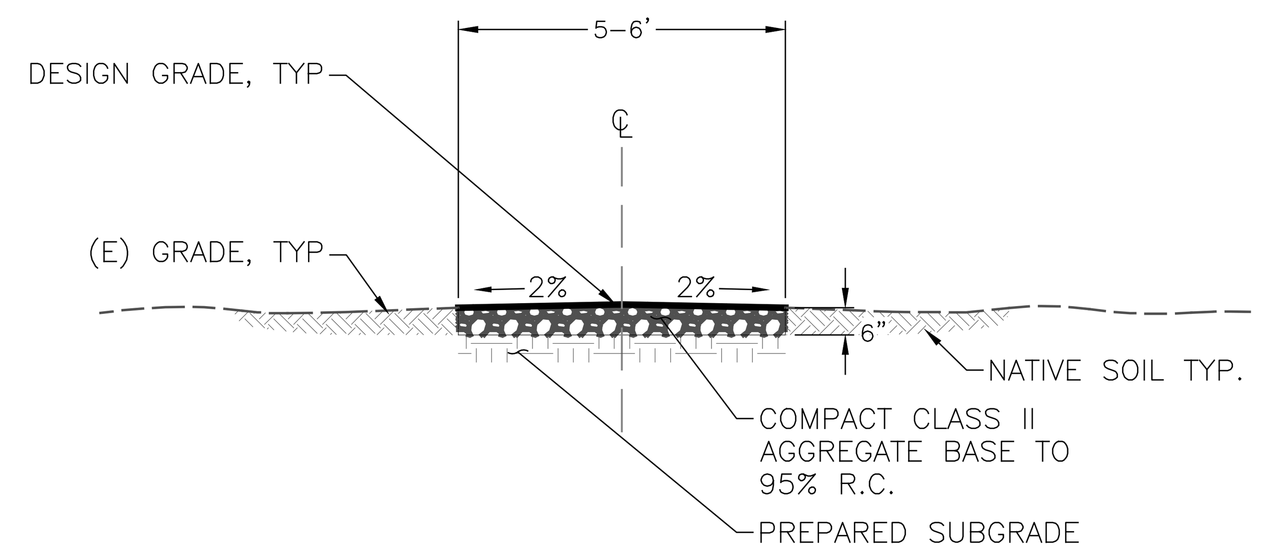
FILE: K:\projects_2016\D160447.00 - Ormond Beach Wetlands Restoration\10 CAD\Dwgs\TRAILS SECN DETL.dwg PLOT DATE: 8/14/2020 6:41:21 PM PLOTTED BY: AMBER INGGS



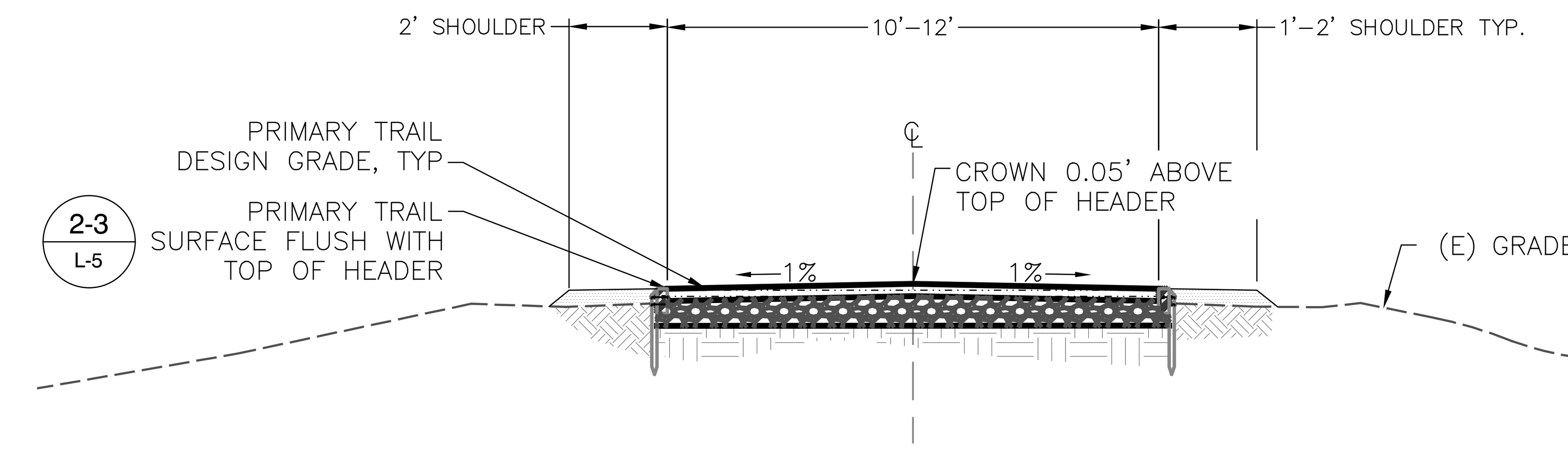
5 SECONDARY TRAIL - COMPACTED NATIVE SOIL
SECTION
SCALE: N.T.S.



