Draft

SCOTT CREEK LAGOON AND MARSH RESTORATION PROJECT

60%-Complete Basis of Design

Prepared for
The Resource Conservation District of
Santa Cruz County

December 2020

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1 INTRODUCTION

This Basis of Design (BOD) report details the 60%-complete design for the Scott Creek Lagoon and Marsh Restoration Project (Project). This advances a 30%-complete design of the project, which was developed with the Preliminary Design Report (PDR) submitted in November 2019 and revised in November 2020. The 60% design described here has been updated by ESA based on guidance from the Integrated Watershed Restoration Panel Technical Advisory Committee (TAC) and further design progression by ESA. ESA developed this BOD and associated 60% plans for the Resource Conservation District (RCD) of Santa Cruz County with a focus on the restoration components of the project. The design of the Highway 1 Bridge replacement is being led by Caltrans, and is not detailed in this BOD. However, the bridge replacement and removal of the northern highway embankment are critical elements of the restoration, and these are described as components of the overall project phasing and approach.

1.1 Background

Scott Creek Lagoon is a small bar-built estuary in central California that provides critical habitat for a number endangered and threatened species. Apart from its ecology, the site is important as a popular public access point for the coast, and as a transportation corridor for Highway 1 (ESA 2020). The design described in this document builds on the preliminary design and on the collective understanding of the site, its habitat, and various opportunities and constraints that were developed through several years of coordination between Caltrans, the RCD, the Santa Cruz County Regional Transportation Commission (RTC), various public agencies and stakeholders, and ESA. For further background, refer to the PDR (ESA 2020).

1.2 Purpose of Basis of Design Report

This BOD presents specific advancements of the project to the 60%-complete level of design and is intended to amend and supplement the prior PDR (ESA 2020). ESA has incorporated comments from the RCD and the TAC, along with new technical analyses of the new channel diversion structure and the large wood habitat structure design elements.

This BOD documents the state of the 60% design, including the refinements and changes of the design from the 30%-complete level, as well as the rationale for design decisions. We understand that the 60%-complete plans and design will be used by others to initiate discussions for permitting and California Environmental Quality Act (CEQA) compliance.

The BOD also provides a foundation from which to coordinate the Scott Creek Lagoon and Marsh Restoration Project with the roadway revisions being developed by others. The design described by this BOD and associated 60% plans are focused on the habitat restoration components of the project, which primarily include excavation of a new creek channel through the existing marsh and to the beach, filling the existing creek channel, and construction of a channel diversion structure composed of large wood and natural materials. The primary coordination needs are associated with the new roadway and bridge alignment and the existing bridge and north embankment to be removed, which are in the restoration project area, and are pertinent to water management, earthwork balance and coastal resource protection.

1.3 Structure of Report

This report is organized as follows:

Section 2: Overview of Restoration Design – Provides an overview of the project description and related setting information, including a basis for elevations and implications of the recent 2020 wildfires that occurred in the watershed.

Section 3: Restoration Design Elements – Describes the different restoration design elements and how they have been advanced from preliminary design to 60% design, as well as additional design refinements to be considered at subsequent stages of design.

Section 4: Construction Period and Phasing – Discussion of the likely construction approach, available options to the assumed approach, and other construction-related activities that we expect to be needed, such as water and sediment control. The section addresses the likely windows of construction considering habitat and species constraints.

Section 5: Engineer's Estimate of Probable Construction Costs – Presents the engineer's estimate of probable construction costs for the 60% design. Includes a discussion on assumptions made for cost estimating purposes, potential options for future refinements, and areas that need additional research and analysis.

Section 6: Summary of Recommended Next Steps and Outstanding Design Issues – Brief summary of the remaining design tasks that are needed for final design.

Appendix A – 60%-complete plans

Appendix B – Outline of Technical Specifications

2 OVERVIEW OF RESTORATION DESIGN

This section describes the restoration design of the Scott Creek Estuary and Lagoon Restoration Project. Details on the project setting, including site location, site topography and major features, historical conditions, hydrology and geomorphology, and reference sites, are not included in this BOD; see the PDR (ESA 2020).

2.1 Project Description

The project aims to restore habitat and hydraulic function within the lower Scott Creek estuary and lagoon system by:

- Re-aligning the Scott Creek main channel,
- Removing the northern Highway 1 roadway embankment,
- Removing portions of training dikes along the northern bank of the existing channel, and
- Filling the existing channel downstream of the new re-aligned main channel.

Several other features of the restoration elements within the larger project have been developed to further enhance the hydraulic and habitat function of the system. These restoration elements are:

- Four backwater alcoves,
- A diversion structure composed of primarily large wood and other natural materials at the upstream connection of the new channel with the existing channel, and
- Several large wood habitat structures along the new channel alignment designed to create in-channel complexity both for habitats and hydraulics.

2.2 Restoration in the Context of Bridge Replacement

Restoration of the lagoon and marsh is dependent on the removal of the existing Highway 1 northern roadway embankment. Caltrans is planning on replacing the existing bridge embankment with a longer bridge built on piers located immediately east of the existing highway alignment. Once the new bridge is constructed, the existing roadway embankment (i.e., northern bridge approach) can be removed, which will allow a natural connection from the beach to the marsh and lagoon and allow Scott Creek to migrate through the new bridge piers.

ESA is scoped to develop 60% plans and cost estimates for the Scott Creek Lagoon and Marsh Restoration Project, to help inform the highway re-alignment and new bridge design presently underway by Caltrans.

2.3 Project Goal and Objectives

The project goals and objectives were developed to guide selection of a preferred restoration alternative. ESA describes the project goals and objectives in the PDR, Section 3 and discusses the preferred restoration alternative in Section 4 of the PDR.

2.4 Project Setting

ESA describes the detailed project setting at Scott Creek Lagoon in the PDR (ESA 2020). This section builds on the previous PDR with recent updates to the project setting and recommendations for further actions to take during subsequent design stages.

2.4.1 Project Location and Vicinity

The project site is located in unincorporated Santa Cruz County at Scott Creek, located north of the intersection of Highway 1 Swanton Road. The existing features of the project site are shown in Figure 1.

SOURCE: ESRI

Scott Creek Lagoon and Marsh Restoration. D160350.00

Figure 1
Existing Conditions and Major Site Features

2.4.2 Basis of Elevations

The 60% plans display a composite existing grade topography built from the 2009-2011 California Coastal Conservancy Coastal Lidar Project and ESA ground survey data collected in 2011, 2012, 2016, and 2019. All elevations are presented in feet relative to North American Vertical Datum of 1988 (NAVD or NAVD88).

ESA retained Sierra Overhead Analytics (SOA) to conduct an aerial survey of the project site, which was completed on September 19, 2019. ESA worked with SOA to establish base station control, set aerial target control points, and set three survey control points (rebar with caps and flagging). Table 1 shows the established and occupied survey control from the September 2019 Survey. ESA occupied the National Geodetic Survey (NGS) monument (MON 0402) to check and correct elevations for the project.

TABLE 1
SURVEY CONTROL POINTS

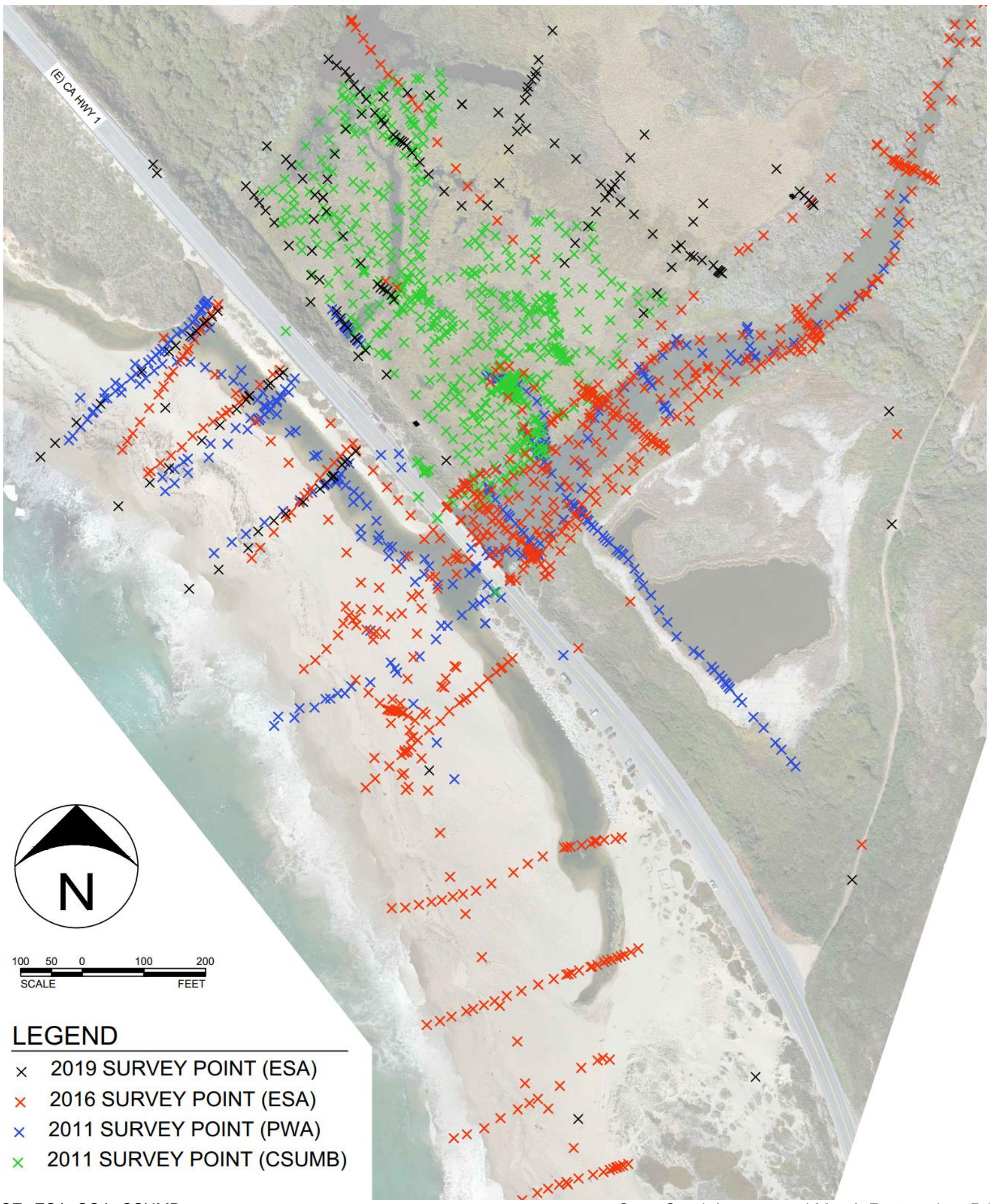
Point Name	Easting (Ft)	Northing (Ft)	Elevation (Ft, NAVD88)
NGS MON 0402	6060701.4400	1837348.3600	89.21
ESA CP101	6058712.6310	1843053.0440	25.73
ESA CP102	6056922.5970	1842147.7930	12.51
ESA CP103	6057533.2180	1842517.0100	11.07

NOTES:
a Horizontal Datum: NAD83 (2011) CA State Plane Zone 3, Epoch 2010.00
b Vertical Datum: NAVD88 (GRS80 Geoid 12B)

ESA collected topographic and bathymetric data via ground survey using total station and RTK GPS, including a profile along the proposed channel centerline, seven transects orthogonal to the proposed channel centerline, and three transects perpendicular to the shore along the beach in the vicinity of the proposed channel outlet location (North Beach adjacent to bluff). Survey points were collected at all perceived grade breaks along each transect. Figure 2 shows the ground survey points collected by ESA and others since 2010. Note that data gaps remain along the existing roadway embankment, in areas of dense vegetation, and at areas around the perimeter of the site.

SOA conducted a drone-based aerial survey of the site, which was post-processed by SOA and provided to ESA to use as part of the 60% design. Because of the presence of a significant amount of vegetated cover, SOA recommended using their drone-based LiDAR technology in the hopes that the vegetation could be penetrated to yield an accurate bare-earth representation of grades. However, after post-processing the data, significant ground elevation deviations of several feet (vertical) were observed in vegetated areas. Notable areas of vegetation bias were found along bands of cattails in the North Marsh as well as along high riparian scrub along the existing channel training dikes. Due to the high level of variability of the grades shown by the aerial survey as compared to the ground survey, only the ground survey data (i.e. the surveyed proposed channel centerline and cross sections) were used for design and quantities takeoffs. In light of the dense vegetation cover, as well as recent fires and anticipated sedimentation of the lagoon and marsh, we recommend additional surveys prior to construction.

The LiDAR topography products provided by SOA have some value for the roadway and highway embankment, or in areas void of significant vegetation. The LiDAR provided by SOA may also be helpful as a 'diagrammatic level' depiction of existing topography at Scott Creek, but otherwise may be limited in its utility.



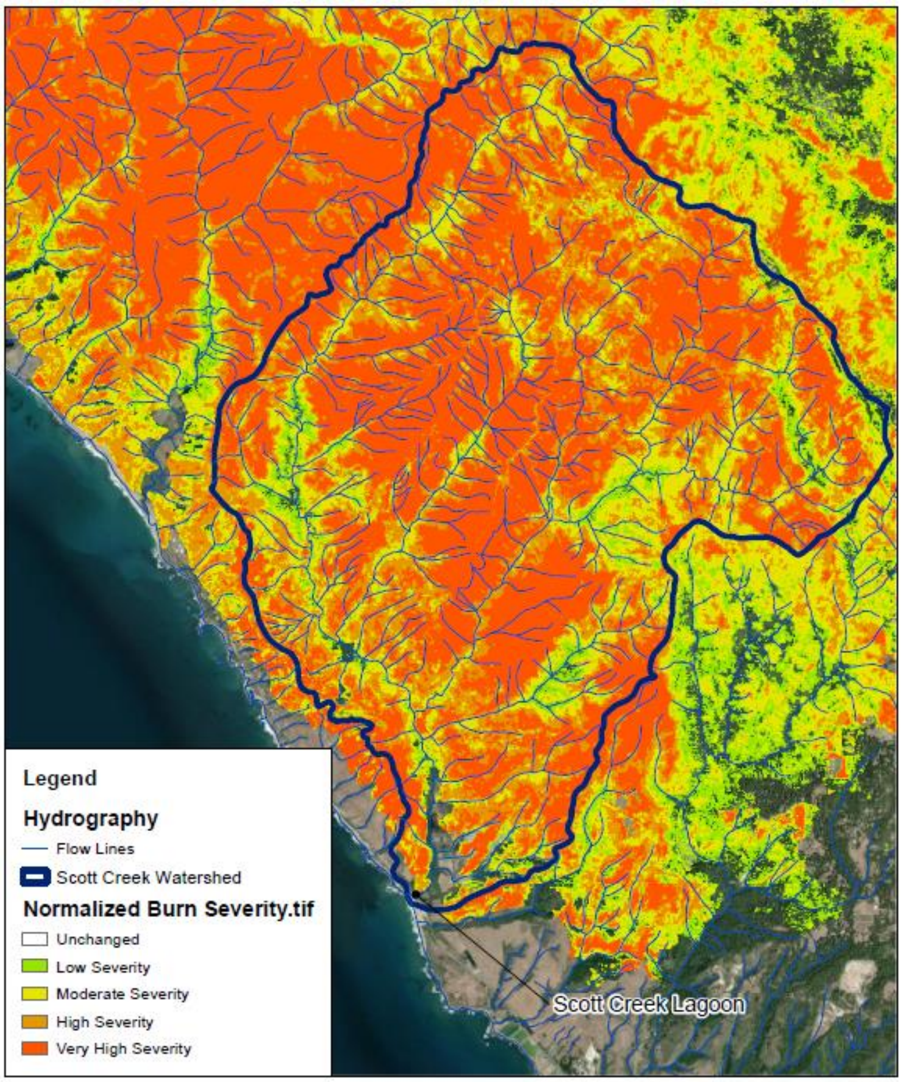
SOURCE: ESA, SOA, CSUMB

Scott Creek Lagoon and Marsh Restoration. D160350.00

Figure 2
Ground Survey Data Collected for the Scott Creek Project since 2011 by ESA and Others

2.4.3 Implications of 2020 Wildfire on Hydrology and Geomorphology of Project Site

The CZU Lightning Complex Fire in August and September 2020 burned 86,509 acres in Santa Cruz County, including approximately 95% of the Scott Creek Watershed (Santa Cruz County). ESA has not assessed the effects of the fire on hydrology, but it is our judgment that implications can include increased rainfall runoff and sediment delivery. Recent fires may have an effect on the project design due to potentially increased sediment delivery and sedimentation and hydrology, including flood flows and water levels. These implications have not been incorporated into the development of the 60% design. Figure 3 presents a map of the burn severity of the CZU Lightning Complex Fire in the Scott Creek watershed.



SOURCE: USGS, Spatial Informatics Group, ESRI

Scott Creek Lagoon and Marsh Restoration. D160350.00

Figure 3
Scott Creek Watershed and CZU Lightning Complex Fire Burn Severity

Because the burn severity throughout the Scott Creek watershed is primarily medium to very high, we expect that significant post-fire hydrologic effects could occur in the short to medium term, including increased peak flows, decreased lag times, and increased sediment yields. Subsequent design stages should assess how the changes in the watershed may affect the design of the project and account for potential changes to the site grades. Note that increases in sediment delivery to the estuary could help the marsh elevations keep pace with sea-level rise (see Appendix I of ESA 2020). Assuming that fire risk will increase in the future, the main implication (to be confirmed by planned monitoring of sedimentation) is that the higher sedimentation scenarios may be more likely in the future. This means that the lagoon is less likely to be drowned by sea-level rise and more likely that it will remain perched above ocean tides and have the same seasonal functionality as it currently does.

A research group through the University of California at Riverside, led by Andrew Gray, plans to conduct high-resolution monitoring of sediment in the Scott Creek Lagoon during the 2021 water year. The research will focus on geomorphic changes in the lagoon system, which may help to inform sediment loads and sedimentation rate changes resulting from the CZU Complex Fire.

3 RESTORATION DESIGN ELEMENTS

This section summarizes the restoration design elements and their advancement from preliminary design to 60% design. It is worth noting that some of the restoration design elements have not changed from preliminary design. Sections 3.5 and 3.6 describe how the proposed channel diversion and log habitat structures were progressed to 60% design. The 60%-complete construction drawings are provided in Appendix A. Figure 4 provides an overview of the restoration design elements discussed below.

3.1 New Channel

The new channel geometry (alignment, sections and thalweg elevations) is described in detail in the PDR (ESA 2020). Refinements to the bench design have been incorporated into the plans.

There are two typical sections, Type 1 and 2. Type 1 is a prismatic trapezoidal channel. Type 2 is similar to Type 1, but includes a bench at an elevation range from 5 to 8 feet NAVD with varying width along transitional segments. The plans include a table that describes the width of each bench along the channel stationing, as well as the channel thalweg elevation. The northing and easting of the channel alignment should be added to the table at a subsequent stage of design.

Materials generated from the channel excavation are expected to be primarily organic marsh peats and soils, with potential for coarse gravel and sand about three feet below grade. Sand and gravel materials shall be salvaged and spread along the bottom of the newly excavated channel, or otherwise reused as identified by the RCD and others. Organic peat materials will be excavated and transported out of the system to stockpile and/or disposal: The potential for beneficial or benign reuse on site may be practical with consideration of the oxygen demand and other potential water quality effects of peat backfill. The ultimate offsite disposal location of excess material has not been identified. We suggest retaining approximately 2,000 cubic yards of the organic marsh sediments for final placement as a top layer on the fill of the existing creek channel (see Section 3.3).

3.2 Alcoves

The new main channel includes four backwater channels (alcoves). The goal of the alcove features is to mimic the functions of the existing finger channel (see Figure 1) in the existing Scott Creek main channel, and to provide off-channel habitat for target species under the restoration objectives, with emphasis on tidewater goby habitat. The alcove features will also serve to maintain hydraulic connectivity to adjacent marshplain by providing inundation and drainage pathways, specifically for lagoon breach events. Reference Section 5.1.2 of the PDR for additional information. For final design, we suggest adding additional horizontal controls to lay out the preferred angle of each of the alcoves. Also note that a large wood habitat structure is located at the upstream corner of each of the alcoves, which is intended to provide habitat complexity and augment hydraulics by promoting scour around the alcove entrance.

