2. PROJECT DESCRIPTION AND ALTERNATIVES

This Draft Environmental Impact Report (Draft EIR) addresses the potential environmental impacts of a tidal wetlands restoration project in the Dutch Slough area at the mouth of Marsh Creek in Eastern Contra Costa County. The Dutch Slough Restoration Project entails wetland and upland restoration and public access on the 1,166-acre Dutch Slough property owned by the California Department of Water Resources (DWR). Three Dutch Slough Restoration Project alternatives are described in detail in this chapter as well as several options for various project components.

Two neighboring projects proposed by other agencies that are closely related to the Dutch Slough Restoration Project also are evaluated in this Draft EIR: the City of Oakley's Community Park and Public Access Conceptual Master Plan (City Community Park Project) for 55 acres adjacent to the wetland restoration project and four miles of levee trails on the perimeter of the DWR lands; and the Ironhouse Project, a restoration of a portion of the Marsh Creek delta on an adjacent 100-acre parcel to the west of Marsh Creek, owned by the Ironhouse Sanitary District (ISD). Subsequent refinement and CEQA review may be required by the respective Lead Agencies (City of Oakley and ISD, respectively) for the related projects. Certain additional studies needed for approval of the related projects are identified in the Draft EIR's technical sections.

2.1 PROJECT LOCATION

The Dutch Slough Restoration Project site is located in the City of Oakley in northeast Contra Costa County. The site is located on the historic delta of Marsh Creek, which drains a large area on the east side of Mt. Diablo and enters the Sacramento-San Joaquin Delta (Delta) on the northwest corner of the Dutch Slough site (see Figure 2-1).

The 1,166-acre Dutch Slough Restoration Project site is bounded on the south by the Contra Costa Canal, on the west by Marsh Creek, on the north by Dutch Slough and on the east by Jersey Island Road. The 55-acre Community Park is located within the south-central part of the Dutch Slough Restoration Project site. The Ironhouse Restoration Project proposes restoration of an additional 100 acres of land immediately west of Marsh Creek on lands owned by the ISD (see Figure 2-2).

The Dutch Slough Restoration Project site encompasses three adjacent parcels: the 438-acre Emerson, the 292-acre Gilbert, and the 436-acre Burroughs properties (See Figure 2-2). The property is bordered on the west by Marsh Creek, and includes two dead end sloughs, Emerson Slough and Little Dutch Slough. Separate levee systems protect each parcel from flooding.

2.2 SITE HISTORY

Prior to European settlement, the Dutch Slough site was a tidal marsh bordered by seasonal and riparian wetlands and ancient dunes at the historic delta of Marsh Creek. The parcels were diked and drained for agriculture during the nineteenth century, perhaps as early as the 1850s. Emerson Slough, Little Dutch Slough, and the eastern portion of Dutch Slough are all artificial channels that

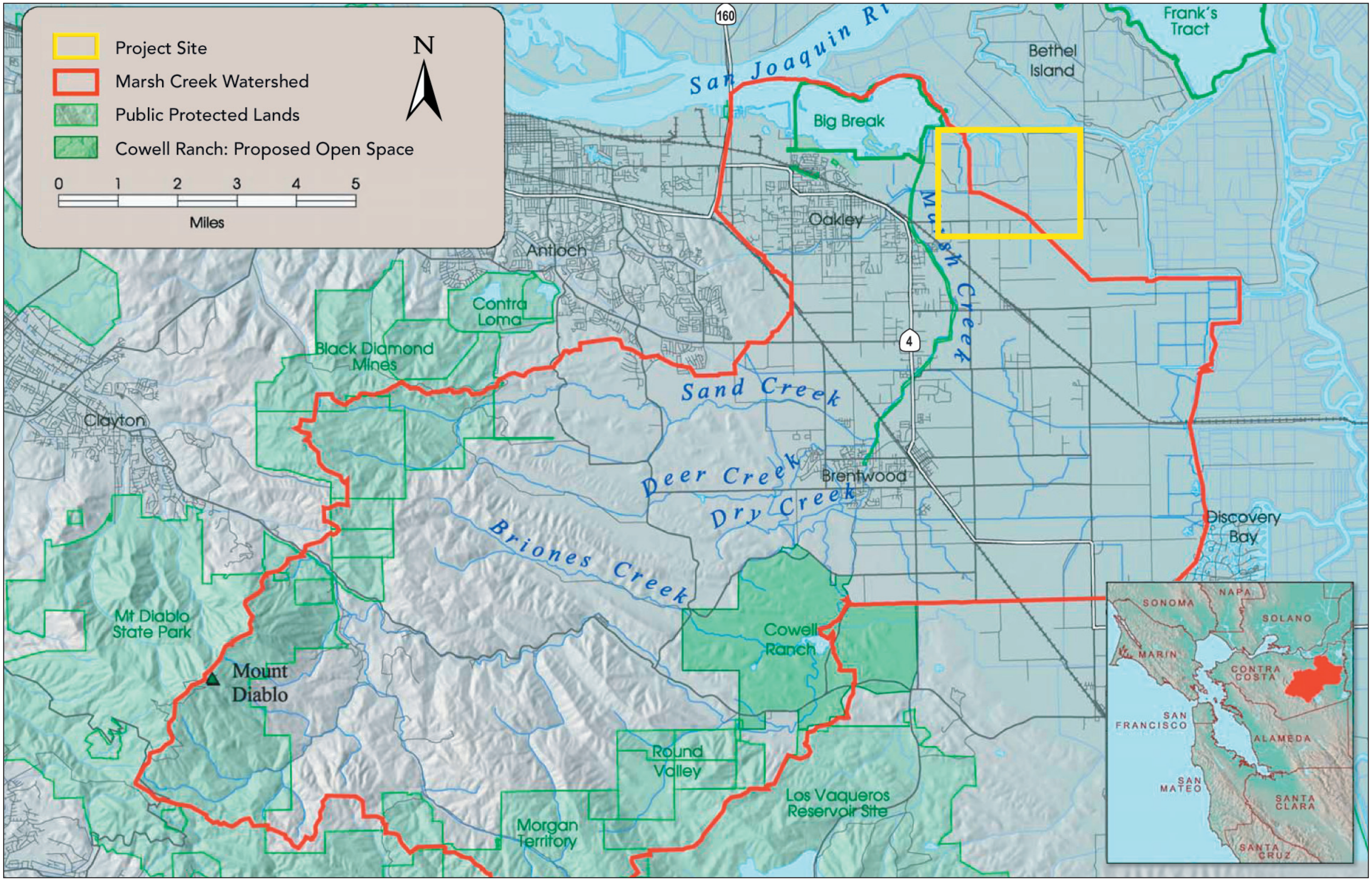


Figure 2-1

Regional Location

Sources: USGS, TIGER, EBRPD, GreenInfo Network

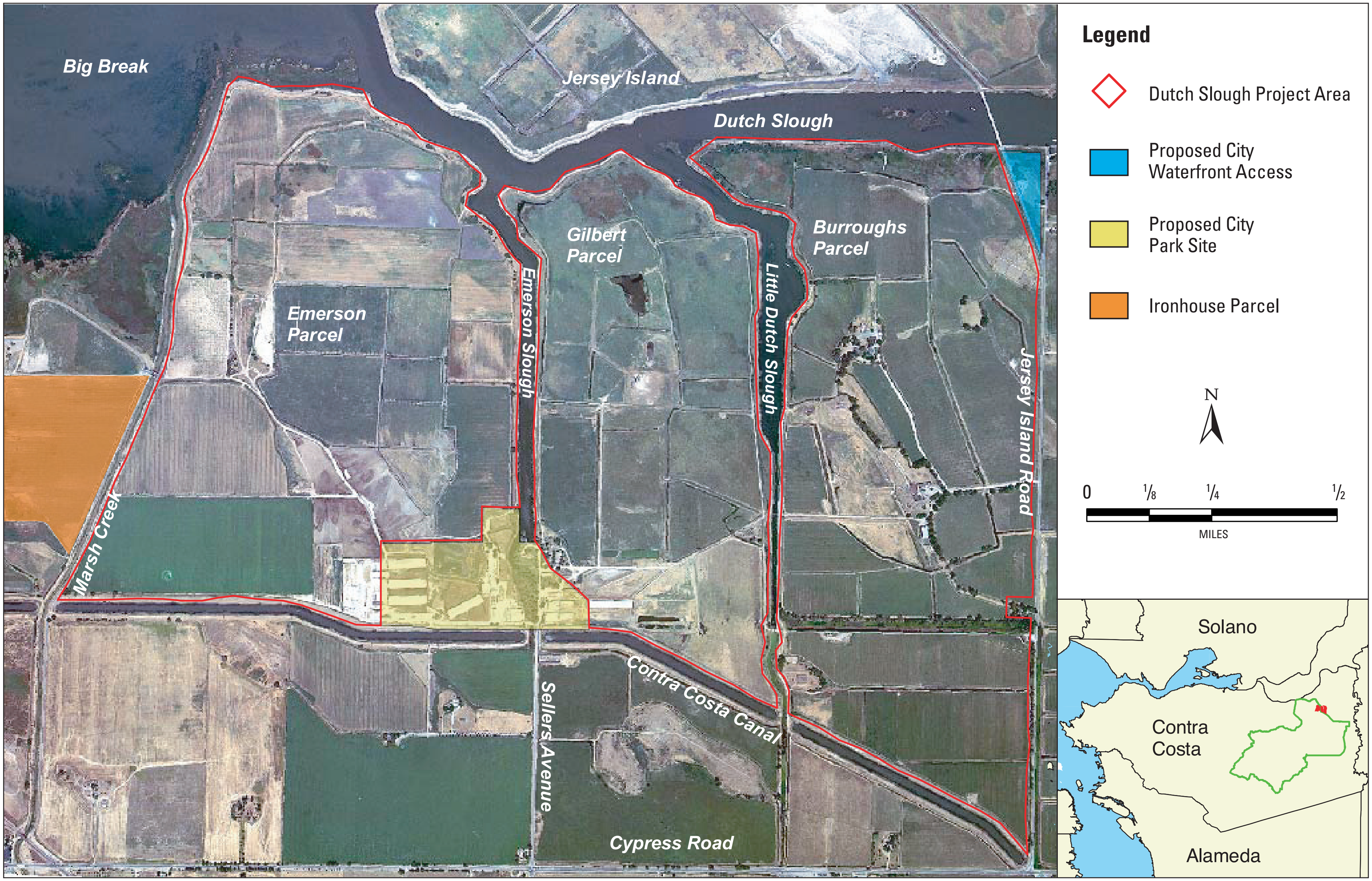


Figure 2-2

Dutch Slough Restoration Project Area

Sources: USGS, GreenInfo Network, Engeo, Inc., NHI were dredged between 1904 and 1910. These artificial channels displaced a pre-existing channel network that was more sinuous and irregular. The Contra Costa Canal is an artificial tidal channel that was constructed in 1937 to deliver water to large areas of Contra Costa County. Big Break, the 1,600 acres of open water to the west of the Dutch Slough site, was once a reclaimed Delta island that was flooded when a levee broke in 1938.

The Emerson parcel was managed continuously as a dairy from 1913 until 2003. The Gilbert and Burroughs parcels were managed as dairies from the early 1900s until the mid 1970s, when the dairies were closed. For the last 30 years they have been managed as grazing lands. All three parcels were zoned for mixed-use development in the 1990 Contra Costa County General Plan. In 1997, the Emerson, Gilbert, and Burroughs families entered into a development agreement with Contra Costa County to develop a master-planned community of 4,500 to 6,100 housing units. The site and the development agreement were subsumed by the City of Oakley when it incorporated in 1999.

The 1,166-acre Dutch Slough property was purchased by DWR in 2003 with funds from the California Bay Delta Authority and the California State Coastal Conservancy (SCC). The City of Oakley is pursuing a development agreement to own 55 acres at the end of Sellers Avenue that is contiguous with the Dutch Slough property and is proposed as a community park. The SCC and DWR have developed the Dutch Slough Tidal Marsh Restoration Conceptual Plan and Feasibility Report that guides restoration of the DWR parcels (Feasibility Report) (PWA, May 2006). The Feasibility Report also includes a conceptual restoration plan for the 100-acre Ironhouse Sanitary District, immediately west of the DWR site. The City of Oakley has similarly completed the Dutch Slough Community Park and Public Access Conceptual Master Plan (2M Associates 2006) for the 55-acre community park site as well as the public access component of the Dutch Slough Restoration Project. These reports provide detailed descriptions of the various projects and are summarized below.

2.3 SITE AND VICINITY CONDITIONS

Site land uses include a former dairy operation, vineyards, waterways, and grazing lands. A complex of former dairy buildings and three occupied residential compounds remain on the restoration and park sites. The 100-acre Ironhouse site is currently used as a spray-field for treated wastewater effluent. The topography and soils of the Dutch Slough and Ironhouse sites are unusually diverse relative to other lands in the Delta. Site elevations range from ten feet below sea level to fifteen feet above sea level (See Figure 2-3). The sites encompass ten different types of organic and mineral soils (See Figure 2-4). The project site also includes a wide range of vegetation types that are described in detail in Section 3.4, and shown on Figure 2-5.

Several utility easements traverse various portions (see Figure 2-6) of the Dutch Slough site, and the restoration would need to be designed so that it does not interfere with the operation of these facilities in order to avoid the significant expense associated with relocation of these facilities. A PG&E high voltage power line traverses the northeast corner of the Burroughs parcel. A PG&E gas line passes below ground across the Burroughs parcel. The Ironhouse Sanitary District conveys treated sewage effluent through a pipeline along the northwestern border of the Emerson parcel. Reclamation District (RD) 799 maintains and operates two pumping stations on the Burroughs