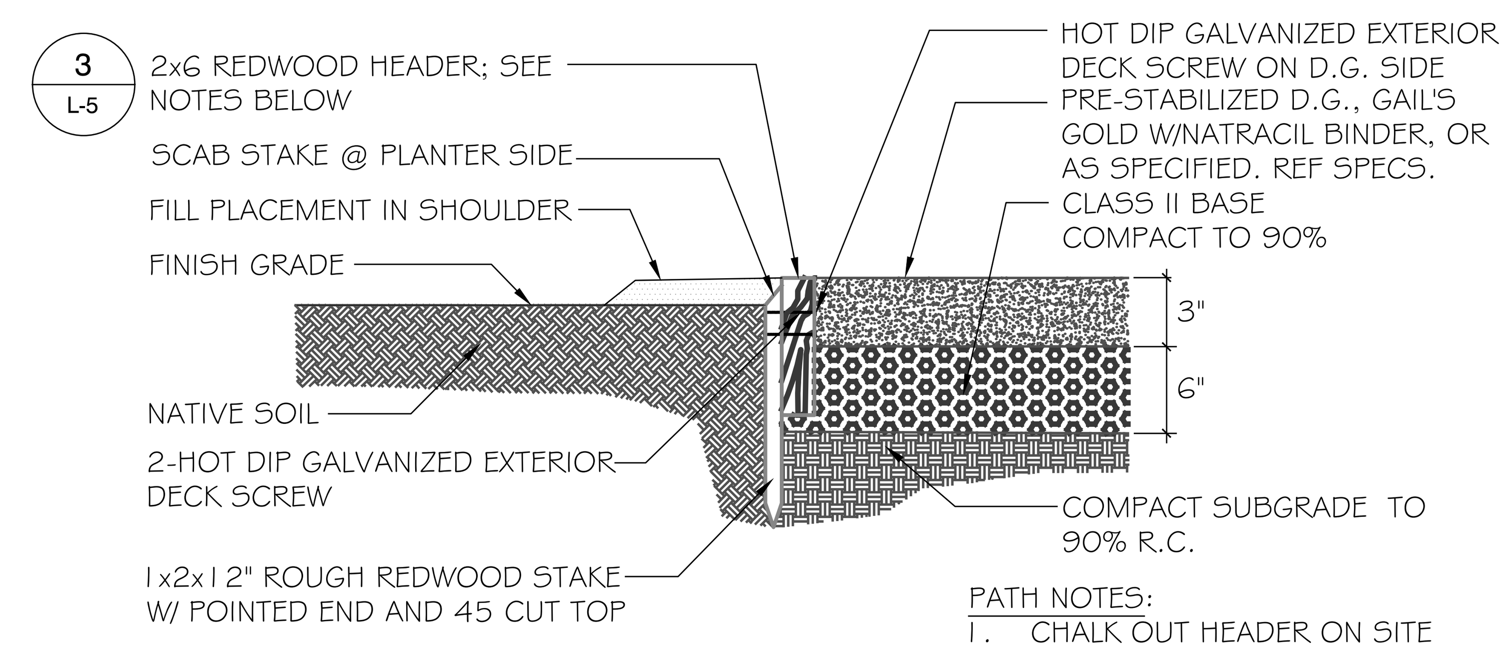
6 TERTIARY TRAIL
SECTION
SCALE: N.T.S.



4 SECONDARY TRAIL - AGGREGATE SURFACING
SECTION
SCALE: N.T.S.

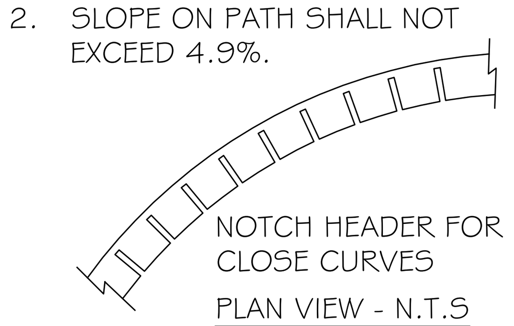


1 PRIMARY TRAIL OVERVIEW
SECTION
SCALE: N.T.S.



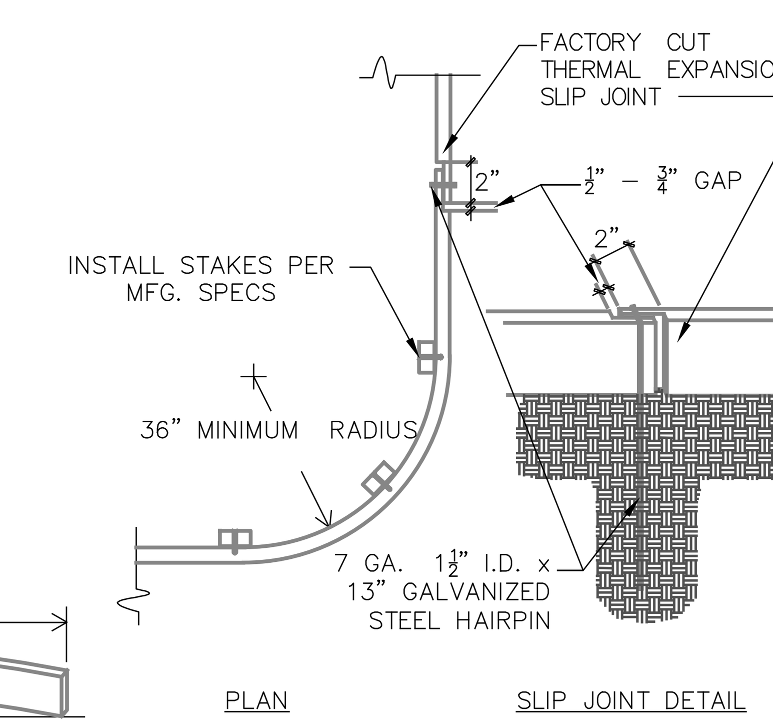
HEADER NOTES:
1. STRAIGHT LINES=2x6 HEADER WITH 3/8"x4x24" REDWOOD; SCAB EACH SPLICE. STAKES AT 6' MAX SPACING
2. GRADUAL CURVES=2-1x6's WITH 4' MIN OVERLAP. GALV. DECKING SCREWS AT 2' ON CENTER. STAKES AT 5' MAX SPACING, OR SAW CUT 2x4.
3. CLOSE CURVES=SAW-CUT NOTCHES ON INSIDE EDGE OF 2x6 HEADERS AS INDICATED ABOVE. STAKES AT 4' MAX SPACING.
4. CONTRACTOR SHALL LAYOUT HEADER BOARDS W/GYPSUM AND CALL LANDSCAPE ARCHITECT FOR REVIEW.

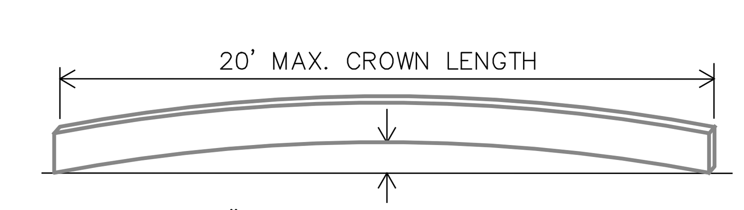
PATH NOTES:
1. CHALK OUT HEADER ON SITE PRIOR TO INSTALLATION. UTILIZE HAND TOOLS TO GRADE PATH.
2. SLOPE ON PATH SHALL NOT EXCEED 4.9%.