3.3 Fill Existing Creek Channel

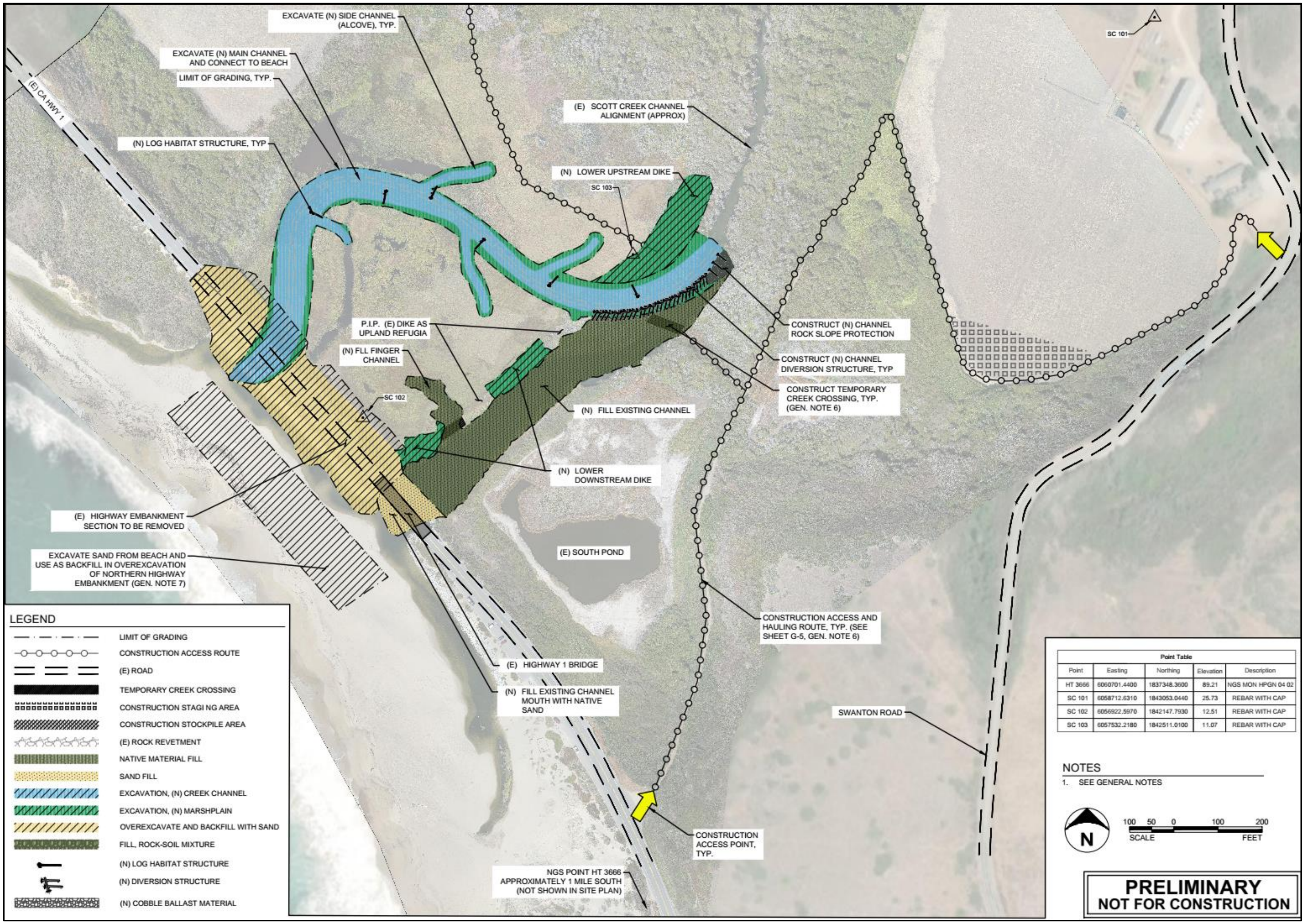
The project proposes to excavate a new channel through the north marsh and fill the existing channel to marshplain elevation (approximately elevation 10.5± feet NAVD). We suggest using material generated from excavating the northern Highway 1 embankment as the primary fill in the existing creek channel. As noted above, organic peat materials generated from the new channel excavation can be placed as a top layer to encourage revegetation. The filling of the existing channel would occur after the new main channel is connected to the ocean, and the diversion structure is constructed (see Section 4.4).

The 60% Drawings indicate that the existing finger channel (shown in Figure 1) be filled to a maximum fill elevation of 9 feet NAVD. The final fill elevation should be assessed during subsequent stage of design, and discussed with agencies. Because the existing finger channel is considered an ecologically productive feature, ESA was directed to limit fill placement at this location. The extent this feature is retained, or some form of it, such as a local depression, may be reassessed.

The design proposes to fill the existing creek channel mouth in the vicinity of the existing bridge with beach sand. We estimated that approximately 1,500 cubic yards of sand would be sufficient to partially fill the existing creek channel at its seaward end (this is in addition to the volume of sand for backfill of the roadway over-excavation described in Section 3.8). The sand would be harvested locally from the beach and placed in the existing creek channel. This sand fill is immediately adjacent to the roadway embankment over-excavation, which is also proposed to be filled with locally harvested sand. We expect the placed sand to create a continuous back beach transition to the marsh and lagoon.

Subsequent design stages should consider how elevated lagoon water levels will drain from the site, especially along the filled existing creek channel. As the water levels recede, we expect that flows will move across the marsh plain and along the paths of least resistance toward the new creek channel. We expect a likely drainage pathway will be along the filled channel to the west, and then to the north along a low area between the marsh and beach at the east edge of the excavated highway embankment. The conditions are not fully defined, as this is also the approximate location of the new bridge piers.

The final design should also consider whether any additional erosion protection is needed for the filled channel. In particular, the potential velocity and scour potential of outflows draining from the South Pond and cascading down to the fill.



Point Table				
Point	Easting	Northing	Elevation	Description
HT 3666	6060701.4400	1837348.3600	89.21	NGS MON HPGN 04 02
SC 101	6058712.6310	1843053.0440	25.73	REBAR WITH CAP
SC 102	6056922.5970	1842147.7930	12.51	REBAR WITH CAP
SC 103	6057532.2180	1842511.0100	11.07	REBAR WITH CAP

SOURCE: 60% plans, Appendix A

Scott Creek Lagoon and Marsh Restoration. D160350.00

Figure 4
Restoration Site Plan and Design Elements

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3.4 Dike Removal

Part of the design for the project includes lowering portions of the existing training dike along the northern bank of the existing creek channel to marshplain elevation (approximately elevation 10.5± feet NAVD). The dike will be lowered upstream of the new channel connection, downstream of the new channel connection, and immediately downstream of the existing finger channel to the north roadway embankment. One or two areas of the dike will remain to serve as upland refugia during high water levels for terrestrial animals.

3.5 Channel Diversion Structure

A channel diversion structure will be installed across the upstream end of the existing channel at the point where it will be filled. This structure, constructed of logs and coarse backfill, will span the existing channel bank to bank. The purpose of the channel diversion structure is to direct creek flows along the new channel alignment, and discourage an avulsion back to the existing channel, particularly in the first few years after construction. The channel diversion structure will provide a near-term structural component to train the flow toward the right meander. The structure is intended to maintain the meander in the 5 to 10 years after construction, allowing the new channel and marshplain to vegetate and establish. The wood blockage spans the entire distance from the existing left bank to the right bank training berm to prevent flanking immediately after construction. The design includes rock bank protection on the existing left bank, sized based on predicted 100-year flow (Q100), to prevent channel flanking east of the wood structure.

Wood (rather than concrete or rock) was selected as the primary building material due to its potential to provide habitat value in a dynamic geomorphic setting. Additionally, the wood will eventually decay, allowing natural channel migration to occur once the filled channel has consolidated and vegetated to a level that provides similar erosion resistance to the overall marshplain.

The structure consists of multiple logs with intact rootwads installed parallel and perpendicular to the flow. The logs are designed to engage flows between the low flow water surface elevation (7 feet NAVD) and the bankfull water surface elevation (9.5 feet NAVD). While lagoon water levels are typically higher during periods of closure (up to approximately 11 to 12 feet NAVD), flow velocities at those times are very low. The submerged rootwads will provide complex cover for juvenile salmonids as well as locations for macroinvertebrates and other food sources to reside The rootwads will create scour pools and provide low velocity refugia and channel shade over a range of flow depths.

The structure includes multiple, pinned vertical logs for stability, to withstand buoyancy and drag forces. The piles are used in lieu of large (>12” diameter) ballast boulders, which would likely be exposed in the dynamically erosive setting. The design does not include large rock in the system in response to the feedback provided by the agencies during the August 2020 TAC meeting.

The channel diversion structure is presented in Appendix A, Sheets D-1 and D-2. A summary of the design criteria is provided in Table 2. ESA developed the design criteria using recommended factors of safety and design guidance from various publications including U.S. Bureau of Reclamation (USBR 2014) and USACE (USBR and USACE 2016). This section outlines the assumptions, methods, and results of the channel diversion structure analysis.

TABLE 2
CHANNEL DEFLECTION STRUCTURE DESIGN VARIABLES

Criteria	Value	Basis
Safety Factors		
Minimum Factor of Safety - Sliding	1.50	Stability criteria for ‘low’ public safety risk rating and ‘moderate’ property damage rating (USBR 2014)
Minimum Factor of Safety – Buoyancy	1.75	Stability criteria for ‘low’ public safety risk rating and ‘moderate’ property damage rating (USBR 2014)
Minimum Factor of Safety – Rotation	1.50	Stability criteria for ‘low’ public safety risk rating and ‘moderate’ property damage rating (USBR 2014)
Minimum Factor of Safety - Overturning	1.50	Stability criteria for ‘low’ public safety risk rating and ‘moderate’ property damage rating (USBR 2014)
Hydraulics		
Stability Design Flow	100-year	USBR 2014 recommends 25-year flow for risk assessment. 25-year model run not available; ESA used 100-year for analysis.
Design Velocity	6.4 feet per second	Peak velocity at structure location for stability design flow.
Design Water Surface Elevation	El 14.0	Peak water surface elevation at structure location for stability design flow
Scour Depth	El 4.0	Assume potential migration of new channel invert
Structure Variables		
Height of Structure	El 11	Fill existing channel up to average marsh plain elevation (approximately El 10.5)
Height of Rootwads	El 7 to 9.5	Inundate rootwads between summer low flow water surface elevation and bankfull water surface elevation
Longevity	25 years[a]	Establish new channel and marsh plain, and allow for future creek migration
Log Diameters	18” – 24”	Balance log longevity and rootwad size with buoyancy
Log Dry Unit Weight	27 pounds per cubic foot	Unit dry weight for redwood. Assume imported wood material.
Bank Soil Class	Silt	ESA field observations
Bank Unit Dry Weight	82 pounds per cubic foot	Rafferty 2013
Streambed Soil Class	Very Coarse Gravel	ESA field observations
Streambed Unit Dry Weight	131.4 pounds per cubic foot	Rafferty 2013
Vertical Pile Installation Method	Driven	Structure stability relies upon skin friction of vertical piles. Vertical pile friction reduces by a factor of 0.5 if piles are drilled, and a factor of 0.25 if installed via excavation and backfill.
Anchoring Method	Stainless steel pin	Logs are anchored together by drilling a single threaded stainless steel rebar through the two logs. Method avoids cabling or epoxy.

[a] Approximate owing to uncertainties such as wood longevity and future events

3.5.1 Structure Risk and Safety Factors

For large wood structures, the criteria for resistance to movement is expressed as a combination of target design floods and associated factor of safety. The factor of safety is the ratio of net stabilizing force to net destabilizing force. There are four factors of safety critical for large wood design: resistance to flotation, overturning, sliding and rotation. The minimum factors of safety were selected according to guidance in USBR's *Large Woody Material Risk Based Design Guidelines* (2014), based on the structure's perceived risk to public safety and infrastructure.

The public safety risk addresses the risks posed by large wood within the wetted perimeter of a channel that can cause harm to people that are likely to be in and around the stream corridor. The site has no easy public recreational access (such as a boat ramp or trail), with minimal expected use by recreational craft or swimmers. A public safety risk rating of 'low' is appropriate for this site.

The property damage/infrastructure risk identifies risk to public and private infrastructure as a variable of potential dynamic stream response. The site is set in an alluvial fan with a highly mobile and erodible bed, with marsh sediments susceptible to bank erosion. The 'high' stream response rating is offset by the absence of building structures or sensitive utilities located directly adjacent to the channel diversion structure. Downstream structures include the existing Highway 1 crossing (600 feet downstream) and the new Highway 1 bridge abutments and piers (located approximately 1000 feet downstream). We assumed the new piers are spaced wide enough to allow mobilized wood material to pass through unimpeded, while any wood transported to the existing crossing would have negligible impact on the filled abutment. While the creek is geomorphically active, in the event of wood structure failure, the risk to infrastructure is mitigated by the highway improvements downstream. Therefore, a property damage risk rating of 'moderate' is appropriate for this site.

For the channel diversion structure design, ESA used the USBR (2014)-recommended factors of safety for a structure with a 'low' public safety risk rating and a 'moderate' property damage risk rating. See Table 2 for the design criteria. The USBR recommends using a stability design flow with a 25-year return period for this level of risk. ESA did not model the 25-year flood event, so we used hydraulic results from the more conservative 100-year return period for the large wood structural analysis.

3.5.2 Structure Design Criteria

ESA calculated the stability of the channel diversion structure using force balance analysis and generally following the guidance presented in the National Large Wood Manual (USBR and USACE, 2016). Evaluated forces included buoyance, lift, draft, passive earth pressure, pile friction, and lateral resistance. As this structure is anticipated to experience bank erosion and porous flow, we assumed some mobilization of the marsh fill placed on and around the log structure. The structure calculations therefore neglect the ballast weight of the marsh fill, and rely solely on the vertical piles for stabilization. The following assumptions were used in the analysis:

- Log Density: the log density affects the buoyance of the structure; with lower density species resulting in more buoyant force. We assume the logs will be imported redwood. Redwood is durable and ideal for use in structures, though it is a relatively low density wood. For the stability calculations, we use the more conservative dry density for redwood, at 27 pounds per cubic foot. Since the logs are expected to be partially submerged year-round due to the lagoon system, the expected actual (semi-saturated) density of the logs is expected to be greater than the dry density.

- Hydraulics: A design velocity of 6.4 feet per second is used for calculating drag forces on the rootwad and trunk. The velocity is the peak velocity at the diversion structure as derived from ESA's 2D hydraulic model run of the proposed 100-year flow event.

- Soil Parameters: Soil parameters are used for calculating the stabilizing forces acting on the log structures. To provide ballast weight and resistance to scour, the log structure backfill below elevation 9.0 is cobble ballast, which is a mixture of cobbles, gravels, and native material. The top layer of exposed fill is marsh fill. Since scour and mobilization of the backfill material is anticipated over time, material ballast weight was neglected in the stability calculations. The in-situ channel and floodplain soil parameters are used for the passive earth force and lateral resistance calculations. Geotechnical data is limited for the project site as no project-specific geotechnical investigation has been conducted thus far. From ESA's limited floodplain auguring and visual observations, the surface silty marsh material is around 3 feet thick and underlain by the coarse gravels and cobbles. For the stability analysis, we assume the in-situ floodplain soils subsurface are predominately coarse gravels.

3.5.3 Stability Analysis Results

ESA analyzed the channel diversion structure following the guidance presented in the USBR and USACE, 2016. The results of the vertical and horizontal force analysis are presented in Table 3.

TABLE 3
SUMMARY OF CHANNEL DEFLECTION STRUCTURE ANALYSIS

Type	Design Minimum	Calculated
Factor of Safety Sliding	1.50	6.72
Factor of Safety Buoyancy	1.75	2.58
Factor of Safety Rotation	1.50	6.76
Factor of Safety Overturning	1.50	1.73

The calculated safety factors all exceed the minimum design factors of safety, with the overturning moment as the restrictive safety factor for the structure. The analysis indicates that the design embedment depth of the vertical piles is critical for structure stability. ESA recommends a geotechnical investigation at the channel diversion structure location to verify the feasibility of installing driven piles to the specified depth. If hard rock or large cobbles prevent the pile installation depths shown on the 60% Drawings, alternate anchoring methods would be needed. These methods may include using large (1-ton and up) boulders or deeper subgrade excavation for greater embedment. The structure as currently designed is incompatible with these alternate anchoring methods, and additional design and analysis would be required.

3.6 Log Habitat Structures

The design includes Log Habitat Structures that provide various habitat and hydraulic functions depending on their locations within the lagoon and marsh. Please reference Appendix A, Sheets C-1 and D-3 for locations and details of the Log Habitat Structure, respectively. The design process for the Log Habitat Structures is similar to the Channel Deflection Structure described in Section 3.5. The structures use vertical pinning and minimizes large rock in the system. Stability analysis was performed in accordance with USBR's *Large Woody Material Risk Based Design Guidelines* (2014), and compared with minimum safety factors as described in Section 3.5.1 above.

3.6.1 Location and Target Functions

Table 4 summarizes the location and proposed function of each of the six Log Habitat Structures.

TABLE 4
LOG HABITAT STRUCTURE LOCATION AND FUNCTION SUMMARY

			Target Habitat			Geomorphic Function		
Location	Plan Station	Restoration Element	High Flow Refugia -Salmonids -Gobies	Scour Pool with Cover -Salmonids -Gobies -Amphibians	Basking -Amphibians	Wood Recruitment	Pool Scour Alcove connectivity	Sediment Sorting
Alcove Connection	4+50	Log Habitat Structure	X	X	X		X	X
Bench	6+50	Log Habitat Structure	X	X	X	X		X
Alcove Connection	8+40	Log Habitat Structure	X	X	X		X	X
Alcove Connection	9+00	Log Habitat Structure	X	X	X		X	X
Alcove Connection	11+00	Log Habitat Structure	X	X	X		X	X
Bench	13+50	Log Habitat Structure	X	X	X	X		X

Note: See Plans, Sheet D-3 for details on Log Habitat Structure

ESA proposes LHS at two primary locations to support and enhance the natural system processes that occur in lagoon and estuarine systems, including:

1. LHS positioned on channel benches to create low flow habitat, high flow refugia, and recruit additional wood debris in the system

2. LHS positioned at alcove connections to create low flow habitat and maintain hydraulic connectivity to alcoves by inducing scour.

3.6.2 Design Criteria

ESA developed design criteria based on outputs from hydraulic modeling completed for the PDR (Appendix F in ESA 2020). Table 5 summarizes recommended design criteria used to calculate stability of the Log Habitat Structure members.

TABLE 5
LOG HABITAT STRUCTURE DESIGN VARIABLES

Criteria	Value	Basis
Safety Factors		
Minimum Factor of Safety - Sliding	1.50	Stability criteria for 'low' public safety risk rating and 'moderate' property damage rating (USBR 2014)
Minimum Factor of Safety – Buoyancy	1.75	Stability criteria for 'low' public safety risk rating and 'moderate' property damage rating (USBR 2014)
Minimum Factor of Safety – Rotation	1.50	Stability criteria for 'low' public safety risk rating and 'moderate' property damage rating (USBR 2014)
Minimum Factor of Safety - Overturning	1.50	Stability criteria for 'low' public safety risk rating and 'moderate' property damage rating (USBR 2014)
Hydraulics		
Stability Design Flow	10-year	USBR 2014 recommended flow for risk rating.
Design Velocity	4.5 feet per second	Peak velocity at structure location for stability design flow.
Design Water Surface Elevation	El 11.6	Peak water surface elevation at structure location for stability design flow
Scour Depth	El 2.0	Assume potential migration of new channel invert
Structure Variables		
Longevity	10 - 25 years	Habitat elements
Log Diameters	18" – 24"	Balance log longevity and rootwad size with buoyancy
Log Dry Unit Weight	27 pounds per cubic foot	Unit dry weight for redwood. Assume imported wood material.
Bank Soil Class	Small Cobble	Import cobble ballast for wood trench.
Bank Unit Dry Weight	137.0 pounds per cubic foot	Rafferty 2013
Streambed Soil Class	Very Coarse Gravel	ESA field observations
Streambed Unit Dry Weight	131.4 pounds per cubic foot	Rafferty 2013
Vertical Pile Installation Method	Driven	Structure stability relies upon skin friction of vertical piles. Vertical pile friction reduces by a factor of 0.5 if piles are drilled, and a factor of 0.25 if installed via excavation and backfill.
Anchoring Method	Stainless steel pin	Logs are anchored together by drilling a single threaded stainless steel rebar through the two logs. Method avoids cabling or epoxy. Pins are located above the MHHW to minimize dewatering during construction.

3.6.3 Stability Analysis Results

ESA analyzed each log member of the Log Habitat Structure following guidance presented in the USBR and USACE, 2016. This analysis includes analysis of weight, drag, lift, buoyancy, ballasting, passive earth pressures, vertical skin friction, and log-log interactions to determine stabilizing and destabilizing forces and moments. Calculated results for forces and moments are then analyzed to determine resulting factors of safety and compared against risk-based safety factors.

Table 6 presents the results of the force balance analysis, which shows that the Log Habitat Structure will be stable within the design safety factors. Similar to the channel diversion structure, stability is contingent on the installation of the vertical log pile. During final design, a geotechnical assessment should be conducted to confirm the feasibility of installing the driven piles to the specified depth.

TABLE 6
SUMMARY OF LOG HABITAT STRUCTURE ANALYSIS

Type	Design Minimum	Calculated
Factor of Safety Sliding	1.50	49.50
Factor of Safety Buoyancy	1.75	2.59
Factor of Safety Rotation	1.50	1.92
Factor of Safety Overturning	1.50	44.70

3.7 Bank Protection

To prevent flanking of the channel diversion structure, the 60% design includes rock slope protection of the creek left (east) bank upstream of the large wood structure. The rock slope protection consists of a buried rock toe extending up to the average marsh plain elevation, with large wood and rootwads incorporated within the rock toe. The rock slope protection is intended to resist lateral (eastward) movement of the channel long-term. Rock sizing for the bank protection was based on the 100-year event, with a design velocity of 6.4 feet per second. ESA sized the rock material using the method outlined in USACE (1995). The design rock size is a Caltrans Class II (9-inch nominal) RSP per Caltrans Standard Specification Section 72-2.