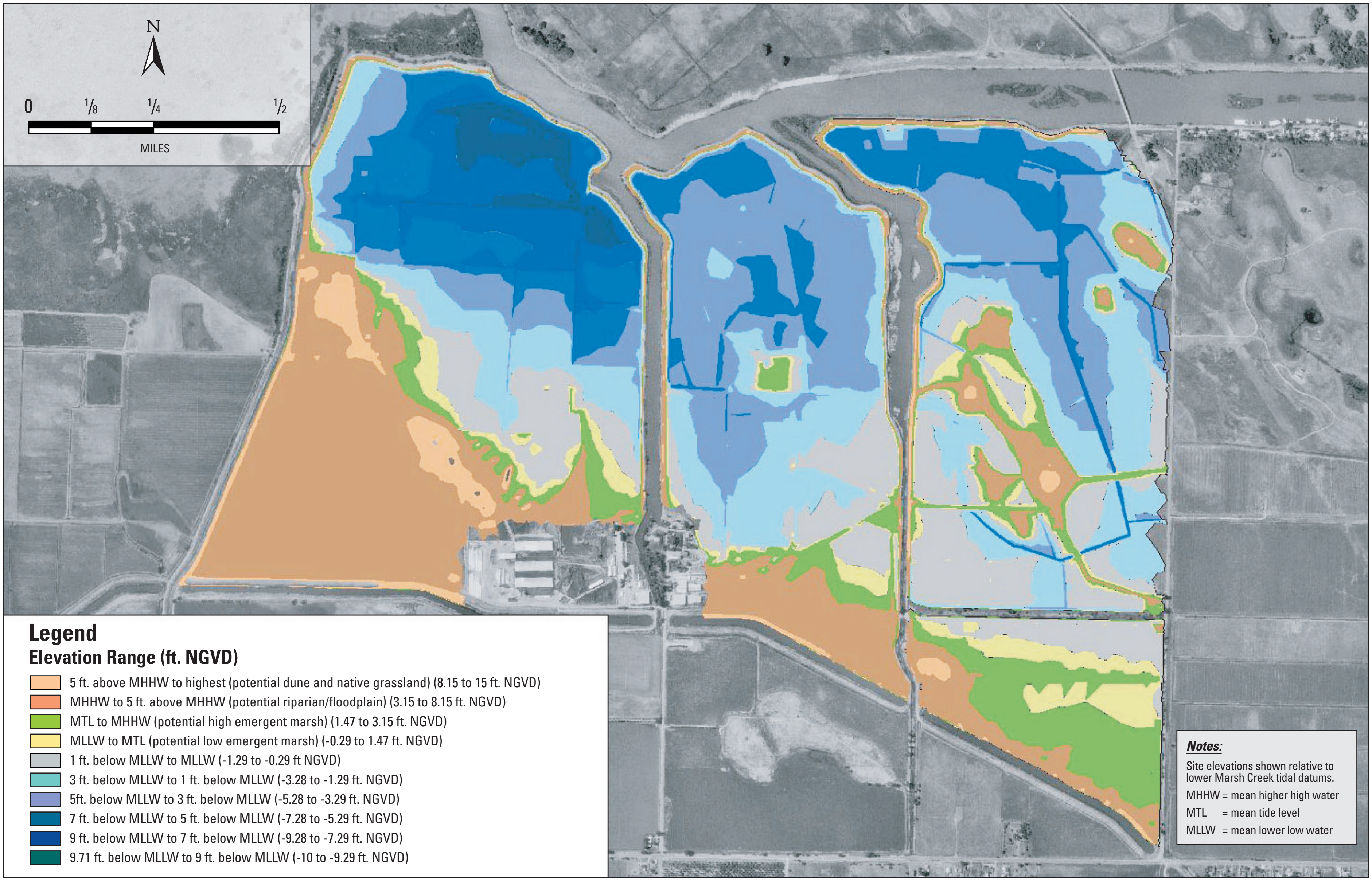


Figure 2-3

Dutch Slough Restoration Project Site Elevations

Sources: Carlson, Beebee, & Gibson, Siegel, USGS

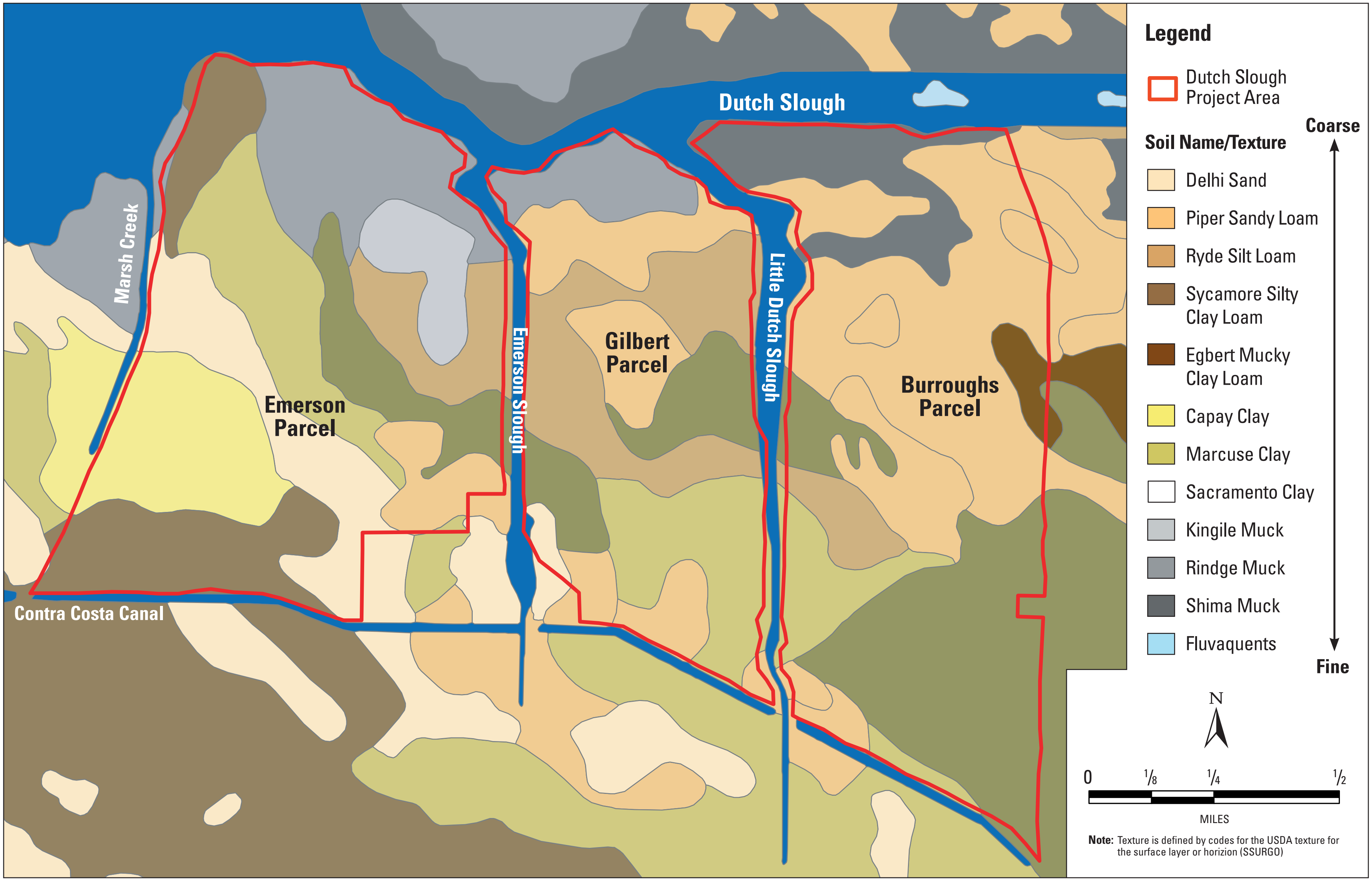


Figure 2-4

Dutch Slough Restoration Project Area - Soils Map

Source: NRCD

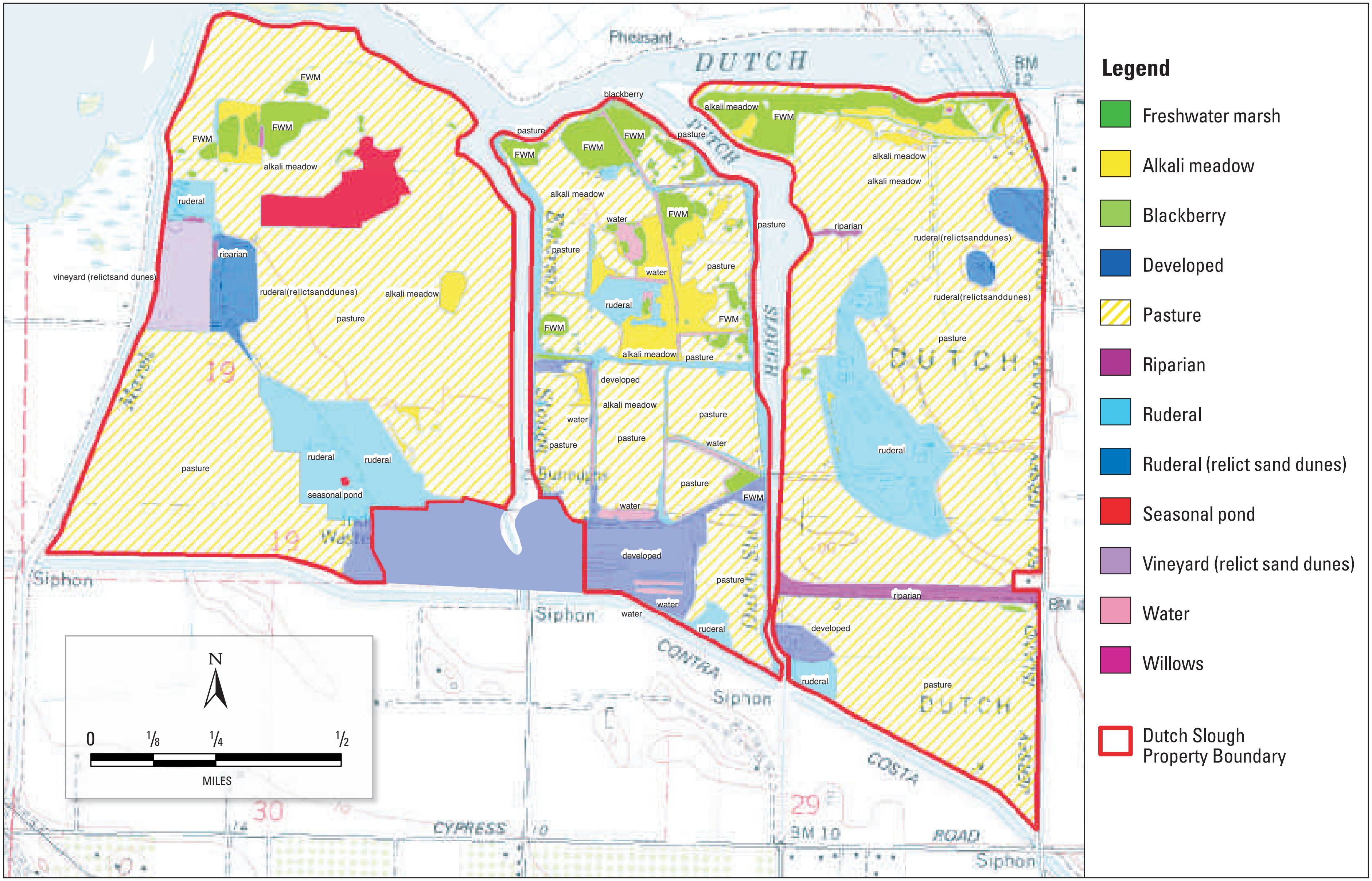


Figure 2-5

Dutch Slough Restoration Project Site - Vegetation Map

Source: DWR, 2005

parcel. Reclamation District 2137 is responsible for discharge pumps on the Emerson and Gilbert parcels.

Natural gas wells exist on all three properties (See Figure 2-6). The gas wells on the Emerson and Gilbert properties are plugged and abandoned. Mineral and surface rights are reserved for the possible future operation of a single gas well on each parcel. The Burroughs property retains eight natural gas wells (Tom Hall, DWR, pers. comm.; ENGEO 2003a). Of the eight, two are plugged and abandoned, four are inactive, and two actively produce natural gas for commercial use. Storage tanks, concrete, and site contamination at the plugged and abandoned wells have been removed and cleaned up (DWR 2003). Under terms of an agreement, inactive gas wells must be plugged and abandoned on or before July 1, 2008**.**

The City of Oakley is currently considering plans to develop more than 2,000 residential units on approximately 480 acres immediately south of the Dutch Slough site between the Contra Costa Canal and Cypress Road. In addition, the East Cypress Corridor Specific Plan proposes the development of up to 5,759 residential units on approximately 2,500 acres adjacent to the Contra Costa Canal, from the Rock Slough trash rack to Cypress Road, east of the project site. Approximately 1,330 of these houses are under construction or completed (See Figure 5-1).

A single residential dwelling is located on 1.36 acres along the west side of Jersey Island Road and abuts the Burroughs parcel on three sides (See 'Private House" indicated on Figure 2-6).

2.4 PROJECT PURPOSE AND NEED

The Dutch Slough Restoration Project

The Dutch Slough Restoration Project provides a significant opportunity to improve understanding of restoration science in tidal marsh wetland ecosystems in the region. It also would provide restored habitat for native fishes and other aquatic and wetland species.

The Dutch Slough Restoration Project has the following overarching goals:

1. Benefit native species by re-establishing natural ecological processes and habitats.
2. Contribute to scientific understanding of ecological restoration by implementing the project under an adaptive management framework.
3. Provide shoreline access, educational and recreational opportunities.

Formulation of the Dutch Slough Restoration Project alternatives was driven primarily by Goals 1 and 2. The public access and recreation features of the Dutch Slough Restoration Project (Goal 3) were developed in a separate master planning process, led by the City of Oakley, and are generally compatible with all the restoration alternatives and complement the adjacent City Park that is considered in this Draft EIR.

In response to goals 1 and 2, the Dutch Slough Restoration Project alternatives were developed to provide both ecosystem restoration and adaptive management benefits. Each restoration alternative includes habitat restoration features and adaptive management experiments. The experimental and restoration features are not mutually exclusive. Many of the experimental features are expected to

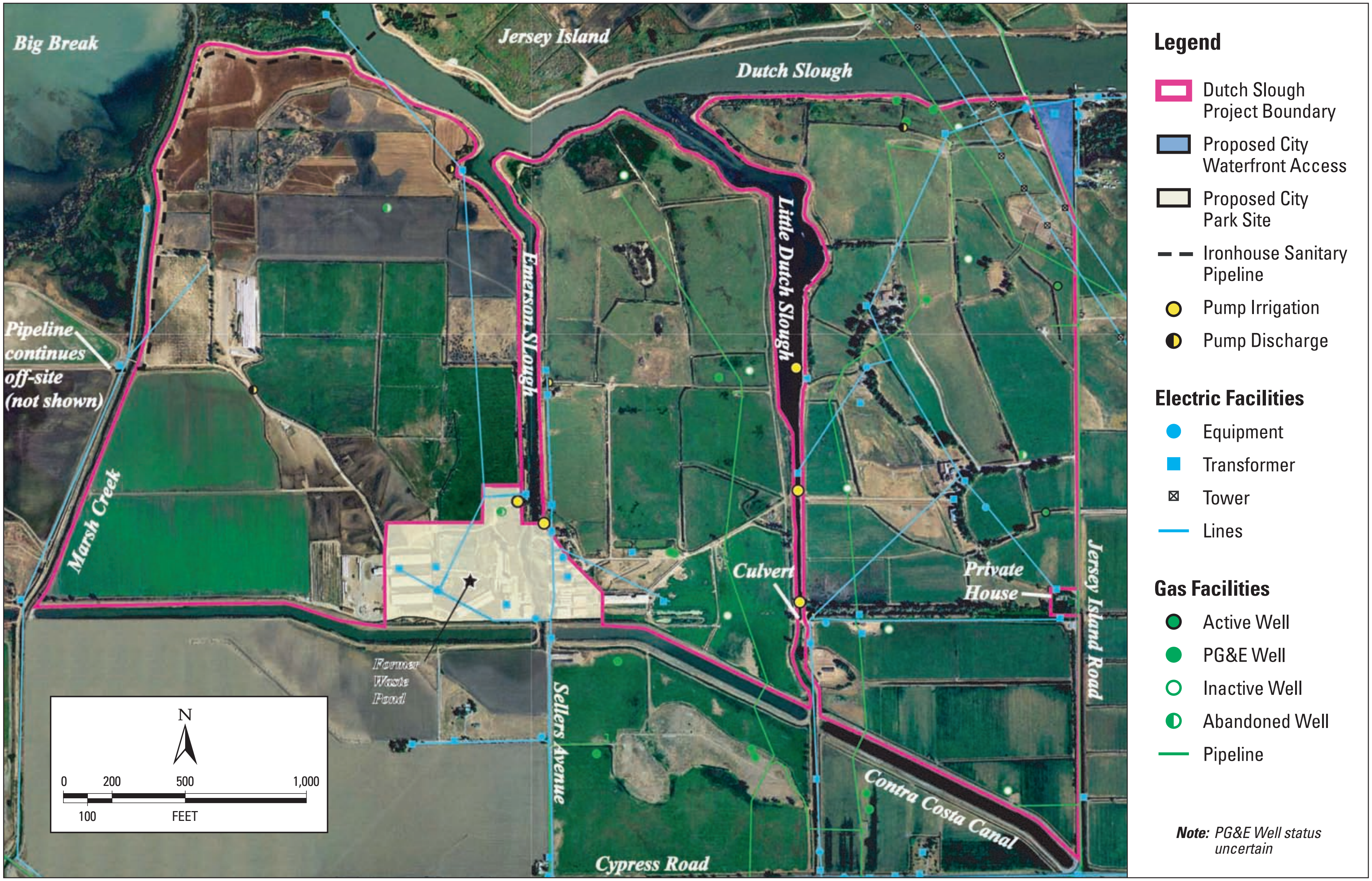


Figure 2-6

Dutch Slough Restoration Project Site - Existing Infrastructure

Sources: PG&E, Engeo, Inc., USGS, NHI

provide significant restoration benefits, and restoration features provide opportunities for experimentation.

Dutch Slough Habitat Restoration Goals and Objectives

With respect to habitat restoration the Dutch Slough Restoration Project has the following goals and objectives.

1.1 Goal: Reestablish the hydrologic, geomorphic, and ecological processes necessary for the long-term sustainability of native habitats and the plant and animal communities that depend upon them.

Objectives:

1.1.1 Reestablish tidal connections to the site for exchange of water, sediments, and nutrients;

1.1.2 Contribute to primary productivity of the Suisun Marsh and San Francisco Bay through export of nutrients;

1.1.3 Create food supply for target species identified in Appendix A of the Conceptual Plan (Included in Appendix D to this Draft EIR);

1.1.4 Seasonally inundate high marshplain for spawning and rearing by Sacramento splittail; and

1.1.5 Re-route Marsh Creek, if feasible, to reestablish a supply of natural freshwater flows and fluvial sediments to the site.

1.2 Goal: Restore a mosaic of wetland and upland habitats.

Objectives:

1.2.1 Restore large areas of tidal emergent marsh and tidal channels. (Invasive species are addressed separately below);

1.2.2 Expand shaded riverine aquatic habitat along the sloughs and Marsh Creek;

1.2.3 Establish plant communities once common in the Delta but now rare such as the willow-lady fern community, sandmound riparian woodland, Antioch dune scrub, and perennial grasslands;

1.2.4 Create natural gradients between uplands and wetlands for the restoration of biologically rich transitional habitats (ecotones); and

1.2.5 Restore a dynamic, natural creek delta at the mouth of Marsh Creek, if feasible.

1.3 Goal: Contribute to the recovery of endangered and other at-risk species and native biotic communities.

Objective:

1.3.1 Focus restoration design to benefit tier 1 species, and adjust restoration to benefit tier 2 species. Maintain opportunities to benefit tier 3 species consistent with restoration of tier 1 species. Tier 1 species include juvenile Chinook salmon, Sacramento splittail, Delta smelt, and Antioch Dune scrub species; and

1.4 Goal: Minimize establishment of and reduce impacts from non-native invasive species.

Objectives:

1.4.1 Design and manage the project to minimize the introduction of invasive, non-native animals;

1.4.2 Design and manage the project to minimize potential for establishment of non-native submerged aquatic vegetation (e.g., *Egeria densa*);

1.4.3 Design and manage to prevent colonization and establishment of *Arundo donax*, pepper weed and *Phragmites*; and

1.4.4 Minimize human impacts to wildlife, particularly nesting avian species.

Dutch Slough Adaptive Management Research Goals

The California Bay-Delta Authority's Strategic Plan for Ecosystem Restoration (CALFED 2000) is a guide for the restoration of the Bay-Delta ecosystem. One of the purposes of the plan is to establish adaptive management as the primary tool for achieving ecosystem restoration objectives and preparing to make future decisions for large-scale restoration projects. In the CALFED context, adaptive management involves:

1) having clear goals and objectives for management that take into account constraints and opportunities inherent in the system to be managed;
2) using models to explore the consequences of a range of management policy and program options in relation to contrasting hypotheses about system behavior and uncertainty; and
3) selecting and implementing policies and programs that sustain or improve the production of desired ecosystem services while, at the same time, generating new kinds of information about ecosystem function.

With the assistance of a panel of scientists, the project team will design restoration actions to test hypotheses about how ecosystems function and how best to restore them (see Dutch Slough Adaptive Management Plan, Appendix D). In this respect, adaptive management interventions are conducted as experiments. This does not suggest that management interventions are conducted on a trial-and-error basis, because management actions are guided by the best ecological engineering information available.

2.1 Goal: The Strategic Plan identified 12 critical uncertainties that should be evaluated in the course of restoration activities and 8 opportunities for pilot projects in the Delta to reduce these uncertainties, including:

Objectives:

2.1.1 Initiate a program that, among other things, establishes habitat conditions that favor native fishes;

2.1.2 Develop large-scale pilot projects accompanied by long-term monitoring to resolve key uncertainties regarding the role of fresh water marsh for sustaining native fish and ecosystem productivity;

2.2.3 Develop a pilot project to study contaminants in the Central Valley; and

2.3.4 Develop pilot projects to enhance and measure fry rearing in the Delta.

2.2 Goal: In addition, the following opportunities could be pursued at the Dutch Slough site:

Objectives:

2.2.1 Initiate several large-scale pilot projects using different approaches to restoring tidal marshes in the Delta;

2.2.2 Develop means to control invasive aquatic plants in the Delta;

2.2.3 Establish large-scale pilot projects on leveed Delta islands to test and monitor techniques for returning subsided Delta islands to shallow-water and marsh habitats; and

2.2.4 Develop large-scale pilot projects that examine the relationship between variable salinity and the maintenance of native species in the Delta, especially in shallow-water habitats.

2.3 Goal: The project would contribute to scientific understanding of ecological restoration by implementing the project under an adaptive management framework as follows:

Objectives:

2.3.1 Establish technical review committees to review restoration design, management practices, and monitoring study design and results;

2.3.2 Articulate, test, refine, and grow understandings about natural and human systems. Conduct hypothesis based research on the ecological processes that shape and maintain ecosystems;

2.3.4 Establish and improve communication pathways between science, management, and public communities that will result in the sharing of knowledge developed in the course of the Dutch Slough Restoration Project; and

2.3.5 Conduct long-term project monitoring to evaluate the effect of the restoration project on sensitive species, habitat value, and water quality.

2.5 DESCRIPTION OF PROJECT ALTERNATIVES

The core project entails wetland and upland restoration, and public access on the 1,166-acre Dutch Slough property owned by DWR. Two related projects are also evaluated in concept in this Draft EIR to identify cumulative impacts with the Dutch Slough Restoration Project, and additional mitigation for those cumulative impacts:

- The City of Oakley's Community Park Project for 55 acres adjacent to the wetland restoration project and the proposed four miles of levee trails around the DWR lands; and
- Proposed restoration of a portion of the Marsh Creek Delta on a 100-acre parcel owned by the Ironhouse Sanitary District to the west of Marsh Creek and Contra Costa County Flood Control District channel.

Development of these projects is not within the control of DWR; however, because of their geographical and environmental connection with development of the restoration project, these projects are assessed at a conceptual level. Subsequent environmental review may be required for these related projects.

The Dutch Slough Tidal Marsh Restoration Conceptual Plan and Feasibility Report identified a range of restoration alternatives to meet the habitat restoration and adaptive management goals, with consideration of economic feasibility. The alternatives represent different mixes of habitat, with different amounts of grading and imported fill to create these habitats. In addition, the City of Oakley worked with DWR and SCC to develop the City Community Park Project that is consistent with the restoration alternatives. As described in Chapter 1, the EIR addresses each of the restoration alternatives in conjunction with the City Community Park Project and the Ironhouse Project. The No-Project Alternative addresses the scenarios that may occur in the absence of construction of these projects consistent with existing City of Oakley (Open Space) general plan and zoning designations.

The primary differences between the project restoration alternatives are the amount of open water and the mix of different marsh types. These differences are summarized in Table 2-1. The alternatives range from minimal fill, which has the greatest amount of open water, to maximum fill, which has the largest marsh areas. Each alternative is described below with respect to habitat restoration, design features (including the diversion of Marsh Creek as described below) and adaptive management experiments. Table 2-1, below, summarizes and compares the main differences between the alternatives. The three "action" alternatives (Alternatives 1 – 3) vary the mix of restored habitats, the amount of fill used to create emergent tidal marsh, and the possible diversion of neighboring Marsh Creek. Alternative 1 proposes minimal grading in all three parcels. Alternative 2 proposes on-site grading (approximately 1,320,000 cubic yards) to create tidal marsh in all three parcels, and requires a moderate amount of additional fill (approximately 360,000 cubic yards). Alternative 3 proposes a larger amount of grading and imported fill (approximately 3 million cubic yards total).

"No Burroughs" Option

In each "build" alternative for the Dutch Slough Restoration Project, the option exists to retain the Burroughs parcel as terrestrial and wetland habitat. If exercised, this option would result in several significant changes to the project, including:

- Reduce the restored tidal marsh acreage by up to one-half.
- Retain the largest existing blocks of freshwater marsh and riparian habitats.
- Eliminate the need for a levee along Jersey Island Road.
- Move adaptive management experiments from the Gilbert and Burroughs parcels to Emerson and Gilbert, which would also require breaches to occur on Emerson Slough rather than Little Dutch Slough. This, in turn, would necessitate additional bridges on the Emerson parcel to allow the public access trail to circle the parcel.
- Reduce project impacts to terrestrial and wetland habitats and associated species.

Although this option could result in a substantial reduction in project costs, it may also compromise the project goals of tidal marsh restoration, ecosystem enhancement, and adaptive management research. Whether to exercise this option will be decided later, as the specific restoration designs are developed.

Features Common to All Dutch Slough Restoration Project Alternatives

The restoration alternatives have many features in common, including the restoration approach for native plant revegetation, marsh plain micro-topography, tidal channel networks, levee breaching and lowering, open water areas, infrastructure protection, and public access and recreation. These restoration features assume a 50-year planning horizon, consistent with that used by other San Francisco Bay-Estuary restoration projects currently in planning. The relevant planning horizon for the adaptive management part of the restoration is shorter, on the order of several years to one or two decades, since experimental results are expected to be applied within this shorter timeframe.

The following describes restoration activities common to Alternatives 1 to 3.

MARSH PLAIN GRADING

Fill material would be used to raise existing ground elevations up to marsh plain elevations suitable for the growth of native emergent freshwater marsh plant communities. Some high elevation areas would be graded down to marsh plain elevations.

Average design elevations for marshplain grading are:

Low marsh: MLLW (-0.3 ft NGVD)

Mid marsh: MTL (1.5 ft NGVD)

Design elevations would vary by up to 0.5 ft above and below the average design elevation, with marsh plains generally sloping towards the channels to facilitate marsh plain drainage. Mixed marsh areas with channel networks draining both low marsh and mid marsh would gradually slope from approximately -0.8 ft NGVD to +2 ft NGVD. A grading tolerance of 0.5 feet would be allowed in construction to reduce construction costs and create micro-topography on the marsh plain, which is expected to have habitat benefits. The minimum low marsh elevation (approximately –0.8 ft NGVD or 0.5 ft below MLLW) is within the elevation range where tule vegetation is observed to transition to unvegetated mudflat in Delta marshes (See Figure 2-5). Based on available data, tules are expected to dominate an area at –0.8 ft NGVD, with some areas of unvegetated mudflat interspersed.

REVEGETATION

Restored habitats would be revegetated with native plant species to provide a diversity of habitat functions (shelter, food, nesting) for fish, birds, and other wildlife. Revegetation would also help the adaptive management experiments by providing more consistent vegetation types between parcels. With active restoration of desired native plant species, including removal of invasive weeds during the establishment period, native plants are expected to dominate most plant communities, potentially providing habitat for both common and sensitive wildlife and plants. Once established, native plant species may out-compete invasive non-native species. Without active revegetation in upland habitats, plant community development based on volunteer colonization would likely lead to the dominance of invasive weeds in many plant communities because the propagules (seeds, rhizomes, etc.) of invasive non-native upland species are abundant in the vicinity of the project area. Invasive plant species are considered to have reduced value to many native wildlife and fish species.