PLAN VIEW - N.T.S

2 PRIMARY TRAIL SURFACING
SECTION
SCALE: N.T.S.

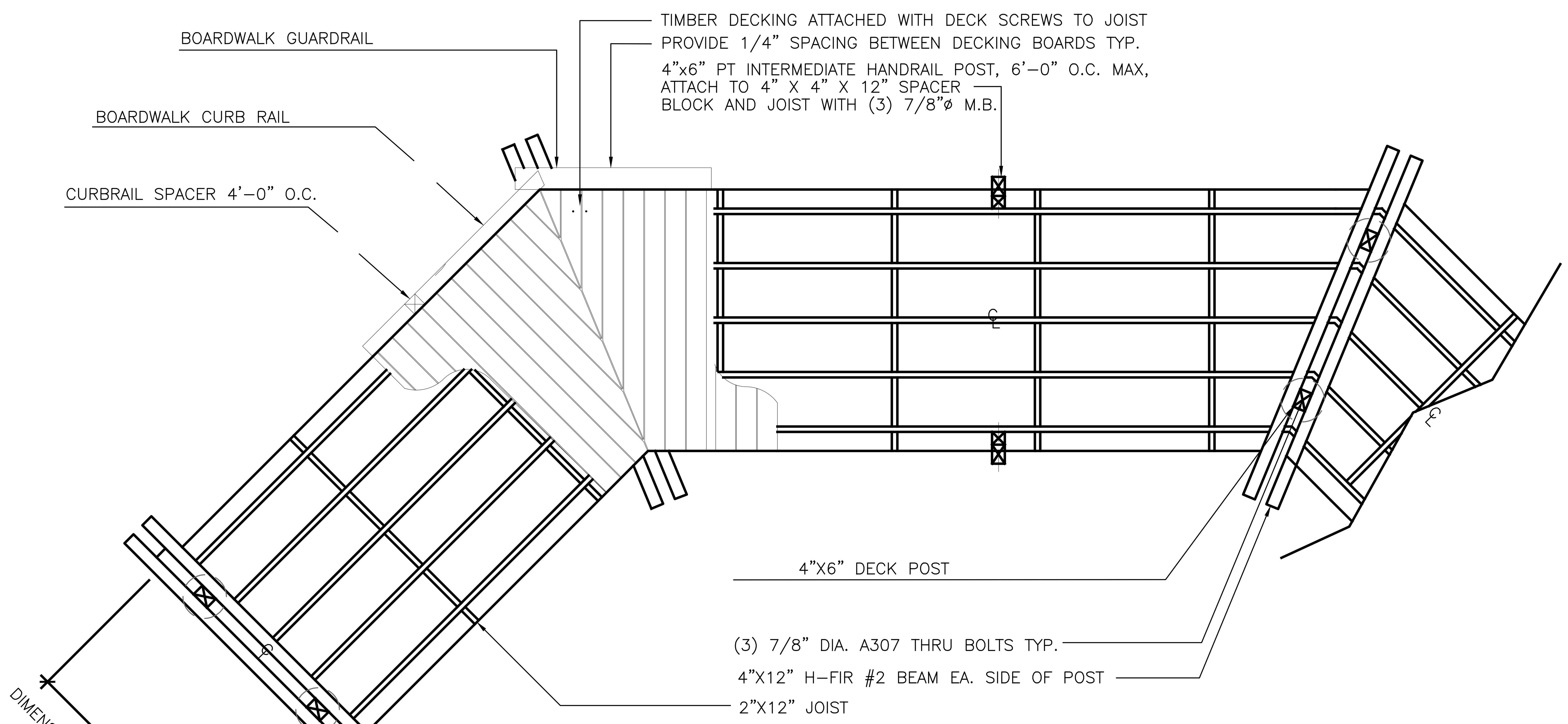




ELEVATION – CROWN DIMENSIONS

HEADER PLAN VIEW DETAIL NOTES:
1. CONTRACTOR SHALL USE 2X6 REDWOOD BOARD. INSTALL ACCORDING TO MANUFACTURER'S INSTRUCTIONS.
2. CONTRACTOR SHALL LAYOUT EDGE BOARDS WITH GYPSUM (CHALK) AND CALL OWNER'S REPRESENTATIVE FOR REVIEW PRIOR TO INSTALLATION.
3. CONTRACTOR SHALL ALLOW FOR THERMAL EXPANSION WHEN INSTALLING EDGE BOARDS; DO NOT SCREW THROUGH SLIP JOINT.
4. CONTRACTOR SHALL USE WOODWORKING TOOLS FOR CUTTING AND DRILLING EDGE BOARDS.

3 PRIMARY TRAIL HEADER W/ STAKE
SECTION
SCALE: N.T.S.



NOTE:
1. BOARDWALK WIDTHS WILL MATCH TRAIL WIDTHS.
2. ACTUAL DIMENSIONS, JOIST QUANTITY AND SPACING, FOOTINGS, AND ABUTMENTS WILL VARY BASED UPON BOARDWALK WIDTH, TRAIL WIDTH, LOCATION, HEIGHT ABOVE GROUND LEVEL, AND SUBSTRATE. FORTY-FIVE DEGREE INTERSECTIONS SHOWN.
3. MITRE DECKING FOR SYMMETRICAL MATCH AT INTERSECTIONS.
4. ALL STRUCTURAL WOOD MEMBERS TO BE PRESSURE TREATED.
5. POST/FOOTING DISTANCES VARY BETWEEN BOARDWALK SECTIONS BUILT WITH GUARD RAILS AND BOARDWALK SECTIONS BUILT WITH CURB RAILS.
6. CURB RAIL FOOTINGS AND GUARD RAIL FOOTINGS TO BE LOCATED BY CENTERING THEIR SEPARATION OVER THE CENTERLINE OF THE BOARDWALK.
7. CHAMFER CORNERS AT TERMINATION OF HANDRAIL.
8. IN LOCATIONS WHERE POST/FOOTING SPACING IS LESS THAN 12' O.C., CONTRACTOR TO DIVIDE SPACE EQUALLY WITH INTERMEDIATE HANDRAIL POST.
9. ALL FASTENERS SHALL BE 100% STAINLESS STEEL.

