Technical Memorandum

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Project Name	CALTROUT-CANNIBAL ISL. RESTORATION		
Subject	Habitat Conversion Analysis		

1. Introduction

The Cannibal Island Restoration Project (hereafter "Project") will restore the natural tidal range in much of the Project Area, enhancing tidal channels and salt marsh. Portions of the existing dike network within the Project Area will be reconfigured or removed. A new set-back levee will be constructed to protect remaining prime agricultural lands at risk of conversion from future tidal inundation resulting from both restoration of the tidal regime and sea level rise. Cannibal Island Road will be elevated to correct existing chronic seasonal flooding, and to protect agricultural lands to the south as the full tidal range is restored. A public parking lot will be constructed along Cannibal Island Road to enhance public access to CDFW-owned land (**Attachment 1, Figure 1—Project Area and Components**). The proposed Project Area includes much of Cannibal Island north of Cannibal Island Road (with a small strip of pasture just to the south of Cannibal Island Road) up to the water's edge at Seven Mile Slough and Mosley Slough.

The purpose of this memorandum is to inform the Project's CEQA compliance through the Statutory Exemption for Restoration Projects (SERP) pathway, as well as the Project's forthcoming management plan (the details of which will not be addressed in-depth within this technical memo). This memorandum will inform and accompany Project permitting documents, as applicable. This memorandum outlines the methods and results to estimate the Project's existing tidal conditions relative to proposed conditions to more accurately evaluate how habitat types may transition in the Area of Potential Effect (Project Area) once full tidal influence is restored. Additionally, the potential effect of this tidal influence on sensitive plant species populations in the Project Area is approximated and evaluated.

1.1 Methodology for Conversion Analysis

The Habitat Conversion Analysis was performed using field surveys, ground elevations, and modelling of surface water levels within the Project Area. Existing habitat surveys were used to establish the extent of various habitats. Existing topography was used to associate elevations to habitats within the muted and unmuted tidal areas as well as areas above tidal influence, all of which are included in the Project Area. Proposed habitats within the Project Area were estimated based on the topography and habitat relationship

established for unmuted areas. The following habitat elevation ranges (NAVD88) were used for proposed conditions and compared to existing habitat mapping (**Attachment 1, Figure 4—Existing Habitat**):

- <2.5 ft – aquatic (subtidal channel and sloughs)
- 2.5-6 ft – intertidal channel and mudflats
- 6-8 ft – coastal salt marsh and brackish marsh
- >8 ft – generally no change in habitat, depending on the location and extent of existing habitat

2. Setting

2.1 Biological Studies Conducted On-site

GHD conducted multiple studies within the approximately 795-acre Project Area, including vegetation classification and mapping of native and non-native communities (**Attachment 1, Figure 2—Existing Vegetation Communities**) and protocol-level botanical surveys (**Attachment 1, Figure 3—Rare Plants**) (GHD 2022), both of which have been used in this Habitat Conversion Analysis. These studies inform the baseline conditions of habitat types in the Project Area, and the presence of and/or potential to host native or non-native species. These studies also inform what habitat types may be altered based on the results of proposed elevation changes and tidal regime shifts following Project implementation (existing versus proposed conditions).

2.2 Regulatory Framework for Delineating Habitat Types and Species Assemblages

For each study listed above, a variety of protocols and regulations guided the methods for how surveys were conducted, the information gathered during the field investigation, and the analysis and mapping of results. The results of these combined studies have informed the habitat types that were characterized and mapped in the Project Area at a level of fine detail (individual species populations), to broad groupings (vegetation associations). The following subsections describe the general federal and/or state regulations that guided the Project studies and the definition of the resource being investigated.

Vegetation Communities

Sensitive biological communities include habitats that are limited in extent, are particularly sensitive to disturbance, fulfil special functions or have special values, such as wetlands, streams, dunes, or riparian habitat. These habitats may be protected under federal regulations such as the Clean Water Act; state regulations such as the Porter-Cologne Act, the Coastal Act, and the California Department of Fish and Wildlife (CDFW) Streambed Alteration Program; or local ordinances or policies.

Additionally, plant communities (herbaceous alliances) may also be considered sensitive resources under state regulations such as the Coastal Act. Sensitive natural communities are those listed as Sensitive in CNDDB. These vegetation alliances are ranked 1 through 5 based on NatureServe's (2022) methodology, with those alliances ranked globally (G) or state-wide (S) with status of 1 through 3 considered to be critically imperiled, imperiled, or vulnerable, respectively (NatureServe 2022). Some species or communities may have a GNR designation (globally not rated) but are considered sensitive within the state (have a State ranking of 1 through 3).

Non-sensitive biological communities are those communities that are not afforded special protection under CEQA, and other state, federal, and local laws, regulations, and ordinances. However, these non-sensitive communities may provide suitable habitat for some special-status plant or wildlife species, are part of the

general existing site conditions, and may be afforded protection. Alternatively, non-native species and/or communities should be monitored and managed.

Environmentally Sensitive Habitat Areas (ESHA)

The Project Area is within the California Coastal Zone, with primary permitting jurisdiction by the California Coastal Commission (CCC) for a Coastal Development Permit. Environmentally Sensitive Habitat Areas (ESHAs) are defined by the Coastal Commission as follows (CCC 2022):

> *"Environmentally sensitive area means any area in which plant or animal life or their habitats are either rare or especially valuable because of their special nature or role in an ecosystem and which could be easily disturbed or degraded by human activities and developments."* (Pub. Resources Code, § 30107.5)

The Coastal Commission's designation of ESHA generally includes vegetation alliances listed in CDFW's California Sensitive Natural Communities List with a S1- S3 ranking. The Coastal Commission's ESHA category is broadly defined, and it also includes habitat for special-status species, wetlands, riparian areas, and other areas that provide important ecosystem functions (CCC 2013). While there is not a specific list of habitats considered to be ESHA for the State or County, the Coastal Commission through the Coastal Act and counties or municipalities through the Local Coastal Program (LCP) are the jurisdictional agencies that exert authority in identifying and protecting ESHA during project activities.

Sensitive Natural Communities

Sensitive Natural Communities (SNC) are primarily classified at the Alliance level according to *A Manual of California Vegetation, Online Edition* (CNPS 2022a), which is based on the older classification manual, *A Manual of California Vegetation* (Sawyer et al. 2009). Legacy SNC are listed in CNDDB according to the Holland classification system (1986), and Holland types may be used when a current Alliance-level classification does not exist (CDFW 2022a).

Federal and State Protected Plant Species

Special status plant species under federal jurisdiction include those listed as endangered, threatened, or as candidate species by the Fish and Wildlife Service (USFWS) under the Federal Endangered Species Act (FESA).

Special status plant species under CDFW jurisdiction include the following:

- Endangered, Threatened, or Candidate plant species listed under the California Endangered Species Act (CESA),
- Plants listed as Rare under California Native Plant Protection Act (Fish & G. Code, § 1900 et seq.) and,
- California Rare Plant Ranking (CRPR) rare plants on the California Native Plant Society's (CNPS 2022a) Lists 1 and 2.

Plant species on CNPS Lists 1 and 2 are considered eligible for state listing as Endangered or Threatened pursuant to the California Fish and Game Code, and CDFW has oversite of these special status plant species as a Trustee Agency. Such species are considered during the CEQA process because they meet the definition of Threatened or Endangered under Sections 2062 and 2067 of the California Fish and Game Code. Plants on CNPS Lists 3 and 4 do not have formal protection under CEQA but may merit consideration in certain circumstances. CDFW publishes and periodically updates lists of special status species which include all taxa of concern that are tracked by CDFW. Additionally, locally uncommon plants (CEQA Guidelines, § 15380, or as designated in local or regional plans, policies, or ordinances) are considered special status plant species (CDFW 2018).

3. Existing Habitat Conditions

3.1 Vegetation Communities Described On-site

Protocol-level botanical surveys and vegetation characterization and mapping occurred in 2020-2022 (GHD 2022). Potentially sensitive vegetation, and invasive dense-flowered cordgrass marsh were mapped at the Alliance level (**Attachment 1, Figure 2**) and are summarized in **Table 3.1**. Understanding the elevation range of vegetation types within the muted tidal prism compared to the adjacent marsh exposed to full tidal influence was of interest, and predicting how vegetation might be altered by opening the site to full tidal influence. Thus, elevation data were collected in the field using a Trimble Geo 7X Handheld Global Positioning System (GPS) with the Global Navigation Satellite System (GNSS) with the capability to define vegetation transition locations to be used in mapping and collecting characteristic central elevations within and outside the dikes (**Table 3.1**). Sensitive Natural Communities characterized within the Project Area include Northern Coastal Salt Marsh (a SNC as defined by Holland 1986) occur within and outside the muted tidal prism, and include the following vegetation alliances (defined according to Sawyer et al. 2009, CNPS 2022a):

- Low marsh dominated by pickleweed (G4 S3),
- Low marsh dominated by salt grass (GNR S4),
- High marsh dominated by gum plant (G2 S2), and
- Brackish marsh dominated by salt rush (G3 S2).

Additionally, 0.6 acres of eel grass beds (GNR S3) are anchored in subtidal slough bottom near McNulty Slough, to the west and outside of the existing dike. Coastal brambles dominated by California blackberry (*Rubus ursinus*), which may be classified as a SNC (G4 S3), occur along and adjacent to upland dikes. Because coastal brambles occur as linear features along existing dikes and contain a substantial proportion of non-native species, we recommend that this alliance not be considered a protected SNC in this context.

These vegetation alliances have been grouped according to broad habitat types in **Section 3.3**.