ESA recommends that the RSP be placed using Caltrans Method A placement (no dumping), in order to achieve better rock-to-rock contact on the slope, although this should be reassessed. The Class II RSP is underlain by a gravel filter layer instead of a geotextile fabric, in order to avoid use of synthetic materials in the stream channel. The gravel filter layer gradation and thickness will be designed in accordance with *Design Information Bulletin No. 87* (Caltrans, 2014). The bank protection design aims to reduce the surface rock to the extent feasible. The Class II RSP will be covered with a layer of marsh fill, and the upper banks will be seeded to encourage vegetation establishment.

3.8 Removal of Highway 1 Northern Embankment

Removal of the Highway 1 Northern Embankment is a critical component of the project that will facilitate a connection of the new creek channel to the beach and ocean. Since its initial construction in the 1930s, we expect that the embankment and subgrade has consolidated considerably. Therefore, we have split this item into two primary components:

1. The removal of the highway prism down to marsh plain elevations (elevation 10.5± feet NAVD), to be coordinated with the roadway project.

    a. Excavation volume on the order of 50,000 cubic yards; not included in this design or in the cost estimate for the restoration project.

    b. Material generated likely best candidate for filling the existing Scott Creek channel, pending sediment tests (physical and chemical)

    c. Existing rock slope protection on ocean side will need to be removed and salvaged

    d. The existing roadway paving and subgrades will require demolition and disposal, or salvage and recycle if feasible

    e. Utilities – ESA has not investigated utilities which may exist in the roadway prism.

2. Over-excavation of the embankment subgrade to elevation 2 feet NAVD. Over-excavation along the length of the removed embankment is to allow the channel to migrate laterally from its design location over time without being constrained by resistant subgrade material at the deepest point of the invert.

    a. Excavation volume on the order of 27,000 cubic yards; volume is included in this design and is incorporated into the cost estimate for surplus material offhaul

    b. Excavate down to elevation 2 feet NAVD, or as refined during final design. This elevation was selected based on the observed channel invert elevations in the vicinity of the existing bridge.

    c. Excavation area is likely to fill with groundwater, which may require work in water and/or water control and pumping

    d. If native sands are encountered during excavation, the sand material above elevation 2 feet NAVD should be excavated and retained for loose placement in the over-excavation area

    e. On land side, daylight over-excavation into marsh after removing as much of the imported fill as is feasible

    f. On ocean side, daylight over-excavation into existing lagoon channel and/or beach sands after removing as much of the imported fill as is feasible

    g. Place locally harvested beach sands in over-excavation area to construct back-beach transition to lagoon and marsh (if sufficient sand material is available, may want to pursue constructing dunes with crest elevations greater than elevation 10.5 feet NAVD)

4 CONSTRUCTION PERIOD AND PHASING

The following sections include a discussion of some of the new factors that were identified that could influence construction, the general construction approach, an estimate of the likely construction windows, a brief description of construction access and staging, suggestions on project phasing, and possible water management strategies. Possible construction phasing is addressed pending further development of the roadway design and associated coordination between roadway and restoration design elements.

4.1 New Factors that Influence Construction

Construction methods and phasing were initially described in the PDR, but refined in this report to consider the following:

- Habitat constraints tabulated by the TAC (see Appendix B in PDR), further input on habitat from members of the ESA team, and ongoing monitoring findings from NOAA fisheries.
- Seasonality of lagoon water levels controlled by the lagoon mouth, runoff, and wave overwash, and possibilities to manage the beach berm, and hence water levels to facilitate construction during relatively lower water levels.
- Existing conditions of the likely construction access routes to the site, and potential improvements that may be required
- Potential for alternative approaches to construct the restoration project
- Caltrans' design of the new bridge, which, as of November 2020, is tentatively planned to be aligned to the east of the existing highway, but other alternatives are expected to be evaluated.

4.2 Approximate Construction Windows

We identified construction windows based on typical lagoon water levels and expected habitat constraints. Construction of the project will occur in three primary zones with distinct habitat characteristics (See locations in Figure 1 and Figure 4):

1. North marsh
2. Existing channel, both upstream and downstream of the existing bridge
3. Beach

Using seasonal water level data and the habitat matrix developed by the TAC (PDR, Appendix B), we developed a matrix for each of the three zones that shows water levels and species use for each month of the year. The lowest water levels of the year typically occur in spring and early summer, when the mouth is still open and draining to the ocean. The matrices are intended to assist in identifying the ideal construction windows that would minimize disturbances to habitat, or would help identify potential mitigation measures that would facilitate construction.

4.2.1 North Marsh Construction Windows

We identified the ideal construction window in the north marsh to be from approximately April through July (Table 7). Average water levels range from 6 to 9 feet NAVD in the months from March to June, which is just below the threshold level that the north marsh starts to become inundated. Timing the construction for low water levels would make excavation and sediment placement easier using traditional or low-ground-pressure (LGP) equipment, as the water table would be lower and soils would be easier to work with. The construction window could be extended into the early fall by managing the lagoon mouth and hence water levels (see Section 4.5), which could help maintain drier conditions for using construction equipment on the marsh.

TABLE 7
NORTH MARSH: PREFERRED CONSTRUCTION WINDOW AND SPECIES USE CONSTRAINTS

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Water Level (feet NAVD88)	*9 ± 2*	*9 ± 2*	*8 ± 1*	*8 ± 1*	*8 ± 1*	*9 ± 1*	*9 ± 2*	*9 ± 1*	*9 ± 1*	*9 ± 1*	*10 ± 2*	*10 ± 2*
Chance mouth is closed	*25%*	*10%*	*5%*	*5%*	*10%*	*30%*	*60%*	*70%*	*85%*	*90%*	*80%*	*40%*
Steelhead (Adult Migration)												
Steelhead (Juvenile Rearring)												
Steelhead (Smolt Out- migration)												
Steelhead & Coho (Smolt Feeding)												
Coho (Adult)												
Coho (Juvenile Rearring)												
Coho (Smolt Out-migration)												
TWG - Spawning			not near open mouth									
TWG – Adult	above bridge, not near mouth when open											
CRLF – Breeding												
CRLF – Tadpole												
CRLF - Foraging												
Plover – Adult												
Plover - Breeding												
WPT												
Tricolored Blackbird												

"= Peak intensity activity"
"= Low intensity activity"

Construction activities in the north marsh will be focused on excavating the new channel and alcoves. We suggest managing water levels in the lagoon through spring and early summer by maintaining the sand bar/beach berm at approximately elevation 6 to 7 feet NAVD to target a lagoon water level of 7 feet NAVD or lower. Although Table 7 shows peak intensity use of the north marsh by CRLF during these months, we suggest considering the possibilities of implementing the construction at this time, which may require using specific species avoidance and mitigation measures to be determined by others.

4.2.2 Existing Channel Construction Windows

We identified the optimal construction window for filling the existing channel to be in the late summer through fall months, which will limit disturbance to tidewater gobies, steelhead, and Coho (Table 8).

TABLE 8
EXISTING CHANNEL: PREFERRED CONSTRUCTION WINDOW AND SPECIES USE CONSTRAINTS

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Water Level (feet NAVD88)	*9 ± 2*	*9 ± 2*	*8 ± 1*	*8 ± 1*	*8 ± 1*	*9 ± 1*	*9 ± 2*	*9 ± 1*	*9 ± 1*	*9 ± 1*	*10 ± 2*	*10 ± 2*
Chance mouth is closed	*25%*	*10%*	*5%*	*5%*	*10%*	*30%*	*60%*	*70%*	*85%*	*90%*	*80%*	*40%*
Steelhead (Adult Migration)												
Steelhead (Juvenile Rearring)												
Steelhead (Smolt Out- migration)												
Steelhead & Coho (Smolt Feeding)												
Coho (Adult)												
Coho (Juvenile Rearring)												
Coho (Smolt Out-migration)												
TWG - Spawning												
TWG – Adult												
CRLF – Breeding												
CRLF – Tadpole												
CRLF - Foraging												
Plover – Adult												
Plover - Breeding												
WPT												
Tricolored Blackbird												

"= Peak intensity activity"
"= Low intensity activity"

Activities in the existing channel would not commence until the new proposed channel alignment is active and connected to the beach and ocean under the new bridge. Therefore, the channel is not expected to have a high level of use by the target species, and there are more opportunities to relocate species away from the existing channel after it is isolated from the active new channel. However, initial efforts to remove species from the existing channel should be undertaken prior to construction. Ongoing monitoring would be expected through the construction period. Similar to work in the north marsh, management of the water levels is suggested by maintaining a low beach berm at approximately 6 to 7 feet NAVD.

4.2.3 Beach Construction Windows

Construction activities on the beach would occur during and after removal of the existing Highway One north embankment. Construction activities include over-excavation and removal of embankment materials and backfilling with beach sand. Depending on the source of sand material, construction activities could include movement of sand from the beach in the vicinity of the new mouth connection, and as part of the ongoing water management strategy. Other sand sources could include harvesting windblown sand, or harvesting beach sand from near the mouth of Molino Creek, which would entail moving sand from the south end of the beach.

To limit disturbances to Snowy Plover habitat, we recommend construction activities on the beach during September and October (Table 9). However, we also acknowledge that it is desirable to conduct lagoon mouth management of the beach berm potentially from the spring and into the fall, which may require special conditions and construction-period mitigation measures.

TABLE 9
SPECIES USE CONSTRAINTS AT BEACH

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Water Level (feet NAVD88)	*9 ± 2*	*9 ± 2*	*8 ± 1*	*8 ± 1*	*8 ± 1*	*9 ± 1*	*9 ± 2*	*9 ± 1*	*9 ± 1*	*9 ± 1*	*10 ± 2*	*10 ± 2*
Chance mouth is closed	*25%*	*10%*	*5%*	*5%*	*10%*	*30%*	*60%*	*70%*	*85%*	*90%*	*80%*	*40%*
Steelhead (Adult Migration)												
Steelhead (Juvenile Rearring)												
Steelhead (Smolt Out- migration)												
Steelhead & Coho (Smolt Feeding)												
Coho (Adult)												
Coho (Juvenile Rearring)												
Coho (Smolt Out-migration)												
TWG - Spawning												
TWG – Adult												
CRLF – Breeding												
CRLF – Tadpole												
CRLF - Foraging												
Plover – Adult												
Plover - Breeding												
WPT												
Tricolored Blackbird												

"= Peak intensity activity"
"= Low intensity activity"

4.3 Construction Access and Staging

Three construction access routes were identified in the PDR, and are shown on the plans. We suggest maintaining more than one route into and out of the site to provide one-way traffic for circular hauling as is possible.

We expect that the access routes along the existing trails would require improvements to facilitate transport of heavy equipment and trucks, including a potentially significant amount of grading to widen and resurface the access routes. This would involve removal of existing vegetation and grading to achieve minimum required dimensions and stability criteria (to be determined). Other site access opportunities should be considered in connection with the construction of the new bridge.

Access within the interior of the project site will be challenging. A primary activity of the project is to excavate the new channel and remove about 20,000 cubic yards of marsh sediments. For purposes of designing the 60%-complete plans and estimates, we assumed that the contractor will construct a temporary access road through the marsh within the footprint of the proposed channel. As excavation progresses, the road materials would be removed.

4.4 Phasing

The phasing of construction of the restoration project is very closely tied to bridge construction. We are presenting five considerations that are key to establishing the optimal construction approach and phasing. We do not have enough information at this time to make a recommendation on phasing, but we are suggesting a possible sequence.

The five primary considerations for establishing the optimal construction approach and phasing are:

– Limiting habitat impacts
– Water management
– Soils management
– Equipment access
– Bridge construction

Based on a preliminary assessment of the considerations listed above, we suggest the following potential construction sequence presuming that the roadway and restoration components are integrated in construction contract or the contracts are otherwise implemented coincidentally:

1. Water management and control – beach berm management
2. Construct access route(s) to North Marsh
3. Construct interior North Marsh access route along new channel
4. Excavate new channel and remove interior North Marsh access route; stockpile approximately 2,000 cubic yards of organic marsh sediments, and offhaul remaining sediment
5. Construct new Highway 1 bridge, and reroute traffic
6. Excavate existing Highway 1 embankment, including over-excavation; stockpile approximately 10,000± cubic yards of sediment to be used for filling the existing creek channel, and offhaul remaining sediment
7. Harvest sand from beach and backfill Highway 1 embankment footprint
8. Extend new lagoon channel through beach
9. Connect new lagoon channel to existing channel upstream (option: construct channel earlier as “blind” dead-end channel during other construction)
10. Isolate existing channel with coffer dams upstream and downstream
11. Dewater existing channel
12. Construct channel diversion structure and bank protection
13. Fill existing channel
14. Removal of temporary access routes and coffer dams
15. Restore conditions and revegetation (planting)

Other factors not addressed in this report may affect construction phasing, and other phasing is possible and may be desired. For example, the roadway work could be completed first and the restoration construction follow. This approach would also require coordination of the earthwork and hydraulic connectivity within the existing and new roadway construction corridors. Conversely, the majority of the restoration construction could be accomplished first, with the channel fill occurring as part of the transportation project. The phasing discussion is provided to illuminate apparent opportunities and constraints for consideration by project leaders in their programming of implementation.

4.5 Water Management

ESA recommends a series of water management actions for surface and groundwater levels in the lagoon listed below. In addition, ESA recommends ongoing monitoring of water surface elevations and water quality in the lagoon during construction activities.

4.5.1 Water Surface Elevations

Scott Creek has a natural tendency to maintain low water levels in spring and early summer by spilling over the beach through a long, non-erosive channel (Hayes et al. 2008). This tends to maintain low water levels (6-7 feet NAVD88) prior to seasonal closure of the lagoon in mid-summer. This is possible because late spring/summer freshwater flows are very low and the high elevation of the lagoon (i.e., 'perched conditions') limits how deep the mouth can erode. To the extent feasible, we suggest encouraging this condition by managing beach elevations at the mouth during the construction activities. When not feasible, we recommend the use of pumping and water control structures.

Lagoon Mouth Management

Permitting efforts for the project should consider intermittent lagoon mouth management activities focused on maintaining water surface elevations at or near 6 to 7 feet NAVD88 during construction, and maintaining suitable water quality conditions for relocation efforts. Lagoon mouth management activities to be considered are:

- Managed outflow
- Installation of water control structures, and
- Pumping.

Management of the lagoon mouth should be considered following local precipitation (runoff-driven) and/or swell (wave-driven) events.

Managed Outflow

Managed outflow involves excavation of a notch through the sand bar at specific elevations to encourage controlled outflow from the lagoon once water levels rise to a threshold elevation (the elevation created by the notch in the berm).

This method can be applied to control water levels in the lagoon without causing a full breach (erosion of the mouth to lower levels) by applying lessons learned from other sites in Santa Cruz and San Mateo counties, including the San Lorenzo River and Pescadero Lagoon: (1) timing excavation during rising tides, (2) using a long channel alignment to minimize channel slope on the beach, and (3) placing sand in the channel if necessary to slow flows. Maintaining non-erosive outflows can also be achieved by back filling the notch with coarse rock (gravels and cobbles) to create a natural low permeability conduit for specific water elevations.

ESA recommends that pre-defined breach protocols include:

1. Active and continuous lagoon water level and water quality monitoring throughout lagoon mouth management activities with designated construction staff members monitoring local weather (precipitation and waves) forecasts
2. Pre-defined locations and access routes for lagoon mouth management activities
3. Protocols for species protection and monitoring biological conditions before, during, and after lagoon mouth management activities.

Water Control Structures

Water Control Structures would include a combination of culverts, weirs, orifices, and risers such that drainage of the system is activated at a specified elevation. If selected for lagoon mouth management, WCSs should be designed around threshold water surface elevations in the lagoon.

Pumping in North Marsh and Existing Channel

Pumping may be an optional/additional action to take during the filling of the existing channel with sediments. To be feasible, we expect that a series of cells would need to be constructed in the isolated existing channel so that pumping could effectively have a greater chance at lowering the water elevations of a given area for a sustained period. Cells could be constructed of natural and imported materials, although only specific natural and suitable materials would be permitted to remain onsite after construction. Suitable materials could include large wood, rock debris, and other natural materials; less suitable material that would need to be removed include steel or vinyl sheet piles, etc. Construction of cells and associated water management is one potential approach for the construction of the channel diversion structure and for progressively filling the channel.

Manual Breaches of Lagoon Mouth [Not Recommended]

ESA does not recommend manually breaching the lagoon, which typically involves using heavy equipment to dig a deep notch in the beach at outgoing tide that encourages formation of an erosive channel and full drainage of the lagoon. Manual breaching can maximize potential adverse effects to plants, animals and habitat and further study is recommended prior to allowing this approach.

4.5.2 Groundwater Seepage into Excavated Channel

Changes in ground water levels are possible as a result of construction. Excavating the new channel on the north marsh during the first phase of construction will create a seasonal pool that will collect groundwater from the surrounding marsh. Theoretically, water diversion to the new channel could influence water levels in the adjacent existing channel, which may receive less groundwater from the north marsh than under existing conditions. However, we expect that the water capture in the new channel will be lower than the rate at which the groundwater is replenished by base flows in the creek, and so we do not anticipate any significant threat to water volumes in the creek. We estimated a rough volume of potential groundwater ponding in the excavated new channel to be on the order of 3 to 4 acre-feet (assuming that 1,000 feet of channel is excavated from the existing embankment and up to the existing creek connection, but remains isolated). With a creek base flow of 1 to 2 cubic feet per second (cfs), the daily flows are approximately 2 to 4 acre-feet per day and hence the volume of the new channel is similar to the daily base inflow. Therefore, if the channel is constructed over a period of several weeks, we think that the water levels in the existing channel will not be diminished significantly as the new channel fills.

4.5.3 Water Quality

Maintaining and managing water quality at the site will help mitigate construction impacts to coastal resources. Construction activities for the project are expected to increase turbidity and decrease dissolved oxygen in the system. Construction activities should be carried out in a manner to minimize negative impacts to water quality conditions in the north marsh and existing channel during all phases of construction. Water quality should be continuously monitored in the existing and new channels during construction. Potential water quality metrics that could be tracked include the turbidity, dissolved oxygen, and the salinity. Water quality metrics should be assessed and detailed further during final design so that the contractor can implement mitigating protocols if selected water quality thresholds are exceeded. The primary concern is that volumes of water with poor water quality or low levels of dissolved oxygen could mix with water with good quality, and cause a biochemical oxygen demand that would potentially impact aquatic organisms and/or cause a fish kill. For example, care should be taken when the existing channel is connected to the new channel so that there are no unintended consequences of the ponded water mixing with the existing creek flows.

Based on prior reporting by Gormley (2013) and groundwater monitoring and sediment water quality testing performed as part of the PDR effort (see Appendix E of ESA 2020), we expect that groundwater in the north marsh will seep into the new channel, and that initially this water will have low levels of dissolved oxygen. This is consistent with prior observations of a sulfur odor in ponded areas at the seasonally ponded areas of the north marsh.

Prior observations indicate that poor water quality conditions could dissipate over time once groundwater enters the new channel. Gormley (2013) found that when exposed to the atmosphere, this water in the north marsh rapidly re-oxygenated. Further, Appendix E of the PDR noted biochemical oxygen demand values were lower with proximity to the main channel (which acts as a ponded channel during closed lagoon conditions). Groundwater monitoring in the former channel location by ESA also indicated rapid shifts in salinity, suggesting high levels of subsurface water flow (i.e. not stagnant conditions). These observations suggest that water seeping into the new channel would be expected to improve in quality over time. Despite this, these areas should be monitored further and determined whether there is potential to degrade water quality in the excavated new channel.

4.6 Alternative Construction Methods for Consideration

To aid cost estimating and engineering design of the project, we made several assumptions to identify the construction methods described above. We acknowledge that several alternative construction methods may provide cost and or feasibility benefits with additional information.

One possible method that was used recently at Pescadero Creek, another coastal lagoon restoration project located approximately 20 miles north of Scott Creek, was an amphibious excavator and suction dredge. The project pumped the excavated material as a slurry which was discharged into an existing channel, where it decanted. This is a possibility for the Scott Creek site as well. Implementing a slurry operation requires a significant amount of water. Additional assessment of the water availability at the site to facilitate this approach would be needed, as well as opportunities to collect and reuse the decant water. The potential implications of this approach on habitat and species use would also need to be assessed.

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5 ENGINEER'S ESTIMATE OF PROBABLE CONSTRUCTION COSTS

Table 10 presents an estimate of the probable construction cost for the project, totaling approximately $7 million. This estimate represents the probable construction costs at a 60%-complete level of design, and should be refined as the design progresses.