Table 2-1. Summary of Dutch Slough Restoration Project Alternatives

Alternative	Marsh Creek Delta Restoration Option	Approximate Habitat Acreages[1]			Summary of Marsh Acreage		Adaptive Management Experiments[2]		Implementation Considerations			
		Open Water	Marsh	Uplands	Low marsh	Mid marsh	Marsh plain elevation	Marsh scale	Fill type	Fill amount	Construction costs	Management costs[3]
No Action Alternative	NA	9.7	54[4]	1045.5	0	0	NA	NA	None	None	None	High (levee maint.)
Alternative 1: Minimal Fill	No[5]	450	390	180	340	50	No	Yes	Onsite borrow	Small	Low	Low
Alternative 1: "No Burroughs" option		310	180	530	140	40						
Alternative 2: Moderate Fill	Yes	260	660	100	420	240	Yes	Yes	Imported material[6] or onsite borrow	Moderate	Medium[7]	Low-high[8]
Alternative 2: "No Burroughs" option		210	380	430	220	160						
Alternative 3: Maximum fill.	Yes	110	830	80	480	350	Yes	Yes	Onsite borrow and imported material	Large	High[7]	Low
Alternative 3: "No Burroughs" option		110	480	430	130	350						

Notes:

NA: Not Applicable

1. Approximate habitat acreages are for the purpose of alternative comparison only.
2. Indicates the consistency with testing large-scale experimental variables.
3. Indicates long-term or on-going management and maintenance costs. Does not include costs of monitoring adaptive management experiments.
4. Existing freshwater marsh.
5. Alternative 1 does not allow for the option to restore a Marsh Creek delta.
6. If available and cost effective.
7. Depends on the type and cost of fill material.
8. Depends on which open water management option is used.

TIDAL MARSH

To maximize native species establishment and minimize colonization by non-target invasive species, tules would be established prior to breaching the site. The pre-establishment of tules would allow for the experimental comparison of vegetated marsh areas immediately after breaching. This would avoid an initial period of natural colonization under tidal conditions and increase comparability by providing more consistent vegetation cover between locations. Water management would be used to encourage natural recruitment by periodically flooding and then drawing down water levels in marsh areas (i.e., flood irrigation). A limited amount of tules would be planted on a large scale, possibly using farm equipment or volunteer labor, and would supplement natural recruitment.

Areas of high marsh would provide opportunities to restore rose-mallow, a special-status species, along the ecotone (transition area) with riparian communities. Mason's lilaeopsis, another special-status plant, can also be restored in even small (e.g., less than 100 sq-ft) unvegetated saturated mudflat areas in the ecotone with riparian communities.

RIPARIAN AREAS

Riparian uplands and habitat levees would be planted with native woody species to maximize the ultimate extent and diversity of native riparian plant communities and hasten the process of volunteer establishment. Riparian woodland plantings would include Fremont cottonwood, willows, box elder, Oregon ash, California blackberry, wild rose, buttonbush and others. Following initial control of weeds, a seed mix of native riparian grasses, sedges, and wildflowers would be drilled on areas within appropriate elevations. Cuttings from native riparian trees and shrubs would be collected from the project vicinity and installed in the riparian zones. Areas within the elevation range of 3.2 ft NGVD to 16.5 ft NGVD (MHHW to 15 feet above MTL) are expected to be suitable for riparian vegetation. Low elevation moist areas would be planted with water-tolerant species such as alders and sandbar willow, while intermediate and higher riparian zone areas will be planted with deep-rooted riparian species such as cottonwoods, valley oaks, and Oregon ash. In higher elevation areas, (above 6.5 ft NGVD or 5 ft MTL), long "pole" cuttings would be planted in deeply augured holes so as not to rely on irrigation. Riparian trees and shrubs may also be field grown and transplanted in the winter as bare root stock, as appropriate.

Without active restoration (and under the no-action alternative), volunteer establishment of native woody and herbaceous riparian plants would likely be minimal due to the lack of adjacent existing native riparian plant communities to provide a source for colonization. Instead, there would be a high potential for establishment of invasive non-native species currently abundant in the vicinity, including Himalayan blackberry, perennial pepperweed, Bermuda grass, milk thistle, Italian ryegrass, vetch, and curly dock. Volunteer establishment of native plants would probably be limited to areas adjacent to existing native riparian plant communities, and would likely take decades to succeed beyond initial willow scrub phases to cottonwood-willow forests.

Existing riparian communities above 3.2 ft NGVD (MHHW) may survive after the levees are breached. Riparian communities not tolerant of inundation, such as cottonwoods and red willows, may die out over time and be replaced by species that do tolerate inundation, such as sandbar willow and alder.

NATIVE GRASSLANDS

Areas of native grasslands and native herbaceous floodplain vegetation would be restored with a mix of competitive (creeping wildrye, deergrass, and meadow barley) and other native grasses (blue wildrye, purple needlegrass, California brome, and California melic). Following initial weed control, these native grasses would be seeded and mulched on clay soils in upland areas of the site above approximately 8.2 ft NGVD (5 ft above MHHW). The seed mix would also include native wildflowers such as California poppies and lupines. Native grasses would also be a component of transitional habitats between high marsh, riparian communities and native grasslands. Sandy soils in the higher elevations would be seeded with a mix of grasses such as one-sided bluegrass and forbs such as lupines and asters adapted to dry coarse soils. Native grassland plant communities are not expected to develop without planting, even in the long-term, because of the extremely limited existing sources of native seed and propagules, and competition from non-native annual grasses and other invasive species.

DUNE SCRUB

Native dune habitat would be restored in the Emerson parcel by planting and/or seeding with a mix of native dune scrub plants (Contra Costa wallflower, naked buckwheat, broom snakeweed, etc.) following initial weed control. As with native grasslands, native dune habitat is not expected to develop without planting even in the long term. Because of the limited experience with dune scrub restoration, various planting techniques would be tested in small-scale experiments prior to full-scale planting.

MARSH DRAINAGE DIVIDES

The perimeter of marsh drainage areas would be constructed to gently slope up to the elevation of MHHW to create marsh drainage divides. Marsh drainage divides are expected to support native freshwater marsh plant species and provide high marsh habitat. During high tides, marsh drainage divides would be tidally inundated and tidal exchange between adjacent marsh areas may occur. For the purposes of adaptive management experiments, marsh drainage divides would define drainage areas for the small, medium, and large low marsh and mid marsh channel systems to facilitate the comparison between different marsh areas. As an example, marsh drainage divides would be necessary for monitoring fish and water quality in different marsh areas. For open water management options that would use water control structures to lower water levels below tide levels, taller marsh drainage divides may be necessary between marsh and open water areas to prevent frequent overtopping and the potential for scour.

HABITAT LEVEES

The existing levees surrounding the Emerson, Gilbert, and Burroughs parcel would be restored to provide a mix of high marsh, riparian woodland, and native grassland habitats under Alternatives 1-3. Portions of the existing levees would be planted with riparian woodland to provide woody aquatic habitat, if levees soils are suitable for planting. These habitat levees are expected to provide shaded riverine aquatic (SRA) cover habitat along the water's edge with benefits to native salmonids and other native fish. These levees may provide SRA mitigation for the Delta Levees Integrity Program. Other portions of the levees would be lowered to marsh plain elevation to provide high marsh habitat and allow for high tide flows and fish access to restored marsh areas.

Riparian habitat levees are shown as upland habitat in Figure 2-7. Portions of the existing levees along Emerson Slough and Little Dutch Slough that currently protect the Gilbert and Burroughs parcels would be lowered to elevations ranging from 6 to 8 ft NGVD, where the roots of riparian woodland plantings can reach the groundwater table. The public trails on the Burroughs and Gilbert parcels would be on the levee along Dutch Slough, not levee segments that may be lowered. The existing elevations of levees around the Emerson parcel and along Dutch Slough in the Gilbert and Burroughs parcel would be maintained for two purposes. The existing levee elevations along Dutch Slough would be maintained to reduce overtopping and the possibility of exposing Jersey Island levees to wind-waves generated in open water areas on-site. The existing levee elevations around the Emerson parcel would be maintained to provide access for the public trail and the Ironhouse Sanitary District's pipeline.

Habitat levees would be planted with alder, box elder, and sandbar willow. If the levees are very compacted or low in nutrients, the soils may need to be ripped and amended with slow release fertilizer. Invasive weeds such as Himalayan blackberry would need to be removed. Riparian woodland may be interspersed with non-woody canopy openings (e.g., 100-foot long or greater areas along levees), particularly in locations above the zone of inundation or natural sub-irrigation (i.e., the tops of habitat levees along Dutch Slough and around the Emerson parcel). These openings or clearings are expected to add diversity by supporting native riparian herbaceous vegetation, such as creeping wildrye, Barbara sedge, and native grasses and forbs. These herbaceous habitats are also expected to provide opportunities to restore special-status plant species such as Delta tule pea, Suisun marsh aster, Suisun thistle and rose-mallow.

Figure 2-8 shows a conceptual schematic for a typical cross-section of a habitat levee planted with riparian woodland. Riparian woodland plantings would extend down to 3.2 ft NGVD (MHHW) on the outboard or slough side of the habitat levees and 5.0 ft NGVD on the inboard side. It may not be necessary to remove existing rip-rap (rock armament) on the outboard side of the levee; however, the rip-rap may be moved around to allow for interspersed planting. Retaining the existing rip-rap along Dutch Slough is expected to provide an effective and low cost method of protecting the levee from boat-wake erosion. On the inboard side of the levee, a gently sloping levee bench (5:1 horizontal: vertical or flatter) would be constructed from 5.0 ft NGVD to existing grade using fill material. Measures to protect the inboard slope of the levee from erosion due to wind-waves over the open water fetch may depend on the open water management options. In locations where habitat levees adjoin restored marsh areas, slope protection would not be necessary.

For open water management options that create tidal open water areas, the inboard levee slope would be revegetated with tule and high marsh plant species. This would create a wide tule edge (approximately 30 ft minimum width) that is expected to protect the levee slope from wave erosion and provide marsh and transitional habitat. Tules would be established on the levee slope prior to breaching. The proposed method is to encourage natural recruitment through flood irrigation and water management, with limited supplemental planting of rhizomes. To revegetate the levee slope, tules would first be established at the lowest elevations in the open water areas. Water levels would be gradually increased to allow tules to spread to higher elevation areas through natural recruitment and rhizomal extension until the vegetation reaches the levee slope. Tules established in lower elevation areas are not expected to survive as inundation depths increase; however, a sufficient width of tule at the open water edge is expected to provide short-term protection from wind waves and erosion, allowing for still-water conditions suitable for tule establishment at higher elevations.

Habitat levee plantings and slope protection are expected to help protect against complete levee failure, except in the case of an earthquake. In some locations, the habitat levees may settle, scour, or be overtopped by extreme water levels, which have the potential to cause unintentional breaches. Breaches would be repaired where habitat levees surround managed open water areas or where breaches lead to new tidal openings that would complicate adaptive management experiments. Otherwise, breaches of habitat levees surrounding tidal areas would be allowed to remain.

Other portions of the levees along Little Dutch Slough would be lowered to provide high marsh habitat and allow for high tide flows and fish access to the marsh plain. The design elevation of the lowered levees would be 3.2 ft NGVD (MHHW) or slightly higher. The lowered levee would be overtopped by about 10-15% of the twice-daily high tides. As the existing levee elevation is approximately 8 to 10 ft NGVD, lowering the levee would provide a source of fill material. The material excavated from the lowered levees may be sidecast into the parcels as marsh fill.

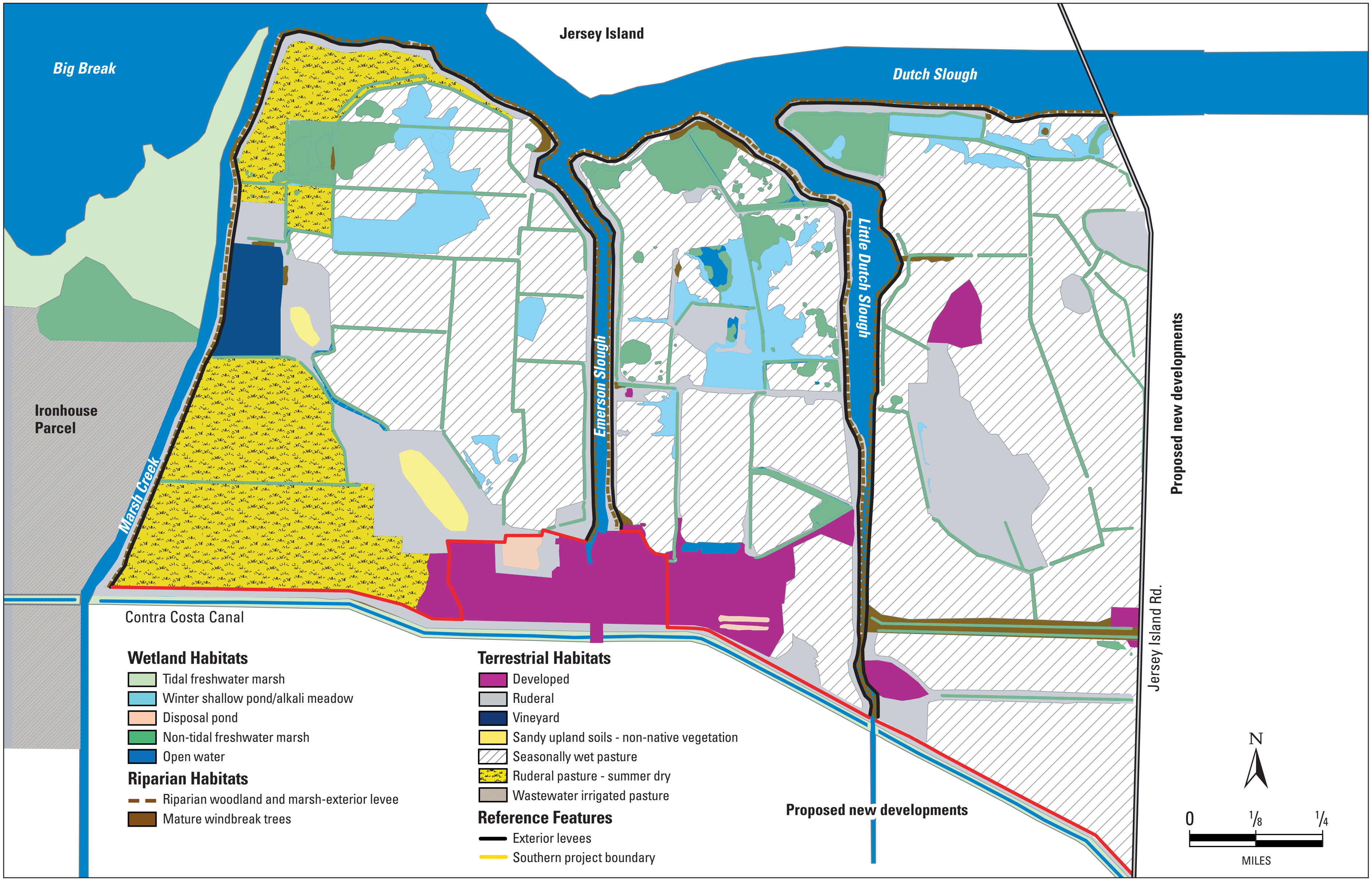


Figure 2-7

Dutch Slough Restoration Project Area - Existing Habitats

Source: PWA

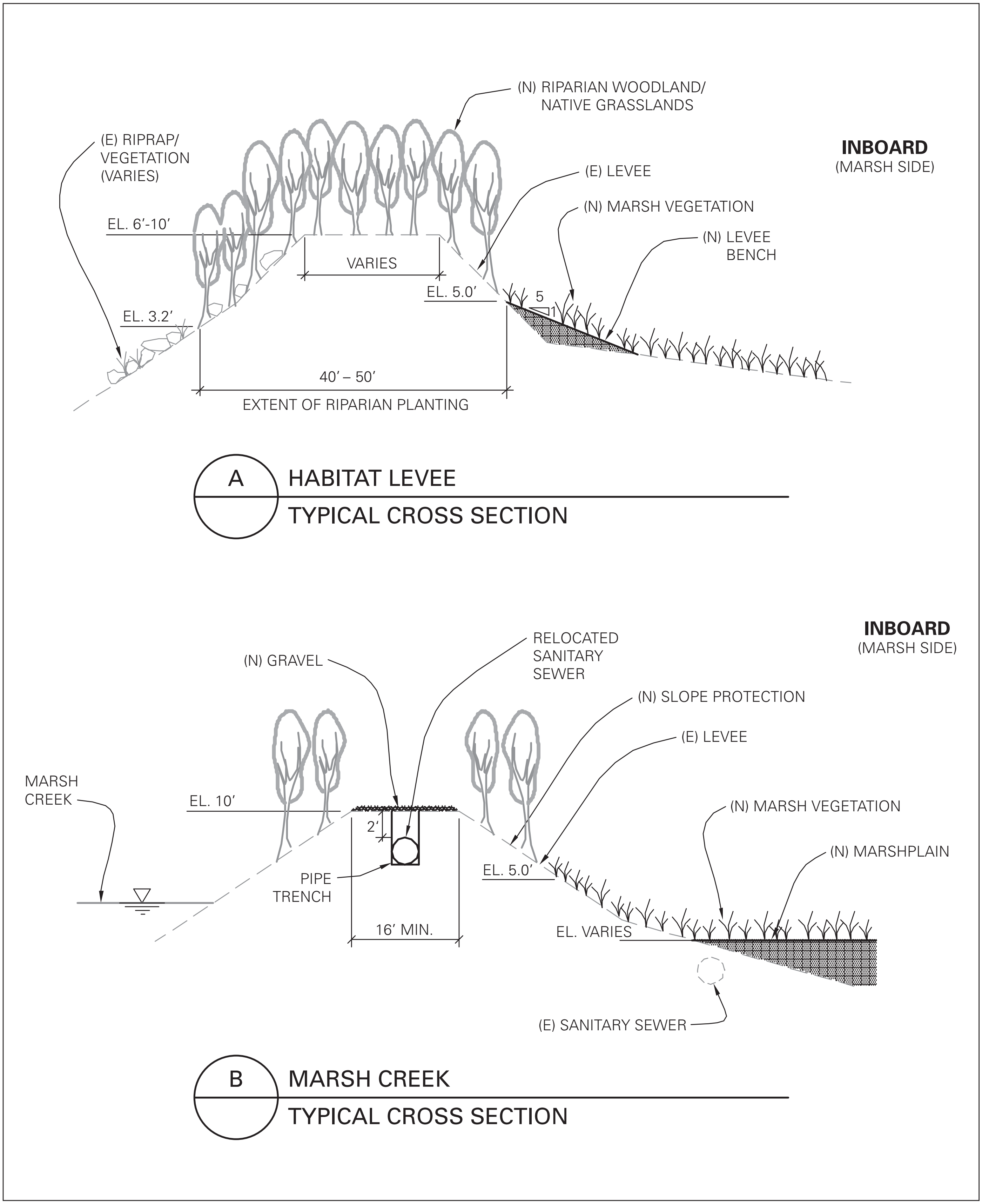


Figure 2-8

Conceptual Schematic of Marsh Creek and Habitat Levees

Source: PWA

LEVEE BREACH SIZES

Breaches would be sized to provide full tidal exchange between the sloughs and the restored marsh and open water areas. Empirical channel relationships (hydraulic geometry) for Delta marshes would be used to size the breaches. For large marsh areas (approximately 230 acres), breaches are expected to be approximately 60 to 80 ft wide at MHHW and 15 ft deep below MHHW. The open ends of the breaches of the habitat levees will need to be protected from tidal erosion. Rock rip-rap is one option to stabilize these banks.

TIDAL CHANNEL NETWORK CONFIGURATIONS

Tidal channel systems in the three parcels would be excavated into the marshplain. The channel networks would be sinuous and branching, similar to the forms of natural channel networks in freshwater and more saline tidal marshes. The design length of tidal channels would be estimated from channel densities in historic or mature freshwater marshes, which are expected to be approximately 100 feet per acre (SFEI, 2004). The curvature, meander, and bifurcation of the tidal channel networks would also mimic natural tidal marshes. Channel side slopes would be constructed as steep as possible to mimic natural channel banks. It may be feasible to construct side slopes of 2:1 (horizontal:vertical) or steeper, depending on the type of soil used for marsh fill.

The dimensions of the main tidal channels in large marsh areas are expected to be similar to the breach dimensions discussed above.

TIDAL CIRCULATION

Full tidal drainage in restored marsh areas is important for tidal marsh function at Dutch Slough. If significant tidal damping[1] occurs, low marsh vegetation may be stressed due to water-logging. Tidal damping occurs to a small degree in natural marshes due to the upstream dissipation of tidal energy in natural tidal channel systems, which typically reduce in size away from the tidal source. Damping may be more pronounced in restored marshes if flows from the tidal source are constricted, such as from too small a levee breach or too narrow a source channel. Drainage is also affected by local topography, as depressions (ponds or pannes) and other slow-draining geomorphic features that can prolong the hydroperiod for marsh vegetation.

With full tidal exchange for the Gilbert and Burroughs parcels connecting to Little Dutch Slough, the depth, duration, and frequency of tidal inundation are expected to be approximately the same for all tidal marsh areas on these two parcels, which would facilitate comparison for adaptive management experiments. Full tidal drainage is also important to avoid potential drainage impacts to the area south of the Dutch Slough Restoration Project, which drains to Little Dutch Slough and Emerson Slough.

The current size of Little Dutch Slough is too small to allow full tidal exchange for restored tidal marsh on the Gilbert and Burroughs parcels and would need to be enlarged. Little Dutch Slough could be enlarged, either by dredging or allowing the channel to scour in response to the restored tidal flows. PWA modeled scenarios to assess the effect of enlarging Little Dutch Slough. Based on model results, enlarging the wider downstream (northern) reach of Little Dutch Slough is expected

[1] Tidal damping is a decrease in tidal range at a given location due to frictional losses between the location and the source tide. Dampening can also change local mean tide level.

to allow full tidal drainage in marshes draining to this reach and improve tidal drainage in marshes draining to the narrow upstream (southern) portion of Little Dutch Slough. Additional enlargement of the narrow upstream (southern) portion of Little Dutch Slough is expected to be necessary to achieve full tidal drainage in marshes draining to this reach.