Table 3.1 Acreage of Existing Vegetation Types within the Project Area (Elevations in NAVD 88)

Vegetation Mapping Unit	Area (acres)	Mean Elevation (ft) Within Dikes ± Std	Mean Elevation (ft) outside Dikes ± Std
Pickleweed salt marsh	287.7	6.16 ± 0.69	7.11 ± 1.19
Gum plant patches	28.7	7.16 ± 1.37	7.96 ± 1.26
Salt rush swales	26.2	7.39 ± 1.12	-
Salt grass flats	17.8	6.21 ± 1.37	7.40 ± 1.26
Eelgrass beds	0.6	-	-
Coastal brambles	2.9	7.77 ± 0.34	9.10 ± 0.38
Dense-flowered cordgrass	61.6	6.05 ± 0.88	6.85 ± 1.03
Mudflats	93.4	5.89 ± 0.75	6.82 ± 0.17
Subtidal	16.1	-	-
Pale spike rush marsh	0.15	6.21± 0.64	-
Non-native pasture	208.7	6.68 ± 0.73 (*Agrostis stolonifera* pasture only)	-

Vegetation Mapping Unit	Area (acres)	Mean Elevation (ft) Within Dikes ± Std	Mean Elevation (ft) outside Dikes ± Std
Non-Native Vegetation/Developed	49.8	-	-

3.2 Existing Special Status Plant Populations

During surveys conducted in 2020, three special status plant species (CRPR 1 or 2) were observed during floristic surveys of the Project Area: Lyngbye's sedge (*Carex lyngbyei,* CRPR 2B.2), Humboldt Bay owl's clover (*Castilleja ambigua* ssp. *humboldtiensis,* CRPR 1B.2), and Point Reyes bird's beak (*Chloropyron maritimum* ssp. *palustre,* CRPR 1B.2). Additionally, seacoast angelica (*Angelica lucida*, CRPR 4.2), a limited distribution plant, was widespread in the Project Area (**Attachment 1, Figure 3**). Specific details for each species and their population dynamic within the Project Area are described below.

Lyngbye's sedge (*Carex lyngbyei*), CRPR 2B.2

Lyngbye's sedge is a rare perennial rhizomatous sedge that occurs in coastal salt marshes and brackish marshes along the Pacific Coast of North America from California to Alaska, as well as in Greenland and Iceland (CNPS 2022b). Although NatureServe ranks the sedge as secure throughout its range (Global Rank G5), it is considered vulnerable in California (State Rank S3). CNPS ranks the sedge as rare or endangered in California, where it is threatened by non-native species, habitat disturbance, and grazing (CNPS 2022b). Lyngbye's sedge occurred in dense patches along sloughs on the outside of the dike and sparsely scattered among invasive dense-flowered cordgrass on the outside of the dikes. The densest populations of Lyngbye's sedge can be found along the slough outside the dikes where brackish water exits the failed culvert. Lyngbye's sedge occurred around 5.5-6 feet elevation (NAVD88) along external sloughs and was not found within the muted tidal prism.

Humboldt Bay owl's clover (*Castilleja ambigua* ssp. *humboldtiensis*), CRPR 1B.2

Humboldt Bay owl's clover is a rare hemi-parasitic annual herb endemic to the North Coast of California (Baldwin et al. 2012). NatureServe ranks the sub-taxon as imperiled throughout its range (G4T2 S2), and CNPS ranks it as rare or endangered in California and elsewhere (CNPS 2022a). Humboldt Bay owl's clover was widespread in high marsh on the outside of the dikes, and some can be found on the interior around the dike breach. A total of 5,000-10,000 plants were estimated by roughly counting and visually estimating the number of individuals. Less than 100 of these were inside the dikes at the breach.

Point Reyes bird's beak (*Chloropyron maritimum* ssp. *palustre*), CRPR 1B.2

Point Reyes bird's beak is a rare annual hemi-parasitic herb that occurs in coastal salt marshes from Central California to Southern Oregon (Baldwin et al. 2012). Point Reyes bird's beak typically occurs in diverse mixed high marsh habitats (USFWS 2022). A total of ~7,000-10,000 plants occurred around the outside of the dikes and around the breach. Less than 100 were in inside the dikes around the breach where over-wash regularly occurs. Populations of Point Reyes bird's beak overlapped with Humboldt Bay owl's clover, occupying native high marsh habitat outside the dikes. Point Reyes bird's beak (and by proxy, co-occurring Humboldt Bay owl's clover) occurred around 7 feet elevation (NAVD88).

Seacoast angelica (*Angelica lucida*), CRPR 4.2

Seacoast angelica is a limited distribution plant (CRPR 4).Although it is considered vulnerable in California (S3), it is secure throughout its global range (G5). Seacoast angelica was widespread on dikes, berms, and

other higher-elevation microhabitats throughout the Project Area. The population is estimated to be ~1000 plants throughout the Project Area, all located on or within the dikes.

3.3 Groupings of Existing Habitat Types for Conversion Analysis

The Project Area contains sensitive and non-sensitive vegetation assemblages, and populations of sensitive plant species, some of which are expected to be affected by Project implementation.

The intent of this conversion analysis is to crosswalk the existing mapped vegetation assemblages with broad habitat groupings to better document and assess the potential shifts to these habitat types and individual species following Project implementation. **Table 3.3** provides a crosswalk between the vegetation communities characterized during botanical surveys and the broader habitat category they fit within based on Proposed habitats within the Project Area. These broad groupings were estimated based on the topography and habitat relationship established for unmuted areas. A description of the community dynamics of each vegetation mapping unit within these groupings is summarized below. **Attachment 1, Figure 4** shows where these habitat types occur within the Project Area.

Table 3.3 Crosswalk of Existing Habitat Types and Associated Broad Habitat Groupings

Broad Habitat Type for Use in Conversion Analysis	Vegetation Mapping Unit from Botanical Surveys	Area (acres)	Associated Elevation	Total Area (acres)[1]
Aquatic (Subtidal Channel and Sloughs)	Eelgrass Beds	0.6	<2.5 ft.	16.7
	Subtidal Sloughs (Unvegetated)	16.1		
Intertidal Channel and Mudflats	Mudflats/Estuarine Intertidal Shore	93.4	2.5-6 ft.	93.4
Coastal Salt Marsh and Brackish Marsh	Pickleweed Salt Marsh	287.7	6-8 ft.	360.4
	Gum Plant Patches	28.7		
	Salt Rush Swales	26.2		
	Salt Grass Flats	17.8		
Dense-Flowered Cordgrass Marsh	Dense-Flowered Cordgrass	61.6	6-8 ft.	61.6
Coastal Brambles	Coastal Brambles	2.9	>8 ft.	3.3
Coastal Willow Thickets	Coastal Willow Thickets	0.4		
Agricultural Pasture	Non-Native Pasture	208.7	>8 ft.	208.9
	Pale Spike Rush Marsh	0.15		
Ruderal	Non-native Vegetation (not functioning as pasture)	43.0	>8 ft.	43.0

1. Approximately 7.9 acres exist as areas of development (pervious/impervious surfaces, etc.).

Aquatic (Subtidal Channel and Sloughs)—Elevation <2.5 feet (NAVD88)

Eelgrass beds—*Zostera marina* Alliance (GNR S3)

Eelgrass beds were observed at low tide rooted within the subtidal zone outside of the failed culvert near the confluence with McNulty Slough. Eelgrass beds are a SNC (State Rank S3), and they are also regulated by the National Marine Fisheries Service as Essential Fish Habitat (NOAA 2014). Eelgrass was sparse within the Project Area. The area occupied by eelgrass was roughly mapped based on field observations as covering approximately 0.6 acres.

Subtidal Sloughs

Subtidal sloughs cover approximately 16.1 acres. Subtidal sloughs appear to have an unvegetated mud bottom within the dikes. Eelgrass occurs in the subtidal slough outside the failed culvert on the outer limits of the Project Area (see *Eelgrass beds* above). Many sloughs within the dikes appear to hold water throughout the tidal cycle throughout the year, based on personal observations at low-low tide during the dry season.

Intertidal Channel and Mudflats—Elevation 2.5-6 feet (NAVD88)

Mudflats/Intertidal Estuarine Shore

Mudflats were barren or covered by algal beds with no vascular vegetation, and these areas may provide valuable foraging habitat for shorebirds. The upper edge of mudflats occurred around 5.5-6 feet elevation (NAVD88) within the muted tidal prism, and around 6.5-7 feet elevation outside the dikes. The lower limit of mudflats within the dikes appeared to be around 4-foot elevation. The elevation range of mudflat and intertidal unconsolidated shore was much greater outside of the dikes, where they are exposed to the full tidal range, compared to the muted environment inside the dikes. Mudflats covered approximately 93.4 acres of the Project Area.

Coastal Salt Marsh and Brackish Marsh—Elevation 6-8 feet (NAVD88)

Gum plant patches—*Grindelia stricta* Alliance (G2 S2)

Gum plant (*Grindelia stricta* var. *stricta*) dominates a great deal of diverse high marsh at the site, both within and outside the dikes. Gum plant is often associated with tufted hairgrass (*Deschampsia cespitosa*). At gum plant's upper extent, it also associated with yarrow (*Achillea millefolium*), bird's foot trefoil (*Lotus corniculatus*), and Pacific aster (*Symphyotrichum chilense*). At the lower elevation areas of gum plant dominance, it also associated with pickleweed (*Salicornia pacifica)*, salt grass (*Distichlis spicata)*, and salt rush (*Juncus lescurii*). Gum plant dominates 28.7 acres of the Project Area. Gum plant was primarily found around 7 feet elevation (NAVD88) within the muted tidal prism, and at 8 feet (NAVD88) outside the dikes.

Pickleweed salt marsh—*Salicornia pacifica* Alliance (G4 S3)

Pickleweed dominates much of the subsided former pasture that was historically diked and drained for agriculture. The Pickleweed Alliance is a SNC, with a State Rank of S3. Pickleweed-associated species included salt grass, fat hen (*Atriplex prostrata*), and saltmarsh dodder (*Cuscuta salina*). Northern Coastal Salt Marsh dominated by pickleweed covers 287.7 acres of the Project Area. Pickleweed primarily dominates lower elevation areas around 6 feet (NAVD88) within the muted tidal prism and is primarily found at 7 feet elevation (NAVD88) outside the dikes.

Salt rush swales—*Juncus lescurii* Alliance (G3 S2)

Salt rush dominates 26.2 acres of brackish marsh at the site. Salt rush swales are a SNC with a State Rank of S2. Salt rush was often associated with Pacific silverweed (*Potentilla anserina* ssp. *pacifica*) and creeping

bentgrass (*Agrostis stolonifera,* Cal-IPC Limited). It often appeared to occupy a transition zone between pasture grass dominated by creeping bentgrass and pickleweed or mixed salt marsh at an elevation around 7-8 feet (NAVD88) within the dikes and did not dominate areas outside the dikes.