TABLE 10
ENGINEER'S ESTIMATE OF PROBABLE CONSTRUCTION COSTS – 60%-COMPLETE DESIGN

Item	Description	Quantity	Unit	Unit Cost	Extended Price
1	Mobilization	1	LS	$ 470,000	$ 470,000
2	Temporary Access Roads	1	LS	$ 75,000	$ 75,000
3	Water Control and Beach Berm Management	1	LS	$ 150,000	$ 150,000
4	SWPPP Compliance	1	LS	$ 50,000	$ 50,000
5	Clear and Grub	1	LS	$ 120,000	$ 120,000
6	Demo Existing Highway 1 Culvert	1	LS	$ 30,000	$ 30,000
7	Excavation - Channel, Alcoves, and Dike	20,000	CY	$ 70	$ 1,400,000
8	Over-excavation Beneath Highway Embankment	27,100	CY	$ 30	$ 813,000
9	Channel Diversion LWD Unit	14	EA	$ 18,300	$ 256,200
10	Bank Protection	80	LF	$ 1,000	$ 80,000
11	LWD Log Habitat Structure	6	EA	$ 6,000	$ 36,000
12	Sand Cut and Fill at Existing Channel Mouth	1,500	CY	$ 25	$ 37,500
13	Sand Cut and Fill at Over-excavation	10,000	CY	$ 25	$ 250,000
14	Fill Existing Channel with Highway Embankment Material	9,000	CY	$ 40	$ 360,000
15	Surface Fill of Existing Channel (Marsh Sediment)	2,000	CY	$ 30	$ 60,000
16	Export Remaining Fill	30,685	CY	$ 50	$ 1,534,250
17	Dune Planting	2	AC	$ 40,000	$ 80,000
18	Wetland Planting	3.7	AC	$ 15,000	$ 55,500
	Subtotal				$ 5,857,450
	Contingency	20%			$ 1,171,490
	Total				$ 7,028,940
	Total (Rounded)				**$ 7,030,000**

NOTES:
1. This estimate reflects only costs associated with the habitat restoration
2. We assume that costs of bridge replacement and roadway modifications are separate and not included
3. We estimate that the roadway embankment excavation to be approximately 50,000 CY (not included)
4. Unit cost for offhaul is an allowance and no specific site has been determined

Note that this estimate reflects only the costs associated with the habitat restoration, and does not include costs of bridge replacement and roadway modifications. We estimate that the removal of the northern highway embankment to increase the excavation volumes by approximately 50,000 cubic yards. Fill volumes in the existing channel represent neat-line volumes that do not account for settlement; export volumes were decreased by 15% to account for losses during construction, including for fill placement. The unit cost for offhaul and export of remaining fill is an allowance and no specific site has been determined.

These cost estimates are intended to provide an approximation of total project costs appropriate for the 60%-complete level of design. These cost estimates are considered to be approximately -15% to +30% accurate, and include a 20% contingency to account for project uncertainties (such as final design, permitting restrictions and bidding climate). 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 monitoring and/or ongoing maintenance. Estimated costs are presented in 2020 dollars, and would need to be adjusted to account for price escalation for implementation in future years. This opinion of probable construction cost is based on: ESA's previous experience, bid prices from similar projects, consultation with contractors/suppliers, R.S Means (2020) cost database. 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.

6 NEXT STEPS AND FINAL DESIGN

We identified the following list of items that should be considered and potentially refined during final design:

- Determine construction phasing with particular consideration of roadway construction.
- Survey data: Conduct supplemental ground survey of site to fill data gaps, and check prior surveys and control. If fires in the watershed result in significant marshplain and channel sedimentation, additional resurvey may be required. Prepare a site base map for all design activities, including bridge replacement and roadway modifications and the restoration components.
- Geotechnical assessment of site conditions for diversion structure to assess the feasibility of driving vertical pile logs to the specified depth. This could also be used to inform feasibility for vertical pins at the log habitat structures.
- Incorporation of post-fire watershed conditions on estuary system and project design (e.g., effects on sedimentation and grades, flood elevations, flood velocities, etc.)
- Assessment of construction periods relative to habitat windows and appropriate species avoidance and mitigation measures. Confirmation with regulatory agencies.
- Access routes and staging areas need to be better defined. Final design should select the preferred access locations and include additional information for site access on plans.
- Assess whether erosion control measures and/or flow management of water discharged from south pond to the filled channel is needed to minimize potential scour impacts.
- Determine approach for retaining or filling the existing finger channel; including whether all areas of the existing channel should be filled, the maximum design elevation and whether to include micro-topographic features for additional habitat benefits.
- Identify suitable locations for stockpile of excavated materials to be reused onsite.
- Identify suitable offhaul locations for reusing surplus excavated materials.
- Conduct physical and chemical testing of Highway 1 northern embankment to confirm that excavated materials are acceptable for filling the existing channel.
- Confirm that sand backfill can be borrowed locally from the beach.
- Confirm that managing beach berm to a specific elevation for water management will be allowed

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7 REFERENCES

ESA, 2020, Preliminary Design Report, Scott Creek Lagoon and Marsh Restoration Project, Prepared for Resource Conservation District of Santa Cruz County, November 2020.

Gormley, M.D. 2013. The Influence of Hydrogeomorphology, Soil Redox Conditions, and Salinity on the Spatial Zoning of Saltgrass, Salt Rush, and Cattails in Scotts Creek Marsh, Swanton Pacific Ranch, CA. M.S. Thesis. California Polytechnic State University, San Luis Obispo.

Hayes, S.A., Bond, M.H., Hanson, C.V., Freund, E.V., Smith, J.J., Anderson, E.C., Ammann, A.J., and MacFarlane, R.B., 2008, Steelhead Growth in a Small Central California Watershed: Upstream and Estuarine Rearing Patterns, *Transactions of the American Fisheries Society*, 137, pp. 114-128.

U.S. Bureau of Reclamation, 2014, Pacific Northwest Region Resource and Technical Services - Large Woody Material Risk Based Design Guidelines. US Department of the Interior, Bureau of Reclamation, Pacific Northwest Region, Boise, Idaho.

U.S. Bureau of Reclamation and US Army Corps of Engineers, 2016, National Large Wood Manual, Assessment, Planning, Design, and Maintenance of Large Wood in Fluvial Ecosystems: Restoring Process, Function, and Structure. January 2016.

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8 ACKNOWLEDGEMENTS

We graciously thank and acknowledge the contributions of all of the members of the Technical Advisory Committee and the RCD of Santa Cruz County. Specifically, we acknowledge the contributions of the following RCD staff:

Lisa Lurie

Daniel Nylen

Jim Robins (Alnus Ecological)

The following ESA staff contributed to the development of the 60% design documents and this Basis of Design Report:

Dane Behrens, PhD, PE (Project Manager)

Andy Collison, PhD (Project Director)

Louis White, PE (Project Engineer, C76509)

Marisa Landicho, PE

Scott Smith, EIT

Bob Battalio, PE

Ann Borgonovo, PE

Jorgen Blomberg

Damien Kunz

Becca Deshetler

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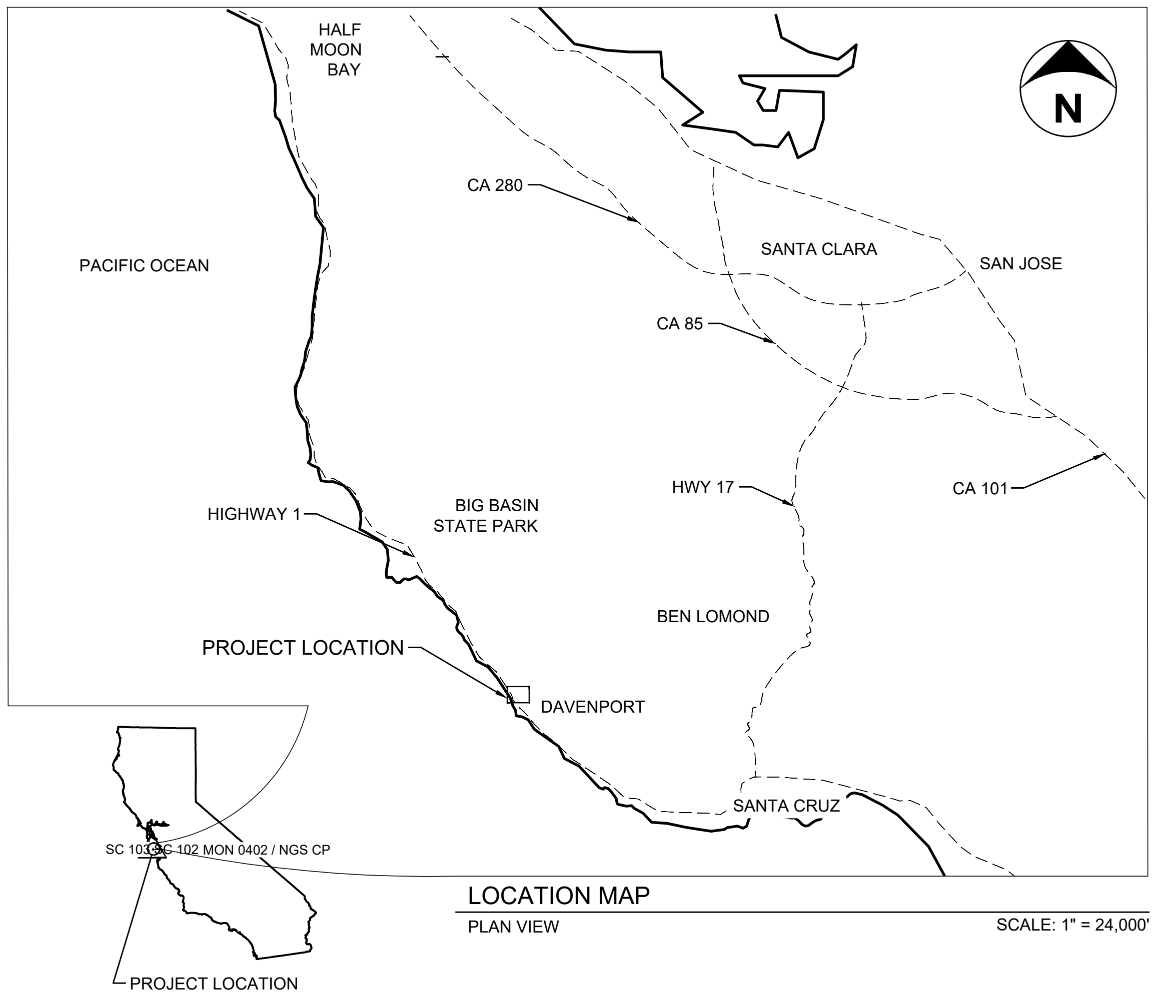
Appendix A
60%-Complete Plans

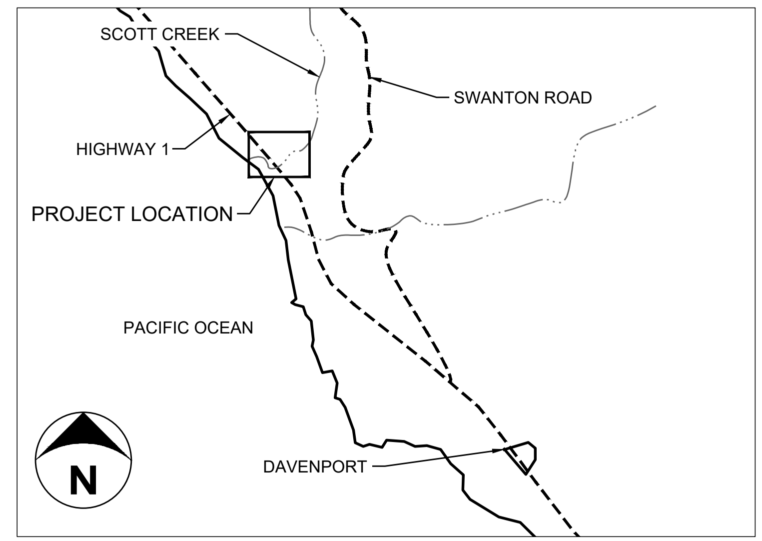
SCOTT CREEK LAGOON AND MARSH RESTORATION PROJECT

60% DESIGN
NOVEMBER 30, 2020



LOCATION MAP

PLAN VIEW — SCALE: 1" = 24,000'

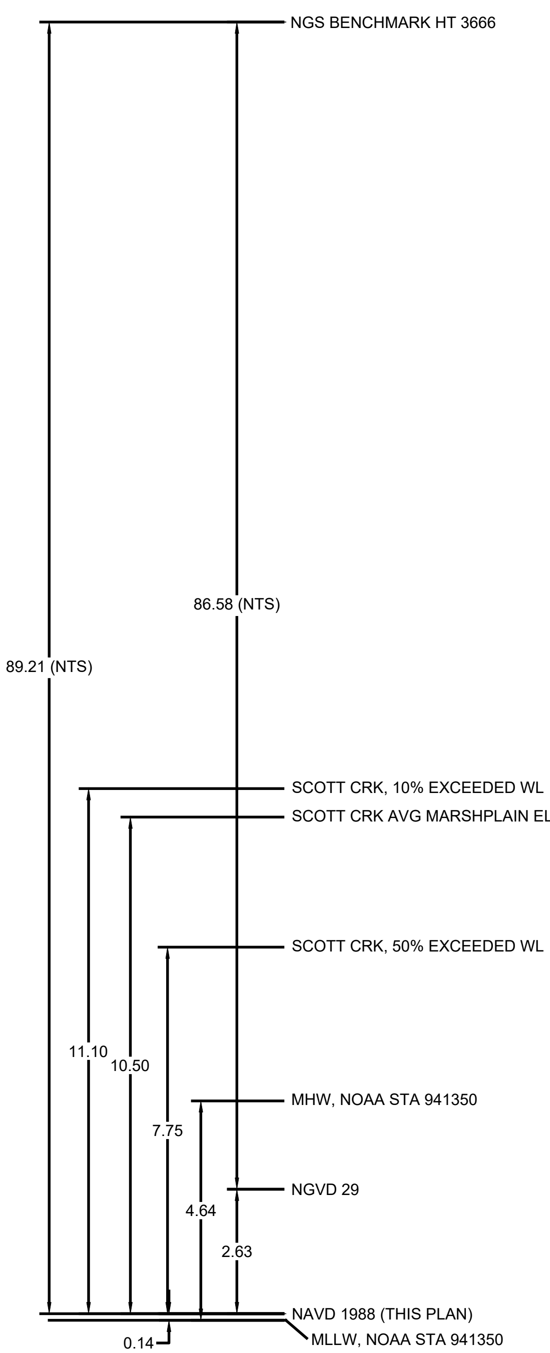


VICINITY MAP

PLAN VIEW — SCALE: 1" = 2000'

INDEX OF SHEETS

DATUMS (GENERAL NOTE 4)



DEFINITIONS

PROJECT OWNER: RESOURCE CONSERVATION DISTRICT OF SANTA CRUZ COUNTY
820 BAY AVENUE, SUITE 136
CAPITOLA, CA 95010

CONTACT: LISA LURIE
PH: (831) 464-2950

PROJECT ENGINEER: ENVIRONMENTAL SCIENCE ASSOCIATES
550 KEARNY STREET, SUITE 800
SAN FRANCISCO, CA, 94116

CONTACT: LOUIS WHITE, PE
PH: (415) 896-5900

PRELIMINARY
NOT FOR CONSTRUCTION

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SAN FRANCISCO, CA 94108
OFFICE - 415.896.5900
WWW.ESASSOC.COM

STAMP

PRELIMINARY

PREPARED FOR:
RESOURCE CONSERVATION DISTRICT OF SANTA CRUZ COUNTY

PROJECT NAME
SCOTT CREEK LAGOON AND MARSH RESTORATION PROJECT

REVISIONS

#	DATE	DESCRIPTION

DESIGNED	L. WHITE
DRAWN	S. SMITH
CHECKED	L. WHITE
IN CHARGE	L. WHITE C76509
PROJECT NUMBER	D160350.00
ISSUE DATE	11/30/20

SCALE IS AS SHOWN WHEN PLOTTED TO FULL SIZE (22"x34")
1"

PHASE
60% DESIGN

SHEET TITLE
TITLE SHEET

DRAWING NUMBER
G-1

SHEET 1 OF 12

FILE: K:\projects_2016\D160350.00 - Scott Creek Lagoon and Marsh Restoration\10 CAD\Dwgs\30pct Design\01 TITLESHEET.dwg PLOT DATE: 11/30/2020 1:10:35 PM PLOTTED BY: SCOTT SMITH

LEGEND

PARCEL BOUNDARY	(E) MAJOR CONTOUR LINE
LIMIT OF WORK	(E) MINOR CONTOUR LINE
LIMIT OF GRADING	(N) MAJOR CONTOUR LINE
MATCHLINE	(N) MINOR CONTOUR LINE
CONSTRUCTION ACCESS ROUTE	FILL, ROCK-SOIL MIXTURE
(E) ROAD	(E) ROCK REVETMENT
(E) ROCK REVETMENT	NATIVE MATERIAL FILL
FILL	SAND FILL
EXCAVATION	EXCAVATION, (N) CREEK CHANNEL
OVERHEAD POWERLINES	EXCAVATION, (N) MARSHPLAIN
(E) ROAD	OVEREXCAVATE AND BACKFILL WITH SAND
CLEARING AND GRUBBING	FILL, ROCK-SOIL MIXTURE
TEMPORARY CREEK CROSSING	(N) LOG HABITAT STRUCTURE
CONSTRUCTION STAGI NG AREA	(N) DIVERSION STRUCTURE
CONSTRUCTION STOCKPILE AREA	(N) COBBLE BALLAST MATERIAL
CONSTRUCTION ACCESS POINT	
ORDINARY HIGH WATER	

ABBREVIATIONS

APPROX	- APPROXIMATE
CFS	- CUBIC FEET PER SECOND
DEMO	- DEMOLISH
DG	- DESIGN GRADE
DIA	- DIAMETER
DS	- DOWNSTREAM
(E)	- EXISTING
EG	- EXISTING GRADE
EL, ELEV	- ELEVATION
FG	- FINISHED GRADE
FT	- FEET
GB	- GRADE BREAK
LF	- LINEAR FEET
MAX	- MAXIMUM
MIN	- MINIMUM
MISC	- MISCELLANEOUS
(N)	- NEW
PIP	- PROTECT IN PLACE
ROW	- RIGHT OF WAY
(SYM)	- SYMMETRIC
TBD	- TO BE DETERMINED
TYP	- TYPICAL
US	- UPSTREAM
VIF	- VERIFY IN FIELD

GENERAL NOTES (FOR FINAL DESIGN)

1. THIS 60%-COMPLETE PLAN SET REPRESENTS PRELIMINARY ENGINEERING DESIGN THAT IS SUITABLE TO INFORM PROJECT PERMITTING AND ENVIRONMENTAL REVIEW, BUT REQUIRES ADDITIONAL DETAILS, STUDY, AND REFINEMENTS PRIOR TO BEING CONSIDERED A FINAL CONSTRUCTION PACKAGE. THE DESIGN SHOWN IN THIS PLAN SET REPRESENTS THE RESTORATION COMPONENTS OF THE HIGHWAY ONE RENOVATION AT SCOTT CREEK PROJECT, INCLUDING EXCAVATING A CHANNEL THROUGH THE EXISTING MARSH TO RESTORE THE HISTORIC ALIGNMENT OF SCOTT CREEK, REMOVAL OF THE EXISTING NORTHERN HIGHWAY EMBANKMENT, AND FILLING OF THE EXISTING MAIN CREEK CHANNEL TO MARSH PLAIN ELEVATION. PROPOSED BRIDGE REPLACEMENT PROJECT IS NOT SHOWN IN THESE PLANS, AND THE BRIDGE DESIGN IS BEING COMPLETED BY CALTRANS. THE ROADWAY AND RESTORATION PROJECT DESIGNS SHALL BE COORDINATED PRIOR TO DESIGN COMPLETION, PERMITTING AND CONSTRUCTION.

2. TOPOGRAPHIC MAPPING OF EXISTING GRADES SHOWN ON PLANS IS APPROXIMATE OWING TO GRADES OBSCURED BY VEGETATION AND CHANGES RESULTING FROM HYDRAULICS AND SEDIMENTATION. ESA COMPILED THE EXISTING GRADES USING MULTIPLE DATA SOURCES, INCLUDING LIDAR DATA FROM THE 2009-2011 CALIFORNIA COASTAL CONSERVANCY COASTAL LIDAR PROJECT, ESA GROUND SURVEYS OF EXISTING AND PROPOSED CHANNEL CROSS SECTIONS AND MARSHPLAIN SPOT HEIGHTS IN 2010, 2011, 2016, AND 2019, AND GROUND SURVEY COLLECTED BY CSU MONTEREY BAY IN 2011. AERIAL IMAGERY OF PROJECT SITE IS FROM SURVEY CONDUCTED BY SIERRA OVERHEAD ANALYTICS (SOA) IN SEPTEMBER 2019. SOA SURVEY DATA NOT SHOWN. OTHER AERIAL IMAGERY WAS OBTAINED FROM MAXAR VIVID IMAGERY, 2019.

3. ELEVATIONS AND HORIZONTAL CONTROL ARE REFERENCED TO NGS BENCHMARK 0402. ELEVATIONS ARE REFERENCED TO NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88). HORIZONTAL CONTROL IS CALIFORNIA STATE PLANE COORDINATE SYSTEM, ZONE 3, IN FEET (NAD83). ALL ELEVATIONS AND HORIZONTAL COORDINATES ARE IN FEET.