7 BOARDWALK - CONCEPTUAL LAYOUT
PLAN VIEW
SCALE: N.T.S.

ESA
550 KEARNY STREET, SUITE 800
SAN FRANCISCO, CA 94108
OFFICE - 415.896.5900
WWW.ESASSOC.COM

STAMP
PRELIMINARY - NOT FOR CONSTRUCTION

CONSULTANT

PROJECT NAME:
ORMOND BEACH RESTORATION AND PUBLIC ACCESS PROJECT
OXNARD, CA

REVISIONS

#	DATE	DESCRIPTION

DESIGNED	BB, KT, EPK
DRAWN	JJ, AI, IS
CHECKED	AB, BB, EPK
IN CHARGE	RS
PROJECT NUMBER	D160447.00
ISSUE DATE	MM/DD/YY

SCALE IS AS SHOWN WHEN PLOTTED TO FULL SIZE (22"x34")
1"

PHASE
PRELIM CONSTRUCTION DOCUMENTATION

SHEET TITLE
TRAILS DETAILS

SHEET NUMBER
L-5

FILE: K:\projects_2016\D160447.00 - Ormond Beach Wetlands Restoration\10 CAD\Dwgs\TRAILS SECN DETL.dwg PLOT DATE: 8/14/2020 6:41:28 PM PLOTTED BY: AMBER INGGS

Appendix H
Conceptual Revegetation Plan

Ormond Beach Wetlands Conceptual Revegetation Plan

July 8, 2020

Prepared by:

Coastal Restoration Consultants

772 Monte Vista Ave.
Ventura, CA 93003
Contact: Matt James
matt@crcsb.com

Prepared for:
ESA
550 Kearney St., Suite 800
San Francisco, CA 94108

1. INTRODUCTION

Re-establishment of native vegetation communities is a crucial aspect of implementing ecological restoration projects. Native plants provide many important ecosystem services, including:

- Stabilization of soils and erosion control,
- The basis for the food web and nutrient cycling,
- Physical structure that supports wildlife,
- Increasing resistance to invasion by non-native plants, and
- Improving water quality.

Despite the obvious importance of revegetation, in practice, many restoration projects struggle with achieving desired outcomes related to establishing target plant communities and reaching goals for metrics such as native plant cover and diversity. This can happen for many reasons, but a common problem is failure to match appropriate species to their appropriate physical growing conditions. Important physical factors vary widely by habitat, but some important processes that effect patterns in southern California's coastal wetlands include soil moisture dynamics, hydrology, scour and sedimentation, soil salinity, soil texture, slope steepness and aspect, and climate. In order for revegetation to be successful at a restoration site, these physical growing conditions must be understood across different areas of the site. This allows us to match appropriate native plant communities and species to the appropriate areas. Or, conversely, to design a restoration project to support target habitats.

In southern California's coastal wetlands, relatively small differences in elevation can lead to very different vegetation communities. This is due to the fact that important physical stressors on plants (*e.g.*, flooding duration and depth, soil salinity, etc.) can vary strongly with elevation. Our tidal estuaries have highly variable but fairly predictable water levels and salinities, therefore the elevation ranges for typical plant communities are fairly well understood in these systems. In contrast, the intermittently tidal and non-tidal wetlands at Ormond Beach will have water levels and salinities that vary considerably both within and between years in ways that will be difficult to predict. Restoring these natural dynamics is an important aspect of the overall restoration effort for this site. Establishing self-sustaining native plant communities in such dynamic conditions will be challenging and will require experimental and adaptive approaches.

1.1 Purpose of This Plan

The Ormond Beach Restoration and Public Access Plan includes a conceptual plan for the site that identifies target habitats expected after alterations to existing hydrology and topography. The proposed grading plan was developed to optimize the project's attainment of its goals and objectives, including those related to target plant communities. While these plans are based on the best available information for the site, important data gaps remain (*see* OBRAP Restoration Plan Section 8). Until some of the most important data gaps are filled, developing a detailed revegetation plan for the site will not be feasible. Proposed future planning work, especially the development of a conceptual model linking existing hydrology and vegetation patterns to expected post-restoration hydrology and vegetation patterns, will be crucial in fine-tuning where different plant species will be expected to occur on site. This conceptual model will allow for much more detailed planning and cost estimations for the revegetation effort.

The purpose of this chapter is to provide more detailed definitions of the different plant communities targeted for restoration and to lay out a plausible path towards establishing those communities. Restoring target plant communities within different parts of the Ormond Beach Wetlands complex will be complicated given myriad differences in surface and groundwater hydrology, soil texture and salinity, and ground surface elevations throughout the site. Given this above-average uncertainty, it will be important to develop and employ an adaptive management framework to guide the revegetation efforts to assure that appropriate strategies are being used to accomplish project goals. This conceptual revegetation plan is meant to provide guidance for future rounds of planning and support the environmental review process.

2. NATIVE PLANT COMMUNITIES

The proposed project will expand wetland habitats at the site and restore existing degraded wetland, transition, and upland habitats. The primary restoration actions include re-routing of the Oxnard Lagoon Waterway (OLW), earthmoving to lower ground surface elevations and create ponding features, improving hydrologic connectivity within the site, and converting agricultural land to native habitats. Post-restoration, the site could support brackish marsh, salt marsh, open water, foredune and dune scrub, dune swale wetlands, saline-affected seasonal wetlands, coastal sage scrub, and a range of transitional habitats (**Figure 1**). The exact distribution of these habitats will depend strongly on the post-restoration hydrology, especially as it relates to water levels (or depths) and salinity. At this stage of restoration planning, many of these details are not known. The goal of this conceptual revegetation plan is to lay out general approaches for successfully establishing native plant communities and controlling invasive non-natives on the restored site.

2.1 Fresh/Brackish and Brackish/Salt Marsh

Brackish marsh is a general term used to describe the types of wetlands that occur where typical water salinities are between 0.5 parts per thousand (ppt) and 30 ppt. Brackish conditions are also referred to as mixohaline by Cowardin et al. (1979), and distinct from limnetic (<0.5 ppt), euhaline (30-40 ppt) and hyperhaline (>40 ppt). Cowardin et al. (1979) distinguish three types of wetlands within mixohaline class, oligohaline (0.5-5 ppt), mesohaline (5-18 ppt) and polyhaline (18-30 ppt). In southern California, brackish marshes within these three subclasses generally have different vegetation associations. These habitats are expected to occur in Areas 1, 2, and 3a. Generally, oligohaline (referred to in this plan as fresh/brackish marsh) would be expected in Area 2 and northern parts of 3a and mesohaline (referred to as brackish/salt marsh) would be expected in Areas 1 and southern parts of 3a where there is more influence from the ocean.

Different brackish marsh species occur at different elevations within a given marsh. The stratification of vegetation is due to differing stress tolerances of different species and interspecific competition. In oligohaline systems, vascular vegetation can grow in areas that are flooded more or less year-round to about three feet in depth; elevations below this will be open water or may support algae and/or aquatic vegetation.