Salt grass flats—*Distichlis spicata* Alliance (GNR S4)

Salt grass dominated 17.8 acres of Northern Coastal Salt Marsh at the site. Although the Alliance is not rated as a SNC (State Rank S4), it represents one alliance that can occur within the Northern Coastal Salt Marsh CDFW legacy SNC (Holland 1986). Salt grass was often associated with marsh jaumea (*Jaumea carnosa*) and pickleweed. Salt grass dominance appeared to occur in slightly higher elevation in salt marsh compared to pickleweed dominance, but analysis of elevations collected in the field showed similar overlapping elevation ranges around 6 feet NAVD88 within the dikes (muted), and 7 feet in areas of full tidal influence.

Dense-flowered Cordgrass Marsh—Elevation 6-8 feet (NAVD88)

Dense-flowered cordgrass marsh –*Spartina densiflora* Semi-natural Alliance (Cal-IPC High)

Invasive dense-flowered cordgrass (*Spartina densiflora,* Cal-IPC High) dominates a great deal of the lower salt marsh on the outside of the dikes near McNulty Slough, and it has invaded muted salt marsh areas near the dike breach and the northern failed culvert. The average elevation of invaded salt marsh within the muted tidal prism was around 6 feet elevation (NAVD 88) and around 7 feet elevation (NAVD88) outside of the dikes. Dense-flowered cordgrass marsh covers approximately 61.6 acres of the Project Area.

Coastal Brambles and Coastal Willow Thickets—Elevation >8 feet (NAVD88)

Coastal brambles—*Rubus ursinus* Alliance (G4 S3)

Coastal brambles dominated by California blackberry (*Rubus ursinus*) occurred primarily on upland dikes and extended into marginal palustrine wetlands on the interior side of the dikes. California blackberry often associated with Pacific aster and weedy upland species such as wild radish (*Raphanus sativus*) (Cal-IPC Limited). California blackberry primarily occurred around 8 feet elevation (NAVD88) on the interior side of the dikes, and 9 feet elevation (NAVD88) on the exterior side. Coastal brambles occupied approximately 2.9 acres of the Project Area.

Coastal Willow Thickets—*Salix hookeriana* Alliance (G4 S3)

An incidental detection and small patch of coastal willows (*Salix hookeriana*) was observed along the eastern edge of the Project Area, bordering a dirt road and footpath that borders the Sevenmile Slough channel. The coastal willow patch totals 0.34 acres. This area was mapped to record the location and extent.

Agricultural Pasture—Elevation >8 feet (NAVD88)

Non-native Pasture—*Agrostis stolonifera* (Cal-IPC Limited) Semi-natural Alliance

Much of the remaining 208.7 acres is pasture characterized by non-native creeping bentgrass *(Agrostis stolonifera*), which spans from areas with lesser saltwater infiltration around 6.5 to 7 feet elevation to uplands around 10 feet (NAVD88). The non-native pasture was differentiated from other non-native dominated and developed areas like roads and dikes that also contained creeping bentgrass and other pasture grasses but did not function as pasture. Much of this area was wet pasture (dominated by facultative species).

Pale spike rush marsh—*Eleocharis macrostachya* Alliance (G4 S4)

Pale spike rush (*Eleocharis macrostachya)* marsh was identified to the south of Cannibal Island Road in two discrete patches trending toward the middle of the southernmost boundary of the Project Area covering

approximately 0.15 acres, where pale spike rush was dominant in the herb layer with Pacific silverweed. These areas were surrounded by Non-native Pasture congruent with the characterization of the wet Non-native Pasture mapped to the north of Cannibal Island Road. The areas at the margin and outside of the spike rush marsh were dominated by predominantly non-native facultative species.

Ruderal—Elevation >8 feet (NAVD88)

Non-Native Vegetation/Developed

Many weedy uplands and marginal wetland areas occur around access roads, dikes, artificial berms, and remnants of former agricultural development, covering a total of 43 acres. These areas are predominantly characterized by evidence of previous anthropogenic disturbance and the presence of many weedy non-native species such as wild radish (*Raphanus sativus*), Queen Anne's lace (*Daucus carota*), and poison hemlock (*Conium maculatum*). Pacific aster (*Symphyotricum chilense*), a native species, was also fairly widespread in this vegetation type. Creeping bentgrass and other non-native grasses also occurred in this habitat, but these areas are not functional for use as pasture.

4. Proposed Habitat Conditions and Conversion Analysis

4.1 Proposed Vegetation Community Conversions

Habitats in the Project Area are expected to convert with the introduction of full tidal influence east of the existing dikes. The persistence of existing salt marsh vegetation and other habitats is primarily a function of the species tolerance to frequency and duration of tidal inundation (Eicher, 1987). Therefore, the ground elevation and tidal range primarily influence habitat types. The muted tidal hydraulics (reduced tidal range and elevation) east of the existing dikes results in a vertical shift downward of similar habitats compared to the full or open tidal environment west of the dikes. Given the proposed increase in tidal range (full tidal) east of the dikes, habitats within the interior of Cannibal Island are expected to convert to the habitat-elevation relationship west of the existing dikes, in full tidal areas (**Attachment 1**, **Figure 5—Habitat Post-Construction in Proposed Project**)**.** The estimated change in habitat types following Project implementation is summarized in **Table 4.1**.

For elevations above 8 feet (NAVD88), predictions for transitions in habitat types were based on the following conventions:

– Existing agricultural pasture on the outboard side of the new setback-levee will become coastal grassland,
– Ruderal areas south of the new constructed channel will become coastal grassland,
– Any previously muted intertidal channel and mudflats, or coastal salt marsh and brackish marsh will become full and no longer muted, and
– All other areas above 8 feet (NAVD88) will remain unchanged.

The post-construction habitats outboard of the new setback-levee and east of the existing dikes are anticipated to evolve with sediment deposition associated with the increased tidal range and exposure to higher sediment loads throughout the year. In particular, Intertidal Mudflats will evolve into Coastal Salt Marsh and Brackish Marsh. Sedimentation rate was previously estimated in the Eel River Estuary. Moffatt and Nichol (M&N) used a 1-dimensional sedimentation model to approximate sedimentation rates on estuarine lands adjacent to Cannibal Island for the Ocean Ranch Estuary Restoration Project (Moffatt and Nichol, 2015). The lowest elevation subunit within the site (3.4 feet NAVD 88) was used for the sedimentation analysis. The results showed varying durations for subsided lands within the restoration site to accrete by 1-foot depending on the specified design alternatives. One of those design alternatives, which included a fully restored open tidal system, was estimated to take four years to increase elevations by 1-foot. This rate of sedimentation would be expected to keep pace with projected sea-level rise.

Historically, nearly the entire area east of the existing dikes was converted to Agricultural Pasture. As tidal waters returned to the lower elevations in this area (muted tide), through the existing culverts, Agricultural Pasture has converted back to Coastal Salt Marsh and Brackish Marsh and Intertidal Channel and Mudflats. Sea-level rise will continue to increase the footprint and elevation of tidal influence, thereby decreasing Agricultural Pasture. Implementation of the set-back levee will protect and preserve a portion of Agricultural Pasture to future changes due to sea level rise or other events increasing tidal extent, such as a breach in the exterior dikes or further culvert failure.

Table 4.1 Existing Habitats and Proposed Conversions

Habitat Type	Existing Area (acres)	Proposed Area (acres)	Change in Habitat (acres)[1]
Agricultural Pasture	208.7	90.4	(118.3)
Aquatic (Subtidal Channel and Sloughs)	16.7	30.4	13.7
Coastal Grassland	0	25.0	25.0
Coastal Salt Marsh and Brackish Marsh (Full)	89.3	315.3	226.0
Coastal Salt Marsh and Brackish Marsh (Muted)	332.8	0	(332.8)
Coastal Brambles	2.9	1.9	(1.1)
Coastal Willow Thickets	0.4	0.4	0.0
Developed	6.8	2.6	(4.2)
Intertidal Channel and Mudflats (Full)	4.6	319.3	314.7
Intertidal Channel and Mudflats (Muted)	88.7	0	(88.7)
Ruderal	43.0	10.1	(32.9)
Uncategorized[2]	1.1	0.1	(1.0)
Total	795.2	795.2	0.0

1. Red text denotes a negative change in area calculations (i.e., a net loss of that habitat type).
2. Uncategorized Habitat Type includes small areas that were left over from digitization of field data into the geospatial data collection software that don't include any habitat types.

4.2 Analysis of Habitat Conversions

The communities defined within the Project Area provide quality habitat for a variety of wildlife and plants. Coastal Salt Marsh and Brackish Marsh onsite provides high-value habitat for avifauna, invertebrates, and diverse plant species and communities. Mudflats provide high-value foraging habitat for shorebirds. Subtidal Channels and Sloughs have the potential to support the growth of eelgrass and provide high-value habitat for salmonids, the tidewater goby, and other aquatic species. Analyzing potential shifts in these ecotones will provide insight to what habitat value the transformed landscape will hold after restoration implementation is complete. Based on modelling of elevation and topographic changes, vegetation is hypothesized to change as follows when the area is opened to full tidal influence:

- Reduction of dense-flowered cordgrass marsh
- Increase in Subtidal Channel and Sloughs,
- Increase in full tidal Intertidal Channel and Mudflat,
- Increase in full tidal Coastal Salt Marsh and Brackish Marsh and associated rare plants,
- Reduction in muted tidal habitats,

- Reduction in habitats dominated by non-native species (Agricultural Pasture and Ruderal), and restoration of this habitat type to full tidal Coastal Salt Marsh and Brackish Marsh; and,
- Reduction in uplands and Coastal Brambles (dominated by coastal brambles intermixed with upland non-native species).