4. TIDAL DATUMS FOR SITE ARE BASED ON THE NOAA NOS STA 941350 MONTEREY, AND PRESENTED ON SHEET G-1. ALSO SHOWN ARE APPROXIMATE WATER SURFACE ELEVATIONS AT LOWER SCOTT CREEK IN THE VICINITY OF THE PROJECT WORK THAT ARE EXCEEDED AT APPROXIMATELY 10% AND 50% OCCURRENCE, WHERE 50% EXCEEDENCE CORRESPONDS TO MEDIAN WATER LEVEL AS DETERMINED FROM WATER LEVEL DATA COLLECTED DURING DEVELOPMENT OF THE DESIGN. SEE PRELIMINARY DESIGN REPORT (ESA 2020).

5. MULTIPLE THREATENED AND SENSITIVE SPECIES UTILIZE THE PROJECT SITE. ALL CONSTRUCTION ACTIVITIES SHALL CONFORM TO THE SPECIFICATIONS AND THE PERMIT CONDITIONS TO AVOID UNNECESSARY IMPACTS TO SPECIES AND HABITAT. ALL DISTURBED AREAS SHALL BE RESTORED TO NATIVE CONDITIONS OR AS ESTABLISHED BY THE OWNER'S REPRESENTATIVE.

6. ACCESS TO AND WITHIN THE SITE WILL REQUIRE SIGNIFICANT IMPROVEMENTS, INCLUDING WIDENING AND IMPROVING EXISTING TRAILS TO ACCOMMODATE TRUCKS AND HEAVY EQUIPMENT, TEMPORARY CREEK CROSSING(S), AND FACILITATING ACCESS AND HAULING ACROSS THE EXISTING MARSH PLAIN. ACCESS IN THE NORTH MARSH IS RESTRICTED TO GRADING AREAS UNLESS NECESSARY, IN WHICH CASE THE AREA WILL BE IMPACTED TO MINIMUM ACCEPTABLE DIMENSIONS (TO BE CONFIRMED WITH OWNER'S REPRESENTATIVE). ALL IMPORTED MATERIALS USED TO ESTABLISH ACCESS AND HAULING ROUTES SHALL BE REMOVED PRIOR TO COMPLETION OF CONSTRUCTION, AND CONDITIONS WILL BE RESTORED TO NATIVE CONDITIONS OR AS ESTABLISHED BY THE OWNER'S REPRESENTATIVE.

7. THE PROJECT SITE IS SUBJECT TO FLOODING BY EXTREME FLUVIAL, COASTAL, OR COMBINED CONDITIONS, AS WELL AS UNDER CALM CONDITIONS WITH A HIGH BEACH BERM. CONTRACTOR SHALL CONTROL WATER LEVELS AT THE SITE WITHIN ACTIONS ALLOWED BY PERMITS AND AS DESCRIBED IN THE SPECIFICATIONS. PENDING APPROVAL BY PERMIT AGENCIES, WE EXPECT THAT THE CONTRATOR MAY BE ALLOWED TO EXCAVATE THE BEACH BERM SEAWARD OF THE EXISTING BRIDGE TO ELEVATION 7 FEET NAVD (APPROX.), AND MAINTAIN THIS CONDITION THROUGH THE CONSTRUCTION PHASES FOR EXCAVATION OF THE NEW LAGOON CHANNEL AND FILL OF THE EXISTING LAGOON CHANNEL. THE CONTRACTOR SHALL STOCKPILE HARVESTED SAND FOR PLACING AT THE AREA OF OVER-EXCAVATION BENEATH THE NORTHERN ROADWAY EMBANKMENT. A SUITABLE STOCKPILE LOCATION NEEDS TO BE DETERMINED, AND PLACEMENT OF MATERIALS ALONG THE SEAWARD TOE OF THE NORTHERN HIGWAY EMBANKMENT SHOULD BE CONSIDERED AT THE NEXT PHASE OF WORK AND THROUGH DISCUSSIONS WITH AGENCIES.

8. SOIL CONDITIONS WITHIN THE PROJECT SITE ARE EXPECTED BE CHALLENGING FOR CONSTRUCTION DUE TO THE PRESENCE OF SATURATED PEAT SOILS AND PONDED WATER. CONTRACTOR SHALL ANTICIPATE LOW DEPTH-TO-GROUNDWATER AND HIGH LIKELIHOOD FOR EXCAVATED AREAS TO FILL RAPIDLY WITH WATER. CONTRACTOR SHALL BE RESPONSIBLE FOR AND EMPLOY SUITABLE METHODS OF WATER AND SEDIMENT MANAGEMENT, INCLUDING POTENTIAL FOR USE BY SPECIES, DEGRADED WATER QUALITY, SEDIMENTATION AND SLOUGHING OF EXCAVATION, ETC. SEE SPECIFICATIONS.

9. UTILITIES, PROPERTY BOUNDARIES AND EASEMENTS TO BE LOCATED BY CALTRANS

PRELIMINARY
NOT FOR CONSTRUCTION

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PRELIMINARY

PREPARED FOR:

RESOURCE CONSERVATION DISTRICT OF SANTA CRUZ COUNTY

PROJECT NAME

SCOTT CREEK LAGOON AND MARSH RESTORATION PROJECT

REVISIONS

#	DATE	DESCRIPTION

DESIGNED	L. WHITE
DRAWN	S. SMITH
CHECKED	L. WHITE
IN CHARGE	L. WHITE C76509
PROJECT NUMBER	D160350.00
ISSUE DATE	11/30/20

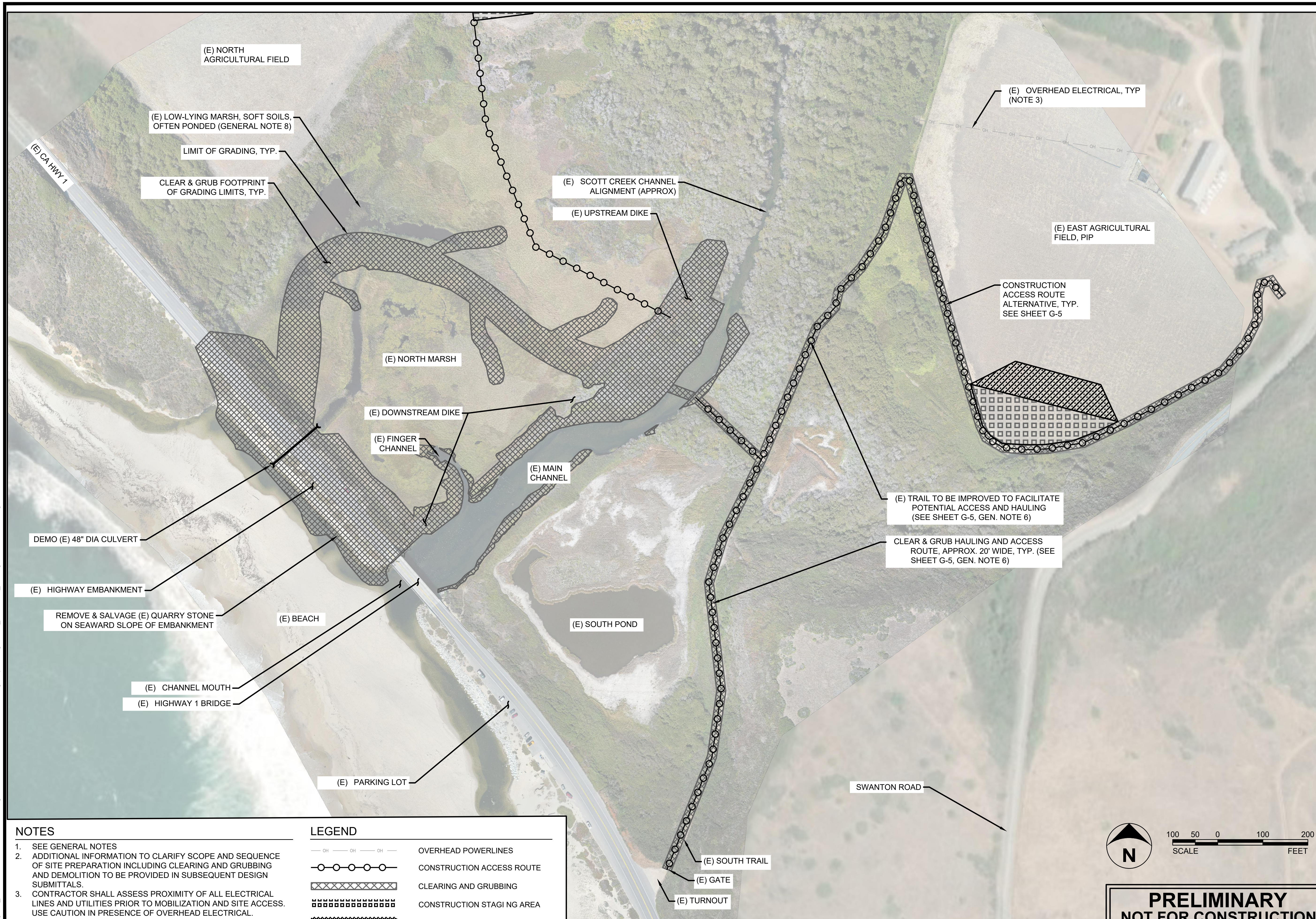
SCALE IS AS SHOWN WHEN PLOTTED TO FULL SIZE (22"x34")

PHASE
60% DESIGN

SHEET TITLE

GENERAL NOTES, ABBREVIATIONS, AND LEGEND

DRAWING NUMBER
G-2



NOTES

1. SEE GENERAL NOTES
2. ADDITIONAL INFORMATION TO CLARIFY SCOPE AND SEQUENCE OF SITE PREPARATION INCLUDING CLEARING AND GRUBBING AND DEMOLITION TO BE PROVIDED IN SUBSEQUENT DESIGN SUBMITTALS.
3. CONTRACTOR SHALL ASSESS PROXIMITY OF ALL ELECTRICAL LINES AND UTILITIES PRIOR TO MOBILIZATION AND SITE ACCESS. USE CAUTION IN PRESENCE OF OVERHEAD ELECTRICAL.
4. NEW AND TEMPORARY HIGHWAY 1 NOT SHOWN - SEE GENERAL NOTE 1

LEGEND

- OH — OH — OH: OVERHEAD POWERLINES
- CONSTRUCTION ACCESS ROUTE
- CLEARING AND GRUBBING
- CONSTRUCTION STAGI NG AREA
- CONSTRUCTION STOCKPILE AREA

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OF SANTA CRUZ COUNTY

PROJECT NAME

SCOTT CREEK LAGOON AND MARSH RESTORATION PROJECT

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SCALE IS AS SHOWN WHEN PLOTTED TO FULL SIZE (22"x34")
1"

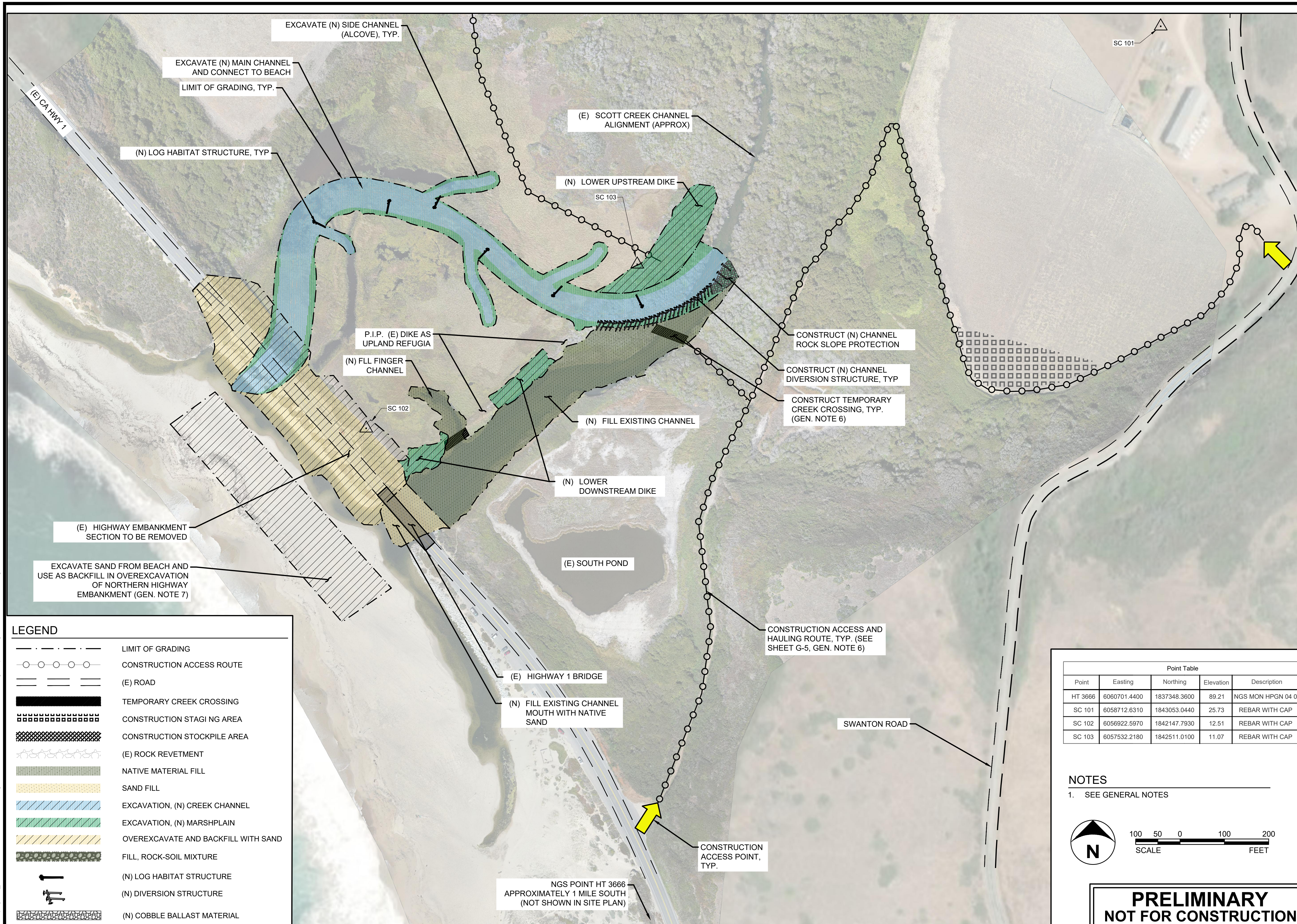
PHASE
60% DESIGN

SHEET TITLE

EXISTING CONDITIONS & DEMO PLAN

DRAWING NUMBER
G-3

SHEET 3 OF 12



LEGEND

- LIMIT OF GRADING
- CONSTRUCTION ACCESS ROUTE
- (E) ROAD
- TEMPORARY CREEK CROSSING
- CONSTRUCTION STAGI NG AREA
- CONSTRUCTION STOCKPILE AREA
- (E) ROCK REVETMENT
- NATIVE MATERIAL FILL
- SAND FILL
- EXCAVATION, (N) CREEK CHANNEL
- EXCAVATION, (N) MARSHPLAIN
- OVEREXCAVATE AND BACKFILL WITH SAND
- FILL, ROCK-SOIL MIXTURE
- (N) LOG HABITAT STRUCTURE
- (N) DIVERSION STRUCTURE
- (N) COBBLE BALLAST MATERIAL

Point Table

Point	Easting	Northing	Elevation	Description
HT 3666	6060701.4400	1837348.3600	89.21	NGS MON HPGN 04 02
SC 101	6058712.6310	1843053.0440	25.73	REBAR WITH CAP
SC 102	6056922.5970	1842147.7930	12.51	REBAR WITH CAP
SC 103	6057532.2180	1842511.0100	11.07	REBAR WITH CAP

NOTES

1. SEE GENERAL NOTES

N

100 50 0 100 200
SCALE FEET

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PROJECT NAME
SCOTT CREEK LAGOON AND MARSH RESTORATION PROJECT

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IN CHARGE	L. WHITE C76509
PROJECT NUMBER	D160350.00
ISSUE DATE	11/30/20

SCALE IS AS SHOWN WHEN PLOTTED TO FULL SIZE (22"x34")
|— 1" —|

PHASE
60% DESIGN

SHEET TITLE
SITE PLAN

DRAWING NUMBER
G-4

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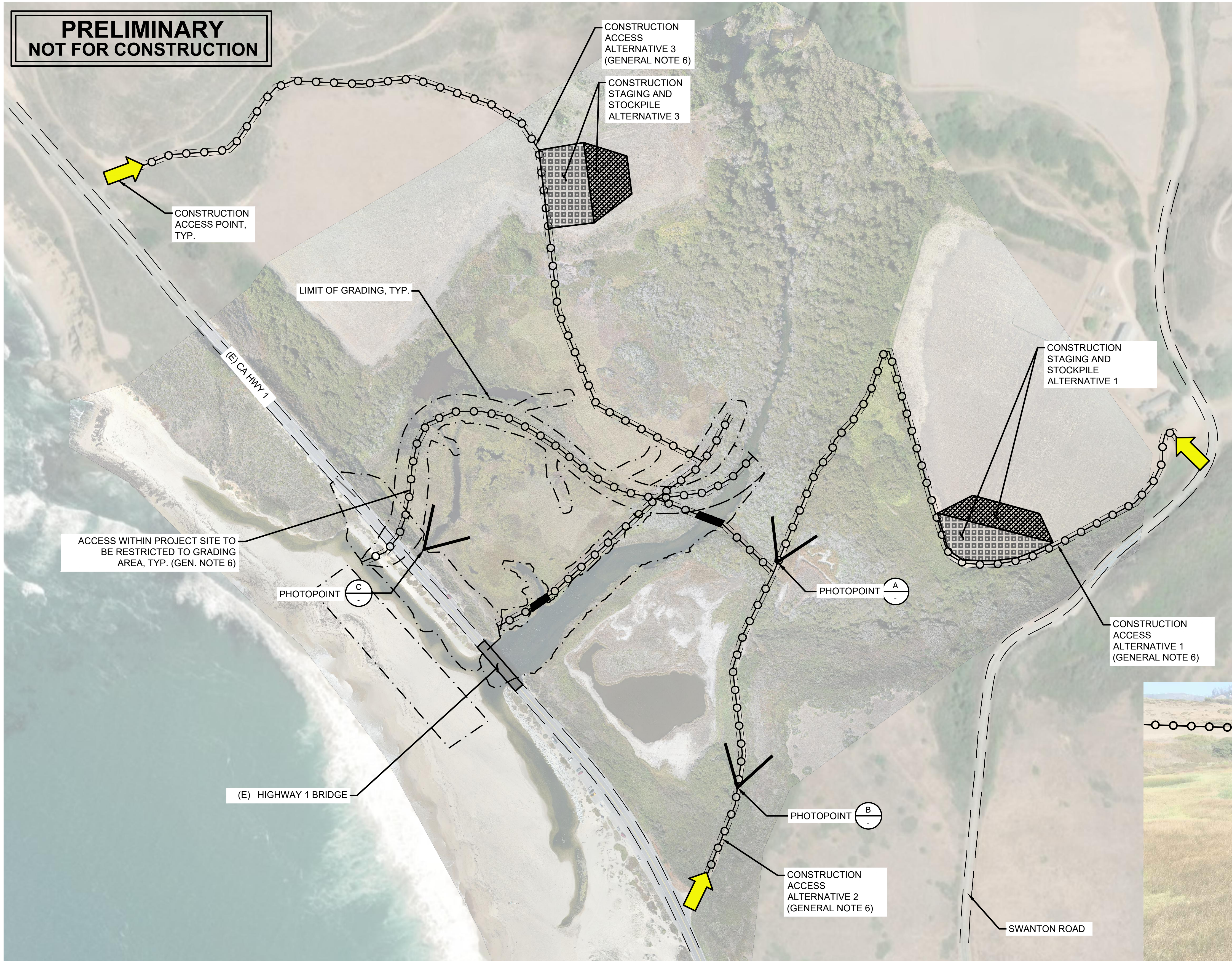
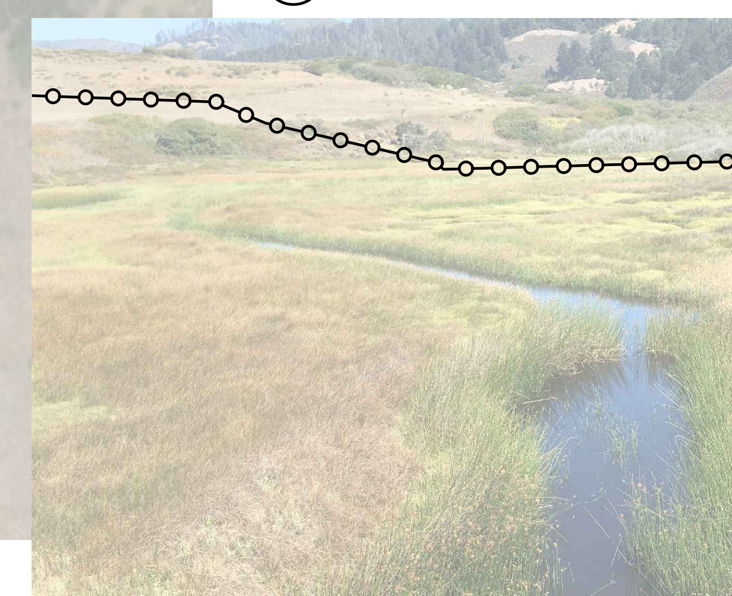