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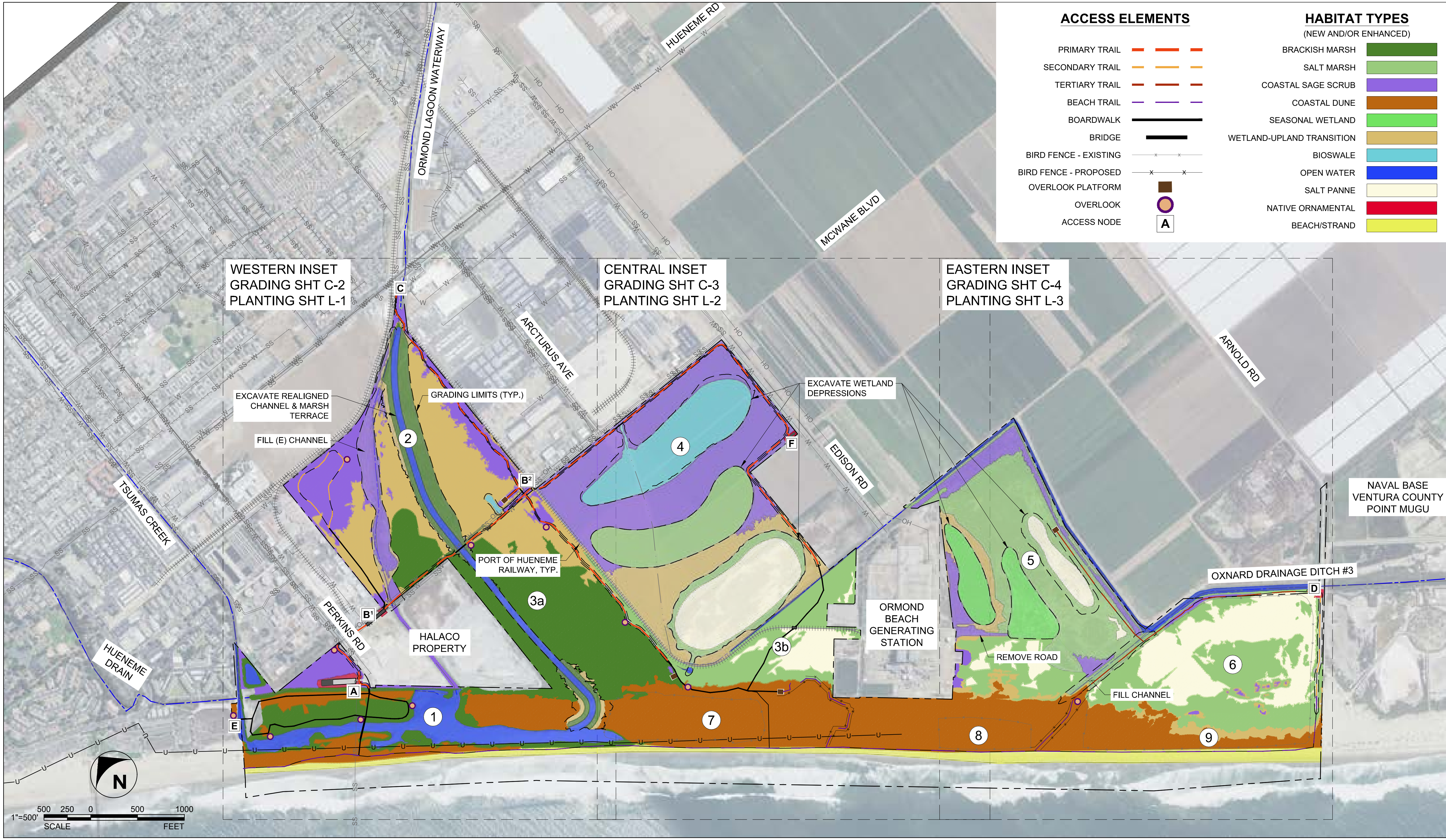

SOURCE: ESRI 7/19/2016, City of Oxnard, Ventura County

Figure 1 Project Overview

In mesohaline systems, vascular vegetation is expected to grow in areas flooded more or less year-round to a foot or two of depth and perhaps somewhat deeper in the non-growing season (winter). Seasonal salinity dynamics will play a role in the lower distributional limit of vascular plants in both systems.

Deeper areas in oligohaline marshes will support monotypic stands of cattail (*Typha* spp.), which might be co-dominant with tule (*Schoenoplectus californicus*) in areas with shallower flooding. Tule will likely dominate seasonally flooded areas though other fresh/brackish species (Table 1) may co-occur or even dominate under certain hydrology/salinity regimes. Areas one to two feet above elevations that flood at least seasonally and don't go hypersaline, are expected to support other native wetland species (Table 1) due to saturated soils (from capillary action in the soil or shallow water table).

Mesohaline or brackish/salt marsh habitats are expected where there is more influence from the ocean (due to wave overwash or shallow saline ground water). This habitat will intergrade with oligohaline marsh and share many of the same plant species but will also support species such as pickleweed (*Salicornia pacifica*) and fleshy jaumea (*Jaumea carnosa*) where soil or surface water salinities are highest. Several other perennial halophytes are expected to grow in these areas at different flooding depths (Table 2).

Table 1. Typical species of an oligohaline fresh/brackish marsh in coastal southern California. These would be typical species around and within the new OLW in Area 2.

Species	**Common Name**	**Preferred Conditions**
Anemopsis californicus	Yerba mansa	Saturated soil
Bolboschoenus robustus	Robust bulrush	Seasonally flooded
Elymus triticoides	Alkali rye grass	Seasonally saturated soil
Equisetum hymale	Scouring rush	Saturated soil
Euthamia occidentalis	Western goldenrod	Seasonally saturated soil
Juncus balticus	Baltic rush	Saturated soil
Juncus textilis	Basket rush	Saturated soil
Schoenoplectus californicus	Tule	Seasonally flooded
Typha domingensis	Southern cattail	Permanently flooded
Typha latifolia	Broadleaf cattail	Permanently flooded

Table 2. Typical species of a mesohaline brackish/salt marsh in southern California. These would be typical species along OLW in Area 3a and around Ormond Lagoon in Area 1.