Generally, it is expected that the Project will result in a loss of muted tidal habitats (muted Coastal Salt Marsh and Brackish Marsh, and muted Intertidal Channel and Mudflats), which do not host the density of sensitive species detected in the Project Area. Special status plant species were found clustered at the outboard edge of the dikes in areas of full tidal influence (**Attachment 1, Figure 3**). Additionally, dense-flowered cordgrass marsh was mapped primarily outside of the dikes, in areas of full tidal influence (**Attachment 1, Figure 2 and Figure 4**). Dense-flowered cordgrass will be removed during Project implementation, thereby opening the habitat up to be restored to full tidal influence (**Attachment 1, Figure 5**). The proposed Project will restore full tidal influence to a variety of habitat types, and based on modelled changes in topography and elevation in relation to tidal fluctuations within the Project Area, will result in a net increase of full tidal influenced Subtidal Channels and Sloughs (+13.7 acres), Intertidal Channel and Mudflats (+314.7), and Coastal Salt Marsh and Brackish Marsh (+226 acres) (**Attachment 1, Figure 5**). Full tidal range restoration is expected to promote recovery and maintenance of tidal marsh habitats that support native fish, invertebrates, wildlife, and plant species, while also enabling marsh elevations to keep pace with sea level rise. Notably, 60.1 acres of Dense-flowered Cordgrass Marsh, 90.4 acres of Agricultural Pasture primarily dominated by non-native grasses, and 10.1 acres of Ruderal comprised of upland non-native species, will be restored to Coastal Salt Marsh and Brackish Marsh, thereby expanding this valuable habitat type, and shrinking low quality habitat types. Additionally, a net increase (13.7 acres) of Subtidal Channels and Sloughs will create more habitat for existing eelgrass populations to expand and provide additional fish habitat (**Attachment 1, Figure 2 and Figure 5**).

One upland SNC (S3 ranking) was identified within the Project Area —Coastal Brambles, which occurred primarily on upland dikes and extended into marginal palustrine wetlands on the interior side of the dikes. Approximately 1.9 acres of the Coastal Bramble habitat in the northern and western reaches of the Project Area (**Attachment 1, Figure 4**) will be converted into Coastal Salt Marsh and Brackish Marsh with the removal of the existing dikes to allow full tidal influence (**Attachment 1, Figure 5**). As mentioned previously in **Section 3.1** and **Section 3.3**, this community exists as a linear feature along dikes and was established from a legacy of disturbance. Additionally, this community is associated with weedy upland species. In this context, it should not be considered a SNC. The conversion of this habitat type to native Coastal Salt Marsh and Brackish Marsh communities (salt grass, salt rush, pickleweed, and gum plant) would convert the community back to the natural community that once inhabited the areas where dikes were constructed.

Ground disturbance and creation of new tidal areas could result in the expansion of dense flowered cordgrass, which could affect the expansion of native communities and SNCs in wetlands. Control of dense-flowered cordgrass in the Project Area using mowing, grinding, excavation, herbicide application, and/or flaming methods will occur to support current regional eradication efforts. Continued control of new invasive plant populations during the maintenance period of the Project will ensure that newly created tidal habitat will not be invaded.

4.3 Special Status Plant Habitat Conversion Analysis

Humboldt Bay owl's clover (CRPR 1B.2), Point Reyes bird's beak (CRPR 1B.2), and Lyngbye's sedge (CRPR 2B.2) primarily occur outside of the dikes in areas of full tidal influence in Coastal Salt Marsh and Brackish Marsh (**Attachment 1, Figure 3**). A small number of Humboldt Bay owl's clover and Point Reyes bird's beak were observed at the dike breach, where regular over-wash likely occurs. The habitat type in this area of the Project is expected to be affected by Project implementation when dikes are lowered to marsh elevation to allow full tidal influence to the interior of Cannibal Island, and thus, portions of these populations are expected to be affected by the conversion of habitat types. Additionally, some individual plants may be directly impacted

by these actions. Overall, the Project aims to restore habitat for these species, which is expected to dramatically expand their population size and vigour over time.

The existing population size, approximate area affected, and approximate area of habitat created by the Project for these species is summarized in **Table 4.3**, and a description of each species and the population dynamic within the Project Area is discussed below.

Table 4.3 Special-Status Plant Species Habitat Affected by Project

Scientific Name	Common Name	Listing Status	Approximate Number of Individuals	Population Area (acres)	Area Affected by Project (acres / square feet)	Area of Habitat Restored by Project (acres)[1]
Angelica lucida	sea-watch	CRPR 4.2	~1000	Widespread, not calculated.	N/A	226
Carex lyngbyei	Lyngbye's sedge	CRPR 2B.2	Not estimated	0.54	0.24 / 10,365	~24,000 feet*
Castilleja ambigua ssp. *humboldtiensis*	Humboldt Bay's owl-clover	CRPR 1B.2	5,000-10,000	1.44	0.23 / 10,012	226
Chloropyron maritimum ssp. *palustre*	Point Reyes bird's beak	CRPR 1B.2	7,000-10,000	2.03	0.16 / 6,804	226
Zostera maritima	Eelgrass	EFH	unknown	0.6	None	13.7

1. The areas shown in this column reflect the potential habitat zones that these species may naturally recruit to and establish within, but are not limited to this extent.

   *Approximation of linear feet of slough channel that will be influenced by a full tidal regime, including both existing and created channels.

Note: California Rare Plant Ranking (CRPR) lists 1A, 1B and 2 and are considered eligible for state listing as Endangered or Threatened pursuant to the California Fish and Game Code.

EFS = Essential Fish Habitat

Rare Plant Populations Affected by Habitat Conversion

Populations of rare plants that are currently inhabiting areas outside of the existing dikes will be affected by Project implementation (**Attachment 1, Figure Set 6—Rare Plant Impacts** and **Table 4.3**).

Lyngbye's sedge may be disturbed by removal of the external dikes, dredging of slough channels, and/or hydrological changes as a result of removing the failed culvert. Similarly, Humboldt Bay owl's clover may be impacted by work on the exterior dike. Opening the area to full tidal influence will create additional tidal marsh habitat on the interior of the dikes and allow natural dispersal to occur, and these species have the potential to expand following restoration. Point Reyes bird's beak may also be affected by work around the dikes and other Project-related activities but has the potential to expand following restoration of full tidal influence.

Seacoast angelica may be impacted by work on the exterior dike, and discrete areas of upland habitat within the Project Area. The Project does not aim to increase upland habitat; however, there will be a small area of uplands created when constructing the setback levee that can be potential habitat for this species to inhabit. This species is a limited distribution plant (CRPR 4) in California that is secure globally and occurs throughout the Project Area.

Summary of Impacts to Rare Plant Populations

A portion of the slough channel connecting the interior of Cannibal Island with North Bay will be graded to support restoration of the dendritic channel network that once connected the interior salt marsh of Cannibal Island with tidal influence from North Bay. This grading, in addition to removal of dense-flowered cordgrass, will impact areas of Humboldt Bay owl's clover, Lyngbye's sedge, Point Reyes bird's beak, and seacoast angelica (**Attachment 1, Figure 6.1 and 6.2**). As dikes in the west of the Project Area are graded and lowered, a small area of Humboldt Bay owl's clover, Lyngbeye's sedge, Point Reyes bird's beak, and seacoast angelica will be impacted (**Attachment 1, Figure 6.3**). Small, discrete populations of Humboldt Bay owl's clover and seacoast angelica will be impacted by grading or filling areas of the interior marsh plain to provide habitat variability and increased complexity (**Attachment 1, Figure 6.4**).

The proposed Project condition will increase full tidal Coastal Salt Marsh and Brackish Marsh by 226 acres, thereby restoring habitat for Humboldt Bay owl's clover, Lyngbye's sedge, and Point Reyes bird's beak. Seacoast angelica populations will be affected by the removal of upland dikes they are currently inhabiting. . Although individual plants will be impacted by removal of the dikes, the population in the Project Area is not likely to be substantially affected.

The proposed Project will restore full tidal influence to a variety of habitat types, resulting in a net increase of full tidal influenced Subtidal Channels and Sloughs (+13.7 acres), Intertidal Channel and Mudflats (+314.7), and Coastal Salt Marsh and Brackish Marsh (+226 acres). The Project goals are to restore habitat types that will provide additional area for these rare plant populations (and other native plant and wildlife species) to expand into. Additionally, removal and monitoring of dense-flowered cordgrass will be a high priority post-construction, as this species has established dominance in many lower marsh areas outside of the dikes and has invaded areas within the dikes with relatively high tidal influence near the dike breach and failed culvert. Dense-flowered cordgrass could rapidly disperse and invade new potential habitat at the site once full tidal influence is restored. Close monitoring of this species will occur post-implementation to ensure restored native habitat is not invaded.

5. Conclusion

The Cannibal Island Restoration Project Area contains a variety of existing habitat types (**Attachment 1, Figure 2**) that have been combined into broad groups (**Attachment 1, Figure 4**) to help analyze the way these habitats may be influenced by the proposed full tidal regime after Project implementation (**Attachment 1, Figure 5**). The Project Area contains three rare salt marsh plants (**Attachment 1, Figure 3**): Humboldt Bay owl's clover (CRPR 1B.2), Point Reyes bird's beak (CRPR 1B.2), and Lyngbye's sedge (CRPR 2B.2), that will be affected by the proposed full tidal regime and resulting conversion of habitat types, as well as Project implementation activities (**Attachment 1, Figure Set 6**).

Project activities are anticipated to result in a net increase in full tidal Coastal Salt Marsh and Brackish Marsh habitat with the reintroduction of tidal influence east of the existing dike. Removal of dense-flowered cordgrass will be employed during Project implementation to open the area currently inhabited to restoration, as well as reduce the likelihood of future recruitment of the species to newly created habitat. This species will be monitored post-construction. Native saltmarsh vegetation is expected to increase and outcompete non-native annual grasses as soil and aquatic salinities increase. Restoring tidal influence is likely to increase available habitat for rare plants. Project activities are also anticipated to result in a net increase in full tidal Subtidal Channel and Sloughs and Intertidal Channel and Mudflats, thereby increasing the potential for eelgrass beds to expand. The net increase in full tidal mudflat and salt marsh habitats by re-introducing the full natural tidal range will promote sediment accretion thereby supporting the landscape in adjusting naturally to sea level rise. This process-based restoration combined with connectivity of historic slough networks will provide an overall

benefit to the ecology of the Eel River Estuary, supporting a variety of native wildlife and aquatic species, vegetation, and ecosystem functions.