A -- ACCESS ALT1 LOOKING EAST
PHOTO

B -- ACCESS ALT 2 LOOKING EAST
PHOTO



C -- NORTH MARSH/ ACCESS ALT 3 LOOKING EAST
PHOTO

N

150 75 0 150 300
SCALE FEET

LEGEND

— · — · —	LIMIT OF GRADING	▬▬	TEMPORARY CREEK CROSSING
-o-o-o-o-	CONSTRUCTION ACCESS ROUTE		CONSTRUCTION STAGI NG AREA
— — —	(E) ROAD		CONSTRUCTION STOCKPILE AREA
	CLEARING AND GRUBBING		CONSTRUCTION ACCESS POINT

NOTES

1. SEE GENERAL NOTES
2. CONSTRUCTION ACCESS TO AREAS OF BEACH GRADING TO BE DEFINED AT SUBSEQUENT DESIGN LEVEL

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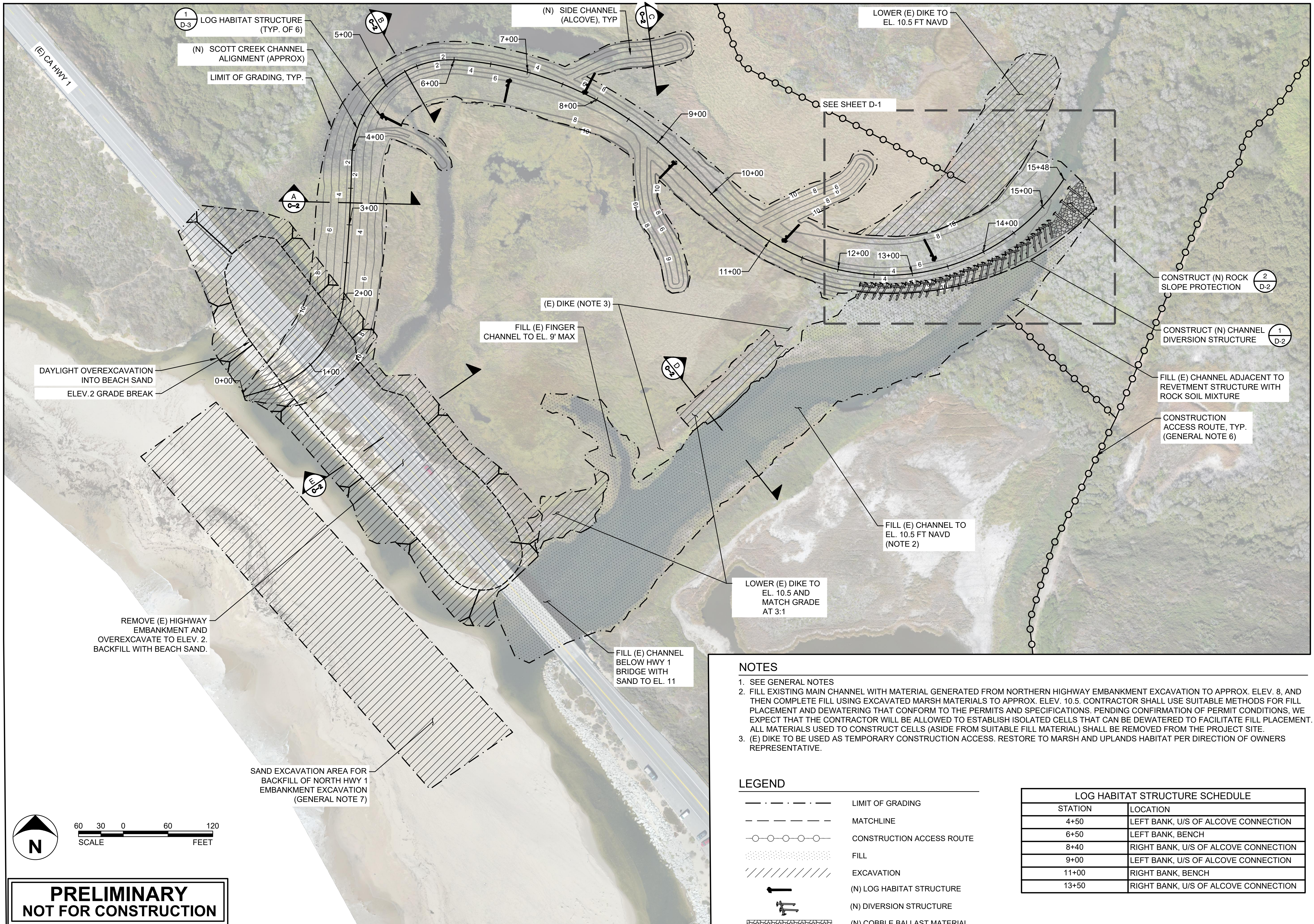
|— 1" —|

PHASE
60% DESIGN

SHEET TITLE
SITE ACCESS

DRAWING NUMBER
G-5

SHEET 5 OF 12



PRELIMINARY
NOT FOR CONSTRUCTION

NOTES

1. SEE GENERAL NOTES
2. FILL EXISTING MAIN CHANNEL WITH MATERIAL GENERATED FROM NORTHERN HIGHWAY EMBANKMENT EXCAVATION TO APPROX. ELEV. 8, AND THEN COMPLETE FILL USING EXCAVATED MARSH MATERIALS TO APPROX. ELEV. 10.5. CONTRACTOR SHALL USE SUITABLE METHODS FOR FILL PLACEMENT AND DEWATERING THAT CONFORM TO THE PERMITS AND SPECIFICATIONS. PENDING CONFIRMATION OF PERMIT CONDITIONS, WE EXPECT THAT THE CONTRACTOR WILL BE ALLOWED TO ESTABLISH ISOLATED CELLS THAT CAN BE DEWATERED TO FACILITATE FILL PLACEMENT. ALL MATERIALS USED TO CONSTRUCT CELLS (ASIDE FROM SUITABLE FILL MATERIAL) SHALL BE REMOVED FROM THE PROJECT SITE.
3. (E) DIKE TO BE USED AS TEMPORARY CONSTRUCTION ACCESS. RESTORE TO MARSH AND UPLANDS HABITAT PER DIRECTION OF OWNERS REPRESENTATIVE.

LEGEND

- LIMIT OF GRADING
- MATCHLINE
- CONSTRUCTION ACCESS ROUTE
- FILL
- EXCAVATION
- (N) LOG HABITAT STRUCTURE
- (N) DIVERSION STRUCTURE
- (N) COBBLE BALLAST MATERIAL

LOG HABITAT STRUCTURE SCHEDULE	
STATION	LOCATION
4+50	LEFT BANK, U/S OF ALCOVE CONNECTION
6+50	LEFT BANK, BENCH
8+40	RIGHT BANK, U/S OF ALCOVE CONNECTION
9+00	LEFT BANK, U/S OF ALCOVE CONNECTION
11+00	RIGHT BANK, BENCH
13+50	RIGHT BANK, U/S OF ALCOVE CONNECTION

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ISSUE DATE	11/30/20

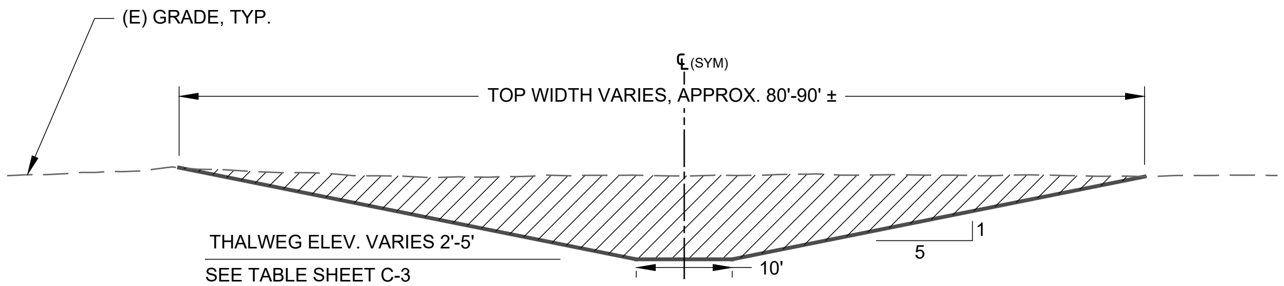
SCALE IS AS SHOWN WHEN PLOTTED TO FULL SIZE (22"x34")
1"

PHASE
60% DESIGN

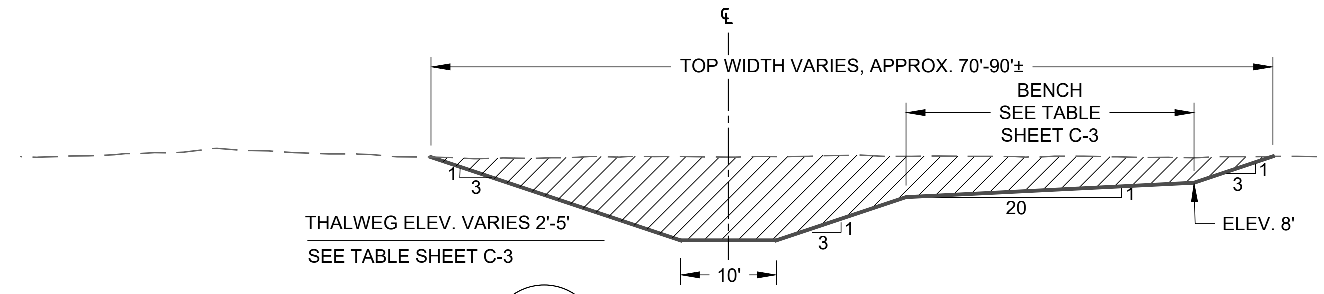
SHEET TITLE
GRADING PLAN

DRAWING NUMBER
C-1

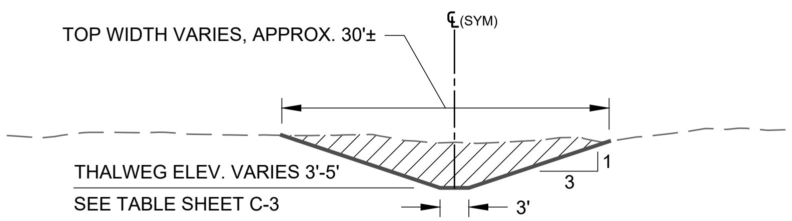
FILE: K:\projects_2016\D160350.00 - Scott Creek Lagoon and Marsh Restoration\10 CAD\Dwgs\30pct Design\C-1-X_ScottCreek_GradingPlans.dwg PLOT DATE: 11/30/2020 1:12:56 PM PLOTTED BY: SCOTT SMITH



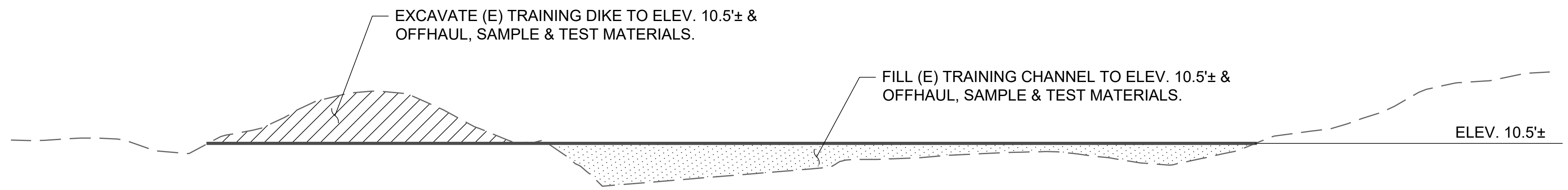
A
C-1 | C-2
CHANNEL TYPE 1
TYPICAL SECTION
1"=10'



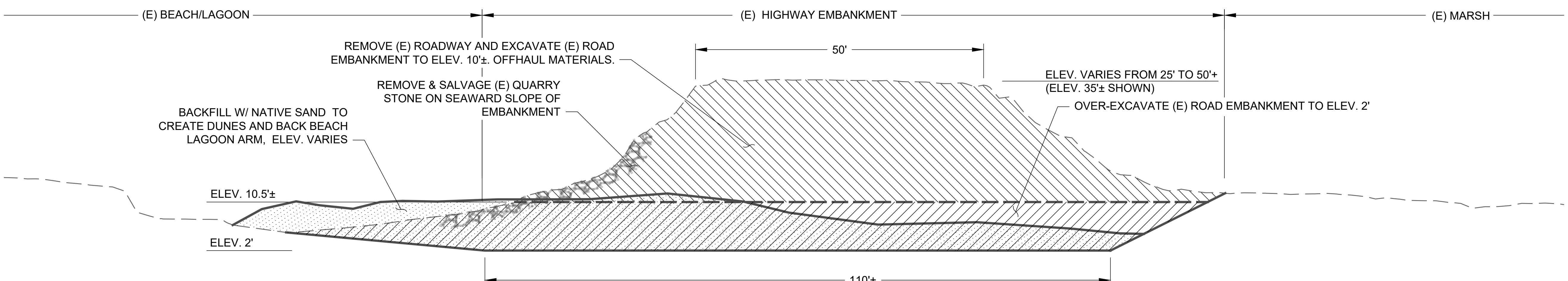
B
C-1 | C-2
CHANNEL TYPE 2
TYPICAL SECTION
1"=10'



C
C-1 | C-2
SIDE CHANNEL (ALCOVE)
TYPICAL SECTION
1"=10'



D
C-1 | C-2
DIKE REMOVAL AND EXISTING CHANNEL FILL
TYPICAL SECTION
1"=10'



E
C-1 | C-2
ROADWAY EXCAVATION
TYPICAL SECTION
1"=10'

NOTES

1. SEE GENERAL NOTES

PRELIMINARY
NOT FOR CONSTRUCTION

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PREPARED BY:

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STAMP

REGISTERED PROFESSIONAL ENGINEER LOUIS A. WHITE C76509 CIVIL STATE OF CALIFORNIA
PRELIMINARY

PREPARED FOR:

RESOURCE
CONSERVATION DISTRICT
OF SANTA CRUZ COUNTY

PROJECT NAME

SCOTT CREEK LAGOON AND MARSH RESTORATION PROJECT

REVISIONS

#	DATE	DESCRIPTION

DESIGNED	L. WHITE
DRAWN	S. SMITH
CHECKED	L. WHITE
IN CHARGE	L. WHITE C76509
PROJECT NUMBER	D160350.00
ISSUE DATE	11/30/20

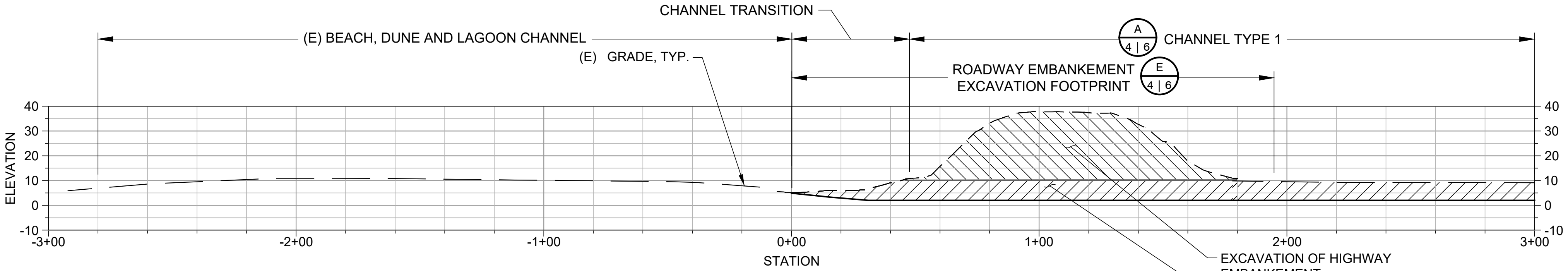
SCALE IS AS SHOWN WHEN PLOTTED TO FULL SIZE (22"x34")
1"

PHASE
60% DESIGN

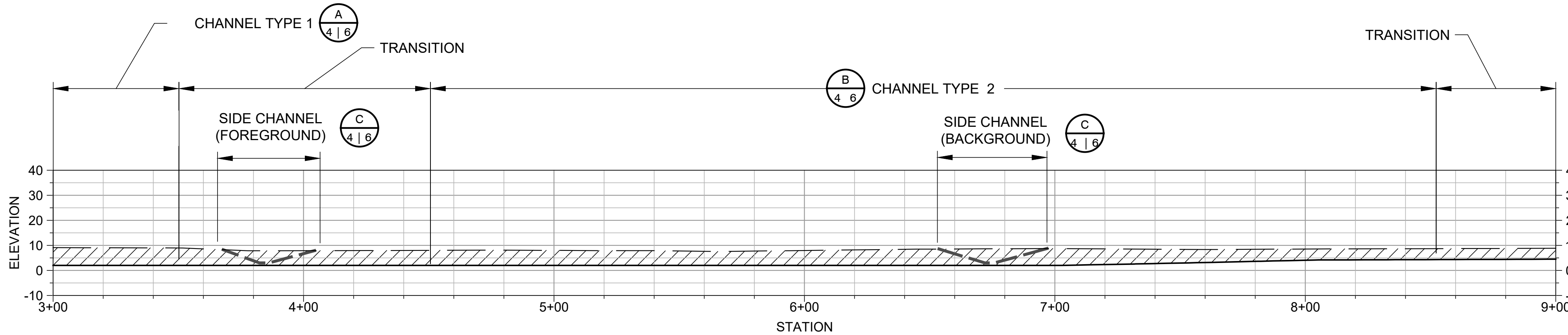
SHEET TITLE
GRADING SECTIONS

DRAWING NUMBER
C-2

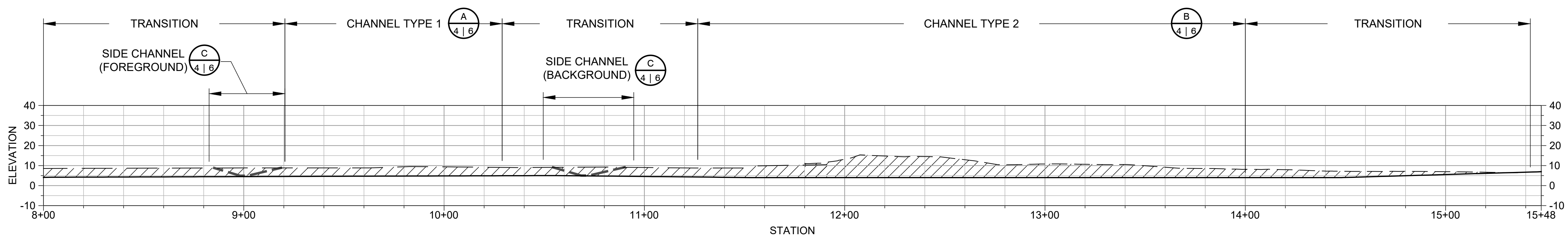
SHEET 7 OF 12



PROPOSED CHANNEL PROFILE
STA 0+00 TO 3+00 SCALE: 1"= 30'



PROPOSED CHANNEL PROFILE
STA 3+00 TO 9+00 SCALE: 1"= 30'



PROPOSED CHANNEL PROFILE
STA 9+00 TO 15+48 SCALE: 1"= 30'

MAIN CHANNEL GEOMETRY

STA OR STA RANGE (ALONG MAIN CHANNEL)	NORTHING (FT)	EASTING (FT)	THALWEG ELEVATION (FT NAVD 88)	CHANNEL TYPE (SECTION/SHEET)	BENCH WIDTH (FT)
0+00			5.24 (EG)	1 (A/C-2)	N/A
0+30			2.00	1 (A/C-2)	N/A
3+50			2.00	1 (A/C-2)	0
4+00			2.00	2 (B/C-2)	12
4+50			2.00	2 (B/C-2)	22
5+00 TO 7+00			2.00	2 (B/C-2)	30
7+50			3.00	2 (B/C-2)	25
8+00			4.00	2 (B/C-2)	20
8+50			4.30	2 (B/C-2)	12
9+00			4.50	1 (A/C-2)	0
9+50			4.60	1 (A/C-2)	N/A
10+00			4.80	1 (A/C-2)	N/A
10+50			5.00	1 (A/C-2)	N/A
11+00			4.60	1 (A/C-2)	0
11+50			4.10	2 (B/C-2)	20
12+00 TO 14+50			4.00	2 (B/C-2)	30
15+00			5.50	2 (B/C-2)	28
15+48			6.91 (EG)	2 (B/C-2)	22