PWA also assessed the potential for tidal channel scour in Little Dutch Slough. The peak velocities modeled for the wider downstream reach of Little Dutch Slough indicate that this reach has the potential to scour because modeled velocities are within the range of threshold velocities for erosion (approximately 1 - 4 ft/s; Delft, 1989). The potential for scour in the narrow upstream reach of Little Dutch Slough may be limited; modeled velocities are lower in this reach and one of the channel banks is armored with rip-rap.

Dredging the narrow upstream reach of Little Dutch Slough is assumed to be necessary due to the limited potential for this reach to scour. However, the project would be designed to minimize or avoid dredging the wider downstream reach of Little Dutch Slough by allowing this reach to scour. Monitoring experience from similar restoration projects in San Francisco Bay suggests that channel scour may occur within several years after breaching. Further assessment of the rate of channel scour and the resilience of low marsh vegetation to partial drainage is necessary to assess whether or not it is necessary to dredge the entire length of Little Dutch Slough.

STORMWATER CONVEYANCE ALONG EMERSON AND LITTLE DUTCH SLOUGHS

Maintaining existing levels of winter stormwater drainage through Emerson and Little Dutch Sloughs is also important to avoid potential drainage impacts to the area south of the Dutch Slough Restoration Project, which drains to these two sloughs. The Dutch Slough Restoration Project is not expected to significantly change tidal drainage in Emerson Slough because restored tidal marsh areas would not be breached to this slough; however, a water control structure to the managed pond would permit some exchange between the Emerson parcel and Emerson Slough. The Dutch Slough Restoration Project could affect tidal drainage in Little Dutch Slough from the addition of the tidal prism from the restored tidal marshes.

FILL MATERIAL

In the Gilbert and Burroughs parcels, imported fill material is needed to create marsh areas and levee construction. Imported fill may be obtained from other projects that generate excess material, either by dredging or excavating from upland areas, as detailed below. Hydraulic placement of dredged material is generally considered to be a cost effective source and method for importing large volumes.

IMPORTED MATERIAL

Imported material may be available from the Ironhouse Sanitary District's land immediately west of the Emerson parcel and Marsh Creek. Material could be excavated from the Ironhouse parcel using self-loading scrapers and transported over Marsh Creek and onto the Emerson parcel via a temporary bridge. Excess material from either the Ironhouse parcel or the Emerson parcel could be transported onto the Gilbert and Burroughs parcels. The Ironhouse parcel soils have been tested and found to be suitable for use as wetland cover (see Sections 3.2 and 3.15 for a detailed discussion of these soils). Only sediments that meet the Regional Water Quality Control Board's criteria for wetland cover would be used for fill.

ONSITE BORROW FROM SUBTIDAL AREAS

If imported material is not available or cost effective for the Gilbert and Burroughs parcels, it is assumed that fill material for creating marsh areas would be generated from onsite excavation of the low (subtidal) northern areas of these parcels.

Self-loading scrapers are usually the most cost effective type of land-based earthmoving equipment; however, their utility is limited to relatively stable, well-drained soils. At the Dutch Slough site, it is assumed that scrapers can be used for cut and fill above elevation –2.0 feet NGVD. For more subsided areas and/or deeper excavations, it is assumed that earthmoving would be accomplished using track-mounted excavators, off-road trucks, and bulldozers. These assumptions are based on the limited groundwater data available.

FLOOD PROTECTION/LEVEES

EASTERN SITE BOUNDARY

A new levee would be constructed along the east boundary of the Burroughs parcel to provide flood and seepage protection for areas to the east once the parcel is restored, either as part of the Dutch Slough Restoration Project or as part of the planned residential development east of the site. The new levee would replace existing levees that currently surround the Burroughs parcel along Dutch Slough and Little Dutch Slough (See Figure 2-9). Negotiations are underway between DWR, the City of Oakley, and developers of adjacent/nearby parcels to determine the feasibility of mutually contributing towards the construction of a levee along Jersey Island Road that will provide 300-year flood protection, as well as protect adjacent areas from possible seepage associated with the restoration project. This increased protection would be far greater than provided by the existing levee around the Burroughs Parcel along Dutch Slough and Little Dutch Slough, which offers less than 100-year flood protection.

The new levee would connect to the levee system owned and maintained by RD 799 to the east. The new levee would be located immediately west of Jersey Island Road and the PG&E easement for on-site power and gas transmission lines. The new levee would also be constructed around the inholding for a private house and easement for the privately operated active gas wells along Jersey Island Road. The alignment and flood protection level of the Jersey Island Road levee would likely be the same, regardless of who constructs it.

For the purpose of this EIR, it is assumed that a new levee along Jersey Island Road would be constructed with a crest elevation of 11.1 feet NGVD, a crest width of 20 feet, a waterside slope and a landside slope of 3:1 (Figure 2-9). This would provide a levee designed for 300-yr protection with 3 feet of freeboard. The existing levees around the Burroughs parcel range in elevation from 8.8 to 10.5 ft NGVD.

Slope protection on the waterside of the new levee could consist of either biotechnical or rock slope protection. Although biotechnical protection is preferred, rock slope protection is assumed at the conceptual planning stage.

The new levee would be constructed of lean clay, which could be imported or excavated from onsite. Peat would need to be excavated from beneath the planned levee alignment to expose the underlying sand or stiff clay soils. As peat soils may underlay the existing Dutch Slough levee (to remain), a transition section of the new levee near its connection with the existing levee would likely have wide berms to maintain stability of the new section and to aid in controlling levee settlement induced by lateral creep.

"NO BURROUGHS" OPTION

If this option were exercised, the Burroughs parcel would not be restored to tidal action, and there would be no need for a levee on the eastern boundary of the parcel.

SOUTHERN SITE BOUNDARY

The Contra Costa Canal and the City Community Park Project border the Dutch Slough Restoration Project to the south. Residential developments are planned for the area to the south of the Contra Costa Canal. The existing agricultural levees around the Dutch Slough site provide some measure of flood protection for areas to the south; however, these levees are not expected to protect against the 100-year flood, according to FEMA (1987). Restoring the Dutch Slough site to tidal action would move the existing line of flood defense provided by levees (less than 100-year) to the existing and restored uplands along the southern site boundary.

New levees to protect against the existing flood hazard are being planned for areas to the south of the project site as part of planned or approved residential development in the City of Oakley. The project would coordinate with other ongoing flood protection planning in progress for areas south of the Dutch Slough site.

CONTRA COSTA CANAL IMPROVEMENTS

The Contra Costa Canal is an open canal surrounded by earth embankments. The embankments are above the 100-year flood elevation and, though they were not designed as flood protection levees, FEMA (1987) shows the embankments as providing 100-year flood protection for areas south of the Dutch Slough Restoration Project. Topographic data, however, indicate that there are gaps in the embankments located at the heads of Emerson Slough and Little Dutch Slough, where the canal is siphoned through underground pipes. Flooding of the area to the south of the canal could occur through the gaps in the embankments.

The Contra Costa Water District plans to encase the Contra Costa Canal in a pipe (Contra Costa Water District, Initial Study, April 2006). The pipe would be installed and buried in the existing canal and the canal embankments would be re-graded. In April 2006, CCWD prepared an Initial Study/Negative Declaration (IS/ND) for the "Contra Costa Canal Encasement Project" that proposed installation of up to 3.97 miles (approximately 21,000 feet) of buried pipeline. After a 30-day public review, the CCWD Board of Directors approved the IS/ND on November 29, 2006. While funding for the full project is being pursued, an initial phase of the Encasement Project will proceed. Phase I of the project, commencing in 2008, involved construction and pipeline installment along approximately 2,000 feet from Pumping Plant 1 eastward to Marsh Creek.

PLANNED RESIDENTIAL DEVELOPMENTS TO THE SOUTH

Residential developments are planned for the area south of the project and north of Cypress Road (See Figure 5-1, Cumulative Projects Map, in Chapter 5 of this Draft EIR). In 2005, a new flood control levee was built south of the Contra Costa Canal to provide 100-year flood protection for one of the developments south of the Emerson parcel (Cypress Grove). A development south of the Dutch Slough site has constructed a similar levee system to provide 100-year flood protection that will be connected to the proposed Gilbert Property project levee system. (City of Oakley, Notice of

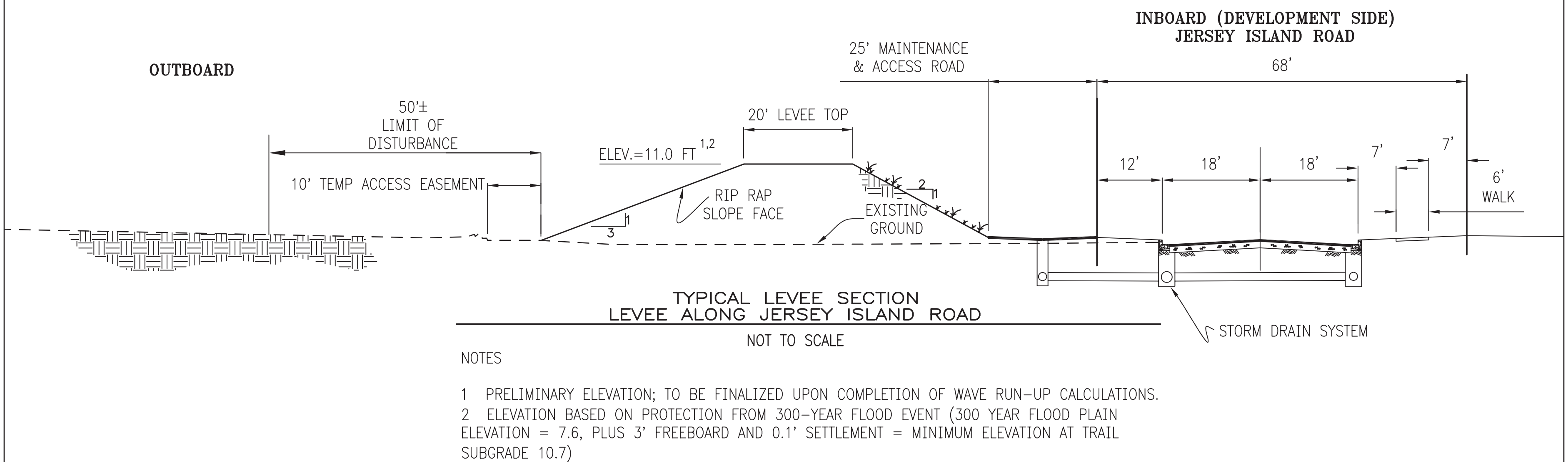


Figure 2-9

Dutch Slough Restoration Project - East Replacement Levee Section

Source: Bellecci & Associates, Inc.

Preparation for the Proposed Emerson Project, May 14, 2007).

City Community Park Project

Low elevation areas of the Dutch Slough site surrounding the park would be raised to restore upland habitats. These areas could be designed to provide the desired level of flood protection for the park in future design phases. Significant portions of the Community Park are planned to flood during a large rainfall/flood event. However, all key new buildings and the relocated Ironhouse School building would be sited to have finished floor elevations of at least 11 feet above mean sea level, above the 100-year flood elevation (P. Miller, pers. comm.).

Western Site Boundary (Marsh Creek)

The levee along the west side of Marsh Creek provides flood protection for the Ironhouse Sanitary District's property to the west of the Dutch Slough Restoration Project site. The restoration project is not expected to affect this levee or flood protection for this property. The levee along the east side of Marsh Creek, adjacent to the Emerson parcel, would not be needed for flood protection once the Emerson parcel is restored to tidal marsh. However, the eastern Marsh Creek levee would be retained to provide access to Ironhouse Sanitary District's pipeline and a public trail.

Infrastructure Protection, Relocation and Replacement, and Vector Control

IRONHOUSE SANITARY DISTRICT PIPELINE

The Ironhouse Sanitary District's pipeline would be relocated from the toe of the Emerson parcel levee along Marsh Creek to near the top of this levee (See Figure 2-11). The existing alignment of the pipeline is shown in Figure 2-6. The pipeline is currently buried in the Emerson parcel just beyond the toe of the Marsh Creek levee. As this area would be restored to tidal marsh, a new pipeline would be installed in the top of the levee to preserve access for service and maintenance. The top of the levee would be lined with gravel to provide an all-weather access road. The existing top width and elevation of the Marsh Creek levee (approximately 20 ft and 11 ft NGVD, respectively) would be adequate for access requirements. The new pipeline would be either buried two feet below the top of the levee or placed under the area by means of directional drilling. The new pipeline would be installed with flexible joints to prevent potential shearing of the pipeline due to levee settlement. As the Marsh Creek levee has existed for some time, the amount of settlement is expected to be small. The existing pipeline would be removed or abandoned once it is replaced by the new pipeline.

The slope of the Marsh Creek levee on the Emerson parcel would be protected to prevent levee scour and to protect the Ironhouse pipeline. This portion of the Marsh Creek levee would not serve as a flood control levee after restoration of the Dutch Slough site. The treatment of the Marsh Creek levee would need to preserve the Marsh Creek flood control channel.

This plan assumes that the Contra Costa County Flood Control District would allow the pipeline to be relocated into their levee. This portion of the levee would no longer provide flood control as the Emerson parcel would be restored to tidal action.

POWER AND GAS FACILITIES LEVEE PROTECTION

The alignment of the new east levee on the Burroughs parcel would protect and preserve access to PG&E's electric transmission line, high-pressure gas line, and gas gathering line. These PG&E lines all cross the northeast corner of the Burroughs parcel, which would not be restored to tidal marsh. The new levee would be located immediately west of the easement for PG&E's electric transmission line and would preserve the existing level of flood protection for the area northeast of the new levee. The new levee would also protect the two privately operated active gas wells along Jersey Island Road (See Figure 2-6). The remaining privately operated inactive gas wells on the three parcels would be plugged and abandoned by the owners of the gas wells (Marquez Energy), per the land sale agreement.

Further coordination with PG&E to develop a plan and costs for moving or decommissioning PG&E's smaller power distribution lines, equipment, and transformers; and gas distribution lines would occur as part of the project.

VECTOR CONTROL

Mosquitoes pose a nuisance to residents of urban areas and certain types of mosquitoes are vectors for the West Nile Virus. Different types of land use (agricultural, urban, wetland) pose different risks for mosquito production. Tidal wetlands can generally be readily designed and managed to pose a low risk of mosquito production. Managed wetlands -- such as the proposed subsidence reversal experiments and other types of managed open water treatments -- require additional design features and management.

Members of the Dutch Slough Restoration Project management team and PWA met with representatives of the Contra Costa Mosquito and Vector Control District (CCMVCD) to discuss methods for minimizing mosquito production with the proposed restoration. There are two basic approaches to minimizing mosquito production: (1) avoiding the creation of mosquito habitat and (2) spraying pesticides. The first approach is preferable and has been incorporated into the design as possible. The primary mosquito habitat of concern is shallow, stagnant, standing water. Deeper water (which supports mosquito-eating fish), waves, and currents would deter mosquito production. Spraying is used as a back-up measure, and requires land access for CCMVCD vehicles.

Tidal restoration generally does not create mosquito habitat, since tidal areas flood and drain on a twice-daily cycle (no standing water). CCMVCD staff monitor the adjacent Big Break tidal wetland and generally find conditions to be acceptable at that location (K. Malamud-Roam, pers. comm.). Sometimes poorly drained areas along the upper edge of a tidal wetland can pond water for up to two weeks between high tide cycles. At the suggestion of the CCMVCD, the upper edge of the Dutch Slough wetlands would be graded with a moderate to steep slope (greater than or equal to 0.5%) to allow for good drainage. In addition, the upland edge would be checked periodically as part of ongoing maintenance to remove any obstacles to drainage, such as build up of debris (e.g., woody debris, rack). The CCMVCD had no objection to the channel drainage density proposed at Dutch Slough (modeled on a natural wetland drainage density) and noted their preference for a drainage density on the high end of the natural range. Native mosquito eating fish are not proposed for the project because they may prey on other native species.

The managed wetland (non-tidal) areas of the site would require additional design features and management. Of concern are shallow continuously ponded areas, particularly those with dense vegetation. Vegetation dampens wave energy and limits access by mosquito-eating fish. Note that the need for spraying in managed pond areas may affect adaptive management experiments and would need to be taken into account in the experimental design.

Dutch Slough Restoration Project Phasing

Project construction (with the exception of levee breaching) would occur over at least two years. Construction activities would include levee grading and construction, utilities relocation, and marshplain grading. It is assumed that all construction would be performed in the dry season (generally April 15th to October 15^{th}. The levee bench and slope would need to "rest" for 1-2 years to stabilize prior to levee breaching.

The first phases of project implementation would include constructing the waterside habitat levees and bench, the new east flood control levee, and relocating the Ironhouse pipeline and on-site power and gas utilities. Site preparation would be included in each of these phases. Constructing the habitat levee bench and relocating the utilities would be necessary prior to managing water levels (i.e., allowing controlled flooding) in low elevation open water areas. Constructing the new east levee could occur prior to or concurrently with marshplain grading in the Burroughs parcel.

Water may be allowed to collect or be pumped onto the low elevation northern areas of each parcel during an interim management phase prior to full project implementation. Interim management of open water areas may have several benefits. Pumping requirements during the winter season would be reduced. Tules are expected to establish in the low elevation areas, which would be a precursor to managing these areas for subsidence reversal or pre-establishing tules on the habitat levee bench prior to tidal breaching. Techniques for native SAV revegetation could also be tested. Vector control measures would need to be considered in the interim management of open water areas. During marsh-plain grading, the site would be drained and tules established in the interim phase may die back; however, tules are expected to re-establish more rapidly in the subsequent revegetation phase than the initial phase of tule establishment.

Marsh plain grading would be a major phase of project implementation and would require site preparation and mobilization. Each parcel is accessible by land for equipment mobilization. Given the relatively large earthwork volumes, construction would likely be phased over at least two years. During marsh plain grading, onsite water should be managed so that soils are as dry as possible to increase earthmoving efficiency (and reduce costs).

The revegetation phase is expected to follow marsh-plain grading. Water control structures would be used to flood graded marsh areas and manage water levels to encourage tule establishment. Water management would also be used to establish tules on the habitat levee bench (see Figure 2-12) in open water areas that are to be breached to tidal action (if any). Riparian woodland, native grassland, and dune scrub vegetation would be planted in upland areas and on habitat levees. Upland plant species may be field grown on-site prior to revegetation. In upland areas that would not be graded, revegetation may begin in an earlier phase; however, this is not expected to be a large area. The grading of habitat levees to create lower elevation riparian and high marsh habitats would likely occur as part of or immediately prior to the revegetation phase.

Once tules are established in the restored marsh areas, the site would be breached to tidal action. The construction schedule would allow for at least one growing season (winter-spring) following completion of site grading to allow vegetation to establish prior to tidal breaching. Therefore, it is likely that the levees may not be breached until three years after marshplain grading commences.

The Gilbert and Burroughs parcels could be restored prior to the Emerson parcel (under any of the restoration alternatives). This approach to phasing has the advantage of allowing the flexibility of phasing project funding. As the large-scale adaptive management experiments would be located on the Gilbert and Burroughs parcels, this approach would allow for experimental comparison of restored marsh areas. Phasing the restoration of the parcels may increase mobilization costs. If funding is available for full project implementation, then restoring all three parcels in a single phase is preferred.

Maintenance and Monitoring

The primary components of the Dutch Slough Restoration Project – marsh areas, uplands, and habitat levees – are designed to be self-maintaining within the project planning horizon. Maintenance may be required for certain design features that are important for conducting adaptive management experiments. This may include removing obstructions from tidal channels (e.g., debris), filling unintentional channels that cut through marsh drainage divides and connect marsh areas, or repairing unintentional breaches in the habitat levees surrounding tidal marsh or managed open water areas. The project assumes that maintenance of adaptive management design features would be required for 20 years after project construction.

The new east flood control levee would require regular maintenance. The levee maintenance includes items such as levee inspections and patrolling, grading, engineering, vegetation and rodent control, debris removal, drainage cleaning, seepage control, underwater surveys, and slope protection (erosion, slipouts, subsidence). Reclamation District 799 would be the agency responsible for maintaining the levee system. (Tom Hall, pers. comm.).

Monitoring would be required to fulfill several objectives: establish baseline conditions, monitor project performance, and perform adaptive management experiments. Project performance monitoring would include physical and biological monitoring at 0, 1, 3, 5, and 10 years after construction. The Natural Heritage Institute led the development of the Dutch Slough Adaptive Management and Monitoring Plan with input from the Dutch Slough Adaptive Management Working Group (see Appendix D).

Alternative 1: Low Marsh and Open Water with Minimal Grading (Minimal Fill Alternative)

In addition to the common features described above, Alternative 1 would create large areas of low marsh and open water habitats, smaller areas of mid marsh and high marsh, and upland habitats (riparian woodland, native grassland, dune, and marsh/upland transitional habitats) using only minimal grading in each parcel (Figure 2-10). Alternative 1 would have the lowest cost and uses minimal fill material.

Habitat and Design Features

The habitat gradient between open water, marsh, and upland would follow the existing site topography. Existing channels and irrigation ditches in the parcels would be enhanced to create tidal channels where possible. Additional tidal channels would be excavated to create sinuous and branching channel networks and to provide adequate tidal drainage. In the Burroughs parcel, irrigation ditches with existing riparian woodland habitat would be incorporated into the tidal channel system; however, it is uncertain whether these riparian communities would survive in the medium- to long-term once tidal inundation is restored.

The exterior levees of the Gilbert and Burroughs parcels would be breached along Little Dutch Slough to restore tidal action to restored marsh areas. Several marsh areas would be breached to the narrow southern reach of Little Dutch Slough. This reach of the slough would be dredged to increase channel conveyance and allow for full tidal circulation to the marsh areas. The restored marsh on the Emerson parcel would not be breached directly to Dutch Slough.