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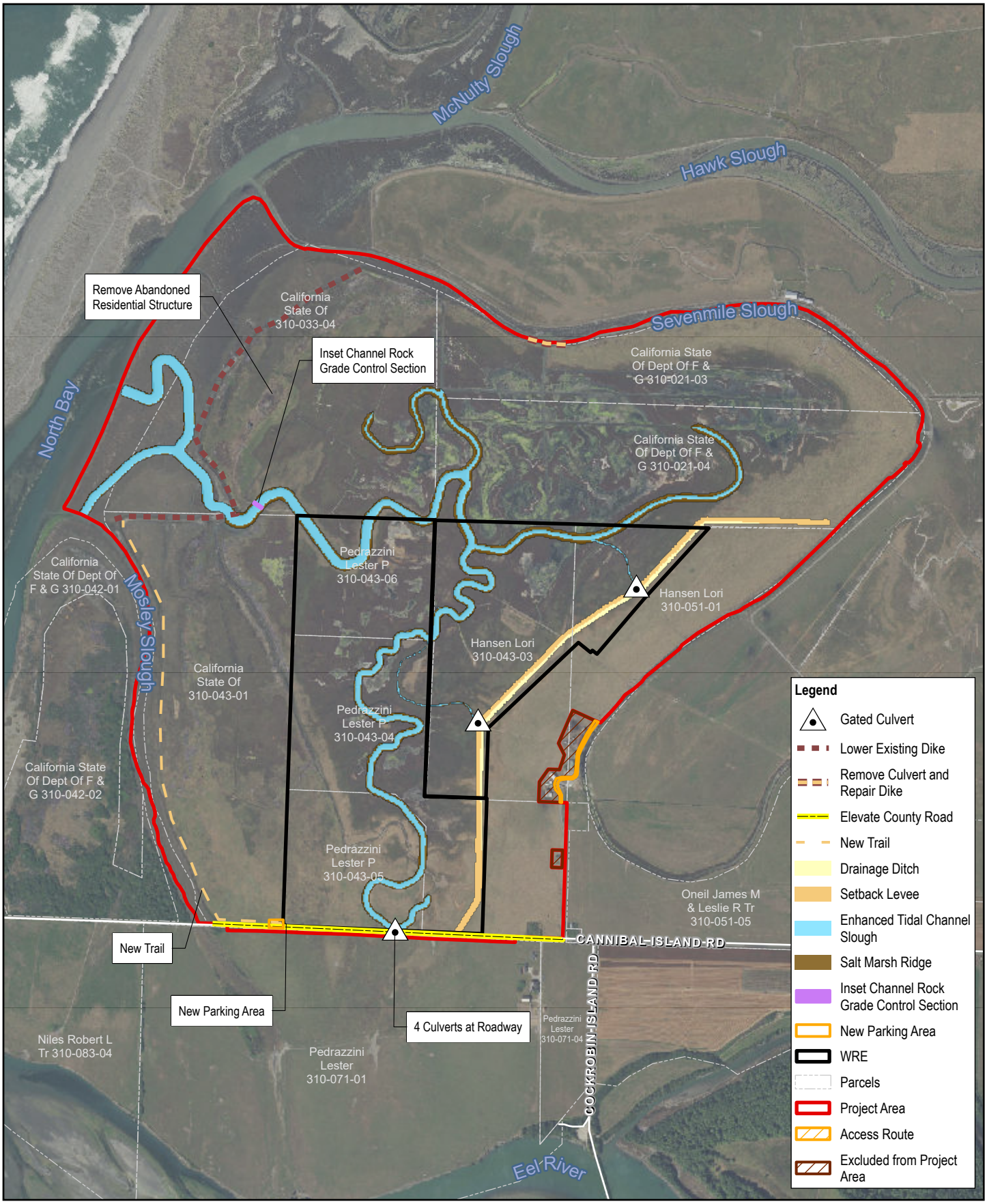
Attachment 1

Figures



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CalTrout
Cannibal Island Restoration Project

Project No. **11206383**
Revision No. **-**
Date **Aug 2023**

Project Area and Components

FIGURE 1

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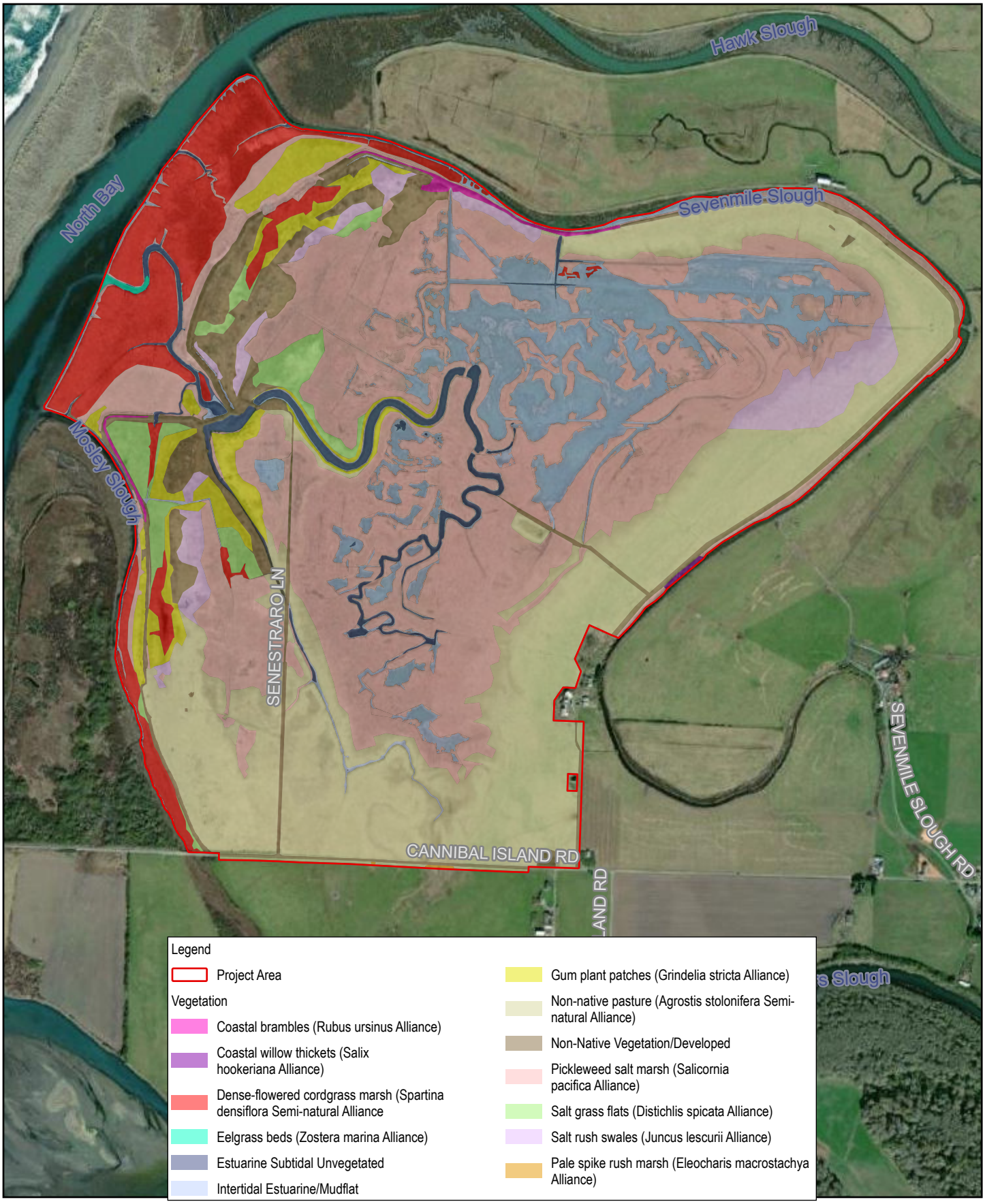

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Cannibal Island Restoration Project

Project No. **11206383**
Revision No. **-**
Date **17 Apr 2023**

Existing Vegetation Communities

FIGURE 2

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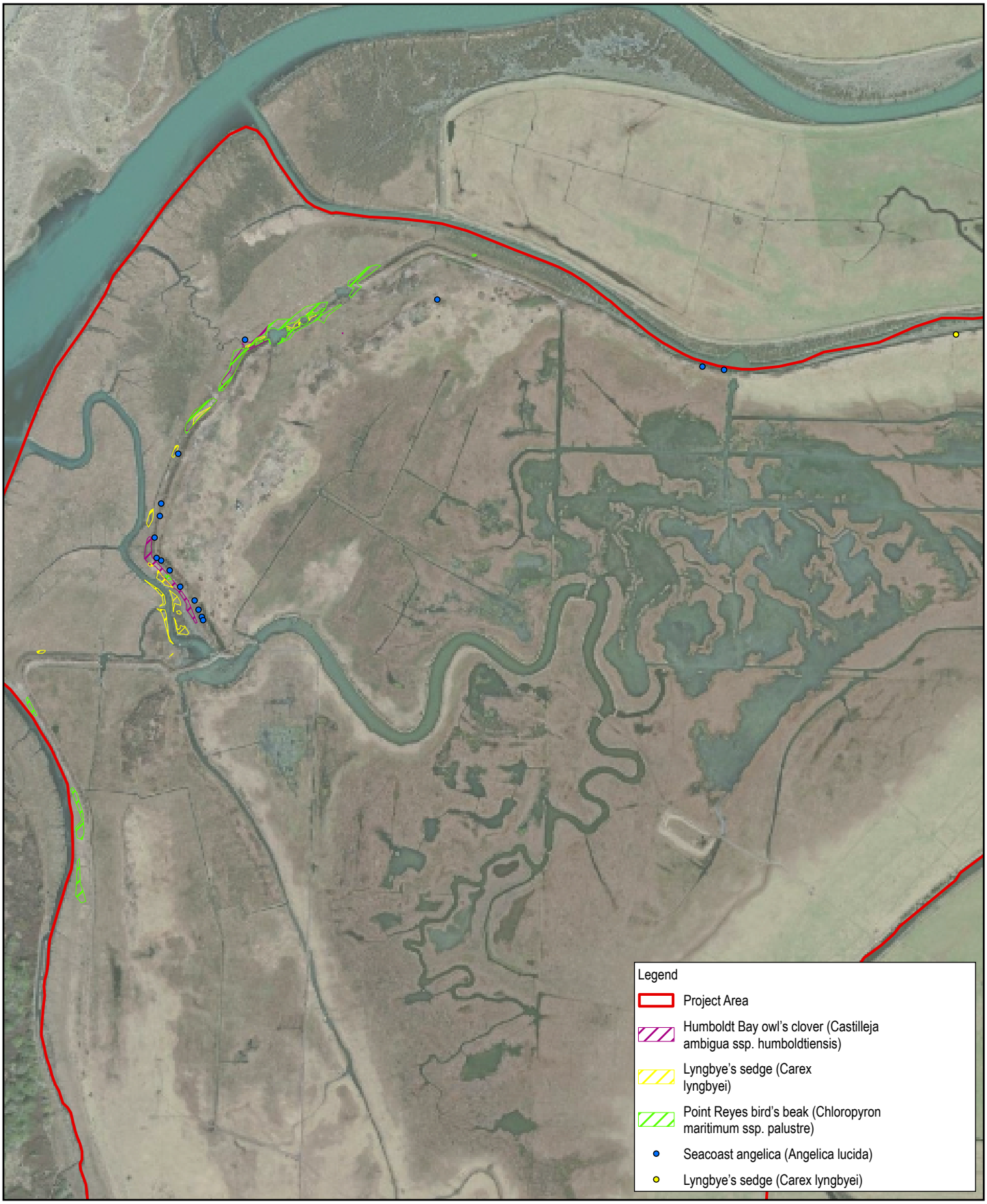