NOTES

1. SEE GENERAL NOTES

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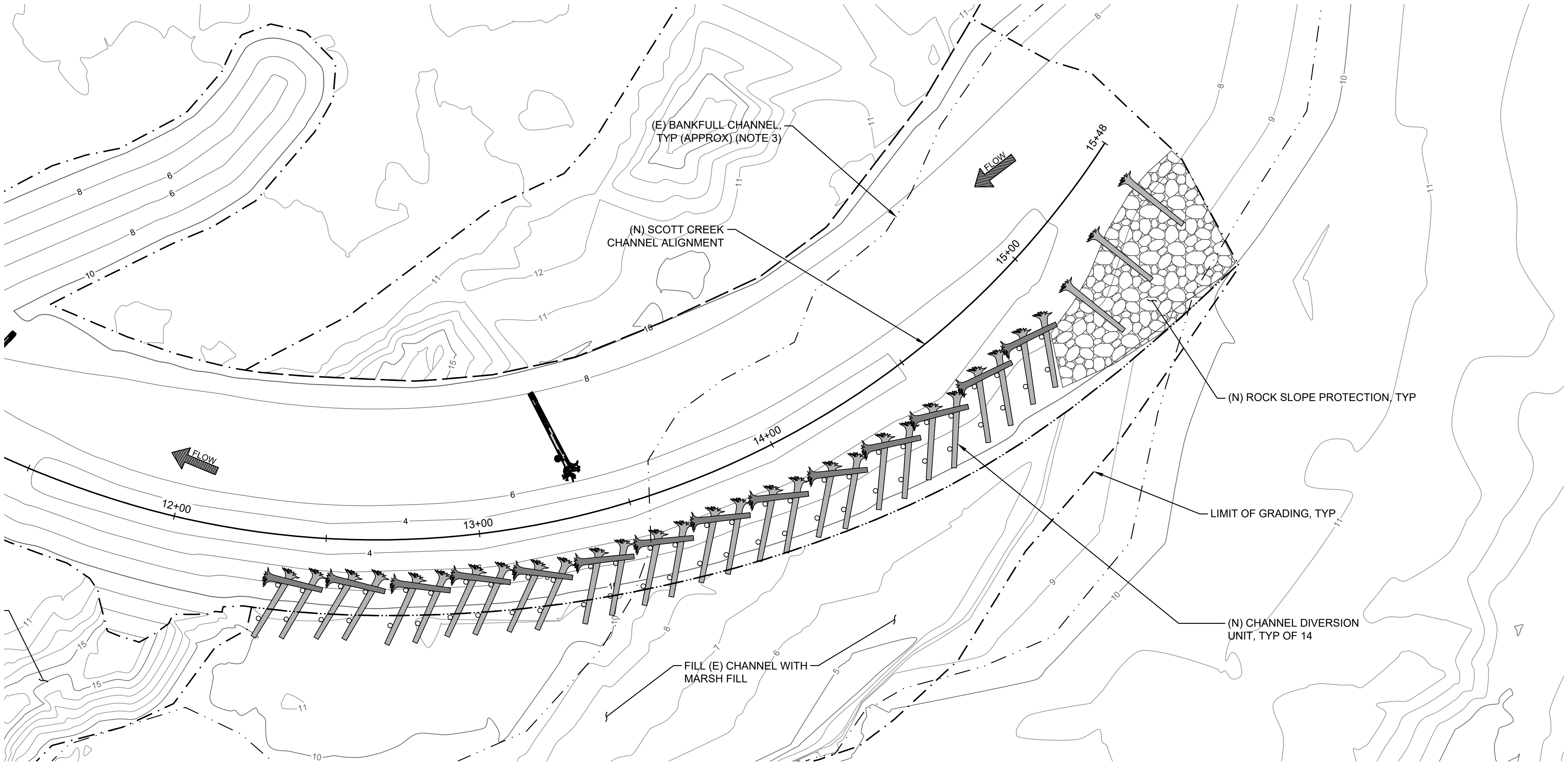
SHEET TITLE
GRADING PROFILE

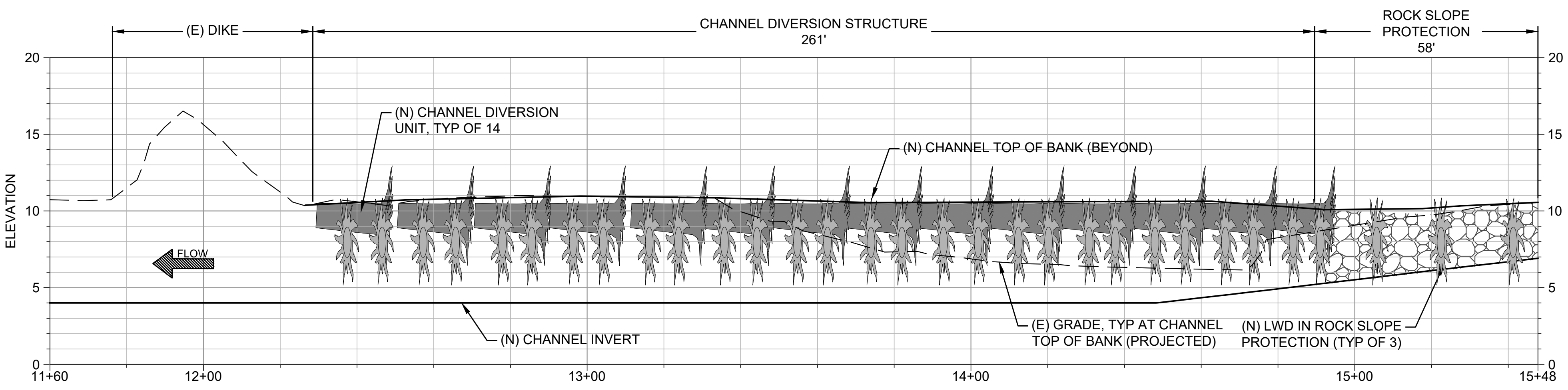
DRAWING NUMBER
C-3

SHEET 8 OF 12

FILE: K:\projects_2016\D160350.00 - Scott Creek Lagoon and Marsh Restoration\10 CAD\Dwgs\30pct Design\C-2.X_ScottCreek_GradingProfile.dwg PLOT DATE: 11/30/2020 1:13:38 PM PLOTTED BY: SCOTT SMITH



1 CHANNEL DIVERSION STRUCTURE
PLAN
SCALE: 1"=20'



2 CHANNEL DIVERSION STRUCTURE
PROFILE
SCALE: 4X EXAGGERATION
HORIZ: 1"=20'
VERT: 1"= 5'

NOTES

1. SEE GENERAL NOTES
2. VERTICAL LOGS NOT SHOWN ON PROFILE FOR CLARITY
3. BANKFULL CHANNEL LIMITS DETERMINED FROM ESTIMATE OF WATER SUFACE ELEVATION. CORRESPONDING TO A 1.5-YEAR FLOW RATE (E.G., Q1.5). APPROX. ELEV. 9.5.

LEGEND

LIMIT OF GRADING
ORDINARY HIGH WATER
(N) COBBLE BALLAST MATERIAL

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RESOURCE CONSERVATION DISTRICT OF SANTA CRUZ COUNTY

PROJECT NAME

SCOTT CREEK LAGOON AND MARSH RESTORATION PROJECT

REVISIONS

#	DATE	DESCRIPTION

DESIGNED	M. LANDICHO
DRAWN	M. LANDICHO
CHECKED	A. BORGANOVO
IN CHARGE	L. WHITE C76509
PROJECT NUMBER	D160350.00
ISSUE DATE	11/30/20

SCALE IS AS SHOWN WHEN PLOTTED TO FULL SIZE (22"x34")
1"

PHASE
60% DESIGN

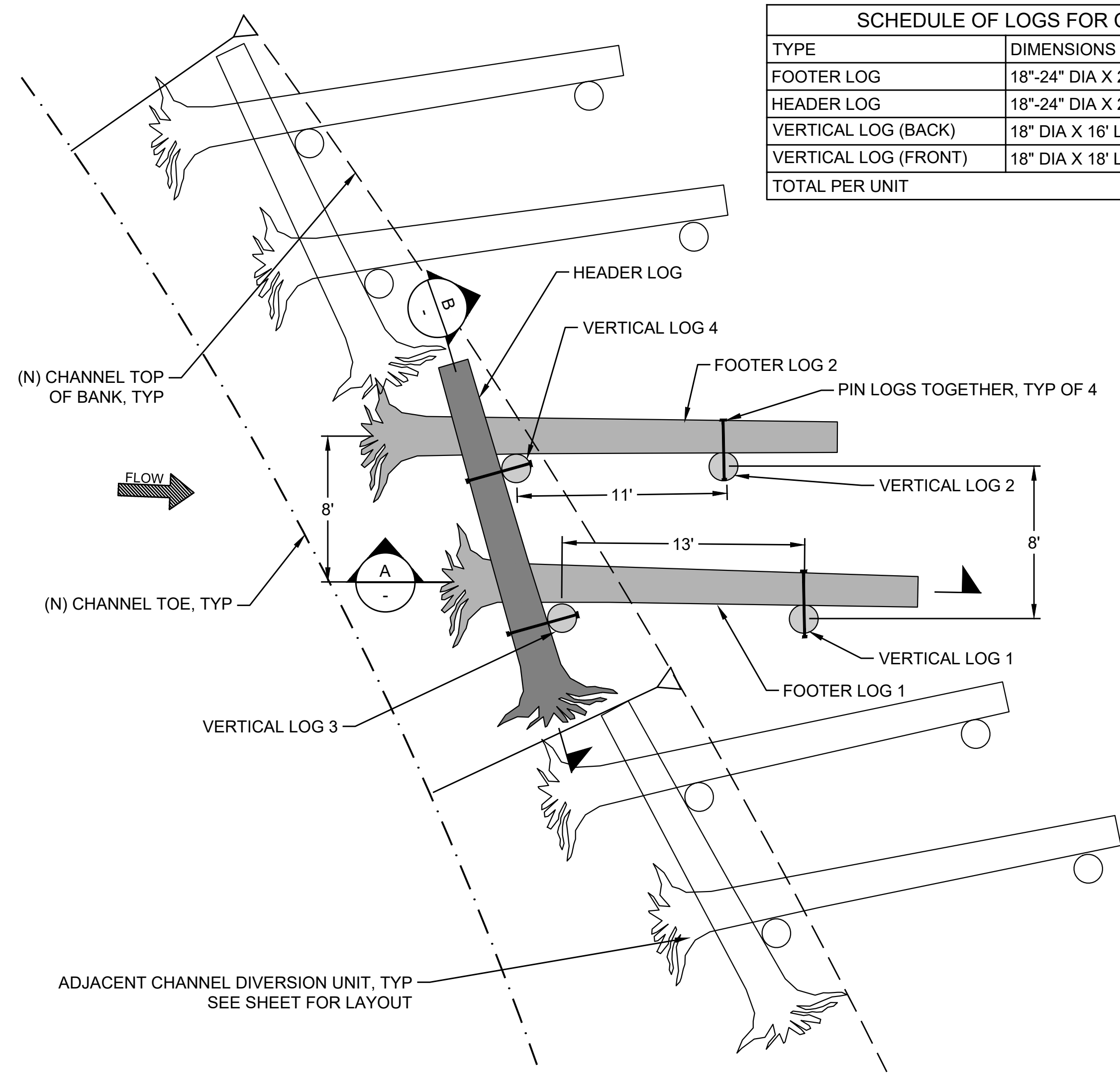
SHEET TITLE
CHANNEL DIVERSION STRUCTURE (1 OF 2)

DRAWING NUMBER
D-1

SHEET 9 OF 12

FILE: K:\projects_2016\D160350.00 - Scott Creek Lagoon and Marsh Restoration\10 CAD\Dwgs\30pct Design\C-3.X_ScottCreek_MeanderPlug.dwg PLOT DATE: 11/30/2020 1:13:43 PM PLOTTED BY: SCOTT SMITH

FILE: K:\projects_2016\D160350.00 - Scott Creek Lagoon and Marsh Restoration\10 CAD\Dwgs\30pct Design\C-3.X_ScottCreek_MeanderPlugDetail.dwg PLOT DATE: 11/30/2020 1:13:48 PM PLOTTED BY: SCOTT SMITH



1 CHANNEL DIVERSION UNIT
PLAN SCALE: 1"=5'

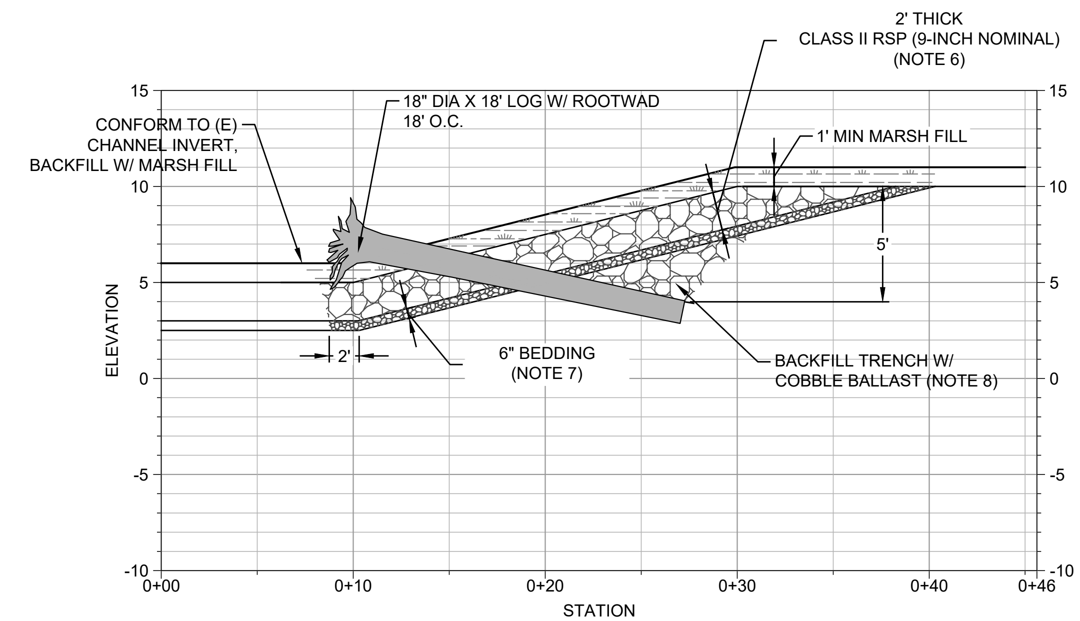
5 2.5 0 5 10
SCALE FEET

SCHEDULE OF LOGS FOR CHANNEL DIVERSION UNIT

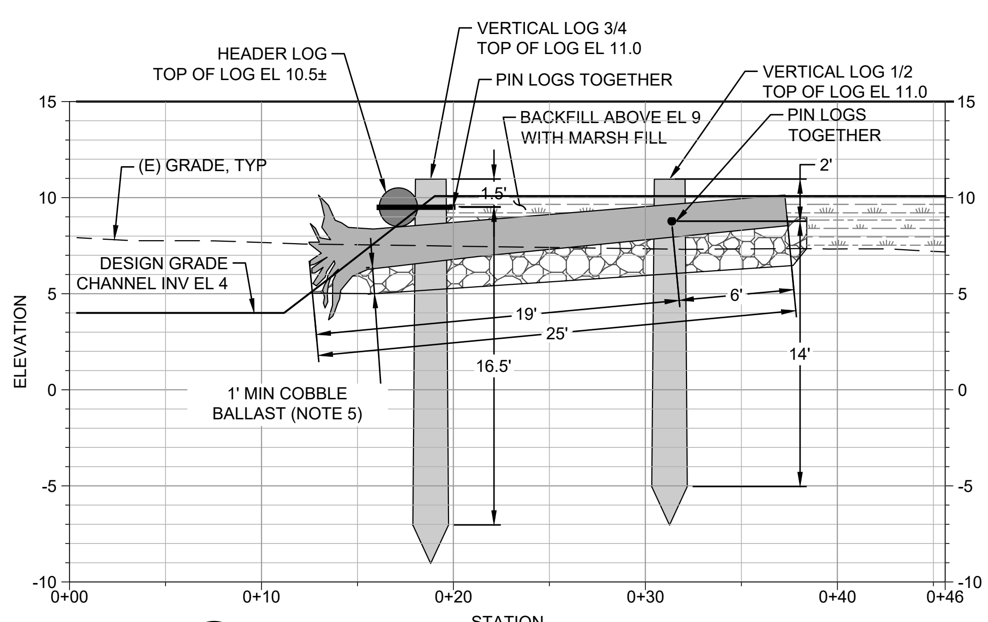
TYPE	DIMENSIONS	ROOTWAD (Y/N)	COUNT
FOOTER LOG	18"-24" DIA X 25' LONG	YES	2
HEADER LOG	18"-24" DIA X 20' LONG	YES	1
VERTICAL LOG (BACK)	18" DIA X 16' LONG	NO	2
VERTICAL LOG (FRONT)	18" DIA X 18' LONG	NO	2
TOTAL PER UNIT			7

NOTES

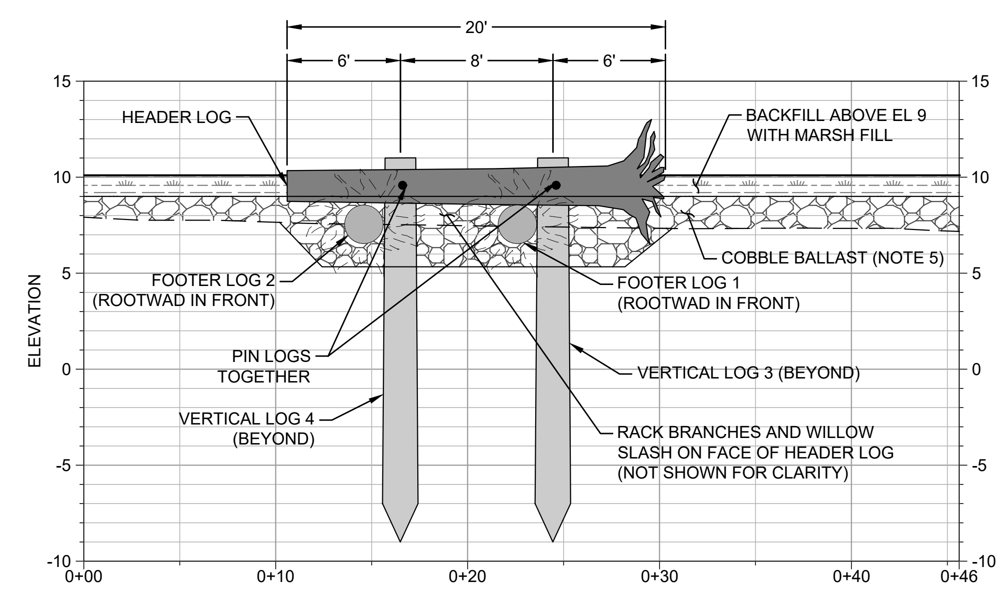
1. SEE GENERAL NOTES
2. LOGS MUST BE PLACED IN THE PRESENCE OF THE OWNER'S REPRESENTATIVE. FIELD FIT AND ADJUST AS NEEDED TO CONFORM IRREGULAR LOGS TO NEAT DIMENSIONS SHOWN.
3. DETAILS SHOW EMBEDMENT DEPTH ASSUMING THE LOG IS THE MINIMUM LENGTH SPECIFIED. IF LONGER LOG IS USED, INCREASE EMBEDMENT LENGTH AND DEPTH AS NEEDED TO MEET REQUIREMENTS SHOWN. DETAIL SHOWS MAXIMUM EXPOSED LOG LENGTH. LENGTH MAY BE INCREASED IF LONGER LOG IS USED. CONFIRM WITH DESIGN ENGINEER.
4. LOGS MAY BE NOTCHED (3" MAX) TO ACHIEVE ORIENTATION AND EMBEDMENT SHOWN.
5. BACKFILL STRUCTURE TO EL 9.0 WITH COBBLE BALLAST. COBBLE BALLAST MIX IS 50% 60-LB (9-INCH), 25% BEDDING, AND 25% NATIVE MATERIAL.
6. INSTALL RSP USING METHOD A PLACEMENT, PER CALTRANS STANDARD SPEC SECTION 72-2.03B. DO NOT PLACE ROCKS BY DUMPING.
7. BEDDING LAYER IS GRAVEL FILTER, GRADATION AND LAYER THICKNESS PER CALTRANS DESIGN INFORMATION BULLETIN NO 87 (2014).
8. COBBLE BALLAST MIX IS 50% 60-LB (9-INCH), 25% BEDDING, AND 25% NATIVE MATERIAL.