"No Burroughs" Option

In this option, the Burroughs parcel would not be restored to tidal action. The Emerson and Gilbert parcels would likely be breached to Emerson Slough.

Adaptive Management Experiments

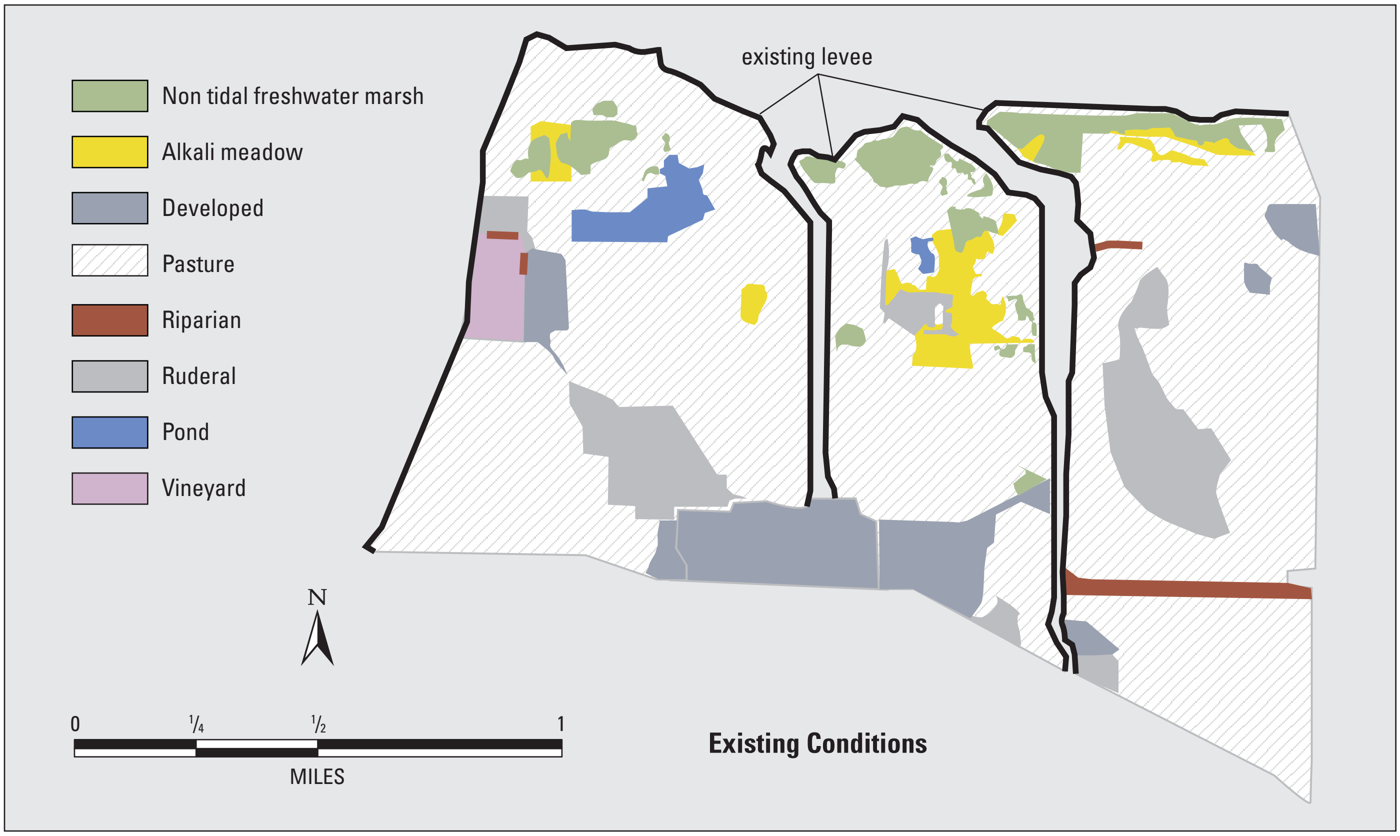
To test the adaptive management hypotheses related to spatial scale, the Burroughs parcel would have low marsh areas drained by a large channel network (approximately 200 acres) and a small network (on the order of 10 acres), which can be compared to a medium sized channel network (approximately 60 acres) in the Gilbert parcel. The medium-sized channel network in the Emerson parcel would provide an additional point of comparison for marsh scale. The testing of marshplain elevation hypotheses would not be possible because only small areas of mid marsh would be created. Small-scale adaptive management experiments (one to two acres) would be accommodated, though the exact locations of these experiments have not yet been decided.

"No Burroughs" Option

In this option, the Burroughs parcel would not be restored to tidal action. The adaptive management experiments would be reconfigured to occur on the Emerson and Gilbert parcels.

Alternative 2: Mix of Mid Marsh, Low Marsh, and Open Water with Moderate Fill (Moderate Fill Alternative)

Alternative 2 would create a mix of marsh, open water, and upland habitats (See Figures 2-11 and 2-12). Alternative 2 would create these habitats using on-site grading (approximately 1,320,000 cubic yards) and a moderate amount of additional fill (approximately 360,000 cubic yards). The 360,000 cubic yards of additional fill material would be imported or borrowed onsite from low elevation open water areas. Alternative 2 would provide opportunities for marsh scale and marshplain elevation adaptive management experiments and the restoration of a natural delta at the mouth of Marsh Creek.



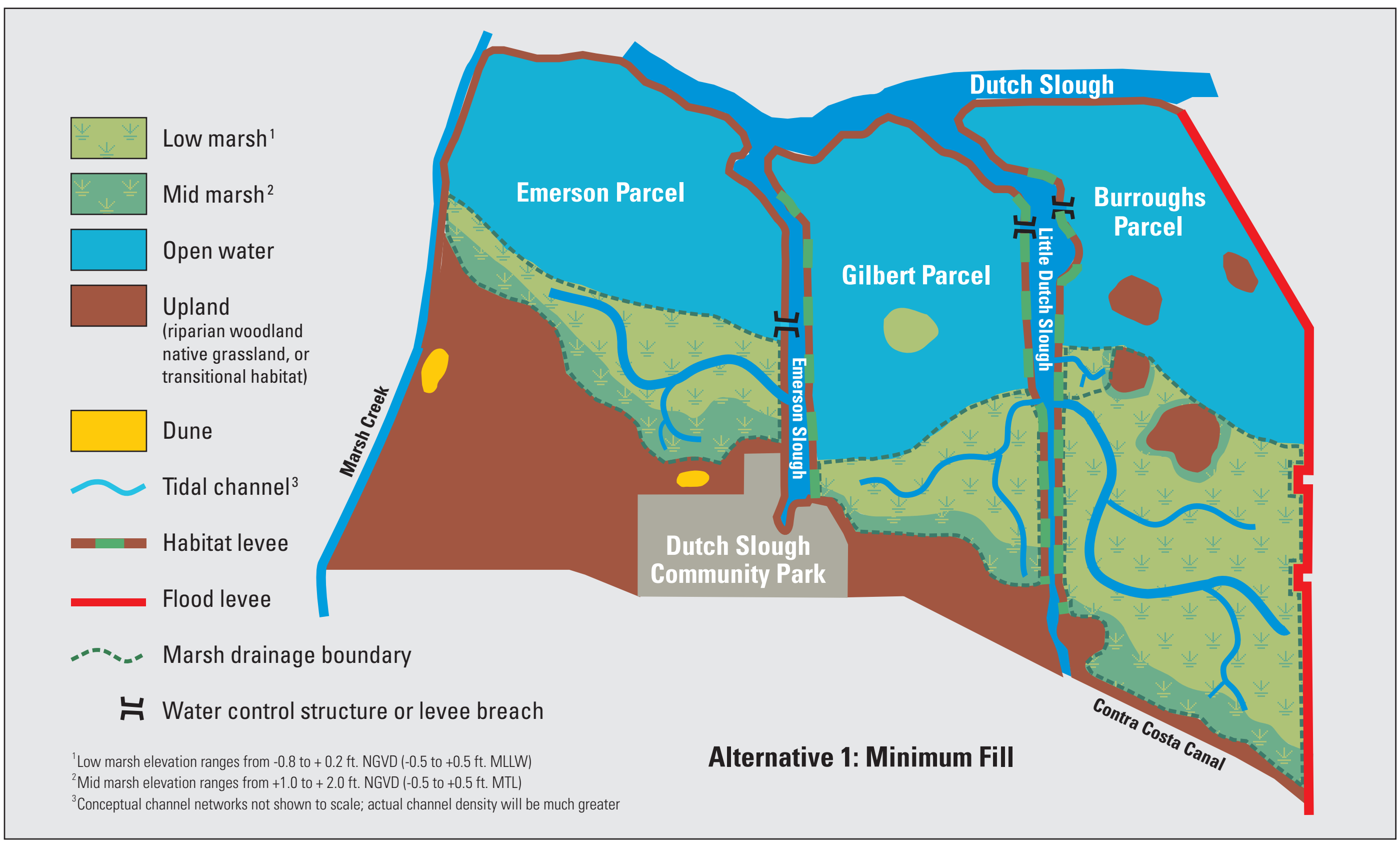


Figure 2-10

Dutch Slough Restoration Project - Existing Conditions
and Alternative 1 Conceptual Plan

Source: PWA

Habitat and Design Features

On-site grading and additional fill would be needed to create marsh areas in Alternative 2 since relying on the existing topography would result in very small areas of mid to high marsh (and large areas of low marsh and open water as in Alternative 1), particularly in the Gilbert parcel. Marsh areas would be located in the higher areas of the parcels to reduce the amount of fill required and increase cost effectiveness. (In general, the higher elevation areas are located in the central and southern portions of each parcel.) Marsh area would be created by excavating approximately 1,320,000 cubic yards of material from higher areas and placing excavated material in lower-lying areas. Grading on the Emerson parcel would generate excess material (approximately 60,000 cubic yards), which would be used for fill in the Gilbert parcel. Additional fill material (approximately 360,000 cubic yards) would be needed for the Gilbert and Burroughs parcels. It would be either excavated from the Dutch Slough Restoration Project site's open water areas or trucked overland directly from the Ironhouse parcel. If Ironhouse parcel fill is available for use, fill would be trucked overland directly from the Ironhouse parcel and supplemented by additional material dredged from the adjacent Restoration Area open water areas. Additional fill material generated onsite by over-excavating the lower northern areas of the Gilbert and Burroughs parcels would deepen these areas, which is expected to limit open water management options (see Project Options). Therefore, the use of imported fill material is preferred over on-site borrow from Gilbert and Burroughs parcels. This Draft EIR assesses the potential impacts of both approaches.

In the Gilbert and Burroughs parcels, the marshplain topography of low marsh and mid marsh areas would vary as described below. The average marshplain elevations of low marsh and mid marsh would differ, with low marsh areas averaging MLLW (-0.3 ft NGVD) and mid marsh areas averaging MTL (1.5 ft NGVD). Each marsh area would have a distinct channel network defined by marsh drainage boundaries or divides, which would facilitate adaptive management experiments. In the Emerson parcel, a single large tidal channel network would connect topographically diverse habitats (low marsh, mid marsh, and upland).

To reduce costs, fill would be placed on higher elevation areas. Typical depths of marsh fill would range from 0 to 4 ft, with a maximum depth of fill of approximately 8 ft. In Alternative 2, marsh areas are generally located to avoid areas with low existing elevations and peat soils shown in the soils map (See Figure 2-4). Assuming that the historic soils map accurately represents existing soils, peat soils are not present over most of the marsh fill area. Near the Emerson parcel breach, 8 ft of fill material would be placed in the location of historic peat soils. Available soil borings suggest that the peat layer may be up to 7 feet thick in this location. A total of approximately 10 ft of fill would need to be placed to achieve a net 8 ft depth of fill due to the settlement of the underlying peat, which is expected to be approximately 2 feet.

The exterior levees of the Gilbert and Burroughs parcels would be breached along Little Dutch Slough to restore tidal action to restored marsh areas. Several marsh areas would be breached to the narrow southern reach of Little Dutch Slough. This reach of the slough would be dredged to increase channel conveyance and allow for full tidal circulation to the marsh areas. The restored marsh on the Emerson parcel would be breached directly to Dutch Slough.

Portions of the existing riparian woodland along the drainage channel (see Figure 2-5) would be retained as part of the marsh drainage divide between the mid marsh and low marsh areas on the Burroughs parcel.

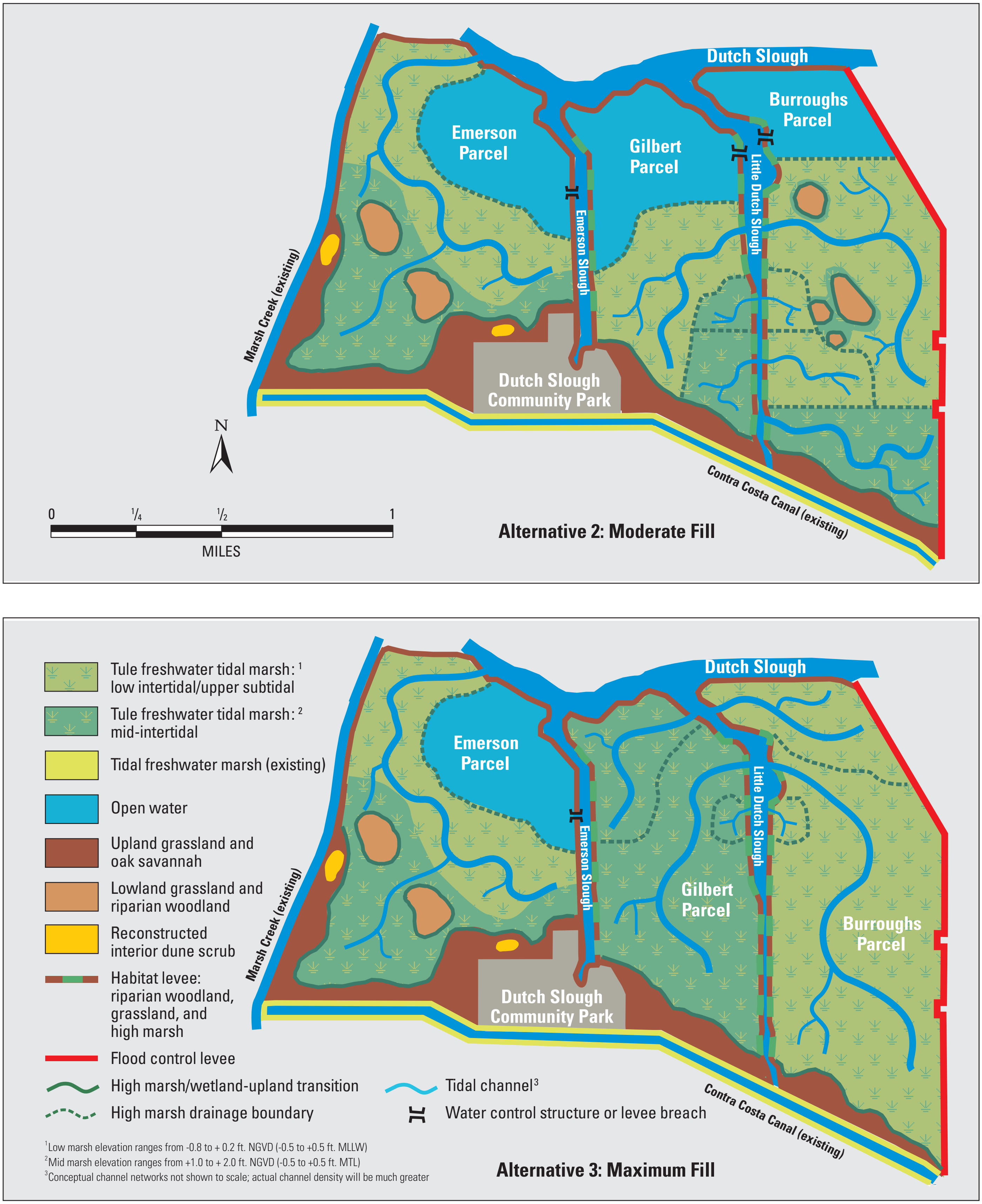


Figure 2-11

Dutch Slough Restoration Project - Alternative 2 and 3 Conceptual Plans

Source: PWA

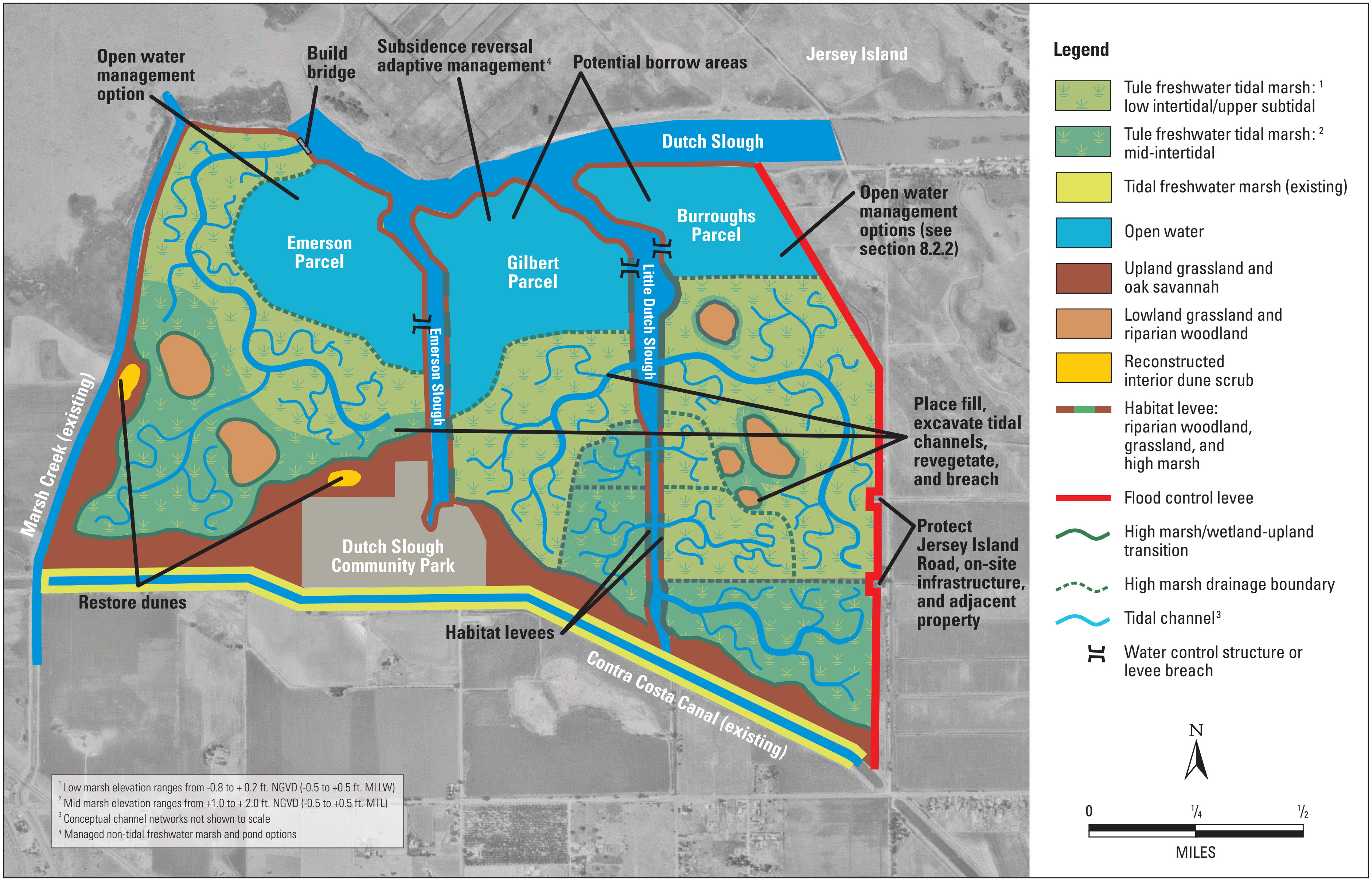


Figure 2-12

Dutch Slough Restoration Project - Alternative 2 Restoration Components

Source: PWA

The restoration approach in the Emerson parcel would allow for the option to restore a natural delta at the mouth of Marsh Creek, if feasible from a water quality perspective (See Figure 2-13). To restore the natural physical processes and ecological values of the creek, Marsh Creek may be diverted into the Emerson parcel through restored tidal marsh.

Restoration design features for Alternative 2 are shown in Figure 2-12.

"NO BURROUGHS" OPTION

In this option, the Burroughs parcel would not be restored to tidal action, resulting in a significant decrease in acreage of restored tidal marsh. The Emerson and Gilbert parcels would likely be breached to Emerson Slough. Because Burroughs would not require any fill material in this option, and may actually be a source of additional fill material, there would be a potential increase in middle marsh acreage on the Emerson and Gilbert parcels. The existing freshwater marsh in the northern portion and riparian habitat in the southern portion of the Burroughs parcel would be retained and possibly enhanced. Because existing terrestrial and wetland habitats would be retained, project impacts to these habitats and associated species would be decreased.

Adaptive Management Experiments

The marshplain and channel configurations of the Gilbert and Burroughs parcels would allow scientists to test the adaptive management hypotheses related to marshplain elevation and spatial scale. These experiments would compare low marsh and mid marsh areas drained by large channel networks (approximately 80 – 90 acres), medium sized channel networks (approximately 30 – 40 acres), and small networks (approximately 10 – 15 acres). Paired sampling of low and mid marsh would allow for comparison between low and mid marsh at different scales. A very large area of low marsh on the Burroughs parcel (approximately 150 acres) would also be compared to the smaller paired-sample marsh areas. The scale of each marsh area and channel network may be refined in future design phases for the purpose of the adaptive management experiments.