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Cannibal Island Restoration Project

Project No. **11206383**
Revision No. **-**
Date **27 Apr 2023**

Rare Plants

FIGURE 3

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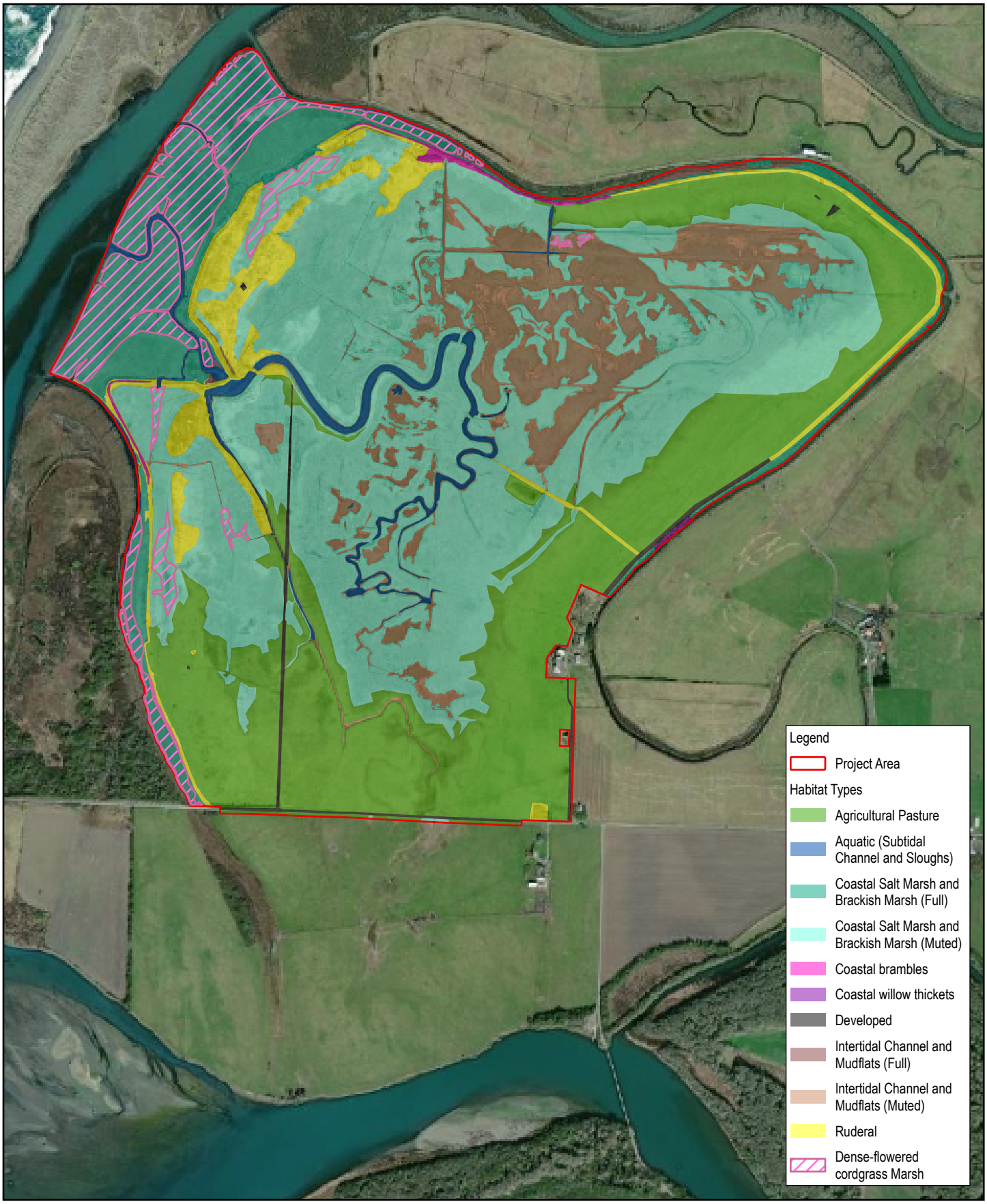

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Cannibal Island Restoration Project

Project No. **11206383**
Revision No. **-**
Date **27 Apr 2023**

Existing Habitat

FIGURE 4

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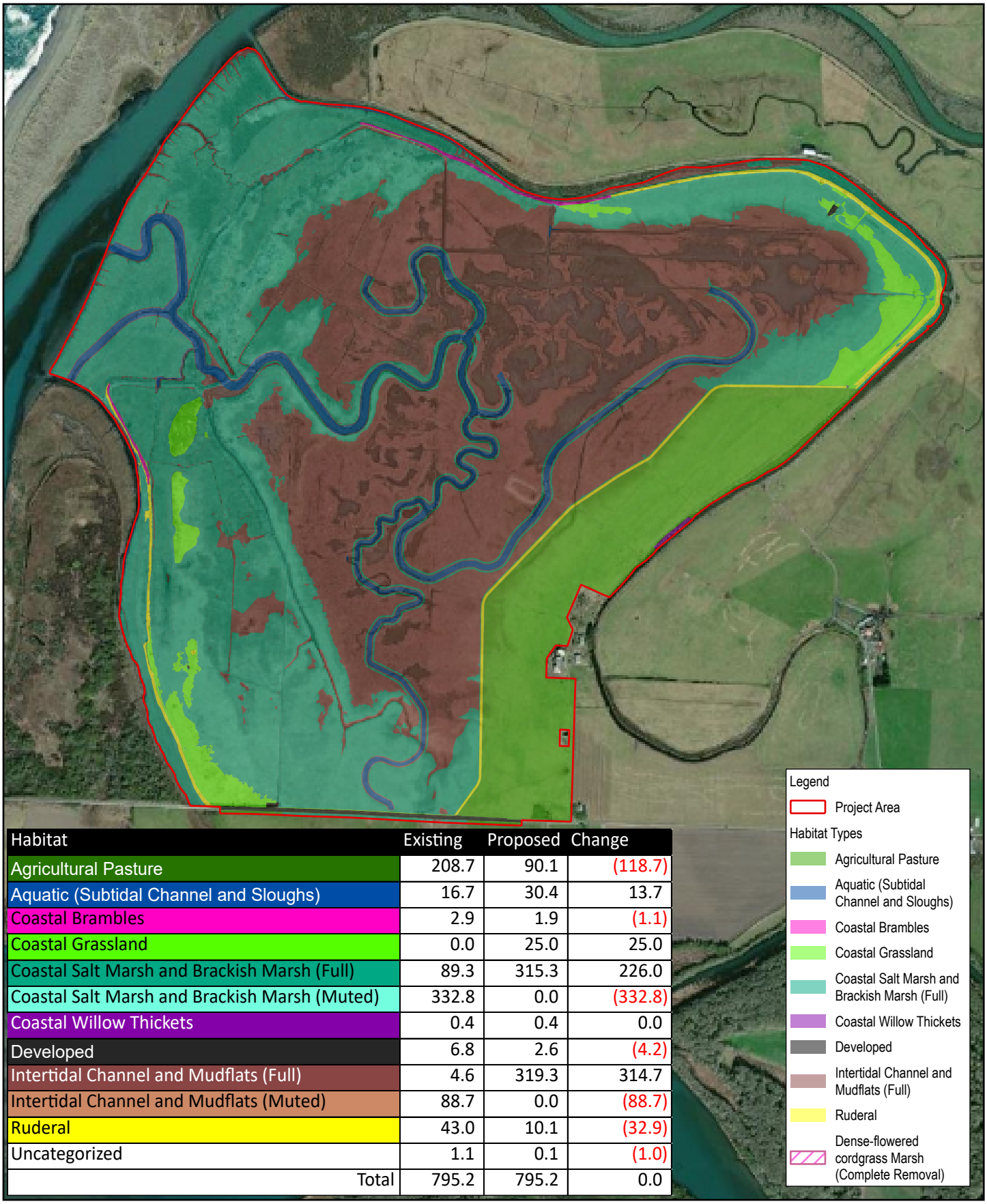

Habitat	Existing	Proposed	Change
Agricultural Pasture	208.7	90.1	(118.7)
Aquatic (Subtidal Channel and Sloughs)	16.7	30.4	13.7
Coastal Brambles	2.9	1.9	(1.1)
Coastal Grassland	0.0	25.0	25.0
Coastal Salt Marsh and Brackish Marsh (Full)	89.3	315.3	226.0
Coastal Salt Marsh and Brackish Marsh (Muted)	332.8	0.0	(332.8)
Coastal Willow Thickets	0.4	0.4	0.0
Developed	6.8	2.6	(4.2)
Intertidal Channel and Mudflats (Full)	4.6	319.3	314.7
Intertidal Channel and Mudflats (Muted)	88.7	0.0	(88.7)
Ruderal	43.0	10.1	(32.9)
Uncategorized	1.1	0.1	(1.0)
Total	795.2	795.2	0.0