2 ROCK SLOPE PROTECTION
SECTION SCALE: 1"=5'



A FOOTER LOG
SECTION SCALE: 1"=5'



B HEADER LOG
SECTION SCALE: 1"=5'

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PREPARED FOR:

RESOURCE CONSERVATION DISTRICT OF SANTA CRUZ COUNTY

PROJECT NAME

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REVISIONS

#	DATE	DESCRIPTION

DESIGNED	M. LANDICHO
DRAWN	M. LANDICHO
CHECKED	A. BORGANOVO
IN CHARGE	L. WHITE C76509
PROJECT NUMBER	D160350.00
ISSUE DATE	11/30/20

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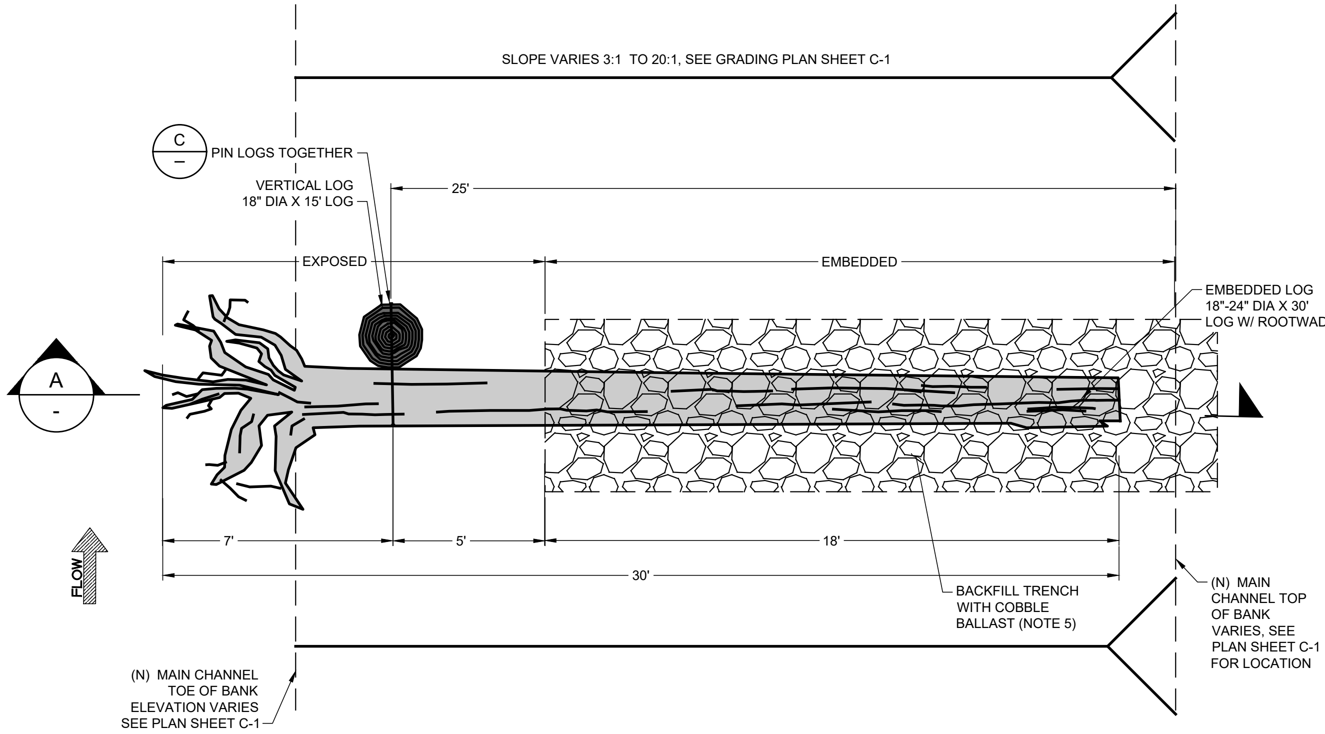
1"

PHASE
60% DESIGN

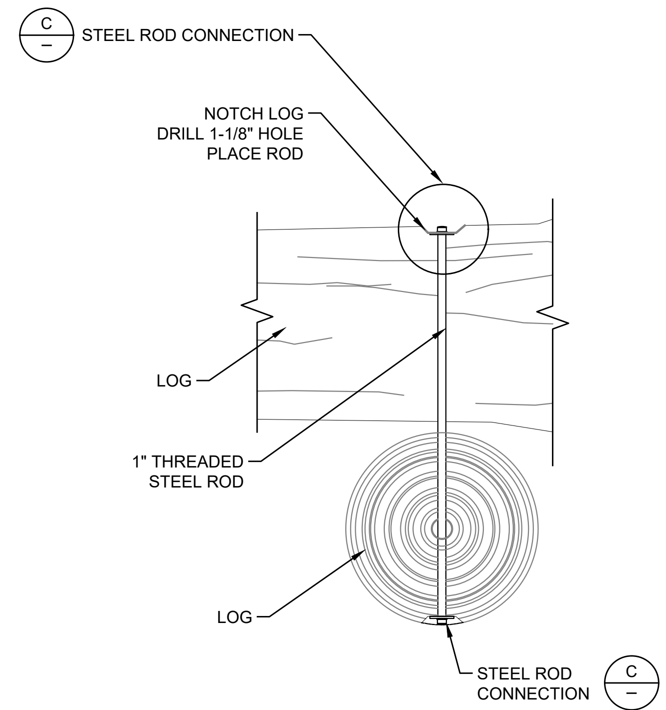
SHEET TITLE
CHANNEL DIVERSION STRUCTURE (2 OF 2)

DRAWING NUMBER
D-2

SHEET 10 OF 12



1 LOG HABITAT STRUCTURE
TYPICAL PLAN VIEW
1"=3'

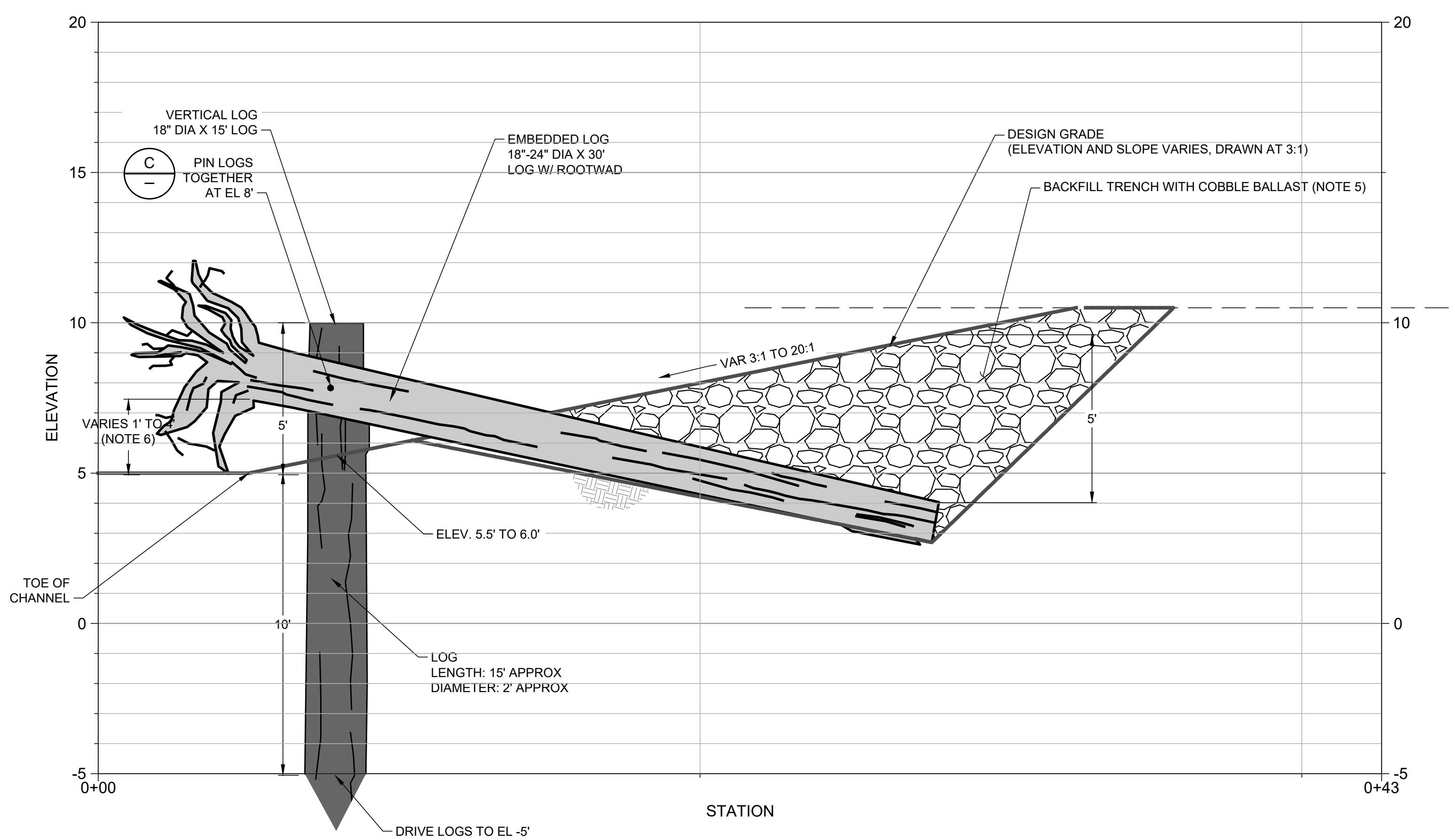


B LOG TO LOG PIN
TYPICAL DETAIL
1"=1'

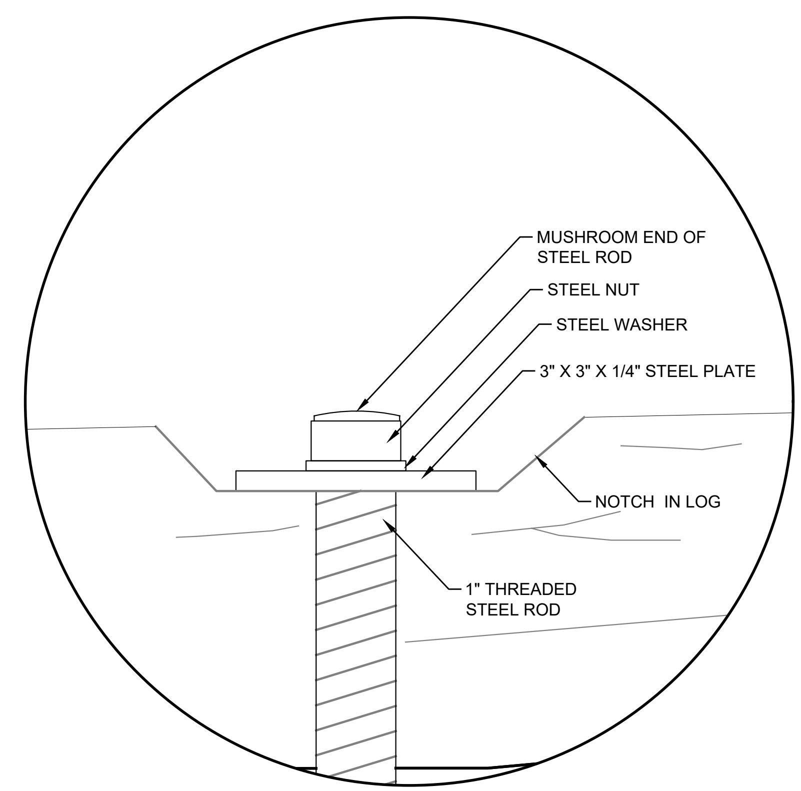
SCHEDULE OF LOGS FOR LOG HABITAT STRUCTURE			
TYPE	DIMENSIONS	ROOTWAD (Y/N)	COUNT
EMBEDDED LOG	18"-24" DIA X 30' LONG	YES	1
VERTICAL LOG	18"-24" DIA X 15' LONG	NO	1
TOTAL			2

NOTES

1. SEE GENERAL NOTES
2. LOGS MUST BE PLACED IN THE PRESENCE OF THE OWNER'S REPRESENTATIVE. FIELD FIT AND ADJSUT AS NEEDED TO CONFORM IRREGULAR LOGS TO NEAT DIMENSIONS SHOWN.
3. DETAILS SHOWS EMBEDMENT DEPTH ASSUMING THE LOG IS THE MINIMUM LENGTH SPECIFIED. IF LONGER LOG IS USED, INCREASE EMBEDMENT LENGTH AND DEPTH AS NEEDED TO MEET REQUIREMENTS SHOWN. DETAIL SHOWS MAXIMUM EXPOSED LOG LENGTH, LENGTH MAY BE INCRASED IF LONGER LOG IS USED. CONFIRM WITH DESIGN ENGINEER.
4. LOG HABITAT STRUCTURE WILL BE INSTALLED OVER A RANGE OF BANK SLOPES. SEE GRADING PLAN SHEET C-1 FOR STRUCTURE LOCATIONS.
5. BACKFILL TRENCH WITH COBBLE BALLAST. BACKFILL LIMITS SHOWN ARE SCHEMATIC ONLY. ACTUAL LIMITS MAY VARY.
6. HEIGHT VARIES 1' TO 4' DEPENDING ON BANK SLOPE.



A LOG HABITAT STRUCTURE
TYPICAL SECTION
1"=3'



C STEEL ROD CONNECTION
TYPICAL DETAIL
1"=1"

PRELIMINARY
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RESOURCE
CONSERVATION DISTRICT
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REVISIONS

#	DATE	DESCRIPTION

DESIGNED	S. SMITH
DRAWN	S. SMITH
CHECKED	A. BORGANOVO
IN CHARGE	L. WHITE C76509
PROJECT NUMBER	D160350.00
ISSUE DATE	11/30/20

SCALE IS AS SHOWN WHEN PLOTTED TO FULL SIZE (22"x34")
1"

PHASE
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SHEET TITLE
LOG HABITAT STRUCTURE DETAILS

DRAWING NUMBER
D-3

SHEET 11 OF 12

FILE: K:\projects_2016\D160350.00 - Scott Creek Lagoon and Marsh Restoration\10 CAD\Dwgs\3\pct Design\C-3.X_ScottCreek_DetailSheet_LogHabitatStructure.dwg PLOT DATE: 11/30/2020 1:13:58 PM PLOTTED BY: SCOTT SMITH

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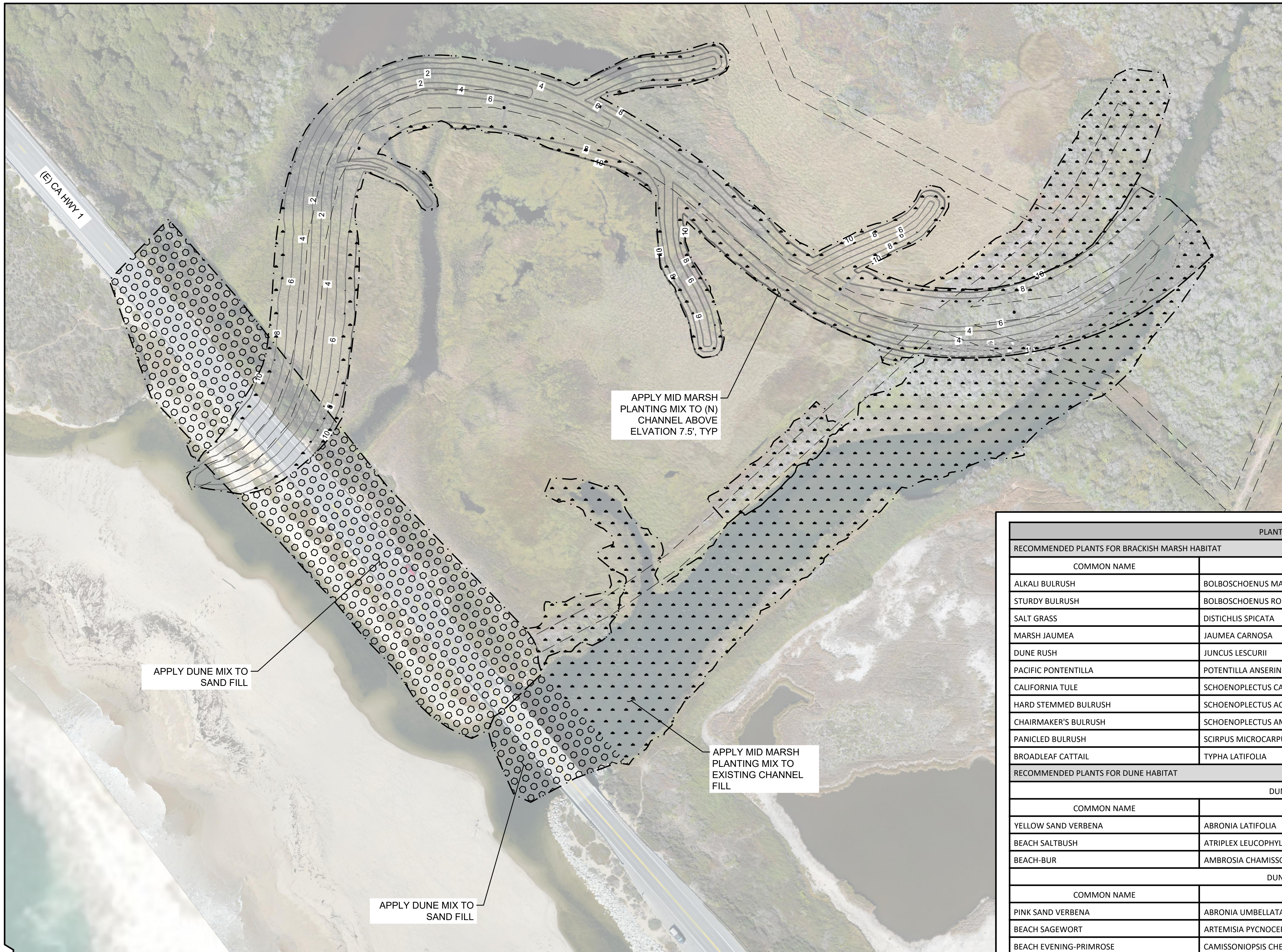

N

60 30 0 60 120
SCALE FEET

NOTES

1. SEE GENERAL NOTES
2. SEED ALL DISTURBED AREAS ABOVE APPROX. ELEV. 8

PRELIMINARY
NOT FOR CONSTRUCTION

PLANTING TABLE		
RECOMMENDED PLANTS FOR BRACKISH MARSH HABITAT		
COMMON NAME	SCIENTIFIC NAME	RATE
ALKALI BULRUSH	BOLBOSCHOENUS MARITIMUS	
STURDY BULRUSH	BOLBOSCHOENUS ROBUSTUS	
SALT GRASS	DISTICHLIS SPICATA	
MARSH JAUMEA	JAUMEA CARNOSA	
DUNE RUSH	JUNCUS LESCURII	
PACIFIC PONTENTILLA	POTENTILLA ANSERINA SSP.PACIFICA	
CALIFORNIA TULE	SCHOENOPLECTUS CALIFORNICUS	
HARD STEMMED BULRUSH	SCHOENOPLECTUS ACUTUS VAR OCCIDENTALIS	
CHAIRMAKER'S BULRUSH	SCHOENOPLECTUS AMERICANUS	
PANICLED BULRUSH	SCIRPUS MICROCARPUS	
BROADLEAF CATTAIL	TYPHA LATIFOLIA	
RECOMMENDED PLANTS FOR DUNE HABITAT		
DUNE FACE		
COMMON NAME	SCIENTIFIC NAME	RATE
YELLOW SAND VERBENA	ABRONIA LATIFOLIA	
BEACH SALTBUSH	ATRIPLEX LEUCOPHYLLA	
BEACH-BUR	AMBROSIA CHAMISSONIS	
DUNE RIDGE		
COMMON NAME	SCIENTIFIC NAME	RATE
PINK SAND VERBENA	ABRONIA UMBELLATA	
BEACH SAGEWORT	ARTEMISIA PYCNOCEPHALA	
BEACH EVENING-PRIMROSE	CAMISSONIOPSIS CHEIRANTHIFOLIA SSP. CHEIRANTHIFOLIA	
BEACH MORNING GLORY	CALYSTEGIA SOLDANELLA	
MID TO REAR DUNE HABITAT		
COMMON NAME	SCIENTIFIC NAME	RATE
CALIFORNIA SAGEBRUSH	ARTEMISIA CALIFORNICA	
SALT GRASS	DISTICHLIS SPICATA	
SAND LETTUCE	DUDLEYA CAESPITOSA	
AMERICAN DUNE GRASS	ELYMUS MOLLIS	
CALIFORNIA GOLDENBUSH	ERICAMERA ERICOIDES	
SEASIDE DAISY	ERIGERON GLAUCUS	

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SHEET TITLE
PLANTING PLAN

DRAWING NUMBER
PL-1

Appendix B

Outline of Technical Specifications

Scott Creek Lagoon and Marsh Restoration Project
60% Design – Outline of Specifications
(based on Caltrans 2018 Standard Specifications)

DIVISION I GENERAL PROVISIONS

1 GENERAL

2 BIDDING

3 CONTRACT AWARD AND EXECUTION

4 SCOPE OF WORK

5 CONTROL OF WORK

6 CONTROL OF MATERIALS

7 LEGAL RELATIONS AND RESPONSIBILITY TO THE PUBLIC

8 PROSECUTION AND PROGRESS

9 PAYMENT

DIVISION II GENERAL CONSTRUCTION

10 GENERAL

12 TEMPORARY TRAFFIC CONTROL

13 WATER POLLUTION CONTROL

14 ENVIRONMENTAL STEWARDSHIP

15 EXISTING FACILITIES

16 TEMPORARY FACILITIES

DIVISION III EARTHWORK AND LANDSCAPE

17 GENERAL

18 DUST PALLIATIVES

19 EARTHWORK

20 LANDSCAPE

21 EROSION CONTROL

DIVISION VI STRUCTURES (adapt for Large Wood)

49 PILING

52 REINFORCEMENT

57 WOOD AND PLASTIC LUMBER STRUCTURES

59 STRUCTURAL STEEL COATINGS

DIVISION VIII MISCELLANEOUS CONSTRUCTION (adapt for Large Wood Anchoring)

72 SLOPE PROTECTION

75 MISCELLANEOUS METAL

DIVISION XI MATERIALS

89 AGGREGATE