Species	**Common Name**	**Preferred Conditions**
Baccharis glutinosa	Salt marsh baccharis	Seasonally saturated soil
Bolboschoenus maritimus	Saltmarsh bulrush	Seasonally flooded
Distichlis spicata	Salt grass	Seasonally saturated soil
Frankenia salina	Alkali heath	Seasonally saturated soil
Jaumea carnosa	Fleshy jaumea	Seasonally flooded
Juncus acutus	Spiny rush	Saturated soil
Salicornia pacifica	Pickleweed	Seasonally flooded
Schoenoplectus californicus	Tule	Seasonally-permanently flooded

2.2 Salt Marsh

Salt marsh habitats occur in southern California in tidal and non-tidal euhaline and hyperhaline wetlands. These habitats are dominated by perennial halophytes such as pickleweed, fleshy jaumea, salt grass (*Distichlis spicata*), and alkali heath (*Frankenia salina*). Salt marsh currently occurs in Areas 3b, 5, and 6. At least two salt marsh species that are typically only found in tidal systems in southern California are known to occur at the site, including salt marsh bird's beak (*Cordylanthus maritimus* ssp. *maritimus*) and arrow grass (*Triglochin concinna*). Both occur in euhaline habitats that are rarely flooded. Existing salt marsh areas could be enhanced to increase floral diversity. New salt marsh habitats may be restored and/or created in Areas 1, 3a, and 5.

Unvegetated hyperhaline salt flats are also an important component of the salt marsh habitats at the site, though they do not support vascular plants. They currently occur in Areas 3b, 5 and 6. Additional salt flats may be restored and/or created in Areas 4 and 5.

Table 3. Typical species of salt marsh habitats in non-tidal coastal wetlands in southern California.

Species	Common Name	Preferred Conditions
Arthrocnemum subterminale	Parish's Glasswort	Seasonally saturated soil
Cressa truxillensis	Alkali weed	Seasonally saturated soil
Distichlis spicata	Salt grass	Seasonally saturated soil
Extriplex californica	California saltbush	Saline soil
Frankenia salina	Alkali heath	Seasonally saturated soil
Jaumea carnosa	Fleshy jaumea	Saturated soil
Juncus acutus	Spiny rush	Saturated soil
Lasthenia glabrata ssp. coulteri	Salt marsh goldfields	Seasonally hypersaline soil
Limonium californicum	Sea lavender	Seasonally saturated soil
Malvella leprosa	Alkali mallow	Saline soil
Monanthochloe littoralis	Shore grass	Seasonally saturated soil
Salicornia pacifica	Pickleweed	Saturated soil
Suaeda taxifolia	Wooly seablite	Saline soil
Triglochin concinna	Arrow weed	Saturated soil

2.3 Coastal Sage Scrub

The upland areas of the site are expected to support coastal sage scrub habitat. Coastal sage scrub (sometimes called soft chaparral) is a highly diverse community dominated by drought-tolerant shrubs and sub-shrubs. Coastal sage scrub occurs on a range of different slope aspects and soil types, which, along with distance from the coast, determine what species are dominant at a given location. Some species such as coast goldenbush (*Isocoma menziesii*), woolly seablite (*Suaeda taxifolia*) and saltbush (*Atriplex lentiformis*) are tolerant of seasonally saline soils and very rare flooding. Most species (Table 4), while tolerant of salty sea spray, do not tolerate these stressors. Coastal sage scrub habitats are found in parts of Area 1, 2, 3a, 5, and 6, though overall diversity tends to be very low. These areas could be enhanced and additional coastal sage scrub may be created and/or restored in all these areas as well as parts of Area 4.

Table 4. Typical species found in coastal sage scrub habitat in southern California.

Species	Common Name	Habit
Artemisia californica	California sagebrush	Shrub
Atriplex lentiformis	Big saltbush	Shrub
Baccharis pilularis	Coyote brush	Shrub
Encelia californica	California encelia	Shrub
Eriogonum fasciculatum	California buckwheat	Sub-shrub
Eschscholzia californica	California poppy	Annual/short-lived perennial
Isocoma menziesii	Coast goldenbush	Sub-shrub
Lupinus succulentus	Arroyo lupine	Annual
Mimulus aurantiacus	Sticky monkey flower	Sub-shrub
Salvia leucophylla	Purple sage	Shrub
Salvia mellifera	Black sage	Shrub
Suaeda taxifolia	Woolly seablite	Shrub

2.4 Coastal Dune Scrub

Coastal sand dune systems in southern California support a range of different annual and perennial plant species that are specifically adapted to burial by blowing sand, well-drained and low-nutrient soils, and seasonal drought. In general, growing conditions are most stressful closer to the ocean, where winter waves can overrun plants and erode sand. This zone, generally referred to as foredune scrub, includes plants that tolerate burial by blowing sand and overwash by ocean waves (Table 5). More landward areas, called backdunes, are not subject to direct impacts from waves and support a different suite of species (Table 6). Both of these habitats are found extensively in Areas 1, 7, 8 and 9. Revegetation efforts in these areas should focus on increasing floral diversity, especially in the back dunes.

Table 5. Typical species found in foredune scrub habitat in southern California.

Species	Common Name	Habit
Abronia maritima	Red sand verbena	Sub-shrub
Ambrosia chamissonis	Beach bur	Sub-shrub
Atriplex leucophylla	Beach saltbush	Sub-shrub

Table 6. Typical species found in backdune scrub habitat in southern California.

Species	Common Name	Habit
Abronia maritima	Red sand verbena	Sub-shrub
Abronia umbellata	Pink sand verbena	Sub-shrub
Acmispon glaber	Deerweed	Sub-shrub
Ambrosia chamissonis	Beach bur	Sub-shrub
Calystegia soldanella	Beach morning glory	Sub-shrub
Camissoniopsis cheiranthifolia	Beach evening primrose	Sub-shrub
Ericameria ericoides	Mock heather	Shrub
Lupinus arboreus	Bush lupine	Sub-shrub

2.5 Dune Swale Wetlands

Dune swale wetlands occur in depressions in dune systems where the water table is at or very near the soil surface. The shallow water table in large dune systems like the one at Ormond Beach is typically fresh and floating on top of salty ground water. The elevation of the salty groundwater controlled primarily by the ocean. The plants found in dune swale wetlands are mostly hydrophytes (Table 7) and may or may not have tolerance to salty soil. Dune swale wetlands could be created in Areas 7, 8 and 9 but current plans do not include this habitat type.

Table 7. Typical species found in dune swale wetland habitat in southern California.