Paper Size ANSI A

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Cannibal Island Restoration Project

Project No. 11206383
Revision No. -
Date 03 May 2023

Habitat Post-Construction in Proposed Project

FIGURE 5

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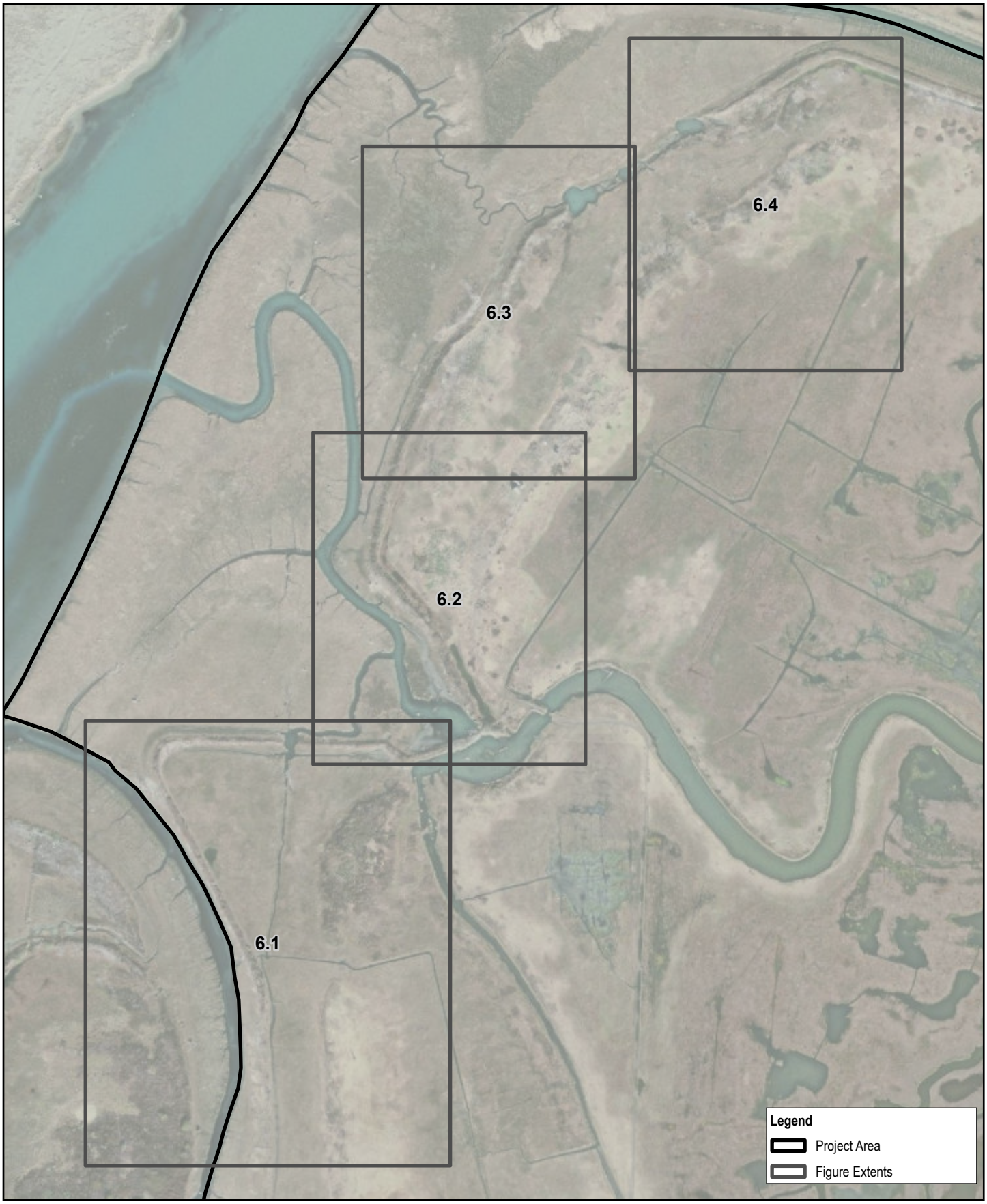

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CalTrout
Cannibal Island Restoration Project

Project No. **11206383**
Revision No. **-**
Date **26 Apr 2023**

Rare Plant Impacts Overview

FIGURE 6

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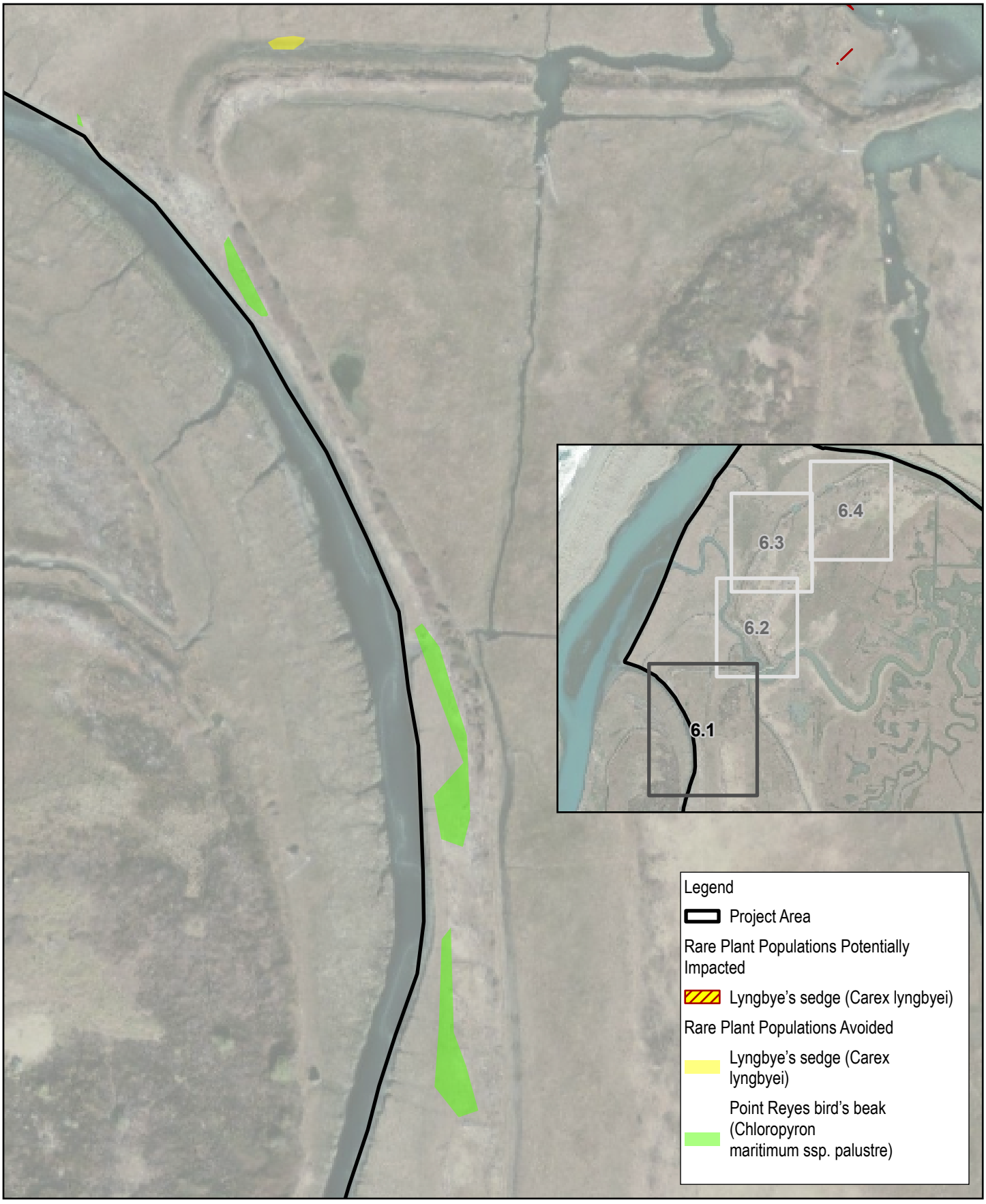

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CalTrout
Cannibal Island Restoration Project