The configuration of channel networks draining to the same inlet channel (Little Dutch Slough) is expected to aid in the comparison of results. Each marsh area and channel network would be drained by one breach to Little Dutch Slough. As possible, the channels draining paired sample areas would be located equidistant from the mouth of Little Dutch Slough. For example, breach channels would be aligned along Little Dutch Slough for the small marsh areas, medium marsh areas, and large and very large low marsh areas. The marsh drainage area for each channel network would be defined by high marsh drainage divides, which would minimize the potential for new channel connections to form between and connect marsh areas.

Until such time as Marsh Creek is diverted onto the Emerson parcel, should this occur, this parcel would provide an additional sample for the adaptive management experiments. In the Emerson parcel, the large area of "mixed" marsh could be compared to the very large area of low marsh on the Burroughs parcel to test the benefits of topographic diversity. The fact that the marsh would drain to different sloughs may complicate experimental comparison. If and when Marsh Creek is diverted onto the Emerson parcel, the marshes in this parcel would no longer be comparable to the other marsh areas due to the complicating factor of Marsh Creek.

As in Alternative 1, Alternative 2 would include small-scale adaptive management experiments (one to two acres).

"No Burroughs" Option

If the Burroughs parcel is not restored to tidal action, a major revision of the adaptive management experiments would be required. Experiments would be conducted on Emerson and Gilbert parcels rather than on Gilbert and Burroughs. Moving the adaptive management experiments may delay implementation of the options to restore a Marsh Creek delta on the Emerson parcel.

Alternative 3: Mid Marsh and Low Marsh Emphasis with Imported Fill (Maximum Fill Alternative)

Alternative 3 would use onsite grading and imported fill material (approximately 3 million cubic yards total) to create large continuous expanses of low marsh and mid marsh in the Burroughs and Gilbert parcels, respectively (See Figure 2-11). Under this alternative, onsite grading would be the same as for Alternative 2 (about 1.32 million cubic yards), and about 1.7 million cubic yards of imported fill would be required. As with Alternative 2, if Ironhouse parcel fill is available for use, fill would be trucked overland directly from the Ironhouse parcel and supplemented by additional material dredged from the adjacent Dutch Slough Restoration Project open water areas. If Ironhouse parcel material is not used on the site, all fill would be derived from deeper onsite dredging and/or barged to the site from other sources. Alternative 3 provides the largest area of restored tidal marsh and opportunities for large-scale adaptive management experiments. The Gilbert and Burroughs parcels would have the largest marsh areas and most complex (highest order) channel networks of all restoration alternatives; however, this would require the largest amount of fill and the highest cost. The restoration of the Emerson parcel in Alternative 3 is identical to Alternative 2.

Habitat and Design Features

Imported fill would be placed to mid marsh elevations in the Gilbert parcel. The Burroughs parcel would be graded to low marsh elevations using cut and fill of onsite material, with supplemental imported fill if necessary. Dredged material is the most likely source of imported fill and could be deposited onsite in a slurry. The marshplain topography of restored marsh areas in Alternative 3 is identical to Alternative 2. Restored marsh areas on the Gilbert and Burroughs parcels would be breached to the wider northern portion of Little Dutch Slough and slough channel dredging is not expected to be necessary.

"No Burroughs" Option

In this option, the Burroughs parcel would not be restored to tidal action. The Emerson and Gilbert parcels would likely be breached to Emerson Slough. Because Burroughs would not require any fill material in this option, and may actually be a source of additional fill material, there would be a potential increase in middle marsh acreage on the Emerson and Gilbert parcels. However, in Alternative 3, almost all of Burroughs is restored to marsh habitat, so if it were not breached there would be an overall and significant decrease in marsh acreage.

The existing freshwater marsh in the northern portion and riparian habitat in the southern portion of the Burroughs parcel would be retained and possibly enhanced. Because existing terrestrial and wetland habitats would be retained, project impacts to these habitats and associated species would be decreased.

ADAPTIVE MANAGEMENT EXPERIMENTS

Alternative 3 provides the largest and most continuous low marsh and mid marsh areas (on the order of 300 - 400 acres), so it is well suited for both the marsh elevation and marsh- scale adaptive management experiments. As in Alternative 2, Alternative 3 would include paired sample areas of low marsh and mid marsh in the Gilbert and Burroughs parcels. The large mixed marsh area in the Emerson parcel would be compared to the large low marsh and mid marsh areas in the Burroughs and Gilbert parcels; however, the same factors discussed for Alternative 2 may complicate this comparison. As in Alternatives 1 and 2, Alternative 3 would also include small-scale adaptive management experiments (one to two acres).

"NO BURROUGHS" OPTION

If the Burroughs parcel is not restored to tidal action, a major revision of the adaptive management experiments would be required. Moving the adaptive management experiments is likely to create conflicts with the options to restore a Marsh Creek delta on the Emerson parcel.

Alternative 4: No Project

The No Project Alternative represents the most likely condition in the absence of a long-term restoration plan for the Dutch Slough and Ironhouse properties, City park, and public access plan. This alternative would leave the site in its current land uses; the land may be fallowed to allow natural processes and vegetation recruitment to occur while managing for non-tidal habitats – such as seasonal (ponded or sub-irrigated) wetlands, freshwater marsh, riparian woodland, and native grasslands – and compatible public recreation. The site also may be leased out or deeded by DWR to local or regional agencies for agricultural, passive recreation or wildlife uses. Any funds available from leasing the land could be transferred to the Reclamation District and used to maintain the levees.

Dutch Slough Restoration Project Options

The three restoration alternatives also include several options with respect to open water management and a separate option to not restore tidal action to the Burroughs parcel. In addition, Alternatives 2 and 3 include options for the possible diversion of Marsh Creek onto the DWR and/or Ironhouse properties to restore its delta as it discharges into Big Break in the San Joaquin River delta. The Marsh Creek diversion would not occur under Alternative 1.

Marsh Creek could be diverted onsite in one of several potential locations under Alternatives 2 and 3. It could either be diverted onto the Emerson parcel or diverted onto the west side of the present location of Marsh Creek onto lands owned by the Ironhouse Sanitary District. Restoration of marsh on the west side of Marsh Creek would not only expand the footprint of the project, but may also provide a source of inexpensive fill necessary to implement the larger Dutch Slough Restoration Project. The Marsh Creek restoration options are flexible and allow for Marsh Creek to be diverted through both the Ironhouse parcel and the Emerson parcel, potentially providing a larger restored delta at the creek mouth. The location and sizing of the Marsh Creek diversion and channel (feasible under Alternatives 2 and 3 only, as described above) would be determined in future design phases. The decision regarding whether and where to divert Marsh Creek would be based in part on the water quality implications of diverting Marsh Creek into the restored Dutch Slough site, cost, fill availability, flood protection issues, and ecological benefit.

The options for managing open water areas, including breaching to create subtidal habitat planted with native submerged aquatic vegetation (SAV), managing open water pond habitat, growing tules as a subsidence reversal technique (biomass accumulation), and constructing wide marsh "berms" to form a "skeletal" tidal channel network. All of these options are compatible with Alternatives 1 to 3.

The Marsh Creek Relocation and Open Water Management options are described in detail below.

MARSH CREEK DELTA RELOCATION OPTIONS

Under the "build" alternatives, Marsh Creek may be diverted onto the Emerson parcel to restore the physical processes and ecological values of a natural creek delta, if feasible from a water quality perspective. Water quality in Marsh Creek would be monitored to determine if conditions are suitable for diverting the creek on-site. A water-quality monitoring plan was developed as part of the PWA Feasibility Report. If conditions are determined to be suitable prior to final design, the implemented project would include the restored delta in the Emerson parcel. If it is not possible to determine the suitability prior to final design, the plan would allow for the possibility of diverting and restoring Marsh Creek after project implementation. If monitoring results indicate that routing Marsh Creek through a restored marsh delta would negatively impact native plant and wildlife species or degrade the water quality of creek discharge to the Delta, the current alignment of Marsh Creek would be maintained.

If Marsh Creek is diverted onto the Emerson parcel, it would connect with the tidal channel network, flowing through the restored marsh to Dutch Slough and creating a system of backwater channels. Flows in Marsh Creek would deliver sediment to the marshes, recreating natural deltaic processes and features that are expected to benefit native fish and wildlife. Over time, Marsh Creek deposition would raise ground elevations within low marsh areas.

Marsh Creek may be diverted onsite in one of several potential locations (see Figure 2-13). The existing Marsh Creek channel would be blocked below the diversion to re-direct flow into the restored delta. A vehicle-accessible bridge would span the diverted Marsh Creek to allow for a trail and maintenance of the Ironhouse Sanitary District pipeline. The Ironhouse pipeline currently crosses over Marsh Creek and into the Emerson parcel at an existing footbridge and would be moved into the Marsh Creek levee. If the creek is diverted onsite downstream of the existing pipeline crossing, the pipeline may need to cross the creek diversion at the new bridge or cross under the marsh via directional boring. There is also a possibility that Marsh Creek may be diverted onto the Ironhouse Sanitary District's parcel to the west of Marsh Creek and the Dutch Slough site as a coordinated project. The Marsh Creek restoration options are flexible and allow for Marsh Creek to be diverted through both the Ironhouse parcel and the Emerson parcel, potentially providing a larger restored delta at the creek mouth.

The location and sizing of the Marsh Creek diversion and channel would be determined in future design phases on the basis of hydraulic modeling and consideration of sediment dynamics and flood risks.

OPEN WATER MANAGEMENT OPTIONS

All three restoration alternatives include areas of open water (characterized on the project as areas below about –3 feet NGVD and extending to depths of about -13.5 feet), which would not be filled (to reduce costs). There are several options for managing open water areas, which include breaching to create subtidal habitat planted with native submerged aquatic vegetation (SAV), managing open water pond habitat, growing tules as a subsidence reversal technique (biomass accumulation), and constructing wide marsh "berms" to form a "skeletal" tidal channel network. All of these options are compatible with Alternatives 1 – 3.

Management options are summarized in Table 2-2, below. The selection of specific management options for open water areas would be determined in later design phases with consideration of habitat restoration and adaptive management objectives, implementation and management costs, and compatibility with the method of fill. If feasible, subsidence reversal through biomass accumulation is the preferred management option for the open water area on the Gilbert parcel. The open water area on the Gilbert parcel is the largest and least subsided and provides the best opportunity for subsidence reversal.

Several of the open water management options are experimental and may be adaptively tested on small-scale plots before application to large-scale areas. Open water management may be treated as a reversible adaptive management action. The success of different open water management options could be compared to each other. If comparison indicates that one option is more successful (e.g., provides more habitat value), this option could then be applied to other open water areas. For example, if experimental results show that subtidal areas planted with native SAV provided significantly less habitat value than marsh areas, the subtidal area could be closed to tidal action and managed for subsidence reversal.

If imported fill is not available or cost-effective, onsite fill material would be excavated from deep borrow areas within the open water areas. The only option that is expected to be compatible with on-site borrow is deep subtidal open water. It may be possible to confine the deep borrow areas to smaller areas within the open water areas, leaving shallow open water areas that could be managed with any of the options. Shallow open water areas are expected to be compatible with all other management options.

Open water areas may be partitioned with berms to allow small-scale application of different management options or to facilitate water management. As described above, marsh drainage divides would separate marsh areas from open water areas. Higher berms may be needed for options that would manage water levels below tide levels to prevent overtopping from marsh areas, which may lead to scour and channel cutting between open water and marsh areas.

SUBTIDAL AREAS WITH NATIVE SUBMERGED AQUATIC VEGETATION (SAV) PLANTING

Certain types of open water management may limit water circulation, such as managed pond, subsidence reversal through biomass accretion, and deep subtidal. Poor circulation could potentially lead to water quality problems related to anaerobic conditions and depth stratification. The managed pond and subsidence reversal options would require vector (mosquito) control measures, which are addressed below.

Breaching open water areas to allow full tidal exchange would create subtidal open water habitats. If fill material is imported and open water areas are not excavated to provide on-site borrow, the existing elevations of the open water areas (approximately -10 to -3 ft NGVD) would provide shallow subtidal habitat (less than approximately 8 to 12 feet below MTL). Native SAV species such as pondweed could possibly be pre-established in open water areas by planting and gradually inundating shallow subtidal areas prior to breaching. Native SAV is expected to provide desirable habitat for the benefit of native fish and invertebrates within the first few years of establishment.

The pre-establishment of native SAV may provide competition to minimize establishment of non-native SAV; however, on-going management would likely be required to control for non-native SAV. This experimental approach has not been tested previously. It may first be tested on a small-scale through an adaptive management approach prior to large-scale application. Without planting to pre-establish native species, shallow open water areas are expected to be invaded by non-native floating aquatic vegetation (FAV) (e.g., water hyacinth) and SAV (e.g., *Egeria densa*) within a few years of breaching.

Optimal depths for planting native SAV are expected to range from –3.5 to –1.5 ft NGVD (-5 to –3 ft MTL) and to depend on light penetration (L. Anderson, pers. comm.). As an alternative option to planting, natural recruitment of native SAV may be possible if non-native SAV is removed and controlled for and if a seed bank of native SAV exists within the vicinity of the project (L. Anderson, pers. comm.).

DEEP SUBTIDAL AREAS

If fill material is borrowed from the open water areas, they may be excavated to a depth of up to approximately -10 to -12 ft NGVD (11.5 to 13.5 ft below MTL). Subtidal open water areas below -10.5 ft NGVD (-12 ft MTL) are not expected to support SAV due to limited sunlight. Areas of deep subtidal open water breached to tidal action would not be suitable for planting native SAV.

Table 2-2. Summary of Open Water Management Options

Open Water Management Options		Expected Habitat	Adaptive Management	Compatible Fill Method
Tidal	Shallow subtidal with native SAV planting	Native SAV, higher proportion of native fish than without planting	Small-scale experiment or large-scale comparison	Import
	Deep subtidal	Predominantly non-native fish	Limited, could be used as a reference site (similar to breached site not optimized for habitat)	On-site borrow
	Skeletal channel network	Marsh edge/ tidal channel bank, intermediate between subtidal and marsh (experimental)	Small-scale experiment or large-scale comparison	Import (possibly on-site borrow)
Managed	Managed pond	Waterfowl or shorebird	None	Import
	Subsidence reversal through biomass (tule) accretion	Future tidal marsh (long-term)	Small or Large-scale experiment	Import

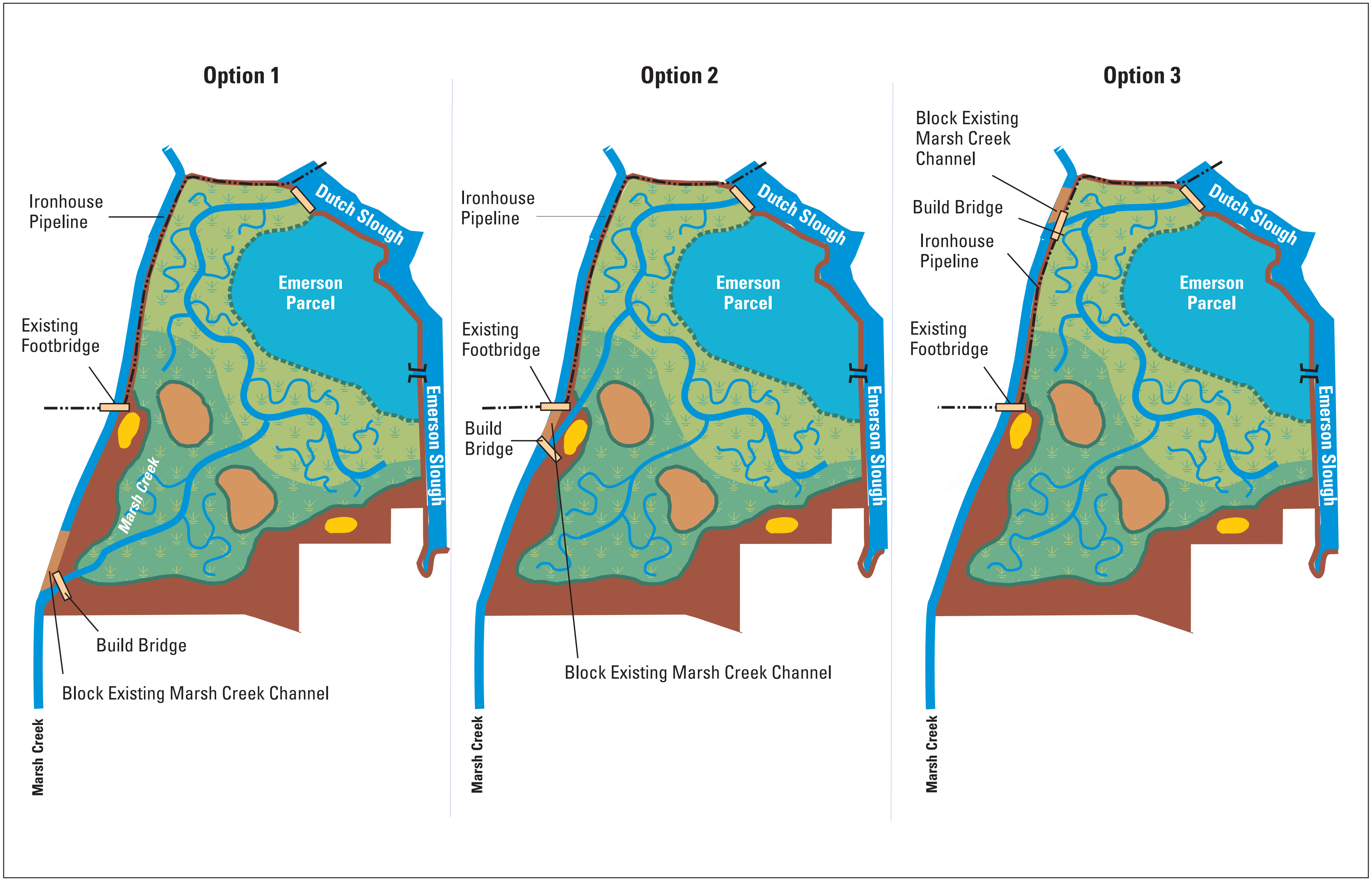


Figure 2-13

Marsh Creek Delta Restoration Options

Source: PWA

Skeletal Channel Network

A "skeletal" tidal channel network could be created by constructing channel banks with fill material, but replacing the marsh interior with subtidal open water. This is an experimental approach, which has not been tested previously. In high marsh habitat, native fish are expected to primarily use the channel bank and marshplain a short distance from the channel. Creating a skeletal tidal channel network may provide some of these benefits while avoiding the need to fill the entire marsh area.

Tidal channel banks would be constructed to an elevation of up to 3.15 ft NGVD (MHHW). The width of marshplain adjacent to the channel bank would be sufficient to provide habitat functions and fill stability. A sinuous and branching tidal channel network similar to natural marshes would be constructed. Subtidal areas surrounding the skeletal network would drain through separate breaches. The subtidal areas would be expected to be invaded with non-native SAV and FAV, if these species are not controlled. Some tidal exchange between the skeletal channel network and subtidal areas would occur during overmarsh tides and possibly through the ends of the channel network. The cost, construction feasibility, and long-term sustainability of a skeletal channel network have not been assessed.

MANAGED POND

Under this option (applicable to all restoration alternatives), in managed non-tidal open water ponds, water levels would be managed with control structures to provide waterfowl or shorebird habitat. Topographic high points in managed pond areas would become islands, which are expected to provide loafing and resting habitat for waterfowl species. Managed ponds may also provide habitat for large raptors and the Western pond turtle, depending on factors such as the depth and size of the ponds and the availability of basking sites and adjacent suitable soil for nesting.

This option would require on-going management of water control structures and levee maintenance. Managed ponds are not expected to be compatible with on-site borrow because deep ponds would not be desirable avian habitat and it may not be feasible to manage for shallow water levels in deep borrow areas. A higher, wider berm would be necessary to prevent high tide overtopping areas into the managed ponds from adjacent restored marsh areas, and to allow access for maintenance.

Non-tidal managed marshes could be created and managed to raise subsided ground to marshplain elevations through either biomass accretion (primarily decayed tules) and/or the use of rice straw. Tules could be planted and grown through flood irrigation to accumulate organic matter (biomass). Once the accumulated biomass reaches marsh-plain elevations, the areas may be breached to create a tidal marsh. Subsidence reversal through biomass accretion is being tested in a USGS demonstration project at Twitchell Island, also in the Delta. The use of rice straw is being evaluated in a separate CALFED-funded project with DWR involvement (Twitchell Island Subsidence Reversal Demonstration Project). For the Dutch Slough Restoration Project, these experimental subsidence reversal techniques may be tested through adaptive management on a small-scale prior to large-scale application. Subsidence reversal areas may be sub-divided with berms to allow for internal gravity drainage. Subsidence reversal techniques are expected to require active management for a number of years (possibly decades) before the managed areas can be breached.

2.6 DUTCH SLOUGH RESTORATION PROJECT ALTERNATIVES AND OPTIONS CONSIDERED AND NOT ANALYZED FURTHER IN THIS EIR

Continuous High Marsh in All Parcels

Although this alternative would restore a marsh system most similar to a natural historic Delta marsh, presumably with great restoration benefits, it has two major drawbacks. It would not meet the adaptive management goal because it would not allow testing of different marshplain elevations. In addition, continuous high marsh in all parcels is probably not feasible because of the large amount of fill it would require.

Equal Areas of Mid Marsh, Low Marsh, and Open Water in the Gilbert and Burroughs Parcels

This alternative could provide "pseudo-replication" of large-scale experimental results by comparing large areas of low marsh in both the Gilbert and Burroughs parcels with large areas of mid marsh in both parcels. This concept was rejected because the AMWG decided that testing a range of small, medium, and large marsh scale was a priority over pseudo-replication. The rejected concept did not allow for medium scale marsh areas.

Continuous Low Marsh or Mid Marsh in Emerson Parcel

Filling the Emerson Parcel to create continuous low marsh or mid marsh was rejected because a limited amount of fill is expected to be available. Priority is given to filling the Gilbert and Burroughs parcels to marshplain elevations for adaptive management experiments.