Species	Common Name	Habit
Carex praegracilis	Sedge	Herbaceous perennial
Distichlis spicata	Salt grass	Rhizomatous grass
Heliotropium curassavicum	Seaside heliotrope	Herbaceous perennial
Juncus acutus	Spiny rush	Perennial rush
Juncus balticus	Wire rush	Rhizomatous rush
Juncus textilis	Basket rush	Rhizomatous rush

2.6 Saline-affected Seasonal Wetlands

Saline-affected seasonal wetlands occur where rainfall or seasonal fluctuations in surface or groundwater levels lead to seasonal ponding or seasonally saturated soils in the rooting zone. This habitat is currently found in Areas 2, 4, and 5, and totals 78.8 acres (12 percent of the Project Area). Seasonal wetlands might occur in depressions that pond water or on flats with clay soils that retain moisture and salt after rainfall. Seasonal wetlands near the coast that are influenced by salt are uncommon today in southern California but can support a wide range of regionally and globally rare plant species, including Virginia pickleweed (*Salicornia depressa*), Coulter's saltbush (*Atriplex coulteri*), Pacific saltbush (*A. pacifica*), Davidson's saltbush (*A. serenana* var. *davidsonii*), horned sea blite (*Suaeda calceoliformis*), and Ventura marsh milk vetch (Astragalus pycnostachyus var. lanosissimus). Some other common species expected in these habitats are listed in Table 8. All the different species will have somewhat different tolerances to different levels of salinity, depths and durations of inundation, and dry-season drought stress.

Table 8. Typical species of saline-affected seasonal wetland habitats in coastal southern California.

Species	Common Name	Preferred Conditions
Arthrocnemum subterminale	Parish's Glasswort	Seasonally saturated soil
Cressa truxillensis	Alkali weed	Seasonally saturated soil
Distichlis spicata	Salt grass	Seasonally saturated soil
Frankenia salina	Alkali heath	Seasonally saturated soil
Lasthenia glabrata ssp. coulteri	Salt marsh goldfields	Seasonally hypersaline soil
Malvella leprosa	Alkali mallow	Saline soil
Salicornia pacifica	Pickleweed	Saturated soil
Suaeda taxifolia	Wooly seablite	Saline soil

2.7 Open Water and Salt Flats

The lowest areas of the project, primarily in Areas 1, 2, and 3a, will be too deep for cattail and will be flooded almost all the time. The open brackish water could support algae and aquatic plants (Table 9). If there are high levels of nutrients (phosphorus and nitrogen) in the water, algae blooms may become a nuisance. When algae becomes abundant and then dies, the microorganisms that consume the dead algae can severely deplete the available oxygen in the water column, leading to die offs of fish and other aquatic species.

Salt flats occur in shallow depressions with very poorly drained soil that trap rainwater and/or wave overwash. As the water evaporates, salts are left behind and soils become too salty for vascular vegetation. These habitats exist currently on site in Areas 5 and 6 and are expected to be created in Areas 4 and 5. These areas may support algae such as sea lettuce (*Ulva* spp.) when flooded.

Table 9. Typical aquatic species found in brackish sub-tidal habitats in southern California.

Species	**Common Name**	**Habit**
Ruppia cirrhosa	Spiral ditch grass	Floating vascular plant
Ruppia maritima	Ditch grass	Floating vascular plant
Ulva intestinalis	Sea lettuce	Floating algae
Ulva lactuca	Sea lettuce	Floating algae

3. REVEGETATION STRATEGIES

We developed a set of general strategies (below) for planting and weeding the site in order to provide a very rough cost estimate for revegetation efforts. A refined revegetation plan and then a detailed implementation plan will need to be developed for the project that will refine these strategies. Those plans will need to be developed concurrently with the final grading plan and include any special conditions set forth in project permits issued by the regulatory agencies. A restoration ecologist familiar with implementing restoration and/or mitigation projects in coastal southern California should prepare the plan.

3.1 Rare and Extirpated Species

The Ormond Beach Wetlands are known to support several rare plant species. These include salt marsh bird's beak (*Chloropyron maritimum* ssp. *maritimum*), red sand verbena (*Abronia maritima*), Coulter's goldfields (*Lasthenia glabrata* ssp. *coulteri*), spiny rush (*Juncus acutus* ssp. *leopoldii*), and woolly seablite (*Suaeda taxifolia*), all of which were observed by CRC during fieldwork for this project and have been found in previous studies. Other rare species have been documented at the site[1] including California seablite (*Suaeda californica*) and island mallow (*Lavatera assurgentiflora* ssp. *assurgentiflora*), though their current status at the site is not clear. Special care should be taken to preserve all existing populations of these species. Ideally, restoration actions should lead to the expansion of those populations.

[1] www.calflora.org

Additionally, there are several regionally or globally rare species that occurred within the region that the site could support, including Coulter's saltbush (*Atriplex coulteri*), south coast saltscale (*Atriplex pacifica*), Davidson's saltscale (*Atriplex serenana* var. *davidsonii*), Lewis' evening primrose (*Camissoniopsis lewisii*), Ventura marsh milk vetch (*Astragalus pycnostachyus* var. *lanosissimus*), beach spectaclepod (*Dithyrea maritima*), curly-leaved monardella (*Monardella undulata*), and California spineflower (*Mucronea californica*). Establishing new populations of such species at Ormond Beach could help with their recovery and conservation. Special permissions from regulatory agencies would be needed to introduce some of these species.

3.2 Planting and Seeding

Planting palettes for the different habitats should be based on Tables 1-7 (we do not recommend "planting" aquatic species in the open water or salt flat areas). These lists will likely need to be adjusted and/or expanded as project planning proceeds through the next stages. Only species native to coastal southern California should be used. Horticultural cultivars of native species should never be used. Plant material (seed and nursery stock) should only be sourced from firms who are able to document the geographic area where propagules were collected for each species. This will help assure appropriate genotypes are introduced. For most of the common species, propagules should be sourced from natural stands (not restoration/mitigation sites) along the coast between Los Angeles and southern Santa Barbara Counties.

Wetland and upland areas should be planted with nursery stock or seeded. Small nursery containers (*e.g.*, 2-inch pots or plugs) are preferred for most species. Large wetland plants such as tule and cattail should be planted from standard 1-gallon nursery stock. Planting in these areas should take place in spring so new plantings can experience a full growing season (spring and summer) and establish extensive root systems capable of stabilizing soil and mechanically anchoring the plants during winter flooding. Planting densities will vary by species. Some wetland species such as pickleweed establish easily on restoration sites from seed. Direct seeding of such species will save substantial money.