Project No. **11206383**
Revision No. **-**
Date **04 May 2023**

Rare Plant Impacts

FIGURE 6.1

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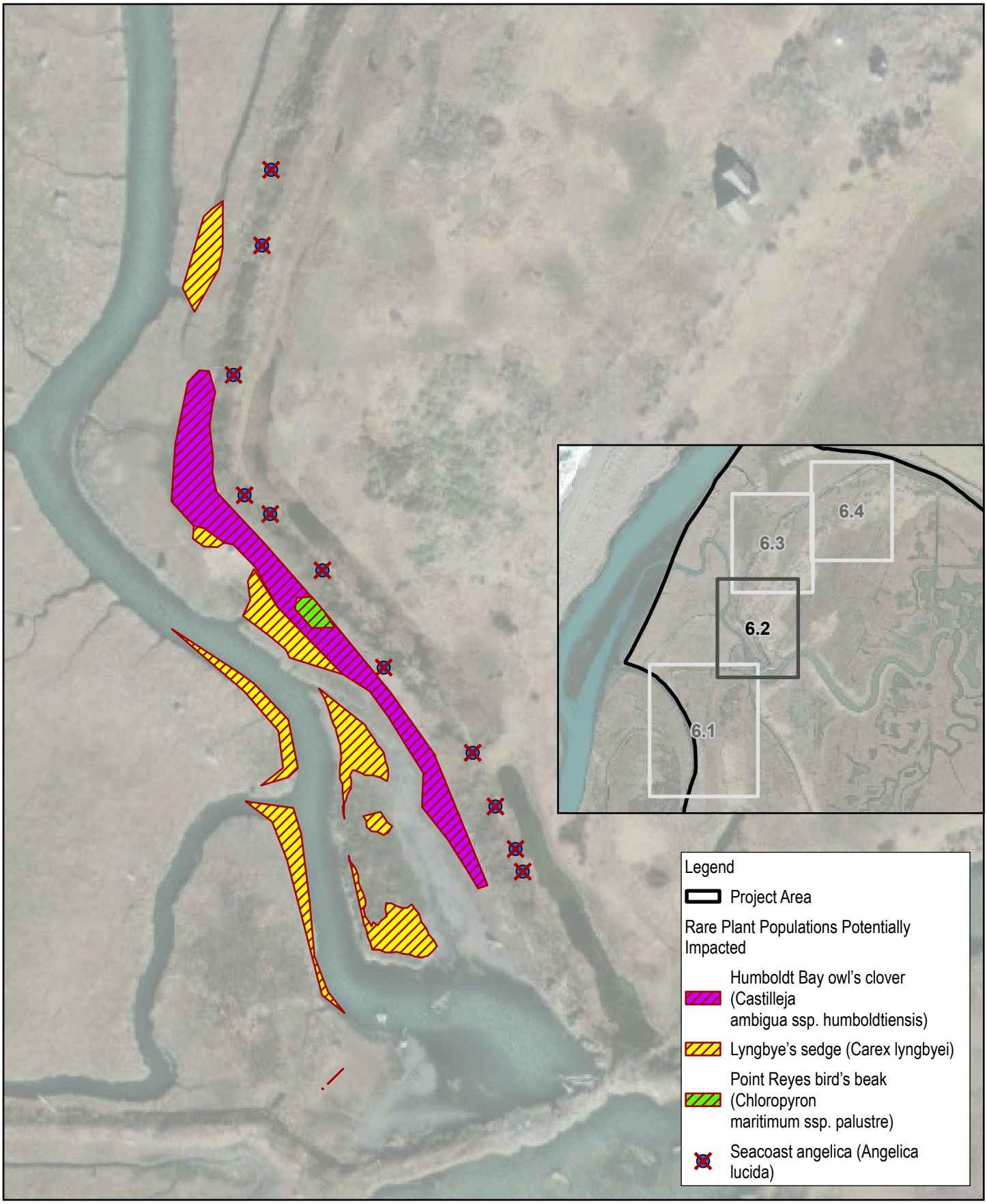

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CalTrout
Cannibal Island Restoration Project

Project No. **11206383**
Revision No. **-**
Date **04 May 2023**

Rare Plant Impacts

FIGURE 6.2

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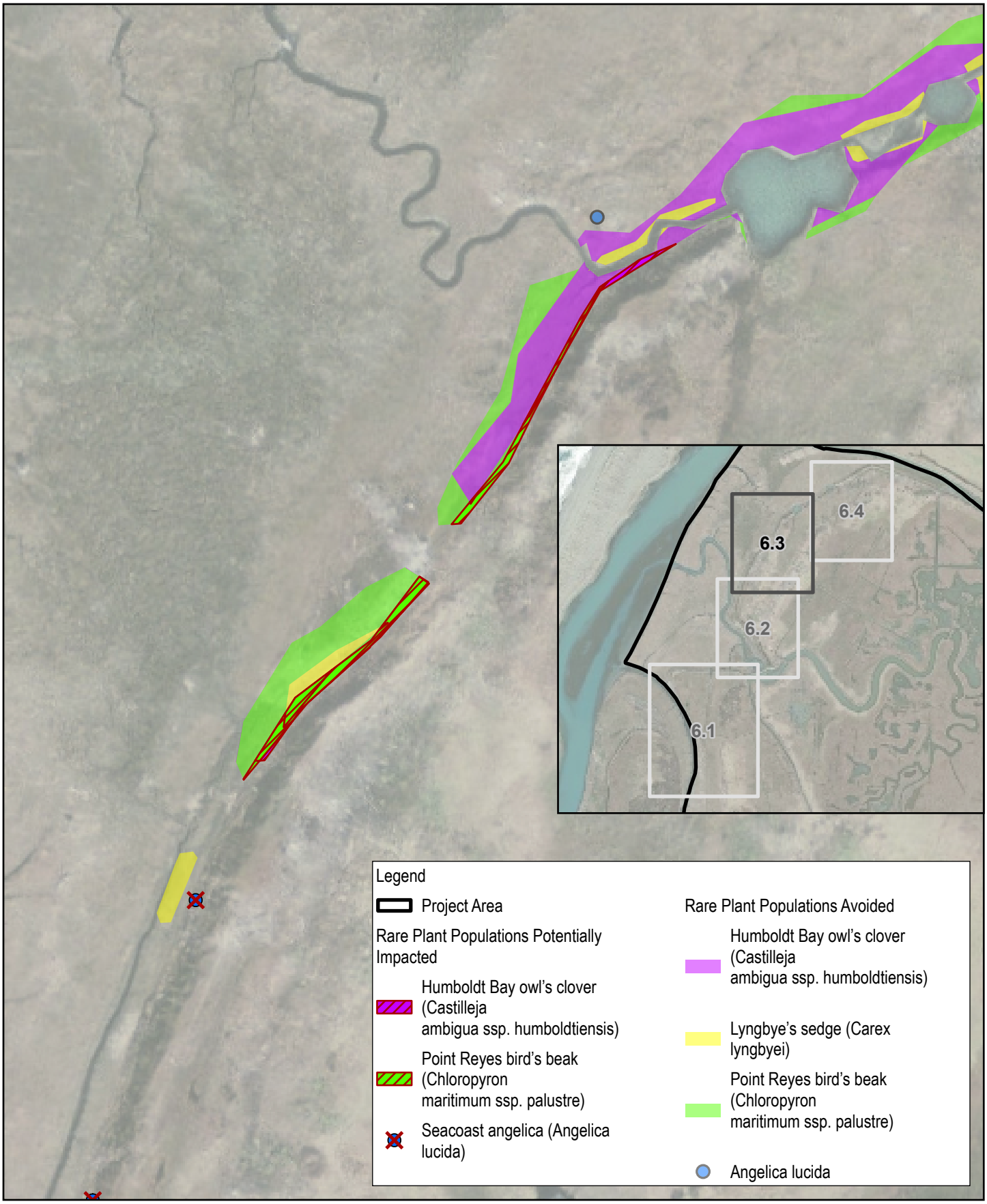

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Project No. **11206383**
Revision No. **-**
Date **04 May 2023**

Rare Plant Impacts

FIGURE 6.3

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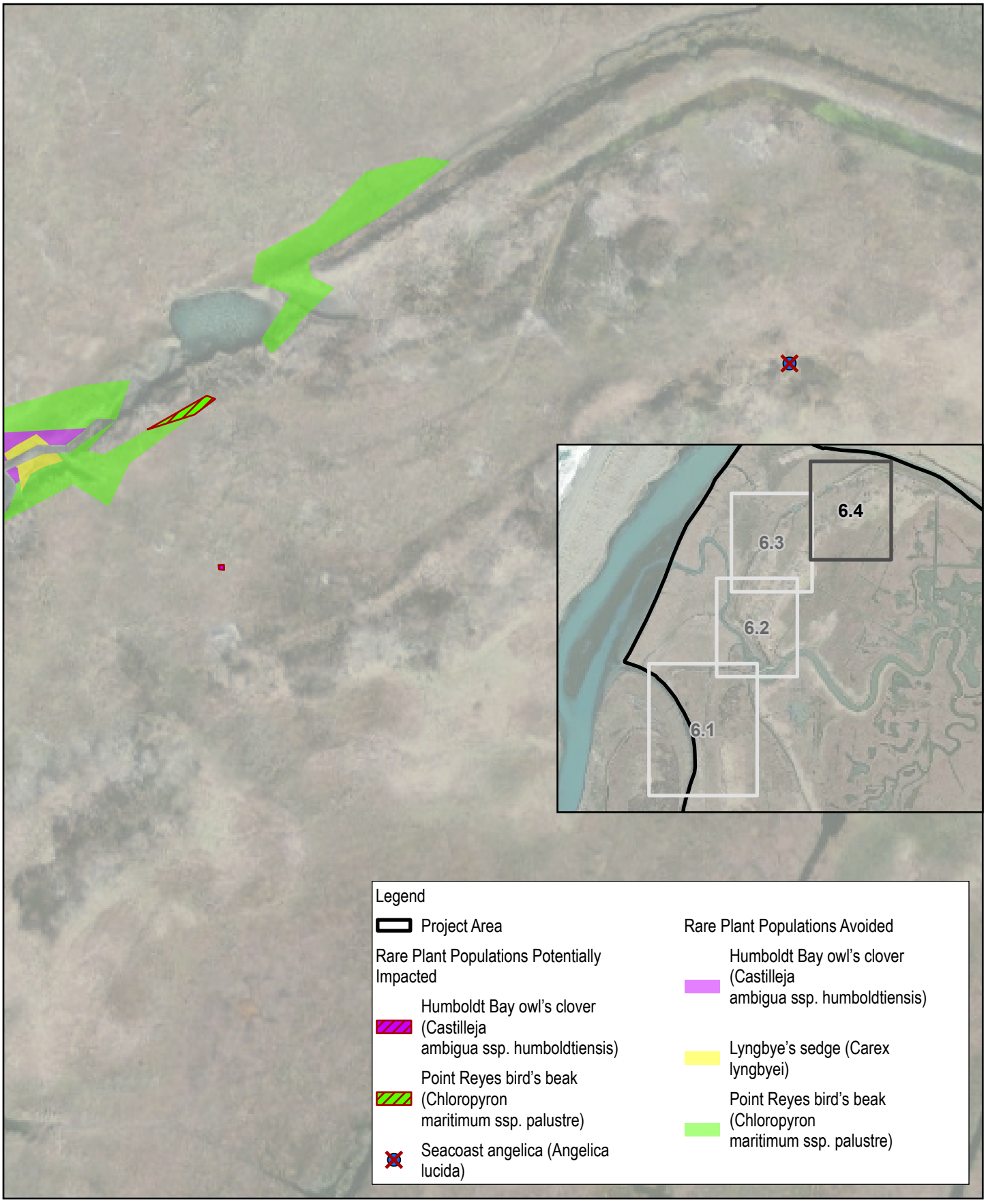

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Cannibal Island Restoration Project

Project No. **11206383**
Revision No. **-**
Date **04 May 2023**

Rare Plant Impacts

FIGURE 6.4

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