2.7 RELATED PROJECTS

This Draft EIR assesses the potential impacts of two related but independent projects, the Ironhouse Sanitary District's proposed West Marsh Creek Restoration Project (Ironhouse Project), and the City of Oakley's Dutch Slough Community Park Conceptual Master Plan (City Community Park Project). The Ironhouse Project is related in that it is adjacent to Marsh Creek and could be integrated with the Dutch Slough Restoration Project depending on whether, and where, Marsh Creek is relocated, and could be a source of fill material for Alternatives 2 and 3 of the Dutch Slough Restoration Project. The City Community Park Project is related to the Dutch Slough Restoration Project in that it provides the parking, staging facilities, and trailheads for the public access component of the Dutch Slough Restoration Project. These related projects are described below.

Ironhouse Project

The Ironhouse Project is located on 100 acres of irrigated pasture owned by the Ironhouse Sanitary District and approximately 10 acres of flood control channel owned by the Contra Costa County Flood Control District (See Figure 2-14). The flood control channel is bordered on either side by levees that confine the entire flow of Marsh Creek preventing the creek from flooding its historic Delta. The flood control district employs a chemical mowing (herbicide) program along the channel and levee banks to prevent colonization of riparian vegetation and maintain flood conveyance capacity. The sanitary district irrigates the pasture with treated wastewater. The elevation of the levees ranges from 12 - 14 feet NGVD and the average elevation of the pasture is 6 feet NGVD. The project, which has been proposed by the Natural Heritage Institute to be implemented by the Ironhouse Sanitary District, could be added as an important component of the adjacent Dutch Slough Restoration Project along the east side of Marsh Creek.

IRONHOUSE PROJECT RESTORATION GOALS

The Ironhouse Project goals (developed by Natural Heritage Institute) are to:

1. Create a large restoration area to improve research opportunities, improve water quality, and increase habitat diversity;
2. Restore riparian vegetation and natural fluvial processes and forms along the Marsh Creek flood control channel (10 acres along 0.9 miles of channel);
3. Restore a large area of higher elevation tidal marsh (MTL) west of Marsh Creek that is comparable to tidal marsh treatments on the Dutch Slough property;
4. Provide up to 500 - 600 thousand cubic yards of borrow material for creation of tidal marsh on subsided portions of the Dutch Slough property; and
5. Maintain the potential to restore a complex delta system at the mouth of Marsh Creek.

PROPOSED RESTORATION ACTIVITIES

The restoration site is currently bisected by the Contra Costa Canal, which constrains the course of Marsh Creek where the two cross. The Contra Costa Water District plans to encase the canal and bury it below the base channel elevation of Marsh Creek. The canal encasement project would effectively eliminate any surface expression of the canal and thus create the opportunity to restore a broad flood/marsh plain and sinuous channel at the mouth of Marsh Creek. The Canal also crosses the Ironhouse restoration site, and a vegetated upland area over the encased Canal will be constructed to provide access for Canal maintenance. Tidal flows will be conducted through this upland via a box culvert or Arizona crossing.

Restoration of the Ironhouse parcel would be implemented so as to maximize adaptive management research opportunities and to minimize unintended consequences. The first phase of the project entails excavating 500 to 600 thousand yards of soil on the Ironhouse pasture to create a tidal marsh immediately west of Marsh Creek. The excavated material would be placed on the adjacent Dutch Slough property to provide the fill material necessary to create large tidal marsh areas on subsided portions of the property. The excavation would grade the Ironhouse pastures to an elevation of approximately 1.5 feet, but would leave an upland edge around the perimeter of the restoration site. The site would be revegetated using the same method employed in the larger Dutch Slough Restoration Project.

During the first phase, Marsh Creek would not be routed through the restored marsh, but would be hydrologically connected to the restored marsh via a tidal channel that opens into Marsh Creek immediately upstream of the pedestrian bridge. Water would not be routed through the restored marsh until the results of a monitoring program determine that the water quality in Marsh Creek would not degrade the restored marsh or that routing the creek through a marsh would not exacerbate water quality problems or create sediment routing problems.

During phase one, the conveyance capacity of Marsh Creek would be expanded to allow for riparian vegetation to be planted along the existing flood control alignment without reducing the existing conveyance and sediment routing. Conveyance capacity would be expanded by creating several notches in the left bank levee to allow floodwater to spread-out into the restored marsh zone during high flow events. The purpose of the overflow zones or notches is to expand channel capacity without routing bedload into the restored marsh or otherwise disrupting the sediment routing functions of the existing channel. The overflow notches should be graded to an elevation approximating the water surface elevation associated with 2-5 year storm events. After initial riparian vegetation plantings, the Marsh Creek flood control channel could be allowed to meander and evolve.

Monitoring during the first phase of the Ironhouse Project, in combination with monitoring of the larger Dutch Slough Restoration Project, would enable managers to measure the ecological benefits of mid marsh relative to low marsh and riparian zones. Water quality and sediment monitoring would determine whether it is prudent to breach the flood control levees to reroute Marsh Creek into new channel(s) across the restored Ironhouse or Dutch Slough marshes. The project would be designed to allow for future breaches at a variety of locations including 1) the upper end of the restored Ironhouse marsh, 2) the southwest corner of the Emerson parcel, and 3) immediately upstream of the pedestrian bridge. If determined to be appropriate from a water quality and sediment perspective, the project could later be modified to include breaching the Marsh Creek flood control levees in one or more places and routing Marsh Creek onto the Ironhouse and/or Dutch Slough marshes.

City Community Park Project

The City Community Park Project, a related project, is intended to provide shoreline access and educational and recreational opportunities for the community. The plan includes a 55-acre community park and public access trails extending from the park around portions of the proposed Dutch Slough restoration parcels.

The Dutch Slough Restoration Project (Alternatives 1-3) would be connected to the City Community Park Project to provide high-quality public access and recreation opportunities. The Dutch Slough site would provide an opportunity for people to access the Delta shoreline and learn about the process of wetland restoration, the habitats created, and the wildlife that use them.

CITY COMMUNITY PARK PROJECT GOALS

The City has provided the following goals and objectives to be achieved by this Plan.

3.1 Goal: Provide and expand public access that is safe and consistent with the ecological and research goals of the project.

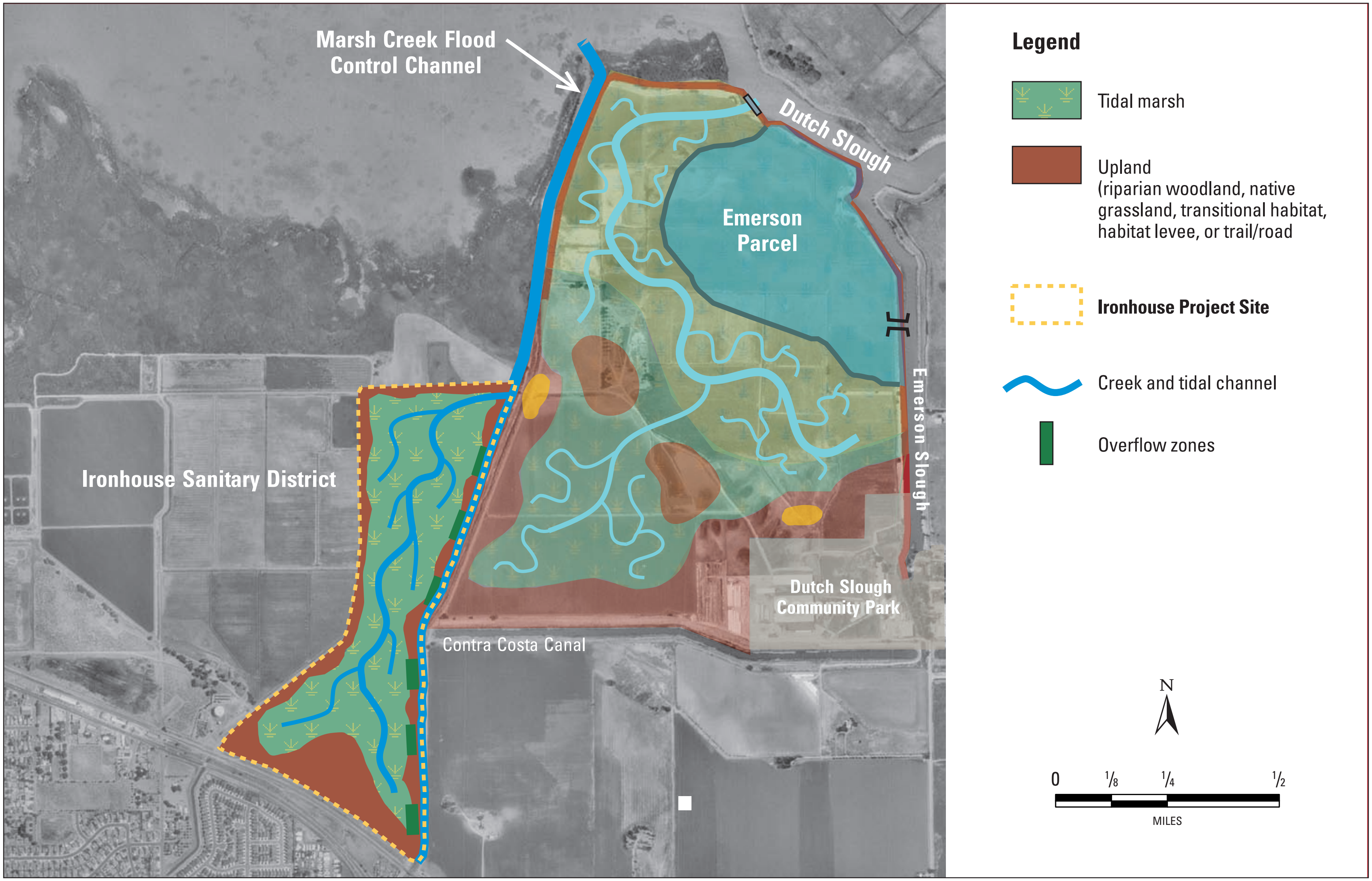


Figure 2-14

Ironhouse Project

Source: PWA

Objectives:

3.1.1 Open a trail around Emerson levee;

3.1.2. Create a 55-acre community park; and

3.1.3. Provide public access to the Delta shoreline.

3.2 Goal: Create educational opportunities compatible with wildlife, habitat, and research goals.

Objectives:

3.2.1. Create signage to educate public about restoration project;

3.2.2. Build wildlife viewing platforms; and

3.2.3. Involve schools and community groups in restoration activities.

3.3 Goal: Create recreational opportunities compatible with wildlife, habitat, and research goals.

Objectives:

3.3.1. Build non-motorized boat launch;

3.3.2. Create swimming opportunities for the public; and

3.3.3. Create opportunities to canoe and kayak where consistent with restoration goals.

PROPOSED PARK PLAN

The City's plan includes the 55-acre Community Park, a trail system with a loop trail encompassing the Emerson parcel, and the City's proposed 8-acre Dutch Slough Access Park (See Figure 2-15). This 8-acre parcel is isolated from the restoration site by Jersey Island Road and is a separate project not addressed in this Draft EIR.

The City of Oakley has worked collaboratively with DWR and SCC to develop a Conceptual Plan for public access to both the restoration site and the community park that balances the objectives of the restoration project with the City's recreational objectives. An illustration of potential public access on the restoration site is depicted in Figure 2-15. The City plans to develop the community park site with a combination of active and passive recreation including sports fields, interpretive and educational facilities and a canoe/kayak boat launch at the head of Emerson Slough.

Dutch Slough Community Park would be the City of Oakley's largest park as well as the main access point to the Dutch Slough Restoration Project. The park, located on a former dairy farm and adjacent to Emerson Slough, affords many opportunities to experience the cultural and ecological history of the site. Existing historic buildings, including a former one-room schoolhouse to be relocated to the site, would be reused for park functions, while remnants and materials from the remaining outbuildings would be incorporated into the design. The park would balance active uses, including ball fields, picnic areas, restroom buildings and playgrounds, with more passive recreation and interpretive trails along the slough. Sustainable design principles would be incorporated throughout, creating a community destination that educates and inspires the public and is compatible with the adjacent sensitive habitat.

Park Organization, Use Areas and Facilities

The Community Park would be organized into a series of active and passive use areas, including a riparian play zone, an historic zone, and a maintenance area (See Figure 2-16). Active recreation areas are all located on the western side of Emerson Slough with more intense uses located to the south, away from the Tidal Marsh Restoration Project area. To recognize the habitat values associated with the tidal marsh restoration area, Community Park use areas are arranged in a fashion that creates a transition between active uses near the southern portion of the site and a vegetated buffer and passive uses around the outer edges of the Park that border the restoration area. With the exception of ball fields and limited use of the historic zone facilities, the Community Park would be for day use only. The park is proposed to be developed in two phases, with initial improvements consisting of expansion of Dutch Slough, clearing of all structures except the Gilbert House, a caretaker's cottage, and a redwood barn, construction of 100 parking spaces, extension of utilities on the site, grading and seeding of the site, and construction of an interim landscape plant nursery and installation of initial plantings. Proposed park facilities are shown on Figure 2-17, and the initial improvements are indicated on Figure 2-18. Facilities and improvements are described below.

LARGE OPEN FIELD AREAS

A series of three open field areas, at approximately three acres each in size, would be located in the western portion of the Community Park, and could be used for any number of individual or group functions and sports/festival events. For example, these areas are all sized to accommodate formal soccer play and other field sports. An amphitheater and nearby concession stand would support the central field as the focal place for events of up to 3,000 to 5,000 people at one time. It should be noted that while field areas and other places within the Community Park could be used for overflow parking, it is likely that additional parking for such events may be required off-site.

SMALL OPEN AREAS

A variety of smaller-sized open areas are located around the Community Park trail system and within the historic zone. They could be used for picnicking, informal play, passive relaxation, and when combined with supporting picnic shelters, small group uses.

FAMILY AND SMALL GROUP PICNIC AREAS

Numerous family and small group picnic shelters (25 to 50 people) are located around the western portion of the Community Park trail system.

RIPARIAN CORRIDOR THEMED PLAY AREAS

Constructed drainage channels would be created as creeks fed in the summer months by groundwater pumped from on-site windmills (see infrastructure, below). While planting along the creeks would enhance the riparian habitat character of the Park, these corridors would also be a connector spine for a series of seven children's play areas.

SOFTBALL FIELDS

Three adult softball fields around a central complex with restrooms, supporting storage facilities, and the concession stand would be developed. The ballfields would be fully fenced and lighted for nighttime use until 11 pm. Lighting for the fields would be generally directed away from the Tidal

Marsh Restoration Project area, and would be buffered from it and adjacent residential areas to the south by perimeter planting.

EMERSON SLOUGH WATER ACCESS

A graded sandy area for sunning and informal water access would be developed just off of the Emerson Slough.

OFF-LEASH DOG USE AREA

An approximately one-half acre area located at the south side of the active recreation zone.

AMPHITHEATER

Located at the southwest corner of the central field area, this multi-use area would accommodate larger events such as the Almond Festival, organized recreational activities and more passive use when not programmed.

CONCESSION STAND

The concession stand is centrally sited to specifically service both the ball fields and amphitheater area, but also is centrally located to most park use.

VISTA PAVILION

A facility just east of the Gilbert House and sited to be used in conjunction with the Gilbert House grounds at the base of Emerson Slough, this multiple-use facility would accommodate weddings/large group uses of up to 300 people indoors at one time. (See 6. Park Design Character and Architectural Identity.)

WINDSWEPT RANCH HISTORIC AREA/MUSEUM CENTER

Eight existing and new buildings would make up the museum complex. The Gilbert House, Caretaker's Cottage, and one barn structure would be retained. The Ironhouse School would be relocated to a site of an existing building just east of the Gilbert House. The footprint of other existing buildings would be repeated with new structures that would reflect the scale and synergy of the existing ranch complex. New structures would include:

- An education center and museum would be located at the entrance to the historic zone near the parking area.
- An administration building including offices and meeting space for docents, a commercial kitchen to support events at the Vista Pavilion, and storage areas.
- Canoe/kayak storage building.

The lawns around the historic area would include individual picnic tables and areas for passive use. A community garden that could initially be used as a nursery for park re-vegetation programs would be sited at the eastern side of the historic zone adjacent to the Administration Building.

INTERPRETIVE FACILITIES

In addition to the Windswept Ranch Historic Area/Museum Center buildings and themed play areas, the following interpretive features would be provided within the Community Park.

OVERLOOKS

Two overlook points along the perimeter park trail with vistas of the Tidal Marsh Restoration Project.

POINT-ACCESS BOARDWALKS AND OVERLOOKS

Two boardwalks with overlook facilities extending into the tidal marsh restoration project.

OUTDOOR CLASSROOMS

Two areas located within the historic zone, one back-dropped by the Emerson Slough riparian landscape and the other by the tidal marshes of the Gilbert property.

INTERPRETIVE SIGNS

Located along the perimeter trail of the Park.

WINDMILLS

Windmills would be used as both an identifying feature for the Community Park and to assist in providing water within the Park's constructed streams and other water features. A "headwater windmill" would identify the southern arm of the internal creek system.

RESTROOMS

Public restrooms would be located throughout the Park.

FENCING

Perimeter fencing of the park, Emerson Slough, historic zone, and maintenance area would be developed as needed for security or for habitat protection purposes.

MAINTENANCE

An approximately 1-acre area at the southeast corner of the Park would be used for park maintenance and storage, and would include operations and storage buildings, and a maintenance shop.

DOGS

Dogs on leash would be permitted within the Park at all times. Early morning hours would be scheduled for off-lease dog use west of the Emerson Slough.

ACCESS

Access to and throughout the Community Park would accommodate a wide variety of transportation modes including autos, buses, bicycles, pedestrians, and small boats, such as canoes