Foredune, backdune, and coastal sage scrub areas should be re-vegetated with a combination of small nursery stock and seed. Planting and seeding in these areas should occur in early winter to take advantage of natural rain. Temporary irrigation could be installed in these areas and used only to the extent necessary. Over-irrigation may lead to plants growing less extensive root systems than those required to survive once irrigation has ceased. There should be a plan and funding in place to remove the irrigation after plants are established (1-3 years).

3.3 Weeding

Weeds are not expected to be a major problem in flooded wetland areas. However, elsewhere on site invasive annual species will be a problem. If not controlled, they can out-compete natives and cause the revegetation effort to fail. If possible, we recommend at least one grow-kill cycle before planting in the coastal sage scrub areas. This is typically done by irrigating the site briefly to sprout weeds from seed and then killing seedlings using an aquatic-approved herbicide, hand weeding, solarization, or similar method. Weeding is much more efficient before native plants are installed or native seed is spread. Weeding non-native annuals will need to continue after planting (spot herbicide or hand removal). Minimizing irrigation will generally favor natives and discourage annual non-native plants. As native shrubs and trees grow larger, they will shade the ground and discourage many of the most problematic annual weeds from germinating.

Non-native perennial plant species are often a long-term maintenance issue at restoration sites. Detecting and removing these species (*e.g., Arundo donax, Cynodon dactylon, Pennisetum clandestinum, Nicotiana glauca, Cortedaria selloana,* and *Tamarix ramosissima*) should be a priority during the installation phase (the first three to five years) and beyond. These species typically require treatment with herbicide or mechanical removal. Early detection, when plants are still small, makes control efforts much easier. A detailed weeding strategy for annual and perennial non-natives should be part of the final implementation plan and should be tailored to achieve goals for non-native cover laid out in regulatory permits.

3.4 Site Preparation and Short-term Maintenance

Future studies and permit conditions will dictate specific measures that need to be undertaken to assure the revegetation effort is successful. These will include at least, an erosion control plan, soil texture and salinity analyses to assess the possible need for soil amendments, short-term fencing to protect new plantings from trampling and, signage to inform the public about the sensitivity of the restoration site to trampling and other disturbance. Plantings should also be monitored for herbivory by gophers, rabbits, squirrels, birds, etc. If plants are being killed or damaged, herbivore protection will need to be installed. This would likely only be a problem in the coastal sage scrub and backdune areas. These issues should all be addressed in the implementation plan, which will be prepared in conjunction with final project design and permitting phases.

4. ECOSYSTEM MONITORING

A detailed monitoring plan will need to be developed for the project as plans are finalized and permits are issued. Most restoration project measure a few fairly simple vegetation metrics (*e.g.,* percent cover of natives and non-natives, diversity, stature, etc.). While these usually are valuable metrics for assessing a project, other biological factors like general wildlife usage (*e.g*., bird surveys) or efforts directed at target species (e.g., tide water goby) are often more effective at demonstrating project benefits and impacts. Collection of data on physical metrics is equally important. Surface water measurements of things like salinity, depth, dissolved oxygen levels, nutrient levels and temperature are relatively easy to collect and are underlying factors that can explain things like wildlife usage and plant zonation. Other physical factors such as erosion and sedimentation dynamics, mouth dynamics and soil salinity are also useful in explaining biological patterns.

A comprehensive ecosystem monitoring program like this serves three primary purposes. First, monitoring is used to assess progress towards project goals and performance criteria. This might include specific requirements that come with funding sources for the actual implementation of the project. For instance, an in-lieu fee mitigation or other off-site mitigation funding source might come with much more complex performance criteria requirements than typical grant funding sources would. Second, monitoring should be used to support decision-making in the adaptive management program (see details below). Third, monitoring reports should contribute knowledge to the greater restoration community on the efficacy of the techniques and approaches used to implement the restoration project (*i.e*., the reports should be publicly available).

5. ADAPTIVE MANAGEMENT

Adaptive management is a tool for achieving success where there is considerable uncertainty as to what actions will be needed to accomplish specific goals. Ecological restoration is inherently filled with uncertainty. There are simply too many variables to control, especially in systems like the Ormond Beach Wetlands with its complex hydrology. Designing and implementing this project using an adaptive management approach will lead to better outcomes and help assure the project meets its goals.

The importance of using an adaptive management approach in ecological restoration has long been recognized, but in practice, it is seldom applied. In many cases, this is due to the fact that most biologists and engineers are reluctant to admit they are uncertain of how a project will proceed. In this conceptual plan, we have emphasized the need to restore ecosystem processes and let naturally functioning habitats develop over time. We only have our educated best guesses as to exactly how these processes will develop and evolve once earthmoving and hydro-modifications are complete. Careful analysis of as-built conditions and continuous hydrologic and salinity monitoring will provide guidance on early revegetation efforts in the wetlands. Elevation ranges may need to be adjusted for different species and communities. Pilot planting efforts (*e.g.,* using a limited number of plants to assess survival at different elevations) can help fine tune planting strategies before large numbers of plants are installed.

We have provided a plausible path towards developing more naturally functioning habitats at the site. We are confident that the site will support these habitats though the exact locations and proportions of given habitats are uncertain. Careful monitoring and experimental approaches should be used to help understand how the site is evolving and predict future conditions. Data should be used to inform changes to initial implementation strategies for all aspects of the restoration implementation, including erosion control, planting and weeding.

6. COST ESTIMATES

It is premature to estimate costs for revegetation of the site. The more detailed revegetation plan that will be developed based on the conceptual model (*see* Section 1.1 of this plan) will allow for more realistic budgeting. Ultimately, costs will depend on the strategies chosen (*e.g.,* seeding vs. planting, herbicide vs. no herbicide, etc.), yet to be determined details for the planting areas (*e.g*., need for soil amendments, availability of irrigation water, etc.), and phasing. As budgets for the revegetation effort are developed, it will be important to also include funds for longer term maintenance (at least five years) and ecosystem monitoring and reporting (at least annually for five years).

7. REFERENCES

Cowardin L., Carter V., Golet F., Laroe E. 1979. Classification of wetlands and deepwater habitats of the United States. U.S. Fish and Wildlife Serv. Office of Biological Services. FWS/OBS-79/31. 103.