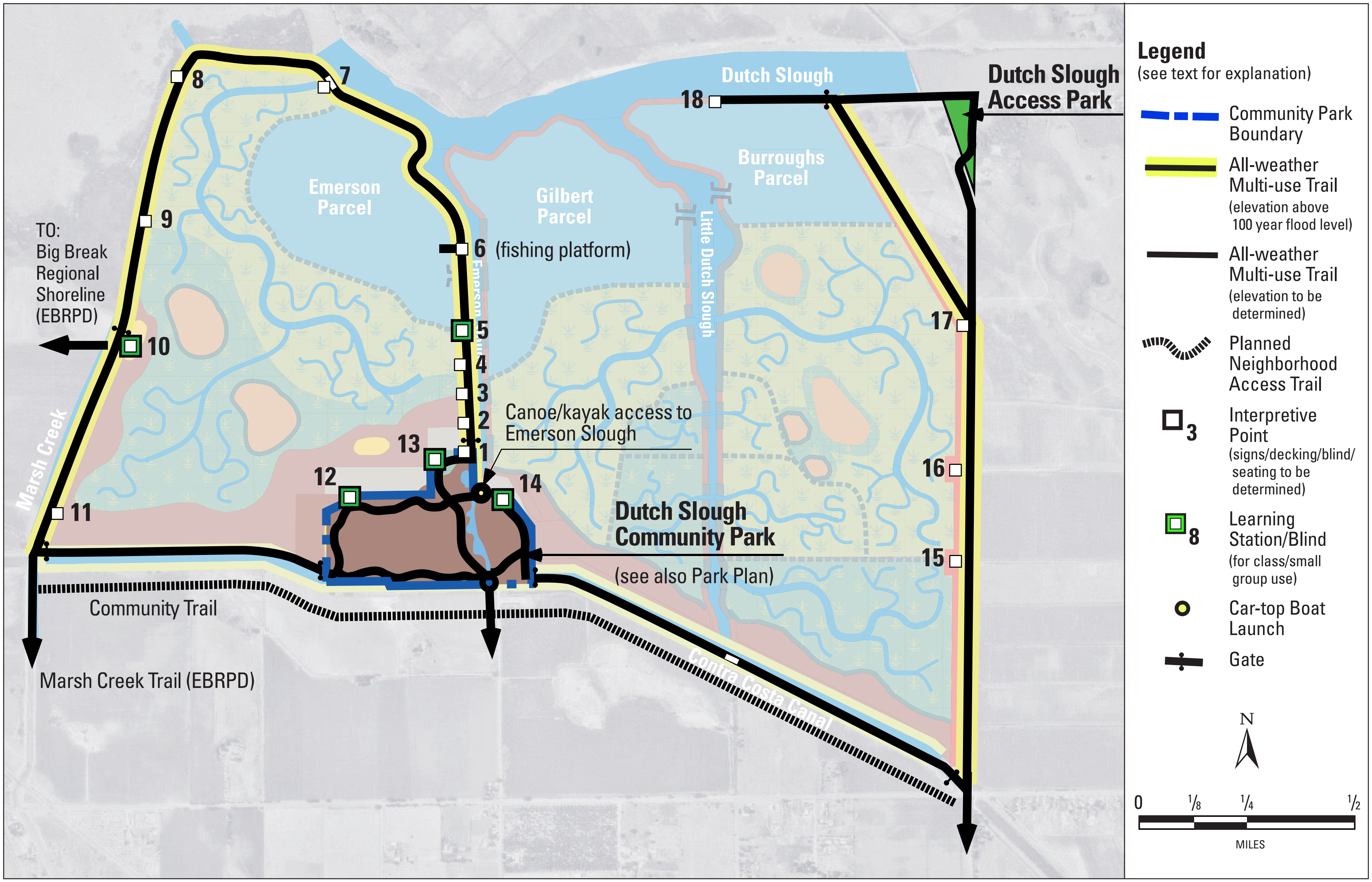


Figure 2-15

Public Access Plan

Source: 2M Associates

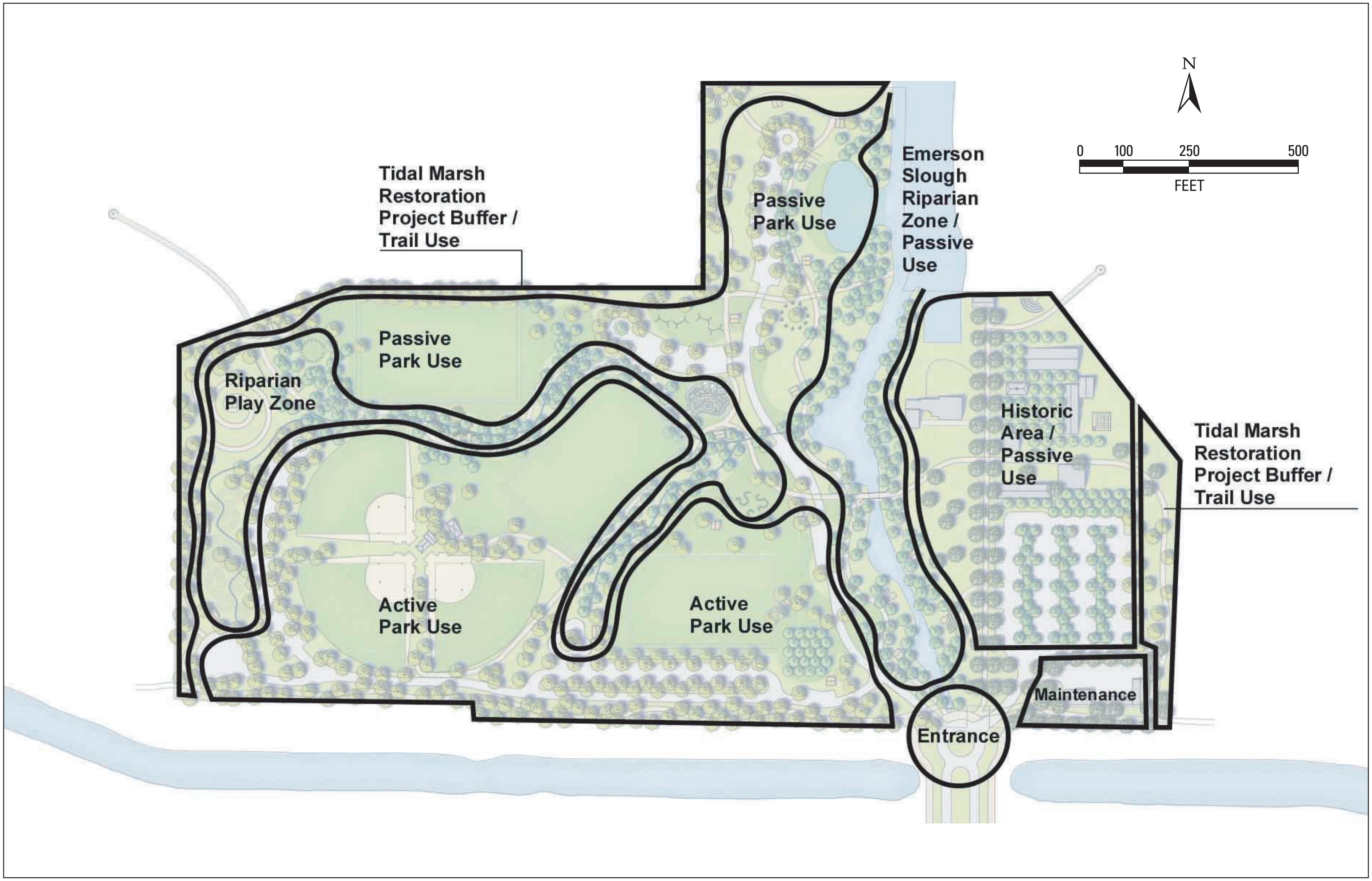


Figure 2-16

City Community Park Use Zones

Source: City of Oakley

Figure 2-17

City Community Park Plan

Source: 2M Associates

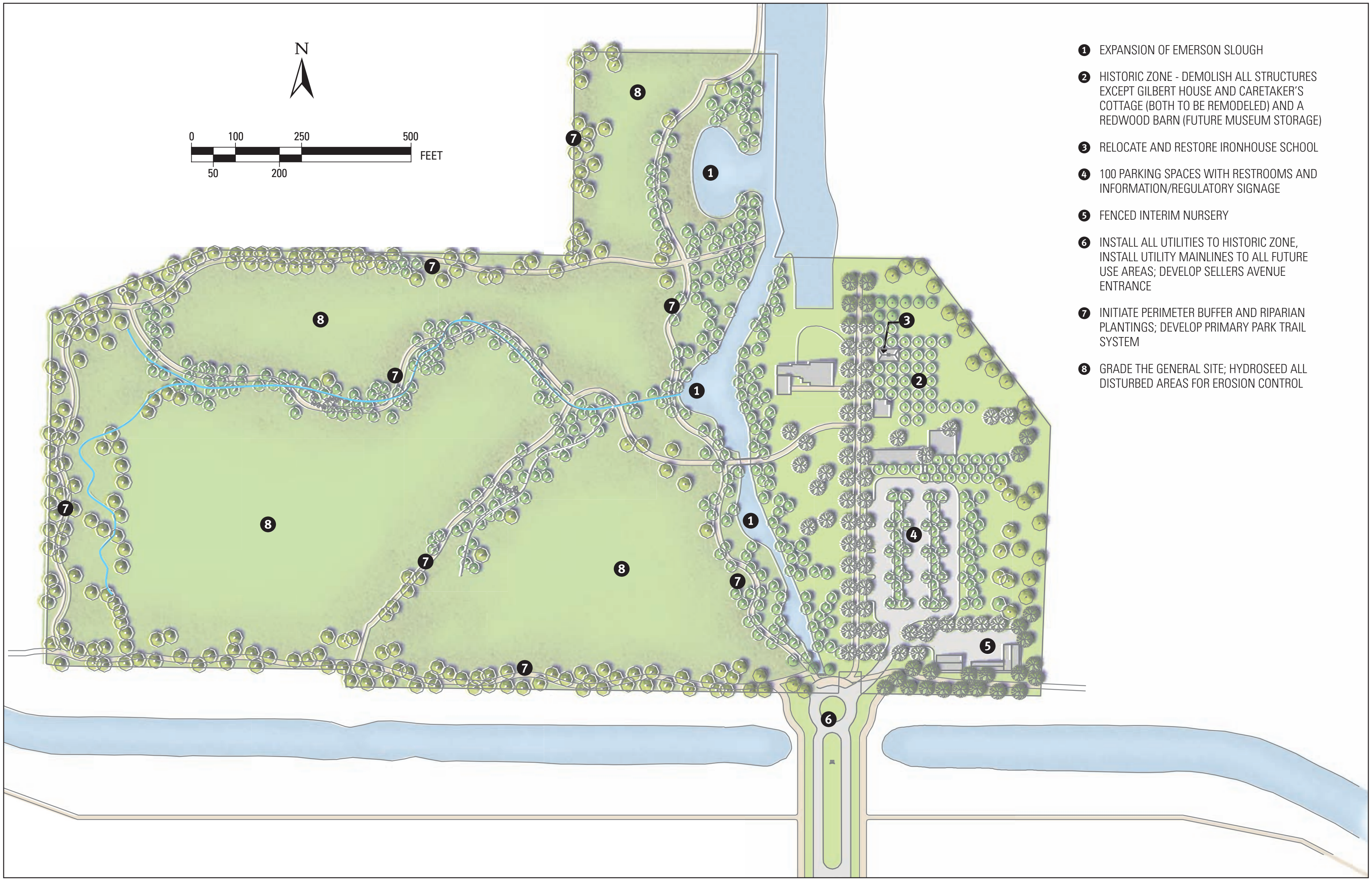


Figure 2-18

City Community Park - Initial Improvements

Source: 2M Associates

and kayaks. The primary access to the Park would be from Sellers Avenue and would serve as the Gateway to the Dutch Slough Restoration Project Area.

SELLERS AVENUE ENTRY GATEWAY

Access to the Community Park would be via Sellers Avenue. The character of the street landscape would change as it approaches the Community Park. The transition would include a road that, if necessary, could be used for two lanes of traffic. However, at most times, the vehicular traffic would be limited to one lane with an expanded bicycle lane to both calm traffic and to encourage non-vehicular use of the Park. It would culminate in a round-about with a central water feature.

PARKING

A total of 432 parking spaces would be provided within the Park. There would be an equestrian staging area located at the southwest corner of the Park adjacent to the Emerson Slough Trail. Bicycle parking would be provided at all parking and use areas.

BUS LOADING AREA

A bus loading area is located near the pedestrian entrance to the historic zone.

INTERIOR PARK TRAILS

Approximately 2.5 miles of shared-use trails would provide pedestrian and bicycle access throughout the Park. These trails would connect to trails along Sellers Avenue, the City and local community trail network, the Wetland Restoration Project trails, and the Marsh Creek Trail, a component of the regional trail system.

CANOE/KAYAK ACCESS

Two canoe/kayak access points to Emerson Slough would be provided. A general-use access point is located on the west side of the Slough near two parking areas. The other is located within the historic zone and would be for group use. Associated with that access point would be a small canoe/kayak storage building for use by local school groups and organizations.

TRAIL ACCESS

The Marsh Creek Regional Trail, which extends from Antioch Pier to the City of Brentwood already traverses the southwestern boundary of the site. The conceptual trail plan (See Figure 2-19) negotiated with the City of Oakley assumes that the trails would be largely confined to the top of the levees and the southern edge of the site near the base of the Contra Costa Canal, but this conceptual plan may be revised during development of the public access master plan. As currently planned, the trail system would include:

EMERSON LOOP TRAIL

An approximately 2.9-mile-long trail loop leading west from the Community Park parallel to the Contra Costa Canal, then north along the existing Marsh Creek Trail, extending to the east along Dutch Slough, and back to the Community Park along Emerson Slough.

GILBERT – BURROUGHS TRAIL

This would be an approximately 3-mile-long trail leading east from the City Community Park parallel to the Contra Costa Canal then following the Jersey Island Road levee north to the Dutch Slough Access Park. A point access spur trail would travel west along the Dutch Slough levee.

Trails may eventually be paved to accommodate multiple recreation uses as well as emergency vehicles and policing. A series of interpretive points, observation blinds, and fishing access platforms may be developed along the trail system. A tightly-spaced series of education stations are to be located along Emerson Slough to facilitate school use emanating from the Community Park. Trail mileages are indicated for Alternative 2; they would vary slightly among the various restoration alternatives and options.

INFRASTRUCTURE

Development of the City Community Park would require a network of utilities to service the various structures, buildings and uses. Sustainable approaches to bringing power to the site would be incorporated, where possible, including wind and solar. In addition, stormwater management onsite would address flooding and protecting water quality of the slough.

UTILITIES

All utilities service lines would be underground within the City Community Park. Water, sewer, electrical, and communication services would be extended from Sellers Avenue into the City Community Park. Wells would be developed and well water for irrigation use where possible.

WINDMILLS

A series of functioning windmills would be used to pump groundwater to support the internal creek channels and Park Gateway feature, and to provide water circulation within the Emerson Slough water access area.

GRADING AND DRAINAGE

Most of the City Community Park site is subject to flooding. All new buildings and the relocated Ironhouse School would be sited and designed such that their finished floor elevations would be above the 100-year flood level. Stormwater-treatment swales would be installed at all major parking areas. Drainage from the western portions of the Community Park would be directed to constructed creek channels designed to also serve as water quality features.

Park Landscape

The landscape of the Community Park would reflect the natural and historic setting, as well as respond to the local climatic conditions. This approach would not only reinforce the unique character of the site, but also result in reduced maintenance and water needs.

PLANTS

With the exception of turf areas, existing ornamental trees around the Gilbert House of historic value, community gardens, and two contained orchard theme planting areas, native plants would be used exclusively throughout the Park.

RIPARIAN ENHANCEMENT

Emerson Slough would be expanded to the west and enhanced with native riparian plants. In addition, constructed creek drainages would be designed to extend the riparian zone throughout the western portions of the Community Park.

PERIMETER BUFFER AND WIND PROTECTION

A vegetated zone would extend around the entire perimeter of the Park. This would serve to buffer both adjacent wildlife habitat areas within the marsh restoration project area (See Figure 2-20) as well as residences to the south from park activities. The perimeter plantings, along with the creek riparian zones and other tree plantings, would provide wind protection for most use areas.

City Community Park Project Phasing

Full development of the Community Park is likely to take 10 to 15 years. Initial improvements to be made in the Community Park include:

- Demolition of all structures (with the exception of the Gilbert house, Caretaker's Cottage, and a redwood barn to be used for museum storage) and site preparation of the entire property to render it safe for public access.
- General site grading including expansion of the Emerson Slough and creation of internal drainage channels.
- Hydroseeding for erosion control of all disturbed areas.
- Relocation and restoration of the Ironhouse School.
- Remodeling of the Gilbert house, Caretaker's Cottage, and a redwood barn.
- Development of the Sellers Avenue entrance, a 50-vehicle parking area, restroom, informational/regulatory signage. This would be located adjacent to the Historic Zone.
- Development of the primary park trail system connected to the parking area with limited pedestrian amenities (drinking fountains, benches, picnic tables).
- Installation of all utility mainlines.
- Initiating perimeter buffer and riparian plantings along Emerson Slough and internal park drainage ways.
- Provision of a temporary plant propagation nursery for revegetation of the Community Park and the Tidal Marsh Restoration Project. This would be located in the area that would eventually become the park maintenance area.

Extending public access along Marsh Creek from the existing East Bay Regional Park trail to the mouth of the creek at Dutch Slough is an immediate priority. Initial trail improvements would ideally focus on completing the Emerson Loop Trail coincidentally with the tidal marsh restoration of the Emerson parcel. This would encourage use of the Community Park, allow maximum public exposure, and support interpretation of the Tidal Marsh Restoration Project.

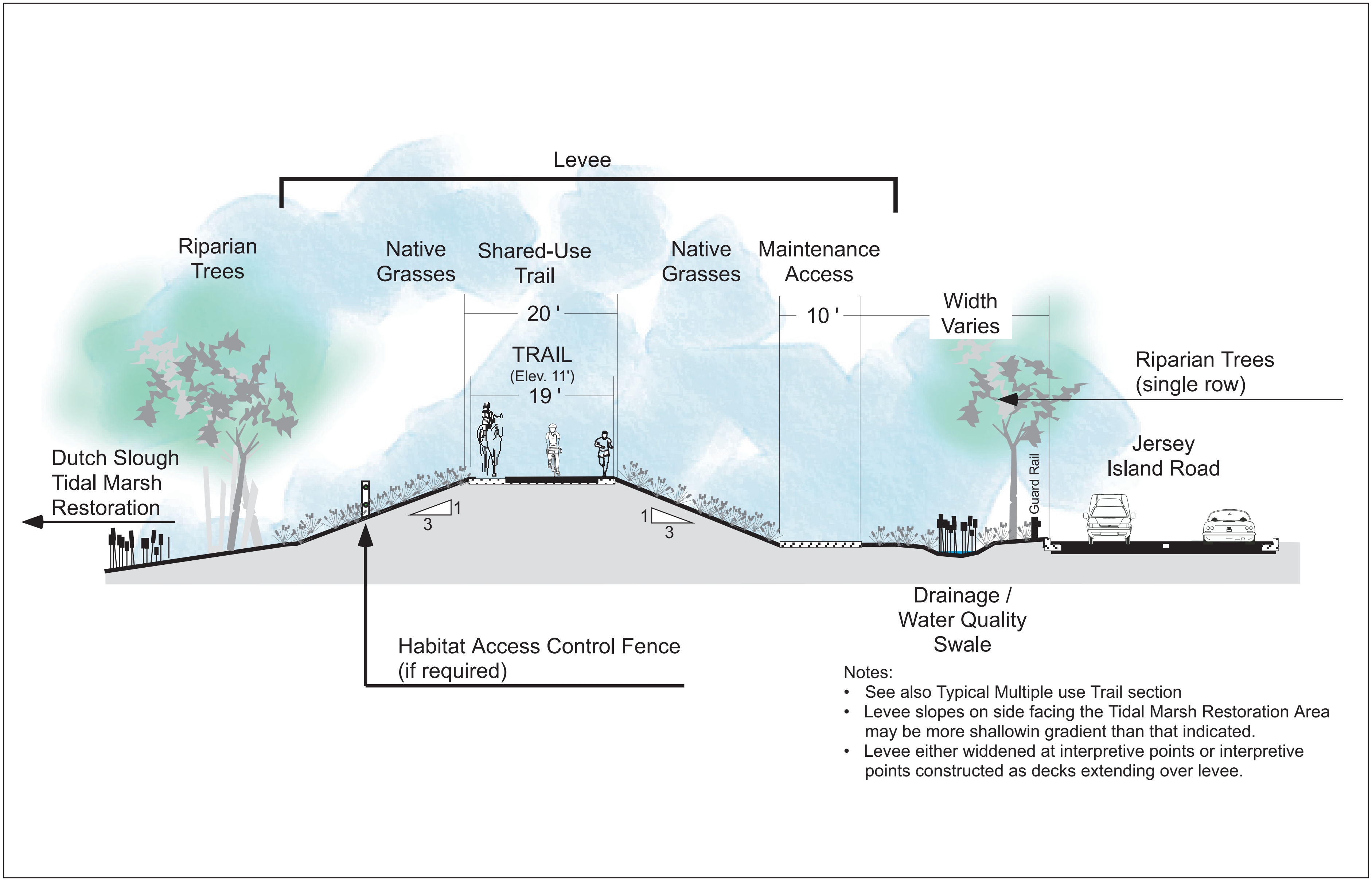
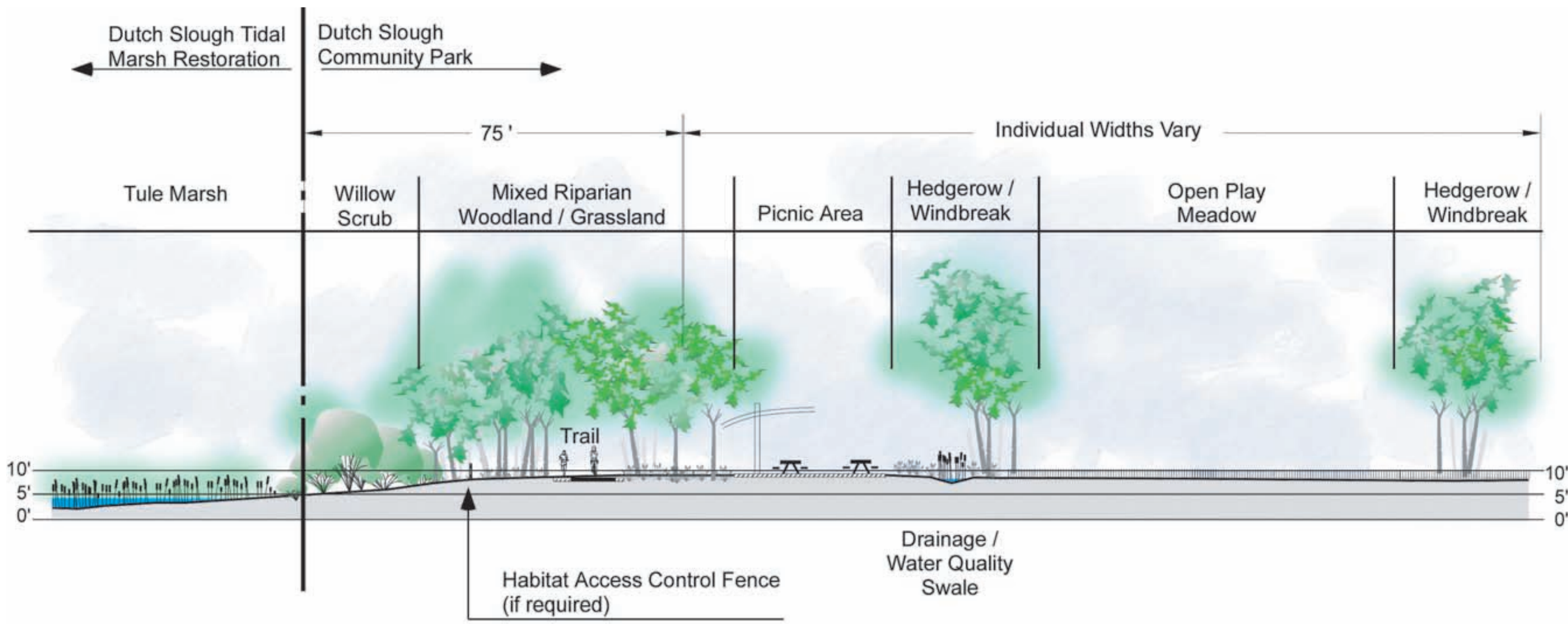


Figure 2-19

Multiple Use Trail Plan

Source: City of Oakley



Botanic Name	Common Name
Willow Scrub	
Salix exigua	sandbar willow
Salix lasiolepis	arroyo willow
Salix lucida	shining willow
Mixed Riparian Woodland	
Acer negundo californicum	box elder
Alnus rhombifolia	white alder
Fraxinus latifolia	Oregon ash
Populus fremontii	Fremont cottonwood
Rosa californica	wild rose
Rubus urisunus	California blackberry

Botanic Name	Common Name
Grassland	
Bromus californicus	California brome
Deschampsia californica	tufted hairgrass
Festuca californica	California fescue
Melica californica	California oniongrass
Nasella pulchra	purple needlegrass
Intenal Park Windbreaks / Water Quality Swales	
Alnus rhombifolia	white alder
Populus fremontii	Fremont cottonwood
Juncus bufonius	toad rush
Hordeum brachyantherum	meadow barley
Leymus triticoides	creeping wildrye
Typha angustifolia	narrowleaf cattail

Figure 2-20

Park/Restoration Area Habitat Buffer

Source: 2M Associates